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Prevalence of Hepatitis C Among Migrants: A Systematic Review and Meta-Analysis

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ABSTRACT

The World Health Organisation has targeted the Hepatitis C virus (HCV) to be eliminated as a public health threat by 2030. Equitable access to HCV testing and treatment services is important in achieving this goal. Migrants often face barriers to accessing health services, and understanding HCV prevalence among this population can support planning for elimination. This systematic review aimed to estimate HCV prevalence among migrants residing in high-income countries with low/intermediate HCV prevalence. Scopus, PubMed, PsycINFO and Cochrane Library were searched for peer-reviewed articles published in English between 2015 and 2024. The studies' quality was assessed using The Joanna Briggs Institute (JBI) Critical Appraisal Tools. A proportional meta-analysis was used to estimate HCV prevalence. Thirty-seven studies were included in this review. Seventeen studies included both people <18 and ≥ 18 years old, 16 studies only included people ≥ 18 years old, and three studies included people aged 18 and younger. The pooled prevalence of HCV antibody (anti-HCV) and RNA (HCV-RNA) were 1.5% (95% CI, 1.1%–2.0%) and 0.6% (95% CI, 0.4%–0.9%), respectively. The prevalence of anti-HCV was higher among males (1.9%) than females (0.6%). Among refugees and asylum seekers, the prevalence of anti-HCV and HCV-RNA were 1.4% and 0.7%, respectively. The prevalence of HCV among migrants is comparable with that among the general population of the destination countries. Given the barriers migrants, especially refugees and asylum seekers, face in accessing health services, their access to HCV information, testing and treatment should be facilitated.

1 | Introduction

Viral hepatitis is the second leading infectious cause of death globally [1, 2]. The World Health Organisation (WHO) estimates that viral hepatitis causes 1.3 million deaths each year worldwide [1]. From 1990 to 2017, the number of deaths attributed to viral hepatitis increased from 0.98 million to 1.41 million, and viral hepatitis associated Disability-Adjusted Life Years increased from 35.2 million to 43.1 million [3]. It is estimated that hepatitis C virus (HCV) infection accounts for 17% of total deaths related to viral hepatitis [1]. In 2022, there were 50 million people with chronic HCV, one million new HCV infections and around 242,000 deaths from HCV [1, 4].

WHO has targeted viral hepatitis to be eliminated as a public health threat by 2030 [5]. To achieve this aim, targets have been set to reduce the incidence of HCV infections by 90% and associated mortality by 65% by 2030 from a 2015 baseline. Improvement of prevention and treatment services coverage, including increased diagnosis coverage to 90% of HCV cases and treatment to 80% of HCV cases, is required to reach these targets [6]. The WHO also highlights the significance of equitable access to viral hepatitis testing and treatment services for achieving elimination [7].

In some high-income countries where the overall incidence and prevalence of HCV are low, specific population groups including

migrants from high HCV prevalence countries may experience higher HCV morbidity and mortality compared with the general population of the destination countries [8, 9]. Migrants may experience barriers in accessing testing and treatment services. Socioeconomic status, cultural norms, language barriers, and fear of discrimination and stigmatisation by healthcare providers and members of society can reduce migrants' engagement with HCV services [10, 11]. At the system level, policies and regulations may create administrative barriers and environments for experiencing stigma and discrimination and limit migrants' access to health services related to HCV [11, 12]. To help inform HCV elimination strategies, information regarding the prevalence of HCV among migrants is needed.

In 2015, Greenaway and colleagues [13] conducted a systematic review and meta-analysis to report anti-HCV prevalence among migrants originating from low/intermediate income, intermediate/high HCV prevalence countries, and arriving in high-income, low/intermediate HCV prevalence countries. They reported the pooled overall prevalence of anti-HCV as 1.9% (95% CI, 1.4–2.7) [13]. Another systematic review used literature published between 2000 and 2014 and estimated the prevalence of anti-HCV and HCV-RNA among migrants in EU/EEA Member States born in HCV-endemic countries as 2.3% and 1.6%, respectively [14].

However, there is a need to update the recent prevalence of anti-HCV and HCV-RNA among all groups of migrants, specifically in the decade from 2015 to 2024. This systematic review aimed to estimate the prevalence of HCV among all migrant populations residing in high-income low- orntermediate HCV prevalence countries.

2 | Methods

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist to guide this systematic literature review preparation and reporting (Appendix S1). The research question was 'What is the prevalence of hepatitis C among migrants in high-income low/intermediate HCV prevalence countries'.

2.1 | Data Sources and Search Strategy

We searched Scopus, PubMed, Cochrane Library, and PsycINFO in August 2024 for quantitative peer-reviewed studies published in English between 2015 and 2024. The year 2015 was chosen as that was the baseline year for the WHO Viral Hepatitis Elimination by 2030 target [6] and to update the last systematic review published in 2015 [13]. The reference lists of included articles were searched for additional articles.

The search strategy used for this review is shown in Appendix S2. Scopus, PubMed, and Cochrane Library databases were searched in the scope of title and abstract; all-field searching was applied to PsycINFO as it does not have the search function focusing on both title and abstract. Initially identified titles and abstracts were screened by the first author (J.S.). For articles that met the eligibility criteria after title and abstract screening, full texts of selected articles were obtained and reviewed independently by two authors (J.S. and D.P.). Any disagreements were resolved through discussion. Reasons for excluding articles in the full-text review process were recorded.

2.2 | Inclusion and Exclusion Criteria

Peer-reviewed studies that investigated the prevalence of anti-HCV and/or HCV-RNA among migrants were included. We only included studies published in English between 2015 and 2024 from high-income, low/intermediate HCV prevalence migrants' destination countries, including European Economic Area (EEA) countries, Switzerland, the United Kingdom (UK), the United States of America (USA), Canada, New Zealand, and Australia.

We used the United Nations (UN) Department of Economic and Social Affairs definition of a migrant as an individual 'who changes his or her country of usual residence, irrespective of the reason for migration or legal status' [15]. Therefore, all migrants, migrant workers, refugees, asylum seekers and international students were considered as populations of interest for this study.

We excluded case studies, case series, conference abstracts, modelling studies and review studies. Studies that performed HCV tests based on certain risk factors such as intravenous drug use, sex work, men having sex with men, individuals being treated for chronic liver disease and based on liver disease symptoms were excluded.

EndNote and Covidence were used to remove duplications and manage the review process.

2.3 | Assessment of Methodological Quality

The methodological quality of the included studies was assessed using The Joanna Briggs Institute (JBI) Critical Appraisal checklist for analytical cross-sectional studies [16]. The checklist includes eight questions that cover inclusion criteria; description of subjects and setting; exposure, condition, and outcomes measurement; identification and dealing with confounding; and statistical analysis (questions presented in Appendix S3) [16]. Answers to these questions included yes, no, unclear, and not applicable (NA). For questions 3, 5 and 6, all studies were assigned as 'Not applicable' (NA) as no exposure and outcome relationship was defined for this review. For the first question, a Yes was assigned if the study clearly defined the inclusion criteria of migrant populations. For question 2, a Yes was assigned if the study used migrant populations and clearly described the settings (e.g., camp, clinic, shelter, special unit, community). Question 7 was assigned Yes if the study used random sampling or national surveillance data or offered HCV tests to all target populations without a sampling method. For Question 8, studies were marked as Yes if they reported the prevalence of HCV with exact numbers and proportions of HCV-positive cases.

Each included study was assessed based on the checklist questions by the first author (J.S.) and was independently

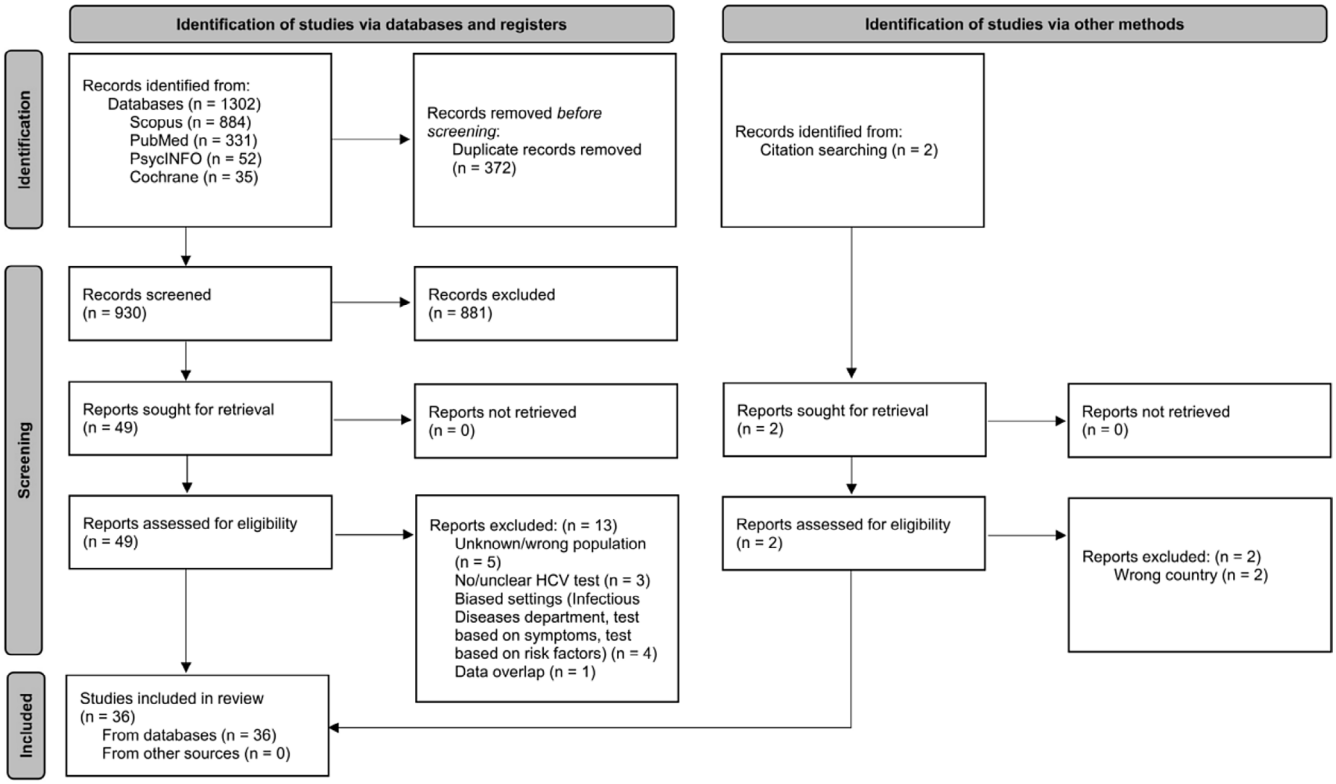

FIGURE 1 | PRISMA flow diagram of literature search and study selection process.

reviewed by another reviewer (D.P.). Disagreements of assessment between the two reviewers were resolved through discussion. Results of the quality assessment are presented in Appendix S3.

2.4 | Data Extraction

Data of interest was preliminarily extracted by J.S. and then independently reviewed by D.P. Data from selected articles that meet the eligibility criteria was extracted and summarised into a Microsoft Excel spreadsheet. Studies with migrants from more than three countries or regions were described as 'Mixed' Studies that reported only the number of HCV-positive cases without specifying the number of cases with positive anti-HCV, HCV-RIBA, or HCV-RNA tests were included exclusively for the estimate of anti-HCV-positive prevalence.

2.5 | Data Synthesis

We conducted proportional meta-analysis to estimate the pooled prevalences of anti-HCV and HCV-RNA. Prevalence was estimated separately for (1) male, (2) female, (3) population aged <18 years old (4) population aged ≥ 18 years and (5) refugees and asylum seekers.

We applied the DerSimonian-Laird random effects model to account for between-study variability. To stabilise variance, proportions were transformed using the Freeman-Tukey double arcsine transformation. Results were reported as prevalence per 1000 persons to enhance interpretation and comprehension, utilising the transform() and scale options in Stata. Statistical heterogeneity was assessed using Higgins' inconsistency index (I^2) and τ^2 values, extracted through the meta summarise command.

For sensitivity analysis, we conducted a leave-one-out approach to assess the robustness of the pooled prevalence estimates. Each study was temporarily excluded, the meta-analysis was rerun and results were plotted.

3 | Results

3.1 | Search Results

A total of 1302 studies were identified through database search, and two studies were identified through the reference list check. These two studies were then excluded as they were not from the destination countries included in this review. After removing 372 duplicates, 930 titles and abstracts were screened. A total of 881 citations were excluded in title and abstract screening, and full-text review was applied to the remaining 49 studies. Thirteen studies were excluded during the process of assessing eligibility criteria in the full-text review, including a study where data were reported as part of another already included study. A total of 36 studies were included in this review (Figure 1).

3.2 | Methodological Quality Appraisal

We did not exclude any study based on quality assessments. 35 studies were assigned Yes to question 1, and one study was No.

All studies were marked as Yes for questions 2 and 4. For question 7, 13 studies [17–29] were marked Yes, 22 studies [30–51] No, and one study [52] that did not report the sampling method was Unclear [52]. The answer to question 8 for 33 studies was Yes [17–19, 30–35, 52] while three were unclear [22, 47, 48]. Among these three, two did not report the exact number of HCV positive cases [22, 47] and one only reported the prevalence of HCV as < 1% [48]. (Appendix S3).

3.3 | Study Characteristics

Characteristics of the included studies are shown in Table 1. All studies included were cross-sectional. The data collection year was between 2004 and 2022. Countries studied included Italy ($n = 14$) [17, 19, 24–27, 33, 35–37, 49–52], UK ($n = 4$) [18, 28, 31, 41], Netherlands ($n = 3$) [29, 30, 43], Spain ($n = 3$) [34, 45, 46], USA ($n = 3$) [38, 40, 44], Canada ($n = 2$) [22, 48], Australia ($n = 1$) [47], England ($n = 1$) [42], France ($n = 1$) [20], Germany ($n = 1$) [23], Greece ($n = 1$) [21], Norway ($n = 1$) [39] and Switzerland ($n = 1$) [32]. Commonly reported study settings involved reception centres, refugee centres, asylum seeker centres, special units/clinics for migrants, and primary care facilities.

Migration status reported in the studies included migrants, refugees, asylum seekers, foreign citizens, migrant agricultural workers, overseas-born patients, and economic migrants. There were 21 studies [18, 21–28, 31–33, 35, 37, 39, 43, 44, 48–50, 52] that included refugees and asylum seekers and 15 studies [17, 19, 20, 29, 30, 34, 36, 38, 40–42, 45–47, 51] included other types of migrants or a mixed population group. Most migrants were from Africa and Asia, and countries of migrants' origin that were commonly reported in these studies included Pakistan, Nigeria, Eritrea, Afghanistan, Syria and Sudan. Five studies only included migrants from a single country (Eritrea [32], Syria [22], Mongolia [38], Nepal [41] and Pakistan [45]), five studies included migrants from one specific region (Africa [25, 27], Sub-Saharan Africa [34, 36] and South Asia [42]), two studies [20, 37] did not report the origin of migrants and the remaining 24 studies [17–19, 21, 23, 24, 26, 28–31, 33, 35, 39, 40, 43, 44, 46–52] included multiple countries/regions.

Convenience sampling was reported in 10 studies [20, 30, 33, 38–40, 42–45]; 10 studies used pre-recorded medical data [18, 21, 31, 34, 36, 38, 44, 45, 47–49]; 12 studies offered HCV tests to all of the target population [19, 20, 22, 24–28, 30, 32, 46, 50] and two studies used random sampling [21, 29]. One study [52] only provided HCV tests to a 25% of the population of interest, two studies [37, 51] had unclear sampling methods, and two studies [17, 41] did not report any methods used to recruit and select participants. Among the two studies that used random sampling, only Zuure et al. [29] used random sampling for recruiting from the study population, and Eonomopoulou et al. [21] sampled randomly from medical records.

The sample size of the studies ranged between 52 [39] and 38686 [44]. The total number of migrants who were tested for HCV from all included studies was 96,616. Most studies did not report the numbers of male and female participants. From those that reported, 13,873 (51.6%) were male and 12,736 (48.4%) were female.

Eighteen studies [17–19, 21–23, 25–27, 32, 34, 35, 37, 46, 48, 50, 52] included both people under 18 and 18 years old and older; 16 studies [20, 29, 30, 33, 36, 38–45, 47, 49, 51] only included people aged 18 and older; and three studies [24, 28, 31] included people aged 18 and younger. Among those who were tested for HCV with reported data of age, the ranges of mean and median age were from 24 to 41 years and 20 to 29 years, respectively.

A total of 35 studies performed anti-HCV test [17–43, 45–52] (three were rapid test [20, 36, 51]), and 20 studies used both anti-HCV and HCV-RNA tests [18, 23, 30, 31, 36, 38–43]. One study reported the use of Anti-HCV or HCV-RIBA (recombinant immunoblot assay) or HCV-RNA tests [44].

3.4 | Prevalence of Hepatitis C Virus

A summary of HCV prevalence in different subgroups is presented in Table 2.

3.4.1 | Overall prevalence of hepatitis C antibody and RNA

The highest anti-HCV prevalence of 9.9%, reported by Ha et al. was among Mongolia-born migrants aged 18 or older in the USA; this number was more than twice as high as the second highest value (9.9% vs. 4.6%) [38, 45]. HCV-RNA prevalence reported by Ha et al. was more than four times higher than the second highest value (7.1% vs. 1.7%) [26, 38]. Data from Ha et al. [38] was considered an outlier and therefore was excluded from the proportional meta-analysis and only included in the description of the range of prevalences and sensitivity analysis (Appendix S4).

The prevalence of anti-HCV positive status among migrants was between 0% and 9.9% [17–24, 30–35, 37–44, 52]. Two studies reported anti-HCV prevalence as 0% [32, 39], one study [32] in Switzerland using cantonal refugee registries and another [39] study of migrants from refugee centres in Norway using convenience sampling. Among those who tested for anti-HCV, a total of 1430 anti-HCV positive cases were reported from included studies, resulting in a pooled anti-HCV prevalence of 1.5% (95% CI: 1.1%–2.0%, I^2: 95.3) (Figure 2) [17–24, 30–37, 39–44, 52]. High I^2 in proportional meta-analysis is common, and it does not necessarily mean that the data is inconsistent [55].

Seventeen studies [23–27, 29–31, 33, 36, 38, 41–43, 45, 47, 50] reported HCV-RNA prevalence; the range was between 0% from Kelly et al. [41] among migrants aged 18 years or older from the Nepali community in the UK, and Cardoso Pinto et al. [31] that included unaccompanied asylum-seeking children aged 13–18 from Unity Clinic's infectious disease screening programme in the UK, and 7.1% from the Ha et al. [38] study. The second highest prevalence was 1.7% from Pisaturo et al., which included refugees/asylum seekers in general practice clinics attended mainly by low-income refugees and undocumented migrants, with screening offered to all migrants observed in the study period [26]. A total of 138 migrants were reported to be HCV-RNA positive, leading to a pooled HCV-RNA prevalence of 0.6% (95% CI: 0.4–0.9, I^2: 70.4%) (Figure 3) [23–27, 29–31, 33, 36, 41–43, 45, 47, 50].

TABLE 1 | Characteristics of included studies.

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Bil et al. [30] (2018)	October 2013–February 2015 July 2015–August 2015	Netherlands—TB department	Migrants	Mixed	Convenience sampling, people aged 18 and older	459 (anti-HCV), 256 (HCV RNA)	M: 211 (46) F: 248 (54)	Median: 29 (26–35)	Anti-HCV: 5 (1.09, 95% CI: 0.47–2.52) HCV-RNA: 1 (0.39, 95% CI: 0.07–2.18)	
Buonfrate et al. [52] (2018)	April 2014–June 2015	Italy—Refugee shelters	Asylum seekers	Sub-Saharan Africa, Asia and North Africa	Routine screening, people aged over 14	118			Anti-HCV: 1 (0.85)	
Cardoso Pinto et al. [31] (2022)	November 2019–March 2022	Italy—Unity Clinic's infectious disease screening programme	Unaccompanied asylum-seeking children	Africa and Asia	Medical data review, people aged 13–18 years	148			Anti-HCV: 1 (0.7) HCV-RNA: 0 (0)	
Chernet et al. [32] (2017)	February–November 2016	Switzerland—Centres for asylum seekers	Refugees	Eritrea	All consenting asymptomatic Eritrean migrants registered in cantonal refugee registries within the past 24 months, people aged 16 years and above	107	M: 95 (88.8) F: 12 (11.2)	Medium: 25 (21–29)	Anti-HCV: 0 (0)	
Colucci et al. [33] (2022)	March 2019–February 2020	Italy—Fondazione ARCA[b]	Refugees	Africa, Asia, others and unknown	Convenience sampling, people aged 19–70 years old	362			Anti-HCV: 6 (1.7) HCV-RNA: 2 (0.6)	

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Coppola et al. [17] (2020)	January 2012–June 2018	Italy—General practice clinics attended mainly by low-income refugees and undocumented migrants	Undocumented migrants, asylum seekers, refugees, economic migrants	Mixed	People from all age groups	3839	M: 3224 (84.0) F: 610 (15.9)	Mean: 28 (10)	Anti-HCV: 136 (3.5)	Anti-HCV: M: 121 (3.7) F: 15 (2.5)
Crawshaw et al. [18] (2018)	March 2013–August 2017	UK—International Organisation for Migration clinics	Refugees	Asian, Africa and Europe	Medical data review, people from all age groups	9223			Anti-HCV: 38 (0.41, 95% CI: 0.3–0.57)	Anti-HCV: M: 19
Cuomo et al. [19] (2019)	March–December 2016	Italy—Migration centre	Refugees, asylum seekers and economic migrants	Africa and Asia	All migrant people referred to the clinic of Infectious Diseases for primary screening of transmittable infection, people from all age groups	304			Anti-HCV: 10 (3.3, 95% CI: 0.01–0.05)	
Delcor et al. [34] (2016)	January 2009–December 2012.	Spain—Shelters attended at the Unit of International Health Drassanes-Vall d'Hebron	Migrants	Sub-Saharan Africa	Medical data review, people from all age groups	167			Anti-HCV: 2 (1.2)	

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Donisi et al. [35] (2020)	January 2015–December 2015	Italy—Migration Health Unit that provides primary health care for all undocumented people	Asylum seekers	Africa and Asia	Any asylum-seekers who referred to Migration Health Unit, people from all age groups	315			Anti-HCV: 6 (1.9)	
Duracinsky et al. [20] (2023)	January 2017–March 2020	France—Office for Immigration and Integration centres	Migrants		Convenience sampling. All migrants needed to go for medical check-ups. 21 out of 32 centres participated. People aged 18 and above	15,343	M: 5707 (37.2) F: 9636 (62.8)		Anti-HCV: 42 (0.3)	Anti-HCV: M: 17 (0.3) F: 25 (0.3)
Eonomopoulou et al. [21] (2016)	March–July 2011	Greece—Holding (detention) centres	Refugees/ asylum seekers	Africa, Asia and undeclared origin	Random sampling based on medical data review, people from all age groups	632			Anti-HCV: 5 (0.8)	
Fiore et al. [36] (2023)		Italy—Facility centres	Migrants	Sub-Saharan Africa	Medical data review, people aged 18 and above	371			Anti-HCV: 1 (0.2) HCV-RNA: 1 (0.2)	
Germinario et al. [37] (2015)	May–July 2008 for viral hepatitis	Italy—Asylum Seeker Centres	Refugee		Unclear voluntary enrolment, people from all age groups	529	M: 442 (83.6) F: 87 (16.4)	Mean: 23.9 (6.7)	Anti-HCV: 24 (4.5)	Anti-HCV: M: 23 (5.2) F: 1 (1.1)
Gruner et al. [22] (2022)	December 2015–April 2016	Canada—Primary care health clinics	Refugees	Syria	All Syrian refugees were offered health assessments in collaboration with the regional health network, people from all age groups	612	M: 337 (55) F: 275 (45)		Anti-HCV: 4 (0.7, 95% CI: 0.0–1.4)	Anti-HCV: M: 4 (1.2) F: 0 (0)

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Ha et al. [38] (2019)	2016–2017	US—Community health centre	Migrants	Mongolia	Convenience sampling, people aged 18 and above	634	M: 268 (42.3) F: 366 (57.7)	Mean: 41 (11.4)	Anti-HCV: 63 (9.9, 95% CI: 7.7–12.8) HCV-RNA: 45 (7.1, 95% CI: 5.6–8.9)	Anti-HCV: M: 23 (8.6) F: 40 (10.9)
Hannula et al. [39] (2021)	September 2015–March 2017	Norway—Refugee centre	Refugees/ asylum seekers	Mixed	Convenience sampling, people aged 18 and above	52		Median: 29	Anti-HCV: 0 (0)	
Jablonka et al. [23] (2017)	August–September 2015	Germany—Reception centres	Refugees	Mixed	Mandatory examination for all refugees, people from all age groups	604	M: 464 (76.8) F140 (23.2)	Median: 26 (20–35)	Anti-HCV: 7 (1.2) HCV-RNA: 4 (0.7)	Anti-HCV: M: 5 (1.1) F: 2 (1.4)
Juon et al. [40] (2019)	November 2009–December 2015	US—Churches, temples, health fairs and community centres	Migrants	Asia and Africa	Convenience sampling, people aged 18 and above	2813			Anti-HCV: 102 (3.6)	
Kelly et al. [42] (2020)	February–June 2018	England—Primary care, Community venues and mosques	Migrants	South Asia	Convenience sampling, people aged 18 and above	211			Anti-HCV: 4 (1.9) HCV-RNA: 1 (0.5)	

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Kelly et al. [41] (2023)		UK—Community (venues close to Nepali population clusters and familiar to the local community)	Migrants	Nepali	People aged 18 and above	994			Anti-HCV: 4 (0.4)	
Klok et al. [43] (2021)	October 2018–October 2019	Netherlands—Primary care facility for undocumented migrants	Refugees/ asylum seekers	Mixed	Convenience sampling (56% participation rate), people aged 18 and above	403			Anti-HCV: 9 (2.2)	
Kumar et al. [44] (2021)	January 2014–December 2016	US—Domestic medical examination data as part of CDC Strengthening Surveillance for Diseases among Newly Arrived migrants and Refugees project	Asylum seekers and refugee	Mixed	Convenience sampling, people from all age groups	Adult asylum seekers: 2065 Adult refugee: 24603 Children asylum seekers: 698 Children refugee: 11320			Anti-HCV: Adult asylum seekers: 26 (1.3) Adult refugee: 561 (2.3) Children asylum seekers: 2 (0.3) Children refugee: 81 (0.7)	

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Marrone et al. [24] (2020)	January 2013–January 2019	Italy—Reception centres[c]	Refugees/ asylum seekers	Mixed	Unaccompanied minors were recruited upon their arrival at the reception centres. All minors included in the study underwent a complete medical examination, people aged 9–18 years	836			Anti-HCV: 9 (1.1) HCV-RNA: 6 (0.72)	
Marrone et al. [25] (2023)	August 2019–December 2020	Italy—Reception centres	Refugees and asylum seekers	Africa	African refugees and asylum seekers were recruited upon their arrival at the reception centres. All underwent a complete medical examination and infectious disease screening, people from all age groups	783			Anti-HCV: 20 (2.5) HCV-RNA: 2 (0.3)	
Martró et al. [45] (2022)	March 2019–February 2020	Spain—Community	Migrants	Pakistan	Convenience sampling and medical data review, people aged 18 and above	502 (anti-HCV) 501 (HCV RNA)			Anti-HCV: 23 (4.6, 95% CI: 2.8–6.4) HCV-RNA: 6 (1.2, 95% CI: 0.2–2.1)	
Norman et al. [46] (2021)	2018–2019	Spain—Specialised unit for migrants	Regular migrants, irregular migrants, asylum seekers and refugee	Mixed	Testes were requested for all patients seen in the unit for the first time, people from all age groups	451	M: 325 (72.1) F: 126 (27.9)		Anti-HCV: 11 (2.4)	Anti-HCV: M: 10 (3.1) F: 1 (0.8)

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Pisaturo et al. [26] (2023)	January 2012–February 2020	Italy—General practice clinics attended mainly by low-income refugees and undocumented migrants	Refugees/ asylum seekers	Mixed	Screening was offered to all migrants observed in the study period with acceptance rate of 97%, people from all age groups	2923		Median: 27 (12)	Anti-HCV: 101 (3.5) HCV-RNA: 50 (1.7)	Anti-HCV: M: 87
Prestileo et al. [27] (2022)	January 2015–December 2017	Italy—Reception centres	Refugees/ asylum seekers	Africa	Screening was offered to all migrants during the study period with acceptance rate of 95.9%, people from all age groups	2639	M: 1903 (72.1) F: 736 (27.9)	Mean: 24	Anti-HCV: 24 (0.9) HCV-RNA: 18 (0.7)	Anti-HCV: M: 19 (1.0) F: 5 (0.7)[d]
Prince et al. [47] (2020)	July 2018–February 2019	Australia—Emergency department	Overseas born patients	Mixed	Medical data review, people aged 18 and above	4778			Anti-HCV: 127 (2.7) HCV-RNA: 37 (0.8)	
Redditt et al. [48] (2015)	December 2011–June 2014	Canada—Specialised primary care clinic for refugees	Refugees	Mixed	Medical records review, people from all age groups	886	M: 386 (43.6) F: 500 (56.4)	Median: 29 (15–39)	Anti-HCV: 4 (0.5)	Anti-HCV: M: 3 (0.8) F: 1 (0.2)
Russo et al. [49] (2015)	March 2012–February 2013	Italy—Asylum Seekers Centres	Asylum seekers	Mixed	Medical data review, people aged 18 and above	322			Anti-HCV: 11 (3.4, 95% CI: 1.9–6)	Anti-HCV: M: 9 F: 2
Scotto et al. [50] (2019)	January–December 2015	Italy—Reception centres for asylum seekers	Asylum seekers	Africa and Asia	All guests at the Reception Centre were invited (728 persons), people from all age groups	205	M: 205 (100)		Anti-HCV: 8 (3.9) HCV-RNA: 3 (1.5)	Anti-HCV: M: 8 (3.9) HCV-RNA: M: 3 (1.5)

(Continues)

TABLE 1 | (Continued)

Study (year)[a]	Data collection date	Country of study and study settings	Migration status	Country or region of migrants' origin	Sampling method	Sample size	Sex, *n* (%)	Age mean, years (±SD)/ median, years (IQR)	HCV positivity, *n* (%)	Male/ female-specific positivity, *n* (%)
Totaro et al. [51] (2023)	January 2020–April 2021	Italy—Three ghettos (shanty town, also called a slum or squatter settlement)	Migrant agricultural workers	Africa and Asia	Unclear screening, people aged 18 and above	309	M: 272 (88) F: 37 (12)	Mean: 28.5 IQR: 18–61	Anti-HCV: 9 (2.9)	
Williams et al. [28] (2020)	January 2016–December 2018	UK—Paediatric infectious diseases clinics	Unaccompanied asylum-seeking children and young people	Mixed	All unaccompanied asylum-seeking children aged 18 years or under referred to the paediatric infectious disease clinics were included, people aged 18 and under	211			Anti-HCV: 1 (0.5)	
Zuure et al. [29] (2019)	January 2011–June 2014	Netherlands-HELIUS (Healthy life in an urban setting) study	Migrants	Mixed	Random sampling based on HELIUS study, people aged 18 and above	2493			Anti-HCV: 5 (0.2) HCV-RNA: 4 (0.2)	

[a]All these included studies used cross-sectional study designs.
[b]ARCA is an NGO officially appointed by the local authorities to provide legal, social and health assistance [33].
[c]Reception centre in Italy is a place where a asylum seeker or holder of a form of protection is placed [53, 54].
[d]There is a mistake in Prestileo study, the female-specific HCV positivity should be 0.7 (5/736) [27].

TABLE 2 | Summary of HCV prevalence among migrants overall and in subgroups.

	Test type	Number of studies	Prevalence
Overall	Anti-HCV	35	1.5% (95% CI: 1.1%–2.0%)
	HCV RNA	14	0.6% (95% CI: 0.4%–0.9%)
Male	Anti-HCV	9	1.9% (95% CI: 0.9%–3.2%)
	HCV RNA	1	1.5%
Female	Anti-HCV	8	0.6% (95% CI: 0.1%–1.3%)
Migrants less than 18 years old	Anti-HCV	1	0.7%
Migrants aged 18 years or older	Anti-HCV	15	1.5% (95% CI: 0.9%–2.4%)
	HCV-RNA	7	0.5% (95% CI: 0.2%–0.8%)
Refugees and asylum seekers	Anti-HCV	21	1.4% (95% CI: 0.9%–1.9%)
	HCV-RNA	8	0.7% (95% CI: 0.4%–1.1%)

3.4.2 | Prevalence of Hepatitis C Among Male and Female Migrants

Anti-HCV prevalence among male migrants was reported by 13 studies [17, 18, 20, 22, 23, 26, 27, 37, 38, 46, 48–50]. Apart from the two studies that reported 0% prevelance [32, 39], reported prevalence ranged between 0.3% [20] among migrants aged 18 years or older in French Office for Immigration and Integration centres using convenience sampling, and 8.6% from the Ha et al. [38] study. The second highest anti-HCV prevalence among males was 3.9% from the Scotto et al. study, which only included male asylum seekers in reception centres in Italy [50]. Among male migrants, there were a total of 233 anti-HCV positive cases from 13,261 males in 10 studies. Three studies [18, 26, 49] were excluded from the calculation as they only reported prevalence, not the number of male migrants tested for HCV. After excluding the Ha et al. [38] study, there were 210 cases, and the pooled anti-HCV prevalence was 1.9% (95% CI: 0.9%–3.2%, I^2: 94.0%) [17, 20, 22, 23, 27, 37, 38, 46, 48, 50] (Appendix S5 Figure S1) [17, 20, 22, 23, 27, 37, 46, 48, 50]. Only one study reported HCV-RNA prevalence. The study reported the prevalence as 1.5% [50].

Among female migrants, apart from the two studies that reported 0% in all samples [32, 39], nine studies reported anti-HCV prevalence between 0% [22] among Syrian refugees in Canadian primary care health clinics and 10.9% from the Ha et al. [38] study. The second highest value for anti-HCV prevalence was 2.5% from the Coppola et al. [17] study that included a mixed migrant group from general practice clinics in Italy. There were 90 anti-HCV cases among 12,201 tested. After excluding the Ha et al. [38] study from the meta-analysis, there were 50 anti-HCV positive cases; the anti-HCV prevalence was 0.6% (95% CI: 0.1%–1.3%, I^2: 80.1%) (Appendix S5 Figure S2) [17, 20, 22, 23, 27, 37, 46, 48]. None of the studies reported HCV-RNA prevalence among female migrants.

3.4.3 | Prevalence of Hepatitis C Among Migrants by Age Groups

Only one study reported prevalence among children aged under 18 years [44]. The study included asylum seekers and refugees aged younger than 18 years using the USA domestic medical examination data and reported 0.7% anti-HCV prevalence [44]. Among migrants aged 18 years and younger, three studies [24, 28, 31] reported a range of anti-HCV prevalence between 0.4% and 1.1% and one study [24] reported 0.7% HCV-RNA prevalence.

There were 16 studies [20, 29, 30, 33, 36, 38–45, 47, 49, 51] that reported anti-HCV prevalence among migrants aged 18 years or older; the range was from 0% [39] to 9.9% (Ha et al. study) [38]. The second highest anti-HCV prevalence was 4.6% from the Martró et al. [45] study that included a medical record review of Pakistani migrants in community settings. After removing the Ha et al. [38] study, there were 935 cases with a pooled anti-HCV prevalence of 1.5% (95% CI: 0.9%–2.4%, I^2: 97.0%) (Appendix S5 Figure S3) [20, 29, 30, 33, 36, 39–45, 47, 49, 51]. Eight studies [29, 30, 33, 36, 38, 42, 45, 47] reported HCV-RNA prevalence among this group, with a range from 0% in Kelly et al. [41] to 7.1% in Ha et al. [38]. The second highest HCV-RNA prevalence was 1.2% from the Martró et al. [45] study. After removing the Ha et al. [38] study, there were 52 HCV-RNA positive cases, with a pooled HCV-RNA prevalence of 0.5% (95% CI: 0.2%–0.8%, I^2: 61.2%) (Appendix S5 Figure S4) [29, 30, 33, 36, 42, 45, 47].

3.4.4 | Prevalence of Hepatitis C Among Refugees and Asylum Seekers

HCV prevalence specifically among refugees and asylum seekers was reported by 21 studies [18, 21–28, 31–33, 35, 37, 39, 43, 44, 48–50, 52]. Anti-HCV prevalence ranged between 0% [32] and 4.5% [37]. The highest prevalence was reported by a study that included refugees from asylum-seeker centres in Italy with unclear sampling methods. The pooled anti-HCV prevalence among refugees and asylum seekers, with 949 positive cases, was 1.4% (95% CI: 0.9%–1.9%, I^2: 92.2%) (Appendix S5 Figure S5) [18, 21–28, 31–33, 35, 37, 39, 43, 44, 48–50, 52]. Eight studies reported HCV-RNA prevalence with a range of 0% [31] and 1.7% [26] from a study among undocumented migrants and low-income refugees in general practice clinics in Italy. Overall, there were 85 HCV-RNA positive cases; the pooled HCV-RNA prevalence among this group was 0.7% (95% CI: 0.4%–1.1%, I^2: 66.3%) (Appendix S5 Figure S6) [23–27, 31, 33, 50].

4 | Discussion

Among migrants regardless of their migration status, we estimated pooled anti-HCV and HCV-RNA prevalence of 1.5%

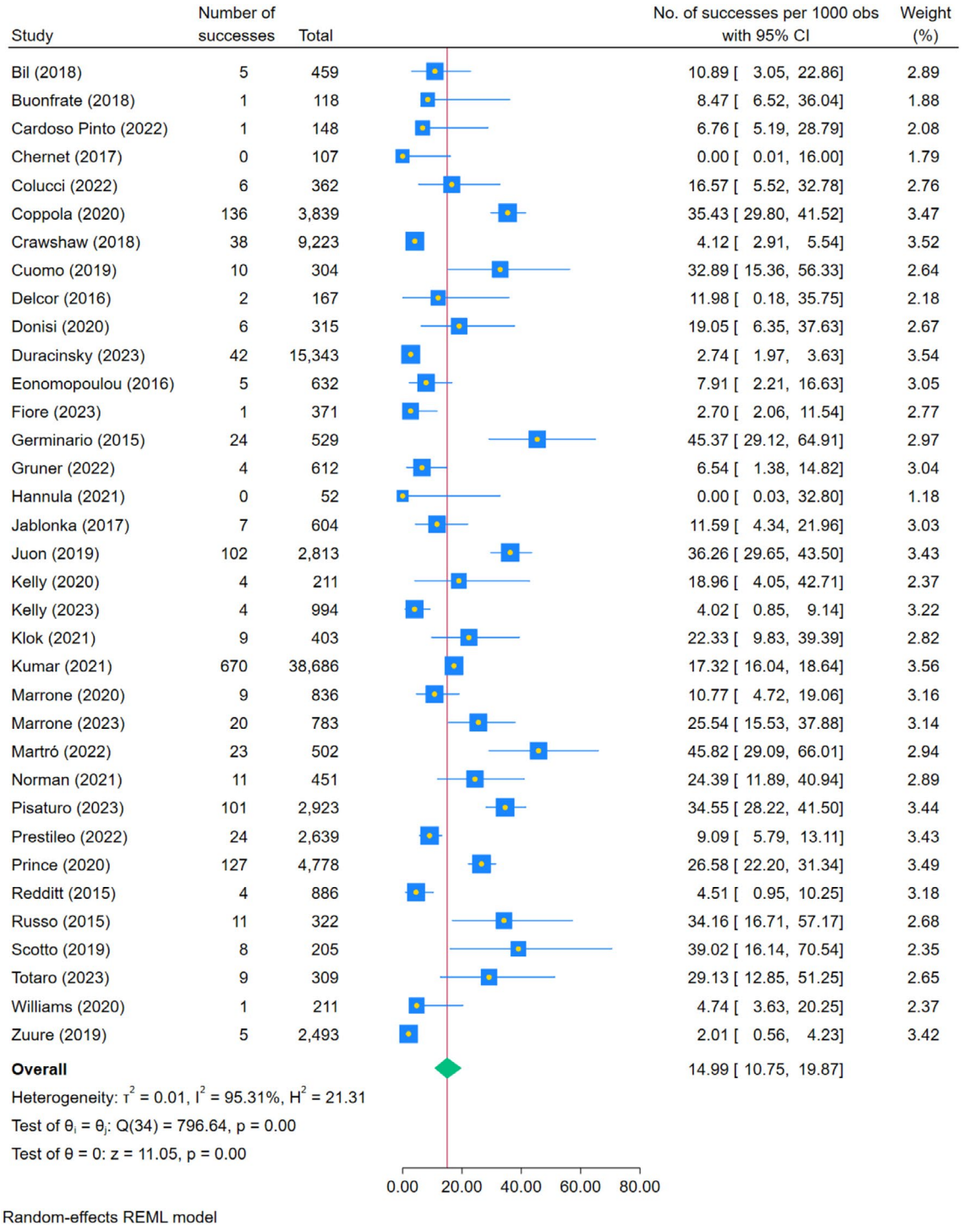

FIGURE 2 | Forest plot of anti-HCV prevalence per 1000 among migrants from included studies.

and 0.6%, respectively. This result is comparable to a previous study published by Greenaway et al. in 2015 with an overall anti-HCV prevalence of 1.9% [13]. The differences may be caused by different targeted populations and included countries and hepatitis elimination efforts by countries in recent years. Globally, HCV prevalence among the general population was estimated at 0.7% or 56.8 million cases living with HCV infection in 2020 [56]. In EU/EEA regions, the national estimate of HCV-RNA prevalence among the general population was 0.5% in 2019, with a range between 0.04% for the Netherlands and 2.26% for Romania [8, 56]. In the USA, between 2017 and 2020, the anti-HCV prevalence range among adults was between 2.2% and 2.9%, and the HCV-RNA prevalence range was between 1.0% and 1.6% [57]. Another study estimated the HCV-RNA prevalence in the USA in 2020 as 0.8% [58]. The National average anti-HCV prevalence in Australia was estimated at 0.8% in 2020, with an estimated HCV-RNA prevalence of 0.5% [58, 59]. In Canada, the estimated anti-HCV and HCV-RNA prevalences were 1% and 0.5%, respectively [60]. These data highlight that compared to general populations in high-income countries included in this review, HCV prevalence among migrant populations is

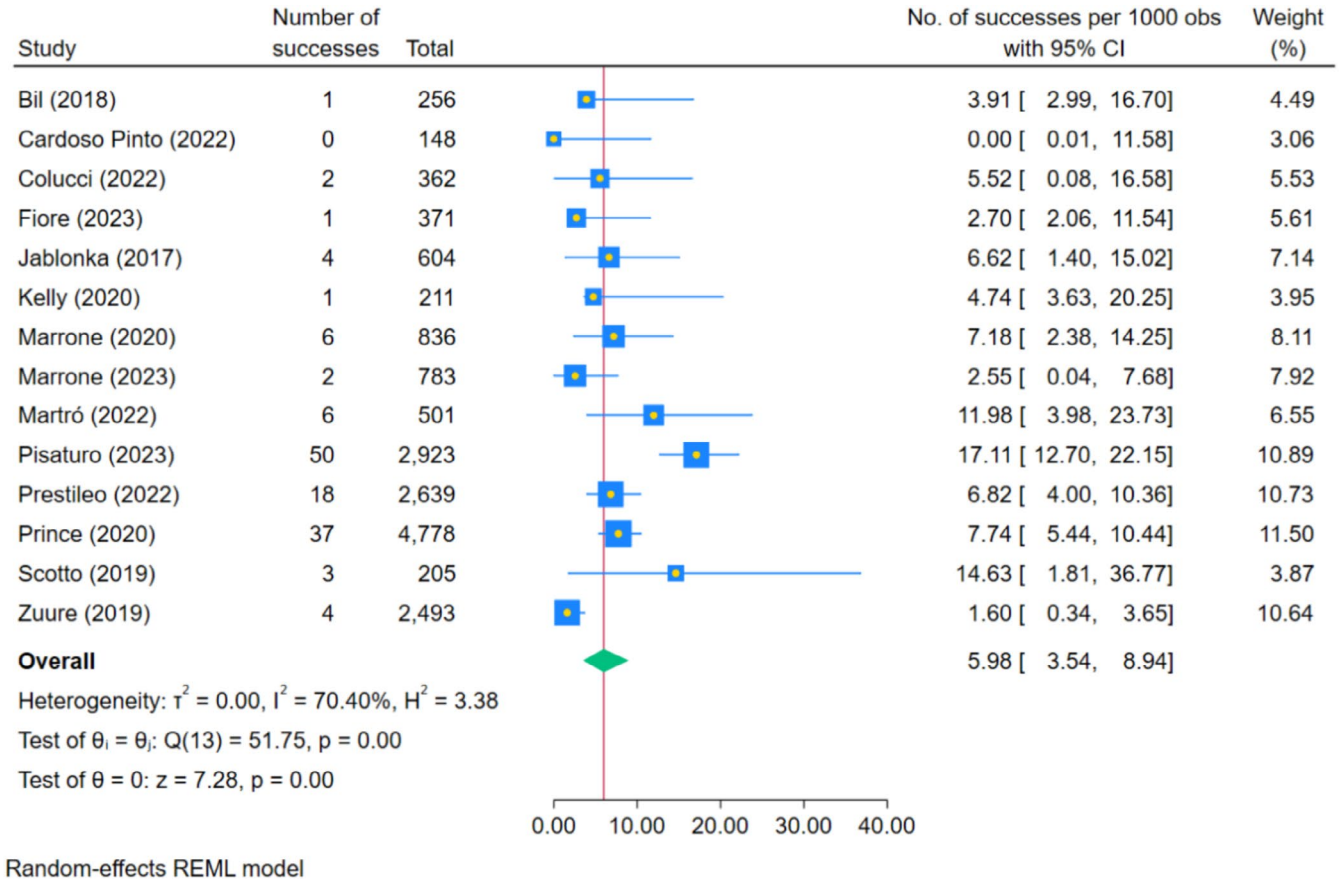

FIGURE 3 | Forest plot of HCV-RNA prevalence per 1000 among migrants from included studies.

similar and at a comparable level. It needs to be noted that these represent current HCV prevalence from these countries or regions, while our estimate in this review included data from 2004 to 2022, with more adults than children and more males than females among included migrants.

We also found that anti-HCV prevalence was higher among males compared with females (1.9% vs. 0.6%) and among those 18 years and older compared with younger migrants (1.6% vs. 0.7%). Males, especially those aged 20 to 40, are at higher risk of HCV infection due to multiple factors, including a higher risk of exposure to unsafe medical practices, sharing injecting drug equipment and unprotected sexual activities [13, 61].

When we calculate the prevalence of anti-HCV and HCV-RNA based on studies that only included refugees and asylum seekers, the prevalence was not higher among refugees compared with the overall prevalence reported in this study and compared with the destination countries. A previous systematic review reported a lower prevalence among refugees compared to other groups of migrants [13]. This finding is despite these groups of migrants being among the most tested populations. As shown in our review, the majority of studies specifically focused on these groups.

Although the prevalence among migrants is not higher than that in the general population, they may experience poorer outcomes compared to the non-migrant population because of their unmet health communication and service needs. Migrants in general, and refugees and asylum seekers specifically, experience several barriers in access to HCV information, testing, and treatment including unmet communication needs and discrimination at health services [11, 12]. Refugees and asylum seekers, in addition, have limited access to health services in many destination countries and experience extra levels of discrimination based on their migration status in the health services [62].

4.1 | Limitations and Strengths

Only two studies in this review used random sampling techniques. Some studies did not specify migration status and only reported 'migrants' as the migration state, and the term 'migrants' is used differently to describe different groups of migrants in different countries. For example, Hannula et al. [39] study reported 'migrants' as the migration state while this study was conducted in a refugee centre. For studies that included multiple migration statuses, nearly all of them only reported pooled HCV prevalence, and only one stratified the prevalence based on participants' migration statuses. More than half of the studies did not report the sex ratio and the number of male and female migrants tested for and with HCV.

We included different groups of migrants including general migrants, refugees, asylum seekers and migrant workers in this

review. This improved the comprehensiveness of the estimated prevalence. This review synthesised data from studies published between 2015 and 2024 to update the knowledge of HCV prevalence within a 10-year range and after the announcement of the viral hepatitis elimination goals by WHO. The JBI assessment tool was used for all included studies for quality assessment. We used proportional meta-analysis, which improved the validity and reliability of the reported prevalence.

There are, however, some limitations of this systematic review. We did not include grey literature and studies published in other languages than English in this review, and only four databases were screened. However, most medical studies are published in these four databases.

5 | Conclusion and Implication

This review shows that the prevalence of HCV in migrant populations is comparable to the prevalence in the general population of the destination countries included in this review. However, as migrants, specifically refugees, experience barriers at different levels in accessing health services in general and for infectious diseases specifically, programs should be implemented to improve their access to HCV information, testing, and treatment.

There is a lack of high-quality data and studies focusing on HCV prevalence among migrants regardless of their migration status; more research should be devoted to this field to investigate the prevalence of HCV among migrants and the barriers they experience in accessing preventive measures, testing, and treatment.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.