

Review Article

Epidemiology of Hepatitis C Virus in Iranian Thalassemic, Hemodialysis and Hemophiliac Patients: A Meta-Analysis Study

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ABSTRACT

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Introduction: Hepatitis C is one of the most serious viral infections that cause chronic liver disease.

Objectives: The current study was conducted to estimate the pooled prevalence and geographical distribution of Hepatitis C Virus (HCV) in thalassemic, hemodialysis, and hemophiliac patients in Iran.

Evidence Acquisition: Articles were identified through international searching databases including PubMed, Scopus, Elsevier, Google Scholar, and Web of Science and Iranian scientific information database (SID), Health.barakatkns, IranDoc, Civilica and MagIran. We reviewed systematically all studies reporting the prevalence of HCV in thalassemic, hemodialysis, and hemophiliac patients. All studies conducted ELISA tests for the evaluation of HCV antibodies. In this study meta-analysis method has been used to estimate the pooled prevalence.

Results: 270 records were identified by the electronic search, of which 151 studies were identified as relevant papers that were meta-analyzed for the pooled HCV prevalence. Overall, prevalence of HCV were 18.27% (15.99%-20.55%), 11.60% (9.98%-13.22%) and 45.16% (36.72%-53.60%) in thalassemic, hemodialysis and hemophiliac patients.

Conclusion: Concerning the high prevalence of HCV among hemophiliac patients, ongoing preventive actions for this group are recommended.

Introduction

Infection with the Hepatitis C Virus (HCV) is a major concern for public health in developing and developed countries around the world (1). In the world, 71 million people are suffering from chronic HCV, according to reports from the World Health Organization (2). A previous study showed Hepatitis C virus infection led to 54,000

deaths and 955,000 disability-adjusted life years worldwide in 2013 (3). Also, there are 3-4 million new cases of HCV infection worldwide each year (3, 4). The area of the Middle East and North Africa (MENA) is the most affected by HCV infection estimated to affect over 3.5% of the population (3, 5, 6). One of the main means of transmission of HCV is through blood and blood transfusion (7). Patients with the

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disease usually have multiple transfusions, such as those with thalassemia, or those with chronic renal failure who have been treated with hemodialysis machines (8, 9). Hepatitis C virus infection is a major cause of chronic hepatitis C and cirrhosis in hemophilia, thalassemia, and renal failure patients, as well as the most common indication of liver transplant in adults (10-12). Iran is a huge country with different ethnicities in different provinces in the Middle East. The prevalence and epidemiology of HCV vary across the country in different groups and regions. In Iran, hepatitis is mainly caused by problems such as increasing the injection population and the need to use common needles among them, to use a blood or its infected derivatives in surgery, or to prolong the survival of patients with thalassemia, hemophilia, and hemodialysis. On the other hand, the increase in the number of hemodialysis centers and blood transfusions for specific patients has unfortunately led to new sources of the virus in Iran (13, 14). Although repeated transfusions of blood and its derivatives may prolong the survival of patients with thalassemia, hemophilia, and dialysis, due to the lack of compliance with important health considerations in infection control in dialysis units (transmission of infection through dialysis and blood purifiers and other health service centers) These patients are at high risk of developing blood-borne viruses, especially hepatitis c viruses (15, 16). According to a recent meta-analysis published in 2018, patients with hemophilia, hemophilia, and thalassemia were at high risk for this virus in Iran and HCV prevalence among high-risk populations was reported at 32.1% (17). Morbidity and mortality associated with HCV put a burden on health care systems around the world (18).

In Iran, HCV is considered a public health problem, with various programs being implemented by the Ministry of Health to fight the disease (19).

Data on the distribution of HCV prevalence in patients with thalassemia, hemodialysis, and hemophilia can contribute to effective policy and management decisions in public health. It has to be said that although many studies on HCV epidemiology have been published in various Iranian cities (17), There is still a lack of strong data on the epidemiology of HCV disease in three groups.

Objectives

Therefore, this systematic and meta-analysis study with the aim of estimating overall HCV pooled effect prevalence in different provinces in 3 high-risk subpopulations has been done.

3. Evidence Acquisition

3.1. Search Strategy

All studies used ELISA tests for assessing HCV antibodies. The literature on the HCV-Ab prevalence in Iran was acquired through international searching databases including PubMed, Scopus, Elsevier, Google Scholar and Web of Science and Iranian scientific information database (SID), IranDoc, Health.barakatks, MagIran and Civilica. Our last search took place on 20 March 2019. To search and include related studies as many as possible, we used the following terms: "Hepatitis C", "HCV", "Prevalence", "Thalassemic", "Hemodialysis", "Hemophiliac", "Iran" (or the names of its provinces), "Epidemiology", as keywords for titles and/or abstracts in MeSH word search database.

3.2. Selection of Studies and Data Extraction

Published studies were regarded as qualified for the analysis if they met the

following criteria: (1) cross-sectional studies with the full text of the paper available in the Persian or English languages, (2) studies with a sample size of more than 30, and (3) studies reporting the prevalence of HCV antibodies by the ELISA test in Iran provinces.

Conversely, the following studies were excluded: (1) non-English or non-Persian full-text reports, (2) studies not providing enough data to estimate the prevalence rate, (3) studies designed as letters to the editor, expert opinions, editorials, commentaries, case-reports, case-series, and reviews, and (4) Studies reporting overlapping data.

3.3. Data Extraction

All articles categorized as potentially relevant were reviewed separately by both of the authors (Alireza Molaei). They evaluated the relevance of each report and summarized the following data using Excel datasheets: First author's name, year of publication, year of study, number of HCV patients, study sample size, name of the province, and mean age of responders. The analysis was conducted according to the preferred reporting items for systematic reviews and meta-analysis (PRISMA) (20). Publication bias was assessed, graphically and statistically, by funnel plot and Based on visual inspection of the funnel plot and on Egger's test, evidence of publication bias was not found. In this study, "The Newcastle Ottawa Scale (NOS)" was used to assess the quality of the included studies. Extracted data were stratified by study populations' risk of acquiring HCV infection as follows:

- 1- Thalassemic
- 2- Hemodialysis
- 3- Hemophiliac

3.3. Statistical Analysis

The prevalence of HCV among thalassemic, hemodialysis and hemophiliac patients from each province of Iran was computed by `metaprop` command. Statistical tests of heterogeneity among the studies were carried out using the Q test ($P < 0.10$ indicates statistically significant heterogeneity) and I-squared statistics. We also used a funnel plot to investigate publication bias. In this study, the results of the meta-analysis were adjusted with the HCV prevalence rates and the population size of each province of Iran (from the last census in 2016, based on the statistical center of Iran). For this purpose, the population size of each province was considered as a weight case in meta-analysis. we used "metafor" package in R software version 3.6. In each study, if the count of HCV was zero the prevalence estimation and confidence interval calculated using Jeffreys interval (25). In the current study maps indicating the geographical distribution of the prevalence prepared by <https://paintmaps.com/map-charts/105/Iran-map-chart>.

finally, for clustering the Iran provinces the hierarchical cluster analysis was used.

4. Results

4.1. Search Results and Study Selection

The study selection process is depicted in Figure 1. A total of 270 studies were potentially associated with the prevalence of HCV in Iran provinces. After reviewing the abstracts and titles, 72 studies were eliminated based on the stated inclusion and exclusion criteria. Then 25 and 21 articles were excluded from the study due to not having the inclusion criteria and being duplicates respectively. After the full text screening and quality assessment, a total of 151 records were deemed as eligible studies published until 2019.

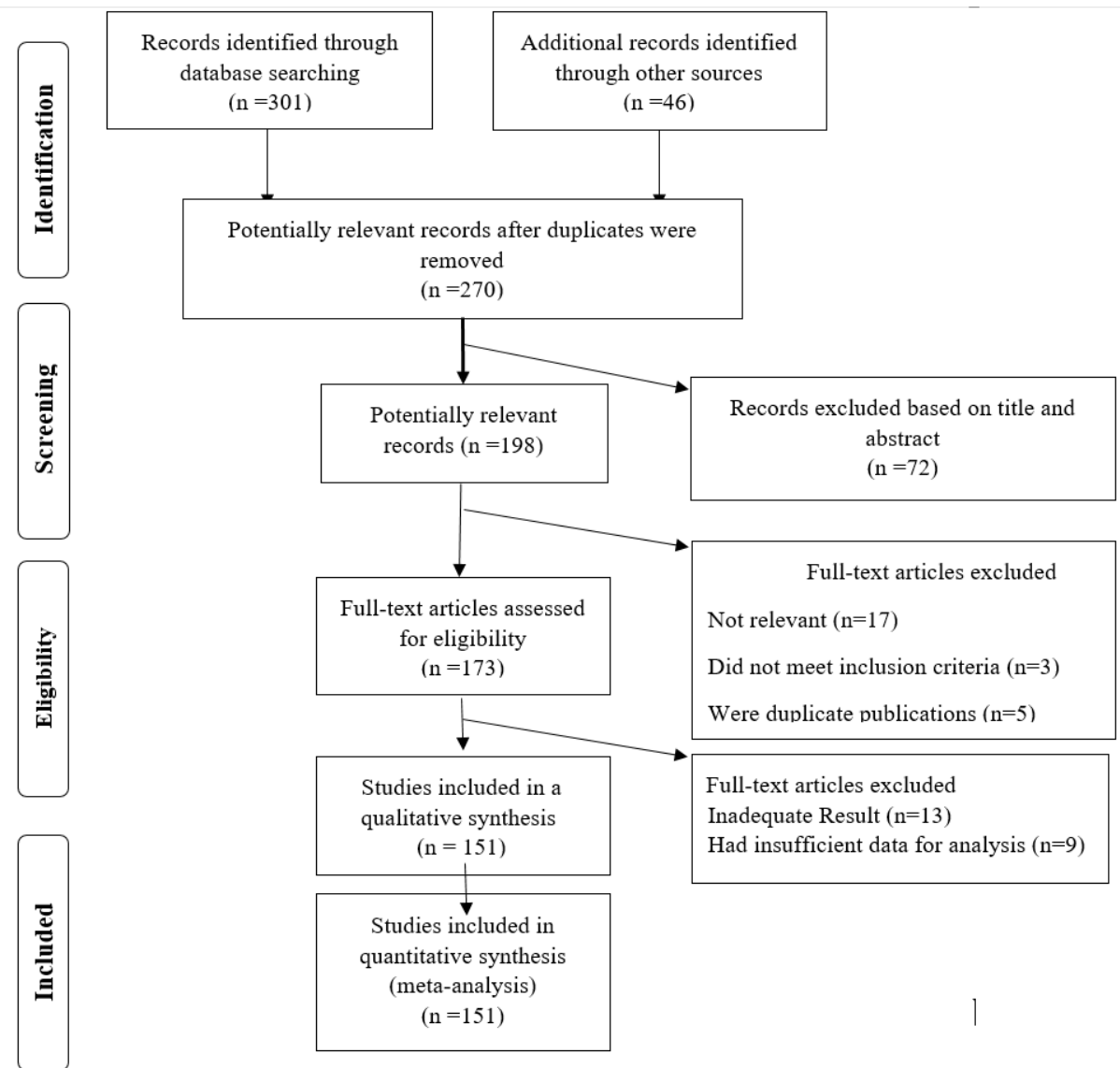


Figure 1. Screening of Articles Based on PRISMA Statement

4.2. Prevalence of hepatitis C in Iran's provinces

Data, including the prevalence of hepatitis C as well as other features like reference, province, first author's name, year of publication, year of study, mean age and male percent, study sample size and prevalence of HCV also 95% confidence interval of each study were presented in Table 1 to Table 3 for Thalassemic, Hemodialysis, and Hemophiliac. Also, the pooled prevalence of hepatitis C according to the 31 provinces of Iran were presented

in Table 4 (Figs 2 and 3). As it can be seen, the average prevalence of HCV also 95% Confidence Interval (CI) in Thalassemic were 18.27% (95% CI: 15.99%-20.55%). The highest pooled prevalence for Thalassemic were in province Kerman(35%) , Gilan(35%) and Hamedan(28%) and the lowest were in Azerbaijan, West (3.745%), Khorasan, South (3.98%) and Lorestan (4.195%). The prevalence of HCV also 95% Confidence Interval (CI) in Hemodialysis was 18.27% (95% CI: 15.99%-20.55%). The highest pooled prevalence for Hemodialysis were in province Golestan

(27.96%) , Kermanshah (27.145%) and Kerman (23.67%) and the lowest were Zanjan (1.32%), Hormozgan (3.35%) and Isfahan (3.46%) .

The prevalence of HCV also 95% Confidence Interval (CI) in Hemophiliac was 45.16%(95% CI: 36.72%-53.60%).

The highest pooled prevalence for Hemophiliac were in province Gilan (71.28%) , Tehran (61.89%) and Isfahan (59.90%) and the lowest were Azerbaijan,

West (11.76%), Fars (15.39%) and Khorasan, South (22.62%) .

The Egger's Test for Hemodialysis (Z=-0.027 , P-Value=0.748), Hemophiliac (Z=-1.48, P-Value=0.139) and Thalassemic (Z=-1.92, P-Value=0.054) in addition Begg's test for Hemodialysis (Z=-1.58 , P-Value=0.139), Hemophiliac (Z=1.21, P-Value=0.235) and Thalassemic (Z=1.66, P-Value=0.102) showed any publication Bias.

Table 1. Characteristics of the included published HCV articles in the field of Thalassemic in Iran

Province	First Author	Ref.	Year of Publish	Year of study	Mean Age	Male Percent	Number of HCV Cases (Study Sample Size)
Alborz	Kashanchi	[37]	2011	2009	19.64	43.7	31(206)
Ardabil	Manochehr barak	[38]	2003	2000	15	62	2(45)
Azerbaijan, East	Mashayekhi	[39]	2011	2008	.	.	3(100)
	Torabi	[40]	2005	2003	21	59.5	6(84)
Azerbaijan, West	Valizadeh	[41]	2015	2014	11.41	56.25	0(32)
Chahar Mahaal and Bakhtiari	Reisi	[42]	2011	2004	13.2	45	21(103)
	Basirat nia	[43]	2002	1998	10	57.6	26(113)
Fars	Karimi	[44]	2001	1999	12.3	53	73(755)
	Hedayat	[45]	2009	2003	.	.	4(30)
	Ansari	[46]	2007	2005	15.3	50.4	116(806)
	Karimi	[47]	2001	1999	11.7	52.1	73(466)
	Kashef	[48]	2008	2006	16	51	24(131)
	Yaghobi	[49]	2012	2009	36	47.7	18(86)
	Akbari	[50]	2011	2003	15.2	50	50(200)
Gilan	Jafroodi	[51]	2015	2007	23.33	48.1	116(1113)
	Ansar	[52]	2002	1997	14	52	46(105)
	Mansour-Ghanaei	[53]	2009	.	.	.	186(370)
Hamedan	Oshvandi	[54]	2009	2009	13	50	11(50)
	Eghbalian	[55]	2002	.	.	.	18(53)
Hormozgan	Aminianfar	[56]	2017	2014	31	47.7	60(587)
Isfahan	Ataei	[57]	2012	2003	17.46	58.3	37(466)
	Kalantari	[58]	2011	2008	27.1	83	50(545)
	Kassaian	[59]	2011	2010	18	6.9	60(570)
	Hariri	[60]	2006	2004	15.5	56	67(616)
	Naghavi	[61]	2007	2005	20.6	60	31(53)
Kerman	Zahedi	[62]	2003	2002	11.5	45	14(100)
	Mirmomen	[9]	2006	2002	17.9	56	19(100)
	Vahidi	[63]	2000	1996	9.2	54.9	24(107)
	KHoshnodmansorkhani	[62]	2003	2002	11.5	45	31(100)
	Hassanshahi	[64]	2011	2007	51	61.2	81(181)
	Arababadi	[65]	2008	2006	12.1	.	27(60)
	Vahidi	[66]	2011	2008	14.72	51.76	228(340)
Kermanshah	Sayad	[67]	2017	2015	22.62	52	14(232)
Khorasan, South	Azarkar	[68]	2009	2007	.	54.1	0(30)
Khuzestan	Kooti	[69]	2017	2004	32.2	54.7	20(179)
	Company	[70]	2007	2005	14.9	50	40(195)
	Kompani	[71]	2008	.	.	.	46(219)
	Ghafourian	[72]	2006	2002	.	59.8	32(122)
	Ghafourian	[73]	2009	2006	16.4	47.1	58(206)
Kohgiluyeh and Boyer-Ahmad	Sarkari	[74]	2012	2009	25.5	66.4	3(49)
Kurdistan	Mohammadi	[75]	2017	2015	18	50.9	6(106)
Lorestan	Vasmehjani	[76]	2018	2015	25.5	74.1	6(143)
Markazi	Samimirad	[77]	2007	2004	13.1	51	5(98)
	Mahdavian	[78]	2008	2004	13.1	51.5	7(97)
Mazandaran	Karami	[79]	2010	2008	23	53	73(1010)
	Tamaddoni	[80]	2007	2005	21.66	43.36	12(113)
	Ghane	[81]	2012	2010	18.38	51	36(245)

Epidemiology of Hepatitis C Virus in Iranian Thalassaemic, Hemodialysis and Hemophiliac Patients

	Ameli	[82]	2008	2006	19.51	.	11(65)
	Najafi	[83]	2001	1998	13.6	49	18(100)
	Rafiei	[84]	2011	2010	35.13	68.9	34(132)
Qazvin	Mirmomen	[9]	2006	2002	17.9	56	18(95)
	Alavian	[85]	2003	2001	11.5	59.5	23(96)
	Bozorgi	[86]	2008	2005	14.29	48.3	50(207)
Qom	Samak	[87]	2012	2007	14.3	53.5	19(142)
Semnan	Mirmomen	[9]	2006	2002	17.9	56	15(81)
Sistan and Baluchestan	Khosravi	[88]	2018	2016	12.7	53.2	140(2387)
	Yousefi	[89]	2017	2015	20.1	69.2	13(152)
	Bazi	[90]	2016	2014	14.8	51	9(90)
	Sanei	[91]	2004	2002	9.7	56.6	49(364)
Tehran	Alavi	[92]	2011	2011	14.6	51.4	4(107)
	Shamsian	[93]	2008	2006	19.6	45.5	11(121)
	Alavi	[94]	2005	2002	.	.	13(110)
	Alavi	[95]	2012	2011	14.1	51	15(90)
	Mirmomen	[9]	2006	2002	17.9	56	77(410)
	Amini	[96]	2005	2004	20.8	.	6(31)
	Nakhaie	[97]	2003	1999	.	.	122(507)
	Azar	[98]	2011	2008	26.26	51.5	170(695)
	Mousavi	[99]	2002	.	.	.	22(81)
	Azarkeivan	[100]	2012	1996	27.5	58	109(395)
	Bastani	[101]	2016	2015	31.4	43.5	41(147)
	Azarkeivan	[102]	2008	2007	22.6	53	117(412)
Keshvari	[103]	2014	2009	29	46	103(257)	
Yazd	Shahshahani	[104]	2006	.	12.6	48.2	8(85)
Zanjan	Mirmomen	[9]	2006	2002	17.9	56	8(46)

Table 2. Characteristics of the included published HCV articles in the field of Hemodialysis in Iran

Province	First Author	Ref.	Year of Publish	Year of study	Mean Age	Male Percent	Number of HCV Cases (Study Sample Size)
Alborz	Tajbakhsh	[105]	2015	2010	54.89	56.2	11(185)
Ardabil	Mamluki	[106]	2011	2011	.	58.8	6(119)
Azerbaijan, East	Somi	[107]	2008	2006	52.1	54.3	55(753)
	Somi	[108]	2014	2012	55.98	60.4	37(455)
	Kheradpezhouh	[109]	2007	2005	50.5	58	66(324)
	Somi	[110]	2007	2006	52.7	55	133(462)
Azerbaijan, West	Khadem-Ansari	[111]	2006	2005	.	.	11(50)
	Valizadeh	[112]	2013	2010	10.3	86	4(34)
Fars	Rais-jalali	[113]	2019	2012	37	100	9(182)
	Jahromi	[114]	2007	2006	51.5	58.8	2(34)
	Moini	[115]	2013	2009	52.7	65.2	13(181)
	Mohsenzadeh	[116]	2012	2011	51.46	67.7	12(62)
	Joukar	[117]	2011	2009	54.8	55.64	61(514)
	Dadgaran	[118]	2005	2004	53.57	58.5	70(393)
	Amiri	[119]	2005	2001	52.2	52.3	73(298)
	Mansour-Ghanaei	[120]	2009	2007	45.5	66	47(163)
Golestan	Jabbari	[121]	2008	2005	47.37	54.8	26(93)
Hamedan	Mohammad alizadeh	[122]	2002	.	.	.	11(96)
Hormozgan	Kheirabad	[123]	2016	2015	56.23	61.7	5(149)
Isfahan	Kassaian	[59]	2011	2010	54	6.9	17(800)
	Seyrafian	[124]	2006	2005	.	.	16(556)
	Kalantari	[125]	2014	2010	52.3	60.7	26(499)
	Salehi	[126]	2014	2008	49	47	4(40)
Kerman	Zahedi	[127]	2012	2010	51	59.6	16(228)
	Hassanshahi	[64]	2011	2007	51	61.2	64(203)
	Arababadi	[128]	2009	2009	60	42.2	30(90)
Kermanshah	Sabour	[129]	2003	2000	45	68.6	38(140)
Khorasan, South	Azarkar	[68]	2009	2007	.	60.4	0(38)
	Ziaee	[130]	2013	2010	54.93	68.3	1(41)
Khuzestan	Beladi Mousavi	[131]	2012	2010	25	65	1(38)
	Mousavi	[132]	2014	2012	55.27	57.4	2(47)
	Samarbaf-Zadeh	[133]	2015	2014	23.68	55.23	39(430)
	Assarehzadegan	[134]	2009	2005	37.3	63.1	34(214)
Kurdistan	Mak	[135]	2001	.	.	.	27(86)
	Sohrabi	[136]	2018	2017	26.15	85	22(121)

Epidemiology of Hepatitis C Virus in Iranian Thalassaemic, Hemodialysis and Hemophiliac Patients

Markazi	Samimi-Rad	[137]	2008	2005	53.7	50.5	10(204)
Mazandaran	Roushan	[138]	2015	2013	54.96	52.5	3(482)
	Darrudi	[139]	2018	.	40.1	50.9	15(216)
	Makhiough	[140]	2008	2006	58.86	65	21(186)
	Taziki	[141]	2008	2006	47.3	52.3	61(497)
	Taziki	[141]	2008	2001	47.3	52.3	64(348)
	Zamani	[142]	2010	2002	50.9	49	67(334)
	Rafiei	[84]	2011	2010	35.13	68.9	31(132)
Qazvin	Hamissi	[143]	2011	2009	63.85	61.5	13(195)
	Haghazali	[144]	2011	2007	54.4	57	6(76)
	Bozorgi	[145]	2006	2004	50.97	50.6	9(89)
	Shad Afzar	[146]	2007	2003	52.6	.	38(141)
	Alavian	[147]	2001	2000	20.65	86.4	16(68)
Qom	Azadegan-Ghomi	[148]	2007	2006	.	.	30(236)
	Ghadir	[149]	2009	2008	.	.	19(90)
Semnan	Babaei	[150]	2004	2004	.	.	5(80)
Tehran	Dadmanesh	[151]	2015	2012	62.16	58	0(138)
	Ramezani	[152]	2014	2013	54.4	53.6	0(30)
	Ataiee	[153]	2018	1991	8.8	51	2(149)
	Ramezani	[154]	2009	2008	55	60	9(289)
	Nemati	[155]	2009	1998	55	54	6(112)
	Eslamifar	[156]	2007	2006	52.1	69	5(77)
	Toosi	[157]	2007	2007	52.9	60	11(130)
	Alavian	[158]	2003	2002	50.41	56.3	111(838)
	Broumand	[159]	2002	2002	45.4	58	107(548)
	Toosi	[157]	2007	2007	52.90	60.00	11(130)
Yazd	Samimirad	[160]	2012	2006	47.6	65	7(160)
Zanjan	Mobaiein	[161]	2013	2011	57	52.7	0(93)

Table 3. Characteristics of the included published HCV articles in the field of Hemophiliac in Iran

Province	First Author	Ref.	Year of Publish	Year of study	Mean Age	Male Percent	Number of HCV Cases (Study Sample Size)
Azerbaijan, East	Torabi	[162]	2006	2004	18.5	89	63(162)
Azerbaijan, West	Valizadeh	[112]	2013	2010	10.3	86	4(34)
Bushehr	Khamisipour	[163]	2000	1999	16	.	13(31)
Fars	Karimi	[164]	2002	2002	17	90	47(310)
	Karimi	[165]	2001	2001	.	.	44(281)
Gilan	MansourGhanaei	[166]	2002	1999	19.7	99	72(101)
Hamedan	Esfahani	[167]	2014	2012	.	88.8	44(89)
	Mohammad Alizadeh	[168]	2006	2004	24.6	83.3	39(66)
Isfahan	Mojtabavi-Naini	[169]	2007	2000	23.4	84	125(553)
	Naghavi	[61]	2007	2005	24.6	94	30(50)
	Hariri	[60]	2006	2004	22	96	77(120)
	Yazdani	[170]	2012	1998	.	97	231(350)
	Kassaian	[59]	2011	2010	24	6.9	232(350)
	Kalantari	[58]	2011	2008	27.1	83	495(615)
Kerman	Zahedi	[171]	2004	2001	21.8	87	43(97)
Khorasan, Razavi	Ziaee	[172]	2005	2004	20.1	97.7	44(80)
Khorasan, South	Ziaee	[173]	2015	2011	27.7	93.5	22(108)
	Ziaee	[174]	2007	2007	21.3	96.3	21(80)
Khuzestan	Ghafourian	[175]	2013	2009	29	57.1	12(56)
	Assarehzadegan	[176]	2012	2008	21.83	87.4	47(87)
Markazi	Samimirad	[77]	2007	2006	86	20	31(74)
	Samimirad	[177]	2007	2004	20.1	87	33(76)
	Mahdavian	[178]	2008	2004	20.3	85	73(165)
Mazandaran	Rafiei	[84]	2011	2010	35.13	68.9	30(132)
Sistan and Baluchestan	Sharifi-Mood	[179]	2006	2005	13	84	23(74)
	Sharifi-Mood	[180]	2007	2004	.	.	24(81)
Tehran	Lak	[181]	2000	1999	37	52	212(385)
	Alavian	[182]	2001	2001	20.65	86	102(176)
	Toosi	[183]	2008	2003	26.6	72.5	145(236)
	Mousavian	[184]	2011	2004	27.5	98.3	792(1095)
Yazd	Javadzadeh	[185]	2006	2003	22.5	93	35(74)
	Shahshahani	[104]	2005	2003	12.6	48.2	36(74)

	Mobini	[186]	2009	2006	21.9	95	38(77)
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Table 4. Pooled prevalence of HCV according to the provinces of Iran and different subgroups

Province	Thalassaemic	Hemodialysis	Hemophiliac	Population Base 2016 survey	Weight in Meta Analysis	Cluster Analysis
Alborz	% 15.05 (% 10.268-% 19.832)	% 5.945 (% 2.608-% 9.282)		2,712,400	3.39%	1
Ardabil	% 7.215 (% 1.056-% 13.374)	% 5.04 (% 1.189-% 8.891)		1,270,420	1.59%	1
Azerbaijan, East	% 5.118 (% 2.244-% 7.992)	% 15.982 (% 7.156-% 24.808)	% 38.89 (% 31.53-% 46.25)	3,909,652	4.89%	2
Azerbaijan, West	% 3.745 (% 0.075-% 7.415)	% 16.703 (% 6.674-% 26.732)	% 11.76 (% 1.147-% 22.373)	3,265,219	4.09%	2
Bushehr			% 41.935 (% 24.908-% 58.962)	1,163,400	1.46%	2
Chahar Mahaal and Bakhtiari	% 21.703 (% 16.319-% 27.088)			947,763	1.19%	3
Fars	% 16.274 (% 12.462-% 20.086)	% 15.178 (% 9.71-% 20.646)	% 15.394 (% 12.544-% 18.245)	4,851,274	6.07%	2
Gilan	% 34.705 (% 4.223-% 65.187)		% 71.285 (% 62.637-% 79.933)	2,530,696	3.17%	3
Golestan		% 27.96 (% 19.023-% 36.897)		1,868,819	2.34%	2
Hamedan	% 27.658 (% 15.955-% 39.362)	% 11.46 (% 5.218-% 17.702)	% 53.841 (% 44.421-% 63.262)	1,738,234	2.17%	3
Hormozgan	% 10.22 (% 7.819-% 12.621)	% 3.355 (% 0.518-% 6.192)		1,776,415	2.22%	1
Isfahan	% 14.055 (% 9.098-% 19.012)	% 3.46 (% 1.78-% 5.14)	% 59.904 (% 37.77-% 82.038)	5,120,850	6.41%	1
Kerman	% 34.753 (% 17.571-% 51.935)	% 23.67 (% 4.279-% 43.062)	% 44.33 (% 34.638-% 54.022)	3,164,718	3.96%	3
Kermanshah	% 6.035 (% 3.031-% 9.039)	% 27.145 (% 19.927-% 34.363)		1,952,434	2.44%	2
Khorasan, Razavi			% 55 (% 44.318-% 65.682)	6,434,501	8.05%	3
Khorasan, South	% 3.98 (% 0.08-% 7.88)	% 4.72 (% 1.262-% 8.178)	% 22.624 (% 16.775-% 28.473)	768,898	0.96%	1
Khuzestan	% 21.135 (% 14.885-% 27.385)	% 12.901 (% 7.275-% 18.526)	% 37.75 (% 5.807-% 69.692)	4,710,509	5.89%	3
Kohgiluyeh and Boyer-Ahmad	% 8.595 (% 1.887-% 15.303)			713,052	0.89%	2
Kurdistan	% 5.66 (% 1.348-% 9.972)	% 18.18 (% 11.448-% 24.912)		1,603,011	2.01%	2
Lorestan	% 4.195 (% 0.976-% 7.414)			1,760,649	2.20%	1
Markazi	% 5.987 (% 2.728-% 9.246)	% 4.9 (% 1.999-% 7.801)	% 43.485 (% 38.121-% 48.849)	1,429,475	1.79%	1
Mazandaran	% 14.986 (% 9.319-% 20.652)	% 13.103 (% 6.074-% 20.132)	% 22.73 (% 15.723-% 29.737)	3,283,582	4.11%	2
Qazvin	% 22.694 (% 18.665-% 26.722)	% 14.433 (% 6.809-% 22.057)		1,273,761	1.59%	3
Qom	% 13.38 (% 7.892-% 18.868)	% 16.121 (% 8.036-% 24.207)		1,292,283	1.62%	2
Semnan	% 18.52 (% 10.229-% 26.811)	% 6.25 (% 1.056-% 11.444)		702,360	0.88%	3
Sistan and Baluchestan	% 9.274 (% 5.077-% 13.472)		% 30.315 (% 23.226-% 37.403)	2,775,014	3.47%	2
Tehran	% 21.414 (% 15.904-% 26.923)	% 7.118 (% 3.36-% 10.876)	% 61.895 (% 52.223-% 71.567)	13,267,637	16.60%	3
Yazd	% 9.41 (% 3.324-% 15.496)	% 4.375 (% 1.273-% 7.477)	% 48.443 (% 42.043-% 54.842)	1,138,533	1.42%	1
Zanjan	% 17.39 (% 6.659-% 28.121)	% 1.325 (% 0.027-% 2.623)		1,057,461	1.32%	1
Overall	% 18.269 (% 15.989-% 20.55)	% 11.601 (% 9.983-% 13.219)	% 45.158 (% 36.716-% 53.6)	79,926,270	100%	

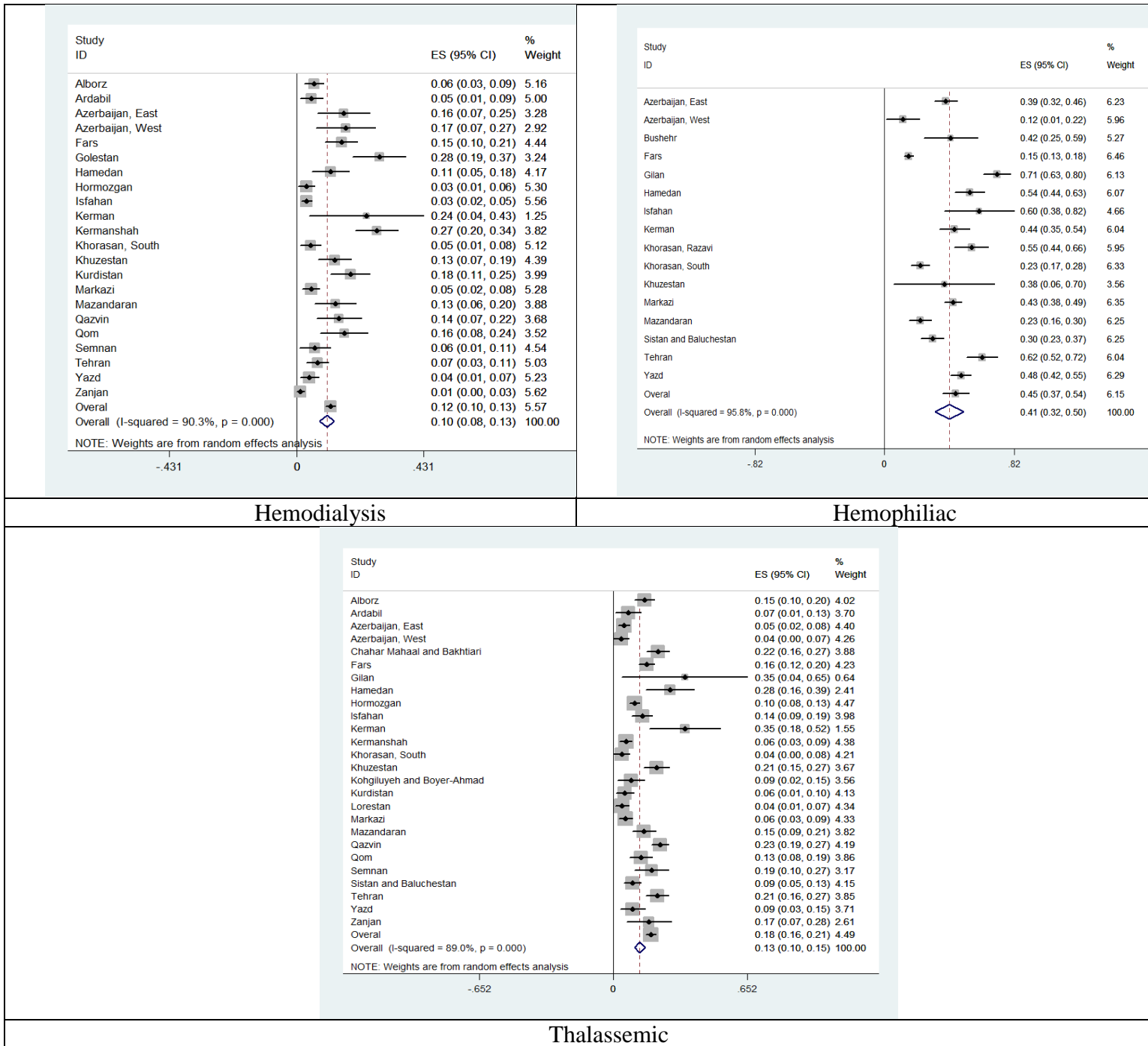


Figure 2: The Forest plot of prevalence of hepatitis C among Thalassemic, Hemodialysis and Hemophiliac patients

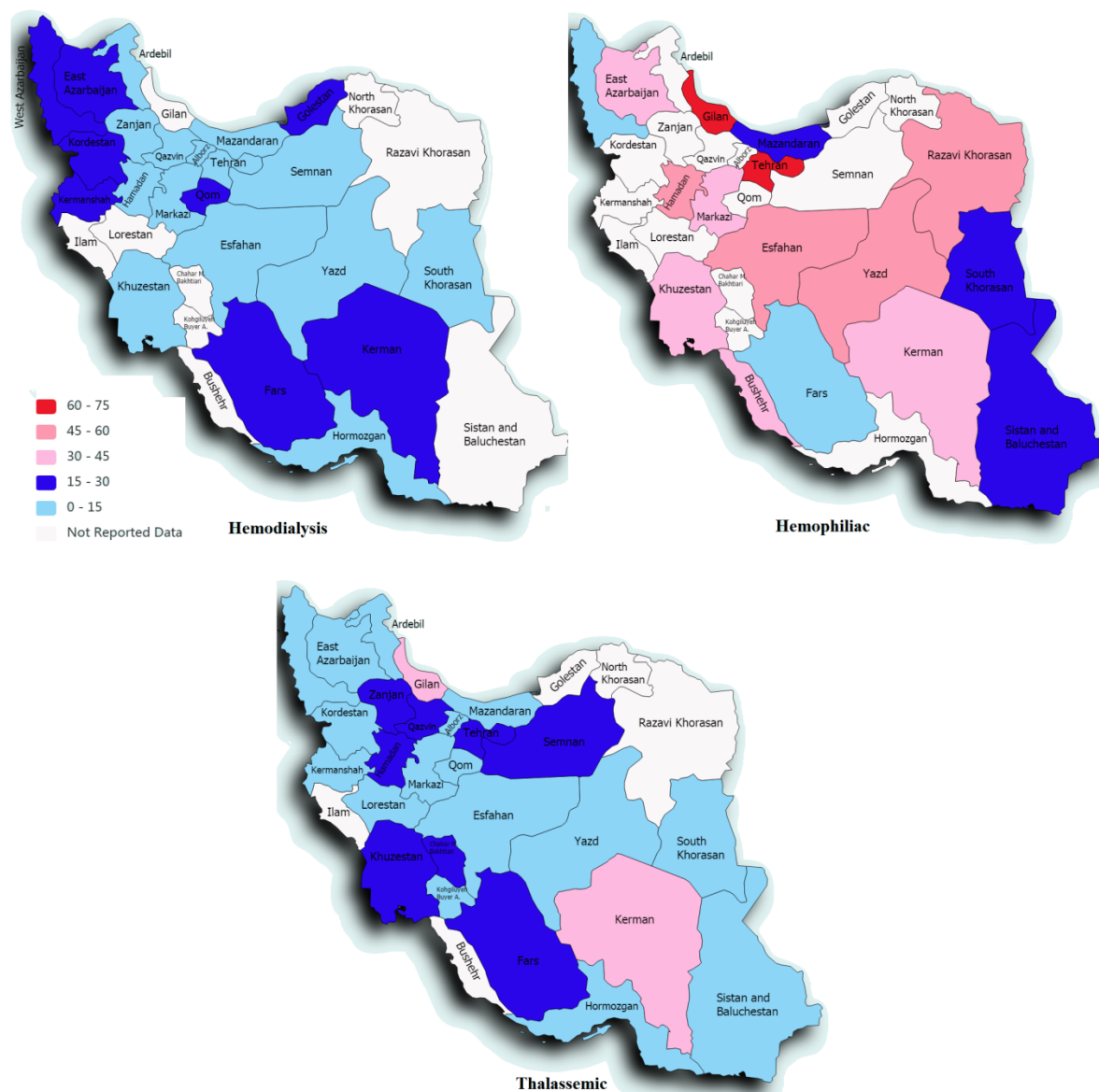


Figure 3: The GIS mapping of prevalence of hepatitis C among Thalassemic, Hemodialysis and Hemophiliac patients

Discussion

The result of this systematic review and meta-analysis study in three Thalassemic, Hemodialysis and Hemophiliac showed that the highest and the lowest HCV prevalence among these three subgroups were for Hemophiliac(45.16%)and Hemodialysis(11.60%) respectively. A previously published meta-analysis study reported HCV prevalence in the various subgroups of the Iranian population.

Alavian et al(26), Mirminachi et al (27)and Mahmud et al (17) reported 0.16%, 0.6% and 0.3% HCV prevalence for general population respectively. Shamshirian et al (28) and Behzadifar et al (29) reported 17% and 19% HCV prevalence for thalassemia patients respectively. Such prevalence for hemodialysis patients was reported 12% (30) ,7.61% (31) and 11% (32). For the Hemophiliac, Iran Hemophilia Center 77.5% (33), 76-82% (34, 35)were reported.

The result of this study also showed that 3 clusters (Low, Moderate and high) according to the HCV prevalence in 3 population sub sample (Thalassemic, Hemodialysis, Hemophiliac) according to the cluster analysis. There are several limitations to be noted in the present study. Firstly, The sample size in some provinces in Iran was insufficient and the amount of data varied between provinces. Secondly, different sample locations (public or private hospitals) were utilized in the sampling method, which may affect the obtained results of the current systematic review. Furthermore, nonexistent data and studies from certain provinces have not allowed us to include them in the final analysis. Also, there are some positive points in this analysis that should be considered. Use of Jeffreys interval and cluster analysis and reporting HCV prevalence in Thalassemic, Hemodialysis and Hemophiliac according to each province is another strong point of this study.

Conclusion

The result showed a high prevalence of HCV in Hemophiliac (45.16%). Therefore, ongoing preventive actions are highly recommended. Because there were not any published studies available for some provinces there are still gaps in our understanding of HCV epidemiology in Iran.

Ethical Approval:

Studies have been performed according to the Declaration of Helsinki and This article is based on the management plans approved by the educational meeting of Tarbiat Modares University with a code of ethics IR.MODARES.REC.1399.016 dated 2020 May 16.

Conflict of interest

The authors say they don't have any conflict of interest.

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