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PULMONARY TUBERCULOSIS IN THE CENTRAL PRISON OF DOUALA, CAMEROON

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## PULMONARY TUBERCULOSIS IN THE CENTRAL PRISON OF DOUALA, CAMEROON

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### ABSTRACT

**Objective:** To determine the prevalence of and factors associated with pulmonary tuberculosis (PTB) in an urban prison in sub-Saharan Africa.

**Design:** A cross-sectional survey.

**Setting:** The Central Prison of Douala, Cameroon.

**Results:** Two thousand four hundred and seventy four (87.4%) out of 2830 inmates underwent screening. Twenty seven (1.1%) of the inmates were under treatment for smear-positive PTB on commencement of the survey while 60 (2.4%) were diagnosed with smear and/or culture-positive PTB during the active case finding, resulting in a point prevalence of PTB of 3.5%. HIV seroprevalence in inmates without clinical signs of PTB was 111/1067 (10.4%) while it amounted to 6/24 (25%) in PTB patients. In multiple stepwise regression analysis, a low BMI, a prison stay of  $\leq 12$  months, and a history of previous incarceration were positively associated with PTB.

**Conclusion:** The study results confirm the high prevalence rates of PTB in prison populations and underscore the need for urgent preventive measures.

### INTRODUCTION

Published prevalence and incidence rates of tuberculosis (TB) in prison populations are among the highest notified in any population (1). While the bulk of recent publications and articles have focused on the TB situation in prisons in the former Soviet Union, data on the prevalence of TB in prisons in sub-Saharan African countries are limited. Based on active screening, studies from Ivory Coast (2), Malawi (3,4), Tanzania (5) and Botswana (6) have, however, found TB prevalence rates in prisons 6-30 times higher than the national rates.

Cameroon, a sub-Saharan African country with a population of about 16.5 millions inhabitants, set up its National Tuberculosis Control Programme (NTCP) based on the recommendations of the UNION and WHO in 1997. For 2003, the incidence rate of smear-positive (sm+) pulmonary TB (PTB) cases was estimated at 78 per 100,000 population (7). While the detection rates of cases are still to catch up with the estimated incidence rates of sm+ PTB, TB case notification within the NTCP increased between 1997 and 2004 from 544 to 18,400, with 69% of these being new sm+ PTB cases. Fifty six percent of all new sm+ PTB cases are males aged between 15 and 54 years (non published data of the NTCP, 2004). It is thought that the increasing incidence rates are due to the unfavourable socio-economic conditions and the rising prevalence of human immunodeficiency virus (HIV) in the country.

Indeed, according to 2004 revised estimates of WHO/UNAIDS (8), 5.5% (4.8-9.8%) of sexually active adults (15-49 years old) in Cameroon are living with HIV/AIDS. Huge differences do however exist in different regions of the country. In Douala, the economic capital, about 3.7% of the adult male population is infected.

At the start of this study in 2003, the prison population in Cameroon's 76 prisons, according to semi-official statistics (9), stood at 21,000 persons or 127 prisoners for 100,000 population, the highest prison population rate in Central Africa (in comparison: Nigeria 34/100,000, Chad 48/100,000). About one third of this prison population is incarcerated in the central prisons of either Yaounde, the administrative capital, or Douala.

In Cameroon, prison health care can be considered as sub-standard and completely underfunded. The drug budget for the year 2004 for New Bell Central Prison (Douala) was an equivalent of 550 USD. In general, prisoners who cannot pay or find a family member to help pay for their health care are not taken care of. Prison health personnel is scarce with only eight medical doctors sharing the medical responsibility for the country's entire prison population including the guards. Prisoners are not systematically screened for TB and data on TB and/or HIV/AIDS prevalence in Cameroonian prisons are non-existent. To prepare for the setting up of a comprehensive TB control programme in the Central Prison of Douala we decided to ascertain the prevalence of pulmonary tuberculosis in inmates of

this prison through active case finding as well as to study some predictors of the disease.

## MATERIALS AND METHODS

**Study setting:** New Bell Central Prison, the sole penitentiary facility for Douala, the economic capital city of Cameroon, was built in 1930. It is Cameroon's second largest prison and although initially built for 700 inmates, it houses between 2750 and 3150 prisoners. Living and sanitary conditions in the prison, reminiscent of all Cameroonian prisons, are extremely deplorable. Half of the cells house more than 150 inmates with a surface area of less than 0.20m<sup>2</sup> per inmate. The cells are extremely poorly ventilated and practically receive no sunlight. The prison has an infirmary comprising an outpatient clinic, an eight-bed ward, a laboratory and a pharmacy. Cases of tuberculosis are routinely identified in this prison through passive case finding. Only patients who present to the clinic with cough of three weeks duration or more are investigated for pulmonary tuberculosis if the financial means necessary for the laboratory investigations are available. Care to TB cases in prisons is sometimes provided by representatives of various churches or lay persons for humanitarian reasons. This is often rather selective (aiming at the church members).

**Methods:** Between October 2003 and February 2004, we received permission from the central and local prison authorities in Cameroon to carry out an active case finding survey in the New Bell Central Prison of Douala to identify cases of pulmonary tuberculosis. Three physicians with several years of experience in tuberculosis control screened the prisoners in the prison's infirmary. All inmates aged 15 years and above were systematically invited cell after cell for this exercise. The inmates of a cell were called upon only once for screening. Some prisoners were out of prison confinement during the day of survey for several reasons, some refused to participate and therefore not all prisoners could be screened. Screening however took place early in the mornings to minimise the number of absentees due to community service or attendance at court sessions. From each screened prisoner, the following information was obtained: cell number, age, sex, length of current stay in prison and history of previous incarceration as well as past history of tuberculosis. They were also asked if they had cough currently and if they were presently taking treatment for tuberculosis. For those currently on anti-tuberculosis treatment precision was obtained about the onset of their illness, the type of tuberculosis and the date on which they started anti-tuberculosis therapy. For prisoners who had a current cough and were not on tuberculosis treatment, the duration of their symptoms was sought for and recorded. All prisoners screened were weighed and their height measured. Body weight was determined to the nearest 0.1 kg using a SECA adult balance and standing height was determined to the nearest 2 mm. Body mass index (BMI) defined as weight in kg divided by height in m<sup>2</sup> was calculated for each screened prisoner.

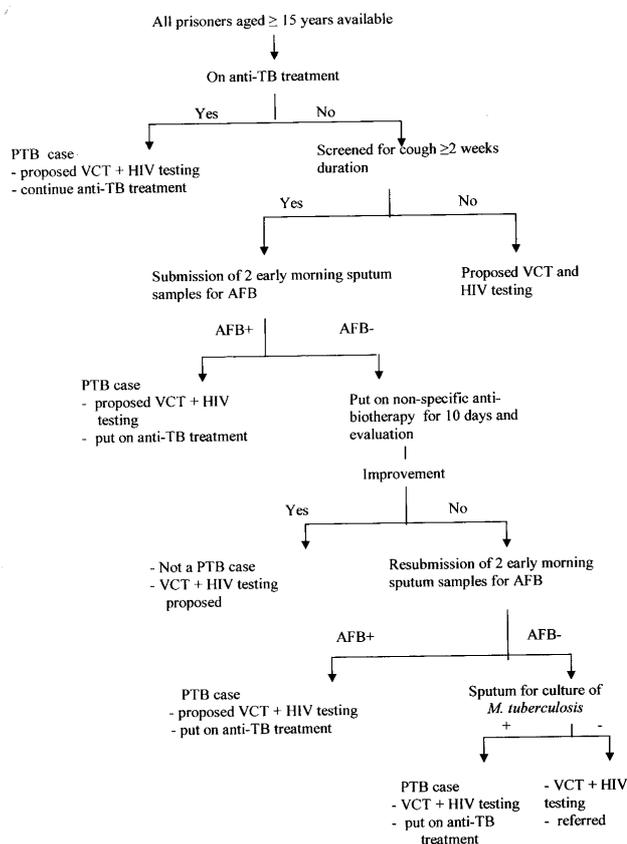
Since prison is a potentially high risk environment for tuberculosis transmission and since in some settings it has been observed that some respiratory patients with cough between 1 and 3 weeks may be sputum-smear positive for acid fast bacilli (AFB) (3,10), we arbitrarily took a symptomatic period of two weeks or more of cough to increase the sensitivity of the screening procedure. Each prisoner who had

a cough of two weeks duration or more was assigned a unique study number and investigated for tuberculosis. These prisoners were asked to submit one early morning sputum sample on two consecutive days. The two sputum samples were examined by smear microscopy for acid-fast bacilli (AFB) with the Ziehl-Neelsen stain in the prison laboratory.

Prisoners with sputum smears positive for AFB were started on short course chemotherapy as recommended by NTCP. Prisoners who were sputum smear negative were given a 10-day course of a broad-spectrum antibiotic, generally cotrimoxazole. If their cough did not improve after this course of non-specific broad-spectrum antibiotherapy, a second series of two early morning sputum samples was collected as described above and examined for AFB. One of the sputum samples from each of these patients notwithstanding whether they were AFB positive or not was sent to the mycobacteriology laboratory of the Centre Pasteur du Cameroun in Yaounde for culture. Prisoners whose sputum smears were positive for AFB on this second series of sputum samples as well as those whose sputum yielded positive cultures for *M. tuberculosis* were placed on anti-tuberculosis treatment. Those whose sputum smears and/or cultures were negative, were referred for further investigations in the chest service of the Hôpital Laquintinie in Douala. A case of pulmonary tuberculosis was defined in this study as a smear and/or culture positive prisoner. The Figure summarises the process of screening and diagnosing pulmonary tuberculosis during the survey.

**Figure**

*Algorithm for detection of PTB in New Bell Central Prison*



All prisoners who were screened for pulmonary tuberculosis were offered voluntary counselling and testing (VCT) for HIV in accordance with the recommendations of the National AIDS Programme in Cameroon. A blood sample was collected from each consenting prisoner. HIV antibodies were detected using two rapid tests: Determine® HIV-1/2 (Abbott Laboratories, Tokyo, Japan) and ImmunoComb® II HIV 1 and 2 BiSpot (Orgenics, Courbevoie, France). When the two tests were positive, the inmate was considered positive for HIV. In case of discordant results, a confirmation test was carried out by the Western blot technique (New Lav Blot®, Sanofi Diagnostics, Pasteur). Cotrimoxazole was offered free of charge to those with a confirmed positive test result.

*Statistical analysis:* Data were collected and analysed by the Epi-Info software programme (Version 6.04b, Centers for Disease Control, Atlanta, G.A., USA). The Chi square test or Fisher's exact test was used to compare propositions while means were compared by the Student's t-test. A difference was considered significant if  $p < 0.05$ . Variables found to be associated with PTB with  $p < 0.20$  value were re-examined in a logistic regression model using R software (Version 2.0.1; The R Development Core Team©).

## RESULTS

During the study period, the mean number of inmates was 2830 out of whom 2474 (87.4%) were screened for PTB. The median age of the inmates screened was 27 years (range 15-79 years) and the majority of them (2407 or 97.3%) were men. The median stay in the prison before the screening exercise for these inmates was five months (range: 1 day to 29 years). Of the 2474 prisoners screened, 363 (14.7%) had a history of previous incarceration and 98 (3.9%) recalled having been treated for tuberculosis in the past. Among the latter, 28 (28.6%) had a past history of incarceration. The nutritional status of the inmates showed wide variations and the median BMI was 20.48 kg/m<sup>2</sup>. Five hundred and forty six (22.1%) of the screened inmates were malnourished, malnutrition being defined as a BMI of  $\leq 18.5$  kg/m<sup>2</sup>. About 10% of the inmates suffered from severe skin diseases, mostly scabies.

Of the 2474 inmates screened, 27 (1.1%) were receiving anti-TB treatment for PTB at the time of the screening exercise. Four hundred and sixty eight (19.1%) of the 2447 remaining inmates fulfilled the criteria for sputum smear examination. Of these, 442 (94.4%) gave

sputum samples for sputum smear examination and 47 (10.6%) were smear positive on microscopic examination for AFB. Three hundred and eighty four (97.2%) of the remaining 395 inmates whose sputum smears were negative for AFB were put on cotrimoxazole for ten days. On completion of this treatment, 61 (5.9%) of them still presented with persisting symptoms and a second series of sputum smear examinations for AFB was performed. From these, seven (11.5%) were positive for AFB. Sixty of 61 sputum samples obtained from these inmates for culture gave 13 positive cultures for *M. tuberculosis*, six of them obtained from samples of inmates who were smear-negative for AFB on the second series of sputum microscopic examination. In total, 60 inmates were found in this survey to be either sputum smear and/or culture-positive (47 during the first series of sputum smear examinations, seven during a second series of sputum smear examinations after completion of a 10 day course of non-specific antibiotherapy and six after culture). On addition of these cases to the 27 PTB cases already on treatment during the screening process, the total number of PTB patients in the New Bell Central Prison at the time of the study was 87. This gives a minimum point prevalence of 3,517 cases per 100,000 inmates.

The prison had 25 cells, one of them being a cell where prisoners are temporarily kept before being dispatched to one of the other cells. Of the 24 permanent cells, 18 (75%) had at least two cases of contagious tuberculosis (median 3, range 2-11). In the temporary cell, two cases were detected. Of the six cells not harbouring cases, five were small cells with less than 20 inmates with a 'privileged' status (police/army officers, foreigners, civil servants, well to-do business men), and the sixth the relatively isolated female inmates' cell.

Voluntary counselling and testing for HIV was offered to all inmates screened. Twenty four (28%) of the 87 PTB cases, 61 (15%) of the 418 symptomatic but smear and/or culture-negative inmates and 1067 (54%) of the 1969 asymptomatic prisoners accepted to be tested. Table 1 shows the proportions of those with a positive HIV serology in the three groups. While there was no significant difference in the HIV seroprevalence rate between PTB cases and symptomatic cases, this rate was significantly higher in the group of PTB when compared to the group of asymptomatic cases ( $p = 0.04$ ).

**Table 1**

*HIV-seropositive in mates among PTB, PTB suspects and asymptomatic prisoners*

	Number offered VCT	Number accepted test (%)	Number positive for HIV test (%)
PTB patients	87	24 (28)	6 (25.0, 95%CI: 10-47)
PTB suspects (cough $\geq 2$ weeks)	418	61 (15)	13 (21.3, 95%CI: 12-34)
Prisoners without clinical signs and symptoms of PTB	1,969	1067 (54)	111 (10.4, 95%CI: 9-12)

**Table 2***Univariate analysis of baseline characteristics of inmates with PTB in the New Bell Central Prison of Douala*

Variable	No.	PTB	OR	95%CI	P-value
Age group (years)*					
15-24	882	33	1		
≥25	1588	54	0.91	0.59-1.44	0.19
BMI **					
>18.50	1932	44	1		
≤18.50	539	43	3.90	2.48-6.14	<0.01
Duration of incarceration (months)					
>12	629	12	1		
0-12	1845	75	2.18	1.14-4.25	0.01
Previous incarceration					
No	2109	67	1		
Yes	365	20	1.77	1.02-3.02	0.03
Previous history of PTB					
No	2376	80	1		
Yes	98	7	2.21	0.91-5.12	0.08
HIV infection					
No	956	18	1		
Yes	111	4	2.87	1.00-7.87	0.04

\*Four values are lacking; \*\*Three values are lacking

**Table 3***Factors significantly associated with PTB in inmates in the New Bell Central Prison, multivariate analysis*

Variable*	No.	PTB	OR	95% CI	P-value
BMI*					
> 18.50	1932	44			
≤18.50	539	43	3.97	2.57-6.14	<0.01
Duration of incarceration (months)					
>12	629	12			
0-12	1845	75	2.89	1.27-4.48	0.01
Previous incarceration					
No	2109	67			
Yes	365	20	1.96	1.13-3.25	0.01

\*2471 data available for analysis

The characteristics of inmates with and without smear and/or culture positive pulmonary tuberculosis are shown in Table 2. Univariate analysis revealed that having PTB in this prison setting was positively associated with inmates having (i) a BMI ≤18.5 kg/m<sup>2</sup> (p<0.01), (ii) a duration of imprisonment of ≤12 months (p=0.01), (iii) a history of previous incarceration (p=0.03), and (iv) HIV co-infection (p = 0.04). Multiple stepwise regression analysis, excluding HIV co-infection due to low acceptance among the inmates, confirmed the former three associations to be independently associated with PTB in prisoners (Table 3).

## DISCUSSION

The point prevalence of PTB among inmates in New Bell Central Prison during the study period was 3.5%. After adjusting for age and sex, this prevalence was 35 times higher than the one found in the male population of Douala. A high monthly turn-over of about 5% of the prisoners in the different prison cells as well as the absence of inmates due to temporary permissions, forced labour inside or outside the prison, appearance before the court or simple refusal to be screened (in a few cases) did not permit the screening

of all inmates. The approximately 400 prisoners not screened and/or having abandoned their screening procedure on different moments of this survey may have constituted a healthier part of the prison population and therefore could introduce a bias towards an overestimation of the prevalence rate of PTB in this prison. On the other hand, however, only symptomatic inmates with prolonged ( $\geq 2$  weeks) productive cough were eligible for screening and only those with bacteriologically confirmed PTB were retained as TB cases. The prevalence rate observed in this survey may therefore be an underestimation of the actual rate because due to logistic reasons (lack of chest X-ray facilities) we missed asymptomatic as well as sputum smear negative cases. This notwithstanding, the high PTB case rate found in this prison as compared to that observed in the general population corroborate results obtained from similar studies or observations obtained during cross sectional studies in Ivory Coast (2), Malawi (3,4), and Tanzania (5).

During the survey, HIV testing was offered to all prisoners after counselling. Acceptance to be tested was particularly low among prisoners identified with PTB and those with prolonged cough without PTB. The reasons for this low acceptance are not clear as we did not investigate them. Nevertheless, although the data base is relatively weak to give a convincing statistically significant association between PTB and HIV infection, the results do suggest, as would have been expected, this association. HIV-infection was found in 25% (95%CI: 10-47) of PTB prisoners who accepted to be tested in this study. This is comparable to the 25-42% of HIV infection observed in PTB patients outside the prison (11). Of prisoners without symptoms for PTB, 54% accepted HIV testing and of these 10.4% were HIV infected. The demographic and other characteristics of inmates who accepted HIV testing did not differ significantly from those who did not accept it. The proportion of asymptomatic inmates infected by HIV was substantially higher than the 3.5% HIV prevalence rate observed in a comparable general male population in the city of Douala. In western countries, high-risk factors for HIV transmission in penitentiary facilities include intravenous injection of drugs, sexual abuse, and homosexual activity (12,13). In Cameroonian prisons, intravenous drug use is very uncommon. However, homosexual activity and abuse, although illegal and not considered as a societal norm, are known to occur frequently in our prisons. As the inmates are mostly young and sexually active men, these may constitute the main modes of HIV transmission among the New Bell Central Prison population.

A low BMI ( $\leq 18.5$ ), a current prison stay of 12 months or less, a history of former incarceration and HIV-infection showed a significant relationship with PTB in this study on univariate analysis (Table 2). Of these factors, a low BMI, a current prison stay of 12 months or less and a history of former incarceration

remained significant predictors of PTB in a multivariate analysis (Table 3). Incarceration as well as HIV-infection (even though not a significant predictor in this study probably due to the small sample size) are well documented risk factors for TB disease (12,14). Malnutrition equally is recognised as a risk factor for the reactivation of latent TB and its progression to disease (15). This link is besides bi-directional as TB can cause or predispose to malnutrition (16). Hence when comparing individuals with and without active PTB in this cross-sectional study with respect to their nutritional status, a causal effect can not be assigned to malnutrition, even though it came out as a significant predictor in the multivariate analysis. Moreover it is also claimed that scientific evidence for a causal relationship between malnutrition and the development of TB disease are weak and that the biological link between the two morbid states is still not well understood (17,18).

The development of TB observed in inmates in the New Bell Central Prison may also be linked to a complex of other adverse conditions like overcrowding, or immune down-regulation by psycho-social stress in inmates with latent TB-infection or prolonged exposure to infective but untreated patients. All these factors while being possible independent risk factors for the development of TB, can also interact synergistically. The association observed between a stay of 12 months or less in prison and the occurrence of PTB in our study may likewise be part of this complex of adverse circumstances. At first glance, the observation of a "protective" effect of a longer prison stay vis à vis the development of PTB may seem counter-intuitive; after all, duration of exposure and infection and/or development of disease are supposed to be positively related. Yet the passage from life outside the prison to a situation of incarceration with its attendant traumatizing disruption of survival conditions may be compared to the situation of individuals confronted with complex emergency situations where the highest excess morbidity and mortality are well known to occur during the acute phase of the emergency (18). Sudden overcrowding, absence of individual shelter, absent psycho-social reference systems, impoverishment, slimming as a result of food shortages, exposure to infectious individuals with no or poor access to health care can be imagined as so many stress factors that can increase the vulnerability to transmission of TB infection or reactivation of latent TB infection and progression to disease. In the long run and after adopting survival strategies inmates may be thought to have established a new balance with stress diminishing and vulnerability decreasing. Results of studies in similar settings to ours looking at the association of the duration of prison stay and the development of TB disease are not concordant. While in some settings TB disease occurs more frequently in the first or second year of imprisonment (2-5), studies from other settings

report the risk for TB to be greater with a longer duration of incarceration (6).

The results of this study were communicated to the Cameroonian health and prison authorities. It was agreed that there was an urgent need to set up a comprehensive TB and HIV control programme in the country's prisons so as to counteract the spread of both infections in this setting. Emphasis will be put on the creation of TB diagnostic and treatment centres in prisons with systematic screening of all new prisoners for PTB on entry, and the entire prison population including prison staff once a year, separation of all infectious patients from the prisons' general population, supervision of prison TB activities by the NTCP and engagement of an NGO to administer an HIV prevention programme including voluntary counselling and testing of inmates and guards, under supervision of the National Aids Control Programme. Other additional measures that will need to be taken should focus on the improvement of living conditions in the prison.

In conclusion, the prevalence of PTB in the New Bell Central Prison of Douala is quite high and suggests that there may be active transmission of tuberculosis in this setting. A low BMI ( $\leq 18.5 \text{ kg/m}^2$ ), a current prison stay of 12 months or less and a history of former incarceration were found to be significantly associated with PTB in this prison. As a result of this survey, the Cameroonian health and prison authorities have resolved to put up progressively a comprehensive package for TB and HIV control in the country's prisons.

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