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Original article

Hepatitis C and B prevalence in Spanish prisons

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Abstract

Purpose: The *Prevalhep* study seeks to determine the prevalence of factors associated with hepatitis C virus (HCV) and B (HBV) in Spanish prisoners

Methods: Observational, cross-sectional study which randomly selected 18 Spanish prisons to participate, and with 21 prisoners/Centre

Results: There were 378 prisoners selected, 370 of whom had serological HCV and 342 had VHB data. The HCV population were predominantly male (91.6%), of middle age (66.7% \leq 40 years of age), of Spanish origin (60.5%), history of injection drug use (IDU; 23.2%), in prison $<$ 5 years (71.2%) and entered prison after 2006 (51.9%). The prevalence of HCV was 22.7% (n=84; 95%CI: 18.3-27.1) and HBV was 2.6% (n=9; 95%CI: 0.2-4.9%). Of the patients with HCV, 40.5% were co-infected with HIV, 0.3% co-infected with HBV, and 1.5% with triple virus co-infection (HBV+HCV+HIV). The three markers of HB had been measured in 99 inmates: 32.1% had post-vaccination immunity (antiHBS+) and 30.4% contact status with HBV (HBcAb+ and/or HBsAg+), while 37.5% were susceptible to HB.

Conclusions: The prevalence of HBV and HCV has decreased in the Spanish prison population, probably as a result of decrease in IDU transmission, and an increase in immigrant prisoner population that does not have this risk behaviour.

[Word count = 198]

Key words: Hepatitis C virus; Hepatitis B virus; Spanish prisons; Hepatitis B vaccination

Introduction

A prison population is characterised by having marginalised population and elevated rates of injection drug use (IDU). These characteristics, together with the condition of being incarcerated in crowded conditions, have resulted in an elevated prevalence of viral hepatitis infection [1-9]. It was estimated that, in the prison population in Spain, the prevalence of HCV infection was between 38.2 and 48% [10-13] and that of VHB surface antigen (HBsAg) was approximately 3.8% [12]. The changes in the socio-demographic characteristics of the prison population in Spain have produced changes in the prevalence. However, there is still a dearth of recent systematic data. With the objective of evaluating this prevalence, the associated predictive factors and the profile of the infected prisoners currently incarcerated, the Infectious Disease Group of the Spanish Society of Prison Health-care [*Grupo de Enfermedades Infecciosas de la Sociedad Española de Sanidad Penitenciaria; GEISESP*] designed this study under the acronym PREVALHEP.

Methods

This is an observational cross-sectional study conducted in June 2008 to assess the prevalence of hepato-viral infection in the prison population. Authorisation was obtained from the Spanish Government. The protocol was approved by the Ethics Committee for Clinical Investigation of the *Gol y Gorina* Foundation of Barcelona [*Comité Ético y de Investigación Clínica de la Fundacion Gol y Gorina de Barcelona*]. The data sources were the clinical histories of the prisoners recruited; in standard clinical practice all prisoners are offered a blood test on entering a Spanish prison.

Sample size

From a total prison population of 62,000, a prevalence of HCV infection estimated from other studies is around 30%. With an assumed variability of 5%, an α error of 5%, and a possible loss to the study of 10%, the number of subjects estimated was 364. Secondary objectives were to determine prevalence of other viral hepatitis infections (HBV and HAV). To evaluate the characteristics associated with natural contact status with HBV, 299 inmates were selected who had the three markers measured (HBs Ag, Ab and HBc Ab) and those who had been vaccinated were censored from the analyses. To evaluate the characteristics of the vaccinated population, the 299 inmates with the three markers (HBs Ag, HBsAb and HBc Ab) were selected, and those infected were censored as were those with natural immunity (anti HBc+)

Sampling methods

Bietapic conglomerates were used with probabilities proportional to the sizes of the first selection units (numbers of inmates per Centre). There were 18 correctional centres selected to represent a distribution throughout Spain, and with 21 randomly selected prisoners per Centre.

Statistical analyses

The measure of frequencies was prevalence. The mean and standard deviation (SD) or median and percentiles were used for quantitative variables. Student *t*-test and χ^2 test was used when appropriate. Crude odds ratios of prevalence (ORp) with its 95% confidence interval (CI) were calculated. For the variables that had both extremes of the 95%CI above and below unity, the adjusted ORp was calculated using a multiple logistic regression model. The level of significance for tests of hypothesis was $p < 0.05$. Analyses were performed with the SPSS package 10.0.

Results

Of 378 inmates studied, 370 (97.9%) had been tested for HCV with no differences in the socio-demographic characteristics of the two groups. Serological testing for HB surface antigen (HBs Ag) had been performed in 342 (90.5%) inmates, in a lower proportion of those <40 years of age (88% vs. 95.2%; $p=0.03$), in non-Spanish nationals (86.6% vs. 93%; $p=0.04$), non-IDU (88.2% vs. 98.8%; $p=0.03$) and those not infected with HCV (90.2% vs. 100%; $p=0.03$). The population testing positive for HCV was predominantly masculine (91.6%), young (66.7% ≤ 40 years of age) and of Spanish origin (60.5%). Among the non-Spanish population, the main groups were South American (12.7%), Moroccan (11.9%), and Romanian (4.6%). The characteristics are summarised in Table 1.

The prevalence (Table 2) of HCV infection was 22.7% ($n=84$; 95%CI: 18.3-27.1) and 2.6% ($n=9$; 95%CI: 0.2-4.9) for HBV; 40.5% of the HCV patients were co-infected with HIV.

There were 299 prisoners (79.1%) tested for the three serological markers of HB. Among these, 96 prisoners (32.1%) had post-vaccination immunity (isolated anti-HBS positive) and 91 (30.4%) had post-vaccination immunity (antiHB surface antigen positive) and 91 (30.4%) had contact status with HBV (HBcAb positive and/or HBsAg positive), while 112 (37.5%) were susceptible to HB. Results of serological testing for HBV, HCV and HIV were available in 342 (90.5%) patients. Of these, 5 (1.5%) presented with triple co-infection, 29 (8.5%) were co-infected with HIV and HCV, and 1 (0.3%) was co-infected with HBV and HCV.

Multivariate analysis (Table 3) confirmed that there was a higher prevalence of infection in those who had been incarcerated longer (OR: 5.2; CI: 2.1-12.8; $p<0.001$), born in Spain (OR: 7.5; CI: 1.8-30.5; $p=0.005$), were IDU (OR: 24.5; CI: 9.8-61.5; $p<0.001$) and in those who were co-infected with HIV (OR: 8.4; CI: 2.2-32; $p=0.002$).

The patients infected with HCV (n=84) corresponded (Table 4) to IDU consumption of 19.3 years duration (SD: \pm 6.5 years). HCV RNA had been measured in 76 (90.5%) patients and, of whom, 55.5% were genotype 1 and 25.4% were genotype 4. Evaluation of fibrosis was performed in the majority of patients using biochemical indices (Table 4). Fibroscan® studies had been performed in 13 (10.7%) patients and 3 had values \geq 14KPa. No patient had presented with clinical cirrhosis.

Treatment for chronic hepatitis C (CHC) had been administered to 13 (15.3%) patients, 8 (9.5%) had been on treatment and 63 (75%) had not been treated. A greater proportion of genotype 3 received treatment (33.3% vs. 7.9%; $p=0.004$); 6 of those treated (46.2%) had sustained viral response, but 1 had been re-infected subsequently.

In relation to HBV infection, the multivariate analysis confirmed the association with HIV (OR: 5.7, 95%CI: 1.0-32.5; $p=0.04$).

The 91 patients (44.8%) infected or with natural immunity were compared with the 112 (55.2%) susceptible to HBV infection. The probability of contact (HBc Ab+) was associated in the multivariate analysis with HCV (+) (OR: 23.2, 95%CI: 5.7-94.6; $p<0.001$). The 96 (46.2%) prisoners who had post-vaccination immunity were compared with the 112 (53.8%) who were susceptible. Vaccination was associated with being infected with HCV (OR: 3.1, 95%CI: 1.0-9.7; $p=0.05$) and date of incarceration (in or before 2006; OR: 5.2, 95%CI: 2.7-10.1; $p<0.001$).

Discussion

The Spanish prison population has changed considerably over the past decade. In 1998 [14] the prison population in Spain was composed of 38,604 individuals, mainly young males. Foreigners constituted around 17.4%, and 39% had a history of IDU. The prevalence of hepatitis viruses was 46.1% for HCV and 3.8% for HVB.

Ten years later, the mean prison population had risen to 68,397 (an increase of 77.2%), the age was greater (33.6% >40 years of age), the proportion of immigrants was higher (39.5%) and there was a decrease in prisoners with history of IDU (23.4%). Also, the prevalence of viral hepatitis had diminished notably; the current figures being 22.7% for HCV and 2.6% for HBV. The probable causes of this decrease are: a) the introduction in our penitentiaries of harm reduction programs associated with injection drug consumption, such as methadone substitution therapy [15,16], and the needle and syringe exchange program [17,18]; b) the introduction of free barrier contraceptives; c) decreased entry into prisons of individuals with a history of IDU, already stated earlier; and d) the implementation of specific programs for the diagnosis and treatment of these pathologies [19-21].

The factors (Table 2) that are significantly associated with HCV infection in our study have been noted previously in the Spanish prison population [10, 13]. In a recent meta-analysis [2] of studies in very different countries, there was a clear association between the prevalence of HCV infection in prisoners and the history of IDU and, at a lower level, with female gender and tattooing. Of note in our study was the strong association of HCV infection with being in prison >5 years (OR: 4.6) which could be related to there having been transmission within the prisons before the implementation of the harm reduction programs. Also of note was the important association with having being born in Spain (OR: 7.5) relative to those prisoners proceeding from other countries. The association was maintained in the multivariate analysis, and which had been hinted-at in earlier studies [13] but which had been difficult to explain. The findings may be related to the lower prevalence of the IDU habit in the immigrant population [22] and to the majority of inmates not born in Spain (Maghreb and South America) having prevalence rates that are similar to, or only slightly higher than, the autochthonous population [23-25].

Of those with HCV infection, 13.2% had undetectable HCV RNA; very similar to that observed in other studies (15-45%) [26, 27]. Of note is that the population studied did not have any biochemical evidence of an elevated grade of fibrosis, as had been described previously [28, 29]. Despite the implementation of programs [19-21, 30] for the control and treatment of CHC in the prisons, we found that the proportion of patients receiving treatment remained low. Among these, we observed sustained viral response (SVR) in 46.2%. The proportion showing re-infection was 7.7%; a proportion that is similar to other published studies [31,32]. With respect to HBV infection (Table 5), it is of note that the prevalence in our penitentiary environment is not proportionally as elevated as that of HCV, relative to the general population, and that this is maintained at slightly lower levels with respect to that in Spanish prisons in 1998 (3.8%). This could be the result of vaccination campaigns that have been conducted in Spanish prisons over the years.

The previous contact with HBV (having antibody HBc+) present in 30.4% of the prisoners, has decreased relative to the 45.6% in the prison population in 1998 [14]. A greater concern is the observed decrease in inmates with indications of having been inoculated (antiHBs+ isolated). In 1998 this was 42.9% and currently is 32.1%; the current level of inmates susceptible to HB is 37.6%, and these individuals need to be vaccinated [33]. This lack of vaccination could be due to a shorter stay in prison or to higher rotation through different prisons and, as well, to a lower efficacy of vaccination programs in prisons.

Appendix

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Competing interests:

None of the authors has any involvement that can be construed as a conflict of interest.

Adolfo Rivera is an employee of Schering-Plough S.A. and provided logistics support throughout the study.

Table 1. Socio-demographic variables in the population with HCV serology measurements

| Variable | | (n = 370) |
|------------------------------|--------------------------|-------------|
| Age; mean (SD) | | 35.8 (10.3) |
| Prison stay; mean (SD) | | 3.5 (4.3) |
| Gender | Male; n (%) | 339 (91.6) |
| | Female; n (%) | 31 (8.4) |
| Ethnicity | Black; n (%) | 14 (3.8) |
| | Maghrebi Arab; n (%) | 54 (14.6) |
| | Spanish Gypsy | 23 (6.2) |
| Non-Spanish nationals; n (%) | | 146 (39.54) |
| IDU; n (%) | | 86 (23.24) |
| Imprisonment | Prior to 2007 n (%) | 178 (48.1) |
| | Subsequent to 2006 n (%) | 192 (51.9) |

HCV: hepatitis C virus; IDU: injection drug users

Table 2. Prevalence of VHC, HCB and HCA infections

| Infection | | Prevalence % (95% CI) |
|----------------------------|----------|-----------------------|
| HCV Ab (n=370) | Positive | 22.7 (18.3-27.1) |
| HBs Ag (n=342) | Positive | 2.6 (0.23-4.9) |
| Natural HB contact (n=299) | Positive | 30.4 (27.7-33.0) |
| HBs Ab (vaccinated; n=299) | Positive | 32.1(29.4-34.8) |

HCV Ab: antibodies to hepatitis C virus; HBs Ag: hepatitis B surface antigen; Natural HB contact: defined as the presence of anti-core and/or HB surface antigen; Vaccinated: presence of the antibody anti-isolated HB surface antigen

Table 3. Variables associated with HCV

| Variable | | n (%) | ORc (95%CI) | p | ORa (95%CI) | p |
|---------------|------------|-----------|------------------|--------|-----------------|--------|
| Gender | Males | 82 (24.2) | 4.6 (1.1-19.8) | 0.02 | 5.5 (0.8-38.2) | 0.09 |
| | Females | 2 (6.5) | | | | |
| Age | ≥ 40 years | 38 (30.6) | 1.96 (1.2-3.2) | 0.008 | 1.5 (0.6-3.7) | 0.4 |
| | < 40 years | 45 (18.4) | | | | |
| Prison stay | ≥ 5 years | 55 (51.9) | 8.7 (5.1-15) | <0.001 | 5.2 (2.1-12.8) | <0.001 |
| | <5 years | 29 (11) | | | | |
| Black | Yes | 0 | 1.3 (1.2-1.4) | 0.04 | | |
| | No | 84 (23.6) | | | | |
| Arab | Yes | 0 | 1.4 (1.3-1.5) | <0.001 | | |
| | No | 84 (26.6) | | | | |
| Gypsy | Yes | 5 (21.7) | 0.9 (0.3-2.6) | 0.9 | | |
| | No | 79 (22.8) | | | | |
| Born in Spain | Yes | 81 (36.2) | 27 (8.3-87.5) | <0.001 | 7.5 (1.8-30.5) | 0.005 |
| | No | 3 (2.1) | | | | |
| IDU | Yes | 67 (77.9) | 55 (27.1-111.5) | <0.001 | 24.5 (9.8-61.5) | <0.001 |
| | No | 17 (6) | | | | |
| Imprisonment | ≤ 2006 | 52 (29.2) | 2.1 (1.3-3.4) | 0.004 | 0.8 (0.3-2) | 0.7 |
| | ≥ 2007 | 32 (16.7) | | | | |
| HIV | Positive | 34 (85.0) | 31.7 (12.7-79.5) | <0.001 | 8.4 (2.2-32) | 0.002 |
| | Negative | 50 (15.2) | | | | |
| HBs Ag | Positive | 6 (66.7) | 6.5 (1.6-26.8) | 0.003 | 10.1 (1.1-92.4) | 0.04 |
| | Negative | 78 (23.4) | | | | |

Notes to Table 3: ORc: Crude odds ratio; ORa: Adjusted odds ratio; HCV Ab: HCV antibody; HBs Ag: HB surface antigen; IDU: injection drug user; HIV: human immunodeficiency virus

Table 4: Characteristics of the population infected with HCV (n=84)

| Characteristic | | Mean (SD) | | |
|--|---------------|------------|--------------|-----------|
| Years of IDU (n= 69) | | 19.3 (6.5) | | |
| Years of HCV infection (n=83) | | 8 (5.2) | | |
| HCV+ RNA (n=76) | | 66 (86.8) | | |
| Detectable viral load HCV(n=62) | | 49 (79) | | |
| Median viral load HCV(n=49) | | 315,000 | | |
| 25 th percentile: 105,837; 75 th percentile: 1,701,043 | | | | |
| Viral load HCV <800,000UI (n=49) | | 31 (63.3) | | |
| Genotype | 1a | 23 (36.5) | | |
| | 1b | 12 (19) | | |
| | 3 | 12 (19) | | |
| | 4 | 16 (25.4) | | |
| APRI (n=78) | >1.5 (F:2-4) | 6 (8.2%) | | |
| | <0.5 (F0-1) | 32 (38.1%) | | |
| Forns (n=69) | >6.9 (F:2-4) | 6 (8.7%) | | |
| | <4.2 (F:0-1) | 33 (47.8%) | | |
| Fib 4 (n=73) | >3.25 (F:3-4) | 0 (4.1%) | | |
| | <1.45 (F:0-2) | 48 (65.8%) | | |
| RNA HCV (n=76) | Positive | Treated | On treatment | Untreated |
| | | 13(15.5%) | 8 (9.5%) | 63 (75%) |
| | | 13 (100) | 8 (100) | 45 (71.4) |

| | | | | |
|----------------|--------------|----------|---|-----------|
| | Negative | 0 | 0 | 10 (15.9) |
| | Not known | 0 | 0 | 8 (12.7) |
| Viral load HCV | Detectable | 8 (61.5) | | |
| | Undetectable | 5 (38.5) | | |

Notes to Table 4: APRI: aspartate aminotransferase to platelet count ratio as an index of fibrosis; Forns: fibrosis index based on platelet count, GGT, age, and cholesterol levels; FIB 4: fibrosis index based on platelet count, ALT and AST

Table 5. Variables associated with HBV

| Variable | | Prevalence HBV +ORc (95CI%) | p | ORa (95%CI) p | |
|---------------|------------|-----------------------------|------------------|---------------|--------------------|
| | | n (%) | | | |
| Gender | Males | 9 (100) | 0.9 (0.95-0.99) | 0.4 | |
| | Females | 0 (0) | | | |
| Age | ≥ 40 years | 4 (44.4) | 1.5 (0.4-5.7) | 0.5 | |
| | < 40 years | 5 (55.6) | | | |
| Prison stay | ≥ 5 years | 4 (44.4) | 2 (0.5-7.7) | 0.3 | |
| | <5 years | 5 (55.6) | | | |
| Black | Yes | 0 (0) | 1.02 (1.01-1.04) | 0.6 | |
| | No | 9 (100) | | | |
| Arab | Yes | 0 | 1.03 (1.01-1.05) | 0.2 | |
| | No | 9 (100) | | | |
| Gypsy | Yes | 1 (11.1) | 1.9 (0.2-15.6) | 0.6 | |
| | No | 8 (88.9) | | | |
| Born in Spain | Yes | 8 (88.9) | 5 (0.6-40.4) | 0.09 | |
| | No | 1 (11.1) | | | |
| IDU | Yes | 4 (44.4) | 2.4 (0.6-9.3) | 0.2 | |
| | No | 5 (55.6) | | | |
| Imprisonment | ≤ 2006 | 3(33.3) | 0.5 (0.1-2.1) | 0.3 | |
| | ≥ 2007 | 6 (66.7) | | | |
| HIV | Positive | 5 (56.6) | 10.6 (2.7-41.5) | <0.001 | 5.7 (1-32.5) 0.04 |
| | Negative | 4 (44.4) | | | |
| HCB Ab | Positive | 6 (66.7) | 6.5 (1.6-26.8) | 0.003 | 2.6 (0.4-15.8) 0.3 |
| | Negative | 3 (33.3) | | | |

Notes to Table 5: ORc: crude odds ratio; ORa: adjusted odds ratio; HB: hepatitis B; IDU: injection drug user; HIV: human immunodeficiency virus; HCV Ab: HCV antibody

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