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Prevalence of viral hepatitis infection in India: A systematic review and meta-analysis

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Abstract:

BACKGROUND: Nowadays, Viral Hepatitis can be comparable to the big three communicable diseases: tuberculosis, HIV/AIDS, and malarial infections. The main purpose of this study was to summarize the prevalence of viral Hepatitis in India from peer-reviewed articles published from February 2000 to February 2021.

MATERIALS AND METHODS: We conducted a systematic search on Science Direct, Scopus, Medline, PubMed, Web of Science, Google Scholar, and other open access journals. We evaluated all relevant papers that looked into the prevalence of viral Hepatitis systematically. Finally, 28 studies on viral Hepatitis published from February 2000 to February 2021 have been selected. These studies have been conducted across the northern, southern, central, eastern, and western regions of India.

RESULTS: Twenty-eight full-text publications were obtained and evaluated consisting of 45,608 research participants. Hepatitis A was found to range from 2.1% to 52.5%. Hepatitis B was found in a wide range of individuals, ranging from 0.87% to 21.4% of the population. Hepatitis C was found to range from 0.57% to 53.7%. The majority of the children were affected by hepatitis A, and 47.4% of third-trimester pregnant mothers were affected by hepatitis E. Diabetes, hospital admission, history of jaundice, history of surgeries, and heterosexual contact were the leading modes of acquiring HBV and HCV infections. As a result of its great magnitude, this disease poses a severe threat to the national healthcare system.

CONCLUSION: Effective public health measures are urgently needed to minimize the burden of viral Hepatitis and eliminate the disease.

Keywords:

Hepatitis, magnitude, meta-analysis, systematic review, viral infection

Introduction

Viral Hepatitis is one of the major global public health issues, and every year millions of individuals suffer from it.[1] Viral Hepatitis caused 1.34 million fatalities worldwide in 2015, with the majority of viral Hepatitis deaths owing to chronic liver disease or primary liver cancer (mortality due to cirrhosis: 720,000; hepatocellular carcinoma (HCC): 470,000). The death rate from viral Hepatitis has continued to climb over time.[2] Nowadays, viral Hepatitis can be comparable to the big three communicable diseases: tuberculosis, HIV/AIDS, and malarial infections.[3] Viral Hepatitis can be caused by any of the known five hepatotropic viruses, namely Hepatitis A Virus (HAV), Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), Hepatitis D Virus (HDV), and Hepatitis E Virus (HEV).[4] Based on the 2017 global Hepatitis report, a large number of individuals do not have access to screening and treatment for Hepatitis, consequently leading to Chronic Liver Disease (CLD) and cancer mortality due to Hepatitis.[5] The World Health Organization (WHO) is urging

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countries to take quick action to increase the knowledge, diagnosis/testing, and treatment services for Hepatitis. According to a WHO report, one in twenty individuals are living with viral Hepatitis.

HAV and HEV are enterically transmitted pathogens that produce sporadic infections as well as outbreaks of Acute Viral Hepatitis (AVH).[1] HAV is a single-stranded RNA virus and it is mostly transmitted through the fecal-oral pathway.[6] In India, HAV infection is common among children, and it generally leads to mild anicteric Hepatitis. The majority of children under the age of two (85%) and nearly half of those aged two to five years (50%) have nonspecific symptoms and are usually anicteric.[2] HAV infection disease severity increases with the patient's age and the prevalence of existing chronic liver diseases.[4,7]

Chronic HBV affects 240 million persons worldwide and chronic HCV affects 130–150 million.[1,4] Chronic Hepatitis affects approximately 400 million individuals worldwide, with the Asia-Pacific area serving as the hub of the epidemic.[1] HBV and HCV are mainly transmitted through the parenteral route and are known to cause chronic Hepatitis, which can progress to serious consequences such as liver cirrhosis and HCC.[8]

HBV and HCV infections are more alike, which include distribution, hepatotropism, disease transmission, and at last leading to chronic infection which may end in liver cirrhosis and HCC.[4,9] HBV and HCV infections do not have a standard of care due to the individual category of infected subjects so it is difficult to cure.[10] Thus, studying the magnitude becomes a crucial component in prevention of HBV and HCV. The current review aimed to summarize the prevalence of viral Hepatitis in India from peer-reviewed articles published from February 2000 to February 2021.

Objectives of the study

To study the overall prevalence of viral Hepatitis in India from peer-reviewed articles published from February 2000 to February 2021.

To review the determinant factors of viral Hepatitis in the Indian region with the included article.

Operational definitions

Hepatitis: According to Centers for Disease Control and Prevention (CDC) "Hepatitis is an inflammatory disease of the liver caused."

Funnel plot: "A funnel plot is a simple scatter plot of the intervention effect estimates from individual studies against some measure of each study's size or precision."[11] Funnel plot is a graphical representation used to detect systematic heterogeneity and publication bias.

Materials and Methods

Study design and setting

Systematic review and meta-analysis: Selected studies have been conducted across northern, southern, central, eastern, and western regions of India.

Study period

Studies published from February 2000 to February 2021 were considered for systematic review and meta-analysis.

Study participants

We included studies of the general population, community studies on children, pregnant women, type 2 diabetes patients, and Voluntary Blood Donors (VBD).

Study selection/Information source

We conducted a systematic search in key databases of scientific articles using Web of Science, Scopus, Medline, PubMed, Science Direct, Cochrane Library, websites of international medical associations/public health journals, Embase, Google Scholar, and other open access journals.

Literature search strategy

With the help of MeSH terms, Boolean operators, and appropriate keywords, suitable articles were identified for the systematic review. MeSH Terms: magnitude *AND* ("virology" [MeSH Terms] *OR* "virology" *OR* "viral") *AND* ("Hepatitis" [MeSH Terms] *OR* "Hepatitis" *OR* "Hepatitis a" [MeSH Terms] *OR* "Hepatitis a") *AND* ("infections" [MeSH Terms] *OR* "infections" *OR* "infection") *AND* "India" [MeSH Terms] *OR* "India".

Data collection tool and technique

We thoroughly reviewed all relevant articles published in India that estimated the prevalence of viral Hepatitis. Titles and abstracts of the relevant research paper were identified from the scientific database, and searches were done by three independent researchers onscreen. Hypothetically significant studies were selected. Inclusion and exclusion criteria are given below. The full-text paper was collected wherever possible, even from the open access journal.

Inclusion criteria of the studies

Inclusion criteria included studies that studied the magnitude of viral Hepatitis infection. The study should be from the Indian region, published in the English language, and should include an India-based epidemiological study. Studies published from February 2000 to February 2021 were considered. Various types of epidemiological study designs, such as cross-sectional,

Table 1: Basic characteristics and summary of results of included studies (Source: Secondary research data)

Author & Year	Sample Size	Study Population	Conclusion
Kaur 2002[18]	306	Acute liver disease	Of the 306 cases, 7 (2.3%) had IgM anti-HAV, 9 (2.9%) had IgM anti-HBc, 37 (12.1%) had hepatitis B surface antigen (HBsAg), 84 (27.4%) had anti-HBs, 10 (3.3%) were HCV infected, and 63 (20.6%) had IgM anti-HEV.
Beniwal 2003[19]	97	Pregnant women (third trimester)	HEV was found to be 47.4%, HAV 5.2%, HBV 7.2%, and HCV 0%. HEV was responsible for 36.2% of the cases of AVH.
Joon 2015[20]	958	Acute viral hepatitis (AVH)	The seroprevalence of HAV- and HEV-positivity were 19.31% and 10.54%, respectively. The co-infection of HAV and HEV was 11.5% in AVH.
Arora 2005[21]	70	Viral Hepatitis patient	Of the 70 serum samples, 40% were positive for HBsAg. The prevalence of anti-HCV was 4.28%.
Chandra 2014[22]	285	Patient	HEV was identified as the most common cause of AVH (41.8%), followed by HBV (21.4%), HAV (17.2%), and HCV (4.6%). HBV and HEV the most common co-infection (3.8%) among the selected subjects.
Barde 2019[23]	1959	AVH-suspected patients	Of the 1901 Hepatitis cases, 597 individuals were positive for AVH infection and HEV was the predominant cause followed by HBV, HAV, and HCV. Co-infection of HEV with HBV was the most common pattern.
Bhaumik 2012[2]	165	Hemodialysis patients	HBV infection was found in 5.5% of the hemodialysis patients and 10.9% of patients got new HCV infection during hemodialysis. Co-infection of HBV and HCV was found among 1.2% of hemodialysis patients.
Sharma 2018[24]	840	HIV	HBV (11%) was found to be less in contrast to HCV (13%) amongst HIV seropositivity. Co-infection of HBV and HCV was found in 15 of 109, and in controls it was 2 of 15.
Mehta 2013[25]	1038	Antenatal mother	The prevalence of HBsAg in the second trimester was the highest (45.16%), followed by the first (32.26%) and third trimester (22.58%).
Kosaraju 2013[26]	1710	Hemodialysis patient	Out of 1710 cases, 45 cases (2.63%) were found to be infected with either HBV or HCV. Out of 45 cases studied, 1.52% tested positive for HBsAg, and 1.11% tested positive for anti-HCV antibodies. And the dual infection with HBV-HCV was seen in two patients.
Agarwal 2018[27]	3750	Healthy individuals	Seroprevalence of HBV and HCV was found to be 3.9% and 1.76% respectively. Co-infection with HBV/HCV was seen in 0.16%.
Grewal 2018[28]	100	Chronic liver disease (CLD)	Out of 100 cases of CLD, 26 were HBsAg-positive and 40 were anti-HCV-positive. Out of 62 seropositive cases, 4 had co-infection of HBV and HCV.
Rao 2020[29]	96	Renal transplant recipients	Prior to renal transplant, the HCV prevalence was the highest viral infection in 7.3% of the samples. The study had pre-transplant cytomegalovirus (CMV) and BK virus (BKV) infection rates of 1.04% each.
Kalita 2020[30]	617	Patients with AVH	HAV and HEV seroprevalence in AVH cases were found to be 14.7% and 28.04%, respectively. Dual infection of HAV-HEV was found in 5.9%.
Harsh 2017[31]	908	Patients with IBD	The prevalence of HBV, HCV, and HIV was 2.4%, 1.4%, and 0.1%, respectively, in the 908 patients with IBD. Among the 581 patients with UC, 2.2% had HBV, 1.7% had HCV, and 0.2% had HIV.
Jain 2013[32]	267	Patients with AVH	Of the 267 viral Hepatitis cases, HAV (26.96%) was the most common cause of AVH followed by HEV (17.97%), HBV (16.10%), and HCV (11.98%). Co-infections with more than one virus were present in 34 cases, with HAV-HEV co-infection being the most common.
Kaur 2017[33]	95	Suspected cases of viral Hepatitis	Out of the total 95 samples, 76.84% were positive for HAV/HEV. Out of the total positive cases, 68.42% had HEV, 2.1% had HAV, and 6.31% were co-infected with HAV-HEV.
Kashyap 2021[34]	671	Suspected cases	Viral etiology (HAV or HEV) was found in 18% of patients. IgM HAV was detected in 11% of patients whereas IgM HEV in 7% of patients.
Jayavelu 2012[35]	60	Oral lichen planus (OLP) and population	All the samples were seronegative for both HBsAg and Hepatitis C antibodies.
Mittal 2013[36]	495	Healthy individuals	The overall infection rate was 4.4% in the sample. The seroprevalence of HBsAg was found to be 2.8% and of anti-HCV antibodies was 1.8%. Dual infection of HBV and HCV was found to be 0.2%.
Khan 2018[37]	2674	Population	Of the 2674 subjects, 5.3% tested positive for HBsAg. Anti-HCV antibody was detected in 0.8% of subjects.
Jamil 2016[38]	507	Hemodialysis	Two point one seven percent were found to be positive for HBV, while 1.38% of patients were found to be positive for HCV. HBV-HCV co-infection was seen in 0.20%. All HBV-positive patients were males and had previous blood transfusions.
Bhate 2015[39]	1833	Population	Out of 2400 subjects, none of the subjects were positive for anti-HCV antibody. Point prevalence for HBsAg positivity was 0.92.

Contd...

Table 1: Contd...

Author & Year	Sample Size	Study Population	Conclusion
Juttada 2019[40]	388	Type 2 Diabetes Mellitus (T2DM) subjects	Prevalence of HBV (9%) was higher compared to HCV (2%) infection in the screened 388 subjects.
Sood 2010[41]	3196	Outpatient Departments (OPDs) or Inpatient Departments (IPDs) patient	The seroprevalence of HBsAg was found to be 0.87%, of and anti-HCV Antibodies (Ab) as 0.28%.
Saraswati 2015[42]	3748	People who inject drugs	Overall prevalence of HIV, HBV, and HCV among 2292 participants tested at First Follow-up Visit (FV1) was 25.9%, 9.7%, and 53.7%, respectively. Six point four percent of the participants had HIV, 34.1% had HCV, and 19.6% had HIV-HCV co-infection.
Shanmugam 2018[43]	18589	Population	A total of 18,589 people were screened, with HBV infection detected in 303 (1.63%) and HCV infection in 56 (0.3%) patients.
Prakash 2014[44]	186	Hemodialysis	Of 186 participants, anti-HCV Ab was positive in 13 patients (6.99%). HCV nucleic acid was detected in all 13 enzyme-linked immunosorbent assay (ELISA)-positive patients. Six patients (3.23%) were positive for HBsAg. One patient had co-infection of HBV and HCV, confirmed by both ELISA and polymerase chain reaction (PCR).

case–control, prospective/retrospective investigations, and longitudinal studies, were employed in selected studies. The current review did not have any restrictions on age and type of population. Systematic screening of the relevant papers was done. After the screening process, we reviewed the full papers and extracted the data for meta-analysis. Nine studies were included for meta-analysis [refer to Table 1].

Exclusion criteria of the studies

Other language articles, case reports, conference papers and abstracts, preprints, and review papers were excluded. The studies that did not meet the inclusion criteria were excluded from this systematic review.

Quality assessment and data extraction

The Newcastle-Ottawa Scale (NOS) was applied to assess the quality of nonrandomized studies.[12] Two different scales of a NOS checklist were used to assess the quality of individual studies.[13,14] Selected studies clearly stated the aim and/or objective of the study, clearly mentioned study design, clearly defined participants, appropriate sample size, missing and replacement of data and data management, and clearly discovered and reported the characteristics of the participants. The information was gathered by DK, KK, and RM and cross-checked by AJ and HK.

Three independent reviewers carried out the data extraction procedure with the help of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[15] The NOS was used to assess the quality of studies that were chosen. Data extraction was done by five of the three independent researchers using the Cochrane collaboration data extraction form or data collection form.[9] Each paper was assigned to another researcher and the extraction was verified by them. Information regarding the title, aim, and objectives, methodology details such as study design, the sample size, the place where the study was conducted, the respondent's details, and the key results and conclusions of the studies were extracted by the researcher. The risk of bias in an individual study was assessed based on the quality of studies and the NOS.[11,12]

Ethical consideration

Being a larger part of the project, the current review was approved by the Institutional Review Board (IRB) of SRM School of Public Health, SRMIST, Kattankulathur, and Tamil Nadu on March 7, 2019. Ethical code is P0/2019/001 (IRB protocol number). Data and study information were gathered from previously published studies that have ethical clearance. The current review is a part of the project and under this, we provide training and enhance the community's knowledge regarding viral Hepatitis.

Data analysis

Finally 28 studies has been selected, the overall magnitude of viral Hepatitis was analyzed and reported. Among these selected studies, only nine studies were used for meta-analysis since they found the co-infection of HBV and HCV. Meta-analyses were carried out using the R programming language (R -version 3.6.1). Meta-analysis was used to look into the co-infection of HBV and HCV within the study population. Because few studies have been conducted in numerous locations, we were unable to locate subgroup analyses. The result was provided as a pooled prevalence for the overall studies, with 95% confidence intervals (95% CI). Selected study proportions were calculated as a pooled effect with a 95% CI. The publication bias was assessed using a funnel plot, which was then confirmed using Egger and Harbord statistical tests. Statistical significance was set at $P < 0.05$ for all computations except heterogeneity testing between studies.[16,17]

Table 2: Summary results of nine studies that were included for meta-analysis (Source: Secondary research data)

Study by and Year	Hospital/ Community	Samples recruited	Region	State	Prevalence of HBV	Prevalence of HCV	Co-infection of HBV and HCV
Mittal 2013 [36]	Community	495	North	Uttarakhand	2.8	1.8	0.2
Kosaraju 2013 [26]	Hospital	1710	South	Karnataka	1.52	1.11	0.11
Mehta 2013[25]	Community	1038	Central	Gujarat	2.9	0.19	0
Jamil 2016[38]	Hospital	507	East	Shillong	2.17	1.38	0.2
Harsh 2017 [31]	Hospital	908	North	New Delhi	2.4	1.4	0.11
Jayavelu 2012 [35]	Hospital	60	North	Uttar Pradesh	0	0	0
Bhate 2015 [39]	Community	1833	Multicentral study		0.92	0	0
Shanmugam 2018[43]	Community	18589	South	Chennai	1.63	0.3	0
Prakash 2014 [44]	Hospital	186	North	Uttar Pradesh	3.23	6.99	0.53

In total, nine studies reported co-infection of HBV and HCV. Table 2 shows the descriptive characteristics. The pooled sample size in the analysis was 25,326. The pooled proportion for the outcome was <0.001% (95% CI: <−0.001%-0.001%)

Results

Synthesis of results

According to the PRISMA flowchart [Figure 1], an electronic search generated a total of 2334 citations. The article were reviewed based on titles and abstracts, and non-relevant studies were excluded based on the exclusion criteria. After the exclusion, 28 articles were selected for further investigations. Only 28 publications out of all the studies matched the inclusion criteria; hence they were included in the descriptive synthesis of results. Only nine papers were included in the meta-analysis; the remainder were eliminated because they did not match the meta-analysis inclusion criteria.

Study selection

The quality of chosen studies was assessed using the NOS. The studies that were included were chosen based on the inclusion criteria.

Study characteristics

We found and evaluated 28 full-text publications with a total of 45,608 research subjects.

In total, nine studies reported co-infection of HBV and HCV. Table 2 shows the descriptive characteristics. The pooled sample size in the analysis was 25,326. The pooled proportion for the outcome was <0.001% (95% CI: <−0.001% to 0.001%) [Figure 2].

We found substantial homogeneity among the studies, reporting outcomes with I^2 = 19.52% (*P*-value <0.05) [Table 3]. Table 4 shows the regression test for the funnel plot asymmetry. Egger's test for publication bias was significant with a *P* value <0.002 (95% CI: 1.47 to 5.24). We could not find the possible impact of publication bias on the shape of the funnel plot [Figure 3] .

Table 1 shows the descriptive characteristics, overall prevalence and risk factors of Hepatitis in selected studies: Overall, 45,608 individuals were recruited

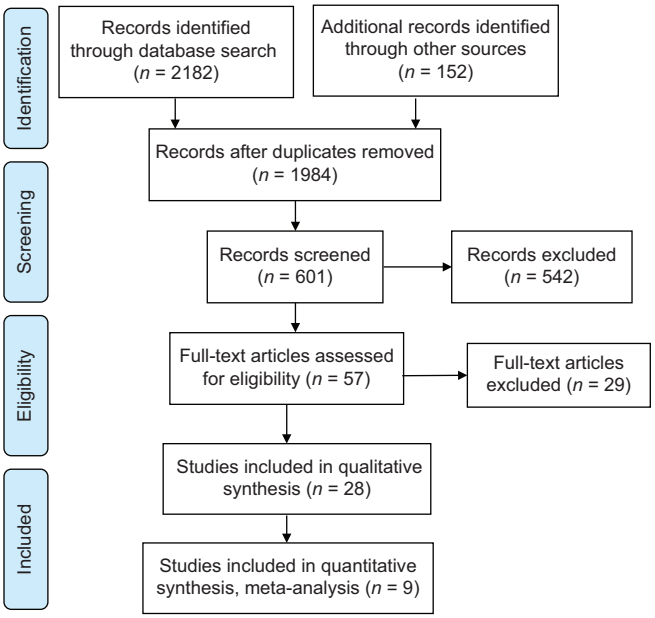

Figure 1: PRISMA studies (Source: Secondary research data)

in the 28 included studies. In terms of study design, the majority of the studies were hospital-based and cross-sectional, followed by retrospective/prospective studies and one case–control study and one longitudinal study. In terms of sex distribution, most of the studies were conducted on both sexes. All studies defined the age and sex distribution of the population. In terms of population, studies were conducted on the community (general population), blood donors, volunteers, pregnant women, drug users, and patients with inflammatory bowel disease, patients with chronic liver disease, hemodialysis patients, and HIV-positive patients.

Most of the children affected by HAV and HEV alone account for 47.4% of third-trimester pregnancy mothers. Other types of parenteral exposure-such as contact with abraded skin of an HBV-infected individual and maternal infection during pregnancy-were the main routes of HBV transmission in India.[45] As per the study done by Barde *et al*.,[23] the proportion of co-infections

Table 3: Random-effects model (k=9) and heterogeneity statistics (Source: Secondary research data)

	Estimate	Standard Error (SE)	Z	P	CI Lower Bound	CI Upper Bound
Intercept	2.89	2.20	1.31	0.18	-0.000	0.001
Tau	**Tau²**	**I²**	**H²**	**df**	**Q**	**P**
0	0 (SE=0)	19.52%	1.24	8	6.973	0.054

Tau² Estimator: Restricted Maximum-Likelihood

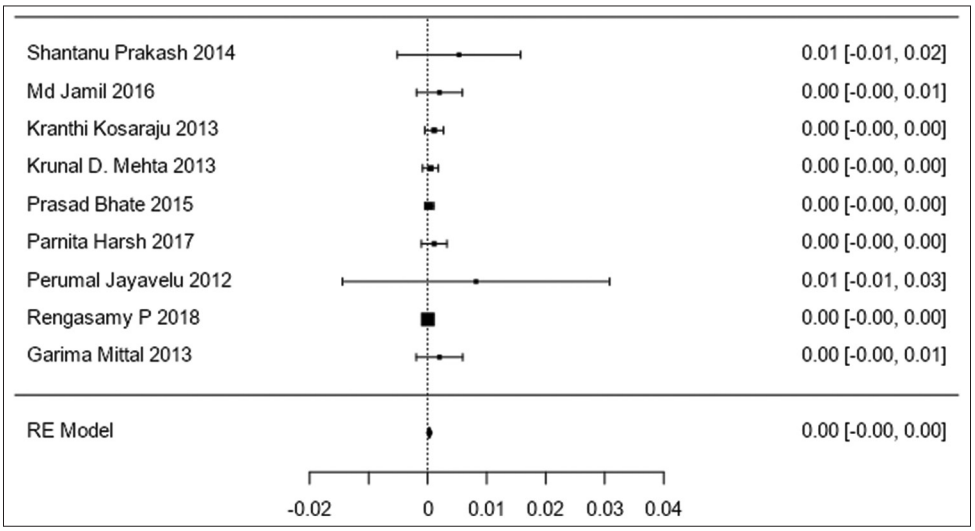

Figure 2: Forest plot of co-infection of hepatitis infection (Source: Secondary research data)

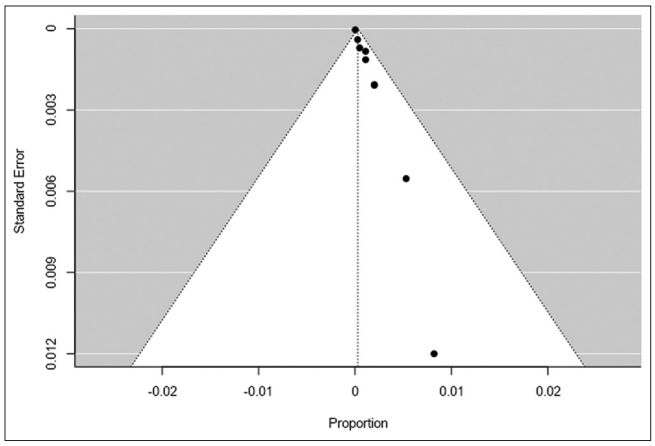

Figure 3: Funnel plot of co-infection of HBV and HCV (Source: Secondary research data)

was higher in adults than children. Acharya *et al*.[46] described HAV-related liver disease as uncommon in India and noted that it occurred mainly in children. Pregnant women and patients with CLD constitute the high-risk groups to contract HEV infection. Grewal US *et al*.,[28] stated that the main risk factors of acquiring HBV and HCV infection are unsafe blood transfusion and drug addiction.

The overall prevalence of HAV ranged from 2.1% to 52.5%. The overall prevalence of HBV ranged from 0.87% to 21.4%. The overall prevalence of HCV ranged from 0.19% to 53.7%. The overall prevalence of HEV ranged from 10.54% to 68.42%. A systematic review by Desikan *et al*.[47] showed the high prevalence of HBV-HCV co-infection in chronic liver patients, followed by HIV-positive patients, followed by persons who injected drugs, and kidney disease patients. A study by Nelson *et al*.[48] showed that Injecting Drug Users (IDUs) had anti-HCV rather than HIV infection. A study by Bhate *et al*.[39] showed that being a healthcare worker ($P = 0.001$) and having a tattoo ($P = 0.03$) were significantly associated with HBsAg-positive in the community. Studies done by Khan *et al*.,[37] and Prakash *et al*.,[44] also showed that blood transfusion was a significant risk factor for both HBV and HCV. A hospital-based study done by Agarwal *et al*.[27] showed that blood transfusion and sexual contact was a statistically significant risk factor for HCV infection ($P < 0.05$). A study done by Mittal *et al*.[36] showed that persons who had received multiple blood transfusions and had a history of Hepatitis among family members were at higher risk of acquiring HBV. Sexual behavior, childhood transmission, reusable syringes, blades, during blood transfusion, previous history of Hepatitis B, tattooing, and being health care workers were found to be associated risk factors for Hepatitis B.

Discussion

The prevalence of Hepatitis B was higher before the implementation of HBV universal vaccination program and it has been decreased from 12.80% between 1996 and 2001 to 11.11% between 2012 and 2017. The prevalence was also higher in rural areas (17.35%)

Table 4: Regression test for funnel plot asymmetry and fail-safe N analysis (Drawer analysis) (Source: Secondary research data)

	P
Fail-safe N	
16	0.003
Z	
2.572	0.01

Fail-safe N calculation using the Rosenthal approach

than in urban areas (11.11%), and a few Indian studies have stated that Chronic Hepatitis B (CHB)/HBV is hyperendemic among tribes, with a prevalence of 22%.[49] A population-based study by Shanmugam *et al*.[50] showed a similar prevalence of HBV and HCV, which were 1.3% and 0.3%, respectively. The current review shows the prevalence of 1.43% for HBsAg and 0.57% for HCV among the blood donors, which is similar to a study done by Khan *et al*.[51] Jain *et al*.'s[32] study showed that HEV was the major cause of acute hepatic failure, and fecal contamination of drinking water and food was a significant risk factor.[33]

Jafari *et al*.[52] reported combined odds ratios (ORs) for the association between tattooing and HBV (1.48 [1.30–1.68]). Populations engaged in high-risk behaviors has highest correlation between tattooing and risk of HBV (OR = 1.64, 95% CI: 1.32–2.03), which is agreeable with Bhate *et al*.'s[39] study.

According Candotti *et al*.,[53] HBV is a "transfusion-transmitted infection", which is comparable with multiple studies under this review, namely, Grewal *et al*.,[28] Khan *et al*.[37] Prakash.,[44] and a hospital-based study conducted by Agarwal *et al*.[27] A study by Mittal *et al*.,[36] agreed that those who had multiple blood transfusions and a family history of Hepatitis were more likely to contract HBV.

According to a study of Pakistani Punjabi patients with CLD who were tested for HBV, significant risk factors for HBV transmission included barber risk (23.60%), blood transfusion risk (4.04%), history of injection (26.19%), reuse of syringes (26.60%), dental risk (11.20%), and surgical procedure risk (4.26%).[54] This is similar to the current review in which sexual behavior, reusable syringes, blades, and blood transfusion were found to be associated risk factors for HBV.

The persistence of unsafe injection-linked HIV and HCV transmission that could be stopped with proven and cost-effective measures remains one of the great failures of the global responses to these diseases.[55] HBV and HCV were considered difficult to cure due to the individual category of infected subjects.[6] The data also reinforces the need for establishing effective prevention programs, which could lead to a reduction in the prevalence of viral Hepatitis.[25] Therefore, a country-specific prevalence estimate of HBV/HCV co-infection would be required for making evidence-based policies related to screening programs, resource distribution, and general prevention and treatment strategies for HBV-HCV co-infection.

Limitations and recommendations

Strengths: Selected studies were analyzed and cross-validated via NOS and the selected papers were also checked based on the STROBE guidelines and current systematic review followed PRISMA guidelines.

Limitations: Heterogeneity between the selected studies was the limitation of this review. Even though selected studies were conducted in various regions and types of populations, it led to heterogeneity. We could not find a subgroup analysis, since only a few studies were done in multiple locations. Study participants were belong to the Indian region, so this review cannot be generalized to global population. Studies included in the review were epidemiological studies, so only prevalence and some relationships could be exposed. The temporality of the relationship was not established.

Conclusions

The overall prevalence of HAV ranges from 2.1% to 52.5%. The overall prevalence of HBV ranges from 0.87% to 21.4%. The overall prevalence of HCV ranges from 0.19% to 53.7%. The overall prevalence of HEV ranges from 10.54% to 68.42%. To our knowledge, the overall burden of viral Hepatitis in India has not been estimated for the last decade; thus, the current study will contribute to national-level representation. This existing systematic review paves the way to develop evidence-based results and combat viral Hepatitis. Viral Hepatitis is clearly an important public health problem and burden in India. As described by its high prevalence, this problem is a significant challenge to the national health care system. There is an urgent need for effective public health interventions to reduce the burden and eliminate the problem.

Registration and protocol: The current review has a number of observational study designs. Due to this, the review was not registered under PROSPERO.

Data availability statement: Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Contributorship statement: The conceptualization of the current study was done by AJ and HK. The data extraction was done by DK, KK, and RM. Formal analysis was done by DK. Writing of the original draft was done by DK, KK, and RM. Supervision, review, editing, and cross-validation were done by AJ and HK.

Abbreviations

AIDS: Acquired immunodeficiency syndrome; AVH: Acute viral hepatitis; Anti-HBC: Antibody to Hepatitis B core antigen; BCC: Behavior change communication; BKV: BK virus; GBD: Global Burden of Disease; CMV: Cytomegalovirus; CHB: Chronic hepatitis B; CLD: Chronic liver disease; FHF: Fulminant hepatic failure; HAV: Hepatitis A virus; HBV: Hepatitis B virus; HBsAg: Hepatitis B surface antigen; HCV: Hepatitis C virus; HDV: Hepatitis D virus; HEV: Hepatitis E virus; HIV: Human immunodeficiency virus; HCC: Hepatocellular cancer; ICMR: Indian Council of Medical Research; IgM: Immunoglobulin M; SDG: Sustainable Development Goal; T2DM: Type 2 diabetes mellitus; MoFH: Ministry of Health and Family Welfare; NOS: Newcastle-Ottawa Scale; NVHCP: National Viral Hepatitis Control Program; OLP: Oral lichen planus; OR: Odds ratio; VBD: Voluntary blood donors; and 95% CI: 95% Confidence intervals

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Conflicts of interest

There are no conflicts of interest.

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