AIDS RESEARCH AND HUMAN RETROVIRUSES
Volume 29, Number 7, 2013

DOI: 10.1089/aid.2012.0239

Risk Factors of Tuberculosis Infection Among HIV/AIDS Patients in Burkina Faso

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Abstract

Tuberculosis (TB) and HIV coinfection is the leading cause of mortality among TB patients and people living with HIV/AIDS (PLWHAs). There is still a need to look for cognitive and behavioral determinants of TB among PLWHAs. This study aims at identifying risk factors of TB infection among PLWHAs in Burkina Faso. A cross-sectional study design and consecutive recruitment method were employed. Adult patients attending TB hospitals or HIV clinics were recruited in two main regions (Hauts-Bassins and Centre) of Burkina Faso from August to October 2010. Stepwise logistic regression models were used for statistical analysis. In total, 734 PLWHAs, including 181 (24.7%) coinfected with TB, participated in this study. Of the latter, 53.4% were from the Hauts-Bassins region and 46.6% from the Centre region. Adjusted TB risk factors among PLWHAs were urban setting, TB history, higher number of persons living in the household, and poor geographic access to care. Moreover adjusted TB risk factors among PLWHAs consisted of CD4 cell counts below 200/μl, a history of sexually transmissible infections, and a past or present history of pulmonary asthma. In addition, lack of education and arterial hypertension were additional risk factors in the Hauts-Bassins region; for PLWHAs in the Centre region, male gender, jobs not in the private and public sector, and past or present history of cardiovascular disease were additional risk factors for TB. Common and different risk factors for TB were identified for PLWHAs in the Hauts-Bassins and Centre regions. This information will be incorporated into the HIV/TB control programs in the future.

Introduction

The World Health Organization (WHO) has projected that tuberculosis (TB) and human immunodeficiency virus (HIV/AIDS) infections will be among the top 20 causes of death in 2030.[1] In 2010, there were 8.8 million (range, 8.5–9.2 million) incident cases of TB and 1.1 million (range 0.9–1.2 million) deaths from TB among HIV-negative people; in addition, there was an additional 0.35 million (range 0.32–0.39 million) deaths from HIV-associated TB.[2]

Prevalent and incident TB cases are significantly associated with mortality in an HIV program.[3] According to the WHO, TB is the leading infectious killer of people living with HIV/AIDS (PLWHAs).[4] Patients who are HIV positive and infected with TB are 20 to 40 times more likely to develop active TB than people not infected with HIV living in the same country.[5,6] Thus, TB has become the commonest HIV-associated opportunistic disease in the world,[6,7] and it affects PLWHAs by accelerating HIV disease progression, by showing increased infectivity, and by reducing HIV treatment efficacy.[6,8,9] While some risk factors are known,[3,7,10–18] there is still a need to investigate TB risk factors among PLWHAs. Such a list of risk factors cannot be exhaustive and new risk factors are added on a continuous basis and even in specific settings. The objective of this study was to identify the risk factors related to TB among PLWHAs from two different regions—Hauts-Bassins and Centre in Burkina Faso.

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Materials and Methods

Study design

This cross-sectional study uses a survey conducted in health centers and nongovernmental organizations (NGOs) located in the Centre and Hauts-Bassins regions of Burkina Faso. These two regions represent about 40% of the total annual TB cases nationwide, have the highest HIV prevalence, and have the largest number of NGOs providing antiretroviral treatment (ART) in the country referenced.[19,20]

In the Centre region, TB patients were identified from data provided by the National TB Diagnosis, Treatment and Research Centre, and five Health Districts (HDs), namely Boulmiougou, Baskuy, Sig-Noghin, Bogodogo, and Nongr-Massom. In the Hauts-Bassins region, TB patients were identified from data provided by the Regional TB Diagnosis and Treatment Centre (TDTC), Souro Sanou National Teaching Hospital (NTH), and six HDs, namely Orodara, Do, Dafra, Lena, Houndé, and Karangasso-Vigué.

HIV patients were identified from data provided by various NGOs and HDs, which were the same as those for the TB patients. The NGOs were the Association-Espoir-Vie (AES) and Responsabilité-Espoir-Vie-Solidarité (REVS+) from Bobo Dioulasso in the Hauts-Bassins region and the Association des Jeunes pour la Promotion des Orphelins (AJPO) from Ouagadougou in the Centre region.

The HIV and TB statuses were confirmed from the medical records of each patient. Coinfected patients were identified from the separate lists of HIV-positive patients and TB-infected patients and by linking the full identifiable names to avoid duplicated cases.

The sample size was calculated using the online sample size calculation software provided by RASOFT.[21] A common margin of 5% was used. Thus a confidence level of 95% was chosen, with a response distribution of 50% and a power of 80%. The distribution was assumed to be normal and, knowing that the total TB cases for the regions were 1,832 in 2008,[19,20] the smallest TB sample size expected was 316 TB cases for the two regions. In terms of HIV sample size, the normal rule of having one case for at least two controls was applied; thus at least 600 HIV cases were needed.

This study was conducted from August 1 to October 8, 2010 after advice and guidance were obtained from the National TB program of Burkina Faso, together with an expert opinion from the West African Health Organization. It was approved by the Research Ethics Committee of Burkina Faso and the Ministry of Health in July 2010. With these approvals, we obtained administrative support that facilitated carrying out the study in the various health regions and districts within the Centre and Hauts-Bassins regions.

A consecutive method was used for patient recruitment. The inclusion criteria were met when the patient was a confirmed TB case from a TB clinic and was undergoing antituberculosis treatment. Similar criteria were used for HIV cases from AIDS clinics under HAART. The patients were required to be 15 years or older and living in the study setting. Cases from both sexes were included. After the cases were identified, this study included two profiles of patients: HIV-infected patients and those having dual infection.

Data collection

After obtaining informed consent from each patient, a face to face interview was conducted using a semistructured questionnaire consisting of two parts. The first part recorded the individual's clinical information and comorbidities (10–15 min) and was completed during the interview. The remaining section of the questionnaire needed 25–30 min to be completed. The independent variables were sociodemographic and economic status (age, sex, area, region, education level, religion, profession, monthly income, means of transportation), adapted self-esteem (an eight-item scale, with Cronbach's alpha = 0.873),[22] adapted quality of life from WHO-quality of life (feelings about life, capability, and expectations for the future, with an eight-item scale, Cronbach's alpha = 0.726),[23] adapted knowledge index about TB,[24] adapted attitude index,[24] adapted perception index (discrimination and isolation),[25] awareness of disease transmission (three-item scale, Cronbach's alpha = 0.783), and medication adherence using the Morisky scale (eight-item scale, Cronbach's alpha = 0.711).[26] In addition to collecting psychosocial and behavioral information from the patients, data were also collected on present or past clinical information (CD4 cell count, diabetes, cardiovascular disease, arterial hypertension, and pulmonary asthma), financial access to care (been an insurance member, having financial problems, been a health mutual member, having treatment free of charge, and having diagnosis free of charge), geographic access (been far from the health center, availability of treatment, having transportation problem to go to health center, and coming to health center but do not find treatment), workforce perceived by patients (kind of relationship with health workers, patients feeling received by health workers, been listened by health workers and considering their concerns, availability of health workers, and patient feeling comfortable with health workers), and waiting time of consultation. Collected psychosocial and behavioral information from the patients were first place of consultation (when sick, for present disease, and when having cough), duration of residence, past history of TB, having ever been lost to follow-up, comorbidities, smoking, alcoholism, prisoner status, knowledge of viral hepatitis B and C, sexually transmissible infections (STIs), illegal drug use (IDU), psychosocial consequences of the disease (change about occupation, housing and source of income, job lost, bothered because of the disease, staying away from people, and sharing disease experience), type of alimentation (mixed, vegetarian, or other), and sexual orientation (heterosexuality, homosexuality, or other). Before conducting the final survey, the questionnaire underwent pretesting in order to reduce bias and to better control the time needed to complete the questionnaire.

Data analysis

The data were entered onto EPIDATA and analyzed using the SPSS PC statistical package, version 17.0. The cut-off point for continuous variables was the median. The level of significance was 0.05. A comparison of the variables, between the HIV only infected patients and those having dual infection, was carried out using the chi-square test. The data were also analyzed by region (Centre and Hauts-Bassins regions). Simple and multiple stepwise logistic regression models were used to identify TB risk factors among PLWHAs. We put in

the multivariate model clinical and socioeconomic TB risk factors identified among PLWHAs only at the univariate analysis stage. We ran the test for collinearity diagnosis at the multivariate analysis stage.

Results

Participants and sample characteristics

In total, 734 PLWHAs, including 181 (24.7%) coinfected with TB, participated in this study. If we divided them by region, 53.4% were from the Hauts-Bassins region and 46.6% from the Centre region. The demographic data of the PLWHAs are shown in Table 1. In brief, the mean age of the PLWHAs was 37.2 ± 8.9 years old, and 68.5% were female. All the patients were heterosexual and ate a mixed diet.

Factors that differ between regions

Factors and variables were compared between the Hauts-Bassins and Centre regions. There was a mean or proportion difference in education level ($p = 0.034$), religion ($p = 0.002$), marital status ($p = 0.020$), ethnic group ($p < 0.001$), distance between living room and the health facility ($p < 0.001$), perceived waiting time ($p = 0.011$), monthly income ($p < 0.001$), financial access to care ($p < 0.001$), alcohol status ($p = 0.025$), and smoking status ($p < 0.001$). Other mean or proportion difference factors between regions included first place for consultation when the patient is sick ($p = 0.027$), ever been lost to follow-up ($p = 0.008$), awareness of disease transmission ($p < 0.001$), attitude ($p < 0.001$), quality of life ($p < 0.001$), self-esteem ($p < 0.001$), discrimination-isolation ($p = 0.002$), adherence ($p < 0.001$), TB knowledge ($p < 0.001$), and psychosocial consequences of the disease ($p < 0.001$).

Factors that differ between patient profiles

Risk factors and variables were compared between HIV and HIV/TB-coinfected patients living in the Hauts-Bassins and Centre regions (Tables 1 and 2). There was no mean or proportion difference in age, region, education, religion, monthly income, means of transportation, number of living family members, number of persons living in the household, number of children per patient, and geographic access to care. Other mean or proportion difference factors between HIV and HIV/TB-coinfected patients included health workforce perceived, perceived waiting time, present or past history of arterial hypertension, IDU, and present or past history of cardiovascular disease.

In the Hauts-Bassins region, the factors that did not differ between the patient groups were age, gender, profession, education, marital status, ethnic group, religion, means of transportation, monthly income, and perceived waiting time. Additionally, other mean or proportion difference factors between HIV and HIV/TB-coinfected patients consisted of medication adherence index, alcohol status, diabetes status, inmate status, knowledge about viral hepatitis B and C, STIs, IDU, past or present history of cardiovascular disease, past or present history of pulmonary asthma, number of living family members, geographic access to care, workforce perceived, discrimination and isolation, and awareness of disease transmission (Table 1).

In the Centre region, the factors that did not differ were age, duration of residence, education, religion, means of transportation, monthly income, perceived waiting time, knowledge about viral hepatitis B and C, STIs, IDU, past or present history of cardiovascular disease, past or present history of arterial hypertension, CD4 cell count, number of living family members, number of children per participant, geographic access to care, workforce perceived, and self-esteem (Table 1).

Logistic regression analysis results: risk factors for TB among PLWHAs

Univariate analysis showed that the TB risk factors among PLWHAs were male patients ($p < 0.001$) from a rural area ($p < 0.001$) and not educated ($p = 0.047$), not working in the private or public sector ($p = 0.002$), living in union ($p < 0.001$), from the Mossi ethnic group ($p < 0.001$), low medication adherence ($p = 0.029$), ever been lost to follow-up ($p < 0.001$), CD4 cell count below 200/μl ($p = 0.003$), TB knowledge ($p < 0.001$), and previous STIs ($p = 0.049$). Additionally, TB risk factors among PLWHAs included consulting healers first when the patient is sick ($p < 0.001$), consulting healers first for present disease ($p < 0.001$), consulting healers first when having cough ($p = 0.009$), higher number of persons living in household ($p = 0.049$), low number of persons sleeping in the household ($p = 0.029$), alcohol consumption ($p < 0.001$), smoking ($p < 0.001$), and previous imprisonment ($p = 0.002$). Finally, other TB risk factors were past history of TB ($p < 0.001$), past or present history of pulmonary asthma ($p = 0.010$), better financial access to care ($p < 0.001$), high self-esteem ($p < 0.001$), better quality of life ($p < 0.001$), poor TB knowledge ($p < 0.001$), better attitude toward TB/HIV ($p < 0.001$), facing less stigma ($p < 0.001$), less discrimination-isolation ($p = 0.001$), facing psychosocial consequences of TB/HIV ($p < 0.001$), and having poor geographic access to care ($p < 0.001$).

Adjusted TB risk factors among PLWHAs were urban setting ($p = 0.002$), TB history ($p < 0.001$), higher number of persons living in the household ($p = 0.003$), poor geographic access to care ($p = 0.003$), CD4 cell count below 200/μl ($p = 0.007$), previous STIs ($p = 0.049$), and past or present history of pulmonary asthma ($p = 0.048$).

In the Hauts-Bassins region, the adjusted TB risk factors among PLWHAs were no education, urban setting, low number of persons living in household, low number of persons sleeping in household, poor geographic access to care, CD4 cell count below 200/μl, past or present history of pulmonary asthma, and previous STIs (Table 3).

In the Centre region, the adjusted TB risk factors were male patients from an urban setting, jobs not in the private or public sector, past or present history of cardiovascular disease, TB history, and poor geographic access to care (Table 3).

Discussion

In this cross-sectional study, we recruited patients with HIV and/or TB infection from different TB and AIDS clinics in two main regions (Central and Hauts-Bassins) of Burkina Faso. The results showed that among the 734 PLWHAs participating in this study, 181 (24.7%) cases were dually infected with HIV and TB. This study exhaustively explored a wide range of risk factors and variables using face to face interviews with a semistructured questionnaire containing scales and indices. Nonetheless, the present study may be criticized for being cross-sectional. Furthermore, some factors explored in

Table 1. Proportion and Mean Difference of the Variables Between Patients Infected with HIV/AIDS and Patients Coinfected with Tuberculosis and HIV per Region

	Hauts-Bassins				*Centre*			
Variables	*HIV (N = 298)*	*Coinfected (N = 94)*	*Total (N = 392)*	p	*HIV (N = 255)*	*Co-infected (N = 87)*	*Total (N = 342)*	p
Area								
Rural	80 (26.8)	50 (53.2)	130 (33.2)	< 0.001*	69 (27.1)	45 (51.7)	114 (33.3)	< 0.001*
Urban	218 (73.2)	44 (46.8)	262 (66.8)		186 (72.9)	42 (48.3)	228 (66.7)	
Gender								
Female	235 (78.9)	66 (70.2)	301 (76.8)	0.083	170 (66.7)	32 (36.8)	202 (59.1)	< 0.001*
Male	63 (21.1)	28 (29.8)	91 (23.2)		85 (33.3)	55 (63.2)	140 (40.9)	
Age								
< 36 years old	127 (42.6)	47 (50.0)	174 (44.4)	0.256	125 (49.0)	38 (43.7)	163 (47.7)	0.543
≥ 36 years old	171 (57.4)	47 (50.0)	218 (55.6)		130 (51.0)	49 (56.3)	179 (52.3)	
Mean ± SD	38.0 ± 9.1	36.2 ± 9.6	37.5 ± 9.2	0.104	37.0 ± 8.3	36.7 ± 9.6	36.9 ± 8.6	0.783
Distance between living room and the health facility								
< 4 km	62 (20.8)	33 (35.1)	95 (24.2)	0.012	80 (31.4)	19 (21.8)	99 (28.9)	0.001
4–9 km	144 (48.3)	33 (35.1)	177 (45.2)		87 (34.1)	18 (20.7)	105 (30.7)	
> 9 km	92 (30.9)	28 (29.8)	120 (30.6)		88 (34.5)	50 (57.5)	138 (40.4)	
Duration of residence								
≤ 24 months	42 (14.1)	25 (26.6)	67 (17.1)	0.005	43 (16.9)	10 (11.5)	53 (15.5)	0.303
> 24 months	256 (85.9)	69 (73.4)	325 (82.9)		212 (83.1)	77 (88.5)	289 (84.5)	
Profession								
Other sectors	263 (88.3)	84 (89.4)	347 (88.5)	0.769	227 (89.0)	60 (69.0)	287 (83.9)	< 0.001*
Private-public sector	35 (11.7)	10 (10.6)	45 (11.5)		28 (11.0)	27 (31.0)	55 (16.1)	
Marital status								
Widowed, separated, and divorced	104 (34.9)	22 (23.4)	126 (32.1)	0.074	71 (27.8)	10 (11.5)	81 (23.7)	0.006*
Monogamous, polygamous, and cohabiting	161 (54.0)	63 (67.0)	224 (57.1)		146 (57.3)	64 (73.6)	210 (61.4)	
Single	33 (11.1)	9 (9.6)	42 (10.7)		38 (14.9)	13 (14.9)	51 (14.9)	
Religion								
Other religion	95 (31.9)	32 (34.0)	127 (32.4)	0.070	108 (42.4)	41 (47.1)	149 (43.6)	0.423
Muslim	203 (68.1)	62 (66.0)	265 (67.6)		147 (57.6)	46 (52.9)	193 (56.4)	
Ethnic group								
Other ethnic groups	217 (72.8)	73 (77.7)	290 (74.0)	0.351	161 (63.1)	22 (25.3)	183 (53.5)	< 0.001*
Mossi	81 (27.2)	21 (22.3)	102 (26.0)		94 (36.9)	65 (74.7)	159 (46.5)	
Have ever been lost to follow-up								
No	167 (56.0)	39 (41.5)	206 (52.6)	0.014*	121 (47.5)	24 (27.6)	145 (42.4)	0.001*
Yes	131 (44.0)	55 (58.5)	186 (47.4)		134 (52.5)	63 (72.4)	197 (57.6)	
First choice for consultation when sick								
Private clinic	8 (2.7)	0 (0.0)	8 (2.0)	0.008[a,*]	9 (3.5)	8 (9.2)	17 (5.0)	< 0.001[a,*]
Public clinic	283 (95.0)	86 (91.5)	369 (94.1)		243 (95.3)	55 (63.2)	298 (87.1)	
Healers	7 (2.3)	8 (8.5)	15 (3.8)		3 (1.2)	24 (27.6)	27 (7.9)	
First choice for present disease								
Clinics	264 (88.6)	55 (58.5)	319 (81.4)	< 0.001*	227 (89.0)	55 (63.2)	282 (82.5)	< 0.001*
Healers	34 (11.4)	39 (41.5)	73 (18.6)		28 (11.0)	32 (36.8)	60 (17.5)	
First choice for cough								
Healers	61 (20.5)	23 (24.5)	84 (21.4)	0.410	57 (22.4)	33 (37.9)	90 (26.3)	0.004*
Clinics	237 (79.5)	71 (75.5)	308 (78.6)		198 (77.6)	54 (62.1)	252 (73.7)	
Medication adherence								
< 6 (low)	129 (43.3)	38 (40.4)	167 (42.6)	< 0.001*	103 (40.4)	33 (37.9)	136 (39.8)	< 0.001*
6–7.99 (medium)	70 (23.5)	42 (44.7)	112 (28.6)		66 (25.9)	51 (58.6)	117 (34.2)	
Equal 8 (high)	99 (33.2)	14 (14.9)	113 (28.8)		86 (33.7)	3 (3.4)	89 (26.0)	
Mean ± SD	6.3 ± 1.5	6.2 ± 1.7	6.3 ± 1.6	0.490	6.3 ± 1.6	5.8 ± 1.9	6.3 ± 1.7	0.018
CD4 cells count (/μl)	*N* = 298	*N* = 36	*N* = 334		*N* = 255	*N* = 16	*N* = 271	
> 200	129 (43.3)	3 (8.3)	132 (39.5)	< 0.001*	89 (34.9)	6 (37.5)	95 (35.1)	0.893
≤ 200	169 (56.7)	33 (91.7)	202 (60.5)		166 (65.1)	10 (52.5)	176 (64.9)	
Mean ± SD	181.4 ± 73.4	142.5 ± 48.1	177.2 ± 72.0	< 0.001*	172.2 ± 67.9	171.4 ± 85.9	172.1 ± 68.9	0.966

(*continued*)

Table 1. (Continued)

Variables	Hauts-Bassins				Centre			
	HIV (N = *298*)	*Coinfected* (N = *94*)	*Total* (N = *392*)	p	*HIV* (N = *255*)	*Co-infected* (N = *87*)	*Total* (N = *342*)	p
Diabetes status								
No	262 (87.9)	78 (83.0)	340 (86.7)	0.410	217 (85.1)	64 (73.6)	281 (82.2)	0.009
Yes	6 (2.0)	2 (2.1)	8 (2.0)		7 (2.7)	9 (10.3)	16 (4.7)	
Unknown	30 (10.1)	14 (14.9)	44 (11.2)		31 (12.2)	14 (16.1)	45 (13.2)	
Education								
Not educated	160 (53.7)	53 (56.4)	213 (54.3)	0.735	110 (43.1)	48 (55.2)	158 (46.2)	0.069
Educated	138 (46.3)	41 (43.6)	179 (45.7)		145 (56.9)	39 (44.8)	184 (53.8)	
Monthly income								
≥67 USD	146 (49.0)	43 (45.7)	189 (48.2)	0.666	86 (33.7)	22 (25.3)	108 (31.6)	0.184
<67 USD	152 (51.0)	51 (54.3)	203 (51.8)		169 (66.3)	65 (74.7)	234 (68.4)	
Means of transportation								
None and bicycle	206 (69.1)	69 (73.4)	275 (70.2)	0.509	158 (62.0)	59 (67.8)	217 (63.5)	0.395
Scooter, car, and bus	92 (30.9)	25 (26.6)	117 (29.8)		97 (38.0)	28 (32.2)	125 (36.5)	
STIs								
Never had STIs	116 (38.9)	31 (33.0)	147 (37.5)	0.359	113 (44.3)	29 (33.3)	142 (41.5)	0.095
At least once	182 (61.1)	63 (67.0)	245 (62.5)		142 (55.7)	58 (66.7)	200 (58.5)	
Waiting time								
Acceptable	232 (77.9)	65 (69.1)	297 (75.8)	0.114	174 (68.2)	55 (63.2)	229 (67.0)	0.467
Longer	66 (22.1)	29 (30.9)	95 (24.2)		81 (31.8)	32 (36.8)	113 (33.0)	
Alcohol								
Yes	55 (18.5)	24 (25.5)	79 (20.2)	0.136	48 (18.8)	46 (52.9)	94 (27.5)	<0.001*
No	243 (81.5)	70 (74.5)	313 (79.8)		207 (81.2)	41 (47.1)	248 (72.5)	
Smoking								
Yes	10 (3.4)	10 (10.6)	20 (5.1)	0.012[a,*]	12 (4.7)	34 (39.1)	46 (13.5)	<0.001*
No	288 (96.6)	84 (89.4)	372 (94.9)		243 (95.3)	53 (60.9)	296 (86.5)	
Inmate status								
At least once	4 (1.3)	3 (3.2)	7 (1.8)	0.365[a]	6 (2.4)	9 (10.3)	15 (4.4)	0.004[a,*]
Knowledge of viral hepatitis B and C status								
Yes	30 (10.1)	17 (8.1)	47 (12.0)	0.037*	28 (11.0)	12 (13.8)	40 (11.7)	0.481
Past or present history of arterial hypertension								
Yes	62 (20.8)	7 (7.4)	69 (17.6)	0.003*	53 (20.8)	20 (23.0)	73 (21.3)	0.665
Past or present history of pulmonary asthma								
Yes	5 (1.7)	2 (2.1)	7 (1.8)	0.675[a]	3 (1.2)	7 (8.0)	10 (2.9)	0.003[a,*]
Number of persons living in the family								
Mean ± SD	10.0 ± 7.2	8.4 ± 5.7	9.6 ± 6.9	0.060	8.8 ± 6.4	9.5 ± 6.2	9.0 ± 6.3	0.359
Number of persons sleeping in the family								
Mean ± SD	7.2 ± 5.2	5.2 ± 3.3	7.0 ± 5.1	<0.001*	6.2 ± 4.2	7.9 ± 6.4	6.5 ± 5.0	0.022
Number of children per participant								
Mean ± SD	2.9 ± 2.3	2.3 ± 1.9	2.8 ± 2.3	0.025*	2.6 ± 2.3	3.0 ± 2.3	2.7 ± 2.4	0.184
Attitude								
Mean ± SD	9.1 ± 4.3	13.1 ± 3.6	9.5 ± 4.3	<0.001*	9.7 ± 4.1	12.6 ± 2.3	9.8 ± 4.0	<0.001*
Financial access								
Mean ± SD	0.5 ± 0.06	1.4 ± 1.1	0.5 ± 0.6	<0.001*	0.6 ± 0.6	1.7 ± 0.8	0.6 ± 0.6	<0.001*
Geographic access								
Mean ± SD	2.9 ± 0.9	2.7 ± 1.0	2.9 ± 0.9	0.061	2.8 ± 1.0	2.8 ± 0.9	2.8 ± 1.0	0.535
Work perceived								
Mean ± SD	4.4 ± 0.9	4.2 ± 1.0	4.4 ± 0.9	0.098	4.2 ± 1.0	4.0 ± 1.1	4.1 ± 1.0	0.317
Past history of TB								
Mean ± SD	0.7 ± 0.9	1.4 ± 0.9	0.8 ± 0.9	<0.001*	0.6 ± 0.8	1.0 ± 1.1	0.7 ± 0.9	0.001*
Self-esteem								
Mean ± SD	25.1 ± 3.3	27.1 ± 6.0	25.0 ± 3.3	0.003	24.4 ± 2.9	25.4 ± 4.5	24.4 ± 2.9	0.055

(*continued*)

Table 1. (Continued)

Variables	Hauts-Bassins				Centre			
	HIV (N = *298*)	*Coinfected* (N = *94*)	*Total* (N = *392*)	p	*HIV* (N = *255*)	*Co-infected* (N = *87*)	*Total* (N = *342*)	p
Stigma perceived								
Mean ± SD	6.4 ± 2.0	8.6 ± 2.5	6.5 ± 2.0	< 0.001*	6.2 ± 1.8	7.9 ± 2.7	6.2 ± 1.8	< 0.001*
Discrimination and isolation								
Mean ± SD	3.7 ± 1.7	3.4 ± 2.0	3.8 ± 1.8	0.235	3.9 ± 1.6	3.2 ± 2.0	3.9 ± 1.6	0.001*
Total TB knowledge								
Mean ± SD	24.0 ± 5.4	22.3 ± 7.0	24.5 ± 5.6	0.035*	24.3 ± 5.2	16.7 ± 6.6	24.5 ± 5.4	< 0.001*
Quality of life								
Mean ± SD	23.3 ± 4.1	25.8 ± 5.4	23.3 ± 4.1	< 0.001*	23.2 ± 3.6	26.0 ± 5.4	23.2 ± 3.5	< 0.001*
Awareness of disease transmission								
Mean ± SD	8.5 ± 4.1	8.4 ± 3.6	8.4 ± 4.0	0.764	8.6 ± 4.0	7.4 ± 3.1	8.5 ± 4.0	0.005*
Psychosocial consequences of disease								
Mean ± SD	9.4 ± 1.5	10.0 ± 2.1	9.5 ± 1.5	0.008*	9.4 ± 1.3	10.9 ± 1.8	9.4 ± 1.4	< 0.001*
IDU								
At least once	13 (4.4)	3 (3.2)	16 (4.1)	0.771[a]	14 (5.5)	8 (9.2)	22 (6.4)	0.335
Past or present history of cardiovascular disease								
Yes	45 (15.1)	7 (7.4)	52 (13.3)	0.083	44 (17.3)	15 (17.2)	59 (17.3)	0.998

[a]Fisher exact test.
*$p < 0.005$.
SD, standard deviation; STI, sexually transmitted infection; TB, tuberculosis; IDU, intravenous drug use.

the literature were not examined in the present study because the records from the TB and AIDS clinics were not identical and because they were not systematically collected as part of the patients' medical records. These included the clinical forms of TB or HIV,[7,14] the patient's hemoglobin,[14] infection with helminthes,[14] the plasma viral load,[7,16] indoor air pollution,[27] and undernutrition.[27]

According to Lönnroth *et al*., the risk factors for active TB disease are HIV infection, malnutrition, diabetes, alcohol use, active smoking, and indoor air pollution. These are individual risk factors that can double or triple the risk of developing active tuberculosis.[27] In the present study we assessed alcohol use, smoking status, and diabetes status; these variables were risk factors at the univariate stage but were not predictors at the multivariate stage, even for a specific region. Mohammed *et al.* reported that smoking was not a risk factor for TB in Ethiopia,[14] but several authors have described smoking as an established factor in relation to active TB.[28,29]

Analysis of the past history of TB showed that after adjustment it was a TB risk factor among PLWHAs, which is in agreement with a number of previous studies.[11,14,30,31] But this was not the case in the Hauts-Bassins region and in a study by Lawn *et al*., which reported that the risk of TB infection was not independently associated with a previous history of TB.

Several studies have used the patients' CD4 cell counts to assess immune suppression and found that a lower CD4 cell count was associated with a higher risk of TB infection.[3,7,12,14,16,17,32–37] These studies are consistent with our findings where the median CD4 cell count was 151.4 ± 62.6 cells/μl among coinfected individuals; however, this was not the case in the Centre region. It is important to note that the presence of TB can also decrease the CD4 lymphocyte count in patients infected with HIV.[38,39]

IDU has previously been shown to be associated with a higher risk of TB.[12] In the present study IDU was not a potential risk factor of TB among PLWHAs. This discrepancy can be explained by differences in the type of epidemiological study (a temporal relationship) and the fact that the present study used the term "illegal," which implies a social desirability bias whereby illegal drug users may deny their status.

Gender analysis previously showed that being male is a risk factor for TB,[14,31,40,41] which has been explained by a combination of behavioral, socioeconomic, and true biological/genetic factors.[40,42] However, not all researchers have found such a gender discrepancy.[7,13] In the present study, being male was a risk factor at the univariate stage [OR: 2.318 (1.637–3.281)] but not at the multivariate stage [adjusted OR: 2.206 (0.890–5.469)]. These findings are consistent with those of a Danish study.[16] Nonetheless, male gender was a TB risk factor among PLWHAs in the Centre region.

Education level was also considered in this study because a low level of education has been found to be a risk factor for active TB among PLWHAs.[14,43,44] Our study results on education were in agreement with this finding. Studies showed that patients aged under 33–40 years were at a higher risk for TB at the univariate stage but not at the multivariate stage.[7,16] Our findings showed that the median age of the subjects was 37.2 ± 8.9 years. Lawn *et al*. found it difficult to explain why a younger age was a risk factor, but suggested it may reflect behavioral differences in terms of exposure.[7] In the present study, age was not a TB risk factor; this finding was similar to that of Sudre *et al*.[13]

Finally, poor housing conditions, which can be used as a proxy for low socioeconomic status, has been found to be associated with active TB.[14] In addition, being a member of a poor household and being subjected to overcrowding at home have been found to be major risk factors for the development

Table 2. Comparison of the Risk Factors Between Patients with HIV Only and Patients Coinfected with Tuberculosis and HIV

	Profile of the patients			
Variables	*HIV* N = *553 (%)*	*Coinfected TB-HIV* N = *181 (%)*	*Total* N = *734 (%)*	p
Area				
Rural	149 (26.9)	95 (52.5)	244 (33.2)	< 0.001*
Urban	404 (73.1)	86 (47.5)	490 (66.8)	
Sex				
Female	405 (73.2)	98 (54.1)	503 (68.5)	< 0.001*
Male	148 (26.8)	83 (45.9)	231 (31.5)	
Age				
< 36 years old	252 (45.6)	85 (47.0)	337 (45.9)	0.810
≥ 36 years old	301 (54.4)	96 (53.0)	397 (54.1)	
Mean ± SD	37.5 ± 8.7	35.0 ± 9.6	37.2 ± 8.9	0.173
Distance between living room and the health facility				
< 4 km	142 (25.7)	52 (28.7)	194 (26.4)	0.003*
4 to 9 km	231 (41.8)	51 (28.2)	282 (38.4)	
> 9 km	180 (32.5)	78 (42.1)	258 (35.1)	
Self-esteem (Mean ± SD)	24.8 ± 3.1	26.3 ± 5.4	25.2 ± 3.9	< 0.001*
Quality of life (Mean ± SD)	25.9 ± 3.8	23.2 ± 5.4	23.9 ± 4.4	< 0.001*
Profession				
Other professional sector and unemployed	490 (88.6)	144 (79.6)	634 (86.4)	0.002*
Private-public sector	63 (11.4)	37 (20.4)	100 (13.6)	
Marital status				
Widowed, separated, and divorced	175 (31.6)	32 (17.7)	207 (28.2)	0.001*
Monogamous, polygamous, and cohabiting	307 (55.5)	127 (70.2)	434 (59.1)	
Single	71 (12.8)	22 (12.2)	93 (12.7)	
Religion				
Other religion	203 (36.7)	73 (40.3)	276 (37.6)	0.432
Muslim	350 (63.3)	108 (59.7)	458 (62.4)	
Ethnic group				
Other ethnic groups	378 (68.4)	95 (52.5)	473 (64.4)	< 0.001*
Mossi	175 (31.6)	86 (47.5)	261 (35.6)	
Duration of residence				
≤ 24 months	85 (15.4)	35 (19.3)	120 (16.3)	0.256
> 24 months	468 (84.6)	146 (80.7)	614 (83.7)	
Knowledge about anti-TB treatment duration				
Insufficient knowledge	506 (91.5)	61 (33.7)	567 (77.2)	< 0.001*
Good knowledge	47 (8.5)	120 (66.3)	167 (22.8)	
Knowledge about TB transmission (mean ± SD)	8.8 ± 3.0	4.0 ± 3.7	7.6 ± 3.8	< 0.001*
Knowledge about side effects of anti-TB treatment (mean ± SD)	1.1 ± 2.2	2.7 ± 2.0	1.5 ± 2.3	< 0.001*
Other aspects of knowledge (mean ± SD)	6.8 ± 1.1	4.8 ± 1.9	6.3 ± 1.6	< 0.001*
Total TB knowledge (mean ± SD)	24.1 ± 5.3	19.6 ± 7.4	23.0 ± 6.2	< 0.001*
Attitude (mean ± SD)	12.9 ± 4.2	9.4 ± 3.1	10.3 ± 4.2	< 0.001*
Ever lost to follow-up?				
Never	288 (52.1)	63 (34.8)	351 (47.8)	< 0.001*
Has been lost to follow-up	265 (47.9)	118 (65.2)	383 (52.2)	
Past history of TB (mean ± SD)	0.6 ± 0.9	1.2 ± 1.0	0.79 ± 0.1	< 0.001*
Stigma (mean ± SD)	6.3 ± 1.9	8.3 ± 2.6	6.8 ± 2.3	< 0.001*
Discrimination and isolation (mean ± SD)	3.8 ± 1.6	3.3 ± 2.0	3.7 ± 1.8	0.002*
Medication adherence				
< 6 = low	232 (42.0)	71 (39.2)	303 (41.3)	< 0.001*
6 to 7.99 = medium	136 (24.6)	93 (51.4)	229 (31.2)	

(*continued*)

Table 2. (Continued)

Variables	Profile of the patients: HIV N = 553 (%)	Coinfected TB-HIV N = 181 (%)	Total N = 734 (%)	p
Equal 8 = high	185 (33.5)	17 (9.4)	202 (927.5)	
Mean ± SD	6.3 ± 1.6	6.0 ± 1.8	6.2 ± 1.6	0.028*
Awareness of disease transmission (mean ± SD)	8.6 ± 4.0	7.9 ± 3.4	8.4 ± 3.9	0.039*
Psychosocial consequences of disease (mean ± SD)	9.4 ± 1.4	10.4 ± 2.0	9.7 ± 1.6	< 0.001*
Financial access (mean ± SD)	0.6 ± 0.6	1.6 ± 1.0	0.8 ± 0.8	< 0.001*
IDU				
At least once	27 (4.9)	11 (6.1)	38 (5.2)	0.662
Past or present history of cardiovascular disease				
Yes	89 (16.1)	22 (12.2)	111 (15.1)	0.244
First choice when the patient is sick				
Private clinic	17 (3.1)	8 (4.4)	25 (3.4)	< 0.001*
Public clinic	526 (95.1)	141 (77.9)	667 (90.9)	
Healer	10 (1.8)	32 (17.7)	42 (5.7)	
First choice for consultation place about the present disease				
Clinics	491 (88.8)	110 (60.8)	601 (81.9)	< 0.001*
Healer	62 (11.2)	71 (39.2)	133 (18.1)	
First choice for consultation place when having cough				
Healer	118 (21.3)	56 (30.9)	174 (23.7)	0.011*
Clinics	435 (78.7)	125 (69.1)	560 (76.3)	
Education				
Not educated	270 (48.8)	101 (55.8)	371 (50.5)	0.123
Educated	283 (51.2)	80 (44.2)	363 (49.5)	
Monthly income				
≥ 67 USD	232 (42.0)	65 (35.9)	297 (40.5)	0.177
< 67 USD	321 (58.0)	116 (64.1)	437 (59.5)	
Means of transportation				
None and bicycle	364 (65.8)	128 (70.7)	492 (67.0)	0.261
Scooter, car, and bus	189 (54.2)	53 (29.3)	242 (33.0)	
Waiting time				
Acceptable	406 (73.4)	120 (66.3)	526 (71.7)	0.080
Longer	147 (26.6)	61 (33.7)	208 (28.3)	
Alcohol				
Yes	103 (18.6)	70 (38.7)	173 (23.6)	< 0.001*
No	450 (81.4)	111 (61.3)	561 (76.4)	
Smoking				
Yes	22 (4.0)	44 (24.3)	66 (9.0)	< 0.001*
No	531 (96.0)	137 (75.7)	668 (91.0)	
Inmate status				
Never been prisoner	543 (98.2)	169 (93.4)	712 (97.0)	0.001*
Imprisoned at least once	10 (1.8)	12 (6.6)	22 (3.0)	
Knowledge of viral hepatitis B and C				
Yes	58 (10.5)	29 (16.0)	87 (11.9)	0.062
Sexually transmissible infection (STI)				
Never had STI	229 (41.4)	60 (33.1)	289 (39.4)	0.048*
At least once had STI	324 (58.6)	121 (66.9)	445 (60.6)	
Diabetes status				
Yes	13 (2.4)	11 (6.1)	24 (3.3)	0.011*
No	479 (86.6)	142 (78.5)	621 (84.6)	
Unknown	61 (11.0)	28 (15.5)	89 (12.1)	
Past or present history of pulmonary asthma				
Yes	8 (1.4)	9 (5.0)	17 (2.3)	0.006*
Past or present history of arterial hypertension				
Yes	115 (20.8)	27 (14.9)	142 (19.3)	0.103

(*continued*)

Table 2. (Continued)

Variables	Profile of the patients: HIV N = 553 (%)	Coinfected TB-HIV N = 181 (%)	Total N = 734 (%)	p
CD4 cells count (/μl)	N = 553	N = 52	N = 605	
CD4 more than 200	218 (39.4)	9 (17.3)	227 (37.5)	0.003*
CD4 less than or equal 200	335 (60.6)	43 (82.7)	378 (62.5)	
Mean ± SD	177.1 ± 71.0	151.4 ± 62.6	174.9 ± 70.6	0.012*
Number of persons living in the family (mean ± SD)	9.4 ± 6.9	9.0 ± 5.9	9.3 ± 6.6	0.405
Number of persons sleeping in the family (mean ± SD)	6.7 ± 4.8	6.5 ± 5.2	6.7 ± 4.9	0.614
Number of children per participant (mean ± SD)	2.8 ± 2.3	2.7 ± 2.1	2.8 ± 2.3	0.523
Geographic access (mean ± SD)	2.8 ± 0.9	2.8 ± 0.9	2.8 ± 0.9	0.310
Work perceived (mean ± SD)	4.3 ± 0.9	4.1 ± 1.1	4.3 ± 1.0	0.058

*$p < 0.005$.
SD, standard deviation.

Table 3. Multivariate Analysis for Predicting Coinfected Status Among HIV Patients per Region and for Pooling Data

Independent variables	Hauts-Bassins region: AOR (95% CI)	p	Centre region: AOR (95% CI)	p
Area				
Urban	1		1	
Rural	0.200 (0.042; 0.966)	0.045*	0.022 (0.001; 0.410)	0.010*
Gender				
Female	1		1	
Male	2.806 (0.598; 7.220)	0.244	20.619 (1.284; 331.221)	0.033*
Education				
Not educated	1		1	
Educated	0.356 (0.134; 0.948)	0.039*	0.815 (0.167; 3.988)	0.801
Profession				
Private-Public Sector	1		1	
Other professional sector and unemployed	2.370 (0.435; 12.930)	0.319	2.612 (1.618; 5.632)	0.010
CD4 cells count				
≤ 200/μl	1		1	
> 200/μl	0.090 (0.022; 0.378)	0.001*	0.692 (0.150; 3.190)	0.637
Present or past history of HTA				
Yes	1		1	
No	0.225 (0.053; 0.952)	0.043*	1.410 (0.869; 7.302)	0.068
Present or past history of cardiovascular disease				
No	1		1	
Yes	1.396 (0.321; 5.464)	0.636	2.054 (1.083; 4.973)	0.041*
Present or past history of pulmonary asthma				
No	1		1	
Yes	9.697 (1.006; 36.694)	0.043*	1.680 (0.383; 7.361)	0.491
Sexually transmissible infections (STIs)				
Never	1		1	
At least once	2.131 (1.082; 4.117)	0.041*	1.744 (0.434; 2.864)	0.316
TB past history	1.655 (0.958; 2.859)	0.071	3.667 (1.298; 10.358)	0.014*
Geographic access	0.523 (0.302; 0.908)	0.021*	0.384 (0.169; 0.871)	0.022*
Number of persons sleeping in the family	0.876 (0.782; 0.981)	0.022*	1.058 (0.885; 1.266)	0.534
Number of persons living in the family	1.080 (1.018; 1.147)	0.011*	1.071 (0.943; 1.216)	0.292

*p-value < 0.0.
AOR, adjusted odds ratio; 95% CI, 95% confidence interval.

of TB.[14,40,41] Living in a house made of mud has been shown to be independently associated with developing active tuberculosis among PLWHAs.[14] Moreover, housing condition is a risk factor for TB in Canada.[15] In the present study, household overcrowding was assessed. The findings showed that the TB risk factors were the number of living family members in the pooled data and in the Hauts-Bassins region and the number of persons sleeping in the household in the Hauts-Bassins region. In addition, the present study included a number of new factors associated with PLWHAs that had not been investigated in previous studies, including previous STIs, TB knowledge, attitude toward TB/HIV patients, discrimination and isolation, and self-esteem. In addition, profession, past or present history of pulmonary asthma, past or present history of cardiovascular disease and arterial hypertension, geographic and financial access to care, quality of life, stigma, and psychosocial consequences of disease were risk factors among PLWHAs. Consulting healers first when sick was also a TB risk factor among PLWHAs. This could be the subject of further study. We think that this could be explained by the confined setting of the consultation place, the TB profile of healers, patients looking for more solutions for dual infections, and the severity of the disease. In this context, these new variables need to be included and assessed in future research.

Conclusions

The identified influential factors are important considerations that needed to be incorporated into current TB and HIV control programs. In addition, the following factors have to be carefully considered regarding the specific settings: region, area, gender, education, profession, past or present history of pulmonary asthma, past or present history of cardiovascular disease and arterial hypertension, first place for consultation when sick, CD4 cell count, STIs, past history of TB, household crowding, and geographic access to care. Additionally, consulting healers first when sick must be explored as a TB risk factor in future research. TB programs need to be tailored in order to offer support for specific groups and settings.

Acknowledgments

The authors wish to thank all subjects who participated in this study as well as the peer educators and social workers from the NGOs and the health workers from public clinics for their help in collecting the questionnaires. The staff from the International Health Program of the National Yang-Ming University, Taipei also needs to be thanked. We are also very grateful for the assistance of Wen-chun Chen and Yen-Ju Chen from the AIDS Prevention and Research Center, National Yang-Ming University, Taipei. We would like to give special thanks to Mr. Yahaya Nombré for supervising the data gathering, to Mr. Ibrahima R. Diallo for creating the EPIDATA file for the study, and to Mr. Cyprien Diarra and Mr. Bakyono François doing the data entry.

This study was supported in part by grants from the AIDS Prevention and Research Center and the International Health Program of the Institute of Public Health, National Yang-Ming University of Taipei, Taiwan.

Author Disclosure Statement

No competing financial interests exist.

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