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Reevaluation of hepatitis B transmission modes: A systematic analysis

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Abstract

Background and Aim: Results from post-birth vaccination have indicated that the theory of perinatal transmission of HBV is largely incorrect. Current prevention guidelines on some risk factors from different agencies still contradict each other. One reason why these problems occur is that there are no animal and epidemiological research data that have pin pointed whether infections occur through this route rather than another. The present study compares two existing transmission theories based on common sense that a valid theory should be able to consistently explain the phenomena in the given field.

Methods: The present study systematically analyze high-risk populations, progress in HBV preventive practices, and HBV infection rates between regions with high and low mosquito abundance globally.

Results: A wide range of epidemiological data and progress in HBV prevention can be consistently explained by the theory of mosquito transmission, but not by the current transmission theory.

Conclusion: These solid and consistent data strongly suggest that HBV mainly spreads through mosquitoes and mistakes have occurred in our understanding of HBV transmission. Further research is urgently needed.

Keywords: HBV; Risk factor; Mosquito; Sex; Vector transmission

1. Introduction

In Northwestern Europe, North America, and Australia, the rate of HBV infection is very low during young childhood compared to adulthood (Fig. 1A-1C).[1-3] In contrast, in Asia, Africa, and some countries in Southern Europe/Latin America, high or the highest rates of infection occur during young childhood before widespread vaccination or among children without vaccination (Fig. 1D-1H)?[4-8] Guidelines explain that HBV infections mainly occur through perinatal transmission and infections during early childhood in high-endemicity regions.[9,10] Why do these infections not often occur in Northwestern Europe, North America, and Australia, despite the similarities in pregnancy and deliveries and the similar contact with others in childhood between the two groups of regions?

Vaccination only prevents infections that occur after the vaccination has taken effect. HBV infections among young children have been reduced by more than 80% after post-birth vaccination in many global regions,[11] and infections are expected to continue to drop with the increase in vaccination coverage. These data indicate that more than 80% of infections among young children occur after vaccination has taken effect. In other words, the theory of perinatal transmission is largely incorrect.

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The guideline from WHO states that, HBV is spread predominantly by percutaneous or mucosal exposure to infected blood, saliva, and other body fluids.[9,12] However, the guideline from US CDC announce that HBV transmission cannot occur through kissing, sneezing, or coughing.[13] Clearly, kissing exposes others' percutaneous or oral mucosa to saliva, while sneezing and coughing spurt out countless saliva and other fluid particles into the air, exposing others' percutaneous or respiratory tract mucosa.

One reason why the above problems occur with the prevention guidelines is that there is no animal and epidemiological research data that have pin pointed whether infections occur through this route rather than another. What should we do about this kind of problem? A valid theory should be able to consistently explain the phenomena in the given field. Therefore, the present study tests two existing transmission theories with a wide range of global data.

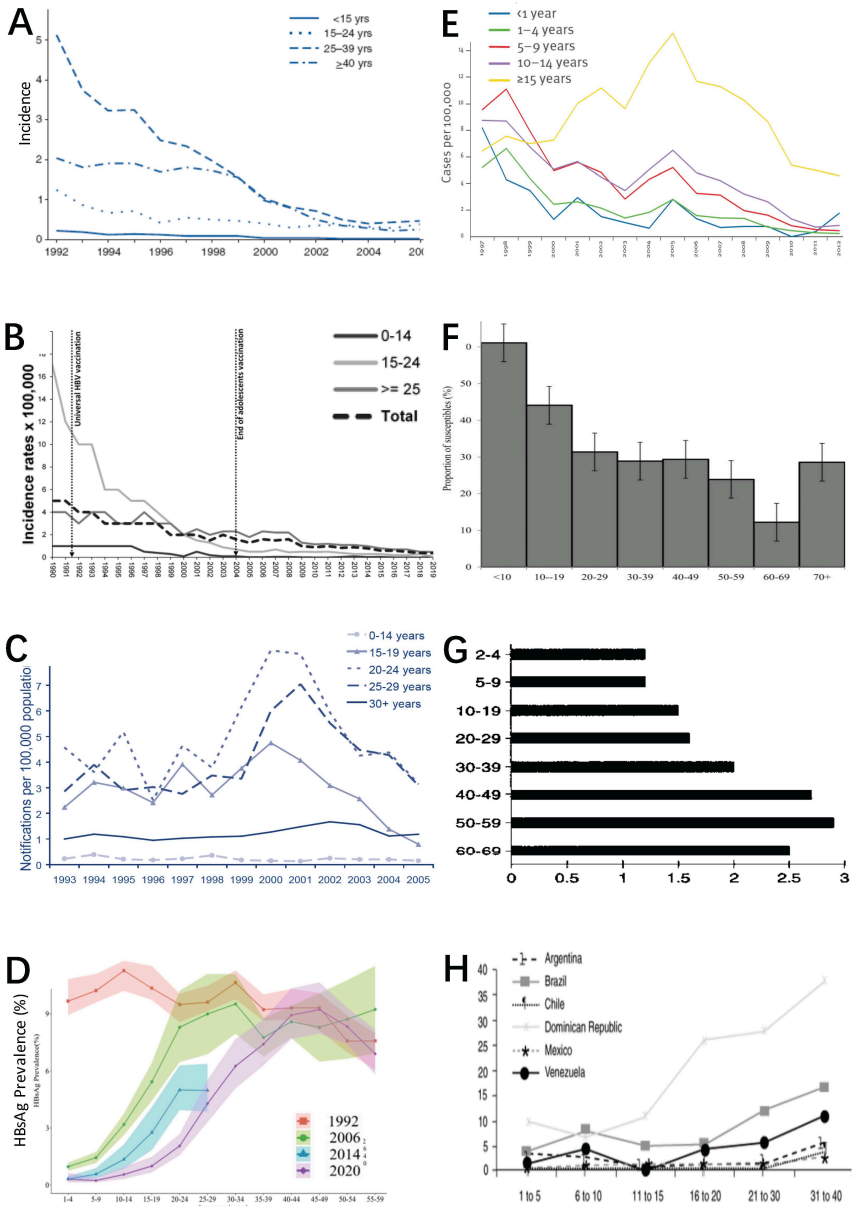

Figure 1 A) Incidence of acute hepatitis B, United States, 1990-2006. Source.[1] B) Acute HBV infection, Italy. Source.[2] C) Acute hepatitis B notification rates, Australia. Source.[3] D) Age specific HBsAg prevalence, China, 1992–2020. Source.[4] E) Notification rates for acute hepatitis B, Turkey, 1997–2012. Source.[5] F) Proportion of susceptible, Nigeria. Only 7.9% participants showed serologic evidence receiving vaccination. Source.[6] G) Prevalence of HBV carriers in different age group, 1990–1991, Iran. Source.[7] H) Seroprevalence of hepatitis B in different age groups in countries of Latin America, 1996–1997. Source.[8]

2. Methods

2.1. Research strategy

The present study compares the current transmission theory and the theory of mosquito transmission to see if they can consistently explain a wide range of epidemiological data.

The present study systematically analyzes high-risk populations based on lists stated in clinical guidelines,[9,11,13-15] HBV infection rates between regions with high and low mosquito abundance based on a map of the global distribution of A. aegypti mosquitoes (Fig. 2A), and the progress in HBV prevention by examining published systematic review or meta-analysis studies.

3. Analysis

3.1 Geographic distribution of mosquitoes and HBV infection

The global distribution of A. aegypti mosquitoes (Fig. 2A)[16] is generally similar to that of HBV infections (Fig. 2B).[11.] In the following, we compare the rates of HBV infection between regions with a high prevalence of A. aegypti mosquitoes and their neighboring regions with a low prevalence of the mosquitoes based on the map shown in Fig. 2A.

In Argentina, the abundance of mosquitoes is higher in the northern boundary region (Fig. 2A). Consistently, the risk of HBV infection was highest in the Northwest, followed by the Northeast.[17] The Andes separate the South American continent, with much higher rates of mosquitoes in the east than in the west (Fig. 2A). Consistently, Brazil and Paraguay have higher rates of HBV infections than narrow coast Chile (Fig. 2B). In Bolivia, mosquitoes are higher in its eastern region (Fig. 2A), where the prevalence of HBV seropositivity is 59.7%, several to more than 10 times higher compared to other regions (Fig. 2C).[18] In Peru, the abundance of mosquitoes is higher in east and central regions (Fig. 2A). Consistently, HBV infections are higher in these regions compared to the west coast (Fig. 2D).[19] We have not found HBV data from Ecuador, a country with a similar mosquito distribution as Peru.

Exceptionally, in the northern end of South America bordering the Caribbean Sea, although the abundance of mosquitoes is similarly high as in neighboring regions (Fig. 2A), the rate of HBV infections is low (Fig. 2B). Another map provides an explanation – while this region has a similar prevalence of A. aegypti mosquitoes as neighboring regions from July to November, it has a much lower prevalence of the mosquitoes from December to May.[20]

In Mexico and the United States, there is a high prevalence of mosquitoes along the coasts and in the Southeast, respectively (Fig. 2A). Consistently, HBV infections are generally higher along the coasts in Mexico (Fig. 2E),[21] and in the Southeast in the United States (Fig. 2F).[22]

In Africa, red lines separate areas with high and low prevalence of mosquitoes (Fig. 2A). In North Africa, the prevalence of HBV south of the red line is much higher than on the north side (Fig. 2B). In Southern Africa, the red line crosses the northern boundary region of Namibia and the northeast of South Africa (Fig. 2A). Consistently, HBV prevalence is highest in the northern region of Namibia (Fig. 2G),[23] and the northeast region of South Africa.[24]

In Australia, A. aegypti mosquitoes are most prevalent in the northern region (Fig. 2A), where HBV infections are also most common (Fig. 2H).[25] In China, mosquitoes are most abundant on the southeast coast (Fig. 2A), where chronic HBV infections were highest (Fig. 2I).[26]

The prevalence of mosquitoes in India dramatically decreases in the North due to the Himalayas (Fig. 2A). In Pakistan, the highest HBV prevalence occurs in a region of the southwestern province (Fig. 2J).[27] As marked by the red arrow in Fig. 2A, this region has a high abundance of mosquitoes. However, why does the highest rate of HBV infections in Pakistan not occur in the northern region where A. aegypti mosquitoes are most abundant (Fig. 2A)? This issue will be discussed in the following sections.

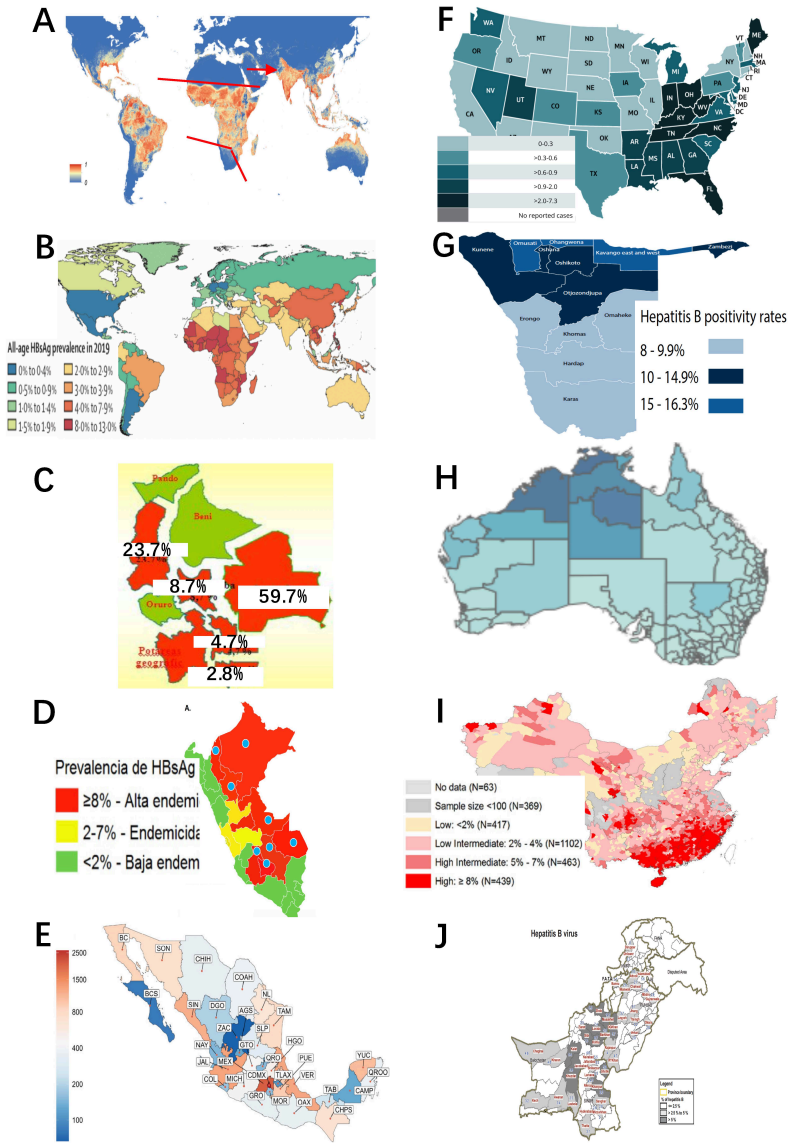

Figure 2 A) Predicted distribution of A. aegypti mosquitoes. Source.[16] B) All-age HBsAg seroprevalence, 2019. Source.[11] C) Prevalence of HBV seropositivity, Bolivia. Source.[18] D) Prevalence of HBsAg, Peru. Source.[19] E) Accumulated HBV incidence, Mexico, 1995-2021. Source.[21] F) Rates of reported acute hepatitis B, United States, 2018. Source.[22] G) HBV infection rate, Namibia. Source.[23] H) Chronic hepatitis B prevalence, Australia, 2022. Source.[25] I) Chronic HBV infection, China, 2010. Source.[26] J) Prevelence of hepatitis B, Pakistan. Source.[27]

3.2 Infections among children in different regions

One of the biggest puzzling observations is why rates of HBV infections are highest in Africa and Asia but low in Northwestern Europe, North America, and Australia. The current theory of perinatal transmission is often used as an explanation, but has been proven largely incorrect due to results from post-birth vaccination.

Mosquitoes are active at night. If mosquitoes transmit HBV, the disease should easily spread among people sleeping in the same room. This is because sleeping in a room allows mosquitoes to bite two people within a short interval (e.g. minutes). The fresh blood left on a mosquito's mouthparts from one person will be immediately transferred to the bloodstream of another person during subsequent bites. In Asia, Africa, and some countries in Southern Europe/Latin America, it is common for infants and children to share a bed with their parents.[28,29] However, this practice is much less common in Northwestern Europe, North America, and Australia. [28,29] This helps explain why HBV infection rates are high or highest among children in Easter countries but low among children in developed Western countries (Fig. 1).

A common characteristic of mosquito-borne diseases is that high rates of infection occur among children in Africa and Asia but are low among children in Western developed countries. For example, in a US national survey, among 1,132 people infected with West Nile virus, children aged 1 to 17 years accounted for only 2%.[30] In contrast, in Nigeria and India, the infection rates of West Nile among children aged 1 to 17 were 22.9% and 33%, respectively.[31,32]

Within the United States, bed-sharing also varies between different ethnic populations, with much less among white populations (Fig. 3A).[33] Consistently, HBV infections among white children are much lower compared to black children before widespread vaccination (Fig. 3B).[34]

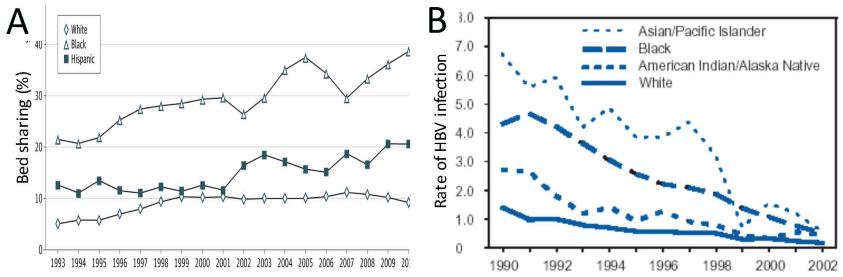

Figure 3 A) Trends in Usual Bed-Sharing (3-year moving average), United States. Source.[33] B) Rate of acute hepatitis B (≤19 years), United States, 1990–2002. Source.[34]

3.3 High-risk populations

According to the guidelines,[9,11,13-15] the following populations are at high risk of infection: 1) People with other diseases (e.g. HIV, renal diseases, chronic liver diseases, etc.); 2) Health care and public safety workers who are exposed to blood; 3) Travelers to countries endemic with HBV; 4) People who inject drugs or share syringes. 5) Persons born in regions of high or intermediate HBV endemicity; 6) All pregnant women; 7) Homeless individuals; 8) People who have been in prisons and other closed settings; 9) Infants born to HBsAg-positive mothers; 10) Sex partners of people who have hepatitis B; 11) People who live with someone who has hepatitis B; 12) Sex workers; 13) Men who have sex with men.

The first 4 populations involve a different story. Therefore, we examine how the theory of mosquito transmission explains high infections among the remaining 9 populations.

Population 5: These regions are either prevalent with mosquitoes and/or popular for bed-sharing between children and parents. Population 6: It is well known that mosquitoes like to bite pregnant women.[35] Population 7: Homeless people are more often exposed to mosquitoes. Population 8: Sleeping in crowded spaces allows mosquitoes to easily bite two people within a short interval.

Population 9: Infants are at risk of HBV transmission due to bed-sharing with mothers, which occurs more or less in different regions. Explanations for Population 10, 11, and 12: sleeping in the same room exposes to risk of disease transmission between sexual partners and familiar members by mosquitoes.

The characteristics of mosquito biting help explain high infections among MSM (Population 13): 1) Men are more likely than women to attract mosquitoes.[36] Two men staying together are more attractive to mosquitoes than a man and a woman together, followed by two women together. 2) When two people sleep in a room, mosquitoes usually bite the more attractive one. If a bite is interrupted, they either come back to bite or fly away, but are less likely to bite the other one. However, if two people have similar attractiveness, the insect is likely to bite either one after an interrupted bite, potentially leading to disease transmission. Two men are more likely to have similar attractiveness to mosquitoes than a man and a woman.

Therefore, infection rates of HBV are much higher among men than women.[22] In fact, this is another characteristic of mosquito-borne diseases. For example, in a US national survey on West Nile and other mosquito-borne diseases, rates of infections are much higher in men than in women.[30]

Fishing communities are also consistently reported to be a high-risk population,[37] but are neglected in guidelines. Fishing men live in humid environments where mosquitoes are abundant, thus exposing them to risk.

3.4 Rapid decline in HBV prevalence after 2000

Fig. 4A–4D display global vaccine three-dose coverage,[38] birth dose coverage,[38]HBsAg prevalence of all ages,[11] and HBsAg prevalence in children (< 5 years),[11] respectively.

Although the coverage of HBV vaccination increased rapidly in the 1990s, HBV prevalence remained relatively stable from 1990 to 2000 (Fig. 4C & 4D). However, HBV prevalence, both total and in young children, suddenly started to decline rapidly after 2000 (Fig. 4C & 4D).

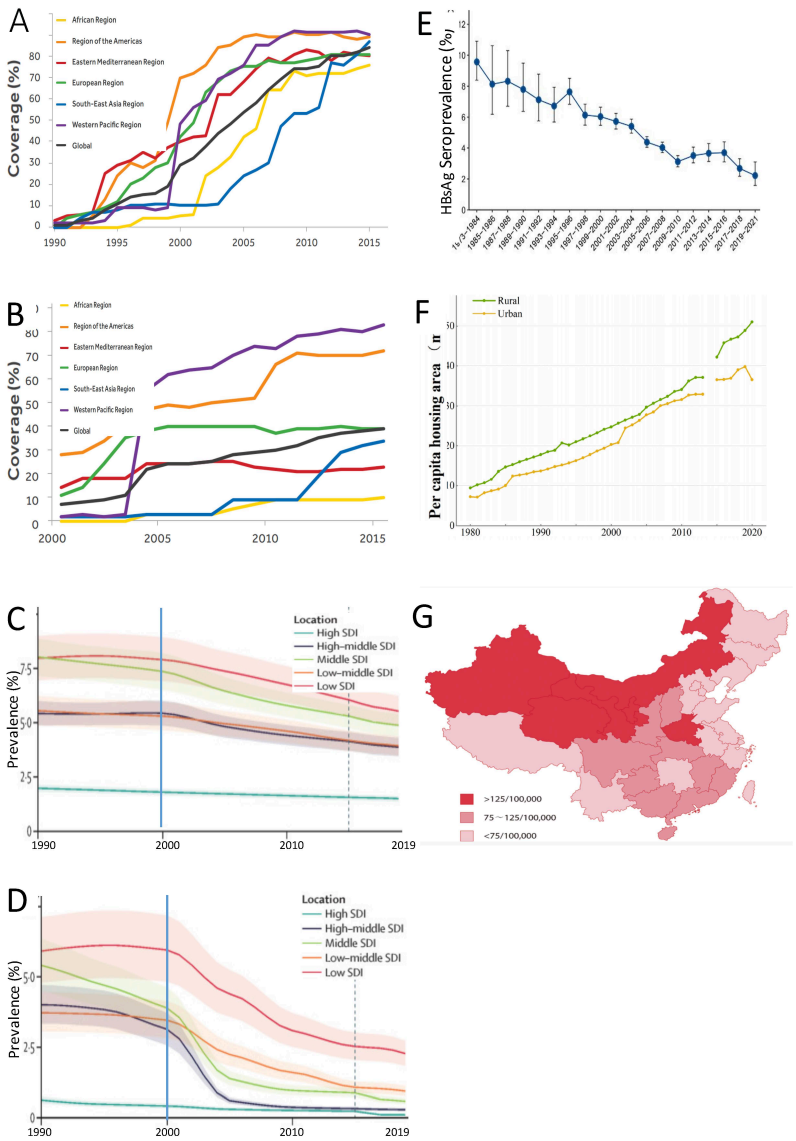

Figure 4 A) Three-dose vaccine coverage, from 2000 to 2015. Source.[38] B) HBV vaccine birth dose coverage, from 2000 to 2015. Source.[38] C) Global HBsAg prevalence for all ages, from 1990 to 2019. Source.[11] D) Global HBsAg prevalence in children (<5 years), from 1990 to 2019. Source.[11] E) Pooled estimates of HBsAg seroprevalence by two-year study intervals, China. Source.[41] F) Trends in per capita housing area, China, from 1980 to 2020. Source.[42] G) Reported incidence of hepatitis B, 2005–2010, China. Source.[43]

As of 2000, half of the countries in the world were endemic with malaria. Unprecedented efforts to prevent malaria were launched in endemic regions after 2000.[39] For example, in sub-Saharan Africa, more than half of the population slept under insecticide-treated mosquito nets in 2015, compared to only 2% in 2000.[40] Children are prioritized in the distribution of mosquito nets because they accounted for 90% of deaths due to malaria.[39] These facts help explain why HBV infections suddenly started to decline after 2000, and why the decline among children was so striking.

Let's provide a separate analysis for China, as it has 20% of the global population, and its progress is unique. A meta-analysis study reported that HBV infections (all ages) started to decrease rapidly since 1980, 10 years earlier than widespread vaccination (Fig. 4E).[41] The seroprevalence of HBsAg in all age groups had reduced by nearly 80% by 2020 (Fig. 4E), three times larger compared to the global average (Fig. 4C).

In the 1960s and 1970s, sharing sleeping rooms in China was common due to high poverty. As one Chinese proverb said: "One room with half being the bed, three generations are crowded there". This situation has been changing quickly since opening up to the outside world in the late 1970s. The per capita housing area has increased rapidly after 1980 (Fig. 4F).[42] This means that the number of people sharing a room for sleeping is rapidly decreasing. This helps explain the rapid decrease in HBV infection 10 years earlier before widespread vaccination.

To explore why the decline in HBV infections is much larger on the southeast coasts, we compare the national survey data on chronic infection (Fig. 2I) with the data on national reported cases (Fig. 4G).[43] There are several types of data: chronic infection, HBsAg, acute infection, or reported cases. Chronic infection is more related to infections decades before because these infections occurred over many decades leading up to the time of the survey and infections occurring in childhood easily become chronic infections. On the other hand, "reported cases" represent the current infection rate during the time of the survey.

Comparing Fig. 2I and Fig. 4G shows that, the southeast coasts experienced the largest decrease in HBV infections, going from the highest prevalence of infection to common levels. Why did this occur? China first opened up to the outside world in the southern coastal region in the late 1970s, followed by the southeastern and northeastern coastal regions in the following 10 to 20 years. Economic reform in western regions started after 2000. This chronological order corresponds to the timing and scale of economic growth and housing improvements in the relevant regions.

3.5 How does the current theory explain?

Obviously, it is difficult to use the current theory to explain the much higher rates of HBV infections that occur in regions with a high abundance of mosquitoes compared to regions with a low abundance of mosquitoes and among children in Eastern populations compared to children in Western populations, as well as the rapid decline in rates of HBV infection that suddenly started after 2000. Here, we examine whether the current theory can explain high risk populations.

Let's test with data from a specific country. According to the 2023 US national surveillance report on acute hepatitis B, injection drug use and having multiple sexual partners are the two most important identified risk factors, accounting for 32% and 18% of cases, respectively.[44] However, the rate of illicit drug use is usually higher in the West (Fig. 5A),[45] while the rate of having multiple sexual partners is generally similar nationwide (Fig. 5B).[46] These contradict the fact that HBV infections in the Southeast are several to 10 times higher than in other regions (Fig. 2F).

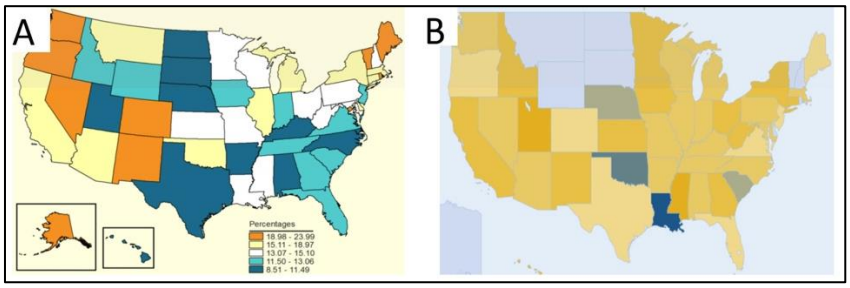

Figure 5 A) The percentage of illicit drug use among people aged 12 or older in the United States in 2021. Source.[45] B) The average number of sexual partners by state in the United States. Source.[46]

Blacks have significantly lower rates of illicit drug use,[47] and black women have a significantly higher rate of condom use in preventing sexual diseases compared to white women.[48] Why do black people have several times higher rates of HBV infections compared to white people?[49]

Why are prisoners, who live in a strictly controlled environment and are less likely to come into contact with drug and sex risk factors, at a high risk of HBV infection?

According to US national surveillance, approximately 89% of infections have no identified risk.[44] Investigations typically adhere to guidelines, such as examining whether consume drugs, whether have sex with a positive partner, etc. If the

partner is HBV positive, the risk factor is assumed to be sex. This practice greatly overestimates risk factors as asserted by guidelines. Despite that, the risk factor cannot be identified for 89% of infections. Why?

According to the 2023 US national survey data, among cases with identified risk factors, 17.1% of transmissions occur due to surgery, transfusion, and dialysis.[44] This is very surprising. How is it possible that, in the United States, one of the most advanced countries, 17.1% of HBV infections with identified risk factors are from medical accidents?

Therefore, based on the current transmission theory, there are many contradictions and questions. However, the theory of mosquito transmission can consistently explain the data in the United States without contradictions. The much higher prevalence of mosquitoes in the Southeast explains the highest infections in the region. The reason why risk factors cannot be identified in most infections (89%) is that mosquitoes, the key risk factor, are not included in investigations. Mosquitoes prefer to bite men more than women, explaining why men have higher rates of HBV infections. The explanation for why the rates of infection in the United States increases rapidly after entering adulthood is that people begin to share a bed or sleeping room with sexual partners, which exposes them to the risk of disease transmission by mosquitoes. The more partners one has, the higher the risk of contracting HBV. Black people are more likely to share a bed and have a higher rate of homelessness (another risk factor), which helps to explain the higher rate of HBV infections among them. Explanations for prisoners, pregnant women and other populations in the United States are similar to the explanations above.

During 2008–2019, there were 24 healthcare-associated hepatitis B outbreaks in the United States.[50] These outbreaks occurred in the states of PA, CA, VA, NC, TX, FL, IL, WV, SC, and NJ.[50] After investigation, the proposed risk factors include: blood glucose monitoring, personal hygiene, and unsafe clinical practices, among others.[50] Clearly, A. aegypti mosquitoes are prevalent in these states (Fig. 2A). Why have all 24 of these outbreaks not occurred in other states? Our explanation is simple: mosquitoes.

3.6 Research on mosquito transmission

There are a limited number of studies reported on the vector transmission of HBV. The existing data have shown conflicting results.

Khaleel conducted a mini-review and suggested that more research needs to be done due to conflicting results.[51] When T. belangeri mosquitoes were fed blood infected with HBV and then allowed to bite monkeys, some monkeys became infected. However, inoculation of susceptible chimpanzees with macerated pools of mosquitoes after digestion of blood meal did not produce hepatitis or serologic evidence of infection.

HBV cannot enter mosquito salivary glands, and therefore cannot be transmitted through a biological mechanism. HBV can only be detected in mosquitoes for a limited period, and the viability and infectivity of the virus in the mosquitoes' mouthparts or digestive ducts should be lost even sooner due to the presence of many digestive enzymes. Therefore, a limiting factor for the mechanical transmission of HBV on mosquitoes' mouthparts is the interval period between two mosquito bites. The sooner the higher infectivity of the transferred virus. If a mosquito's feeding is interrupted, it can quickly move to feed on others in the same room within minutes. The fresh blood on its mouthparts is mechanically transferred almost immediately into the bloodstream of other people in the room. No literature has addressed this issue.

Therefore, animal research exploring the mechanical transmission of HBV should mimic a scenario where mosquitoes bite two people within minutes. Moreover, research should try different types of mosquitoes because each type of mosquito may be capable of transmitting specific pathogens. Existing problems in research may be the reason why results are conflicting.

Rukunuzzaman et al. reported that children who consistently use mosquito nets have a lower prevalence of HBV infection.[52] Children from the jungle zone (more prevalent with mosquitoes) had infection rates of HBV several times higher compared to other regions.[53] Papaevangelou et al. also reported that mosquitoes may transmit HBV.[54]

Hawkes et al. compared HBV prevalence between four regions in New Guinea.[55] The Sepik River region has the highest prevalence of mosquitoes among the four regions, and also the highest prevalence of HBV. This data supports the theory of mosquito transmission. Contradictingly, the Foothills region has the lowest prevalence of mosquitoes among the four regions, yet the second highest prevalence of HBV. Therefore, the authors suggested that mosquitoes do not transmit HBV. Unfortunately, they ignored a fact: many people do not use mosquito nets when there are a small number of mosquitoes. They should examine this issue in the Foothills region.

A group of authors in India hypothesized that, if mosquitoes transmit HBV, the incidences of malaria and acute HBV infection should show a linkage.[56] They found that malaria was a seasonal disease but no distinct peak for acute hepatitis B was observed. Therefore, they suggested that mosquitoes do not transmit HBV. However, the authors neglected a fact: symptoms for acute hepatitis B usually appear within a range of 60–150 days after infection,[57] whereas malaria symptoms typically start within 10–15 days after infection.[58]

4 Discussion

One may argue that animal research on mosquito transmission of HBV is conflicting, therefore the mosquito transmission mode cannot be confirmed. However, is there any animal research data reporting that HBV is transmitted through sex or other modes asserted in the current guidelines? No, according to the best of our knowledge.

A valid theory should be able to explain the phenomena in a given field. As discussed above, a wide range of data can be consistently explained by the theory of mosquito transmission, but not by the current theory. Moreover, there is no animal research data supporting the current theory. How can we be sure that HBV is transmitted through the current theory, but not mosquitoes?

Finally, let's explain another important observation - why Central Asia, Mongolia, some Middle Eastern countries, and some Eastern European countries have a quite high rate of HBV infections (Fig. 2B), despite the low abundance of mosquitoes in these regions (Fig. 2A). In these regions, sleeping in a yurt, a tent-like home, is an old tradition.[59] This practice has been transitioning to living in houses more or less due to economic and other factors. Sleeping in a yurt is akin to sleeping in a room. This sleeping practice helps explain the high rates of HBV infection in these regions. Sleeping in a yurt is much more common in the southwestern province of Pakistan than in other provinces. Sleeping in a yurt and the high abundance of mosquitoes in the region work together to explain the highest HBV infections at sites as shown in Fig. 2J.

It may be easy to control HBV, just by controlling mosquito bites. As shown above, all global data consistently support this point. Mistakes in our understanding of HBV transmission may have occurred.

To test the theory of mosquito transmission, the present study suggests two simple experiments for global researchers: 1) comparing HBV transmission rates among children who sleep in the same room as their parents, versus those who sleep alone; and 2) comparing HBV prevalence between people who consistently use mosquito nets and those who do not.

5 Conclusion

The present study demonstrates that HBV mainly spreads through mosquitoes and calls for urgent research into this issue.

Compliance with ethical standards

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Disclosure of conflict of interest

The author declares no conflict interests.

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References

[1] Wasley A, Grytdal S, Gallagher K. Surveillance for Acute Viral Hepatitis --- United States, 2006. MMWR. 2008; 57(SS02):1-24. https://www.cdc.gov/mmwr/preview/mmwrhtml/ss5702B1.htm

[2] Stroffolini T, Morisco F, Ferrigno L, et al.-Effectiveness of Hepatitis B Vaccination Campaign in Italy: Towards the Control of HBV Infection for the First Time in a European Country. Viruses. 2022; 14:245. https://doi.org/10.3390/v14020245

[3] Brotherton J, Wang H, Schaffer A, Quinn H. Vaccine preventable diseases and vaccination coverage in Australia, 2003 to 2005. 2007. Commun Dis Intell Q Rep. V31.

[4] Zheng H, Wang Y, Wang F, et al. New progress in HBV control and the cascade of health care for people living with HBV in China: evidence from the fourth national serological survey, 2020. The Lancet Regional Health -Western Pacific. 2024;51: 101193. https://doi.org/10.1016/j.lanwpc.2024.101193

[5] Ay P, Torunoglu MA, Com S, et al. Trends of hepatitis B notification rates in Turkey, 1990 to 2012. Euro Surveill. 2013;18(47):pii=20636. http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20636

[6] Olayinka A. Seroprevalence of Hepatitis B Infection in Nigeria: A National Survey. American Journal of Tropical Medicine and Hygiene. 2016; 95(4):902-907. https://doi.org/10.4269/AJTMH.15-0874

[7] Zali MR, Mohammad K, Farhadi A, et al. Epidemiology of hepatitis B in the Islamic Republic of Iran. La Revue de Sante de la Mediterranee orientale. 1996; 2:290-298.

[8] Hepatitis B seroprevalence in Latin America. Rev Panam Salud Publica/Pan Am J Public Health. 1999; 6(6): 378-383.

[9] WHO. Hepatitis B. https://www.who.int/news-room/fact-sheets/detail/hepatitis-b

[10] de Franchis R, Hadengue A, Lau G, et al. EASL International Consensus Conference on Hepatitis B. 13-14 September, 2002 Geneva, Switzerland. Consensus statement (long version). J Hepatology. 2003; 39 Suppl 1:S3-25.

[11] GBD 2019 Hepatitis B Collaborators. Global, regional, and national burden of hepatitis B,1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. 2022; Lancet Gastroenterol Hepatol. 7:796–829. https://doi.org/10.1016/S2468-1253(22)00124-8

[12] WHO. Guidelines for the prevention, diagnosis, care and treatment for people with chronic hepatitis B infection. March 2024. https://iris.who.int/bitstream/handle/10665/376353/9789240090903-eng.pdf?sequence=1

[13] US CDC. Hepatitis B Prevention and Control. https://www.cdc.gov/hepatitis-b/prevention/index.html

[14] AASLD. Update on Prevention, Diagnosis, and Treatment of Chronic Hepatitis B: AASLD 2018 Hepatitis B Guidance. Hepatology. 2018. 67:1560-1599. DOI 10.1002/hep.29800

[15] US CDC. Viral Hepatitis Among People Experiencing Homelessness. https://www.cdc.gov/hepatitis/hcp/populations-settings/peh.html

[16] Kraemer MU, Sinka ME, Duda kA, et al. The global distribution of the arbovirus vectors Aedes aegypti and Ae. albopictus. Elife. 2015; 4:e08347. DOI: 10.7554/eLife.08347

[17] Flichman DM, Blejer JL, Livellara BI, et al. Prevalence and trends of markers of hepatitis B virus, hepatitis C virus and human Immunodeficiency virus in Argentine blood donors. BMC Infectious Diseases 2014, **14**:218 http://www.biomedcentral.com/1471-2334/14/218

[18] González Treasure AL. Hemovigilancia Hepatitis B y C en Bancos de Sangre de Bolivia. Año 2004. https://www.monografias.com/trabajos82/hemovigilancia-hepatitis-bolivia/hemovigilancia-hepatitis-bolivia3

[19] Cabezas C, Trujillo O, Gonzales-Vivanco A. et al. Seroepidemiology of hepatitis A, B, C, D and E virus infections in the general population of Peru: A cross-sectional study. PLoS ONE 15(6): e0234273. https://doi.org/10.1371/journal.pone.0234273

[20] Liu-Helmersson Jing, Brannstrom A, Sew MO, et al. Estimating Past, Present, and Future Trends in the Global Distribution and Abundance of the Arbovirus Vector Aedes aegypti Under Climate Change Scenarios. Front. Public Health. 2019. 7:148. doi: 10.3389/fpubh.2019.00148

[21] Panduro A. Roman S, Laguna-Meraz S. et al. Hepatitis B Virus Genotype H: Epidemiological, Molecular, and Clinical Characteristics in Mexico. Viruses 2023, 15, 2186. https://doi.org/10.3390/v15112186

[22] US CDC. Viral Hepatitis Surveillance Report 2018 — Hepatitis B. https://archive.cdc.gov/www_cdc_gov/hepatitis/statistics/2018surveillance/HepB.htm

[23] Mhata P, Rennie TW, Small LF, et al. Distribution of hepatitis B virus infection in Namibia. S Afr Med J. 2017; 107(10):882–886. DOI:10.7196/SAMJ.2017.v107i10.12171.

[24] Moonsamy S, Suchard M, Pillay P, Prabdial-Sing N. Prevalence and incidence rates of laboratory-confirmed hepatitis B infection in South Africa, 2015 to 2019. 2022; BMC Public Health. 22:29. https://doi.org/10.1186/s12889-021-12391-3

[25] Viral Hepatitis Mapping Project. CHB prevalence. Hepatitis B Mapping 2022. Australia. https://public.tableau.com/app/profile/nationalhepmapping/viz/HepatitisBMappingPortal2022data/State (please NOTE: Under this webpage, click on the link "SA3" (statistics level 3). When a new page appears, click on the link "CHB prevalence")

[26] Wang Y, Zhou H, Zhang L, et al. Prevalence of chronic hepatitis B and status of HBV care among rural women who planned to conceive in China. SCIENTIFIC Reports. 2017; 7:12090. DOI:10.1038/s41598-017-12005-2

[27] Qureshi H, Bile KM, Jooma R, et al. Prevalence of hepatitis B and C viral infections in Pakistan: findings of a national survey appealing for effective prevention and control measures. EMHJ. 2010; 16:S15-22.

[28] Covington L, Armstrong B, Black MM. Bed Sharing in Toddlerhood: Choice Versus Necessity and Provider Guidelines. Glob Pediatr Health. 2019; 6:2333794X19843929. doi: 10.1177/2333794X19843929.

[29] Hintz-Zambrano K. Do you lie about co-sleeping? If so, you're not alone. https://www.mothermag.com/co-sleeping-and-bed-sharing/

[30] Sutter RA, Lyons S, Gould CV et al. West Nile Virus and Other Nationally Notifiable Arboviral Diseases — United States, 2022. MMWR. 2024;73:21https://www.cdc.gov/mmwr/volumes/73/wr/pdfs/mm7321a2-H.pdf

[31] Abdullahi IN, Emeribe AU, Ghamba PE, et al. Distribution pattern and prevalence of West Nile virus infection in Nigeria from 1950 to 2020: a systematic review. Epidemiol Health. 2020;42:e2020071

[32] Sushan A, Mahesh N, Harikumar S. An outbreak of West Nile Fever in Kerala, India, 2024. https://www.researchgate.net/publication/387018493_An_Outbreak_of_West_Nile_Fever_in_Kerala_India_2024/fulltext/675c22c9da24c8537c6baf33/An-Outbreak-of-West-Nile-Fever-in-Kerala-India-2024.pdf?origin=publication_detail&_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uRG93bmxvYWQiLCJwcmV2aW91c1BhZ2UiOiJwdWJsaWNhdGlvbiJ9fQ

[33] Colson ER, Willinger M, Rybin D, et al. Trends and Factors Associated With Infant Bed Sharing, 1993-2010. JAMA Pediatr. 2013;167(11):1032-1037. doi:10.1001/jamapediatrics.2013.2560

[34] Shepard C, Finelli L, Bell B, Miller J. Acute hepatitis B among children and adolescents --- United States, 1990—2002. MMWR. 2004; 53:1015–1018. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5343a4.htm

[35] Ansell J, Hamilton KA, Pinder M, et al. Short-range attractiveness of pregnant women to Anopheles gambiae mosquitoes. Trans R Soc Trop Med Hyg. 2002. 96(2):113-6. doi: 10.1016/s0035-9203(02)90271-3.

[36] Fradin MS. Mosquitoes and Mosquito Repellents: A Clinician's Guide. Annals of Internal Medicine. 1998; 128(11):931–940. doi: 10.7326/0003-4819-128-11-199806010-00013 https://www.acpjournals.org/doi/10.7326/0003-4819-128-11-199806010-00013#xref-ref-27-1

[37] Iversson LB, Granato CF, da Rosa AT, Pannuti CS. Relationship between the prevalence of antibodies to hepatitis B core antigen and arbovirus in fishermen from the Ribeira Valley, Brazil. Rev Inst Med Trop Sao Paulo. 1990; 32:415–220. doi: 10.1590/s0036-46651990000300012

[38] WHO. Global hepatitis report, 2017.

[39] WHO. Community involvement in rolling back malaria. 2002. https://iris.who.int/bitstream/handle/10665/67822/WHO_CDS_RBM_2002.42.pdf?sequence=1

[40] Cibulskis RE, Alonso R, Aponte J, et al. Malaria: global progress 2000 - 2015 and future challenges. Infect Dis Poverty. 2016; 5: 61. doi: 10.1186/s40249-016-0151-8

[41] Liu Z, Lin C, Mao X, et al. Changing prevalence of chronic hepatitis B virus infection in China between 1973 and 2021: a systematic literature review and meta-analysis of 3740 studies and 231 million people. Gut. 2023; 72:2354–2363. doi:10.1136/gutjnl-2023-330691

[42] Luo Y, Chen R, Xiong B, et al. The impact of household dynamics on land-use change in China: past experiences and future implications. Land. 2024; 13:124. https://doi.org/10.3390/land13020124

[43] Yan Y, Su H, Ji Z, et al. Epidemiology of Hepatitis B Virus Infection in China: Current Status and Challenges. J Clin Transl Hepatol. 2014; 2(1):15–22 doi: 10.14218/JCTH.2013.00030

[44] US CDC. Acute Hepatitis B: Risk & Exposure Data. https://www.cdc.gov/hepatitis-surveillance-2023/hepatitis-b/table-2-3.html#:~:text=Among%20risk%20behaviors%20and%20exposures%20identified%2C%20the%20most,of%20the%20256%20male%20cases%20with%20information%20available%29

[45] SAMHSA. National Survey on Drug Use and Health, 2021. https://www.samhsa.gov/data/sites/default/files/reports/rpt39463/2021NSDUHsaeMaps110122/2021NSDUHsaeMap110122.htm

[46] Superdrug. What's your number? https://onlinedoctor.superdrug.com/whats-your-number/

[47] Lee YH, Woods C, Shelley M, et al. Racial and Ethnic Disparities and Prevalence in Prescription Drug Misuse, Illicit Drug Use, and Combination of Both Behaviors in the United States. International J Mental Health and Addiction. 2023; 22:3818-3824.

[48] Soler H, Quadagno D, Sly D, et al. Relationship dynamics, ethnicity and condom use among low-income women. Family Planning Perspective. 2000; 32:82–89.

[49] US CDC. Number and rate* of newly reported cases† of chronic hepatitis B, by demographic characteristics — United States, 2023 https://www.cdc.gov/hepatitis-surveillance-2023/hepatitis-b/table-2-6.html https://iris.who.int/bitstream/handle/10665/255016/9789241565455-eng.pdf?sequence=1

[50] National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.). Division of Viral Hepatitis. Healthcare-Associated Hepatitis B and C Outbreaks (≥ 2 cases) Reported to the CDC 2008-2019. https://www.cdc.gov/hepatitis/outbreaks/pdfs/healthcareinvestigationtable.pdf

[51] Khaleel HA. Hepatitis B virus: Can it be a vector-borne transmitted infection? Trop Med Surg. 2015; 3:2 http://dx.doi.org/10.4172/2329-9088.1000186

[52] Rukunuzzaman M, Afroza A. Risk factors of hepatitis B virus infection in children. Mymensingh Med J. 2011; 20:700–708.

[53] Pannuti CS, Iversson lB, de Mendonca JS, et al. Relationship between the prevalence of antibodies to arbovirus and hepatitis B virus in the Vale do Ribeira region, Brazil. Rev Inst Med Trop Sao Paulo. 1989; 31:103–109. doi: 10.1590/s0036-46651989000200008.

[54] Papaevangelou G, Kourea-Kremastinou T. Role of Mosquitoes in Transmission of Hepatitis B Virus Infection. Journal Infectious Diseases. 1974; 30:78–80. https://doi.org/10.1093/infdis/130.1.78

[55] Hawkes RA, Boughton CR, Ferguson V, Vale TG. The seroepidemiology of hepatitis in Papua New Guinea. II. A long-term study of hepatitis B. Am J Epidemiol. 1981; 114:563–573. doi: 10.1093/oxfordjournals.aje.a11322

[56] Ghoda MK, Shah RA. A prospective epidemiological study to see if mosquito bite could be responsible for spread of hepatitis B virus infection. Trop Gastroenterol. 2005; 26:29–30.

[57] US CDC. Clinical Signs and Symptoms of Hepatitis B. https://www.cdc.gov/hepatitis-b/hcp/clinical-signs/index.html

[58] WHO. Symptoms and treatment (Malaria). https://www.afro.who.int/node/5754

[59] National Geographic Society. Yurt. https://education.nationalgeographic.org/resource/yurt/