Pulmonary Tuberculosis Among Detainees in Bertoua Prison in 2018 in Cameroon: Incidence, Screening and Overcrowding Effect

Tuberculose Pulmonaire parmi les Détenus de la Prison de Bertoua en 2018 au Cameroun : Incidence, Dépistage et Effet de la Surpopulation

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Abstract This is a retrospective study carried out in Bertoua prison which has benefited from the medical and nutritional program of the International Committee of the Red Cross (ICRC) since 2015. We evaluated Pulmonary tuberculosis (PTB) incidence, PTB screening and overcrowding effect in 2018, considering Douala prison as a control. The data extraction took place over a period of three months (January to March 2019). Of the 975 and 3300 persons incarcerated on average from 1st January to 31st December 2018 in Bertoua and Douala prisons, 27 and 79 cases of PTB, including 23 and 51 new cases, were identified and diagnosed according to the good clinical practices recommended by the National Tuberculosis Control Program (NTCP). Screening at entry was symptomatic. The detection rates of PTB of inmates were 5.23% ± 0.061 against 2.39% ± 0.034 (p<0.05). The PTB incidence was 24 per 1000 population in Bertoua versus 15 per 1000 population in Douala. The rate of overcrowding was almost 4 (387.50%) higher than the theoretical capacity in Bertoua prison; it was 3 (243.75%) times higher than theoretical capacity in Douala prison; difference was not statistically significant (p>0.05). In spite of the interventions related to the program of ICRC, PTB incidence, screening for PTB, and overcrowding were still major problems in the Bertoua prison. Such program may yet play an additional role in the systematic initial screening of newly introduced prisoners and the periodic screening of all prisoners. Other measures may be required to alleviate PTB burden in such settings.

Pulmonary Tuberculosis (PTB) is a major health problem worldwide. In fact, every year, 9.6 million people contract PTB worldwide. A third of these cases go unnoticed, are not diagnosed, treated or reported [1]. This disease whose infectious agent is Mycobacterium tuberculosis, is transmitted from one person to another via the air by inhalation of aerosols of fine particles emitted by the person suffering from tuberculosis during cough, sneeze or yell [2]. This makes overcrowded places such as prisons, ideal environments for the spread of the disease and hot spots of infection [3].

PTB in correctional facilities is not a new problem [4]. In Africa, PTB in prisoners remained very little known despite a remarkable endemicity [5]. This situation was more worrying in some African countries such as Cameroon where precarious socio-political conditions, minor security and crises in neighbouring countries (i.e., Central African Republic) prevailed. The incidence of PTB in Cameroon was 203 cases per 100,000 populations in 2016 [6]. This country has been classified among the 30 high burden countries with PTB and HIV/AIDS co-infection. However, very few studies have been published on the incidence rates of PTB in the prisons of Cameroon. A study conducted by the Institute for Criminal Policy Research [7] combined with studies by Biadglegne, Rodloff and Sack [8,9] estimated the prevalence of pulmonary tuberculosis at 3.5% in Cameroonian prisons [9]. The Bertoua prison in Bertoua, the capital of the eastern region of Cameroon bordering the Central African Republic, was experiencing an overcrowding rate of prisoners, and this made it impossible to respect the dignity of the detainees. Thus, the minimum legal conditions of detention were difficult to identify [10,11]. To alleviate such situation, since 2015, the International Committee of the Red Cross (ICRC) has made an objective with multifaceted interventions in the Bertoua prison, including the prevention of malnutrition through the provision with food and drinks, the facilitation of access to care and medication for all prisoners, particularly patients suffering from tuberculosis, donations of catering utensils, and provision of drinking water.

The aim of this study was to evaluate PTB incidence, PTB screening and overcrowding effect on PTB in the Bertoua central prison after such interventions, considering the Douala central prison as a control.

2. Material and methods
2.1. Description of the two prisons

Bertoua central prison is is located in the eastern region (Cf. Fig. 1). It was created in the 1930s and was not operational until 1962 with an initial capacity of 120 prisoners. In terms of infrastructure, the Bertoua central prison is partly made up of colonial buildings and partly with recent constructions. Managed by the Prison Administrator, it currently houses a prison population ranging from 900 to 975 prisoners [12]. According to some sources [13], Bertoua central prison has an overcrowding rate of 479% for a ratio of one supervisor for 11 detainees against 1 jailer for 3 which is the standard ; the cells of this prison are not also sufficiently ventilated .This Quality Of Life (QOL) caused by the overcrowding and infrastructures of this prison, leads to opportunistic diseases such as scabies, tuberculosis or diarrhoea, that may interact with other diseases such as HIV/AIDS infections.

Behind this building, we have the different quarters for prisoners: the juvenile quarter, the male quarter and the female quarter. The prison has two watchtowers: one overlooking the juvenile quarter and the other overlooking the male quarter. In the detention block, there is the Office for Discipline of Detainees. This scene is similar to that in the Douala prison.

The Health Centre at Bertoua prison is under the authority of a prison administrator whose mission is to ensure scrupulous respect for the rights of access to quality care for all residents. She also watches over the prisoners' food. The infirmary service coordinates the ICRC's programs within the prison, including the nutritional and medical program aiming at reducing the mortality and morbidity rates in such prison. She is assisted in her daily tasks by a Senior State Registered Nurse, three Caregivers and one Laboratory Technician.

Detainees are entitled to a daily ration. This ration must be balanced and sufficient to avoid detainees suffering...
from food deficiencies and to give them the energy they need for their health and for carrying out the work in which they have to carry out. This formula is well observed in the central prison of Bertoua in view of the quality and quantity of the meal served daily. The work is carried out in the kitchen by a team of inmates expertly chosen by the Supervisor under the effective supervision of two supervisors. They are responsible for supervising the cooking of the prisoners’ meals and their equitable sharing and also the rational management of the consumption of these commodities. A Caregiver is responsible for ensuring the quality of the food prepared as well as compliance with the related hygiene rules. However, despite these efforts, the state budget allocated to the care of detainees is thought to be so meagre that prisoners sometimes have to rely on their families to eat well, sleep well and look after themselves. As a result, those who are abandoned may die from lack of care.

Fig. 1: Map of Douala and Bertoua prisons readjusted.
Source: Google Map, 2018

Central prison of Douala

Douala central prison is located in the Littoral region (Figure 1). The Douala central prison, housing a dozen mostly dilapidated colonial buildings, was built between the 1930 and 1933. It was first used as a barracks during the colonial period. Erected in central prison in 1973 in favour of the first harmonized prison regime in Cameroon, and enshrined in decree n°73/774 of December 11, 1973, the Douala Central prison has an initial accommodation capacity of 700 places [13].

It experienced an additional 260 places with the construction of a building by a Cameroon-European Union cooperation project in 2005. The cells of this prison are sufficiently ventilated. As in Bertoua prison, the Douala Central prison has administrative, socio-cultural services and an Health Centre. The Health Centre, operated with a doctor, a general administrator of prisons, nurses, assistant-nurses, and a Medical laboratory staff, has an office for the General Administrator, an office for the Intendant, a main treatment room and consultation, a hospital room, a sick
2.1. Subjects and type of study

This was a retrospective study conducted on prisoners diagnosed with PTB and issued from two prisons (Bertoua and Douala), during the period from 1\textsuperscript{st} January to 31\textsuperscript{st} December 2018.

2.2. Assessment of indicators

2.3.1. PT Screening

In both prisons, the diagnosis was essentially biological and symptomatic. Prisoners were not screened systematically. Passive screening of symptomatic subjects was used by sputum culture including the methods Gene Xpert and Ziehl Neelsen. Bacilloscopic confirmation was done in Tuberculosis Diagnosis and Treatment Centers (DTC). Case estimates and post-incarceration delays were calculated from the dates of entry within these prisons.

2.3.2. PTB Incidence

For the calculation of incidence in both inmate populations, the sum of PTB cases newly detected in 2018 during incarceration was reported as the sum of the detainees (from freedom and transfers from other prisons) over that period, to the same denominator made up of all detainees. Furthermore, we calculated the incidence density in each prison and in the related general population (population of the East region and Bertoua for Bertoua, and that of Littoral region for Douala). Incidence density was defined as the number of events divided by the person-time at risk. To determine the person-time of inmates at risk in each targeted prison, the monthly count of inmates per prison was added up. We also calculated a density incidence ratio (IRR), calculated by dividing the incidence density among the exposed portion of the population by the incidence density in the unexposed portion of the population.

2.3.3. Adequacy of housing

In order to assess whether the housing of the detainees was adequate and not conducive to the transmission of PTB in these prisons, the concept of « occupancy rate » were used. The official occupancy rate, also known as the prison population density, was obtained by comparing the number of prisoners present at the date “t” to the number of places defined by the official capacity of the prison [10, 19].

2.3. Data source

We used data from medical diagnoses of incarceration registers on admission to prison and the standardized registers of the NTCP (World Health Organization (WHO) format, adapted) including both passive (symptomatic by sputum microscopy) and active (at-risk) screening, such as people living with HIV, contacts of PTB cases in general. The latter relied on clinical data (cough greater than two weeks ± general or pulmonary signs), sputum culture including the methods Gene Xpert and Ziehl Neelsen recommended by the national program in charge of this pathology. The bacilloscopic confirmation was made in the Tuberculosis Diagnosis and Treatment Centers (DTC) of the Tuberculosis of the each previously cited prisons, made up of all new and old cases detected and monitored over the period from January 1st to December 31st, 2018 collected.

2.4. Data collection

Data were collected by trained research assistants with close supervision and assistant of the principal investigator. Data extraction took place over a period of three months (January to March, 2019). Medical records of PTB detainees were reviewed manually. Data was extracted from different medical files, arranged monthly and yearly. The data were on over 3 previous years (2016, 2017 and 2018).

2.5. Statistical analysis

Rates were calculated with 95% confidence intervals (95% CI) for a p-value <0.05 (p) of significance for all variables. Fisher and Student statistical tests were performed to compare potential differences between the two sites. These results were expressed as mean ± standard deviation (for quantitative variables) or percentage (for qualitative variables). Statistical analyses were performed using SPSS 21.0 (Statistical Package for Social Sciences, Chicago, IL, United States).

3. Results and Discussion

3.1. Results

3.1.1. Characteristics of TB detainees

Characteristics of the populations of the two studied prisons were shown in Table 1. There was no difference in distribution of nationality, gender, age or duration of detention between prisoners of the two prisons (Cf. Table 1).
Inmate screening

The screening rate varied between the two prisons. The respective detection rates of PTB in symptomatic inmates in 2018 were 5.23% ± 0.061 and 2.39% ± 0.034 in Bertoua and Douala (p<0.05). The length of detention for the 2nd quartile of prisoners before the diagnosis of tuberculosis was around 14 months ± 4.27 (> 12 months) in the Bertoua prison, ranging from 1 to 48 months; it was 7 months ± 5.02 (6-12 months) in Douala prison, varying from 1 to 96 months depending on the prisoners’ sentences following the judgement. The test showed a difference in PTB screening efforts in the two prisons (Cf. Table 2). It thus appeared that in the Bertoua prison the characteristic signs of tuberculosis or the physical state of the patient let the disease show up a little later after the entry of the prisoners than in that of Douala.

Tab. 2 : Distribution of PTB detainees by time before diagnosis of PTB in prison CDTS

<table>
<thead>
<tr>
<th>Risk indicator of contagion and screening</th>
<th>Prison Bertoua (n=27)</th>
<th>Douala (n=79)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time interval for diagnosing PTB after entry (month)</td>
<td>Count(%)</td>
<td>Count(%)</td>
<td></td>
</tr>
<tr>
<td>&lt;1</td>
<td>1(3.7)</td>
<td>8(10.1)</td>
<td>0.011</td>
</tr>
<tr>
<td>1-6</td>
<td>6(22.2)</td>
<td>28(35.4)</td>
<td></td>
</tr>
<tr>
<td>6-12</td>
<td>2(7.4)</td>
<td>19(24.1)</td>
<td></td>
</tr>
<tr>
<td>&gt;12</td>
<td>18(66.7)</td>
<td>24(30.4)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Result of this study

*For IC= 95% (Significant for p-value < 0.05)
Despite this difference, there is no delay (eight days or less) between incarceration and the result of screening.

### 3.1.3. PTB incidence

In 2018, the PTB incidence in Bertoua central prison was 24 per 1000 population of prisoners (23/975), it was 15 per 1000 population of prisoners (51/3300) in Douala central prison (Cf. Table 3). The difference in such incidences was statistically significant (p= 0.0123).

Tab. 3 : Incidence rates of PTB in 2018

<table>
<thead>
<tr>
<th>Central prison</th>
<th>New cases of PTB in 2018</th>
<th>Prisoners incarcerated in 2018</th>
<th>PTB Incidence density in prison (a)</th>
<th>PTB incidence density in general population* (b)</th>
<th>IRR(95%CI)</th>
<th>Ratio of PTB per 100 000 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bertoua</td>
<td>23</td>
<td>975</td>
<td>2 359</td>
<td>6.0 (3.9–6.8)</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Douala</td>
<td>51</td>
<td>3300</td>
<td>1 545</td>
<td>5.4 (3.6–8.4)</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

Source: Result of this study

During the same period, there were about 96 cases per 100 000 people and 66 cases per 100 000 people in the general populations of the East and Douala. The incidence density ratio (IRR) were 6.0 (3.9 – 6.8) and 5.4 (3.6 – 8.4) per 100 person-years of contribution to PTB transmission. It should also be noted that the test carried out showed significant differences between the incidences density of PTB among the inmates in the two targeted penitentiaries (p=0.0123).

PTB incidence rates were 25 and 24 times higher than the incidence of PTB in the general population of the respective targeted regions over the same period (Cf. Table 3).

In addition, the incidence rate of PTB in the Eastern region (Figure 1) was different from the rate in the Littoral region (Figure 1), the penetration of PTB would be more important in the city of Douala (because of the very high density of its population) than in the city of Bertoua.

### 3.2. Discussion

Gender and age were two interesting characteristics of the studied populations. These latter were mainly men in both prisons and this was in accordance with national records and patterns elsewhere.

A study carried out in 2014 in Cameroun suggested that there were less than 2% of women and girls in detention centers [14]. Another study on Key populations of prisoners showed that only 6.5 per cent of the world's prisoners are women, and that this figure represented a
five-fold increase in the female prison population over the past 15 years [15]. Data on PTB among female prisoners may thus be insufficient; however, a study in Brazil found that time spent in prison increased the risk of contracting PTB for women [16], and a study conducted in Zambia reported a rate of PTB screening among female prisoners lower than that of their male counterparts [17]. The proportion of minors in the studied prisons was higher than the national average which, according to a report of the National Institute of Statistics (INS), was estimated at 2.3% in 2014 in Cameroon [13].

PTB can be successfully treated if the screening is done on time as suggested by Fares (2016) [1]. It appeared that in the Bertoua prison the characteristic signs of tuberculosis or the physical state of the patient let the disease show up a little later after the entry of the prisoners than in the control prison. This can further spread PTB among prisoners. To prevent this, increased human resources, better capacity of prison medical staff and further efforts by prison authorities may be required [9]. WHO recommended two approaches for screening in prisons, i.e., active and passive. Active screening must occur both at the admission of prisoners in prison and throughout the period of imprisonment, during which prison populations should regularly be screened for PTB [18]. The application of this standard in the Bertoua prison in 2018 has made it possible to detect more cases of latent PTB after incarceration than the symptomatic screenings that, made only at the entrance, did not allow tracking down. Agencies such as WHO also recommended that, upon admission, detainees with suspected PTB should be separated from the general prison population, in particular from prisoners living with HIV. This temporary separation can protect both potential prisoners with PTB for whom treatment can be started and the general prison population to contract PTB from their peers. Such a strategy can allow prison authorities to fulfill their obligation to protect the health of all prisoners [15,19,18]. Furthermore, a recent study in Mongolia showed that initial screening and separation of prisoners with PTB had a significant impact on the prison PTB curve; over a nine-year period, the country has reduced the prison PTB rate by more than half through the screening and isolation process and the reorientation of prisoners with PTB in prison hospitals. However, it should be noted that such a model would require resources that may not always be available [15,20], and this may be the case of prisons in Cameroon. It is worth noting that in all the research done in Africa and in Cameroon in particular, we were unable to get information with regards to the rate of PTB screening in prisons for new inmates. Besides, screening for PTB / HIV is a joint activity in all Cameroonian prisons. In those targeted by our study, a lack of financial, human and material resources was reported by the medical teams, particularly in the Douala prison. Despite these deficiencies, for a more rational control of tuberculosis in detention centers, systematic screening of PTB should be established by the care teams in conjunction with the NTP and the Administration before any admission to prison and during incarceration rather than only in suspicion as was the case. It is also necessary to develop new diagnostic methods and other technologies that can accelerate and facilitate the detection of PTB in prisons.

Overcrowding rate was similar in the two studied prisons. However, this rate far exceeded the national average in Cameroon, estimated at 137 (7%) [13]. These results provided an idea on the cell occupancy rates, the level of ventilation of the cells and the risk of contact with a person infected with PTB, which appeared to affect more the prison of Bertoua, mainly because of the absence of confinement cells / isolation, than the Douala prison. Experts attributed the growth of the population in prisons to the repressive philosophies that may guide many policy makers. These policies may be based on the demand for more severe sentences in response to violence, but it became known that the use of incarceration has little impact in reducing or preventing violent crime [16, 26]. Yet these policies may remain, as well as others that may target marginalized groups. According to recent studies, about one-third of the world’s 10.2 million prison population was in pre-trial detention, with a waiting time of up to four years [21,16]. In 2013, about 63.2% of such detainees were reported in Cameroon [13].

High rates of incarceration had an effect on the incidence of PTB in the two prisons. These rates were higher than the incidence of PTB in the general population of the two targeted regions over the same period (2018). They also exceeded the national average rate in Cameroon which was 95 cases per 100000 inhabitants in 2018. This was in accordance with previous studies. In a study conducted in 2012 in 10 prisons, such rate was 1700 cases per 100000 people Cameroon [22]. Also, in a recent systematic review, the mean annual PTB incidence density in Cameroonian prisons was 1 700 cases in 100 000 person-years at risk [23]. In this study, IRR of 6.0 (3.9 – 6.8) and 5.4 (3.6 – 8.4) per 100 person-years were significantly different in the two prisons. In similar studies these ratios were 9.4 per 100 person-years in Cameroon in 2012, 5.5 cases per 100 person-years in 2011 in South Africa, 5.9 in low-income countries, and 6.3 in middle-income countries [22,23, 24].

Our study had some limitations. The sample size of inmates screened was small as the number of prisoners screened for PTB at entry was small in the studies prisons, and this may be due to financial and logistic
issues. However, our study population represented about 20% of Cameroon’s total central prison population. Lack of data related to inmates’ characteristics (malnutrition as an example) was another limitation as this prevented us from getting more insight into PTB in the studied prisons. Despite these limitations, to our knowledge, this is the first study to have evaluated PTB incidence, PTB screening and overcrowding effect on PTB in the Bertoua central prison after the interventions program of ICRC, launched in 2015 in the Bertoua prison.

4. Conclusion
In spite of the interventions program of ICRC, PTB incidence, screening for PT, and overcrowding were still major problems in the Bertoua prison. Such program may yet play an additional role in the systematic initial screening of newly introduced prisoners and the periodic screening of all prisoners. Furthermore, measures such as separating the PTB cases, improving criminal procedures, and adopting new proposed scheme to track and treat released prisoners may all minimize the burden of PTB in Bertoua prison and in such settings in Cameroun.

Ethics and consent

The Institutional Research Ethics Committee for Human Health at the University of Douala has approved the research proposal. The people interviewed were willingly.

Contribution of the authors

No support in the form of grant was received for this study and no conflict of interest between the authors. Mr. LINJOUOM NCHOUTPOUEN Abdou Aziz, Pr. ASSOB NGUEDIA Jules Clément, Pr. CHICHOM MEFIRE Alain, Pr. BESSONG Joseph BESSONG and Mr. Dublis NGUEFACK were involved in the concept and design of this study, collection, analysis and interpretation of data and the final drafting, revising and approval of the manuscript submission.

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