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Prevalence and risk of Propagation of Covid-19 Infection among Prisoners in Niamey-Niger

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Abstract

Background: Covid-19 pandemic is still a major global public health concern. The World Health Organization recommends several measures for the disease prevention particularly in disfavored settings like prisons. However, these measures are difficult to implement due to overcrowding, low education level, and poor medical conditions of prisons. We aim to determine the prevalence and the risk of propagation of Covid-19 among prisoners at the prison civile of Niamey, Niger.

Methods: A standardized questionnaire was used to collect detainee's epidemiological and clinical characteristics. Nasopharyngeal swabs and blood samples were collected for respectively the molecular detection of SARS-CoV-2 by qRT-PCR and determining the seroprevalence using WANTAI SARS-CoV-2 Ab ELISA kit. Importantly, the ELISA kit was used as reference test to assess the diagnostic performance of the Panbio™ COVID-19 IgG/IgM Rapid Test Device.

Results: A total of 301 inmates were enrolled of which 273 (90.70%) were male and median age of 30.49 years. qRT-PCR confirmed cases accounted for 32 (10.63%) while 253 (84.10%) were positive for total antibodies using ELISA test. The sensibility and specificity of the rapid test compared to the reference test were respectively 63% [IC95% (+/- 5.37)] and 90% [IC95% (+/- 3.05)]. The assessment of detainee's compliance to Covid-19 prevention measures showed that hand washing was the most used practice.

Conclusions: Our findings highlighted the circulation of SARS-CoV-2 virus in carceral institution in Niger. More data needs to be gathered in order to fully estimate the sanitary impact of this threat. Therefore, this vulnerable group should be considered in the prevention strategy including vaccination.

Keywords: Prison, Covid-19; Prevalence, Assessment, Niger

Background

The ongoing global pandemic of coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and has become a major public health concern since 2020 [1, 2]. Covid-19 is a highly contagious infection and it's mainly transmitted via the respiratory route through droplets inhalation or contact with infected cases or surfaces [3]. The disease has broad clinical manifestations that commonly include fever, dry cough, fatigue and loss of taste [4]. The spectrum of Covid-19 ranges from asymptomatic to critical including mortality [5]. Globally, as of

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15 July 2022, about 560 million confirmed cases out of which more than 6,37 million died have been reported. In Niger, officially 9,096 confirmed cases among which 311 fatal cases have been reported although, this number is certainly underestimated due to the low number of tests performed [6].

The prison is a confined environment where the only contact inmates have with the outside world is carceral staff and family visits [7]. However, the prisons are at high risk of Covid-19 propagation as they concentrate a disadvantaged population within a significantly closed vicinity with overcrowding, poor healthcare services quality and inability to comply with most of social distancing and hand hygiene rules [8, 9]. Moreover, inmates are often more exposed to other predisposing Covid-19 factors such as, smoking, weak immune defense, poor nutrition and pre-existing diseases [10].

The World Health Organization (WHO) recommends several measures to prevent and limit the spread of Covid-19 worldwide which include social distancing, wearing masks, washing hands regularly and vaccination [11, 12]. As part of public health action, additional guidelines on COVID-19 preparedness, prevention and control in prison and other detention settings have been developed such as decongesting and limiting family visits to the inmates [13].

However, preliminary studies conducted in France and in Italy by the International Prison Observatory have reported the vulnerability of inmates to Covid-19 highlighted by hundreds of contaminations despite the measures set-up [13, 14] Since the detection of the first cases of Covid-19 on 19th March 2020, the emergency situation related to the spread of COVID-19 in Niger has led to inevitable consequences on the penitentiary system. The risks of epidemics in prisons are mainly related to persistent overcrowding which makes social distancing difficult and isolation of contagious cases hard to manage [15]. Therefore, this study aims to report the prevalence and the risk factors for propagation of Covid-19 among prisoners at the prison civile of Niamey, the capital city of Niger.

Methods

Study design

The prison civile de Niamey is among the oldest carceral institution in Niger and has been created in 1947 (during the colonial period). The prison is now located in the downtown of the capital city and is composed of two main quarters for men and women. The population of the prison has highly increased over years and to date more than 1,300 detainees including minors, adults and women are incarcerated for a theoretical capacity of 350 meaning an occupancy rate of 371%.

With the advent of Covid-19 outbreak in Niger, a number of measures for prevention and containment of SARS-CoV-2 infection has been adopted by the government in order to mitigate the risk of propagation of the virus in prisons. Some of these measures include closing of parlors, suspensions of family visits and incarceration of new prisoners. We conducted a prospective study from November 2020 to February 2021 at the prison civile of Niamey to determine the prevalence of Covid-19 among this vulnerable population and also to assess the control measures in place.

We used a random nonprobability sampling method to select individual from a list of detainees with detention stay less than six months. In the absence of Covid-19 data among prisonners, the sample size was calculated based on the prevalence of SARS-CoV-2 infection in Niamey at the study period, which was about 20% among the general population. Therefore, the expected prevalence was estimated to be < 10% (+/- 5%) with an alpha risk of 5% and a power of 95%. Inclusion to the study was conducted regardless to the Covid-19 case definition. A standardized questionnaire was administrated to record detainee's demographic characteristics, clinical symptoms, preexisting affections, Covid-19 exposure history, nutritional status, adherence to infection prevention and control measures.

Sample collection and laboratory procedures

Nasopharyngeal swabs (NS) and blood specimens (BS) were collected from all enrolled detainees. The NS were placed in cryovials containing virus transport medium (Copan kit) and kept in cold box before transportation to CERMES. These samples were used for the molecular detection of SARS-CoV-2 by real-time reverse transcription polymerase chain reaction (qRT-PCR) according to the laboratory protocol. The BS were collected by venipuncture using sterile syringe and vacutainer tube holder. This technic was carried out by experienced phlebotomist and appropriate disposal container was used to handle sharp materials. These samples were used to determine inmate exposure to SARS-CoV-2 using Panbio™ COVID-19 IgG/IgM Rapid Test Device and WANTAI SARS-CoV-2 Ab ELISA kit. This ELISA kit was also used as the reference test to assessed the diagnostic performance of the Panbio™ COVID-19 IgG/IgM Rapid Test Device.

Assessment of detainee's nutritional status

Optimal nutrition and dietary nutrient intake impact the immune system, therefore could expose to severe form of Covid-19. We therefore assess the inmates nutritional status based on the CDC Growth Charts including obesity, overweight, underweight, and short stature. Anthropometric index such as weight, height and age were recorded for all detainees included in the study. Dietetic habits were assessed through consumption of animal products, vegetables, fruits and tubers.

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Assessment of prevention and control measures

Compliance to three main measures recommended by the health authorities for the prevention and control of Covid-19 including hand washing, use of hydroalcoholic gel and use of mask were assessed through the questionnaire administration. While hand washing stations were easily accessible by detainees, the availability of masks and hydroalcoholic gel depends mainly on the support of non-governmental organizations. The frequency use of the three measures were categorized into five variables as follow ''Never''; ''Rarely''; ''Occasionally''; ''Most of time'' and ''Always as recommended''.

Data management and analysis

Questionary information and laboratory results were recorded in an Excel database and analysis were made using Stata version 12 (StataCorp, Texas, USA). We used the X2 test,fisher exact test and Kruskall-Wallis test to assess differences in proportion. A two-sided p-value of <0.05 was considered significant. We analyzed the demographic characteristics of the study subjects and the positive cases of SARS-CoV-2 using different tests, as well as assessment of prevention and control measures at the prison civile de Niamey.

Ethics and enrollment procedures

This study has been approved by the National Ethics Committee of Niger (CCNE) by letter referenced 050/2020/CNERS of 5th October 2020 and by the Ministry of Justice in charge of carceral institutions Management in Niger. An information note detailing the study objectives, the types of samples collected and the participant rights, was first addressed to the detainees by the survey staff. Additionally, because the majority of the inmates were not educated a verbal informed consent was obtained prior to enrolment.

Results

Over the study period we enrolled a total of 301 inmates, of which 273 (90.70%) and 28 (9.30%) were respectively male and female. The majority of inclusions 276 (91.7%) were between age of 15 to 45 with a median age of 30.49 years. Asthma and other chronic lung diseases including tuberculosis were the predominating predisposing diseases with respectively 29 (9.63%) and 24 (7.97%). 216 (71.80%) inmates have contact with outside visitors during the month proceeding the study (Table 1).

Table 1: Study population demographic characteristics compared to Covid-19 status

Characteristics	qRT-PCR			ELISA		
	Negative (n=268)	Positive (n=32)	Total (N=301)	Negative (n=48)	Positive (n=253)	Total (N=301)
Age (years)						
< 30	152 (50.67)	13 (4.33)	165 (55.00)	28 (9.63)	137(45.51)	165 (54.82)
30-44	98 (32,55)	14 (4.67)	112 (37.20)	16 (5.22)	94 (31.22)	110 (36.54)
45-59	17 (5.67)	3 (1.00)	20 (6.67)	3 (1.00)	15 (4.98)	18 (5.98)
≥ 60	2 (0.67)	2 (0.67)	4 (1.33)	1 (0.33)	7 (2.33)	8 (2.66)
Sex						
Female	27 (8.97)	1 (0.33)	28 (9.30)	23 (7.64)	5 (1.66)	28 (9.30)
Male	242 (80.40)	31 (10.30)	273 (90.70)	25 (8.31)	248 (82.39)	273 (90.70)
Contact with visitors						
No	80 (26.67)	4 (1.33)	84 (28.00)	15 (4.98)	69 (22.92)	84 (27.91)
Yes	188 (62.67)	28 (9.33)	216 (71.80)	33 (10.96)	183 (60.80)	216 (71.76)
Common predisposing diseases						
Asthma	28 (9.30)	1 (0.33)	29 (9.63)	8 (2.66)	21 (6.98)	29 (9.63)
Others lung diseases	22 (7.31)	2 (0.66)	24 (7.97)	5 (1.66)	19 (6.31)	24 (7.97)
HIV	3 (1.00)	1 (0.33)	4 (1.34)	0 (0.00)	4 (1.33)	4 (1.33)

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The nutritional status of detainees has been assessed based on the nature of food consumed and the determination of the Body Mass Index (BMI) using the anthropometric indicators. Foods containing animal products were mostly consumed (201; 66.78%) compared to tubercules (99; 32.89%) and vegetables (85; 28.24%). Globally, 248 (82.39%) detainees have normal BMI, 48 (15.95%) were under weight and 99 (32.89%) were overweight. However, 163 (54.15%) inmates have been detained for less than 15 days. There is no statistical relationship between the nutritional and covid-19 status (p>0.05), although no detainees presented a severe form of Covid-19.

Covid-19 positive cases by qRT-PCR accounted for 32 (10.63%) with 31 (96.9%) cases been male (Figure 2) and 27 (8.97%) were aged less than 44 years (Table 1). There was high statistically significant relation between positive cases and number of visits received by inmates during the last two weeks 28 (87.50%; p=0.026) (Table I). The detention period for enrolled inmates varies with 251 (83.40%) detained for less than one month with a maximum stay of 6 months.The majority of qRT-PCR confirmed cases (6.64%) has detention length of less than one week, and this number seems to decrease with long detention period (Figure 1).

Three measures for the prevention and control of Covid-19were mainly used, including hand washing, use of hydroalcoholic gel and use of mask. Globally, 181 (60.13%) detainees perform hand washing always as recommended compare to use of mask 32 (10.63%) and use of alcoholic gel 6 (1.99%) (Figure 2). However, there is no statistical correlation between the non-compliance with the prevention and control measures and the qRT-PCR confirmed cases (P>0.05).

The global exposition status of detainees to SARS-CoV-2 has been assessed using WANTAI SARS-CoV-2 Ab ELISA kit, with 253 (84.05%) been positive for total antibodies with a majority (91.36%) aged less than 44 years (Table I). Considering the results of the Panbio™ COVID-19 IgG/IgM Rapid Test Device, only 165 (54.81%) cases were positive for either IgM and IgG. Indeed, 17 (5.64%) were positive for IgM, 138 (45.84%) positive for IgG and 10 (3.32%) positive for both IgM and IgG. (Figure 3)

Part of this study, we assessed the diagnostic performance of the Panbio™ COVID-19 IgG/IgM Rapid Test Device compared with the WANTAI SARS-CoV-2 Ab ELISA kit used as the reference test. While the ELISA test was able to detected total antibodies among 84.01% detainees, the RDT only detected antibodies in 54.80% cases among which 5 (3.03%) were not confirmed positive by the reference test and 43 (31.60%) were confirmed negative. Globally, the sensibility and specificity of the rapid test compared to the reference test were respectively 63% [IC95% (+/- 5.37)] and 90% [IC95% (+/- 3.05)].

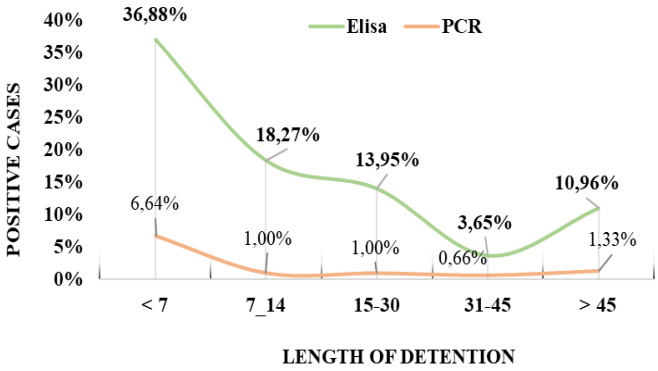

Figure 1: Impact of detention against RT-PCR and ELISA positive cases

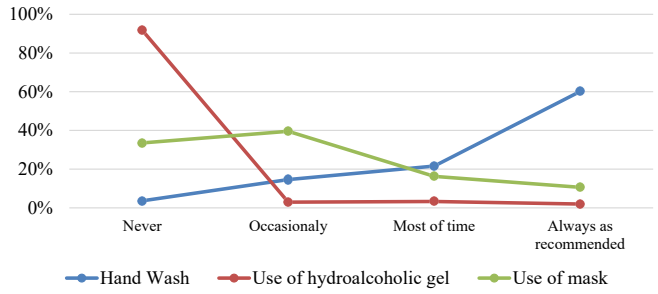

Figure 2: Assessment of the compliance of detainees to Covid-19 prevention and control measures

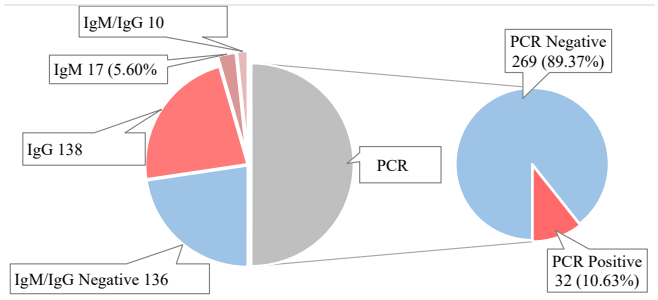

Figure 3: Covid-19 confirmed cases by qRT-PCR and RDT

Discussion

Between November 2020 to February 2021 Niger experimented a second wave of Covid-19 epidemics in Niger. During this time, this study was conducted to determine the prevalence of Covid-19 among detainees at the civilian prison of Niamey. The nutritional status of detainees enrolled in this study showed satisfactory results with the majority of detainees presenting normal condition. These findings are contrary to those reported in a similar study in Democratic Republic of Congo where 86% of detainees suffered for malnutrition [16]. This could be explained by the limited duration of detention for most detainees, as 73.11% have a stay less than 30 days.

The detection rate of Covid-19 by qRT-PCR (10.63%)

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among detainees was much higher than that reported by the national surveillance during the study period. Indeed, by 31st December 2020, the Covid-19 qRT-PCR detection rate in Niamey was estimated at 3.8%, although mostly among travelers (Niger Sitrep Covid-19 N°153 of 18 to 21 December 2020). This high detection rate could be attributed mainly to the environmental conditions characterized by surpopulation of the prison and the poor control and prevention measures in use. This was in agreement with data reported by a previous study in Italy where, during the first and second waves, such a discrepancy between detainees and general population was described [17]. In our study, the rate of Covid-19 infection was found to be much higher among males (96.9%) than females, which could be mainly attributed to high predominance of males in the carceral population (91%) resulting in surpopulation of the male quarters, as previously reported [18, 19]. However, this study was conducted after the resume of social visits and short time of detention during which contamination could have occurred.

In the same line, seroprevalence of Covid-19 among detainees using ELISA tested was very high (84.05%) meaning that nearly all detainees have been exposed to SARS-CoV-2 virus whether during or before incarceration. This results is consistent with that reported by similar study conducted in Brazil although using different diagnostic method [20], and support the necessity to conduct seroprevalence studies among general population in Niger in order to better estimate the level of contamination. Moreover, the high Covid-19 seroprevalence among detainees with a short detention period could support this group represent an elevated risk for Covid-19 dissemination in the prison. This result is in accordance with the result of a study from Switzerland which reported that people living in detention who were incarcerated before the beginning of the pandemic had a significantly lower seroprevalence rate [0.9%, CI 95%: 0.1%-5.9%] compared to the general population (6.3%, CI 95%: 5.6-7.3%) (p = 0.041) [21]

To routinely monitor the contamination of prisoners, one strategy could be the use of Covid-19 rapid diagnostic test for testing of the carceral population or for symptomatic cases. As part of this study, we evaluate the performance of the Panbio™ COVID-19 IgG/IgM rapid test, which showed acceptable sensibility and specificity compared to the Elisa test used as reference. This finding, were in agreement with the results of previous studies which reported acceptable performance of this test particularly after 14 days symptoms onset [22, 23].

Besides, our findings, pointed out the role of prevention and control measures in the covid-19 risk mitigation. including hand washing, use of alcoholic gel and wearing of mask at the prison civil of Niamey to contain the risk of infection. Among these assessed control measures, hand washing appears to be the most used by detainees based on the answers provided. This could be explained by the constant availability and probably socio-cultural practice [10]. Importantly, at the beginning of the epidemics, the social distancing strategy such as suspension of family visits and parlor closures have been approved by the government. However, the high level of overcrowding constitutes an elevated risk for virus dissemination in the prison particularly with admission of new prisoners [18]. Therefore, it's important to develop a specific contingency plan for control and prevention of Covid-19 based on the WHO guidelines on preparedness, prevention and control of Covid-19 in prisons and other places of detention [24]

One of the main limitations of this study was the inability to study the correlation between covid-19 infection among incarcerated individuals and prison staff although it has been planned but not allowed by the carceral authorities. Secondly, this study is only limited to the main carceral institution in the capital city where the incarceration conditions could be better compared to other prisons.

Conclusion

This study highlighted the circulation of SARS-CoV-2 virus in a carceral institution in Niger although the infection prevention and control measures set in place. The management of Covid-19 confirmed cases has been a real challenge due to a lack of appropriate isolation ward in the prison. Overcrowding has been identified as the main risk of propagation of the disease. Experience of Covid-19 pandemic should be considered to develop a specific contingency plan for the control and prevention of infectious disease to help carceral institutions in Niger to prepare efficiently for next health emergencies. Furthermore, there is an urgent need to consider this vulnerable group in the national Covid-19 prevention strategy including vaccination.

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Competing interests

The authors declare no competing interest.

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Consent for publication

Not applicable

Authors' contributions

Conception and design of the study: AL, RJ

Data collection and analysis: AL, ZAL, FH, WH, HY, AF, FAA, SM, GIO, HO, RHL, RJ

Drafting the manuscript: AL, ZAL, FH,

Critical revision of the manuscript: AL, ZAL, RHL, RJ

All authors have read and agreed to the final version of this manuscript.

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