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The Prevalence of Hepatitis C Infection in Blood Donors: A Meta-Analysis and Systematic Review

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Abstract

Context: Hepatitis C virus (HCV) infection is one of the major bloodborne diseases worldwide. Although many screening tests were introduced and utilized for blood donations, as the main source of HCV transmission, it has still remained a global concern.
Evidence Acquisition: The prevalence of HCV infection among blood donors in every country and every WHO region was investigated. A Comprehensive electronic systematic search algorithm in the international databases PubMed, ISI, Scopus, and ProQuest were adopted for articles published until October 2016, using the following keywords: ("Blood Donors" OR "blood donation" OR "donor" OR "donation" OR "blood" OR "blood safety" OR "bloodborne" OR "residual risk" OR "transfusion-transmitted infections") AND ("prevalence" OR "epidemiology") in combination with "hepatitis C" OR "HCV" for hepatitis C. Only cross-sectional studies, which had appropriate measurement and sampling methods, were selected.
Results: The review of the literature showed that the global prevalence of HCV was 854.09 in 100,000. The highest and lowest rates of HCV among WHO divisions were seen in the African region by 2503.61 and the European region by 450.21 in 100,000, respectively. The highest and lowest rates among the countries were seen in Cambodia by 14,670 and Netherlands by 25.370 in 100,000.
Conclusions: It seems that strategies for prevention of HCV infection in blood donations should be considered for the policymakers; low prevalence countries are suggested to share their knowledge and countries with lower socioeconomic status should be aided to control the HCV infection among their blood donors.

Keywords: Blood Donors, Blood Safety, Hepatitis C, Meta-Analysis, Prevalence

1. Context

Although many improvements have been made toward the treatment and management of Hepatitis C (HCV), it is still one of the major concerns for health care providers worldwide in both developed and developing countries (1). In spite of rigid hygienic controls, HCV transmission mainly takes place by exposure to infected materials and devices such as shared intravenous injections, virus-infected blood products, hemodialysis, and also organ transplantations (2). The global prevalence of HCV infection was estimated to be about 2.2% (3). Epidemiological investigations for the potential risk factors, such as blood donation, medical procedures, vaccinations, tattooing, and unprotected injections have revealed an immense geographical difference leading to noticeable implications for management, prevention, and control plans in different populations (4, 5). Prospective surveys have indicated that around 80% of patients suffering from acute hepatitis C progress to chronic disease and more than one-tenth of them would end up with complications of chronic liver disease, including liver cirrhosis and even liver cancer (5, 6).

Among the risk factors evaluated in many surveys, the following can be mentioned in brief as the most important ones: blood transfusion, history of hemodialysis, sex (male > female), number of sexual partners, age of starting intercourse, ethnicity (higher in whites and Hispanics), education (less than 12 years old < more than 12), intravenous drug use and addiction, occupation and employment situation, vaccination, organ transplantation, etc. (7). The test of HCV antibody is the initial screening test for HCV infection through various antibody tests such as laboratory-based enzyme immunoassays (EIA) and HCV RNA by Poly-

merase chain reaction (PCR) assay are available (8). However, HCV RNA testing is performed when a reactive or undetermined antibody test is reported to distinguish occult infections (9, 10).

The most efficacious way of virus transmission is via repeated or frequent exposures to blood, including illicit drug injections, blood transfusion, or organ transplantation from infected donors (11). The introduction of routine examinations of donated blood has noticeably decreased the transmission of HCV through blood transfusion (12); in some countries such as the United States, Japan, and England, the prevalence has reduced significantly; however, in many others, the reduction of the transmission rates are still unsatisfying and the need for better examinations and improvement of hygienic and testing protocols are still remained (13, 14). Although determining the prevalence of this viral infection among blood donors may lead to underestimation of the real prevalence of HCV in a region since they are a highly selected population, knowing the rate among this population is a fundamental need to provide health policymakers and care providers with information about their supervision region and enable them to compare and analyze the data for better planning for prevention and infection control programs for healthier blood donation.

2. Objectives

To the best of our knowledge, no comprehensive report was found, particularly during the last decade, considering the prevalence of HCV infection among blood donors all over the world. In this study, we performed a systematic review aiming to estimate the prevalence of HCV infection in blood donors globally.

3. Methods

In this study, HCV prevalence was investigated in blood donors based on the published data from countries all over the world via a systematic literature review followed by data integration and statistical analysis of the results.

3.1. Study Question

Herein, the population of interest were registered blood donors and the presence of positive HCV-antibody was the outcome of interest in the blood samples based on any of the tests like ELISA or RIBA/PCR tests even if other laboratory evaluations were not identified clearly.

3.2. Search Strategy

An electronic systematic search algorithm in the international databases including PubMed, Web of Science, Scopus, and ProQuest, were adopted for articles published until October 2016, using the following keywords: "Blood Donors" OR "blood donation" OR "donor" OR "donation" OR "blood" OR "blood safety" OR "bloodborne" OR "residual risk" OR "transfusion-transmitted infections" AND "prevalence" OR "epidemiology" in combination with “hepatitis C” OR “HCV” for hepatitis C. References of the reviews, systematic reviews and meta-analyses, and relevant retrieved articles were searched to increase the sensitivity.

3.3. Eligibility Criteria and Study Selection

Only studies on blood donors that were published in English and measured the prevalence of HCV were included in the systematic review. The exclusion criteria were: (1) no accessible full text or insufficient statistical information about the prevalence and number of positive cases, and (2) specific blood donors' population (i.e. studies that recruited only HCV positive blood donors).

3.4. Data Collection and Data Items

One reviewer (LK) extracted the data and double-checked them for the following items extracted from the studies: authors' names, publication year, study period, location, sample size, the prevalence of HCV, and blood donation status (first time, lapsed and regular blood donor). In the case of ambiguity about the study information extraction, the problem was resolved by the MSM.

3.5. Statistical Analysis

A meta-analysis was conducted using the command “Metaprop” in STATA software version 14.0 (Stata™, TX, USA). The extracted data consisted of the first author, year of conducting the study, sampling method, and sample size, sample population, location, age, male to female ratio, HCV detection method, and prevalence of HCV in the individuals. For estimating the statistical heterogeneity of the results, Cochrane Q-test was employed with a significance level of less than 0.1. I-square, expressing a range of 0% (no heterogeneity) to 100% (significant heterogeneity) was used; 25%, 50% and 75% values were considered low, medium, and high heterogeneity, respectively (15). If the heterogeneity of the study was significant ($P < 0.1$), a random effect meta-analysis was used; otherwise, a fixed effect meta-analysis was applied to combine the prevalence. The countries were grouped according to the WHO list of countries of each regional office, namely South-East Asia Regional office (SEARO), African Regional office (AFRO), Region of the Americas (AMRO), European Region (EURO), Western Pacific Regional office (WPRO), and Eastern Mediterranean Regional office (EMRO) (16).

4. Results

In the electronic search of PubMed, Web of Science, Scopus, and ProQuest 425, 540, 537, 151 articles were identified, respectively. After exclusion of a number of articles (852) due to not being written in English (15), not providing full-text paper (60), not related to the targeted population (8), not related according to the data (119), and being duplicated or irrelevant (658), and reviews (5), 169 out of 856 articles met the inclusion criteria (Figure 1). Five articles had reported the prevalence of HCV based on the blood units' data.

The total sample size included in the meta-analysis was 5,259,729, ranging from 531 to 507,531. Eleven, 6, and 10 studies had reported the prevalence of HCV among the first time (265,019 donors ranging from 2,789 to 171,831), lapsed (31,717 donors ranging from 728 to 13,668), and regular (231,862 donors ranging from 3,463 to 109,925) blood donors, respectively.

The overall prevalence of HCV globally was 0.87% (854.088 in 100,000; 95% CI: 800.464 - 907.711; heterogeneity: Q = 37,871.08, df = 99.8%, P < 0.001). Table 1 indicates the distribution of the HCV prevalence among donors with different donation status, genders, donation reasons, and ages. The prevalence of HCV was higher in the first time donations and in replacement donors. No significant difference was seen between females and males according to the literature surveyed. Moreover, HCV prevalence was seen to be higher in donors aged over 50 years. The highest and lowest prevalence rates of HCV among WHO divisions were seen in AFRO by 2.16% (2503.608 in 100,000; 95% CI: 1835.972 - 3171.244) and EURO by 0.51% (450.208; 95% CI: 378.666 - 521.751), respectively (Supplementary File). The highest and lowest prevalence rates among the countries overall were in Cambodia by 14.66% (14,670.76 in 100,000; 95% CI: 12,711.22 - 16,792.61) and Netherlands by 0.02% (25.37 in 100,000; 95% CI: 20.24 - 30.49), respectively. The prevalence of HCV among blood donors in different regions of WHO as well as in each country is shown in Supplementary File.

5. Discussion

The HCV virus, as well as HIV and HBV viruses, are among the three most important agents which account for TTI, particularly in those receiving blood products. Moreover, HCV is still among the most common causes of post-transfusion hepatitis around the world and is the main cause of end-stage liver disease (17). The past several decades have witnessed significant advances in the methods and techniques of detecting these agents, such as nucleic acid amplification (NAT) and RNA assay by PCR, which have led to a considerable decrease in the prevalence of TTI, especially in developed and rich countries (18). It seems that economic situation of a country and provision of medical supplies play major roles along with the knowledge and education of the general population. Blood donation is one of the risk factors of affliction with TTIs, such as HCV, and screening the blood and the donors leads to a noticeable decline in the prevalence of the infection, especially in high prevalence regions. Herein, we made an attempt to present a comprehensive report of the prevalence of HCV in blood donors all over the world according to the published literature in major medical databases. We classified the countries considering the WHO divisions and gave out separate data for each division. As it is presented, EURO division has shown the lowest rates and Netherlands' blood donations appeared to be the most HCV-clear ones; this can be due to the economic situation of most of the developed European countries compared to other parts of the world. However, Georgia shows a noticeably high prevalence which must be considered by the policymakers and health care providers of this European country. Accordingly, AFRO region, which also has the poorest countries in its division, has shown the highest prevalence among all, most of the countries in this region, lowest in Algeria (0.17%) and highest in Burkina-Faso (8.69%). In SEARO region Nepal with 0.39% and Mongolia with 9.64% showed the lowest and the highest rates of infection. In AMRO, although the countries which gave out reliable reports were few, and may be not reliable, the United States had the highest (1.04%) and Brazil had the lowest (0.28%) rates based on their published documents. Although WPRO had a low prevalence overall, it included Cambodia which revealed the highest rate of infection (14.66) among all countries in this study; Korea showed the lowest prevalence in this region (0.15%). In EMRO region, considering the diverse number of studies for each country, Iran showed the lowest rate (0.13%), while Egypt had the highest (8.96).

Global eradication of HCV is feasible; however, it needs an abundant source of funding and most countries cannot afford it at present. Using a series of activities such as prevention education, screening methods for clinical patients and the population, sufficient treatment and management of the sources of infection, and promotion of health-care policies regarding updated reports of HCV prevalence in the community can help to reduce the rates of infection in the area (19, 20). Detecting asymptomatic individuals and providing effective therapeutic care as well as educating the households and relatives of these patients can prevent the occurrence of new infections and eradicate the 'silent epidemies' (19-21). Primary prevention should be considered to decrease the risk of HCV transmission and secondary preventive strategies can reduce the risk of complications such as chronic liver disease by early diagnosis and appropriate treatment plans (20, 22).

Table 1. Demographic Data of the Study of the Prevalence of HCV Infection Among Blood Donors

Criterion, Condition	No. of Studies	No. of Blood Donors	No. of Infected Donors	Prevalence, %	Between Studies, P Het[a]	Between Subgroups, P Het[a]
Donation status						0.001
First time	5	284238	1680	0.59	0.001	
Lapsed	1	43724	9	0.02	-	
Regular	4	26887	73	0.27	0.001	
Gender						0.001
Male	17	1133017	3737	0.33	0.001	
Female	17	232946	810	0.35	0.001	
Reason of donation						0.001
Replacement	1	90637	531	0.58	-	
Voluntarily	1	4065	7	0.17	-	
Age						0.001
≤ 29	7	243177	377	0.15	0.001	
30 - 39	7	75961	327	0.43	0.001	
40 - 49	5	52508	244	0.46	0.001	
≥ 50	4	8483	196	2.31	0.001	

[a]Heterogeneity.

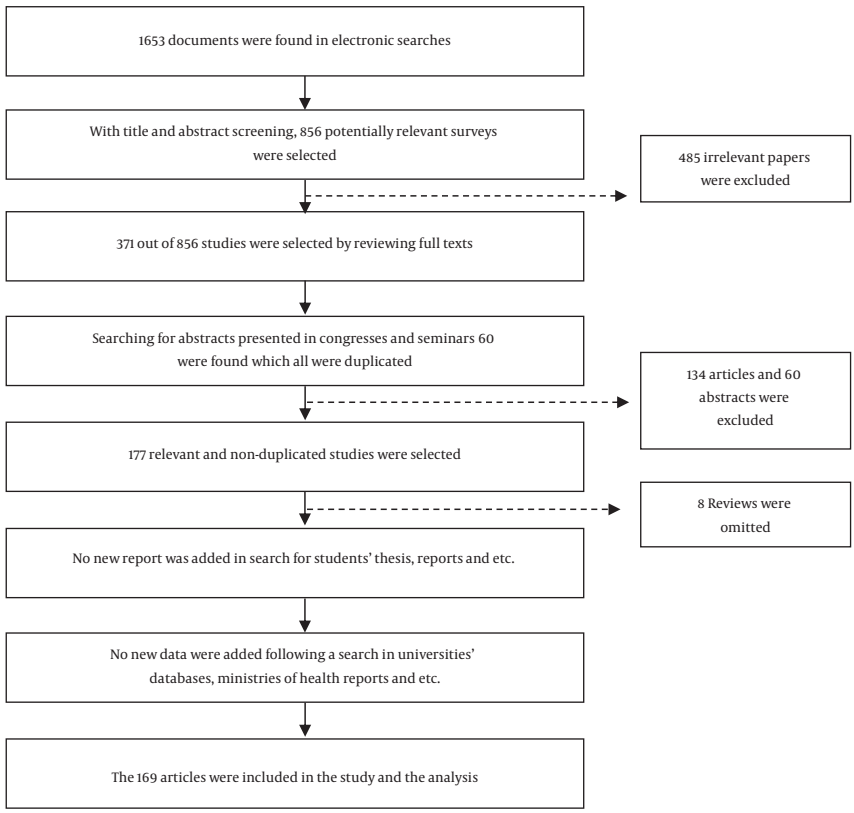

Figure 1. Flow diagram of systematic review and searches for HCV infection prevalence among blood donors of the countries all over the world.

Overall, the data presented in this study besides updated strategies for the prevention of HCV infection in blood donations should be considered for the policymakers in this regard in order to alleviate the burden of HCV infection all around the world. Experiences of low prevalence countries and those who have reached beneficial

methods in controlling the infection should share their knowledge and countries with lower socioeconomic situations should be aided to be able to control the infection.

The limitation of the present paper was the insufficient number of studies in some of the countries and a lack of data in many countries that made us unable to provide a better comparison and more comprehensive data. Thus, to the best of our knowledge, this is no comprehensive study evaluating the prevalence of HCV infection among blood donors and the result of this paper may be a good guide for further policies and strategies in this regard.

Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

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Footnotes

Authors' Contribution: Leila Kasraian gathered the data, performed the search, screened the papers and extracted the data. Mohammad Salehi Marzijarani performed the data analysis, helped us to search and prepare the draft. Soheil Ashkani-Esfahani and Sahar Hosseini assisted in searching and extracting the data, writing the draft, categorizing the data. Alireza Ebrahimi and Sahar Hosseini helped to prepare and classify the data and edit the draft. All authors reviewed the draft and helped to finalize it.

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