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ORIGINAL ARTICLE

Medication-adherence predictors among patients with tuberculosis or human immunodeficiency virus infection in Burkina Faso

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Background: Adherence to treatment remains a key issue for tuberculosis (TB) and human immunodeficiency virus (HIV) programs. The study objective was to identify potential determinants of medication adherence (MA) among patients with TB, HIV, or both.
Methods: In this cross-sectional study, adult patients attending TB or HIV clinics were recruited in two main regions (Centre and Hauts-Bassins) of Burkina Faso from August to October 2010. Questionnaires were collected and simple and multiple step-wise linear regression models were used to identify predictors of MA.
Results: In total, 1043 patients (309 with TB, 553 with HIV, and 181 coinfected with both) participated in this study. For patients with TB, adjusted predictors of good MA were no alcohol use, ever been lost to follow-up, and awareness of disease transmission. For patients with HIV,

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adjusted predictors of good MA were less stigma, good knowledge about TB transmission, and awareness of disease transmission. For patients with dual infection, adjusted predictors of good MA was good attitude. Furthermore, adjusted predictors of poor MA for patients with TB or with dual infection were poor financial access to care and high number of persons sleeping in the household, respectively.

Conclusion: This study provides information on MA in patients infected with TB, HIV, and those coinfected with TB and HIV. TB and HIV programs have to consider the environment of the patient and its characteristics, including stigma, attitude, status of loss to follow-up, TB knowledge, financial access to care, alcohol use, awareness of disease transmission, and number of persons sleeping in the household. These identified factors in this study need to be taken into account for a specific patient profile and during sensitization, project planning, and research stages.

Introduction

The World Health Organization (WHO) has stated that tuberculosis (TB) and human immunodeficiency virus (HIV) infections will be among the top 20 causes of death up to 2030.[1] Both are chronic infectious diseases that mainly affect the most disadvantaged populations, involve complex treatment regimens with potentially severe side effects, and are frequently associated with non-adherence to treatment, which may result in drug resistance.[2,3]

According to Bangsberg et al, adherent patients have a longer period of successful treatment and also have lower mortality rates than patients who are less adherent in urban settings of San Francisco.[4] Access to anti-TB treatment and to antiretroviral (ARV) medication has become more widely available. For Corless et al, the question remains as to how to maintain high adherence with respect to ARV treatment in the context of lack of food and other basic necessities in Durban, South Africa[5]; in the context where interrupted treatment may reduce treatment efficacy and cause drug resistance, it can result in increased morbidity and mortality as well as additional infections.[6] It is known that adherence rates to long-term medication in high income countries have been estimated to be only 50%, whereas adherence in developing countries seems to be even lower.[2] Therefore, adherence of TB and HIV/AIDS patients to treatment remains a challenge. An important difference in medication adherence between TB and HIV patients is that TB patients only need to take 6—9 months of medication and HIV patients need lifelong treatment. Additionally, some factors have not been considered in previous studies: ever been lost to follow-up, duration of residence, number of persons sleeping in the household, first choice for consultation for the disease, awareness of disease transmission, and psychosocial consequences of the disease. Using a large range of variables, the present study aims to identify potential determinants of medication adherence among patients with TB, HIV, and patients coinfected with TB and HIV in a developing country, Burkina Faso.

Methods

Study type and setting

This cross-sectional study uses a survey conducted in health centers and non-governmental organizations (NGOs) located in the Centre and Hauts-Bassins regions of Burkina Faso. These two regions harbor approximately 40% of the TB cases nationwide, have the highest HIV prevalence, and have the largest number of NGOs providing ARV treatment in the country.

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. In total, 309 incident TB cases and 52 prevalent TB cases participated in this study.

HIV patients were identified from data provided by various NGOs and HDs, which were the same as those for 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.

Sample size calculation

Sample size was calculated using the online sample size calculation provided by RASOFT.[7] A common margin of error of 5% was used. Thus, a confidence level of 95% was chosen, with a response distribution of 50%, a power equal to 80%, and assuming a normal distribution. With the knowledge that the total number of TB cases for both regions was 1832 in 2008,[8,9] the minimal TB sample size expected was 316 cases for the two regions. In addition, 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.

Study planning, research approval, and recruitment of patients

The study was conducted from 1 August to 8 October, 2010 after advice and guidance was obtained from the National Yang-Ming University of Taipei (Taiwan) and from the National TB program of Burkina Faso, together with an expert

opinion from the West African Health Organization. The study 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.

This study used a consecutive patient method. The inclusion criteria were filled when the patient was a confirmed TB case from a TB clinic and was undergoing anti-TB treatment. Similar criteria were used for HIV cases from AIDS clinics under highly active antiretroviral therapy (HAART). In addition, the patient was required to be 15 years and older, and living in the study setting. Both sexes were included.

Formative research and data collection

After obtaining informed consent from each patient, a face-to-face interview was conducted using a semi-structured questionnaire consisting of two parts. The first part recorded the individual's clinical information and comorbidities (10—15 minutes) and was completed during the interview. The remaining section of the questionnaire needed 25—30 minutes 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 (eight-item scale, with Cronbach's $\alpha = 0.873$),[10] adapted quality of life from the WHO quality of life (feelings about life, capability, and expectations for the future, with an eight-item scale, Cronbach's $\alpha = 0.726$),[11] adapted knowledge index about TB,[12] adapted attitude index,[12] adapted perception index (discrimination and isolation),[13] awareness of disease transmission (three-item scale, Cronbach's $\alpha = 0.783$).

Medication adherence was measured using the Morisky scale (eight-item scale, Cronbach's $\alpha = 0.711$).[14] It is a validated and qualified scale which is an indirect method for evaluating medication with behavior using a self-report and patient behavior in the context of chronic diseases. In this regard, we minimized the effect linked to the duration of treatment in different patients at different stages and avoided the effect of insufficient managing by medical charts. We referred only to anti-TB and ARV treatments according to the context in Burkina Faso: the drugs for prevention were not systematically used. The sum of medication adherence index ranged from zero (lowest) to eight (highest). Predictors of good adherence were defined as those that were positively correlated with medication adherence, whereas poor predictors were defined as those that were negatively correlated with medication adherence.

In addition to collecting psychosocial and behavioral information from patients, data were also collected on present or past clinical information (CD4 cell count, diabetes, cardiovascular disease, arterial hypertension, and pulmonary asthma), health system-related factors (financial and geographical access, work force perceived by patients, waiting time of consultation), 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 transmitted infections (STIs), and injection drug use (IDU)], psychosocial consequences of the disease, type of alimentation, and sexual orientation. Before conducting the final survey, the questionnaire underwent pretesting in order to reduce bias and to better control the time needed for completing the questionnaire.

HIV testing and TB confirmation

HIV status and TB status were confirmed from the medical and biological records of each patient. In TB patients, TB

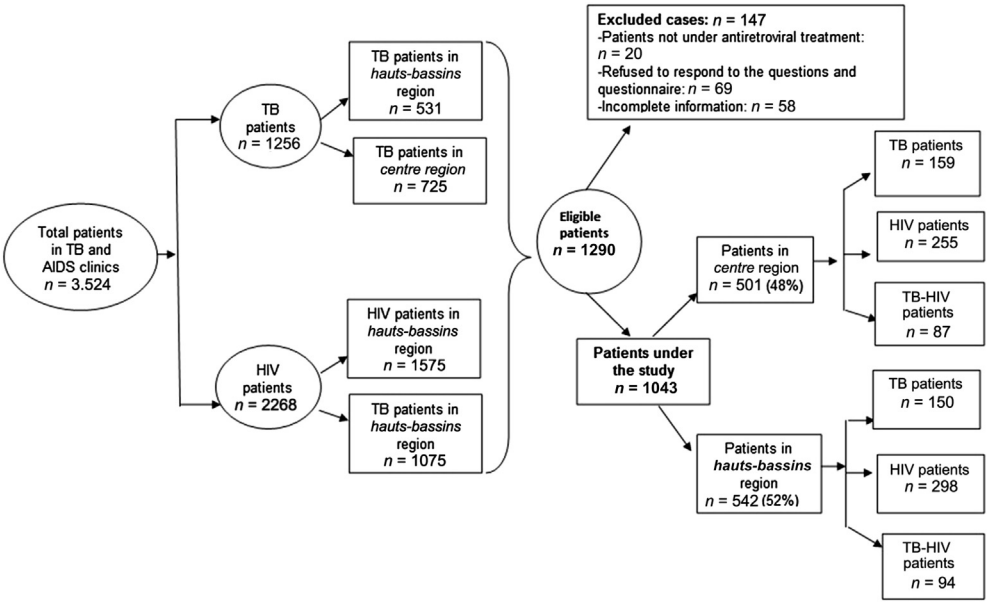

Figure 1. Participants and sample characteristics.

Table 1 Univariate and multivariate analyses of potential factors that predict medication adherence

Influential factors	Subgroups	Frequency	Adherence score mean ± SD	*t* test		Univariate analysis				Multivariate analysis			
				Test value	*p*	β	Lower bound	Upper bound	*p*	β	Lower bound	Upper bound	*p*
Status of patient	TB and HIV	862	6.3 ± 1.6	2.307	0.021	0.307	0.046	0.568	0.021	0.146	−0.119	0.411	0.281
	Coinfected	181	6.0 ± 1.8										
Alcohol	No	777	6.4 ± 1.5	5.221	<0.001	0.642	0.418	0.866	<0.001	0.366	0.144	0.589	0.001
	Yes	266	5.8 ± 1.8										
Illegal drug use	Never	967	6.3 ± 1.6	3.225	0.001	0.623	0.244	1.003	0.001	0.455	0.093	0.817	0.014
	At least once	76	5.7 ± 1.6										
Having ever been lost to follow-up	Yes	619	6.4 ± 1.6	2.773	0.006	0.288	0.087	0.489	0.005	0.240	0.041	0.438	0.018
	No	424	6.1 ± 1.7										
First choice for consultation when sick	Clinics	975	6.3 ± 1.7	5.128	<0.001	−0.587	−0.872	−0.302	<0.001	−0.133	−0.435	0.169	0.387
	Healers	68	5.0 ± 1.8										
First choice for consultation about present disease	Healers	228	5.8 ± 1.8	4.648	<0.001	−0.602	−0.839	−0.365	<0.001	−0.272	−0.527	−0.017	0.036
	Clinics	815	6.4 ± 1.6										
First choice for consultation when having cough	Clinics	822	6.4 ± 1.6	2.788	0.006	0.365	0.124	0.607	0.003	−0.200	−0.464	0.065	0.139
	Healers	221	6.0 ± 1.8										
Waiting time perceived by patients	Longer	290	6.1 ± 1.7	2.302	0.022	−0.259	−0.479	−0.038	0.022	−0.022	−0.238	0.193	0.839
	Acceptable	753	6.3 ± 1.6										
Number of persons sleeping in the household		1043				−0.030	−0.051	−0.010	0.004	−0.023	−0.043	−0.004	0.018
Attitude		1043				0.058	0.033	0.082	<0.001	0.031	0.001	0.062	0.057
Financial access to health care index		1043				0.125	0.027	0.223	0.013	0.248	0.120	0.377	<0.001
Work force perceived by patient index		1043				0.228	0.127	0.328	<0.001	0.101	0.001	0.201	0.050
Self-esteem index		1043				0.051	0.032	0.069	<0.001	0.015	−0.009	0.039	0.213
Stigma index		1043				0.124	0.087	0.161	<0.001	0.097	0.044	0.150	<0.001
Discrimination and isolation index		1043				0.149	0.097	0.201	<0.001	0.028	−0.031	0.088	0.347
Awareness of disease transmission index		1043				0.095	0.069	0.121	<0.001	0.057	0.030	0.083	<0.001
Knowledge about TB transmission index		1043				0.033	0.010	0.057	0.005	0.013	−0.018	0.044	0.410

SD = standard deviation.

smear result was considered positive when at least two sputum samples of the patient were examined and the germ of the TB disease was detected by light microscopy after Ziehl-Neelsen staining. In HIV patients, a HIV test was positive when antibodies were detected by an initial test based on the ELISA method, and then confirmed by a second test using the Western blot procedure.

Data analysis

Data were entered into EPIDATA (3.0 Software, EpiData Association, Odense, Denmark) and analyzed by the SPSS PC statistical package, version 17.0 (SPSS Inc., Chicago, IL, USA). The cut-off point for continuous variables was the median. The level of significance was 0.05. A comparison of the variables between patients with TB, HIV, and both was carried out using the Chi-square test for categorical data and a two-sample *t* test or *F* test for continuous data. Simple and multiple stepwise linear regression models were then used to identify predictors of the medication adherence index. Only significant predictor factors of medication adherence at the univariate analysis were entered into the model for multivariate analysis.

Results

Participants and sample characteristics

There were 1290 patients who met the inclusion criteria during data collection (Fig. 1). After eligibility and enrollment, the sample size under study was reduced to 1043 participants out of which 605 patients were from HIV clinics (from public sector and NGOs, and 52 were coinfected with TB and HIV) and 438 from TB clinics (all from public sector, and 129 were coinfected with TB and HIV). The non-eligible cases were those who refused to respond

Table 2 Univariate and multivariate analyses of potential factors that predict medication adherence for TB patients

	Subgroups	Frequency	Adherence score mean ± SD	Univariate analysis				Multivariate analysis			
				β	Lower bound	Upper bound	p	β	Lower bound	Upper bound	p
Alcohol use	No	216	6.6 ± 1.4	0.987	0.610	1.363	<0.001	0.621	0.258	0.984	0.001
	Yes	93	5.6 ± 1.8								
Illegal drug use	Never	271	6.4 ± 1.6	0.821	0.281	1.361	0.003	0.493	−0.010	0.997	0.055
	At least once	38	5.6 ± 1.6								
Having ever been lost to follow-up	Yes	236	6.6 ± 1.5	1.251	0.852	1.651	<0.001	0.986	0.597	1.376	<0.001
	No	73	5.4 ± 1.6								
First choice for consultation when sick	Clinics	283	6.4 ± 1.6	−0.446	−0.863	−0.030	0.036	0.030	−0.381	0.441	0.886
	Healers	26	5.3 ± 1.8								
First choice for consultation about present disease	Clinics	214	6.5 ± 1.4	−0.627	−1.011	−0.244	0.001	−0.370	−0.770	0.031	0.070
	Healers	95	5.9 ± 1.8								
First choice for consultation when having cough	Clinics	262	6.3 ± 1.6	0.150	−0.351	0.651	0.556				
	Healers	47	6.2 ± 1.6								
Waiting time perceived by patients	Longer	82	6.0 ± 1.6	−0.434	−0.838	−0.029	0.036	−0.062	−0.472	0.348	0.767
	Acceptable	227	6.4 ± 1.6								
Number of persons sleeping in the household		309		−0.029	−0.069	0.011	0.158				
Attitude		309		0.196	0.099	0.294	<0.001	0.054	−0.049	0.157	0.307
Financial access to health care index		309		−0.370	−0.621	−0.119	0.004	−0.387	−0.620	−0.154	0.001
Work force perceived by patient index		309		0.229	0.042	0.416	0.016	0.010	−0.187	0.207	0.921
Self-esteem index		309		0.054	0.026	0.082	<0.001	0.010	−0.023	0.043	0.555
Stigma index		309		0.157	0.087	0.227	<0.001	0.070	−0.012	0.152	0.095
Discrimination and isolation index		309		0.137	0.052	0.222	0.002	0.020	−0.077	0.116	0.691
Awareness of disease transmission index		309		0.063	0.008	0.118	0.024	0.058	0.006	0.110	0.030

SD = standard deviation.

to the questions and the questionnaire ($n = 69$), HIV patients who were not under ARV treatment ($n = 20$), and those who responded but provided incomplete information ($n = 58$). This final sample of 1043 patients consisted of 309 TB patients, 553 HIV/AIDS cases, and 181 patients coinfected with TB and HIV. All patients were heterosexual and ate mixed food.

Factors that differ among TB infected, HIV infected, and TB/HIV coinfected patients

There were no differences among patients with TB, HIV, and TB/HIV coinfection in alcohol status, waiting time perceived by patients, patient status (TB infected and HIV infected versus coinfected with TB and HIV), ever been lost to follow-up, IDU, place for consultation when sick and having a cough, and past/present disease history.

Predictors of medication adherence index

Univariate analysis predictors for medication adherence were patient status (TB and HIV infection versus coinfection with TB and HIV), alcohol status, IDU, ever been lost to follow-up, first choice for consultation, waiting time perceived by patients, number of persons sleeping in the household, attitudes, financial access to care, perceived work force, self-esteem, stigma, discrimination isolation, awareness of disease transmission, and knowledge about TB transmission (Tables 1–3). Sociodemographic variables were not predictor factors of medication adherence.

Table 3 Univariate and multivariate analyses of potential factors that predict medication adherence for HIV patients

	Subgroups	Frequency	Adherence score mean ± SD	Univariate analysis				Multivariate analysis			
				β	Lower bound	Upper bound	p	β	Lower bound	Upper bound	p
Alcohol	No	450	6.4 ± 1.6	0.249	−0.093	0.590	0.154				
	Yes	103	6.1 ± 1.7								
Illegal drug use	Never	526	6.4 ± 1.6	0.545	−0.072	1.162	0.083				
	At least once	27	5.8 ± 1.6								
Having ever been lost to follow-up	Yes	265	6.3 ± 1.6	−0.073	−0.339	0.194	0.593				
	No	288	6.4 ± 1.6								
First choice for consultation when sick	Clinics	543	6.4 ± 1.6	0.159	−0.446	0.763	0.606				
	Healers	10	6.3 ± 1.2								
First choice for consultation about present disease	Clinics	491	6.4 ± 1.6	−0.283	−0.705	0.139	0.188				
	Healers	62	6.1 ± 1.6								
First choice for consultation when having cough	Clinics	435	6.4 ± 1.6	0.220	−0.105	0.545	0.183				
	Healers	118	6.2 ± 1.7								
Waiting time perceived by patients	Longer	147	6.2 ± 1.5	0.164	−0.138	0.465	0.287				
	Acceptable	406	6.4 ± 1.6								
Number of persons sleeping in the household		553		−0.011	−0.038	0.017	0.461				
Attitude		553		0.054	0.022	0.085	0.001	−0.024	−0.065	0.017	0.247
Financial access to health care index		553		−0.197	−0.410	0.015	0.068				
Work force perceived by patient index		553		0.098	−0.044	0.240	0.176				
Self-esteem index		553		0.091	0.049	0.133	<0.001	0.026	−0.022	0.075	0.286
Stigma index		553		0.208	0.141	0.275	<0.001	0.116	0.029	0.203	0.009
Discrimination and isolation index		553		0.131	0.050	0.211	0.001	0.050	−0.042	0.141	0.287
Awareness of disease transmission index		553		0.105	0.073	0.136	<0.001	0.073	0.039	0.108	<0.001
Knowledge about TB transmission index		553		−0.627	−0.983	−0.272	0.001	0.050	<0.001	0.099	0.048

SD = standard deviation.

From the pooled data, adjusted predictors of good medication adherence were no alcohol use, ever been lost to follow-up, first place consultation for present disease, financial access to care, perceived work force, less stigma, and awareness of disease transmission (Tables 1–3). Furthermore, adjusted predictors of poor medication adherence were high number of persons sleeping in the household and consulting healer for present disease. Patient status was not found to be predictive of medication taking behavior [β: 0.146 (−0.119 to 0.411)].

In TB patients (Table 1), the adjusted predictors of good medication adherence were no alcohol use, ever been lost to follow-up, and awareness of disease transmission. Poor financial access to care was an adjusted predictor of poor medication adherence.

In HIV/AIDS patients (Table 4), the adjusted predictors of good medication adherence were fewer stigmata, good knowledge about TB transmission, and high awareness of disease transmission.

In patients coinfected with TB and HIV (Table 4), good attitude was an adjusted predictor of good medication adherence, whereas high number of persons sleeping in the household was an adjusted predictor of poor medication adherence.

Table 4 Univariate and multivariate analyses of potential factors that predict medication adherence for coinfected patients with TB and HIV infection

	Subgroups	Frequency	Adherence score mean ± SD	Univariate analysis				Multivariate analysis			
				β	Lower bound	Upper bound	p	β	Lower bound	Upper bound	p
Alcohol	No	111	6.3 ± 1.6	0.811	0.293	1.329	0.002	0.273	−0.259	0.805	0.313
	Yes	70	5.5 ± 1.9								
Illegal drug use	Never	170	6.0 ± 1.8	0.307	−0.776	1.389	0.577				
	At least once	11	5.7 ± 1.3								
Having ever been lost to follow-up	Yes	63	6.2 ± 1.6	0.395	−0.146	0.935	0.151				
	No	118	5.8 ± 2.0								
First choice for consultation when sick	Clinics	149	5.9 ± 1.8	−1.219	−1.764	−0.673	<0.001	0.093	−0.667	0.853	0.809
	Healers	32	4.5 ± 1.7								
First choice for consultation about present disease	Clinics	110	6.4 ± 1.7	−0.940	−1.452	−0.429	<0.001	−0.428	0.151	−1.012	0.157
	Healers	71	5.4 ± 1.7								
First choice for consultation when having cough	Clinics	125	6.3 ± 1.6	0.824	0.277	1.370	0.003	−0.240	0.461	−0.882	0.401
	Healers	56	5.5 ± 1.9								
Waiting time perceived by patients	Longer	61	5.3 ± 1.9	−1.049	−1.574	−0.524	<0.001	−0.252	−0.901	0.397	0.445
	Acceptable	120	6.4 ± 1.6								
Number of persons sleeping in the household		181		−0.084	−0.132	−0.035	0.001	−0.058	−0.105	−0.012	0.014
Attitude		181		0.207	0.128	0.286	<0.001	0.148	0.047	0.249	0.004
Financial access to health care index		181		−0.058	−0.323	0.207	0.666				
Work force perceived by patient index		181		0.495	0.265	0.725	<0.001	0.272	−0.003	0.547	0.053
Self-esteem index		181		0.060	0.013	0.107	0.013	−0.048	−0.107	0.012	0.117
Stigma index		181		0.168	0.073	0.263	0.001	0.095	−0.024	0.214	0.117
Discrimination and isolation index		181		0.186	0.060	0.312	0.004	0.017	−0.132	0.166	0.818
Awareness of disease transmission index		181		0.099	0.024	0.174	0.010	0.043	0.032	0.118	0.259
Knowledge about TB transmission index		181		−0.283	−0.860	0.294	0.335				

SD = standard deviation.

Table 5 Description of the variables by patient profile

Variables	Profile of patient				χ^2 test or *F* test	*p*
	TB, $n = 309$	HIV, $n = 553$	TB_HIV, $n = 181$	Total, $n = 1043$		
Area						
—Rural	227 (73.5)	149 (26.9)	95 (52.5)	471 (45.2)	177.964	<0.001
—Urban	82 (26.5)	404 (73.1)	86 (47.5)	572 (54.8)		
Sex						
—Female	87 (28.2)	405 (73.2)	98 (54.1)	590 (56.6)	164.504	<0.001
—Male	222 (71.8)	148 (26.8)	83 (45.9)	453 (43.4)		
Age group						
—<36.5	203 (65.7)	280 (50.6)	90 (49.7)	573 (54.9)	20.573	<0.001
—≥36.5	106 (34.3)	273 (49.4)	91 (50.3)	470 (45.1)		
Mean ± SD	34.6 ± 13.2	37.5 ± 8.7	36.4 ± 9.6	36.5 ± 10.4	7.573	0.001
Self-esteem (Mean ± SD)	30.4 ± 6.3	24.8 ± 3.1	26.3 ± 5.4	26.7 ± 5.3	144.239	<0.001
Quality of life (Mean ± SD)	28.8 ± 5.2	23.2 ± 3.8	25.9 ± 5.4	25.4 ± 5.2	150.304	<0.001
Profession						
—Others	238 (77.0)	490 (88.6)	144 (79.6)	872 (83.6)	22.027	<0.001
—Private—public sector	71 (23.0)	63 (11.4)	37 (20.4)	171 (16.4)		
Marital status						
—Widowed, separated, and divorced	20 (6.5)	175 (31.6)	32 (17.7)	227 (21.8)	89.648	<0.001
—Monogamous, polygamous, and cohabiting	209 (67.6)	307 (55.5)	127 (70.2)	643 (61.6)		
Single	80 (25.9)	71 (12.8)	22 (12.2)	173 (16.6)		
Religion						
—Other religion	82 (26.5)	203 (36.7)	73 (40.3)	358 (34.3)	12.604	0.002
—Muslim	227 (73.5)	350 (63.3)	108 (59.7)	685 (65.7)		
Ethnic group						
—Other ethnic group	123 (39.8)	378 (68.4)	95 (52.5)	596 (57.1)	67.911	<0.001
—Mossi	186 (60.2)	175 (31.6)	86 (47.5)	447 (42.9)		
Means of transportation						
—None and use	179 (57.9)	364 (65.8)	128 (70.7)	671 (64.3)	9.274	0.010
—Scooter, car, and bus use	130 (42.1)	189 (34.2)	53 (29.3)	372 (35.7)		
Monthly income						
—≥67 USD	82 (26.5)	232 (42.0)	65 (35.9)	379 (36.3)	20.381	<0.001
—<67 USD	227 (73.5)	321 (58.0)	116 (64.1)	664 (63.7)		
Duration of residence						
—≤24 months	105 (34.0)	85 (15.4)	35 (19.3)	225 (21.6)	41.225	<0.001
—>24 months	204 (66.0)	468 (84.6)	146 (80.7)	818 (78.4)		
Has ever been lost to follow-up						
—Yes	236 (76.4)	265 (47.9)	118 (65.2)	619 (59.3)	69.630	<0.001
Financial access to health care (mean ± SD)	2.1 ± 0.7	0.6 ± 0.6	1.6 ± 0.9	1.2 ± 1.0	490.660	<0.001
Geographical access to health care (mean ± SD)	3.2 ± 0.8	2.8 ± 0.9	2.8 ± 0.9	2.9 ± 0.9	15.883	<0.001
Work force perceived by patients (mean ± SD)	4.5 ± 1.0	4.3 ± 0.9	4.1 ± 1.1	4.3 ± 1.0	7.623	0.001
First choice for consultation when sick						
—Private clinic	31 (10.0)	17 (3.1)	8 (4.4)	56 (5.4)	80.079	<0.001
—Public clinic	252 (81.6)	526 (95.1)	141 (77.9)	919 (88.1)		
—Healers	26 (8.4)	10 (1.8)	32 (17.7)	68 (6.5)		
First choice for consultation when having cough						
—Healers	47 (15.2)	118 (21.3)	56 (30.9)	221 (21.2)	16.926	<0.001
—Clinics	262 (84.8)	435 (78.7)	125 (69.1)	822 (78.8)		
Knowledge about TB transmission (mean ± SD)	1.6 ± 0.6	8.8 ± 3.1	4.0 ± 3.7	5.8 ± 4.3	755.582	<0.001
Knowledge about TB treatment duration						

(*continued on next page*)

Table 5 (*continued*)

Variables	Profile of patient				χ^2 test or *F* test	*p*
	TB, $n = 309$	HIV, $n = 553$	TB_HIV, $n = 181$	Total, $n = 1043$		
—Insufficient	107 (34.6)	506 (91.5)	61 (33.7)	674 (64.6)	372.042	<0.001
—Good	202 (65.4)	47 (8.5)	120 (66.3)	369 (35.4)		
Knowledge about side effects of anti-TB treatment (mean ± SD)	2.4 ± 1.6	1.1 ± 2.2	2.7 ± 2.0	1.8 ± 2.1	61.168	<0.001
Other aspects about TB knowledge (mean ± SD)	3.9 ± 1.1	6.8 ± 1.1	4.8 ± 1.9	5.6 ± 1.8	588.443	<0.001
Total TB knowledge (mean ± SD)	16.0 ± 4.2	24.1 ± 5.3	19.6 ± 7.4	20.9 ± 6.5	225.905	<0.001
Attitude towards TB/HIV patient (mean ± SD)	14.0 ± 1.8	9.4 ± 4.2	12.9 ± 3.1	11.4 ± 4.0	195.040	<0.001
Past history of TB or HIV (mean ± SD)	1.1 ± 0.9	0.6 ± 0.9	1.2 ± 1.0	0.9 ± 0.9	38.095	<0.001
Stigma (mean ± SD)	9.4 ± 2.5	6.3 ± 1.9	8.3 ± 2.6	7.6 ± 2.6	200.675	<0.001
Discrimination and isolation (mean ± SD)	4.2 ± 2.1	3.8 ± 1.6	3.3 ± 2.0	3.8 ± 1.9	13.244	<0.001
Awareness to transmit disease	7.9 ± 3.3	8.6 ± 4.0	7.9 ± 3.4	8.3 ± 3.7	4.016	0.018
Psychosocial consequences of disease (mean ± SD)	9.8 ± 2.2	9.4 ± 1.4	10.4 ± 2.0	9.7 ± 1.8	24.177	<0.001
Medication adherence (mean ± SD)	6.3 ± 1.6	6.3 ± 1.6	6.0 ± 1.8	6.3 ± 1.6	2.659	0.071
Alcohol status						
—Yes	93 (30.1)	103 (18.6)	70 (38.7)	266 (25.5)	33.726	<0.001
Smoking status						
—Yes	88 (28.5)	22 (4.0)	44 (24.3)	154 (14.8)	110.406	<0.001
Prisoner status						
—Never been prisoner	293 (94.8)	543 (98.2)	169 (93.4)	1005 (96.4)	11.976	0.003
—At least one time	16 (5.2)	10 (1.8)	12 (6.6)	38 (3.6)		
Notion known about viral hepatitis B and C						
—Yes	80 (25.9)	58 (10.5)	29 (16.0)	167 (16.0)	34.967	<0.001
Sexual transmissible infections (STIs)						
—Never had STIs	137 (44.3)	229 (41.4)	60 (33.1)	426 (40.8)	6.069	0.048
—At least a once time been STIs	172 (55.7)	324 (58.6)	121 (66.9)	617 (59.2)		
Illegal drug use (IDU)						
—At least a once	38 (12.3)	27 (4.9)	11 (6.1)	76 (7.3)	16.609	<0.001
—Never used drug	271 (87.7)	526 (95.1)	170 (93.9)	967 (92.7)		
Diabetes status						
—No	201 (65.0)	479 (86.6)	142 (78.5)	822 (78.8)	65.560	<0.001
—Yes	10 (3.2)	13 (2.4)	11 (6.1)	34 (3.3)		
—Unknown	98 (31.7)	61 (11.0)	28 (15.5)	187 (17.9)		
Past or present history of cardiovascular disease						
—Yes	16 (5.2)	89 (16.1)	22 (12.2)	127 (12.2)	22.089	<0.001
Past or present history of arterial hypertension						
—Yes	21 (6.8)	115 (20.8)	27 (14.9)	163 (15.6)	29.549	<0.001
Past or present history of pulmonary asthma						
—Yes	6 (1.9)	8 (1.4)	9 (5.0)	23 (2.2)	8.002	0.018
—Number of persons sleeping in the household	2.8 ± 2.2	2.4 ± 1.4	2.4 ± 2.0	2.7 ± 1.8	24.177	<0.001

SSD = standard deviation.

Discussion

This cross-sectional study was conducted via TB and HIV clinics using health centers and NGOs of two main regions (Centre and Hauts-Bassins) in Burkina Faso (Table 5). Our objective was to identify predictors of the medication adherence index among TB infected, HIV infected, and TB/HIV coinfected patients in Burkina Faso. This study exhaustively explored a wide range of variables using face-to-face interviews and semi-structured questions in order to construct strong scales and indices. Nonetheless, the present study may be criticized because it is cross-sectional. Furthermore, some factors explored in the

literature were not analyzed in the present study because the records from the TB and HIV clinics were not identical and because they had not been systematically collected as part of the patients' medical records. These included clinical forms of TB or HIV,[15,16] hemoglobin level,[16] plasma viral load,[15,17,18] and undernutrition.[19–21] Because this study identified many variables associated with medical adherence, further evaluation of their interactions may be needed in the future.

The present study found significant differences between socioeconomic and psychosocial variables among TB infected, HIV infected, and TB/HIV coinfected patients. This was in agreement with the findings of a South African study, in which the authors concluded that HIV and TB cohorts had distinct socioeconomic and psychosocial backgrounds.[5]

The results showed that total TB knowledge was significantly and positively correlated with medication adherence in the pooled data ($p = 0.005$) and in HIV patients ($p = 0.001$) at the univariate stage and in HIV patients ($p = 0.048$) at the multivariate analysis stage. This could be explained by information received regularly by HIV patients during group discussions, counseling, and consultations. A study by Kalichman et al showed that the ability of patients to understand both their disease and its treatment had a major effect on adherence.[22] According to Okanurak et al, a patient's knowledge level of TB and its treatment contributed to treatment success in Bangkok.[23] In Nepal, non-adherent patients cited insufficient knowledge about the need to take daily treatment, especially after they felt better, as a reason affecting patient adherence to directly observed treatment, short course (DOTS).[24] Kaona et al reported that non-compliance was associated with a lack of knowledge of the benefits of completing a course, with running out of drugs at home and with the TB drugs being "too strong" to continue.[25] Thompson et al stated that improving patients' knowledge and understanding of their disease and its treatment, either via nursing staff or via community-led pharmacies, had a positive impact on adherence levels.[26]

In addition to TB knowledge as adjusted predictor factor for medication adherence, the present study found that predictors for medication adherence were alcohol use, attitude towards TB and HIV, awareness of disease transmission, financial access to care, and high number of persons sleeping in the household. At the univariate analysis stage, Shin et al found low social support, substance use, and depression to be associated with non-adherence.[27] Corless et al reported that treatment failure was related to inappropriate regimens, the unavailability of drugs, or lack of access to health care.[20] Sabaté suggested that treatment adherence was also affected by beliefs about the origins, transmission, and treatment of TB and HIV, which often resulted in the stigmatization of those affected.[2] Several questionnaires on behavior have identified psychological determinants that seem to be factors associated with a predisposition towards non-adherence.[18] Moreover, in a multivariable analysis, Shin et al found that low social support was associated with non-adherence.[27]

In contrast to the findings of a literature review, the present study identified other adjusted predictors such as having ever been lost to follow-up and number of persons sleeping in the household. For patients with TB, ever been lost to follow-up was a predictor of good medication adherence. Because this was a cross-sectional study and only enrolled persons returned for treatment, there may be a loss to follow-up bias. Another explanation is that because they returned for treatment, they had fewer problems with complex treatment (ARV or anti-TB). In addition, this may be explained by the Morisky scale questions.

The present study showed the necessity to consider different profiles of patients inside TB and HIV control programs. Indeed, for different patient profiles (TB, HIV, and TB/HIV coinfection), the study identified different predicting factors of medication adherence. These factors should be taken into consideration when designing and implementing projects and programs for TB and HIV.

In conclusion, this study provides information on medication adherence in TB infected, HIV infected, and TB/HIV coinfected patients. The identified factors are important considerations that need to be incorporated into TB and HIV programs. Factors that have to be carefully considered in TB and HIV programs include stigma, attitude, status of loss to follow-up, TB knowledge, financial access to care, alcohol use, awareness of disease transmission, number of persons sleeping in the household. TB programs can be tailored to address each of these concerns in order to develop educational approaches for specific groups.[28] The factors identified in this study need to be taken into account during the sensitization, project planning, and research stages.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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