Journal of Infection and Public Health 13 (2020) 521–526

Contents lists available at ScienceDirect

Journal of Infection and Public Health

journal homepage: http://www.elsevier.com/locate/jiph

Infectious diseases in post-trial detention and comparisons with pre-trial detention: A study in Geneva, Switzerland

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ARTICLE INFO

Article history:
Received 3 September 2019
Received in revised form 30 October 2019
Accepted 11 November 2019

Keywords:
Epidemiology
Infectious diseases
Prison health
Vulnerability

ABSTRACT

Background: Prevalence rates of infectious diseases in post-trial prisons have been scarcely investigated. Due to the specific characteristics of these prison populations, these prevalence rates may differ from pre-trial prisons and more information is needed for developing adequate prevention and treatment interventions. This study compared prevalence rates of hepatitis B virus (HBV), hepatitis C virus (HCV), susceptibility to varicella zoster virus (VZV) and measles in pre- and post-trial detention.
Methods: Data were collected in Geneva post-trial prisons among males (n = 250), including serological tests, demographics, and risk factors, and were compared to those of the Geneva pre-trial prison (n = 273).
Results and conclusions: Incarcerated men in post-trial detention shared a disproportionate burden of infectious diseases compared to community (chronic HBV: 5.9%, HVC: 2.8%, susceptibility to VZV: 5.9%, to measles: 4.7%). Susceptibility to VZV and prevalence rate of HCV were lower in post-trial prisons (p = .034 and p = .080). Prevalence rates of infectious diseases in prison should be interpreted in light of the prison population's characteristics. Screening and treatment should be promoted in all types of prison settings. Since overcrowding and turnover of pre-trial prisons restrict the access to screening, prevention and treatment of infectious diseases, interventions are crucial in post-trial prisons.

Introduction

The risk of infectious diseases is higher in prison than in the general population [1]. This high rate of infectious diseases is explained by several factors including environmental characteristics (e.g., prison overcrowding and promiscuity) and individual factors (e.g., regions of origin of people living in detention (PLD [2]), history of unhealthy behaviors) [3]. Some of these infectious diseases are vaccine-preventable, such as varicella zoster virus (VZV), measles, and hepatitis B (HBV). Other diseases are not vaccine-preventable, such as hepatitis C (HCV) and human immunodeficiency virus (HIV), but prevention programs may reduce exposition and infection. Prison can also be an opportunity of access to health care, including treatment and care of infectious diseases, vaccination programs, and public health prevention [3].

Previous studies reported prevalence rates of infectious diseases in pre-trial prisons, which are designed for PLD awaiting trials and for short-term detention (for example in Switzerland, where this study took place: [4–7]. On the contrary, data on post-trial prison (i.e., detention for sentenced PLD) are scarce. Due to the specific characteristics of these prison populations, such as differences in regions of origin, prevalence rates of infectious diseases in pre- and post-trial prisons may be different and more information is needed for developing adequate prevention and treatment interventions for PLD in post-trial prisons. Indeed, prevalence rates of infectious diseases depend upon the background prevalence rate of the population (i.e., region of origin) and to exposure to risk factors (e.g., injecting drug use) [3,5–7]. Pre-trial detention is more fre-

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https://doi.org/10.1016/j.jiph.2019.11.001

quent for foreigners as opposed to national people [8]. In Europe, several countries have more than 40% of foreign PLD, of whom two third are incarcerated in pre-trial prisons: Austria, Belgium, Cyprus, Estonia, Greece, the Netherlands, Spain, and Switzerland [9]. However, studies investigating differences between PLD in pre- and post-trial prisons are scarce.

To fill these knowledge gaps, this study investigated the prevalence rates of infectious diseases (HBV and HCV) and susceptibility to infectious diseases (VZV and measles) in Geneva post-trial prisons. We compared the PLD's characteristics and prevalence rates of infectious diseases to previous data published in the Geneva pre-trial prison. In addition, we tested associations of serological status with risk factors to provide an extended overview of infectious diseases in post-trial detention.

Material and methods

Study population

Data were collected in a cross-sectional study conducted at the post-trial prisons of Geneva (including three locations: La Brenaz, Favra, and Villars) between October 2010 and July 2013. Participants were eligible for study inclusion if they were not released the following week. All PLD provided informed consent before participating in the study. Consent forms and questionnaires were translated into nine languages (Albanian, Arabic, English, French, German, Italian, Russian, Serbo-Croatian, and Spanish). All questions and blood samples were administered/collected by a physician. A total of 262 PLD were invited to participate in the study, of which 250 accepted (response rate = 84.0%). Most participants were incarcerated at La Brenaz (85.6%, on average sentences of two years and more), 7.2% at Favra (administrative detention for undocumented migrants), and 7.2% at Villars (short term sentences, <6 months). Twenty participants refused the blood test (8.0%).

The Clinical Ethics Research Committee of the University Hospitals of Geneva (HUG) approved the study.

Measures

Measures included blood tests and a socio-demographic questionnaire.

Serological testing

Participants underwent serological testing for HBV, HCV, VZV, and measles. For HBV, we used surface antigen (HBsAg), antibodies against HBV core antigen (anti-HBc) and antibodies against surface antigen (anti-HBs) (EIA Architect system, Unilabs laboratory, Geneva). HBsAg positivity signalled chronic infection. The presence of anti-HBc antibodies and negative HBsAg indicated resolved/prior infection. Serum samples were tested by commercial immunoenzymatic assays for HCV (anti-HCV, Architect, Abbott). Anti-HCV reactivity were always confirmed via INNO-LIA^{TM} HCV score line immune assay (Innogenetics, Belgium). Measles and VZV IgG antibody titers were measured by enzyme-linked fluorescent assay and immunoassay (Vidas, BioMérieux).

Questionnaire

The questionnaire included socio-demographic characteristics of participants (age, educational level, and region of origin), and exposure to risk factors potentially related to infectious diseases (injecting drug use and sexual behavior) [5]. Items are listed in Table 1.

Statistical analyses

We first computed descriptive statistics for socio-demographic variables and prevalence rates of infectious diseases with 95% confidence intervals (CI). Then, we compared socio-demographic profiles and prevalence rates of infectious diseases in post-trial prisons with those obtained in the pre-trial prison in a previous study conducted in 2009 and 2011 (n = 273). This information was collected in a previous study that led to four articles: VZV [7]; measles [6]; HBV [5]; and HCV [4]. We tested whether socio-demographic profiles and prevalence rates were different in the two kinds of prisons using z tests to compare two proportions. Finally, we tested associations of socio-demographics and risk factors with serological status using Fisher exact tests.

Results

Characteristics of the prison sample

Socio-demographic profiles are reported in Table 1, along with comparisons with the pre-trial prison. More than half of the participants were younger than 28 (52.8%), which was non-significantly different from the pre-trial prison ($p = .271$). Participants in post-trial prisons were more likely to come from North Africa ($p < .001$), Western Europe ($p = .003$, with a similar proportion of Swiss participants, $p = .803$), and Asia/Middle East ($p = .052$) than participants in the pre-trial prison. On the contrary, they were less likely to come from sub-Saharan Africa ($p = .004$), Eastern Europe ($p < .001$), and Latin America ($p < .001$). In post-trial prisons, participants were significantly less educated than in the pre-trial prison ($p < .001$). There was no significant difference in injecting drug use ($p = .142$), but there were some significant differences for sexual behaviors, with participants in the post-trial prison having a higher number of sexual partners ($p = .002$) and being more likely to have sexual intercourse with sex workers ($p = .017$). The proportion of first sexual intercourse at 16 or earlier was higher in the pre-trial prison ($p = .043$).

Prevalence rates of infectious diseases

Prevalence rates of infectious diseases are reported in Table 2. A total of 5.9% of the participants from post-trial prisons had a chronic HBV infection (22.0% had a resolved HBV infection, 17.1% were vaccinated, and 55.0% were negative), and 2.8% had HCV. Susceptibility to VZV concerned 5.9% of the participants, and 4.7% for susceptibility to measles. The prevalence rate of HCV was marginally lower in the post-trial prison sample in comparison with the pre-trial prison sample ($p = .080$), and susceptibility to VZV was significantly lower ($p = .034$). There were no differences for HBV and measles between the two kinds of prisons.

Associations between serological status and risk factors

Table 3 reports the associations between serological status and risk factors in the post-trial prison sample. Some regions of origin were associated with an increased prevalence rate of infectious diseases: Sub-Saharan Africa for HBV (statistically significant comparisons with North Africa, Western Europe, and Asia/Middle East, $p < .05$); Eastern Europe and Balkans for chronic HBV (with North Africa and Western Europe, $p < .05$), and VZV susceptibility (with Western Europe, $p < .05$); and Western Europe for HCV (with North Africa and Sub-Saharan Africa, $p < .05$). Of all risk factors for infectious diseases, there was only one significant association: injecting drug use was associated with a significant increase in the prevalence rate of HCV ($p < .001$).

Table 1
Participants' characteristics of the Geneva post-trial prisons and comparisons with previous data in Geneva pre-trial prison.

	Geneva post-trial prisons (2010–2013)	Geneva pre-trial prison (2009–2011)	Comparisons between pre- and post-trial prisons	
			z-test	p
Region of origin				
North Africa	36.9 (92)	11.4 (31)	6.86	<.001
Sub-Saharan Africa	17.3 (43)	28.2 (77)	−2.96	.003
Eastern Europe and Balkans	16.9 (42)	37.7 (103)	−5.30	<.001
Western Europe / Switzerland	18.1 (45) / 3.6 (9)	9.2 (25) / 3.2 (9)	2.98 / 0.31	.003 / .757
Latin America	2.4 (6)	9.5 (26)	−3.38	<.001
Asia/Middle East	8.0 (20)	4.0 (11)	1.94	.052
USA	0.4 (1)	0 (0)	1.05	.294
Age				
< 28	52.8 (132)	48.0 (131)	1.10	.271
≥ 28	47.2 (118)	52.0 (142)		
Level of education				
Not completed secondary school	66.3 (165)	49.4 (131)	−3.88	<.001
Completed secondary school	33.7 (84)	50.6 (134)		
Condom use for sexual protection				
Always	35.0 (86)	32.8 (87)	0.53	.596
Sometimes or never	65.0 (160)	67.2 (178)		
Sexual orientation				
Homosexual/bisexual	3.7 (9)	2.3 (6)	0.93	.352
Heterosexual	96.3 (237)	97.7 (258)		
Number of sexual partners				
0 to 5	15.7 (39)	27.0 (71)	−3.07	.002
6 or more	84.3 (209)	73.0 (192)		
Age of first sexual intercourse				
≤ 16 years	63.6 (154)	54.8 (137)	2.03	.043
> 16 years	36.4 (88)	45.2 (113)		
Sexual intercourse with sex workers				
Never	36.8 (91)	47.2 (125)	−2.38	.017
At least once	63.2 (156)	52.8 (140)		
Injecting drug use				
Yes	3.2 (8)	5.9 (16)	1.47	.142
No	96.8 (242)	94.1 (253)		

Table 2
Prevalence rates of infectious diseases among people living in detention in the Geneva post-trial prisons and comparisons with previous data in Geneva pre-trial prison.

		Infectious diseases in the Geneva post-trial prisons (2010–2013)	Infectious diseases in the Geneva pre-trial prison (2009–2011)	Comparisons between pre-and post-trial prisons	
	n			z-test	p-Value
HBV (chronic infection)	222	5.9 [2.7–9.0]	5.9 [3.6–9.3]	0.0	1
HCV	211	2.8 [0.9–5.2]	6.2 [3.9–9.7]	1.8	.080
VZV (susceptibility)	219	5.9 [3.2–9.1]	12.7 [6.5–18.9]	2.1	.034
Measles (susceptibility)	212	4.7 [1.9–5.2]	6.0 [2.5–12.0]	0.5	.610

HBV: hepatitis B, HCV: hepatitis C, VZV: varicella zoster virus.
Percentages with 95% confidence intervals are reported.

Being born after the mass vaccination campaign in the country of origin was not associated with an increased prevalence rate of susceptibility to measles. Data are reported in Table 4.

Discussion

This study investigated prevalence rates of infectious diseases among incarcerated populations in post-trial prisons and compared prevalence rates and prison population characteristics with a pre-trial prison.

Prevalence rates of infectious diseases

Our results highlighted high prevalence rates of infectious diseases in post-trial prisons. The prevalence of HBV (5.9%) was 33 times higher than that in the Swiss population [10]. This result was similar to the prevalence rate obtained in the Geneva's pre-trial prison [5]. The prevalence rate of HCV was four times higher in post-trial prisons than in the Swiss population [11]. However, it was significantly lower than that in pre-trial prison, in which the previous study reported a nine-fold increase compared with the Swiss population [4]. The susceptibility to VZV (5.9%) was higher than in the general population (susceptibility of 0–3% in Western Europe), and lower than the susceptibility in pre-trial prison [7]. The susceptibility to measles was fairly low (4.7%) and comparable to the susceptibility in pre-trial prison [6].

These different prevalence rates can be understood in light of the characteristics of the prison populations in pre- and post-trial prisons. Indeed, regions of origin were very different in pre- and

Table 3
Associations of serological status with socio-demographics and risk factors in the post-trial prisons sample.

	Chronic HBV		HCV		Susceptibility to VZV		Susceptibility to measles	
n (%)	p-Value	n (%)	p-Value	n (%)	p-Value	n (%)	p-Value	
Region of origin[1]								
North Africa	1/79 (1.3%)		0/77 (0.0%)		6/80 (7.5%)		4/74 (5.4%)	
Sub-Saharan Africa	**7/37 (18.9%)**		0/34 (0.0%)		2/35 (5.7%)		0/37 (0.0%)	
Eastern Europe and Balkans	**4/39 (10.3%)**	–	1/34 (2.9%)	–	**4/40 (10.0%)**	–	2/39 (5.1%)	–
Western Europe	0/41 (0.0%)		**5/40 (12.5%)**		0/39 (0.0%)		2/38 (5.3%)	
Asia/Middle East	1/19 (5.3%)		0/19 (0.0%)		1/19 (5.3%)		1/18 (5.6%)	
Latin America	0/5 (0.0%)		0/5 (0.0%)		0/4 (0.0%)		1/4 (25.0%)	
Age								
<28 years	8/118 (6.8%)	.580	1/113 (0.9%)	.099	8/116 (6.9%)	.579	8/111 (7.2%)	.105
≥28 years	5/104 (4.8%)		5/98 (5.1%)		5/103 (4.9%)		2/101 (2.0%)	
Education level								
Secondary school not completed	9/146 (6.2%)	1	4/140 (2.9%)	1	8/143 (5.6%)	.770	7/139 (5.0%)	1
Secondary school completed	4/76 (5.3%)		2/71 (2.8%)		5/76 (6.6%)		3/73 (4.1%)	
Condom use for sexual protection								
Always	5/69 (7.2%)	.523	2/68 (2.9%)	1.000	4/70 (5.7%)	1.000	1/67 (1.5%)	.175
Sometimes or never	7/152 (4.6%)		4/142 (2.8%)		9/148 (6.1%)		9/144 (6.3%)	
Sexual orientation								
Homosexual/bisexual	0/8 (0.0%)	1	1/8 (12.5%)	.210	0/8 (0.0%)	1	0/7 (0.0%)	1
Heterosexual	12/213 (5.6%)		5/202 (2.5%)		13/210 (6.2%)		10/204 (4.9%)	
Number of sexual partners								
0 to 5	2/33 (6.1%)	1	2/32 (6.3%)	.228	1/33 (3.0%)	.698	2/32 (6.3%)	.651
6 or more	11/188 (5.9%)		4/178 (2.2%)		11/185 (5.9%)		8/179 (4.5%)	
Age of first sexual intercourse								
≤16 years	8/139 (5.8%)	1	3/131 (2.3%)	.671	9/137 (6.6%)	.773	5/133 (3.8%)	.501
>16 years	4/79 (5.1%)		3/76 (3.9%)		4/78 (5.1%)		5/75 (6.7%)	
Sexual intercourse with sex workers								
Never	5/77 (6.5%)	.772	3/74 (4.1%)	.668	4/77 (5.2%)	1	5/73 (6.8%)	.322
At least once	8/143 (5.6%)		3/135 (2.2%)		8/140 (5.7%)		5/137 (3.6%)	
Injection drug use								
No	13/214 (6.1%)	1	2/203 (1.0%)	<.001	13/211 (6.2%)	1	9/294 (4.4%)	.325
Yes	0/8 (0.0%)		4/8 (50.0%)		0/8 (0.0%)		1/8 (12.5%)	

HBV: hepatitis B, HCV: hepatitis C, VZV: varicella zoster virus.
Region of origin: pairwise comparisons between regions were performed. Bold values are significantly different from some other regions at $p < .05$. Otherwise, p-values for exact Fisher tests are reported.
[1] USA was not included in the analyses because n = 1.

Table 4
Relationships between mass campaign vaccination for susceptibility to measles and region of origin.

	n (%)	p-Value
Born before	3/67 (4.5%)	.897
Born after	7/144 (4.9%)	

p-Values for Fisher exact tests are reported.
"Born before" mass campaign vaccination group: born in Western Europe before 1964, Eastern Europe and Balkans before 1982, Latin America before 1982, North Africa before 1982, Middle East before 1992, and all Sub-Saharan Africa (not susceptible to measles).
"Born after" mass campaign vaccination group: born in Western Europe since 1964, Eastern Europe and Balkans since 1982, Latin America since 1982, North Africa since 1982, and Middle East since 1992.

post-trial prisons. PLD in pre-trial detention are more likely to be undocumented migrants or foreigners (except in prisons designed for administrative detention for undocumented migrants). This is especially true in Switzerland, where the proportion of foreign PLD in pre-trial prisons is very high (on average in all Switzerland: 72.0%, [12]; in the largest Swiss pre-trial prison: 87.8%, [13]. In Switzerland, people who committed minor offences may be incarcerated before trial to prevent them from escaping abroad. This situation is more likely to concern foreigners without significant ties in the country (e.g., family, house, job). In prison, PLD's region of origin is associated with different exposures to infectious diseases.

Susceptibility to VZV

VZV may be inactive in tropical and subtropical countries due to climatic reasons [7,14]. As a consequence, the susceptibility to VZV is higher for adults in these regions and for PDL coming from these regions [7]. A lack of immunity of migrants from Eastern Europe has also been previously documented [15]. Additionally, in Western countries, native people are less likely to be susceptible than migrants [16]. Therefore, the lower susceptibility to VZV in post-trial prisons could be explained by the lower proportion of participants from Sub-Saharan Africa and Eastern Europe and the higher proportion of participants from Western Europe compared to the pre-trial prison. VZV is a highly contagious viral disease with more complications and a higher mortality in adults than in children. As the susceptibility rate is higher in prison than in the community, preventive measures such as vaccination and quarantine must be planned to limit the risk of the spread of VZV in prison setting [7].

HBV

HBV is also endemic in some regions. For example, Sub-Saharan Africa is a high endemic area [17]. However, there was no difference in the prevalence rate of HBV between pre- and post-trial prison populations, even if the proportion of PLD originating from Sub-Saharan Africa was lower in post-trial prisons. An inclusive approach to the management of HBV within the global health context needs to also incorporate prison population, as incarcerated people have a disproportionate burden of HBV infection [5].

Measles

Mass vaccination programs conducted in different countries can also affect the incidence of infectious diseases. In Western Europe, before the beginning of mass vaccination programs in the late 1960s, large and frequent outbreaks induced a high morbidity during childhood but led to excellent acquired immunity in adult populations [6]. Mass vaccination reduced the amplitude of epidemics but resulted in non-negligible susceptibility in adulthood, because vaccination coverage was incomplete and unvaccinated people mostly remained non-immune. Additionally, unvaccinated people also often remained susceptible due to lowered virus circulation after a large-scale vaccination has been introduced. In the Balkans and in Northern Africa, vaccination campaigns were implemented in 1981, whereas people from sub-Saharan Africa are likely to be immune against measles because they had the disease in childhood, as large-scale vaccination campaigns were generally inefficient until the turn of the 21st century [6]. Therefore, susceptibility to measles varies according to the region of origin and age of individuals.

However, despite differences in prison populations between pre- and post-trial prisons, there was no difference in susceptibility to measles. Few participants were born before the implementation of mass vaccination programs (participants from North Africa: n = 26, participants from Eastern Europe: n = 11) and there was no significant difference between age and susceptibility to measles for these participants.

HCV

There was a marginal difference in the prevalence rates of HCV between pre- and post-trial prison populations. One important factor that may explain this finding was that some PLD who inject heroin were not incarcerated at the post-trial prisons of Geneva at the time of the study. Indeed, no opioid substitution program was available at that time. Injecting drug use is a major risk factor of HCV [18] and also shown in our results with a significant association between injecting drug use and HCV. As a consequence, the prevalence rate of HCV may be lower in post-trial prisons.

Limitations

This study had several shortcomings. First, there may be a response bias due to the self-assessment of socio-demographics and risk factors. Second, occult HBV infections cannot be excluded, but these cases are rare and result in a limited under-evaluation of HBV [19]. Third, there were a limited number of positive cases and therefore, investigating risk factors was limited by the lack of power. Finally, data were collected a few years ago and there could have been changes in the prison population since then. However, a previous study conducted in this prison reported that the prison population did not change over time (socio-demographic profiles, rates of mental health treatment, and substance use) [20].

Conclusions

This study showed that incarcerated people have a disproportionate burden of infectious diseases. Prevalence rates of infectious diseases in prison should be interpreted in light of the characteristics of the prison population, especially their region of origin and specific risk factors (injecting drug use). Screening and treatment should be promoted in all types of prison settings. Since overcrowding and turnover of pre-trial prisons restrict the access to screening, prevention and treatment of infectious diseases [3], interventions are crucial in post-trial prisons. Such a prevention strategy would also benefit the general population as a whole through the prevention of infectious diseases transmission after release.

Authors contributions

LG and JPR conceived the study's objective. SB drafted the manuscript and performed the statistical analyses. JPR collected data. KCP, JPR, NTT, HW, and LG made substantial contributions in the interpretation of the data. KCP, JPR, NTT, HW, and LG revised the manuscript critically for important intellectual content. All authors approved the final version to be published and agreed to be accountable for all aspects of the work related to its accuracy and integrity.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Funding

No funding sources.

Competing interests

None declared.

Ethical approval

Not required.

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