ORIGINAL ARTICLE

Epidemiological study of Hepatitis C in people deprived of liberty

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Declaration of interests: nothing to declare

ABSTRACT

Introduction: The prevalence of hepatitis C (HCV) is high among prisoners. If untreated, a substantial number of patients progress to cirrhosis, hepatocarcinoma, or liver failure. World Health Organization aims to reduce the incidence of infection by 90% by 2030. **Objective:** To describe the prevalence of anti-HCV and sociodemographic and clinical aspects, related to the presence of the antibody, in the population deprived of liberty. **Methods:** Cross-sectional and epidemiological survey, with exploratory, observational, quantitative-analytical components. A simple random sample of 233 participants, with 95% Confidence Interval (CI) and, a 4% margin of error, was calculated for a population of 1,564 prisoners. The relationship between sociodemographic and clinical variables was evaluated, considering as outcome of the rapid test for anti-HCV results, using the associative measure Prevalence Ratio (PR) with a 95% CI. **Results:** 240 people participated. The prevalence of anti-HCV was 2%, and the use of injectable drugs (PR 14.75; $PRIC_{95\%}$ 2.09-104.28), being born in the decades of 1951 to 1980 (PR 9.28; $PRIC_{95\%}$ 1.06-81.57) and be co-infected with hepatitis B virus (PR 10.75; $PRIC_{95\%}$ 1.66-69.65) were the aspects that presented a relevant prevalence ratio for the presence of the virus, which could be generalized to the population. **Conclusion:** This is a population that is difficult to access, the study is relevant because it contributes to preventive measures of public health in the prison system. Moreover, it shows the need to implement measures to prevent and contain the spread of HCV, aiming at the elimination of hepatitis C in this population.

Keywords: Hepatitis C; prisons; prisoners; risk factors; Epidemiology; Public Health.

INTRODUCTION

Approximately 71 million people live with hepatitis C virus (HCV) in the world today. In 2016, the World Health Organization (WHO) announced goals for the elimination of viral hepatitis, recommending that 90% of people with HCV be diagnosed and that 80% of them be treated so that the incidence of infection is reduced by 90%. Although the most effective therapies have become available, 80% of high-income countries have not reached the WHO targets by 2030 and almost 70% are not expected to achieve them by 2050[1,2].

The prevalence of HCV is higher among persons deprived of their liberty when compared to the general public. Furthermore, the prevalence of HCV in these populations is about 10-20 times higher than in the general population, probably related to the large number of incarcerated drug users. Thus, the criminal justice system is recognized as an important component of virus elimination strategies[3].

Publications of the American Association for the Study of Liver Diseases recommend screening for HCV infection for people who are or have been deprived of liberty, public safety professionals, after accidents/contact with sharp puncture materials, or mucosal exposure to HCV-infected blood, in addition to the risk groups already described for the population of that country. In addition, it is also recommended that treatment be offered quickly to patients at risk of developing serious complications and for those, in whom treatment can reduce transmission, being again mentioned the inmates[4,5].

In Mato Grosso, Brazil, in 12 months, with 3,368 inmates, a prevalence of exposure to HCV of 2.4% was found. Statistical analysis showed a significant association with being male, being over 30 years old, incarceration time, and use of alcohol and drugs

(injectable or not), such as crack, heroin, and hashish. In addition, there was also a significant association with sharing needles and syringes, history of blood transfusions, sexually transmitted infections, surgeries, living with HIV, and having had more than five sexual partners in the last five years ($p<0.05$)[6].

It is important to remember that individuals deprived of their liberty are at much greater risk of contracting incarceration-associated infections, including viral hepatitis. In prison, drug use is frequent, as well as the marginalization of individuals. Several factors favor the spread of high-prevalence infections such as hepatitis C within prisons, such as the sharing of piercing-cutting objects, piercing materials, tattoo needles, and injecting drug use. Generally, people deprived of their liberty do not have knowledge about how infectious diseases are transmitted, which facilitates the high prevalence of hepatitis C in this population[7].

Through this reality, it is of crucial importance to invest in measures that can identify and eliminate the virus in special populations. The micro elimination of the hepatitis C virus consists of the search for these populations, which include people deprived of liberty. The conduct of research supports the recognition of the reality of special populations and the conditions that interfere to perpetuate the spread of the virus.

Being a long-term asymptomatic disease with a difficult early diagnosis, hepatitis C is a serious health problem in the Brazilian prison system. Hepatitis C is a serious health problem in the Brazilian prison system. Thus, more attention is needed for scientific research involving this population and that brings effective recommendations for the control and prevention of the disease. However, an integrative review published in 2017 draws attention to the low scientific production of epidemiological studies in our country related to the population deprived of liberty[8].

In general, the prison population is still invisible in studies. We highlight the difficulties encountered in conducting research in the prison community, such as the accommodation of routines between a team of researchers and the proper functioning of the penitentiary, in addition to the requirement of ostentatious training between the parties and management articulations. Thus, it is strongly recommended to develop research that presents results of and surveys the risk factors existing within the population[9].

Given this reality, this study aims to describe the prevalence of anti-HCV and sociodemographic and clinical variables, and the association with the presence of antibodies, in the population deprived of liberty.

METHODS

This is a cross-sectional and epidemiological study, with an exploratory, observational, quantitative-analytical component. The research was carried out in a penitentiary located in the city of Uberaba, in the state of Minas Gerais, according to the reported experience on the management of action research on hepatitis C investigation with the population deprived of liberty[9].

The study was developed at Professor Aluízio Ignácio de Oliveira Penitentiary, located in Uberaba/MG. The institution is managed by the Secretary of State for Prison Administration (SEAP-MG) and houses convicted prisoners and people awaiting trial.

The site housed almost twice the installed capacity for which it was designed. There were 1,487 men and 77 women.

The Hepatitis C Diagnosis Expansion Program at the HC-UFTM Hepatitis Outpatient Clinic aimed to track new cases of Hepatitis C in the Health Macro-region of the Southern Triangle. The team was responsible for identifying new cases of HCV in

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this scenario, since the hospital team already treats patients deprived of liberty in the aforementioned penitentiary, with a diagnosis of viral hepatitis.

The study population consisted of the interns, totaling 1,564 inmates. For the sample calculation, the population size (n=1,564 people), a proportion of 13% for the prevalence of hepatitis C disease among the prison population in Brazil[10], a confidence level of 95%, and a margin of error of 4% were considered, leading to a sample of 233 people.

All persons in situations of deprivation of liberty were included, being convicted or on trial, and who wanted to participate in the study. People who had in their prison medical records reporting reduced cognitive functions, with obstacles in logical reasoning, concentration, communication, and learning capacity or psychiatric problems that could hinder the understanding of the Informed Consent Form (Informed Consent) were excluded from the study. It is noteworthy that the information from the medical records was reported by the nursing team of the prison institution at the time of data collection, questionnaire application, and testing.

For the development of the research, authorization was previously requested from the State Department of Justice and Public Security of the State of Minas Gerais. After the procedures of the bureaucratic process, the management of the establishment scheduled a visit for the researchers to know the place and become familiar with the rules to be followed. The entire study was carried out within the institution, according to the rules of the Department of Justice and the local management.

The project was conducted with the joint partnership of three universities in the municipality of Uberaba/MG, two private and a federal public university, where the Hepatitis C Diagnostic Expansion Program operates, which was responsible for the

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overall coordination of the study. The team of researchers was composed of three professors, two nurses, three undergraduates of the medical course, two undergraduates of the nursing course, three undergraduates of the Biomedicine course, and a resident physician of the Medical Residency Program in Gastroenterology.

The team was duly trained by the coordination of the project regarding the research instruments and the correct approach to the population deprived of liberty. Furthermore, a technical visit was made before the beginning of data collection with the penitentiary for the setting and better approximation of the routines of the system. At that time, the place to perform data collection was shown in each pavilion, a classroom that precedes the entrance of the courtyard where the interns receive the sun bath.

Data collection occurred between December 2019 and March 2020, interrupted by the advent of the Covid-19 pandemic. The team members divided themselves into the classrooms next to the courtyard and, at the time of sunbathing, explained about the project and invited the interns to participate.

Initially, a detailed reading of the Informed Consent was made to the study participant, emphasizing that the performance of the diagnostic examination could be made independent of the acceptance to participate in the research. And that the follow-up of the person deprived of liberty for the treatment of HCV and/or complications would also be guaranteed regardless of their insertion in the research.

An individual interview was conducted with each participant, using an adapted questionnaire, developed by Coêlho[11], with socio-demographic and clinical characteristics for prison health.

The instrument includes aspects, here considered as risk factors, such as decade of birth, gender, marital status, having children or not, educational level, having been

previously arrested, history of sexually transmitted infections (STIs), use of piercings or having tattoos, having received blood transfusion or derivatives, history of previous surgeries, hemodialysis, being co-infected with HIV or HBV, living or having lived in a street situation, drug use (injectable or not), sexual preference, receiving intimate visit, alcoholism and smoking and, having worked in a hospital. Considering the decades of birth variable, those born in the decades that, according to the literature, have a higher prevalence of exposure to hepatitis C – 1951 to 1980[12] were considered.

After the interview, the rapid immunochromatographic test was performed for the qualitative detection of specific antibodies against HCV in serum, plasma, or human total blood (Alere HCV® Code 02FK10).

It was organized as an Excel database® by independent double typing and consistency check. The information was transposed to the OpenEpi-info application - Open-source epidemiological statistics for Public Health, openly available at *https://www.openepi.com/Menu/OE_Menu.htm*. for statistical analyses. Descriptive analysis of numerical variables was performed by measures of central tendency and dispersion and of categorical variables by frequencies (relative and absolute).

To evaluate the relationship between the sociodemographic and clinical aspects identified and the outcome obtained by the rapid test in the prison population (positive: exposed /negative: not exposed) was applied the associative measure of strength for epidemiological studies, the Prevalence Ratio (PR). This is defined as the ratio between the prevalence of individuals exposed by the prevalence among the non-exposed, according to the outcome – an event of interest to the research. To identify whether PR represents an effect in the general population, the 95% confidence interval for this estimate was calculated. If the value 1 is not contained in the interval we have the

confidence that in the population where the sample was extracted, the PR is different from 1, and therefore the findings are significant. Prevalence Ratios were organized in Table 2x2 dichotomously, through the relationship with the outcome.

In the presence of the limitation for the calculation of prevalence ratio, such as the zero incidence in table 2x2, to present the results descriptively it was considered the relevance of the set of variables for understanding hepatitis C in the prison scenario.

Regarding ethical aspects, for the preservation of confidentiality and anonymity, the subjects were coded by alphanumeric data, which also allowed the transposition of the data to the analytical databases and verification of the consistency of the data along the questionnaires.

By the Declaration of Helsinki and the ethical norms of Brazil, the reported case was approved by the Research Ethics Committee of the Federal University of Triângulo Mineiro, according to a resolution of the National Health Council No. 466/2012, which deals with research with human beings (approval no. 3.918.981).

RESULTS

Considering the 1,564 inmates in the penitentiary at the time of the beginning of the study, 240 individuals were voluntarily included, and five positive results were found for the anti-HCV antibody or 2% prevalence (Figure 1).

According to the described in Table 1, the use of injecting drugs (PR 14.75; PRIC 2.09-104.28), being born in the decades of 1951 to 1980 (PR 9.28; PRIC 1.06-81.57), and being co-infected with hepatitis B virus (PR 10.75; PRIC 1.66-69.65) were the variables that presented a prevalence ratio for the presence of the virus, which could be generalized for the population.

Regarding sexual preference, all five reagents for hepatitis C reported heterosexuality, having been previously arrested, having tattoos, and having used non-injectable drugs. On the other hand, none of the hepatitis C reagents were co-infected with HIV. In addition, none of them had undergone hemodialysis, received blood transfusion or derivatives, nor worked in a place at risk of accident with biological material. This set of variables presented zero incidence in one of the cases in Table 2x2, making it impossible to calculate the prevalence ratio.

DISCUSSION

In general, hepatitis C is more prevalent in people deprived of their liberty. Of the likely 10.2 million individuals involved with justice in the world, approximately 15%, or 1.5 million, are living with HCV. The virus is most prevalent among marginalized populations such as drug users, homeless people, and the mentally ill. Such people are also more present in prisons, mainly due to drug use and crimes related to poverty. High HCV rates, and the prevalence of marginalized populations, make correctional environments extremely important to provide all phases of the HCV care cascade[1]. Globally, people deprived of their liberty do not have access to conventional health services offered to the community, so prisons offer an excellent opportunity for testing and treating large numbers of C virus carriers[13].

In Brazil, a systematic review regarding the presence of virus C in a prison population published in 2015 found a general prevalence of 13.6% (ranging from 1.0% to 41.0%), 6.3% in the state of Minas Gerais[10]. In the present study, the prevalence of anti-HCV was 2%, lower than that found in the study by Magri[8] and higher than the 0.73% prevalence in the population of the region[14].

Regarding the set of predictor variables that can be generalized to the prison population, the relevance of injectable drugs, birth between 1951 to 1980 decades, and co-infection with hepatitis B virus as risk factors for this population is identified. Since 1990, when HCV was being eliminated from blood banks, the most common form of infection became the use of illicit drugs, intravenous and intranasal. People aged between 20 and 39 are now the group in which the C virus infection is most prevalent. An estimated 28% of injecting drug users are under 25 years of age. In the United States, between 2010 and 2015, the number of new cases reported in this age group tripled. This second wave of HCV shifted the demographics of the virus from a disease with a mean age of 50 years to a stable prevalence between the ages of 20 and 60 years[15].

A Latin American study published in 2020 found the use of injectable drugs as a probable type of infection in 9% of cases, although for a large proportion of patients (34%), the origin of infection was unknown[16]. A study published in 2015 estimated a 49% prevalence of anti-HCV in injecting drug users in Latin America and the Caribbean, in high-risk populations, with significant regional variation[17].

This study found the use of injectable drugs as a risk factor for the acquisition of hepatitis C virus (PR 14.75 ICPR 2.09-104.28), which reinforces the current concern with this population at risk. It is worth mentioning that a study published in 2017 estimated that worldwide among people who inject drugs, 52% had detectable anti-HCV and 58% had a history of imprisonment[18]. In 2014, a publication showed that the use of injectable drugs inside the prison entailed a high risk of exposure to the virus, per injection episode[19].

In 2020, research conducted in New York with people deprived of liberty, with HCV, found the use of injectable drugs as a probable risk factor in 78% of cases[3]. Still, a

large European data considering 30 countries found reactive serology for Hepatitis C in deprived of liberty ranging from 2.3 to 82.6%, while injectable drug use was reported by 25.8 to 44% of inmates[20]. In Hungary, where 28% of the prison population was tested, anti-HCV was positive in 5.49% of cases and drug use was the main risk factor found (99%). The study showed that it is possible to treat these patients, obtaining a cure rate of 96.8%[21].

A study conducted in prisons in Mexico found a prevalence of HCV infection of 4.9%. The use of injectable drugs, the sharing of materials for injectable drugs, and being tattooed, before incarceration, were independently associated with HCV[22]. In Brazil, a study conducted in São Paulo with people deprived of liberty found 18.6% of inmates reporting previous intravenous drug use, with a prevalence of 41% of anti-HCV[23]. A study conducted in Goiania prison found a prevalence of HCV of 15%, where 21% were drug users[24].

In the penitentiary of Ribeirão Preto (170 km from the institution investigated by the present study), it was found a prevalence of 8.7% for anti-HCV, being the main age above 30 years, previous history of hepatitis, tattoos, past injectable drugs and sharing syringes, the variables that presented "p" below 0.25 in the univariate analysis[11]. A 2012 publication found a prevalence of 10% for anti-HCV in Santa Cruz do Sul, in people deprived of liberty[25].

Since 2012, the US Centers for Disease Control and Prevention has recommended that those born between 1945 and 1965 (baby boomers) be tested for HCV; that is because the National Health and Nutrition Survey in that country revealed that 75% of individuals infected with the virus were in this age group[26]. In Brazil, the prevalence of the hepatitis

C virus increases in people over 40 years of age; that is, almost half of anti-HCV carriers were born in the 1950s and 1960s[27].

In 2019, a study conducted in the geographic region where the penitentiary in question is located found a prevalence of 0.76% in 24.085 people tested. Of the anti-HCV reagents, 79.3% were born in the 1950s, 1960s, and 1970[12]. The present study found a prevalence of 2%, where one was born in the 1960s, three in the 1970s, and one in the 1980s (80% in the decades of higher prevalence, according to the literature). It is important to emphasize that only 30% of the prison population was born in the decades of higher risk for HCV infection. After the sample was analyzed, the age group of incarcerated individuals was younger than the general population.

As for the co-infection between the B and C viruses, due to the common risk factors, HBV infection is common in carriers of the C virus. Both viruses interact in the host, and in most cases, HCV suppresses the virus, B virus. The eradication of the C virus removes these suppressive effects, allowing for increased replication and reactivation of the B virus. Thus, all patients with HCV should be tested for HBV[15]. A study published in 2021 with 886 prisoners from eleven prisons in Belgium found 5% anti-HCV positivity, 0.8% for HBsAg, and no co-infection[28]. In this study, the presence of hepatitis B virus was shown as an exposure factor, which is not usually as commonly found as HCV-HIV co-infection. Research developed in Iran found in prisoners 24.5% of positivity for hepatitis C and only 1% for hepatitis B, only one intern showed seropositivity for the two viruses[29].

Although the prevalence ratio is not calculable, the variables such as having been previously arrested, having tattoos, and having used non-injectable drugs were present in

the five individuals reactive to hepatitis C, which is in line with what has already been described in the literature[6,30].

Regarding sexual preference, it is believed that the behavior of reporting heterosexuality present in all respondents may be related to the culture, power structure, and gender inequality present in the prison environment, which differs from the existing privacy in a doctor's office. Future research for a better understanding of this behavior is of great importance.

Limitations and challenges

One of the limitations of this study is that the sample was calculated for the population deprived of liberty in general, it is possible a study design with systematization of the sample. On the other hand, the acceptance of the study by prisoners can be observed, since 240 people were tested, a higher number than expected by the sample plus the data collection was interrupted by the COVID-19 pandemic.

In the presence of the limitation for the calculation of prevalence ratio, such as the zero incidence in Table 2x2, we chose to present the results descriptively, considering the relevance of the set of variables for understanding hepatitis C in the prison scenario.

The variable predictors identified as associated with the risk for hepatitis C among the prison population have been limited only to age group, injecting drug use, and co-infection with hepatitis B virus. However, the relevance of the study is established because it is considered that it is a population that is difficult to access. If the set of variables is presented, it contributes to the description of conditions and profile of this population.

Some variables, within the application of the questionnaire, had no answer. However, these incomplete questionnaires were not disregarded, given the specificity of the study population, which is difficult to access. Another limitation, the variables of co-infection with hepatitis B and HIV were clinical, without serological confirmation, and the reality could be different from what the patient informs in the history. Moreover, the study predicted the follow-up of patients reactive to anti-HCV, which, after the initial limitations imposed by the pandemic, began to be performed.

This study contributes to the care service by contributing to preventive public health measures in the prison system. Moreover, it shows the need to implement measures to prevent and contain the spread of HCV, aiming at the elimination of hepatitis C in the prison population. For public policies, the study is a source of information, especially considering the scarcity of research on the subject.

ACKNOWLEDGEMENTSS

REFERENCES

1. Akiyama MJ. Hepatitis C in the criminal justice system: opportunities for global action in the era of viral hepatitis elimination. BMC Med. 2020;18(1):208. https://doi.org/10.1186/s12916-020-01680-0

2. Snow KJ, Richards AH, Kinner SA. Use of multiple data sources to estimate hepatitis C seroprevalence among prisoners: A retrospective cohort study. Plos One. 2017;12(7):e0180646. https://doi.org/10.1371/journal.pone.0180646

3. Akiyama MJ, Ross J, Rimawi F, Fox A, Jordan AO, Wiersema J, et al. Knowledge, attitudes, and acceptability of direct-acting antiviral hepatitis C treatment among people incarcerated in jail: A qualitative study. Plos One. 2020;15(12):e0242623. https://doi.org/10.1371/journal.pone.0242623

4. AASLD/IDSA HCV Guidance Panel. Hepatitis C guidance: AASLD-IDSA recommendations for testing, managing, and treating adults infected with hepatitis C virus. Hepatology. 2015;62(3):932-54. https://doi.org/10.1002/hep.27950

5. AASLD-IDSA HCV Guidance Panel. Hepatitis C Guidance 2018 Update: AASLD-IDSA Recommendations for Testing, Managing, and Treating Hepatitis C Virus Infection. Clin Infec Dis. 2018;67(10):1477-92. https://doi.org/10.1093/cid/ciy585

6. Puga MAM, Bandeira LM, Pompilio MA, Croda J, Rezende GR, Dorisbor LFP, et al. Prevalence and Incidence of HCV Infection among Prisoners in Central Brazil. Plos One. 2017;12(1):e0169195. https://doi.org/10.1371/journal.pone.0169195

7. Queiroz IT, Couras S, Cabral D. Micro-elimination of hepatitis c in the incarcerated population: is it really possible? Arq Gastroenterol. 2021;58(3):399-401. https://doi.org/10.1590/S0004-2803.202100000-67

8. Araújo TME, Pinheiro DM, Souza ATS. Hepatitis C and associated risks in prisons: an integrative review. Rev Pesq Cuidado Fund Online. 2017;9(4):939-45. https://doi.org/10.9789/2175-5361.2017.v9i4.939-945

9. Gomide GPM, Teixeira MS, Pereira GA, Camargo FC, Pastori BG, Dias FF, et al. Experience in the management of action research on hepatitis C investigation with the prison community. Cienc Saude Coletiva. 2022;27(12):4389-96. https://doi.org/10.1590/1413-812320222712.08742022

10. Magri MC, Ibrahim KY, Pinto WP, França FO, Bernardo WM, Tengan FM. Prevalence of hepatitis C virus in Brazil's inmate population: a systematic review. Rev Saude Publica. 2015;49:36. https://doi.org/10.1590/S0034-8910.2015049005886

11. Coêlho HC. Presença dos vírus HBV e HCV e seus fatores de riscos nos presidiários masculinos da penitenciária de Ribeirão Preto. [Dissertation]. [Ribeirão Preto]: Faculdade de Medicina de Ribeirão Preto, Universidade de São Paulo, 2008.

12. Gomide GPM, Melo CB, Santos VS, Salge VD, Camargo FC, Pereira GA, et al. Epidemiological survey of hepatitis C in a region considered to have high prevalence: the state of Minas Gerais, Brazil. Rev Soc Bras Med Trop. 2019;52:e20190202. https://doi.org/10.1590/0037-8682-0202-2019

13. Winter RJ, Holmes JA, Tj Papaluca, AJ Thompson. The Importance of Prisons in Achieving Hepatitis C Elimination: Insights from the Australian Experience. Viruses 2022;14(3):497.
https://doi.org/10.3390/v14030497

14. Gomide GPM, Molina RJ, Pereira GA, Oliveira CCHB. Early diagnosis of hepatitis C by primary health care. REFACS. 2021;9(Supl. 1):271-81.
https://doi.org/10.18554/refacs.v9i0.4242

15. Airewele NE, Shiffman ML. Chronic Hepatitis B Virus in Patients with Chronic Hepatitis C Virus. Clin Liver Dis. 2021;25(4):817-29.
https://doi.org/10.1016/j.cld.2021.06.008

16. Viola L, Marciano S, Colombato L, Coelho H, Cheinquer H, Bugarin G, et al. HEPLA: A multicenter study on demographic and disease characteristics of patients with hepatitis C in Latin America. Ann Hepatol. 2020;19(2):161-5.
https://doi.org/10.1016/j.aohep.2019.09.006

17. Alonso M, Gutzman A, Mazin R, Pinzon CE, Reveiz L, Ghidinelli M. Hepatitis C in key populations in Latin America and the Caribbean: systematic review and meta-analysis. Int J Public Health. 2015;60(7):789-98.
https://doi.org/10.1007/s00038-015-0708-5

18. Degenhardt L, Peacock A, Colledge S, Leung J, Grebely J, Vickerman P, et al. Global prevalence of injecting drug use and sociodemographic characteristics and prevalence of HIV, HBV, and HCV in people who inject drugs: a multistage systematic review. Lancet Global Health. 2017;5(12):e1192-e207.
https://doi.org/10.1016/S2214-109X(17)30375-3

19. Boelen L, Teutsch S, Wilson DP, Dolan K, Dore GJ, Lloyd AR, et al. Per-event probability of hepatitis C infection during sharing of injecting equipment. Plos One. 2014;9(7):e100749.
https://doi.org/10.1371/journal.pone.0100749

20. Nakitanda AO, Montanari L, Tavoschi L, Mozalevskis A, Duffell E. Hepatitis C virus infection in EU/EEA and United Kingdom prisons: opportunities and challenges for action. BMC Public Health. 2020;20(1):1670.
https://doi.org/10.1186/s12889-020-09515-6

21. Werling K, Hunyady B, Makara M, Nemesi K, Horváth G, Schneider F, et al. Hepatitis C Screening and Treatment Program in Hungarian Prisons in the Era of Direct Acting Antiviral Agents. Viruses. 2022;14(2):308.
https://doi.org/10.3390/v14020308

22. Belaunzarán-Zamudio PF, Mosqueda-Gomez JL, Macias-Hernandez A, Sierra-Madero JG, Ahmed S, Beyer C. Risk factors for prevalent hepatitis C virus-infection among inmates in a state prison system in Mexico. Plos One. 2017;12(6):e0179931.
https://doi.org/10.1371/journal.pone.0179931

23. Guimarães T, Granato CF, Varella D, Ferraz ML, Castle A, Kallás EG. High prevalence of hepatitis C infection in a Brazilian prison: identification of risk factors for infection. Braz J Infect Dis. 2001;5(3):111-8.
https://doi.org/10.1590/s1413-86702001000300002

24. Gonçalves K. Life history and health situation in the prison environment of Goiás: study of the prevalence of hepatitis C in inmates [Dissertation]. [Goiânia]: Universidade Católica de Goiás, 2005.

25. Rosa F, Carneiro M, Duro LN, Valim ARM, Reuter CP, Burgos MS, et al. Prevalence of anti-HCV in an inmate population. Rev Assoc Med Bras. 2012;58(5):557-60.
https://doi.org/10.1590/S0104-42302012000500012

26. Akiyama MJ, Kaba F, Rosner Z, Alper H, Holzman RS, MacDonald R. Hepatitis C Screening of the "Birth Cohort" (Born 1945-1965) and Younger Inmates of New York City Jails. Am J Public Health. 2016;106(7):1276-7.
https://doi.org/10.2105/AJPH.2016.303163

27. Oliveira AC, Bortotti AC, Nunes NN, El Bacha IAH, Parise ER. Association between age at diagnosis and degree of liver injury in hepatitis C. Braz J Infect Dis. 2014;18(5):507-11.
https://doi.org/10.1016/j.bjid.2014.04.003

28. Busschots D, Kremer C, Bielen R, Koc OM, Heyens L, Brixko C, et al. A multicentre interventional study to assess blood-borne viral infections in Belgian prisons. BMC Infect Dis. 2021;708.
https://doi.org/10.1186/s12879-021-06405-z

29. Mohtasham-Amiri Z, Rezvani SM, Ashoori F, Behboodi M, Toosi H, Jafari-Shakib R. Seroprevalence of Hepatitis C Virus among Prisoners in Lakan Prison, North of Iran, Is There Still a Concern? Arch Iran Med. 2021;24(10):765-70.
https://doi.org/10.34172/aim.2021.113

30. Tejera-Pérez RJ, Iglesias-Gómez A, Oliva-Oliva A, Rodríguez-Alonso B, Alonso-Sardón M, Ledesma MS, et al. Real-life experience of hepatitis C treatment in a Spanish prison. Rev Esp Chemioter. 2022;35(3):273-8.
https://doi.org/10.37201/req/001.2022

Figure 1: Flowchart of the penitentiary population, sample calculation, and final sample.
Uberaba, Minas Gerais, Brazil, 2022

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│     Total number of inmates 1,564    │
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                    │         ┌──────────────────────────────────────────────┐
                    │─────────│            simple random sample              │
                    │         │                  (n=233)                     │
                    │         │                 considered                   │
                    │         │   Hepatites C prevalence in the penitentiary │
                    │         │                    13%                       │
                    │         │                  95% CI                      │
                    │         └──────────────────────────────────────────────┘
                    │
┌─────────────────────────────────────┐
│   Total of inmates tested voluntary  │
│       participation (n=240)          │
└─────────────────────────────────────┘
                    │
┌─────────────────────────────────────┐
│      anti-HCV positive 5 (2%)        │
└─────────────────────────────────────┘
```
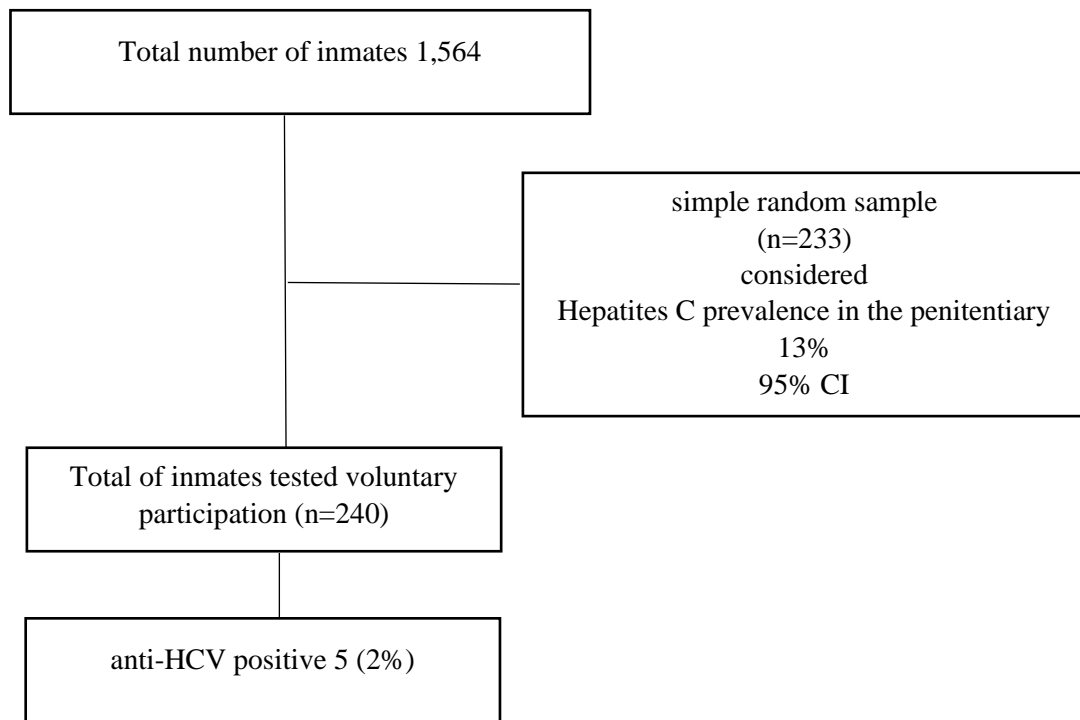
Table 1: Socio-epidemiological association between variables and HCV positivity

Variables	HCV reagent		HCV non-reagent		Bivariate analysis	
	n	%	n	%	PR	PRIC 95%
Gender						
Male	4	2.17	180	97.83	1.22	0.14-10.67
Female	1	1.79	55	98.21		
Marital status						
Married	2	2.30	85	97.70	1.17	0.20-6.88
Single	3	1.96	150	98.04		
Children						
Yes	4	2.42	161	97.58	1.82	0.21-15.99
No	1	1.33	74	98.67		
Schooling						
Up to Elementary school	4	3.15	123	96.85	3.56	0.40-31.38
High school up to college	1	0.88	112	99.12		
STIs						
Yes	2	4.26	45	95.74	2.74	0.47-15.92
No	3	1.55	190	98.45		
Piercing						
Yes	1	1.96	50	98.04	0.93	0.11-8.11
No	4	2.12	185	97.88		
History of Surgery[a]						
Yes	4	3.08	126	96.92	3.35	0.38-29.56
No	1	0.92	108	99.08		
Homeless						
Yes	1	2.86	34	97.14	1.46	0.17-12.72
No	4	1.95	201	98.05		
Injectable drugs						
Yes	**1**	**25.00**	**3**	**75.00**	**14.75**	**2.09-104.28**
No	4	1.69	232	96.31		
Intimate visit						
Yes	2	4.65	41	95.35	3.05	0.53-17.73
No	3	1.52	194	98.48		
Alcohol use						
Yes	4	2.29	171	97.71	1.49	0.17-13.05
No	1	1.54	64	98.46		
Smoking[a]						
Yes	3	2.22	132	97.78	1.14	0.19-6.72
No	2	1.94	101	98.06		
Decades of Birth from 1951 to 1980[a]						
Yes	**4**	**5.56**	**68**	**94.44**	**9.28**	**1.06-81.57**
No	**1**	**0.60**	**166**	**99.40**		
Coinfection with Hepatitis B virus[a]						
Yes	**1**	**33.33**	**2**	**66.67**	**10.75**	**1.66-69.65**
No	**4**	**3.10**	**125**	**96.90**		

[a]Some aspects, within the application of the questionnaire, had no answer (questionnaire without information/blank)