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Prevalence of hepatitis C virus in Brazil's inmate population: a systematic review

ABSTRACT

OBJECTIVE: To estimate the prevalence of hepatitis C virus infection in Brazil's inmate population .

METHODS: Systematic review on hepatitis C virus infection in the inmate population. Brazilian studies published from January 1, 1989 to February 20, 2014 were evaluated. The methodological quality of the studies was assessed using a scale of 0 to 8 points.

RESULTS: Eleven eligible studies were analyzed and provided data on hepatitis C virus infection among 4,375 inmates from seven states of Brazil, with a mean quality classification of 7.4. The overall hepatitis C virus prevalence among Brazilian inmates was 13.6% (ranging from 1.0% to 41.0%, depending on the study). The chances of inmates being seropositive for hepatitis C virus in the states of Minas Gerais (MG), Sergipe (SE), Mato Grosso do Sul (MS), Rio Grande do Sul (RS), Goiás (GO) and Espirito Santo (ES) were 84.0% (95%CI 0.06;0.45), 92.0% (95%CI 0.04;0.13), 88.0% (95%CI 0.09;0.18), 74.0% (95%CI 0.16;0.42), 84.0% (95%CI 0.08;0.31) and 89.0% (95%CI 0.01;0.05) respectively, lower than that observed in the Sao Paulo state (seroprevalence of 29.3%). The four studies conducted in the city of Sao Paulo revealed a lower prevalence in more recent studies compared to older ones.

CONCLUSIONS: The highest prevalence of hepatitis C virus infection in Brazil's inmate population was found in Sao Paulo, which may reflect the urban diversity of the country. Despite Brazilian studies having good methodological quality to evaluate the prevalence of the hepatitis C virus, they are scarce and lack data on risk factors associated with this infection, which could support decisions on prevention and implementation of public health policies for Brazilian prisons.

DESCRIPTORS: Prisoners. Hepacivirus. Prevalence. Hepatitis C, epidemiology. Seroepidemiologic Studies. Review.

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INTRODUCTION

Hepatitis C virus (HCV) infection is a major worldwide health care problem. The World Health Organization estimates that approximately 150 million people are chronically infected with HCV, and more than 350,000 people die every year from hepatitis C-related liver diseases.[a] The disease severity ranges from a mild illness lasting a few weeks to a serious lifelong condition in almost 85.0% of cases, which can lead to liver cirrhosis or liver cancer. Patients can remain symptom-free for a long time; for example, liver disease may appear up to 20 or 30 years after the initial infection.[23]

HCV is transmitted by contact with the blood of an infected person. Although several transmission mechanisms are known, such as injection drug use, tattooing, sexual intercourse, invasive medical or dental procedures, and perinatal transmission, other routes remain unknown.[37]

The population confined in prisons may have a higher prevalence of HCV than the general population due to its low socioeconomic level and high prevalence of injecting drug dependence. The environment in most prisons could also contribute to local transmission. People confined in prisons are more likely to engage in high-risk behaviors for HCV infection than the general population,[38] and the serving time in prison increases risk exposures to other prisoners, because they usually have poor access to health care and live in poverty. This exposure may include high-risk sexual practices, such as sexual intercourse with prisoners with a history of sexually transmitted diseases (STD) or with a former or current injection drug user.[38,45] However, incarceration conditions and the high cost of conducting research hamper a prospective evaluation of the extent of HCV spread within prisons. Few studies have addressed this issue with a prospective follow-up. In 2010, a study conducted among injecting drug-using inmates from Australia evaluated the reinfection of different HCV genotypes and showed that the incidence of HCV infection was 40/100 person-years.[31] In Brazil, Gois et al[15] have argued that prisoner health has become a public health problem.

The prevalence of HCV infection in prisons varies by country: 5.0% in Venezuela,[29] 15.2% in Pakistan,[21] 19.0% in Scotland,[43] 12.0%-31.0% in the United States,[42] 34.1% in Indonesia[34] and 46.0% in Norway.[20] The reason for the difference in results may be variations in the design, aims and criteria of different studies. Most studies around the world are conducted among male inmate populations, probably because they are larger than female ones. In 2012, Brazil had 512,964 male inmates and only 35,039 female inmates.[b] Furthermore, the choice of anti-HCV screening tests can also influence the variation in prevalence among countries, as well as in the general population. More accurate assays, such as molecular testing for HCV RNA detection, can be used for confirmation.[9] Another important factor is whether the survey was performed among inmates entering prison or among already incarcerated inmates, who may have been more exposed to STD and drug use, increasing the chance of intra-prison transmission of HCV. The proportion of inmates that are injecting drug users (IDU) is very relevant information, as well as the number of inmates with tattoos.[38,45]

The aim of this study was to estimate the prevalence of HCV infection among Brazil's inmate population.

METHODS

This systematic review was based on the directions of Stroup et al[41] and Moher et al.[28]

The search included articles from January 1, 1989 until February 20, 2014, using the PubMed (Medline), Lilacs and Embase databases. No language restriction was used. The terms for the search were (hepatitis C OR HCV) AND (prisoners OR inmates) AND Brazil* in all databases. Multiple reports of the same study were identified as duplicates and counted as one study.

In an attempt to identify other relevant studies, references from articles obtained in the database searches and from review articles about the topic were manually researched.

We included studies: reporting primary data; conducted in prisons in Brazil; that conducted biological testing to detect antibodies against HCV (anti-HCV); and that evaluated prisoners aged 18 years or older. The exclusion criteria were: evidence that the study population was not in fact prisoners; studies of subpopulations within the inmates; studies with a sample size smaller than 50 individuals; case reports and case series; and studies that failed to present data clearly enough. Reviews of the literature were excluded, but the data reported were checked and compared with the results of the present study.

First, the titles and abstracts were screened for relevance independently by two of the investigators (MCM and

[a] World Health Organization. Hepatitis C: updated 2014. Geneva; 2014 [cited 2014 Feb 16]. (Fact sheet, 164). Available from: http://www.who.int/mediacentre/factsheets/fs164/en/

[b] Ministério da Justiça, Departamento Penitenciário Nacional – DEPEN. Sistema Nacional de Informação Penitenciária – InfoPen: estatística. Brasília (DF); 2012 [cited 2014 May 21]. Available from: http://portal.mj.gov.br/main.asp?View={D574E9CE-3C7D-437A-A5B6-22166AD2E896}&Team=&params=itemID={2627128E-D69E-45C6-8198-CAE6815E88D0};&UIPartUID={2868BA3C-1C72-4347-BE11-A26F70F4CB26}

WPP or KYI). Second, disagreements were resolved by discussion. Third, the full text of all articles deemed relevant were screened. Finally, all full articles were read by at least two investigators (MCM and WPP or FMT), and whenever there was any disagreement, it was read by a third investigator and discussed.

We extracted the following information from each study: first author, year of publication, city and state, the year in which it was conducted, sex and age of participants, laboratory methods used in anti-HCV detection, sample size and number of participants positive for anti-HCV. To assess the quality of the studies, we created a quality assessment scale (0 to 8 points) based on the criteria proposed by Boyle[8] and Fowkes and Fulton.[14] The scale includes reporting study design, inclusion and exclusion criteria, compliance with established criteria, outcome definition and measurement, total number of participants, proportion of non-respondents, and number of outcome events. A higher score indicates better quality.

The methods used for anti-HCV detection were enzyme-linked immunosorbent assay (ELISA) of any generation and other immunoassay tests. They are listed in Table 1, and we consider the tests appropriate for this aim.

Data used for the analysis were extracted from the eligible studies included in this review. Chi-square tests, odds ratios (OR) and 95% confidence intervals (95%CI) were calculated using logistic regression and the software SPSS, version 20.0.

RESULTS

Using the initial literature search strategies, we identified 50 studies, including 25 duplicates. After reading the abstracts, 11 were excluded. Thus, the full texts of 14 articles were reviewed, all of them available in English, and three of them were excluded (Figure). The studies by Fialho et al[13] and Zanetta et al[48] were excluded in full text review because they included inmates younger than 18 years of age. The study by Strazza et al[39] from 2004 was excluded because it included samples from the same prison as the study by Strazza et al[40] from 2007, which provided detailed information and therefore was included.

Finally, 11 studies were included in the present review, and their mean quality classification was 7.4 (ranging from 5 to 8) (Table 2).

The number of inmates reported in the included studies ranged from 63 to 756. Overall, these studies included 4,375 inmates from seven different Brazilian states and were conducted between 1993 and 2011. Four studies included only male prisons, three included female prisons and four included both male and female prisons. Inmates were aged 18 to 80 years.

The prevalence of HCV infection in Brazilian inmates in all the studies was determined by the presence of anti-HCV in the blood, and the mean prevalence was 13.6%, with the lowest prevalence detected in the state of Espirito Santo (1.0%) and the highest in the state of Sao Paulo (41.0%) (Table 1).

Table 3 shows the prevalence of HCV (with confidence intervals) among inmate populations grouped into the seven Brazilian states included in this systematic review. Furthermore, it presents a comparison of means between Sao Paulo (reference category) and the other states. The chances of inmates being seropositive for HCV in the states of Minas Gerais, Sergipe, Mato Grosso do Sul, Rio Grande do Sul, Goias and Espirito Santo were 84.0%, 92.0%, 88.0%, 74.0%, 84.0% and 89.0% lower, respectively, than in Sao Paulo state.

Table 4 shows the prevalence with confidence intervals from the four studies conducted in the state capital, the city of Sao Paulo, and a comparison of the means from the first and the last studies conducted there. The results indicate that the prevalence reported in later studies was lower than that in the earlier ones. The chance of inmates being seropositive for HCV in Sao Paulo State in the years of 1997 and 2000 was 72.0% and 75.0% lower, respectively, than in 1993-1994.

DISCUSSION

The mean prevalence of HCV in Brazilian inmates in the present systematic review was 13.6%, ranging from 1.0% to 41.0%, with the lowest prevalence detected in the state of Espirito Santo and the highest in the state of Sao Paulo. With at least 550,000 people detained in Brazilian prisons,[b] we can consider that there might be 74,800 inmates with hepatitis C in Brazil. There are few studies available in Latin American countries regarding the prevalence of HCV among inmates. A study carried out in Mexico found a prevalence of 10.0%,[4] and another one in Venezuela found a prevalence of 5.0%.[29] Worldwide, the prevalence rates vary significantly: 4.9% in France,[44] 8.1% in Iran,[5] 16.6% in Canada,[33] 19.2% in Ghana,[3] 21.8% in Ireland,[25] 24.2% in England,[22] 38.0% in Italy,[6] 46.0% in Norway[20] and 57.5% in Australia.[19]

The present review indicates that the city of Sao Paulo has reported the highest prevalence of HCV infection, with a mean prevalence of 27.6% (ranging from 16.2% to 41.0%).[18,26,27,40] This may be explained by the urban diversity of the country. Sao Paulo is considered one of the most populous cities in the world and is one of the main destinations for migrants from other cities of Brazil.

Table 1. Selected studies and prevalence of hepatitis C virus among inmate populations in Brazil.

Citation	Location (city, state)	Year of study	Sample size	Sex	Age (years)	Positive samples	Seroprevalence (%)	95%CI	Methods of anti-HCV detection	Confirmatory tests
Massad et al[26] (1999)	Sao Paulo, SP	1993-1994	631	M	18-80	215/631	34.1	30.4;37.8	ELISA - Abbott Laboratories (2nd generation kit)	Immunoblot kit - Embrabio, Brazil (203/215, 94.4%)
Miranda et al[27] (2000)	Sao Paulo, SP	1997	121	F	N/A	23/121	19.0	12.0;25.9	Imx HCV assay - Abbott Laboratories (generation N/A)	–
Catalan-Soares et al[10] (2000)	Manhuaçu, MG	N/A	63	M	N/A	4/63	6.34		ELISA - Ortho, USA (generation N/A)	–
Guimarães et al[18] (2001)	Sao Paulo, SP	1993-1994	756	M	N/A	310/756	41.0		INNOTEST HCV Ab III - Innogenetics, Belgium (3rd generation)	Undetermined results were submitted to: INNO-LIA HCV Ab - Innogenetics, Belgium (N/A)
Strazza et al[40] (2007)	Sao Paulo, SP	2000	290	F	18-65	N/A	16.2		HBK 425 Hemobio HCV - Embrabio, Brazil (3rd generation)	INNO-LIA HCV Ab III - Innogenetics, Belgium (N/A)
Coelho et al[11] (2009)	Ribeirao Preto, SP	2003	333	M	19-69 mean 30.1	29/333	8.7	5.7;11.7	Bioelisa HCV - Biokit, Spain (generation N/A)	–
Santos et al[36] (2011)	M = Areia Branca, SE F = N/A, SE	2009M/2010F	422 303M/119F	M/F	mean 32.7 (SD = 8.8)	13/422	3.1		HCV Rapid Test Bioeasy (generation N/A)	PCR – in-house (11/12, 91.7%)
Pompilio et al[32] (2011)	Campo Grande, MS	2009	686 443M/243F	M/F	N/A	33/686	4.8 7.0M/0.8F	3.4;6.8	Bioelisa HCV 4.0, BioKit, Spain (3rd generation) Immunoassay - ImmunoComb II HCV kit - Orgenics, Germany (generation N/A)	Weakly reactive results were submitted to: INNO-LIA HCV Ab III - Innogenetics, Belgium (N/A) RT-PCR – in-house (20/29, 69.0%)
Rosa et al[35] (2012)	Santa Cruz do Sul, RS	2010-2011	195 179M/16F	M/F	19-69 mean 33 (SD = 10.4)	19/195	9.7		HCV Rapid Test Bioeasy (generation N/A)	–
Barros et al[7] (2013)	Goiania, GO	2007-2008	148	F	≤30 (60.1%)	9/148	6.1	3.0;11.6	ELISA - Abbott Laboratories, Brazil (generation N/A)	Weakly reactive results were submitted to: INNO-LIA HCV Ab III, Innogenetics, Belgium RT-PCR - in-house (5/9, 55.5%)
Falquetto et al[12] (2013)	Colatina, ES	2010	730	M/F	18-N/A	7/730	1.0		HCV Rapid Test Bioeasy (3rd generation)	RT-PCR – in-house (7/7, 100%)

F: female; M: male; N/A: not available; ELISA: enzyme-linked immunosorbent assay; PCR: polymerase chain reaction; RT-PCR: reverse transcription polymerase chain reaction
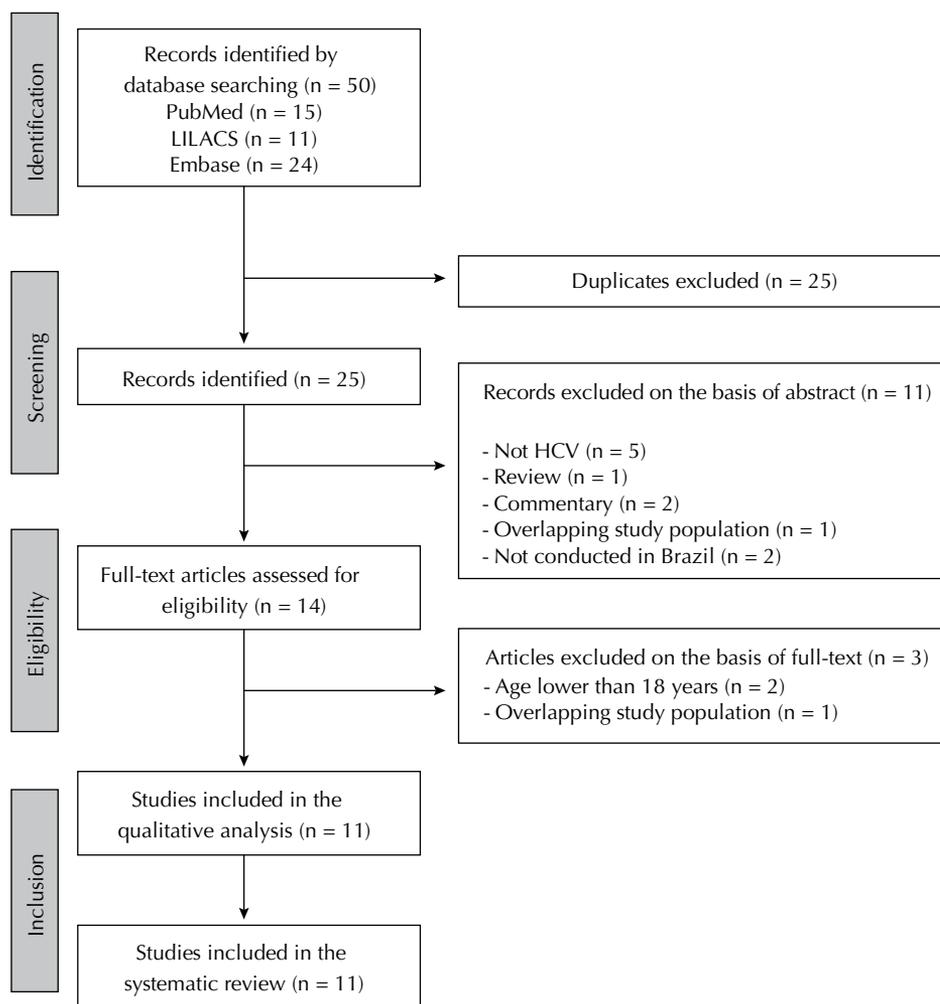
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Identification   Records identified by
                 database searching (n = 50)
                 PubMed (n = 15)
                 LILACS (n = 11)
                 Embase (n = 24)
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Duplicates excluded (n = 25)

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Screening        Records identified (n = 25)
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Records excluded on the basis of abstract (n = 11)

- Not HCV (n = 5)
- Review (n = 1)
- Commentary (n = 2)
- Overlapping study population (n = 1)
- Not conducted in Brazil (n = 2)

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Eligibility      Full-text articles assessed for
                 eligibility (n = 14)
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Articles excluded on the basis of full-text (n = 3)
- Age lower than 18 years (n = 2)
- Overlapping study population (n = 1)

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Inclusion        Studies included in the
                 qualitative analysis (n = 11)

                 Studies included in the
                 systematic review (n = 11)
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Figure. Flowchart of study selection in the different phases of the systematic review.

The study that reported the highest prevalence, 41.0%, was conducted in Sao Paulo, in the Carandiru prison. According to the authors, it was one of the clusters of highest reported HCV infection, and it remains so in Brazil until today. The authors believed that most of the HCV infections occurred prior to imprisonment.[18] It is important to emphasize that Carandiru was huge. There were nine blocks divided into several prison cells according to the features of the crime committed. We do not know the exact election criteria for the inmates/ blocks included in the study. Of note, Carandiru complex was deactivated and partially demolished in 2002.

The studies involved 4,375 inmates in the last 20 years (1993-2013). The first selected study was conducted in 1993. At that time, there was no standard mechanism for consolidating data on the Brazilian inmate population; concrete data have been available at the Brazilian Ministry of Justice website since 2000. In 2000, there were 139,188 inmates in closed regime in Brazil, whereas in December 2011, the year when the last study was performed, that number increased to 203,446.[b] Therefore, the prevalence of HCV infection in this population may have been underestimated. Indeed, the latest (December 2012) statistics available at the Ministry of Justice website about the total inmate population regime shows 548,003 inmates, which is among the largest in the world.[b]

The scale used to assess the quality of the studies was considered appropriate, and the mean quality classification was 7.4 (the lowest score was 5), indicating that the articles included in the analysis were of good quality.

Our study has some limitations, such as the validity of the laboratory tests. Most anti-HCV screening tests use the ELISA technique because of its high sensitivity and specificity, ease manipulation, and low cost,

Table 2. Quality assessment of the studies included in the review.

Citation	Study design	Inclusion/Exclusion criteria	Appropriate selection of participants	Outcome definition	Outcome measurement	Total number of participants	Non-respondent proportion	Number of outcome events	Total score
Massad et al[26] (1999)	✓	✓	NA	✓	✓	✓	✓	NA	6
Miranda et al[27] (2000)	✓	✓	✓	✓	✓	✓	✓	✓	8
Catalan-Soares et al[10] (2000)	✓	✓	✓	✓	✓	✓	✓	✓	8
Guimarães et al[18] (2001)	✓	✓	✓	✓	✓	✓	✓	✓	8
Strazza et al[40] (2007)	✓	✓	NA	✓	✓	✓	✓	NA	6
Coelho et al[11] (2009)	✓	✓	✓	✓	✓	✓	✓	✓	8
Santos et al[36] (2011)	✓	✓	✓	✓	✓	✓	✓	✓	8
Pompilio et al[32] (2011)	✓	✓	✓	✓	✓	✓	✓	✓	8
Rosa et al[35] (2012)	✓	✓	NA	✓	✓	✓	NA	NA	5
Barros et al[7] (2013)	✓	✓	✓	✓	✓	✓	✓	✓	8
Falquetto et al[12] (2013)	✓	✓	✓	✓	✓	✓	✓	✓	8

NA: Not appropriate or not available

besides considerable improvement over the years. Second- and third-generation ELISA have acceptable accuracy and thereby can help reduce the need for polymerase chain reaction (PCR)-based laboratory screening.[24] Diagnostic methods for detecting anti-HCV in the literature have shown differences among the first three generations of ELISA. They found 70.0%-80.0%, 92.0%-95.0%, and 97.0% sensitivity in first-, second- and third-generation ELISA, respectively.[9] A study conducted in Brazil suggested a strong correlation between second-generation anti-HCV ELISA and HCV RNA positivity by PCR.[16] Another study published in the late 2000s about laboratory testing for hepatitis C reported that anti-HCV antibodies are usually detected using third- or fourth-generation immunoenzymatic assays that contain HCV core antigens and HCV nonstructural genes.[17]

In the present systematic review, the studies of Massad et al[26] and Guimarães et al[18] were conducted in 1993 and 1994. The first one used second-generation ELISA and the other, third-generation ELISA. The other studies are from later years,[7,10-12,27,32,35,36,40] when it was possible to access second- and third-generation kits. The articles that described the generation or version of the kit and used the third-generation kit are shown in Table 1.[12,18,32,40] The second- and third-generation ELISA tests have a specificity of approximately 99.0%, so the chance of false-positive results is generally considered not significant. Five studies performed confirmatory tests, four of them with in-house molecular testing (presence of virus), and the percentages of confirmed positive cases were 100%,[12] 94.5%,[26] 91.7%,[36] 69.0%,[32] and 55.5%[7] (Table 1). This raises questions about false-positive results in serology and possible difficulties in molecular testing, such as detecting a phase of low viremia or seroconversion, the high cost of supplemental tests for diagnosing HCV infection and the need for adequate laboratory infrastructure. This issue is still relevant and somewhat controversial; some authors believe that even a specificity of 99.0% does not provide the desired predictive value for a positive test, especially among populations with a low prevalence of HCV infection and populations without liver-related diseases[30,47] such as inmates. Therefore, a number of false-positives by anti-HCV detection could have been present in the analyzed data, possibly constituting a study limitation.

As a second limitation, most studies used convenience sampling of inmates at the institutions. Thus, it is possible that the relevant characteristics of this group do not represent those of the total population. We found only one article on this topic in prisons in Northeastern Brazil,[36] and none in Northern region. We do not know whether the inmates of these regions have similar or different epidemiological characteristics.

Table 3. Prevalence of hepatitis C virus among inmate populations grouped into seven different states of Brazil.

State	Positive samples	Sample size	HCV sero-prevalence (%)	95%CI		OR	95%CI		p
				Lower	Upper		Lower	Upper	
Sao Paulo	624	2,131	29.3	27.3	31.2	Ref.	–	–	< 0.001
Minas Gerais	4	63	6.3	0.3	12.4	0.16	0.06	0.45	
Sergipe	13	422	3.1	1.4	4.7	0.08	0.04	0.13	
Mato Grosso do Sul	33	686	4.8	3.2	6.4	0.12	0.09	0.18	
Rio Grande do Sul	19	195	9.7	5.6	13.9	0.26	0.16	0.42	
Goias	9	148	6.1	2.2	9.9	0.16	0.08	0.31	
Espirito Santo	7	730	1.0	0.3	1.7	0.02	0.01	0.05	
Total	709	4,375	16.2	15.1	17.3	–	–	–	

Ref.: Reference category (based on the highest seroprevalence – Sao Paulo)

Table 4. Prevalence of hepatitis C virus among inmate populations from the four studies conducted in the city of Sao Paulo.

Citation	Year of study	Positive samples	Sample size	HCV sero-prevalence (%)	95%CI		OR	95%CI		p
					Lower	Upper		Lower	Upper	
Massad et al[26] (1999)	1993-1994	215	631	34.1	30.4	37.8	Ref.			< 0.001
Guimarães et al[18] (2001)	1993-1994	310	756	41.0	37.5	44.5	1.35	1.08	1.68	
Miranda et al[27] (2000)	1997	23	121	19.0	12.0	26.0	0.45	0.28	0.74	
Strazza et al[40] (2007)	2000	47	290	16.2	12.0	20.4	0.37	0.26	0.53	

Ref.: Reference category (based on the year of sample collection)

Brazilian prisons are suffering from overcrowding and, worsening the situation, prisoner mobility within the prison system and contact with the external population (conjugal visits) might increase the chances of exposure to other individuals infected with HCV or other STD. In general, STD prevalence is higher among inmate populations than in the general population also because they might engage in high-risk sexual practices.[38] In addition, many prisoners use illicit drugs, including injectable ones. The proportion of current or former IDU is approximately 40.0% of the prison population in many countries.[46] IDU have been considered the main segment infected with HCV in most of the world.[2] A meta-analysis of the risk factors associated with HCV prevalence in Brazilian prisons was not feasible because most studies did not analyze the risk factors for HCV infection, but we believe that the use of injectable drugs favors virus transmission through the blood of the users.

Currently the number of IDU in Brazil is apparently decreasing due to the increased number of crack cocaine users (crack cocaine is smoked),[1,c] which appears to be associated with its low cost and pleasurable effects.[d] Actions to prevent drug use within the prison system should be implemented; however, the acceptability of drugs and their availability within prisons are obstacles to these interventions. Furthermore, prevention and health training programs may also be important, for example workshops on drugs for inmates, psychological care and production of informative materials for prisoners and their families. In summary, it is important to think about the implementation of public policies and policy consistency in public health because these inmates are often confined in extremely unhealthy conditions.

Also, tattooing and body piercing, both prior to or while incarcerated, may affect HCV prevalence. In addition, blood-to-blood contact as a result of violence between inmates should also be analyzed and considered as a possible risk factor in future studies.

Although some progress has been made over the last decades, studies to date are scarce and probably do not reflect the reality of Brazilian prisons. Voluntary testing to detect HCV could be provided, along with necessary information about the infection in the case of a positive test. Specific treatment for hepatitis C should be available with the persistent aim of obtaining a sustained virologic response.

Further studies to better understand inmate risks are needed to control the spread of HCV infection in Brazilian prisons and to make ideal treatment and prevention decisions.

Finally, the prevalence of hepatitis C and STD in Brazilian prisons needs to be considered a consequence not only of the limited care provided to inmates but also of the increasing incarceration rates in Brazil.

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