Systematic review and meta-analysis

Prevalence of hepatitis B virus among people in Somalia and among Somalian immigrants in diaspora: A systematic review and meta-analysis

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A B S T R A C T
Background: The burden of the hepatitis B virus in Somalia is of epidemiological significance. This study aims to assess the prevalence of hepatitis B virus (HBV) among the population of Somalia and Somalian immigrants in the diaspora by a systematic review and meta-analysis. Method: A comprehensive search of literature detailing the frequency of HBV among individuals residing in Somalia and among Somalian immigrants was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) criteria. The meta-analysis was conducted using a single-arm random effects model, employing the DerSimonian and Laird technique. Result: Our search yielded 24 relevant publications encompassing 9976 cases of HBV in Somalia and among Somali immigrants in the diaspora. The prevalence of HBV among those residing only in Somalia was significantly higher (20.9% (CI: 15.2 – 28.1, I² = 97.19%, p <0.001) compared to the overall prevalence among Somalian immigrants and individuals living in Somalia (17.5% (CI: 13.0 – 23.5, I² = 97.11%, p <0.001). The prevalence of HBV among Somalian immigrants in the diaspora group was found to be the lowest, with an incidence of 6.9% (CI: 3.7 – 12.3, I² = 92.81%, p <0.001). The coexistence of various medical conditions (Diabetes, hypertension, and Schistosomiasis) exhibited a strong correlation with the development of HBV in Somalia and among individuals who have immigrated from Somalia. Conclusion: The study provides evidence indicating that the overall prevalence of HBV among Somalians was rather high on a global scale (17.5%), with a greater prevalence observed among those residing in Somalia (20.9%).

Introduction
The infection caused by the hepatitis B virus (HBV) continues to pose a significant threat to public health on a global scale [1]. The incidence of Hepatitis B in Asia and Africa is on the rise despite vaccine intervention1 placing a considerable strain on healthcare systems and impacting millions of people around the world [1]. Understanding the incidence of HBV in Somalia is crucial for developing and implementing effective control strategies, given the country's intricate combination of socio-economic, political, and environmental elements [2].

Somalia, situated in the Horn of Africa, confronts a multitude of health adversities, notably infectious ailments such as hepatitis B [3]. Decades of conflict and instability have greatly affected the country's health infrastructure, resulting in restricted
availability of healthcare services and insufficient disease tracking systems. Furthermore, socio-economic variables such as poverty, unemployment, and food insecurity augment the susceptibility of the population to viral diseases, including HBV [4]. However, there is a lack of reliable data regarding the extent and geographic spread of HBV infection in various parts of Somalia [5].

The research holds great importance as it can provide valuable insights for evidence-based interventions and policies that aim to alleviate the impact of HBV in Somalia. This analysis will enable them to create specific policies for controlling and preventing HBV in Somalia, considering the distinct socio-cultural factors [6], [7]. Furthermore, the knowledge acquired from this study could aid in identifying populations at greater risk and in establishing efficient screening and vaccination initiatives to reduce the spread of HBV in the community [8].

This study aims to fill this gap in knowledge by conducting a comprehensive assessment of existing literature and conducting a meta-analysis to consolidate the available data on the prevalence of HBV in Somalia. This study seeks to analyze existing evidence and identify areas of knowledge that are lacking. Its objective is to offer valuable insights that can inform public health initiatives and help decrease the occurrence of HBV-related illness and death in Somalia.

This systematic review and meta-analysis will give sufficient information on the pool prevalence of HBV in Somalia. Despite the surveillance in several African countries [7], [8], the pooled prevalence of HBV is yet to be reported in Malaysia, and this study provides adequate information.

Methods

To ensure a comprehensive assessment without duplicating existing material or active projects, we conducted an initial search for key terms in two review databases, PROSPERO and DARE. We performed an extensive search on four widely recognized international electronic databases, including PubMed, Scopus, Science Direct, and Google Scholar. Our search followed the preferred reporting items for systematic reviews and meta-analysis guidelines to ensure a thorough and reliable synthesis of information [9]. We were searching for literature regarding the frequency of HBV in Somalia. We employed diverse search methodologies, encompassing key terms such as "Hepatitis B" OR "HBV" and an exhaustive compilation of cities in Somalia. To expand the range of our search, we employed abbreviations such as "HBV," alternative keywords like "Liver cancer," and Boolean operators when necessary. To confirm the validity of our findings, we conducted a comprehensive search that was not restricted to language or publication year. The details of the search strategies employed in the four electronic databases can be found in supplemental file (B1). The most recent search was conducted on February 02, 2024.

The search results obtained from many databases were integrated into the Mendeley desktop reference manager software, and any duplicate entries were eliminated.

Eligibility and data extraction

This review covered cross-sectional studies, prospective cohorts, and retrospective cohorts that had gathered HBV data from Somalia. The inclusion and exclusion process was conducted meticulously. To eliminate repetition and unnecessary repetition, we excluded studies that consisted of review papers, editorials, case reports, brief communications, conference proceedings, and articles lacking clearly defined sample sources and origins. Furthermore, we excluded studies that were not retrievable in their whole or had redundant or duplicated data.

Three authors (KEB, ASAM, and YAN) conducted separate evaluations of each title, abstract, and full-text submission, adhering to the inclusion criteria in order to maintain the utmost objectivity and clarity. In the event of any differences, they were handled through consensus among the writers.

We conducted a comprehensive examination of the complete texts, abstracts, and titles of the relevant papers that met our criteria. The pertinent data was extracted and organized into a systematic proforma, encompassing the authors' names, publication year, country, and study designs. The data was collected by three authors (KEB, ASAM, and YAN) to ensure the accuracy and comprehensiveness of the analysis.

Statistical analysis and quality assessment

In our research, we employed a single-arm random-effects model to determine the combined prevalence of HBV in Somalia. To accomplish this purpose, the DerSimonian and Laird meta-analysis
approach, which is included in the OpenMeta and comprehensive meta-analysis software, was employed [10] – [12]. We employed a funnel plot to quantify the bias in publication. The Cochran's Q test was utilized to evaluate the heterogeneities of subgroup estimations. The heterogeneity index was calculated using the Cochran Q test and $I^2$ values, as per statistical analysis1 [3]. For instance, an $I^2$ score of 25%, 50%, and 75% corresponded to low, moderate, and high degrees of heterogeneity, respectively [13]. We conducted a subgroup analysis to determine the prevalence of HBV among different nationalities and types of studies to gain further insights. This subgroup analysis was conducted using open meta analyst version 10.10.

HBV prevalence data in Somalia were collected and analyzed using descriptive statistics. In each test, a $p$-value below 0.001 was statistically significant. To ensure the general quality of the included studies, we employed the Joanna Briggs Institute (JBI) critical assessment check list for prevalence statistics (Supplementary file B2) [14] – [15]. Three authors meticulously analyzed the investigations conducted by KEB, ASAM, and YAN. Each study was assigned a score of "2" for "yes" and "0" for "no" to establish a quality score ranging from 0 to 18. Studies with a quality score ranging from 14 to 18 were considered satisfactory.

The analysis was conducted using the PRISMA protocol (Supplementary file B3).

**Result**

**Search results and eligible studies**

Our comprehensive search methodology yielded an initial retrieval of 3289 abstracts from four prestigious international electronic databases. Through meticulous scrutiny, we thoroughly analyzed each record and eliminated any instances of duplication, resulting in a meticulously chosen assortment of precisely 2138 articles. Following further scrutiny of titles and abstracts, a total of 1776 items were excluded, resulting in 362 papers remaining for a thorough examination of the complete text. Nevertheless, a total of 338 publications were deemed ineligible during the review phase due to their failure to meet our rigorous inclusion criteria or receiving a low assessment score as per the JBI assessment standards. **Figure 1** depicts a comprehensive illustration of the selection process. Ultimately, a total of 24 articles were examined, encompassing 9976 individuals diagnosed with HBV and cases in Somalia.

**Characteristics of the eligible studies**

Table 1 provides a thorough summary of research investigating the occurrence of HBV within the Somali population. The included articles were published from 1977 – 2021. The study was based on different factors, including authors, sample size, number of individuals positive and negative for HBsAg (Hepatitis B surface antigen), study location, study type, population characteristics, study cohort, presence of multiple sexual partners, age range, and related comorbidities. Various research undertaken in Italy (n = 2), the United States (n = 1), the United Kingdom (n = 1), and Somalia have provided insights into the prevalence of HBV among the Somali people.

Most of the articles included in this study were carried out in Somalia (n = 20). This study differs in its techniques, encompassing cross-sectional and retrospective, and focuses on various target populations, including adults, children, pregnant women, and immigrants. There were more cross-sectional studies than retrospective study designs in this study. Prominent discoveries encompass a variety of cases where HBsAg tested positive in various studies, with certain cases suggesting the coexistence of comorbidities such as diabetes, hypertension, leprosy, and schistosomiasis among the affected individuals, as represented in table (1).

**Pooled prevalence of HBV among people living in Somalia and Somalian immigrants cohort**

There was a high pooled prevalence of HBV among people living in Somalia and Somalians in the diaspora [17.5% CI: 13.0 – 23.5, $I^2$ = 97.11%, $p <0.001]. The forest plot of all the pooled studies reveals the weight of the individual studies was from Somalia and the diaspora, as shown in figure (2). The pooled prevalence of HBV in Somalia and among Somalians in the diaspora was statistically significant at $p<0.001$. There was, however, a publication bias among the included studies, as shown in figure (3). Egger's statistics were insignificant at $p = 0.00876$, as shown in figure (3).

There was a significantly higher prevalence of HBV among people staying in Somalia than the entire Somali cohort globally. The pooled prevalence of HBV in Somalia alone was 20.9% (CI: 15.2 – 28.1, $I^2$ = 97.19%, $p <0.001$).
There was, however, no publication bias in the symmetry of the funnel plot, as shown in figure (5). The pooled prevalence of HBV among Somali immigrants in the diaspora was relatively low in comparison to the prevalence of HBV in people living in Somalia. A pooled prevalence of 6.9% (CI: 3.7 – 12.3, I² = 92.81%, p <0.001) was examined in this study for the Somali immigrant cohorts in the diaspora (Figure 6). Despite the low pooled prevalence of HBV among Somalians in the diaspora, there was high heterogeneity (92.81%) among the included studies in this category. There was, however, a bias in the publication, as shown in the asymmetry pattern of the included studies in this category, as shown in figure (7).

### Subgroup meta-analysis of HBV prevalence in Somalia and among Somali in diaspora

Table 2 presents a subgroup meta-analysis that specifically examines the prevalence of HBV among the Somali population, both within Somalia and in diaspora. The analysis considers various factors such as the source of the sample, study designs, study cohort, multiple sexual partners, population type, and associated comorbidities. Where variable queries were not applicable in the study, such studies were not included in the subgroup meta-analysis of that variable category. In Italy, the prevalence of the condition is 4.9% with a 95% confidence interval ranging from 2.7% to 8.8%. There is moderate heterogeneity, indicated by an I² value of 58.86. Somalia has a prevalence rate of 20.9% (95% CI: 15.2 – 28.1), indicating a substantial level of variation (I² = 97.19). The prevalence of 13.6% and 5.7% has been separately observed in investigations conducted in the United States and the United Kingdom, respectively. There were 19 articles with cross-sectional designs, with a prevalence rate of 19.3% (95% CI: 13.0 – 27.7). The studies showed a significant level of heterogeneity as represented in table (2).

There were 5 retrospective investigations conducted, which found a prevalence rate of 11.7% (95% confidence interval: 8.4 – 16.0). A total of 18 studies from an adult cohort, with a prevalence rate of 17.7% (95% CI: 12.1 – 25.2). There were four studies from the children cohort, with a prevalence rate of 18.5% (95% CI: 12.1 – 25.2). Two studies however were from the pregnant cohort with a reported a prevalence rate of 13.8% (95% CI: 4.8 – 33.6), with a substantial level of heterogeneity identified (I² = 97.06). The prevalence of having numerous sexual partners was found to be 9.4% (95% CI: 4.9 – 17.4) as presented in table (2).

The prevalence of HBV among individuals who do not have several sexual partners was found to be 19.2% (95% CI: 12.0 – 29.3) based on 9 studies. There was however high heterogeneity observed among the studies (I² = 96.47), as represented in table (2).

Somali immigrant’s HBV prevalence in Diaspora was relatively in this study, a prevalence rate of 6.7% (95% CI: 3.5 – 12.3) in comparison to the local population with a prevalence of 20.9% (95% CI: 15.2 – 28.1). The presence of other comorbidities was significant in this study, however there was no heterogeneity in people how reported to have been concurrently infected with HBV and leprosy in this study. Diabetes had a prevalence of 8.7% and hypertension had a prevalence of 31.2%, as presented in table (2).
**Table 1.** Characteristic of the eligible studies showing the prevalence of HBV in Somalia/Somali population.

<table>
<thead>
<tr>
<th>Name of authors</th>
<th>Publication year</th>
<th>Total</th>
<th>HBsAg positive</th>
<th>HBsAg Negative</th>
<th>Nature of study/source of sample</th>
<th>Population</th>
<th>Type of study</th>
<th>Study cohort</th>
<th>Multiple sexual partners</th>
<th>Age range</th>
<th>Age range</th>
<th>Associated comorbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Padovese et al [16]</td>
<td>2014</td>
<td>500</td>
<td>31</td>
<td>469</td>
<td>Italy</td>
<td>Immigrants</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Kadle et al [17]</td>
<td>2012</td>
<td>156</td>
<td>61</td>
<td>95</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Shire et al [18]</td>
<td>2012</td>
<td>1109</td>
<td>151</td>
<td>958</td>
<td>United States</td>
<td>Immigrants</td>
<td>Retrospective</td>
<td>Adult</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Khadjio [19]</td>
<td>2011</td>
<td>147</td>
<td>59</td>
<td>88</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Faustini et al [22]</td>
<td>1994</td>
<td>213</td>
<td>7</td>
<td>206</td>
<td>Italy</td>
<td>Immigrants</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Bile et al (a) [23]</td>
<td>1992</td>
<td>596</td>
<td>95</td>
<td>501</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>children</td>
<td>NA</td>
<td>1 - 017</td>
<td>10.4</td>
<td>Leprosy</td>
</tr>
<tr>
<td>Aceti et al (a) [26]</td>
<td>1989</td>
<td>1138</td>
<td>220</td>
<td>918</td>
<td>Somalia</td>
<td>Local</td>
<td>Retrospective</td>
<td>Adult</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Bile et al (c) [27]</td>
<td>1991</td>
<td>158</td>
<td>3</td>
<td>155</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>Yes</td>
<td>18 - 80</td>
<td>34.2</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Aceti et al (b) [28]</td>
<td>1991</td>
<td>104</td>
<td>52</td>
<td>52</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Jama et al [29]</td>
<td>1987</td>
<td>218</td>
<td>49</td>
<td>169</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Pregnant women</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Bile et al (d) [30]</td>
<td>1987</td>
<td>946</td>
<td>78</td>
<td>868</td>
<td>Somalia</td>
<td>Local</td>
<td>Retrospective</td>
<td>Pregnant women</td>
<td>NA</td>
<td>18 - 50</td>
<td>29.7</td>
<td>NA</td>
</tr>
<tr>
<td>Sebastiani et al (a) [31]</td>
<td>1985</td>
<td>383</td>
<td>46</td>
<td>337</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Nuti et al (a) [32]</td>
<td>1979</td>
<td>102</td>
<td>49</td>
<td>58</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Schistosomiasis</td>
</tr>
<tr>
<td>Nuti et al (b) [33]</td>
<td>1979</td>
<td>157</td>
<td>22</td>
<td>135</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td>Leprosy</td>
</tr>
<tr>
<td>Nuti et al (c) [34]</td>
<td>1978</td>
<td>101</td>
<td>24</td>
<td>77</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Schistosomiasis</td>
</tr>
<tr>
<td>Nuti et al (d) [35]</td>
<td>1979</td>
<td>222</td>
<td>80</td>
<td>142</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>No</td>
<td>NA</td>
<td>NA</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Delia et al[36]</td>
<td>1977</td>
<td>155</td>
<td>118</td>
<td>37</td>
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<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Schistosomiasis</td>
</tr>
<tr>
<td>Sebastiani et al (b) [37]</td>
<td>1984</td>
<td>86</td>
<td>11</td>
<td>75</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Children</td>
<td>NA</td>
<td>18 - 80</td>
<td>34.1</td>
<td>NA</td>
</tr>
<tr>
<td>Ench et al [38]</td>
<td>2021</td>
<td>1124</td>
<td>101</td>
<td>1023</td>
<td>Somalia</td>
<td>Local</td>
<td>Retrospective</td>
<td>Adult</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
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<tr>
<td>Mohamed et al [39]</td>
<td>2021</td>
<td>220</td>
<td>16</td>
<td>204</td>
<td>Somalia</td>
<td>Local</td>
<td>Cross-sectional</td>
<td>Adult</td>
<td>NA</td>
<td>18-90</td>
<td>52.7</td>
<td>NA</td>
</tr>
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</table>

Key: NA-Not applicable
Table 2. Subgroup meta-analysis of the prevalence of HBV among Somali population in Somalia and in diaspora in relation to the source of sample, study designs, study cohort, multiple sexual partner, population type and associated comorbidities.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of studies</th>
<th>Prevalence (%)</th>
<th>95% CI</th>
<th>Q</th>
<th>Heterogeneity test</th>
<th>I² (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DF</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Source of sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>2</td>
<td>4.9</td>
<td>2.7 – 8.8</td>
<td>2.431</td>
<td>1</td>
<td>0.119</td>
</tr>
<tr>
<td>Somalia</td>
<td>20</td>
<td>20.9</td>
<td>15.2 – 28.1</td>
<td>676.257</td>
<td>19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>United States</td>
<td>1</td>
<td>13.6</td>
<td>11.7 – 15.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1</td>
<td>5.7</td>
<td>3.9 – 8.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-sectional</td>
<td>19</td>
<td>19.3</td>
<td>13.0 – 27.7</td>
<td>562.083</td>
<td>18</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Retrospective</td>
<td>5</td>
<td>11.7</td>
<td>8.4 – 16.0</td>
<td>80.819</td>
<td>4</td>
<td>&lt;0.001</td>
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<tr>
<td>Study cohort</td>
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<tr>
<td>Adult</td>
<td>18</td>
<td>17.7</td>
<td>12.1 – 25.2</td>
<td>717.893</td>
<td>17</td>
<td>&lt;0.001</td>
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<tr>
<td>Children</td>
<td>4</td>
<td>18.5</td>
<td>12.1 – 25.2</td>
<td>20.499</td>
<td>3</td>
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<td>4.8 – 33.6</td>
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<td></td>
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<td></td>
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<td>4</td>
<td>9.4</td>
<td>4.9 – 17.4</td>
<td>48.673</td>
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<tr>
<td>No</td>
<td>9</td>
<td>19.2</td>
<td>12.0 – 29.3</td>
<td>226.480</td>
<td>8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Population type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immigrants</td>
<td>4</td>
<td>6.7</td>
<td>3.5 – 12.3</td>
<td>41.714</td>
<td>3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Local</td>
<td>20</td>
<td>20.9</td>
<td>15.2 – 28.1</td>
<td>676.257</td>
<td>19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Associated comorbidities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>3</td>
<td>8.7</td>
<td>1.5 – 37.1</td>
<td>104.248</td>
<td>2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>2</td>
<td>31.2</td>
<td>8.9 – 68.0</td>
<td>33.472</td>
<td>1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Leprosy</td>
<td>2</td>
<td>15.6</td>
<td>13.1 – 18.3</td>
<td>0.351</td>
<td>1</td>
<td>0.554</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>3</td>
<td>49.4</td>
<td>21.1 – 78.1</td>
<td>61.696</td>
<td>2</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Key: - P, probability value; DF, Degree of freedom; I², Heterogeneity index; Q, correlation.
Figure 1. Summary of the article selection process.

Total record (n = 3289)
- PubMed (n = 812)
- Scopus (n = 194)
- Science Direct (n = 19)
- Google Scholar (n = 1047)

Records removed before screening:
- Duplicate records removed (n = 1151)

Records screened for title and abstract after duplicate removal (n = 2138)

Records excluded (n = 1776)
- 1) Review (n = 597)
- 2) No full text (n = 214)
- 3) Sample/Data not within Somalia/no Somali (n = 965)

Full text sought for retrieval (n = 362)

Full text not retrieved (n = 0)

Full text assessed for eligibility (n = 362)

Reports excluded: (n = 338)
- Ambiguous HBV cases (n = 116)
- Sample/data not from Somalia/does not involve Somalis (n = 220)

Studies included in the qualitative and quantitative synthesis (meta-analysis) (n = 24)
**Figure 2.** Forest Plot showing the pooled prevalence of HBV among people living in Somalia and Somalian immigrants cohort.

**Figure 3.** Funnel plot showing publication bias of the pooled prevalence of HBV among the Somalian population in Somalia and the diaspora
**Figure 4.** Forest plot showing the pooled prevalence of HBV in Somalia.

**Figure 5.** Funnel plot showing publication bias of the pooled prevalence of HBV in Somalia.

![Forest Plot](image1.png)

![Funnel Plot](image2.png)

Egger’s p = 0.1314
Discussion

The incidence of hepatitis B infection and other emerging diseases in developing nations over the past decade are of epidemiological significance [10]. Hepatitis B mortality rate in Somalia was approximately 4.3% [14]. The introduction of the HBV neonatal vaccine in the late 1990s did not affect the morbidity of the disease in Africa [14], [34]–[36]. The national burden of HBV in Somalia is very high. Despite the intervention of the government and non-governmental agencies in the provision of adequate awareness for the prevention and management of the disease, the associated morbidity of HBV among Somalians is still of public health concern [13]–[17].

Knowledge of the overall pooled prevalence of HBV in People living in Somalia and among Somalians in the diaspora will help facilitate strategic approaches toward geographically oriented prevention and management of the disease [29].

This systematic review and meta-analysis is the first to report the pooled prevalence of HBV among people living in Somalia and among Somalians in the Diaspora. The study meticulously ensured the inclusion of pertinent and high-caliber literature were considered. The 24 included articles met all the designed criteria for inclusion in this, which are in alliance with the PRISMA recommendation and the JBI checklist [8]. The publications provided encompassed a time frame from 1977 to 2021 and exhibited diversity in terms of study design, sample size, geographic location, and population characteristics. A population of 9976.
Somalians was considered for this study, displaying the robustness of this study.

The findings of this study make a substantial contribution to the comprehension of HBV epidemiology among Somalis. It enhances our understanding of the disease burden in this specific community, going beyond previous research that has examined HBV prevalence in different populations, including immigrant communities.

Most of the study was from Somalia, thereby justifying the overall burden of HBV among the residents of the community. The latter complies with the report of Irekeola et al., where they presented that the burden of disease is correlated to the population of the study area [15].

There were significant differences in the prevalence of HBV in Somalia in relation to different study cohorts in this study. Most of the study participants were adults; the probable reason for the latter is unclear, but it could be attributed to the higher predisposing risk factors towards the acquisition of HBV among adults. Such conditions include but are not limited to unprotected sexual intercourse, use and sharing of sharp objects, intravenous drug usage and the presence of multiple sexual partners. The findings of this study comply with the report of others [16]–[19].

The variety of study designs and demographic cohorts enhances the depth and intricacy of the results. Furthermore, the incorporation of research carried out in additional nations like as Italy, the United States, and the United Kingdom provides a more comprehensive outlook on the frequency of HBV among the Somalians in the diaspora [19].

The combined occurrence of HBV among individuals living in Somalia and Somalians living abroad was significantly high. The latter shows a large burden of HBV within the Somali population, both domestically and globally. The high heterogeneity observed in this study shows that there was variation in the prevalence estimates among different study populations. The findings of this study are concordant with other reports [20], [21].

Despite the variation in characteristics and the high pooled prevalence, there was evidence of publication bias. Therefore, care should be taken in the interpretation of findings to avoid overestimation or underestimation of the actual prevalence of HBV in the population. The latter complies with the report of Bello et al. [12].

An important pattern observed in the data is the difference in HBV prevalence between individuals living in Somalia and Somali immigrants living in other countries. More precisely, the occurrence of HBV was notably greater among individuals residing in Somalia in comparison to the overall Somali population worldwide. This discovery emphasizes the significance of taking into account geographical and environmental elements while comprehending the prevalence and transmission dynamics of diseases.

Moreover, the data indicated a reduced overall occurrence of HBV among Somali immigrants residing in other countries in comparison to persons residing in Somalia. Although the prevalence is lower compared to Somalia, the presence of substantial heterogeneity among the studies indicates that there is fluctuation in the prevalence of HBV among Somali immigrants in different countries. The findings of this study are in alliance with the reports of others [21]–[24]. The pooled prevalence of HBV in Somalia, in comparison to other sub-Saharan Africa, reveals a lower incidence of HBV among immigrants from sub-Saharan African nations. This difference is related to variations in healthcare availability, vaccine coverage, and cultural customs, which could affect the morbidity of the disease [22].

The analysis examines the correlation between HBV and other concurrent medical conditions, such as diabetes and hypertension [23]. Individuals with HBV exhibit a much-increased occurrence of diabetes and hypertension in comparison to the general population, suggesting the presence of potential synergistic effects between these ailments. In addition, the study identifies the simultaneous presence of leprosy and schistosomiasis infections, highlighting the significance of integrated healthcare strategies to tackle co-infections and comorbidities among susceptible populations [24].

The subgroup meta-analysis show offers a detailed insight into the prevalence of HBV among the Somali population, both within Somalia and among Somali immigrants in different diaspora regions. The data shows significant variance in prevalence rates across different geographic areas. In Italy, the prevalence of HBV is 4.9%. However, in Somalia, it is substantially higher at 20.9%, showing a greater burden of HBV among the local Somali people. This discovery is consistent with the
concept that the prevalence of HBV might significantly differ depending on geographical and socioeconomic factors [25]. Notably, the prevalence rates in the United States and the United Kingdom are significantly lower, with 13.6% and 5.7% respectively. This suggests that there may be disparities in healthcare access, screening policies, or population demographics between the two countries. The findings of this study reveal age-specific prevalence rates, with adults exhibiting a prevalence of 17.7% in contrast to children at 18.5%. Pregnant women have a somewhat lower occurrence rate of 13.8%, which may be due to antenatal screening programs that try to reduce the transmission of HBV from mother to child. These findings emphasize the significance of taking demographic factors into account when evaluating the impact of diseases and developing focused therapies. The latter are in alliance with the reports of others [34] – [41].

Having several sexual partners is linked to a lower occurrence of HBV in this study, in contrast to persons who do not. The probable reason for the low incidence of HBV in relation to having multiple sexual partners is unclear. Still, it could be attributed to the behavior of the included individual and the high burden of religion among the participants19.

Strength and limitations
This study is the first to report the pooled prevalence of HBV among Somalians in the diaspora and among people living within Somalia. The strength of this study lies in its thorough approach to combining existing literature and performing a meta-analysis to determine the prevalence of HBV in Somalia. The wide range of study types, sample sizes, and geographic areas offers a thorough and all-encompassing examination of the HBV epidemiology within the Somali population. Furthermore, the subgroup meta-analysis provides in-depth information regarding the occurrence rates among various demographic groups and geographical areas, hence enhancing our comprehension of the disease's impact. Although this study has notable merits, it is important to acknowledge some limitations that should be considered while evaluating its results. A few were studies reporting the prevalence of HBV among the Somali population in the diaspora, and there was also a publication bias in the study. Therefore, care should be taken when interpreting the findings of this study as it might not be the truest representation of the HBV prevalence. Despite the above limitations, this study presents comprehensive epidemiological information on HBV in Somalia.

Conclusion
The pooled prevalence of HBV among Somalians was relatively high globally (17.5%) and higher among people living in Somalia (20.9%). This study offers unique insights into the epidemiological landscape of HBV, which can be used to develop focused prevention and treatment strategies to reduce the effect of the illness in Somalia and other Sub-Saharan Africa.

Supplementary materials
B1: PRISMA guideline.
B3: JBI checklist for the prevalence data.
B4: Quality of included studies by JBI critical appraisal checklist for studies reporting prevalence data.

Author contributions
ASAM and KEB. Conceived and designed the study. Methodology: KEB, ASAM, and YAN select and assess the quality of studies. KEB and ASAM extracted and analyzed data. Analysis and writing: ASAM and KEB interpreted the results and drafted the manuscript. Writing review and editing: KEB, ASAM, and YAN reviewed and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

Institutional review board statement
Not applicable.

Informed consent statement
Not applicable.

Data availability statement
The data presented in this study are available in the supplementary material.

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Conflict of interest
The authors declares no conflict of interest.
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