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Short Communication

Incidence of viral hepatitis in Brazil from 2009 to 2018: an epidemiological study of confirmed cases of viral hepatitis

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Abstract

Introduction: Viral hepatitis is a major public health problem. It is necessary to understand the epidemic, verifying the combination of biological and demographic characteristics. **Methods:** This is an analytical ecological and epidemiological study. Confirmed case data from the Notification Disease Information System (SINAN) were used. **Results:** From 2009–2018, SINAN confirmed 404,003 viral hepatitis cases in Brazil, with 12.49%, 37.06%, and 48.28% cases of hepatitis A, B, and C, respectively. **Conclusions:** In Brazil, 4,296 deaths were associated with viral hepatitis, of which 36.66% were associated with acute hepatitis B. The proportional distribution of cases varied among the five Brazilian regions.

Keywords: Human Viral Hepatitis. Epidemiology. Public health. Hepatitis A. Hepatitis B. Hepatitis C.

Viral hepatitis is an inflammation of the liver caused by a virus. According to the World Health Organization (WHO), human viral hepatitis is classified based on the following etiological agents: *Hepatovirus A* (HAV), *Hepatitis B virus* (HBV), *Hepacivirus C* (HCV), *Hepatitis delta virus*, and *Orthohepevirus A*[1-3].

Viral hepatitis is a major public health concern. At least 400 million people are chronically infected with HBV and HCV worldwide, and 1.4 million people are infected annually with HAV[4]. Chronic viral hepatitis, initially silent, takes several years to develop complications. It is believed that 57% of cases of liver cirrhosis and 78% of cases of liver cancer are directly related to HBV and HCV infections[5]. In highly endemic regions, over 90% of children are infected with HAV at 10 years of age, although few develop complications[6]. Finally, it is estimated that 1.5 million deaths are related to viral hepatitis.

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Therefore, it is necessary to understand viral hepatitis epidemics and their particularities by verifying the association between biological and socioeconomic risk factors and epidemiological characteristics. For investigating the incidence of confirmed cases of viral hepatitis in the five Brazilian regions that use the public health system, we used the data generated by the Disease and Notification Information System (SINAN).

This is an analytical ecological and epidemiological study, the objective of which was to assess socio-demographic variables such as education, race, gender, age group, and the source of infection. For the present study, we used the data of confirmed cases available from the Department of Informatics of the Unified Health System, based on notified regions from SINAN, obtained via a generic public domain tabulator called TABNET v. 4.14., during 2009 to 2018. The tool used to generate graphics was RStudio Version 1.2.5019[7].

In Brazil, from 2009 to 2018, out of 409,003 confirmed cases of hepatitis, 12.49% of cases were infections of HAV (**Figure 1A**). The main routes of infection with HAV are the fecal-oral route, inter-human contact, and transmission through contaminated food and water. The environmental stability of HAV and the high amount of virus present in the feces of infected individuals also influence

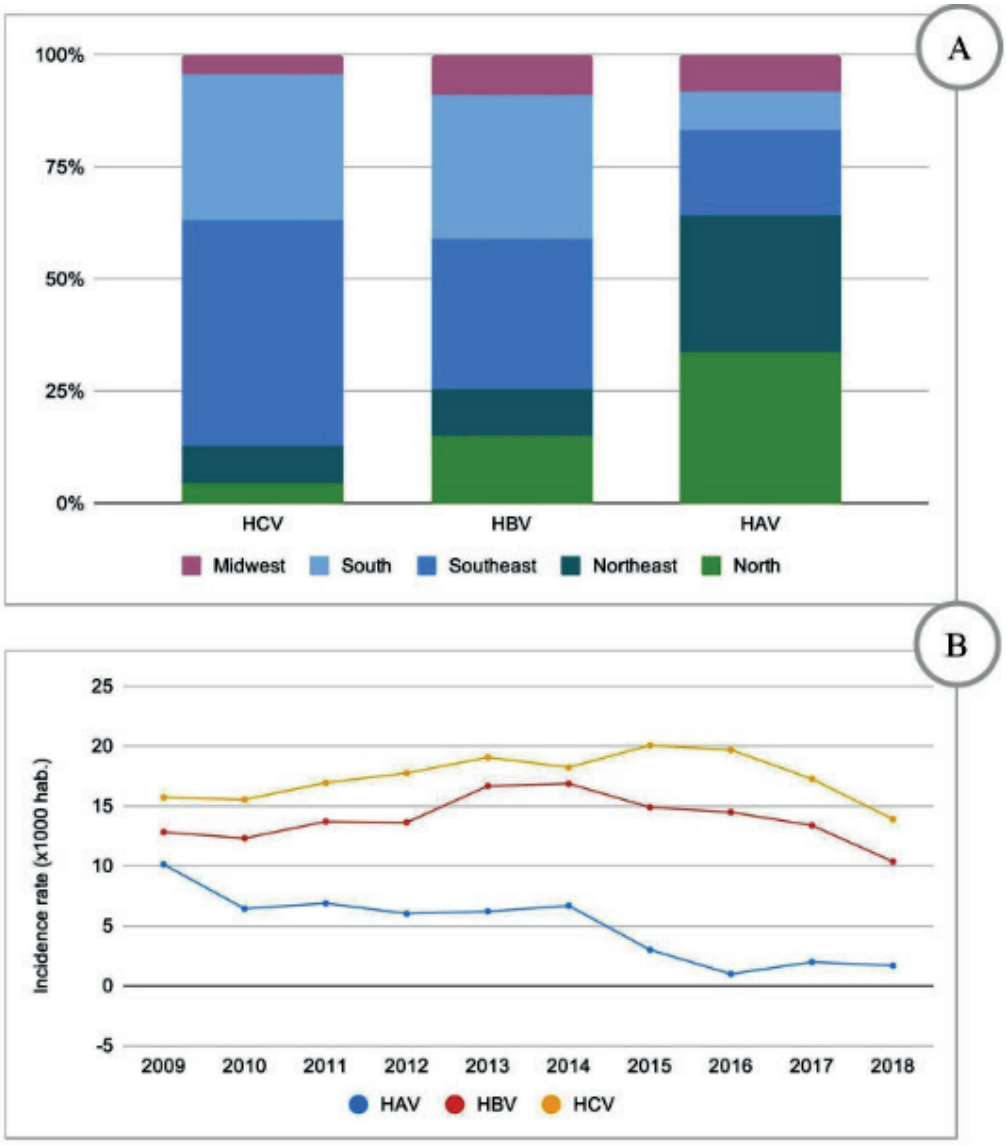

FIGURE 1: Cases of viral hepatitis. **A:** proportional distribution of cases varies among the five Brazilian regions; **B:** viral hepatitis incidence rates.

dissemination viral. Parenteral transmission is uncommon but may occur if the donor is in the viremia phase of the incubation period. Dissemination is related to the reduction of basic sanitation infrastructure and hygiene conditions[8].

Until 2018, the incidence of hepatitis A remained higher in children under 10 years of age compared to other age groups, regardless of gender. Regarding the cumulative cases of hepatitis A in the country, those that occurred in this age group accounted for 30.6% (2009 to 2018, view **Supplementary data in Webappendix Table 1**). This is in agreement with the Brazilian Ministry of Health, which reported in 2018 that in the regions with more sanitation infrastructure and water treatment problems, people are exposed to HAV at earlier ages and present subclinical or anicteric forms of the disease[8,9]. In many cases, hepatitis A is self-limiting and benign, with severe acute liver failure occurring in less than 1% of cases[9].

In this study, most cases of hepatitis A were concentrated in the north and northeast regions of the country, representing 33.6% and 30.8% of all confirmed cases in the period from 2009-2018, respectively, as shown in **Figure 1B**. These results are in agreement with Brazilian Institute of Geography and Statistics Foundation data related to access to basic sanitation services, which indicate that this is still an issue that poses a challenge in northern and northeastern Brazil, according to data from the National Continuous Household Sample Survey Characteristics of Residents and Households. The two regions remain below the national average for water supply, sewage, and garbage collection[9].

The Epidemiological Bulletin of Viral Hepatitis by the Brazilian Ministry of Health, published in 2018, provided a general overview of confirmed cases of hepatitis B from 1999 to 2017, and the results obtained confirm the findings of the present study. This shows that

most confirmed cases of HBV were in the southeast region, followed by the south, north, northeast, and midwest (**Supplementary data in Webappendix Table 2**)[8].

In addition, on stratification of the data from 2007 to 2017, a higher prevalence of cases was found among males (54.4%) and those aged between 25 and 39 years (36.8%). In 2017, there was a higher prevalence of confirmed cases in self-identifying white people (46.5%), followed by brown, black, yellow, and indigenous, at 41.2%, 10.1%, 1.5%, and 0.7%, respectively[8]. These data, once again, corroborate the findings of this study, in which the majority of infected individuals are men, aged between 20 and 39 years, self-identifying as white.

The Pan American Health Organization (PAHO) reported that while the number of hepatitis-related deaths is increasing globally, new HBV infections are declining, and WHO links this reduction in the occurrence to increased vaccination coverage against this virus in children[10]. Additionally, in this study, it is possible to relate the age group with the highest occurrence of hepatitis B cases found in this study (20 to 39 years) with what PAHO understands as pre-vaccine, which covers the period from the 1980s to the beginning of 2000. People born in this period are more likely to be infected with the virus[11].

Bandeira et al. (2018), reported that hepatitis B was the second most reported hepatitis in the state of Minas Gerais from 2010 to 2017, with 39% of the total cases; among these, the main route of transmission was the sexual route, followed by transfusion. The authors noted the importance of hepatitis caused by HBV and HCV based on the large number of infected individuals and the potential chronicity of the pathologies caused by these viruses. The state of Minas Gerais belongs to the southeastern region of Brazil, which, in this study, had the highest percentage of hepatitis B cases, and among the reported cases, the vast majority of patients had chronic hepatitis (81.8%)[12].

PAHO ratifies the importance of prevention, early diagnosis, treatment, and attention to hepatitis as a way of preventing the chronicity of the disease with respect to its evolutions such as cirrhosis and liver cancer, which in 2018, were considered the fourth leading cause of male mortality and the seventh leading cause of female cancer mortality in the Americas, which is a notable public health problem[13].

A study conducted in the city of Minas Gerais showed the main causes of HBV contamination[14]. In this study, the authors noted that among those infected, 19.8% reported having three or more sexual partners, 10.7% reported having sexual contact with HBV carriers, and 5.4% reported having occupational contact with HBV patients. These data demonstrate the relevance of educational campaigns about hepatitis B as well as the awakening from intellectual inertia of the population about the disease.

From 2009 to 2018, 195,039 cases of hepatitis C with one of the anti-HCV or HCV-RNA reactive markers were reported in Brazil. In the analysis of the distribution of cases with anti-HCV and HCV-RNA reagents by region, 50.65%, 32.18%, 8.19%, 4.59%, and 4.39% of these occurred in the southeast, south, northeast, north, and midwest regions, respectively (**Figure 1**). In 2018, the state capitals with the largest confirmed cases of hepatitis C were São Paulo, Rio Grande do Sul, and Rio de Janeiro, with 35%, 20.6%, and 8.8% of cases, respectively. Considering only the confirmed cases of hepatitis C, 57% occurred in males and 43% in females. Throughout the study period, it was observed that most cases of hepatitis C occurred in individuals above 40 years of age, and this trend was observed in both genders (**Supplementary data in Webappendix Table 3**).

In the last decade, hepatitis C has been the leading cause of death in Brazil among the types of viral hepatitis, mainly affecting adults over 40 years. The Epidemiological Bulletin of Viral Hepatitis, published by the Brazilian Ministry of Health in 2012, reported that between 2000 and 2011, 30,931 deaths from hepatitis C, with 16,896 as the underlying cause and 14,035 as an associated cause, were reported in the Mortality Information System, most of them occurring in the southeast (57.5%) and south (25.5%) regions[8].

HCV infection is basically transmitted through blood. Most carriers became infected via transfusions performed before 1992 (when there were no specific tests for virus detection in blood banks) or by sharing needles and syringes, especially among injecting drug users. In the United States, over the past 5 years, 60% of the 25 to 40,000 people who have become infected with HCV have acquired it through injecting drug use[15]. In this study, we observed that 55.7% of the individuals with reported cases were unaware of the origin of the infection (transmission during pregnancy, unprotected sex, or use of contaminated blood in domestic or hospital materials are some possibilities). Because notifications are not complete, it is impossible to detail the main risk factors in our population[16].

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AUTHORS' CONTRIBUTION

APdaS: Conceptualization, formal analysis, investigation, methodology, supervision, validation, visualization, writing-original draft. APS: Conceptualization, methodology, writing-original draft. LMLS: Conceptualization, writing-original draft. ECG: formal analysis, funding acquisition, project administration, resources, supervision, visualization, writing-original draft, writing-review and editing. JLSGVJ: formal analysis, funding acquisition, project administration, resources, supervision, validation, visualization, writing- review and editing.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Webappendix Table 1. Descriptive profile of the population with HAV.

	2009 n=10118		2010 n=6425		2011 n=6878		2012 n=6011		2013 n=6196		2014 n=6667		2015 n=3001		2016 n=974		2017 n=1972		2018 n=1678	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Region																				
North	2413	23.8	1860	28.9	2632	38.3	2535	42.2	2178	35.2	2966	44.5	1498	49.9	382	39.2	191	9.7	145	8.6
Northeast	3780	37.4	2194	34.1	2111	30.7	1569	26.1	2456	39.6	2123	31.8	632	21.1	218	22.4	159	8.1	115	6.9
Southeast	1419	14.0	895	13.9	1121	16.3	1091	18.2	976	15.8	813	12.2	475	15.8	193	19.8	1379	69.9	1138	67.8
South	1190	11.8	1002	15.6	477	6.9	388	6.5	248	4.0	188	2.8	154	5.1	110	11.3	186	9.4	222	13.2
Midwest	1316	13.0	474	7.4	537	7.8	428	7.1	338	5.5	577	8.7	242	8.1	71	7.3	57	2.9	58	3.5
Sex																				
man	5366	53.0	3454	53.8	3683	53.5	3185	53.0	3316	53.5	3564	53.5	1678	55.9	526	54.0	1464	74.2	1157	69.0
woman	4750	46.9	2970	46.2	3195	46.5	2825	47.0	2879	46.5	3101	46.5	1323	44.1	448	46.0	508	25.8	521	31.0
unknown	2	0.02	1	0.0	0	0	1	0.0	1	0.0	2	0.0	0	0.0	0	0.0	0	0.0	0	0
Age group (years)																				
<10 anos	5488	54.2	3223	50.2	3352	48.7	2929	48.7	2868	46.3	3141	47.1	1163	38.8	247	25.4	115	5.8	99	5.9
10-19 anos	2903	28.7	1886	29.4	2074	30.2	1819	30.3	1864	30.1	2107	31.6	905	30.2	216	22.2	222	11.3	237	14.1
20-39 anos	1269	12.5	930	14.5	1039	15.1	905	15.1	1048	16.9	989	14.8	581	19.4	262	26.9	1183	60.0	949	56.6
40 ou mais	454	4.5	383	6.0	411	6.0	356	5.9	414	6.7	429	6.4	352	11.7	249	25.6	451	22.9	393	23.4
unknown	4	0.04	3	0.0	2	0.0	2	0.0	2	0.0	1	0.0	-	-	-	-	1	0.1	-	-
Race																				
white	2894	28.6	1721	26.8	1597	23.2	1232	20.5	1200	19.4	1135	17.0	594	19.8	229	23.5	860	43.6	713	42.5
black	446	4.4	335	19.5	358	5.2	280	4.7	275	4.4	305	4.6	117	3.9	50	5.1	86	4.4	107	6.4
yellow	83	0.8	49	0.8	40	0.6	45	0.7	41	0.7	55	0.8	24	0.8	8	0.8	17	0.9	14	0.8
mulato	5186	51.3	3429	53.4	4019	58.4	3576	59.5	3547	57.2	4346	65.2	1993	66.4	559	57.4	551	27.9	530	31.6
indigenous	103	1.0	97	1.5	73	1.1	105	1.7	214	3.5	178	2.7	49	1.6	18	1.8	7	0.4	5	0.3
unknown	1406	13.9	794	12.4	791	11.5	773	12.9	919	14.8	648	9.7	224	7.5	110	11.3	451	22.9	309	18.4
Education (years)																				
illiterate	53	0.5	47	0.7	45	0.7	42	0.7	58	0.9	60	-	43	1.4	17	1.7	21	1.1	9	0.5
1 to 4	2375	23.5	1376	21.4	1395	20.3	1130	18.8	1171	18.9	1409	21.1	577	19.2	153	15.7	139	7.0	146	8.7
5 to 8	1437	14.2	913	14.2	953	13.9	904	15.0	793	12.8	993	14.9	503	16.8	165	16.9	182	9.2	175	10.4
9 to 11	661	6.5	491	7.6	571	8.3	504	8.4	487	7.9	641	9.6	350	11.7	170	17.5	332	16.8	297	17.7
≥12	149	1.5	96	1.5	164	2.4	130	2.2	117	1.9	150	2.2	111	3.7	43	4.4	389	19.7	283	16.9
unknown	5443	53.8	3502	54.5	3750	54.5	3301	54.9	3570	57.6	3414	51.2	1417	47.2	426	43.7	909	46.1	768	45.8
Source of infection																				
sexual	71	0.7	34	0.5	50	0.7	54	0.9	50	0.6	49	0.7	48	1.6	24	2.5	181	9.2	98	5.8
transfusion	9	0.1	7	0.1	3	0.0	9	0.1	4	0.1	3	0.0	3	0.1	5	0.5	5	0.3	2	0.1
injection drug use	8	0.1	5	0.1	3	0.0	6	0.1	7	0.1	-	-	2	0.1	-	-	9	0.5	7	0.4
vertical transmission	1	0.0	2	0.0	4	0.1	2	0.0	2	0.0	2	0.0	1	0.0	-	-	-	-	1	0.1
work accident	1	0.0	2	0.0	1	0.0	1	0.0	2	0.0	1	0.0	4	0.1	-	-	-	-	1	0.1
hemodialysis	1	0.0	5	0.1	1	0.0	-	-	1	0.0	-	-	-	-	1	0.1	-	-	-	-
home	740	7.3	381	5.9	418	6.1	241	4.0	229	3.7	266	4.0	78	2.6	50	5.1	46	2.3	28	1.7

surgical treatment	6	0.1	3	0.0	3	0.0	2	0.0	1	0.0	2	0.0	1	0.0	2	0.2	5	0.3	1	0.1
dental treatment	109	1.1	50	0.8	50	0.7	41	0.7	23	0.4	25	0.4	20	0.7	9	0.9	13	0.7	14	0.8
person to person	252	2.5	159	2.5	273	4.0	224	3.7	201	3.2	170	2.5	42	1.4	7	0.7	54	2.7	36	2.1
oral/fecal	5597	55.3	3558	55.4	3895	56.6	3949	65.7	4301	69.4	4683	70.2	2237	74.5	573	58.8	656	33.3	713	42.5
others	240	2.4	149	2.3	177	2.6	58	1.0	38	0.6	31	0.5	24	0.8	28	2.9	32	1.6	25	1.5
unknown	3083	30.5	2070	32.2	2000	29.1	1424	23.7	1337	21.6	1435	21.5	541	18.0	275	28.2	971	49.2	752	44.8
Federative unit																				
Rondônia	84	0.8	77	1.2	105	1.5	21	0.3	57	0.9	127	1.9	63	2.1	20	2.1	5	0.3	25	1.5
Acre	71	0.7	100	1.6	402	5.8	619	10.3	302	4.9	223	3.3	97	3.2	72	7.4	37	1.9	14	0.8
Amazonas	904	8.9	693	10.8	729	10.6	391	6.5	675	10.9	1031	15.5	341	11.4	66	6.8	48	2.4	13	0.8
Roraima	243	2.4	104	1.6	67	1.0	123	2.0	129	2.1	129	1.9	42	1.4	18	1.8	9	0.5	22	1.3
Pará	470	4.6	364	5.7	672	9.8	732	12.2	702	11.3	770	11.5	458	15.3	143	14.7	47	2.4	51	3.0
Amapá	173	1.7	262	4.1	340	4.9	219	3.6	96	1.5	412	6.2	214	7.1	40	4.1	35	1.8	14	0.8
Tocantins	468	4.6	260	4.0	317	4.6	430	7.2	217	3.5	274	4.1	283	9.4	23	2.4	10	0.5	6	0.4
Maranhão	463	4.6	337	5.2	446	6.5	300	5.0	268	4.3	281	4.2	158	5.3	43	4.4	28	1.4	14	0.8
Piuaí	298	2.9	139	2.2	171	2.5	152	2.5	85	1.4	91	1.4	31	1.0	20	2.1	9	0.5	12	0.7
Ceará	407	4.0	243	3.8	134	1.9	196	3.3	224	3.6	117	1.8	48	1.6	15	1.5	18	0.9	19	1.1
Rio Grande do Norte	308	3.0	170	2.6	152	2.2	144	2.4	255	4.1	54	0.8	9	0.3	8	0.8	10	0.5	15	0.9
Paraíba	455	4.5	304	4.7	188	2.7	144	2.4	491	7.9	302	4.5	59	2.0	7	0.7	15	0.8	8	0.5
Pernambuco	682	6.7	328	5.1	342	5.0	268	4.5	520	8.4	570	8.5	74	2.5	37	3.8	17	0.9	14	0.8
Alagoas	277	2.7	231	3.6	319	4.6	145	2.4	229	3.7	157	2.4	115	3.8	37	3.8	18	0.9	4	0.2
Sergipe	112	1.1	61	0.9	89	1.3	56	0.9	42	0.7	72	1.1	15	0.5	6	0.6	7	0.4	2	0.1
Bahia	778	7.7	381	5.9	270	3.9	164	2.7	342	5.5	479	7.2	123	4.1	45	4.6	37	1.9	27	1.6

Minas Gerais	755	7.5	299	4.7	432	6.3	278	4.6	153	2.5	133	2.0	131	4.4	78	8.0	109	5.5	104	6.2
Espírito Santo	73	0.7	11	0.2	14	0.2	14	0.2	42	0.7	14	0.2	5	0.2	8	0.8	5	0.3	6	0.4
Rio de Janeiro	419	4.1	477	7.4	541	7.9	680	11.3	643	10.4	420	6.3	170	5.7	22	2.3	205	10.4	433	25.8
São Paulo	172	1.7	108	1.7	134	1.9	119	2.0	138	2.2	246	3.7	169	5.6	85	8.7	1060	53.8	595	35.5
Paraná	510	5.0	123	1.9	86	1.3	87	1.4	88	1.4	39	0.6	84	2.8	42	4.3	76	3.9	41	2.4
Santa Catarina	143	1.4	44	0.7	32	0.5	39	0.6	29	0.5	48	0.7	30	1.0	16	1.6	48	2.4	40	2.4
Rio Grande do Sul	537	5.3	835	13.0	359	5.2	262	4.4	131	2.1	101	1.5	40	1.3	52	5.3	62	3.1	141	8.4
Mato Grosso do Sul	267	2.6	41	0.6	51	0.7	46	0.8	27	0.4	115	1.7	32	1.1	8	0.8	8	0.4	6	0.4
Mato Grosso	309	3.1	129	2.0	220	3.2	86	1.4	142	2.3	327	4.9	149	5.0	37	3.8	16	0.8	33	2.0
Goiás	371	3.7	169	2.6	101	1.5	82	1.4	62	1.0	45	0.7	20	0.7	11	1.1	21	1.1	12	0.7
Distrito Federal	369	3.6	135	2.1	165	2.4	214	3.6	107	1.7	90	1.3	41	1.4	15	1.5	12	0.6	7	0.4

Webappendix Table 2. Descriptive profile of the population with HBV.

	2009 n=12817		2010 n=12303		2011 n=13698		2012 n=13620		2013 n=16666		2014 n=16863		2015 n=14887		2016 n=14475		2017 n=13379		2018 n=10361	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Region																				
North	1762	13.7	1650	13.4	1866	13.6	1794	13.2	3076	18.5	3189	18.9	2141	14.4	2255	1.6	2224	16.6	1774	17.1
Northeast	1232	9.6	1176	9.6	1313	9.6	1370	10.1	1816	10.9	1805	10.7	1574	10.6	1575	10.9	1682	12.6	1391	13.4
Southeast	4632	36.1	4356	35.4	5017	36.6	4911	36.1	5213	31.3	4815	28.6	4791	32.2	4577	31.6	4289	32.1	2930	28.3
South	3789	29.6	3983	32.4	4314	31.5	4392	32.2	5092	30.6	5602	33.2	5102	34.3	4601	31.8	4045	30.2	3518	34.0
Midwest	1402	10.9	1138	9.2	1188	8.7	1153	8.5	1469	8.8	1452	8.6	1279	8.6	1467	10.1	1139	8.5	748	7.2
Sex																				
man	6750	52.7	6481	52.7	7234	52.8	7282	53.5	8981	53.9	9086	53.9	8048	54.1	8144	56.3	7454	55.7	5791	55.9
woman	6065	47.3	5820	47.3	6461	47.2	6334	46.5	7682	46.1	7776	46.1	6838	45.9	6330	43.7	5924	44.3	4566	44.1
unknown	2	0.0	2	0.0	3	0.0	4	0.0	3	0.0	1	0.0	1	0.0	1	0.0	1	0.0	4	0.0
Age group (years)																				
<10 anos	145	1.1	102	0.8	126	0.9	130	1.0	150	0.9	149	0.9	108	0.7	92	0.6	70	0.5	84	0.8
10-19 anos	821	6.4	690	5.6	697	5.1	616	4.5	681	4.1	601	3.6	439	2.9	339	2.3	315	2.4	155	1.5
20-39 anos	6436	50.2	6033	49.0	6377	46.6	6233	45.8	7700	46.2	7419	44.0	6501	43.7	6129	42.3	5589	41.8	4208	40.6
40 ou mais	5409	42.2	5471	44.5	6493	47.4	6639	48.7	8132	48.8	8690	51.5	7839	52.7	7915	54.7	7405	55.3	5914	57.1
unknown	6	0.0	7	0.1	4	0.0	2	0.0	3	0.0	3	0.0	-	-	-	-	-	-	-	-
Race																				
white	6333	49.4	6202	50.4	6668	48.7	6598	48.4	7423	44.5	7609	45.1	6888	46.3	6247	43.2	5534	41.4	4280	41.3
black	896	7.0	897	7.3	905	6.6	967	7.1	1236	7.4	1256	7.4	1275	8.6	1260	8.7	1220	9.1	990	9.6
yellow	303	2.4	180	1.5	153	1.1	217	1.6	230	1.4	230	1.4	229	1.5	174	1.2	188	1.4	126	1.2
mulato	3739	29.2	3667	29.8	4085	29.8	4259	31.3	5859	35.2	6066	36.0	5036	33.8	5189	35.8	5209	38.9	3965	38.3
indigenous	115	0.9	67	0.5	79	0.6	77	0.6	297	1.8	213	1.3	125	0.8	117	0.8	103	0.8	64	0.6
unknown	1431	11.2	1290	10.5	1808	13.2	1502	11.0	1621	9.7	1489	8.8	1334	9.0	1488	10.3	1125	8.4	936	9.0
Education (years)																				
illiterate	221	1.7	202	1.6	224	1.6	205	1.5	324	1.9	352	2.1	254	1.7	242	1.7	304	2.3	195	1.9

1 to 4	1919	15.0	1848	15.0	1919	14.0	2001	14.7	2508	15.0	2577	15.3	2065	13.9	2009	13.9	1799	13.4	1410	13.6
5 to 8	3080	24.0	2798	22.7	2921	21.3	2964	21.8	3546	21.3	3521	20.9	3267	21.9	2992	20.7	2716	20.3	2136	20.6
9 to 11	3044	23.7	3031	24.6	3251	23.7	3370	24.7	3993	24.0	4052	24.0	3856	25.9	3622	25.0	3497	26.1	2669	25.8
≥12	917	7.2	928	7.5	1008	7.4	1103	8.1	1312	7.9	1291	7.7	1276	8.6	1216	8.4	1118	8.4	794	7.7
unknown	3636	28.4	3496	28.4	4375	31.9	3977	29.2	4983	29.9	5070	30.1	4169	28.0	4394	30.4	3945	29.5	3157	30.5
Source of infection																				
sexual	3192	24.9	3035	24.7	3463	25.3	3390	24.9	4403	26.4	4192	24.9	3569	24.0	3471	24.0	3092	23.1	2354	22.7
transfusion	281	2.2	263	2.1	268	2.0	258	1.9	287	1.7	288	1.7	258	1.7	233	1.6	208	1.6	133	1.3
injection drug use	211	1.6	194	1.6	203	1.5	225	1.7	247	1.5	282	1.7	226	1.5	216	1.5	179	1.3	159	1.5
vertical transmission	307	2.4	345	2.8	366	2.7	451	3.3	566	3.4	569	3.4	473	3.2	407	2.8	332	2.5	241	2.3
work accident	46	0.4	37	0.3	46	0.3	45	0.3	47	0.3	57	0.3	49	0.3	33	0.2	50	0.4	26	0.3
hemodialysis	47	0.4	29	0.2	22	0.2	24	0.2	27	0.2	34	0.2	19	0.1	27	0.2	19	0.1	15	0.1
home	586	4.6	467	3.8	548	4.0	520	3.8	601	3.6	572	3.4	503	3.4	453	3.1	442	3.3	340	3.3
surgical treatment	216	1.7	164	1.3	189	1.4	208	1.5	205	1.2	197	1.2	232	1.6	191	1.3	156	1.2	115	1.1
dental treatment	440	3.4	398	3.2	395	2.9	349	2.6	385	2.3	411	2.4	369	2.5	350	2.4	298	2.2	185	1.8
person to person	161	1.3	194	1.6	228	1.7	308	2.3	326	2.0	503	3.0	371	2.5	383	2.6	367	2.7	306	3.0
oral/fecal	33	0.3	28	0.2	24	0.2	30	0.2	46	0.3	45	0.3	27	0.2	20	0.1	24	0.2	27	0.3
others	370	2.9	347	2.8	375	2.7	388	2.8	493	3.0	494	2.9	477	3.2	436	3.0	514	3.8	415	4.0
unknown	6927	54.0	6802	55.3	7571	55.3	7424	54.5	9033	54.2	9219	54.7	8314	55.8	8255	57.0	7698	57.5	6045	58.3
Federative unit																				
Rondônia	411	3.2	423	3.4	475	3.5	500	3.7	759	4.6	699	4.1	663	4.5	621	4.3	549	4.1	407	3.9
Acre	613	4.8	416	3.4	548	4.0	498	3.7	781	4.7	867	5.1	379	2.5	411	2.8	398	3.0	338	3.3
Amazonas	367	2.9	428	3.5	461	3.4	349	2.6	918	5.5	974	5.8	501	3.4	593	4.1	647	4.8	521	5.0
Roraima	96	0.7	83	0.7	97	0.7	98	0.7	77	0.5	113	0.7	92	0.6	129	0.9	87	0.7	112	1.1
Pará	145	1.1	164	1.3	151	1.1	233	1.7	358	2.1	361	2.1	361	2.4	378	2.6	392	2.9	245	2.4
Amapá	17	0.1	27	0.2	17	0.1	22	0.2	20	0.1	28	0.2	33	0.2	54	0.4	49	0.4	38	0.4
Tocantins	113	0.9	109	0.9	117	0.9	94	0.7	163	1.0	147	0.9	112	0.8	69	0.5	102	0.8	113	1.1
Maranhão	207	1.6	200	1.6	245	1.8	186	1.4	201	1.2	208	1.2	197	1.3	195	1.3	176	1.3	184	1.8
Piuaí	21	0.2	25	0.2	24	0.2	51	0.4	72	0.4	72	0.4	43	0.3	47	0.3	60	0.4	44	0.4
Ceará	186	1.5	131	1.1	108	0.8	165	1.2	138	0.8	157	0.9	166	1.1	155	1.1	162	1.2	120	1.2
Rio Grande do Norte	20	0.2	34	0.3	48	0.4	57	0.4	81	0.5	67	0.4	47	0.3	53	0.4	57	0.4	35	0.3
Paraíba	95	0.7	114	0.9	137	1.0	136	1.0	197	1.2	147	0.9	54	0.4	64	0.4	99	0.7	75	0.7
Pernambuco	103	0.8	141	1.1	139	1.0	143	1.0	358	2.1	385	2.3	170	1.1	227	1.6	239	1.8	194	1.9
Alagoas	149	1.2	98	0.8	93	0.7	83	0.6	80	0.5	117	0.7	99	0.7	103	0.7	158	1.2	94	0.9
Sergipe	103	0.8	94	0.8	113	0.8	105	0.8	112	0.7	113	0.7	113	0.8	106	0.7	124	0.9	117	1.1
Bahia	348	2.7	339	2.8	406	3.0	444	3.3	577	3.5	539	3.2	685	4.6	625	4.3	607	4.5	528	5.1
Minas Gerais	750	5.9	695	5.6	733	5.4	611	4.5	754	4.5	936	5.6	926	6.2	824	5.7	772	5.8	615	5.9
Espírito Santo	352	2.7	337	2.7	386	2.8	534	3.9	613	3.7	479	2.8	388	2.6	374	2.6	358	2.7	219	2.1
Rio de Janeiro	688	5.4	633	5.1	886	6.5	717	5.3	736	4.4	586	3.5	597	4.0	598	4.1	526	3.9	271	2.6
São Paulo	2842	22.2	2691	21.9	3012	22.0	3049	22.4	3110	18.7	2814	16.7	2880	19.3	2781	19.2	2633	19.7	1825	17.6

Paraná	1444	11.3	1592	12.9	1755	12.8	1652	12.1	2016	12.1	2039	12.1	1849	12.4	1789	12.4	1670	12.5	1455	14.0
Santa Catarina	1262	9.8	1261	10.2	1415	10.3	1489	10.9	1535	9.2	1728	10.2	1527	10.3	1302	9.0	1051	7.9	882	8.5
Rio Grande do Sul	1083	8.4	1130	9.2	1144	8.4	1251	9.2	1541	9.2	1835	10.9	1726	11.6	1510	10.4	1324	9.9	1181	11.4
Mato Grosso do Sul	275	2.1	186	1.5	165	1.2	143	1.0	195	1.2	162	1.0	123	0.8	111	0.8	133	1.0	108	1.0
Mato Grosso	551	4.3	493	4.0	577	4.2	581	4.3	678	4.1	678	4.0	577	3.9	569	3.9	488	3.6	265	2.6
Goiás	398	3.1	317	2.6	299	2.2	294	2.2	394	2.4	411	2.4	396	2.7	462	3.2	417	3.1	285	2.8
Distrito Federal	178	1.4	142	1.2	147	1.1	135	1.0	202	1.2	201	1.2	183	1.2	325	2.2	101	0.8	90	0.9

Webappendix Table 3. Descriptive profile of the population with HCV.

	2009 n=15712		**2010 n=15535**		**2011 n=16940**		**2012 n=17741**		**2013 n=19063**		**2014 n=18225**		**2015 n=20061**		**2016 n=19684**		**2017 n=17253**		**2018 n=13897**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Region																				
North	651	4.1	623	4.0	674	4.0	642	3.6	1286	6.7	1038	5.7	931	4.6	1013	5.1	1072	6.2	647	4.7
Northeast	1216	7.7	1112	7.2	1318	7.8	1477	8.3	1771	9.3	1560	8.6	1493	7.4	1549	7.9	1434	8.3	1352	9.7
Southeast	8663	55.1	8424	54.2	9169	54.1	9451	53.3	9177	48.1	8383	46.0	9536	47.5	9485	48.2	7873	45.6	5782	41.6
South	4403	28.0	4782	30.8	5038	29.7	5472	30.8	5955	31.2	6429	35.3	7189	35.8	6565	33.4	6060	35.1	5507	39.6
Midwest	779	5.0	594	3.8	741	4.4	699	3.9	874	4.6	815	4.5	912	4.5	1072	5.4	814	4.7	609	4.4
Sex																				
man	9047	57.6	8743	56.3	9376	55.3	9660	54.5	10875	57.0	10422	57.2	11493	57.3	11207	56.9	10046	58.2	7942	57.1
woman	6661	42.4	6786	43.7	7557	44.6	8074	45.5	8165	42.8	7803	42.8	8558	42.7	8473	43.0	7202	41.7	5953	42.8
unknown	4	0.0	6	0.0	7	0.0	7	0.0	23	0.1	-	-	10	0.0	4	0.0	5	0.0	2	0.0
Age group (years)																				
<10 anos	112	0.7	96	0.6	130	0.8	120	0.7	125	0.7	118	0.6	115	0.6	111	0.6	105	0.6	86	0.6
10-19 anos	188	1.2	169	1.1	180	1.1	176	1.0	191	1.0	130	0.7	169	0.8	152	0.8	166	1.0	132	0.9
20-39 anos	3940	25.1	3625	23.3	3848	22.7	3772	21.3	3730	19.6	3549	19.5	3484	17.4	3314	16.8	2992	17.3	2353	16.9
40 ou mais	11459	72.9	11635	74.9	12774	75.4	13671	77.1	15013	78.8	14426	79.2	16292	81.2	16106	81.8	13989	81.1	11325	81.5
unknown	13	0.1	10	0.1	8	0.0	2	0.0	4	0.0	2	0.0	1	0.0	1	0.0	1	0.0	1	0.0
Race																				
white	9051	57.6	8677	55.9	9235	54.5	9751	55.0	10020	52.6	9690	53.2	10715	53.4	10181	51.7	8995	52.1	7171	51.6
black	1098	7.0	1164	7.5	1212	7.2	1277	7.2	1498	7.9	1362	7.5	1653	8.2	1632	8.3	1468	8.5	1233	8.9
yellow	100	0.6	104	0.7	110	0.6	149	0.8	123	0.6	101	0.6	129	0.6	134	0.7	124	0.7	123	0.9
mulato	3413	21.7	3353	21.6	3664	21.6	3873	21.8	5300	27.8	4823	26.5	5080	25.3	5343	27.1	5014	29.1	3609	26.0
indigenous	31	0.2	32	0.2	22	0.1	38	0.2	50	0.3	47	0.3	53	0.3	39	0.2	52	0.3	38	0.3
unknown	2019	12.9	2205	14.2	2697	15.9	2653	15.0	2072	10.9	2202	12.1	2431	12.1	2355	12.0	1600	9.3	1723	12.4
Education (years)																				
illiterate	207	1.3	173	1.1	214	1.3	246	1.4	285	1.5	262	1.4	238	1.2	284	1.4	308	1.8	229	1.6
1 to 4	2241	14.3	2110	13.6	2153	12.7	2257	12.7	2581	13.5	2502	13.7	2673	13.3	2671	13.6	2336	13.5	1706	12.3
5 to 8	4065	25.9	3788	24.4	3885	22.9	4160	23.4	4376	23.0	4166	22.9	4649	23.2	4333	22.0	3902	22.6	2917	21.0
9 to 11	3240	20.6	3107	20.0	3427	20.2	3687	20.8	4222	22.1	3957	21.7	4305	21.5	4195	21.3	3774	21.9	2917	21.0

≥12	1292	8.2	1240	8.0	1315	7.8	1376	7.8	1439	7.5	1272	7.0	1621	8.1	1573	8.0	1377	8.0	1138	8.2
unknown	4667	29.7	5117	32.9	5946	35.1	6015	33.9	6160	32.3	6066	33.3	6575	32.8	6628	33.7	5556	32.2	4990	35.9
Source of infection																				
sexual	1359	8.6	1430	9.2	1457	8.6	1441	8.1	1793	9.4	1699	9.3	1963	9.8	2075	10.5	1867	10.8	1404	10.1
transfusion	1783	11.3	1786	11.5	1859	11.0	1815	10.2	1850	9.7	1606	8.8	1679	8.4	1623	8.2	1363	7.9	974	7.0
injection drug use	2117	13.5	1906	12.3	2013	11.9	2077	11.7	2313	12.1	2219	12.2	2242	11.2	1964	10.0	1656	9.6	1272	9.2
vertical transmission	46	0.3	33	0.2	36	0.2	57	0.3	52	0.3	62	0.3	47	0.2	44	0.2	36	0.2	38	0.3
work accident	94	0.6	81	0.5	73	0.4	85	0.5	73	0.4	71	0.4	65	0.3	65	0.3	66	0.4	46	0.3
hemodialysis	92	0.6	84	0.5	135	0.8	101	0.6	144	0.8	107	0.6	111	0.6	140	0.7	84	0.5	95	0.7
home	67	0.4	61	0.4	84	0.5	78	0.4	82	0.4	82	0.4	99	0.5	87	0.4	81	0.5	111	0.8
surgical treatment	636	4.0	657	4.2	680	4.0	837	4.7	742	3.9	697	3.8	725	3.6	666	3.4	533	3.1	343	2.5
dental treatment	498	3.2	480	3.1	539	3.2	586	3.3	497	2.6	376	2.1	480	2.4	413	2.1	351	2.0	280	2.0
person to person	73	0.5	104	0.7	134	0.8	171	1.0	191	1.0	200	1.1	210	1.0	232	1.2	251	1.5	200	1.4
oral/fecal	7	0.0	7	0.0	10	0.1	8	0.0	12	0.1	11	0.1	9	0.0	12	0.1	12	0.1	12	0.1
others	617	3.9	594	3.8	652	3.8	690	3.9	783	4.1	713	3.9	769	3.8	780	4.0	719	4.2	603	4.3
unknown	8323	53.0	8312	53.5	9268	54.7	9795	55.2	10531	55.2	10382	57.0	11662	58.1	11583	58.8	10234	59.3	8519	61.3
Federative unit																				
Rondônia	65	0.4	90	0.6	112	0.7	137	0.8	170	0.9	159	0.9	176	0.9	176	0.9	168	1.0	122	0.9
Acre	193	1.2	156	1.0	141	0.8	112	0.6	509	2.7	295	1.6	182	0.9	126	0.6	169	1.0	95	0.7
Amazonas	180	1.1	178	1.1	256	1.5	194	1.1	376	2.0	369	2.0	243	1.2	316	1.6	312	1.8	256	1.8
Roraima	28	0.2	10	0.1	20	0.1	5	0.0	20	0.1	16	0.1	15	0.1	17	0.1	15	0.1	19	0.1
Pará	100	0.6	135	0.9	74	0.4	135	0.8	151	0.8	128	0.7	232	1.2	307	1.6	311	1.8	109	0.8
Amapá	36	0.2	28	0.2	27	0.2	23	0.1	27	0.1	20	0.1	33	0.2	28	0.1	48	0.3	22	0.2
Tocantins	49	0.3	26	0.2	44	0.3	36	0.2	33	0.2	51	0.3	50	0.2	43	0.2	49	0.3	24	0.2
Maranhão	193	1.2	143	0.9	223	1.3	164	0.9	129	0.7	117	0.6	133	0.7	98	0.5	88	0.5	119	0.9
Piuaí	17	0.1	32	0.2	40	0.2	50	0.3	64	0.3	64	0.4	64	0.3	47	0.2	43	0.2	22	0.2
Ceará	166	1.1	168	1.1	147	0.9	182	1.0	184	1.0	192	1.1	233	1.2	211	1.1	154	0.9	111	0.8
Rio Grande do Norte	81	0.5	80	0.5	82	0.5	81	0.5	106	0.6	84	0.5	77	0.4	81	0.4	83	0.5	53	0.4
Paraíba	60	0.4	105	0.7	54	0.3	61	0.3	112	0.6	104	0.6	58	0.3	80	0.4	94	0.5	79	0.6
Pernambuco	165	1.1	139	0.9	244	1.4	266	1.5	454	2.4	376	2.1	178	0.9	204	1.0	223	1.3	152	1.1
Alagoas	55	0.4	45	0.3	60	0.4	49	0.3	45	0.2	59	0.3	85	0.4	70	0.4	108	0.6	53	0.4
Sergipe	56	0.4	47	0.3	66	0.4	69	0.4	75	0.4	57	0.3	60	0.3	74	0.4	64	0.4	68	0.5
Bahia	423	2.7	353	2.3	402	2.4	555	3.1	602	3.2	507	2.8	605	3.0	684	3.5	577	3.3	695	5.0
Minas Gerais	830	5.3	923	5.9	1014	6.0	775	4.4	927	4.9	1187	6.5	1301	6.5	1183	6.0	1001	5.8	880	6.3
Espírito Santo	134	0.9	104	0.7	113	0.7	165	0.9	260	1.4	223	1.2	210	1.0	228	1.2	229	1.3	126	0.9
Rio de Janeiro	1454	9.3	1633	10.5	1730	10.2	2048	11.5	1815	9.5	1407	7.7	1674	8.3	1599	8.1	1225	7.1	612	4.4
São Paulo	6245	39.7	5764	37.1	6312	37.3	6463	36.4	6175	32.4	5566	30.5	6351	31.7	6475	32.9	5418	31.4	4164	30.0
Paraná	846	5.4	955	6.1	1073	6.3	927	5.2	1092	5.7	1175	6.4	1409	7.0	1263	6.4	1196	6.9	943	6.8
Santa Catarina	848	5.4	826	5.3	1026	6.1	993	5.6	1085	5.7	1109	6.1	1125	5.6	1024	5.2	952	5.5	854	6.1

Rio Grande do Sul	2709	17.2	3001	19.3	2939	17.3	3552	20.0	3778	19.8	4145	22.7	4655	23.2	4278	21.7	3912	22.7	3710	26.7
Mato Grosso do Sul	259	1.6	184	1.2	214	1.3	191	1.1	227	1.2	218	1.2	115	0.6	141	0.7	179	1.0	147	1.1
Mato Grosso	120	0.8	117	0.8	190	1.1	189	1.1	250	1.3	218	1.2	192	1.0	162	0.8	205	1.2	144	1.0
Goiás	127	0.8	120	0.8	120	0.7	139	0.8	208	1.1	235	1.3	362	1.8	413	2.1	334	1.9	236	1.7
Distrito Federal	273	1.7	173	1.1	217	1.3	180	1.0	189	1.0	144	0.8	243	1.2	356	1.8	96	0.6	82	0.6