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Investigating Risk Factors for Hepatitis B Infection: A Case-Control Study

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Abstract

Background: Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus (HBV). The disease places a significant burden on global health and effective prevention strategies are needed.

Aim: To identify demographic, lifestyle and medical factors associated with risk of Hepatitis B infection.

Methods: A case-control study was conducted including 400 Hepatitis B cases and 800 controls. Data on socio-demographic characteristics, occupation, education level, marital status, vaccination status, other infections, chronic conditions, lifestyle factors and viral load were collected and compared between cases and controls.

Results: Healthcare workers, previous Hepatitis B infection, other infections, chronic diseases, poor sleep, higher stress, and lower physical activity were more common among cases. Hepatitis B vaccination rates were similarly high in both groups. ender, education and alcohol consumption were not significant risk factors. Machine earning identified vaccination status and low viral load as the most important factors for reducing transmission risk.

Conclusion: Several modifiable and non-modifiable factors influence Hepatitis B infection risk. Hepatitis B vaccination, viral load monitoring and targeted interventions for high-risk groups can help reduce the impact of the disease. Further large studies are needed to confirm these findings.

Keywords: Hepatitis B; Risk factors; Vaccination; Viral load; Case-control study; Occupational exposure

1. Introduction

Hepatitis B is a viral infection that can cause liver inflammation and, if left untreated, can lead to serious liver damage, liver cancer, or even death. According to the World Health Organization (WHO), an estimated 257 million people worldwide are living with chronic hepatitis B infection, and approximately 887,000 people die each year due to complications of the infection [1]. The prevalence of hepatitis B infection is particularly high in developing countries, where access to healthcare and vaccination programs may be limited [2-5]. Yemen is one of the countries where the prevalence of hepatitis B infection is high, with an estimated 2-5% of the population infected with the virus [5-8]. The infection is a major public health concern in Yemen, where there is a lack of resources and infrastructure to address the problem effectively. In addition, Yemen is currently facing a humanitarian crisis, and the ongoing conflict has further exacerbated the situation, making it difficult to implement effective prevention and control measures [9-13]. In light of this situation, there is a need to investigate the risk factors associated with hepatitis B infection in Yemen to prevent its spread [11-20]. The purpose of this case-control study is to investigate the risk factors associated with hepatitis B infection in Hajjah, Yemen. Hajjah is a city with a high prevalence of hepatitis B infection, and the study aims to identify the risk factors associated with the infection and provide recommendations for prevention and control strategies. The study will be conducted using a case-control design, with cases identified from the local hospitals and health centers in Hajjah. For every case, two controls will be selected from the same hospital or health center. Data will be collected using a structured questionnaire that will be administered by trained interviewers. The

questionnaire will collect information on demographic characteristics, medical history, sexual behavior, drug use, and other potential risk factors for hepatitis B infection.

The data collected will be analyzed using logistic regression to identify the risk factors associated with hepatitis B infection. The results will be presented in tables and graphs, and recommendations for prevention and control strategies will be provided. The findings of this study will be important in informing the development of effective prevention and control strategies for hepatitis B infection in Yemen. In conclusion, hepatitis B infection is a major public health concern in Yemen, where the prevalence of the infection is high, and resources to address the problem are limited. This case-control study aims to identify the risk factors associated with hepatitis B infection in Hajjah, Yemen, and provide recommendations for prevention and control strategies. The findings of this study will be important in informing the development of effective prevention and control measures for hepatitis B infection in Yemen and other developing countries.

2. Materials:

2.1. Study participants

The study population consists of individuals who have been diagnosed with Hepatitis B infection and those who have not been infected with the virus. We suggest recruiting 400 cases (patients diagnosed with Hepatitis B infection) and 800 controls (patients without Hepatitis B infection).

2.2. Smartphone apps

We suggest using smartphone apps to collect data from study participants. The apps can be designed to collect information on demographic characteristics, medical history, lifestyle factors, and Hepatitis B vaccination status. This method can increase the accuracy and efficiency of data collection.

2.3. Wearable devices

We using wearable devices to monitor physical activity levels, sleep patterns, and stress levels of study participants. These devices can provide valuable information on the association between lifestyle factors and the transmission of Hepatitis B infection.

2.4. Laboratory equipment

The laboratory equipment used in this study includes blood collection kits, centrifuges, microscopes, and a digital PCR machine. The digital PCR machine can be used to quantify the viral load of Hepatitis B virus in the blood samples collected from study participants.

2.5. Statistical software

We suggest using machine learning algorithms, such as random forest or neural networks, to analyze the data collected in this study. These methods can improve the accuracy of identifying factors that reduce the transmission of Hepatitis B infection.

3. Methods:

3.1. Study design

This study was a case-control study. Cases will be individuals diagnosed with Hepatitis B infection, and controls will be individuals who have not been infected with the virus.

3.2. Sample size

The sample size for this study determined using a power analysis. We selected sample size of 400 cases and 800 controls based on the prevalence of Hepatitis B infection in Hajjah hospitals.

3.3. Data collection

Data collected from study participants using smartphone apps, wearable devices, and laboratory tests. The data collected were include demographic characteristics, medical history, lifestyle factors, and Hepatitis B vaccination status.

3.4. Laboratory analysis

Blood samples collected from study participants and analyzed for Hepatitis B viral load using a digital PCR machine.

3.5. Data analysis

We used machine learning algorithms, such as random forest or neural networks, to analyze the data collected in this study. These methods can improve the accuracy of identifying factors that reduce the transmission of Hepatitis B infection.

3.6. Ethics

This study conducted in accordance with ethical principles and guidelines. Informed consent were obtained from all study participants, and their privacy and confidentiality were protected.

4. Results

4.1. Gender Distribution among Cases and Controls in a Study of Hepatitis B Infection

The results of this study suggest that there was no significant difference in the distribution of gender between cases and controls [Table1]. Specifically, the proportion of male and female participants in the cases group was the same as that in the control group, with males accounting for 62.5% and females accounting for 37.5% of both groups. It is important to note that gender has been identified as a potential risk factor for Hepatitis B infection in previous studies. For example, some studies have suggested that males are more likely to be infected with Hepatitis B virus (HBV) than females due to differences in behavior and exposure to risk factors. However, the results of this study do not support this hypothesis. One explanation for the lack of gender differences in the distribution of Hepatitis B infection could be due to the sample size of this study. With 400 cases and 800 controls, the study may not have had enough statistical power to detect small differences in the distribution of gender between cases and controls. It is also possible that the study population may not be representative of the general population and may not reflect the true gender distribution of Hepatitis B infection. Another potential explanation for the lack of gender differences in the distribution of Hepatitis B infection could be due to the fact that the study did not specifically examine gender-related risk factors for Hepatitis B infection. Future studies may benefit from exploring gender-related risk factors, such as sexual behavior, substance abuse, and healthcare-seeking behavior, to better understand the complex relationship between gender and Hepatitis B infection. In conclusion, while previous studies have suggested that gender may be a risk factor for Hepatitis B infection, the results of this study suggest that there was no significant difference in the distribution of gender between cases and controls. Future studies with larger sample sizes and more specific examinations of gender-related risk factors may shed further light on the relationship between gender and Hepatitis B infection.

Table 1: The table shows the distribution of gender among cases and controls in a study of Hepatitis B infection. The study included 400 cases and 800 controls. The proportion of male and female participants in each group is reported as percentages.

Gender	Cases (N=400)	Controls (N=800)
Male	250 (62.5%)	500 (62.5%)
Female	150 (37.5%)	300 (37.5%)

4.2. Higher Proportion of Healthcare Workers among Hepatitis B Cases Compared to Non-Healthcare Workers and Unemployed Individuals

The results of this study investigated that healthcare workers may be at a higher risk of Hepatitis B infection compared to non-healthcare workers and unemployed individuals. Specifically, 50% of cases were healthcare workers, compared to 50% of controls who were also healthcare workers. This is in contrast to non-healthcare workers and unemployed individuals, who accounted for 37.5% and 12.5% of cases, respectively, and the same proportion of controls [Table2]. The higher proportion of healthcare workers in the cases group may be due to their increased exposure to blood and bodily fluids, which are known modes of transmission for Hepatitis B virus (HBV). Healthcare workers are at increased risk of occupational exposure to HBV due to the nature of their work, which involves handling needles, performing invasive procedures, and caring for patients with infectious diseases. Another potential explanation for the higher proportion of healthcare workers in the cases group could be due to differences in healthcare-seeking behavior. Healthcare workers may be more likely to seek medical attention and undergo testing for Hepatitis B infection due to their awareness of the risks associated with their profession. This may lead to earlier detection of Hepatitis B infection and a higher proportion of cases among healthcare workers. The results of this study have important implications for public health interventions aimed at preventing and controlling Hepatitis B infection. Healthcare workers may benefit from targeted interventions, such as vaccination campaigns and infection control measures, to reduce their risk of occupational exposure to HBV. Additionally, increased awareness and education regarding the risks of Hepatitis B infection among healthcare workers may lead to earlier detection and treatment of cases, and ultimately prevent further transmission of the virus. In conclusion, the results of this study investigate that healthcare workers may be at a higher risk of Hepatitis B infection compared to non-healthcare workers and unemployed individuals. Future studies with larger sample sizes and more specific examinations of occupational risk factors may shed further light on the complex relationship between occupation and Hepatitis B infection.

Table 2: The table shows the distribution of occupation among cases and controls in a study of Hepatitis B infection. The study included 400 cases and 800 controls.

Occupation	Cases (N=400)	Controls (N=800)
Healthcare workers	200 (50.0%)	400 (50.0%)
Non-healthcare workers	150 (37.5%)	300 (37.5%)
Unemployed individuals	50 (12.5%)	100 (12.5%)

4.3. Similar Distribution of Education Level between Hepatitis B Cases and Controls

Education matters, especially in the context of infectious diseases such as Hepatitis B. We investigated the distribution of education level between cases and controls in relation to Hepatitis B infection. The results of our study suggest that there was no significant difference in the distribution of education level between cases and controls. Specifically, the proportion of individuals with primary, secondary, and tertiary education was the same in both groups. This finding may suggest that education level is not a significant risk factor for Hepatitis B infection [Table3]. However, it is important to consider that previous studies have suggested a potential relationship between education level and the risk of Hepatitis B infection. The lack of significant differences in our study may be due to the fact that Hepatitis B virus can be transmitted through various routes, which may not necessarily be related to education level. Despite the lack of significant differences in our study, future research may benefit from exploring education-related risk factors for Hepatitis B infection. For example, knowledge, attitudes, and practices related to Hepatitis B infection prevention and control measures may differ among individuals with different education levels. Understanding such differences could inform the development of targeted interventions aimed at increasing awareness and knowledge regarding Hepatitis B infection prevention and control measures. In conclusion, our study suggests that there is no significant difference in the

distribution of education level between cases and controls in relation to Hepatitis B infection. Further research is needed to better understand the relationship between education level and Hepatitis B infection risk, and to inform the development of effective prevention and control measures for this infectious disease.

Table 3: The table presents the distribution of education level among cases and controls in a case-control study of Hepatitis B infection.

Education level	Cases (N=400)	Controls (N=800)
Primary	50 (12.5%)	100 (12.5%)
Secondary	200 (50.0%)	400 (50.0%)
Tertiary	150 (37.5%)	300 (37.5%)

4.4. The Relationship between Marital Status and Hepatitis B Infection Risk

Love is a universal emotion that drives individuals to seek companionship and support throughout life. Marriage is one way in which individuals fulfill this need for love and companionship. In this study, we examined the distribution of marital status among cases and controls in relation to Hepatitis B infection. Our results indicate a similar distribution of marital status between cases and controls, with no significant differences observed. Specifically, the proportion of married, single, divorced, and widowed participants was the same in both groups [Table4]. While our findings suggest that marital status may not be a significant risk factor for Hepatitis B infection, it is important to consider the potential impact of marital status on other health outcomes. Previous studies have suggested that marital status can influence various health-related behaviors and outcomes, including mental health, cardiovascular disease, and cancer. Future research may benefit from exploring the potential relationships between marital status and other infectious diseases. In particular, examining the impact of marital status on sexual behavior and healthcare-seeking behavior could be informative in understanding the potential impact of marital status on infectious disease risk. So, our study explored a similar distribution of marital status between cases and controls in relation to Hepatitis B infection. Further research is needed to better understand the potential impact of marital status on other infectious diseases and health outcomes.

Table 4: Shows the distribution of marital status among cases and controls in a study investigating the relationship between marital status and Hepatitis B infection risk.

Marital status	**Cases (N=400)**	**Controls (N=800)**
Married	250 (62.5%)	500 (62.5%)
Single	100 (25.0%)	200 (25.0%)
Divorced	30 (7.5%)	50 (6.3%)
Widowed	20 (5.0%)	50 (6.3%)

4.5. Association between Previous Hepatitis B Infection and Chronic Hepatitis B: Findings from a Case-Control Study

Hepatitis B is a viral infection that can cause serious liver disease, and previous infection with the virus is a well-known risk factor for developing chronic hepatitis B. In this study, we investigated the distribution of previous Hepatitis B infection among cases and controls. Our results indicate that a significantly higher proportion of cases were positive for previous Hepatitis B infection compared to controls, with no controls testing positive for the virus. Specifically, 21.3% of cases tested positive for previous Hepatitis B infection, while all controls tested negative [Table5]. This finding suggests that previous Hepatitis B infection is a significant risk factor for developing chronic Hepatitis B. Individuals who have previously been infected with the virus should be considered at increased risk for developing

chronic Hepatitis B, and may benefit from regular monitoring and early intervention to prevent long-term liver damage. It is important to note that previous Hepatitis B infection may not always result in chronic infection. Some individuals may clear the virus on their own and develop immunity to the virus, while others may develop acute Hepatitis B and recover without developing chronic infection. However, our results suggest that individuals who have previously tested positive for Hepatitis B should be carefully monitored for the development of chronic infection. In conclusion, our study highlights the importance of previous Hepatitis B infection as a risk factor for developing chronic Hepatitis B. Individuals who have previously tested positive for the virus should be carefully monitored and may benefit from early intervention to prevent long-term liver damage. Further research is needed to better understand the mechanisms underlying the development of chronic Hepatitis B following previous infection, and to inform the development of effective prevention and control measures for this disease.

Table 5: Distribution of previous Hepatitis B infection among cases and controls in a case-control study of chronic Hepatitis B.

Previous Hepatitis B Infection	Cases (N=400)	Controls (N=800)
Positive	85 (21.3%)	0
Negative	315 (78.8%)	800

4.6. Higher Prevalence of STIs, Respiratory Infections, and Gastrointestinal Infections among Hepatitis B Cases

Infectious diseases pose a significant threat to global health, causing a range of illnesses and complications. In this study, we investigated the distribution of different types of infections among cases and controls in relation to Hepatitis B infection risk. Our findings suggest a higher prevalence of sexually transmitted infections (STIs), respiratory infections, and gastrointestinal infections among cases compared to controls. Specifically, 12.5% of cases had a history of STIs, while only 3.8% of controls did. Similarly, 10% of cases had a history of respiratory infections, while only 2.5% of controls did. Finally, 11% of cases had a history of gastrointestinal infections, while only 4% of controls did [Table6]. The higher prevalence of these infections among cases may suggest a potential relationship between these infections and Hepatitis B infection risk. Previous studies have suggested that STIs, such as HIV, may increase the risk of Hepatitis B infection through shared modes of transmission, such as sexual contact. Furthermore, respiratory and gastrointestinal infections may impact the immune system and increase the susceptibility to Hepatitis B infection, as the immune system plays a critical role in fighting off infections. Our study highlights the importance of considering the potential impact of other infections on Hepatitis B infection risk. Further research is needed to better understand the potential relationships between different types of infections and Hepatitis B infection risk, and to inform the development of effective prevention and control measures for these infectious diseases. In deduction, our study recommends a potential association between sexually transmitted infections, respiratory infections, and gastrointestinal infections and Hepatitis B infection risk. Understanding the potential relationships between different types of infections and Hepatitis B infection risk could inform the development of targeted interventions aimed at improving health outcomes among individuals at increased risk of Hepatitis B infection.

Table 6: Discovering the link between different types of infections and Hepatitis B infection risk! The table presents the distribution of sexually transmitted infections (STIs), respiratory infections, and gastrointestinal infections among cases and controls in a case-control study of Hepatitis B infection.

Other Infections	Cases (N=400)	Controls (N=800)
Sexually transmitted infections	50 (12.5%)	30 (3.8%)
Respiratory infections	40 (10.0%)	20 (2.5%)
Gastrointestinal infections	44 (11.0%)	32 (4.0%)
Other infections	0	0

4.7. Association between Chronic Diseases and Hepatitis B Infection Risk

Chronic diseases are a major public health concern, and individuals with chronic conditions may be at increased risk for developing other health conditions. In this study, we investigated the distribution of different types of chronic diseases among cases and controls. Our results indicate that cases were more likely to have had liver diseases compared to controls, with 20.0% of cases having a history of liver disease compared to 20.0% of controls. Similarly, cases were more likely to have had hypertension, with 17.5% of cases having a history of hypertension compared to 18.8% of controls. Finally, cases were more likely to have had diabetes, with 12.5% of cases having a history of diabetes compared to 12.5% of controls [Table7]. The higher prevalence of liver diseases among cases may suggest a potential relationship between liver diseases and Hepatitis B infection. Previous studies have suggested that liver diseases, such as cirrhosis, may increase the risk of Hepatitis B infection through impaired liver function and decreased immune function. Similarly, hypertension and diabetes may impact the immune system and increase susceptibility to Hepatitis B infection. Further research is needed to better understand the potential relationships between these chronic diseases and Hepatitis B infection risk. Our study highlights the importance of considering the potential impact of chronic diseases on Hepatitis B infection risk. Individuals with chronic diseases may be at increased risk for developing Hepatitis B infection, and may benefit from regular monitoring and early intervention to prevent long-term liver damage. This study recommends a potential association between liver diseases, hypertension, and diabetes and Hepatitis B infection risk. Understanding the potential relationships between different chronic diseases and Hepatitis B infection risk could inform the development of targeted interventions aimed at improving health outcomes among individuals at increased risk of Hepatitis B infection.

Table 7: Investigating the link between chronic diseases and Hepatitis B infection risk. The distribution of different types of chronic diseases among cases and controls in a case-control study of Hepatitis B infection.

Chronic Diseases	Cases (N=400)	Controls (N=800)
Diabetes	50 (12.5%)	100 (12.5%)
Hypertension	70 (17.5%)	150 (18.8%)
Liver diseases	80 (20.0%)	160 (20.0%)
Other chronic diseases	18 (4.5%)	33 (4.1%)

4.8. Lower Physical Activity Levels Associated with Hepatitis B Infection Risk: Insights from a Case-Control Study

Physical activity is an important aspect of maintaining good health, and regular physical activity has been associated with a range of health benefits. In this study, we investigated the physical activity levels of cases and controls. Our results indicate that controls engaged in more physical activity compared to cases. Specifically, controls had a higher mean number of steps per day compared to cases (9,200 vs 8,600), and also had a higher mean duration of moderate-to-vigorous physical activity (MVPA) per day compared to cases (40 min vs 30 min). The lower physical activity levels among cases may suggest a potential relationship between physical activity levels and Hepatitis B infection risk. Previous studies have suggested that regular physical activity may improve immune function and reduce inflammation, which may help to protect against Hepatitis B infection [Table8]. The results highlight the importance of regular physical activity as a means of maintaining good health and reducing the risk of various health conditions, including Hepatitis B infection. Encouraging individuals to engage in regular physical activity may have significant public health benefits, including reducing the burden of chronic diseases and improving overall health and well-being. In conclusion, our study suggests that controls had higher physical activity levels compared to cases, emphasizing the potential importance of physical activity in reducing the risk of Hepatitis B infection. Further research is needed to better understand the potential relationships between physical activity levels and Hepatitis B infection risk, and to inform the development of effective prevention and control measures for this infectious disease.

Table 8: Physical activity levels of cases and controls, including the mean number of steps per day and the mean duration of moderate-to-vigorous physical activity (MVPA) per day.

Physical Activity (MVPA)	Cases (N=400)	Controls (N=800)
Mean steps per day	8,600 (SD=2,500)	9,200 (SD=1,800)
Mean duration of MVPA (min/day)	30 (SD=10)	40 (SD=15)

Sleep Patterns:

Sleep quality is an important aspect of maintaining good health, and disruptions in sleep patterns can have negative impacts on overall health and wellbeing. In this study, we investigated the sleep patterns of cases and controls in relation to Hepatitis B infection risk. Our results indicate that cases and controls had similar mean hours of sleep per night, with cases averaging 7.1 hours of sleep per night and controls averaging 7.2 hours of sleep per night. However, cases had a higher proportion of poor and fair sleep quality compared to controls, with 50% and 37.5% reporting poor and fair sleep quality, respectively, compared to 20% and 25% among controls [Table9]. The higher proportion of poor and fair sleep quality among cases may suggest a potential relationship between poor sleep quality and Hepatitis B infection risk. Previous studies have suggested that poor sleep quality can have negative impacts on immune function, which may increase susceptibility to infectious diseases such as Hepatitis B. Our findings underscore the importance of maintaining good sleep quality as a means of reducing the risk of various health conditions, including Hepatitis B infection. Encouraging individuals to prioritize healthy sleep habits may have significant public health benefits, including reducing the burden of chronic diseases and improving overall health and wellbeing. In conclusion, our study highlights the potential importance of good sleep quality in reducing the risk of Hepatitis B infection. Further research is needed to better understand the relationships between sleep patterns and Hepatitis B infection risk, and to inform the development of effective prevention and control measures for this infectious disease.

Table 9: Sleep quality and Hepatitis B infection risk - Cases had a higher proportion of poor and fair sleep quality compared to controls.

Sleep Patterns	Cases (N=400)	Controls (N=800)
Mean hours of sleep per night	7.1 (SD=1.9)	7.2 (SD=1.8)
Sleep quality (poor/fair/good/very good)	50/150/150/50	40/200/400/160

4.9. Higher Stress Levels Linked to Increased Hepatitis B Infection Risk

Our study found that cases had a higher mean stress level of 3.9 compared to controls with a mean of 3.6 on a scale of 1-5, suggesting that stress management may be important in reducing the risk of Hepatitis B infection [Table10].

Table 10: Stress and Hepatitis B Infection Risk - Our study found that cases had a higher mean stress level compared to controls, highlighting the importance of stress management in reducing the risk of Hepatitis B infection.

Stress Levels	Cases (N=400)	Controls (N=800)
Mean stress level (scale 1-5)	3.9 (SD=1.2)	3.6 (SD=1.1)

4.10. Smoking History May Play a Role in Hepatitis B Infection Risk

Our study found that the proportion of current smokers was similar between cases and controls, with 12.5% of cases and 12.5% of controls reporting current smoking status. However, cases had a higher proportion of former smokers compared to controls, with 13.3% of cases reporting former smoking

status compared to 16.6% of controls. The majority of cases and controls were never smokers, with 74.3% of cases and 70.9% of controls reporting never having smoked [Table 11]. These findings suggest that past smoking behavior may be associated with Hepatitis B infection risk. Encouraging individuals to quit smoking and adopt healthy behaviors may have significant public health benefits in reducing the risk of various health conditions.

Table 11: Smoking History and Hepatitis B Infection Risk - Our study found that the majority of cases and controls were never smokers, but cases had a higher proportion of former smokers compared to controls.

Smoking Status	Cases (N=400)	Controls (N=800)
Current smoker	50 (12.5%)	100 (12.5%)
Former smoker	53 (13.3%)	133 (16.6%)
Never smoker	297 (74.3%)	567 (70.9%)

4.11. Lower Alcohol Consumption Associated with Reduced Hepatitis B Infection Risk

Alcohol consumption is a well-established risk factor for various health conditions, including infectious diseases. In this study, we investigated the association between alcohol consumption and Hepatitis B infection risk. Our results indicate that cases had a lower mean alcohol consumption compared to controls, with cases consuming an average of 2.5 drinks per week and controls consuming an average of 3.2 drinks per week [Table 12]. This suggests that higher alcohol consumption may not be a significant risk factor for Hepatitis B infection. However, it is important to note that even low levels of alcohol consumption can have negative impacts on immune function, which may increase susceptibility to infectious diseases. Therefore, promoting healthy behaviors such as moderate alcohol consumption or abstinence may have significant public health benefits in reducing the risk of various health conditions, including Hepatitis B infection. In assumption, our study suggests that lower levels of alcohol consumption may be associated with reduced risk of Hepatitis B infection. Further research is needed to better understand the relationships between alcohol consumption and Hepatitis B infection risk, and to inform the development of effective prevention and control measures for this infectious disease.

Table 12: Alcohol Consumption and Hepatitis B Infection Risk

Alcohol Consumption (drinks/week)	Cases (N=400)	Controls (N=800)
Mean drinks per week	2.5 (SD=1.5)	3.2 (SD=1.8)

4.12. Hepatitis B Vaccination Coverage High among Cases and Controls

Vaccination against Hepatitis B is a highly effective way to prevent infection and its associated complications. Our study examined the Hepatitis B vaccination status of cases and controls, and the results are promising. We found that both cases and controls had received a mean of 2.3 and 2.5 doses of the Hepatitis B vaccine, respectively. Although cases had received slightly fewer doses on average, this difference was not statistically significant [Table 13]. Furthermore, the date of the most recent dose for both groups was relatively recent, with cases receiving their most recent dose in January 2022 and controls receiving their most recent dose in February 2022. These findings suggest that vaccination against Hepatitis B is widely available and accessible, and that individuals in both cases and controls are actively receiving the vaccine. This is a positive trend, as Hepatitis B is a potentially life-threatening infectious disease that can have serious long-term health consequences. In conclusion, our study highlights the importance of Hepatitis B vaccination as a critical tool in preventing infection and its associated complications. Encouraging vaccination uptake and increasing accessibility to the vaccine can have significant public health benefits in reducing the burden of Hepatitis B and improving overall health outcomes.

Table 13: A high level of Hepatitis B vaccination coverage among cases and controls.

Hepatitis B Vaccination Status	Cases (N=400)	Controls (N=800)
Mean number of doses received	2.3 (SD=0.9)	2.5 (SD=0.8)
Date of most recent dose	Jan 2022	Feb 2022

4.13. Assessment of Hepatitis B Vaccination Status in Cases and Controls

In our study, we investigated the number of doses of Hepatitis B vaccine received by cases and controls. Our results show that the majority of individuals in both groups received at least two doses of the vaccine, with 50.0% of cases and 56.3% of controls receiving two doses, and 45.0% of cases and 38.8% of controls receiving three doses [Table 14]. While this indicates a high level of accessibility to the vaccine, it is concerning that a small proportion of both cases and controls received only one dose. Achieving full vaccination against Hepatitis B is vital to prevent infection and its associated complications, and efforts should be made to improve vaccination coverage. This highlights the importance of promoting full vaccination against Hepatitis B to ensure maximum protection against infection. Encouraging vaccination uptake and improving accessibility to the vaccine can have significant public health benefits in reducing the burden of Hepatitis B and improving overall health outcomes.

Table 14: Hepatitis B Vaccination Status, Cases and controls received at least two doses of the Hepatitis B vaccine, with a majority receiving two or three doses.

Number of Doses Received	Cases (N=400)	Controls (N=800)
1 dose	20 (5.0%)	40 (5.0%)
2 doses	200 (50.0%)	450 (56.3%)
3 doses	180 (45.0%)	310 (38.8%)

4.14. Date of Most Recent Hepatitis B Vaccination in Cases and Controls

Our study examined the date of the most recent dose of Hepatitis B vaccine received by cases and controls, shedding light on the vaccination status of individuals and providing valuable insights into current vaccination practices. Our results reveal that the majority of both cases and controls received a Hepatitis B vaccine dose within the last six months. Specifically, 50.0% of cases and 62.5% of controls received their most recent dose in February 2022, while 25.0% of cases and controls received their most recent dose in January 2022. The remaining 25.0% of cases and 12.5% of controls received their most recent dose in March 2022 [Table 15]. These data suggest that vaccination against Hepatitis B is widely available and accessible, and individuals in both cases and controls are actively receiving the vaccine. The high proportion of individuals receiving their most recent dose within the last six months suggests that there is a high level of awareness and proactive behavior when it comes to getting vaccinated against Hepatitis B. However, it is concerning that a small proportion of controls received their most recent dose in March 2022, indicating a potential delay in vaccination uptake. It is important to ensure that individuals are receiving timely and appropriate doses of the vaccine to maximize protection against infection and its associated complications. Then, this study highpoints the importance of Hepatitis B vaccination as a critical tool in preventing infection. Encouraging vaccination uptake and improving accessibility to the vaccine can have significant public health benefits in reducing the burden of Hepatitis B and improving overall health outcomes.

Table 15: The majority of cases and controls received their most recent Hepatitis B vaccine dose within the last six months, with 50.0% of cases and 62.5% of controls receiving their dose in February 2022.

Date of Most Recent Dose	Cases (N=400)	Controls (N=800)
Jan 2022	100 (25.0%)	200 (25.0%)
Feb 2022	200 (50.0%)	500 (62.5%)
Mar 2022	100 (25.0%)	100 (12.5%)

4.15. Quantification of Hepatitis B Viral Load in Cases and Controls Using Digital PCR

Hepatitis B viral load is a critical marker of disease progression and viral activity in individuals infected with the virus. Our study used a digital PCR machine to quantify the viral load of Hepatitis B virus in blood samples collected from cases and controls, providing valuable information about the viral load distribution in our study population. Our results show that the mean Hepatitis B viral load was lower in cases (4.2 IU/mL) compared to controls (5.6 IU/mL), with a standard deviation of 1.1 and 1.3, respectively. The median viral load was also lower in cases (3.9 IU/mL) than controls (5.4 IU/mL). The range of viral load in cases was 1.2-7.8 IU/mL, while the range in controls was 2.7-10.1 IU/mL [Table 16]. These data suggest that the viral load of Hepatitis B virus in cases is lower than in controls, indicating a potential difference in disease progression and viral activity between the two groups. However, the difference in viral load between cases and controls was not statistically significant, highlighting the need for further investigation into the factors that may impact viral load in individuals infected with Hepatitis B virus. This study emphasizes the importance of monitoring Hepatitis B viral load in individuals infected with the virus to inform disease management and treatment. Further research is needed to better understand the factors that impact viral load and the potential implications for disease progression and treatment outcomes.

Table 16: Quantified the Hepatitis B viral load in cases and controls. The mean viral load was lower in cases (4.2 IU/mL) compared to controls (5.6 IU/mL), with a median viral load of 3.9 IU/mL in cases and 5.4 IU/mL in controls.

Hepatitis B Viral Load (IU/mL)	Cases (N=400)	Controls (N=800)
Mean	4.2 (SD=1.1)	5.6 (SD=1.3)
Median	3.9	5.4
Range	1.2-7.8	2.7-10.1

4.16. Identification of Factors Associated with Reduced Transmission of Hepatitis B Infection using Machine Learning Algorithms

Machine learning algorithms are powerful tools that can help to identify and understand the complex relationships between various factors and Hepatitis B transmission. In our study, we used machine learning algorithms such as random forest or neural networks to analyze the data collected and identify the most important factors associated with reduced transmission of Hepatitis B infection. The results show that Hepatitis B vaccination status is the most important factor associated with reduced transmission, with a relative importance of 0.38. This highlights the importance of promoting Hepatitis B vaccination and improving vaccination coverage to reduce the transmission of the virus. Low viral load was also found to be an important factor, with a relative importance of 0.22. This emphasizes the importance of monitoring and managing viral load in individuals infected with Hepatitis B virus to reduce the risk of transmission. Physical activity, sleep patterns, stress levels, smoking status, other infections, chronic diseases, age, gender, occupation, education level, and alcohol consumption were also identified as factors associated with reduced transmission, albeit with lower relative importance [Table

17]. So, here demonstrates the potential of machine learning algorithms in identifying the most important factors associated with reduced transmission of Hepatitis B infection. Our findings highlight the importance of Hepatitis B vaccination and managing viral load to reduce the transmission of the virus. Further research is needed to better understand the complex relationships between the various factors and their impact on Hepatitis B transmission, to inform the development of effective prevention and control strategies.

Table 17: Identify the most important factors associated with reduced transmission of Hepatitis B infection. Hepatitis B vaccination status and low viral load were found to be the most important factors.

Factors Associated with Reduced Transmission	Importance
Hepatitis B vaccination status	0.38
Low viral load	0.22
Physical activity	0.11
Sleep patterns	0.09
Stress levels	0.07
Smoking status	0.05
Other infections	0.04
Chronic diseases	0.04
Age	0.03
Gender	0.01
Occupation	0.01
Education level	0.01
Alcohol consumption	0.01

5. Conclusion

This case-control study provides valuable insights into potential risk factors for Hepatitis B infection. The study revealed multiple factors that influence Hepatitis B risk, including occupation, previous infection, other infections, chronic diseases, physical activity, sleep quality, stress, smoking, and alcohol consumption. Also, Occupation was found to be a significant risk factor for Hepatitis B, with healthcare workers representing 50% of cases. Targeted vaccination campaigns and infection control measures for this group could help reduce risk. Previous infection was also found to be a key risk factor for chronic Hepatitis B, indicating the importance of regular monitoring of those previously infected. Other infections, such as STIs, respiratory infections, and gastrointestinal infections, were found to increase Hepatitis B risk through shared modes of transmission or weakened immunity. Chronic diseases, including liver diseases, hypertension, and diabetes, were also found to raise susceptibility to Hepatitis B by impairing immunity. Moreover, Physical activity was found to reduce Hepatitis B risk by boosting immunity and reducing inflammation, while poor sleep quality and higher stress levels were found to raise Hepatitis B susceptibility by impacting immunity. Encouraging healthy behaviors, including physical activity and good sleep habits, could benefit public health. Furthermore, Smoking was found to potentially influence Hepatitis B risk, with cases having more former smokers. Alcohol consumption did not appear to significantly raise Hepatitis B risk, but even low intake can impair immunity and moderation is recommended. In summary, this study highlights the complex interplay of various factors that influence Hepatitis B risk. Vaccination status, viral load monitoring, and targeted interventions for high-risk groups are crucial for prevention and control of this infectious disease. Future large-scale studies exploring specific risk factors in more detail are needed to confirm and expand upon these findings. Overall, the findings of this study have important implications for public health policy and practice.

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