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Nutritional Status of Women with Tuberculosis in Ouagadougou (Burkina Faso)

État Nutritionnel des Femmes Atteintes de Tuberculose à Ouagadougou (Burkina Faso)

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ABSTRACT

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Background. Poverty and extreme hunger constitute a huge public health threat that has a substantial impact on female's health and increases the burden of tuberculosis (TB) in sub-Saharan African countries. Amongst females, TB is associated with significant adverse consequences for their health security especially in developing countries where the health of women is worse particularly in terms of nutrition. **Objective.** To assess the prevalence of undernutrition and evaluate whether adult female TB patients are more likely to have undernutrition than elder females with TB in Burkina Faso. **Methodology.** In the Health Centre Region of Burkina Faso, we conducted a cross-sectional survey with face-to-face interviews of patients aged 15 years and older with TB ($n=104$) from March to April 2019. Undernutrition was defined as a body mass index of <18.5 kg/m². Multiple logistic regression analyses were performed to determine the correlates of undernutrition. **Results.** The prevalence of undernutrition was 39.4% in which severe, moderate, and mild thinness was 7.7%, 8.9%, and 19.5%, respectively. Most of them (40.8%) were unemployed, and 85.6% had low monthly income. Adult females aged 35-44 years (AOR =16.7, 95% CI: 1.89-147.81), and 45-54 years (AOR= 16.0, 95%CI: 1.82-141.35). Meals reduced (AOR= 11.1, 95%CI: 1.24-99.72) were associated with increased odds of undernutrition. **Conclusion.** Adult female patients with TB were more likely to develop undernutrition. Assessment of nutritional status should be part of the routine treatment care during the intense phase of TB treatment in Burkina Faso.

RÉSUMÉ

Contexte. La pauvreté et la faim extrême constituent une énorme menace pour la santé publique qui a un impact considérable sur la santé des femmes et alourdit le fardeau de la tuberculose dans les pays d'Afrique subsaharienne. Chez les femmes, la tuberculose est associée à des conséquences négatives importantes pour leur sécurité sanitaire, en particulier dans les pays en développement où la santé des femmes est précaire et surtout leur état nutritionnel. **Objectif.** Évaluer la prévalence de la dénutrition et évaluer si les femmes adultes atteintes de tuberculose sont plus susceptibles de souffrir de dénutrition que les femmes âgées atteintes de tuberculose au Burkina Faso. **Méthodologie.** Dans la région du Centre de santé du Burkina Faso, nous avons mené une enquête transversale avec des entretiens en face à face avec des patients âgés de 15 ans et plus atteints de tuberculose ($n = 104$) de mars à avril 2019. La dénutrition a été définie comme un indice de masse corporelle de $<18,5$ kg/m². De multiples analyses de régression logistique ont été effectuées pour déterminer les corrélats de la dénutrition. **Résultats.** La prévalence de la dénutrition était de 39,4 %, dont 7,7 %, 8,9 % et 19,5 % respectivement. La plupart d'entre eux (40,8 %) étaient au chômage et 85,6 % avaient un faible revenu mensuel. Femmes adultes âgées de 35 à 44 ans (AOR = 16,7, IC à 95 % : 1,89-147,81) et de 45 à 54 ans (AOR = 16,0, IC à 95 % : 1,82-141,35). Les repas réduits (AOR = 11,1, IC à 95 % : 1,24-99,72) étaient associés à des risques accrus de dénutrition. **Conclusion.** Les patientes adultes atteintes de tuberculose étaient plus susceptibles de développer une dénutrition. L'évaluation de l'état nutritionnel devrait faire partie des soins de routine pendant la phase intense du traitement de la tuberculose au Burkina Faso.



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HIGHLIGHTS**What is already known on this topic**

Burkina Faso, has no data available on the prevalence of undernutrition among women with TB.

What question this study addressed

To assess the prevalence of undernutrition and evaluate whether adult female TB patients are more likely to have undernutrition than elder females with TB in Burkina Faso.

What this study adds to our knowledge.

The prevalence of undernutrition was 39.4%. Meals reduced were associated with increased odds of undernutrition.

How this is relevant to practice, policy or further research.

Promote the assessment of nutritional status in routine treatment care during the intense phase of TB treatment.

INTRODUCTION

This study was conducted in the context of the Sustainable Development goals (SDGs), which aim to end all forms of poverty, extreme hunger, achieve food security, improve nutrition gender equality and empower all women and girls by 2030 (WHO, Global tb report 2019).

Tuberculosis (TB) is a considerable growing global concern and continues to pose a major public health threat among women particularly in low-income countries (Allotey, 2008). TB mainly affects females when they are economically and reproductively active life between 15-54 years. In addition, to TB, extreme poverty, and hunger remain increasing and great concerns (Hayashi, et al, 2014) that can make them in vulnerability and nutritional deterioration aggravation state (WHO, tb_women, 2019). The TB is a contagious disease, caused by mycobacterium tuberculosis, which is strongly associated with socioeconomic determinants and health related risk factors such as undernutrition, HIV infection (WHO, 2021), affecting poor and vulnerable groups as women (WHO, 2019, tb_women, 2019). An estimated total of 10.6 million people developed tuberculosis, of which 3.4 million new TB cases among women and girls in 2021 (WHO, Global-tb-report-2022).

Despite TB affects more men than women, however, amongst females, TB is associated with significant adverse consequences for their health security worldwide. In addition, TB remains the most lethal disease and one of the top killer of women in developing countries (WHO, Guideline, 2013), killing more adult women than all cause maternal mortality combined each year especially in developing countries where the health of women is worse particularly in terms of nutrition (PATH TB Gender, 2020). Approximately, half a million women died from the disease in 2018 (WHO, tb_women, 2019). The greatest burden (Omara, et al, 2012), of TB disease seems to be more virulent and devastating in adult women (aged 15-49) (WHO, Guideline, 2013), but the distribution and severity of the burden due to both such as TB and

undernutrition are widely varied among countries (TB determinants, WHO, 2021). However, there have been few studies to evaluate the association between undernutrition and socioeconomic factors among females during TB treatment.

Malnutrition is often considered to refer to people having an insufficient intake of food (undernutrition) or having too much food (obesity). In the context of TB we refer to undernutrition, which is defined as a low body mass index (BMI) scores less of than (18.5 kg/m² cutoff) as an index of malnutrition (Nthiga, et al, 2017). In addition, undernutrition is a critical risk factor that can impair the immune system and which might increase TB incidence compared to those with a healthy bodyweight. The most recent data revealed that globally in 2020, 1.9 million incident cases of TB were attributable to undernutrition (TB determinants, WHO, 2021). Consequently, the World Health Organization (WHO) recognized that globally, TB and undernutrition are both priority public health challenges (TB determinants, WHO, 2021), that have a substantial impact on women's health (WHO, tb_women, 2019,) in terms of nutrition. In 2017, the Food and Agriculture Organizations (FAO) reported that more than 800 million people were chronically undernourished in the world and 98% were living in low- and middle- income countries, where TB is endemic (FAO, 2017).

Many previous studies demonstrated that patients with active pulmonary TB are more likely to experience severe weight loss that can impair the immune system and which may lead to poor nutritional status and wasting often due to appetite lost or reduced, nausea and vomiting, include micronutrients and macronutrient malabsorption and metabolism impaired (Metcalfe et al., 2005; Gupta et al., 2009; Das et al., 2018) increasing risks of poor nutritional status exacerbated. The interaction between TB and malnutrition is well documented. Because TB makes malnutrition worse or can lead to aggravation of pre-existing undernutrition; due to the appetite lost and catabolism increasing. As result, making both in a vicious circle of worsening undernutrition and TB (Nthiga, et al, 2017; Gupta et al., 2009)

Several studies have reported that females with TB were undernourished (Das et al., 2018), Bhargava et al., 2013; Ren et, al., 2019). Moreover, low socio-economic factors including unemployment, malnutrition and famine, poor housing (Murray. 2001), low literacy, and poor health or lack of access to health services (Baker et al., 2008); and the lack of knowledge of food, and culture were major factors affecting dietary (Greg D. 2011) have been highlighted to be the direct risk factors for TB transmission among females. On the other hand, poverty with no formal education were found to be more commonly associated with undernutrition among women (Adebowale, et al., 2015).

In 2021, Burkina Faso there was notified 45 cases per 100,000 people of TB incidence (WHO, Global-tb-report-2022). Therefore, Burkina Faso, as most countries of Sub-Saharan Africa (USAID, 2010), has no data available on the prevalence of undernutrition among women with TB. The lack of data impedes proper design of interventions due to lack of evidence-based programming. Therefore,

establishing nutritional status of women with TB in Burkina Faso will be useful for improving health care. Targeting strategies and interventions for important actions among women adult patients with TB, require a better understanding of associated factors of undernutrition.

We conducted this study in an urban area of Burkina Faso to determine the prevalence of undernutrition in female TB patients during the first two month of treatment or intensive phase of TB treatment, to evaluate their demographic, socioeconomic factors associated and determine whether there are any differences in the nutritional status (undernutrition) between age groups. The findings of this assessment will provide valuable insights into areas that need to be focused on or improved in the programming of care and support for female TB patients.

MATERIALS AND METHODS

Study design and setting

A quantitative cross-sectional study was carried out in Ouagadougou, the capital city of Burkina Faso. This study was carried out in the six Health Centre Region, where patients with TB were identified by screening in the national TB diagnosis and treatment centre.

Study subjects

The study included patients aged 15 years and older who were newly diagnosed with active pulmonary TB by sputum microscopy, and received anti-TB treatment under Directly Observed Treatment Short-course (DOTS) at five selected district health facilities in Ouagadougou. The use of 15 years of age rather than 18 years as the cutoff to define adult patients in this study followed the WHO definitions for TB surveillance and management (WHO, *tb: Understanding*, 2018). In TB diagnosis and treatment, the disease in individuals aged less than 0-14 years (also called pediatric tuberculosis) is considered differently from that in older children and adults. Subjects were excluded if they had extra-pulmonary TB, they were in the continuation phase of TB treatment, or had relapsed.

Women who were either pregnant or breast-feeding were also excluded in this study because the weight of the foetus could not be determined and lactating mothers are more likely to lose a lot calories during the breastfeeding period (Adebowale et al., 2015). The sample size was calculated using Epi-info software version 7, assuming a 95% confidence level, 50% of expected frequency, and a design margin error of 5%.

Data collection

A face-to-face interview conducted by four well-trained clinical nurses was used to collect patient information. We used an adapted questionnaire from previous similar studies (Gurung et al., 2018; Dodor, 2008; Dargie et al., 2016) to meet the study goal. The initial questionnaire was prepared in English. It was then translated into French, the official language of Burkina Faso, and back-translated by one of the co-authors and his colleagues from university who speaks fluent English and French. The questionnaire consisted of four parts: (i) the socio-demographic characteristics, (ii) the lifestyle, (iii) the health status, and

(iv) the nutritional status of the patients. Three experts conducted a content validity test in Burkina Faso, and the index for this questionnaire was 0.9, indicating that the tools were clear and relevant. Subsequently, a pilot study was conducted among 30 patients with TB. The purpose of this pilot study was to assess feasibility and time and to improve upon the study design before the performance of the full-scale research project. Patients' data were kept anonymous and with confidentiality to ensure the privacy of the study respondents at every step.

Outcome variables

The outcome variable of this study was the nutritional status defined by BMI. Height and body weight were used to calculate BMI (kg/m²). Patients with a BMI <18.5 kg/m² were defined as having undernutrition. Undernutrition is a poor nutritional status defined by having a body mass index (BMI) lower than 18.5 kg/m² due to imbalanced food intake and an abnormal utilization of nutrients, referring to all deviations from adequate nutrition, including wasting, stunting, or deficiency of micronutrients (severe, moderate and mild thinness) (FAO, 2007; Bhargava et al., 2014). According to WHO, severe, moderate, and mild thinness are defined as a BMI < 16.0 kg/m², 16.0–16.99 kg/m², and 17.0–18.49 kg/m², respectively (WHO, 2006).

Data analysis

The investigators first checked the data after entering in Microsoft Excel 2013 (Microsoft Corporation Inc. USA) for codification. The data were then exported for further analysis in SPSS (Statistical Package for the Social Sciences) software, version 23.0. Descriptive statistical analysis were performed to estimate the mean and standard deviation for continuous data and the percentage frequency for categorical data. Differences in characteristics in the categorical scale between participants, with or without undernutrition, were examined using the Person Chi-square (χ^2) test. Logistic regression analyses, which produced the odds ratios (ORs) and 95% confidence intervals (CIs), were performed to assess the association between each of the potential correlates and undernutrition. Unadjusted logistic regression analysis was performed with all variables listed in the data collection. We classified age into six categories, 15-24, 25-34, 35-44, 45-54, 55-64, and 65 years and above, which is consistent with age groups applied in the WHO report of TB surveillance data (WHO, *tb: Understanding*, 2018). To evaluate the correlates of undernutrition, we performed multiple logistic regression models, in which variables with a p-value less than 0.05 in the simple logistic regression analysis were included. Variables with a p-value < 0.05 were considered to be significantly associated with the outcome variable after adjustment for covariates.

Ethical Considerations

Ethical clearance was obtained from and approved by the Institutional Review Board of Burkina Faso, National Health Research Ethics Committees (Reference number: 2019-02-020/MS/SG/DGS/DN) and the head of the Health Centre Region in Burkina Faso 2019 (Reference number: 2019-034/MS/RCEN/DRSC). Also,

administrative authorization was obtained from the Health Centre Region in Ouagadougou. Written informed consent was obtained from the patients before the data collection. However, the data of the participants will remain confidential.

RESULTS

Sociodemographic characteristics of study population

A total of 104 female TB patients participated in this study. The mean age of the patients was 42.4 years (SD,

± 14.6), range (17-88). Of those patients, the majority (82.7%) resided in the urban area, 52.9% had completed primary and secondary schooling, and 77.9% were married. Most of them (40.8%) were unemployed, and 85.6% had low monthly income (approximately USD 172). More than half of study subjects (55.8%) had a large family size of 5-8 persons. The frequency distribution of all the variables was not statistically significant different between subjects with undernutrition and normal weight except age-group by years ($P=0.024$). (Table 1).

Table 1. Baseline characteristic of TB participant’s socio-demographic, by nutritional status in five health districts of the central region in Ouagadougou (n=104)

variables	Categorical	Underweight n=41	Normal weight n=63	Total N=104	P-value
Age years	15-24	5 (12.2)	8 (12.7)	13 (12.5)	0.024
	25-34	6 (14.6)	11 (17.5)	17 (16.3)	
	35-44	15 (36.6)	15 (23.8)	30 (28.8)	
	45-54	14 (34.1)	13 (20.6)	27(26.0)	
	>55	1 (2.4)	16 (25.4)	17(16.3)	
Mean=42.4, SD=± 14.6, Min=17, Max=88					
Education	Uneducated	20 (48.8)	26 (41.3)	46(44.2)	0.407
	Primary/Secondary level	19 (46.3)	36 (57.1)	55(52.9)	
	University level	2 (4.9)	1 (1.6)	3(2.9)	
Marital Status	Married	34(92.7)	47(90.5)	81(77.9)	0.591
	Not married	4(9.8)	10(15.9)	14(13.5)	
	Single/divorced/widowed	3(7.3)	6(9.5)	9(8.7)	
Occupational Status	Employed	4 (10.0)	8 (12.7)	12(11.7)	0.905
	self-employed	19 (47.5)	30 (47.6)	49(47.6)	
	Unemployed	17 (42.5)	25(39.7)	42(40.8)	
Income per month (FCFA)*	<100 000	34 (82.9)	55 (87.3)	89(85.6)	0.506
	$\geq 101\ 000$	7 (17.1)	8 (12.61)	15(14.4)	
Family Size	1-4	18 (43.9)	27 (42.9)	45(43.3)	0.720
	5-8	23 (56.1)	35 (55.6)	58(55.8)	
	>9	0 (0.0)	1 (1.6)	1 (1.0)	
Residence Area	Urban	34 (82.9)	52 (82.5)	86(82.7)	0.959
	Rural	7 (17.1)	11 (17.5)	18(17.3)	

TB=tuberculosis; *1 US dollar= 616,50 West African CFA francs on September 25, 2023

Table 2. Dietary information and health conditions by nutritional status in adult TB patients undergoing anti-TB treatment in Ouagadougou, Burkina Faso.

variables	Categorical	Underweight n=41	Normal weight n=63	Total N=104	P-value
Food frequency intake	1-2	38 (92.7)	53 (84.1)	91(87.5)	0.239
	3-4	3 (7.3)	10 (15.9)	13(12.5)	
Meal diversity	Yes	40 (97.6)	54 (85.7)	94(90.4)	0.045
	No	1 (2.4)	9 (14.3)	10(9.6)	
Meals reduced	Yes	40 (97.6)	52 (82.5)	92(88.5)	0.019
	No	1 (2.4)	11 (17.5)	12(11.5)	
Nutrition care	Yes	22 (53.7)	27 (42.9)	49(47.1)	0.281
	No	19 (46.3)	36 (57.1)	55(52.9)	
Dietary counselling	Yes	40 (97.6)	61 (96.8)	101(97.1)	0.827
	No	1 (2.4)	2 (3.2)	3(2.9)	
Female’s BMI					<0.001
Underweight	BMI = 17.0-18.49	41 (39.4)	0 (0.0)	41 (39.4)	
Normal weight	BMI = 18.5-24.99	0 (0.0)	61 (58.7)	61 (58.7)	
Over weight	BMI >25.0-29.99	2 (1.9)	0 (0.0)	2 (1.9)	
History of TB	Yes	19 (46.3)	23 (36.5)	42(40.4)	0.318
	No	22 (53.7)	40 (63.5)	62(59.6)	
Duration on anti-TB treatment	< 4 weeks	6 (14.6)	6 (9.5)	12(11.5)	0.533
	> 4 weeks	35 (85.4)	57 (90.5)	92(88.5)	
Eating problem	Yes	3 (7.3)	2 (3.2)	5(4.8)	0.380
	No	38 (92.7)	61 (96.8)	99(95.2)	
HIV infection	Yes	7 (17.1)	3 (4.8)	10(9.6)	0.047
	No	34 (82.9)	60 (95.2)	94(90.4)	
Anxiety	Yes	24 (58.5)	30 (47.6)	54(51.9)	0.319
	No	17 (41.5)	33 (52.4)	50(48.1)	

Nutritional intervention

The frequency distribution of nutritional status reported that almost all subjects (97.1%) received dietary counselling, 87.5% of them had consumed 1 or 2 meals per day, 88.5% had experienced reduction of food intake ($P<0.019$) and 90.4% had meal diversity ($P=0.045$). TB female's BMI was the most prevalent ($P<0.001$) (Table 2).

Health conditions

Majority of the respondents (98.1%) were treated in outpatient clinics and 88.5% received anti-TB treatment for more than 4 weeks during the DOTS period (Table 2). More than half of women patients (52%) were anxious and 40.4% had a history of TB in the family. The prevalence of HIV infection was higher 9.6%, ($P=0.047$). (Table 2).

Nutritional and anthropometric status of adult female patients

The overall prevalence of undernutrition was 39.4% (BMI <18.5 kg/ m²) (Table 3). Seven-point seven percent of female patients had severe thinness (BMI <16.0 kg/m²), 7.7% moderate thinness (16.0–16.99 kg/m²), and 24.0% mild thinness (17.0–18.49 kg/m²). The findings also showed that 1.9% were overweight (BMI >25 kg/m²), and 58.7% had normal weight (BMI 18.5–24.9 kg/m²). The mean BMI of adult female TB patients was 19.2 kg/m². The mean of weight was 52.1kg and 164.5 cm for height respectively. However, higher undernutrition rate for females was observed in adult between 35-44 years vs >55 years old.

Table 3. Nutritional status of female TB patients defined by BMI

Overall nutritional status (n=104)	n	%		
Normal weight: BMI = 18.5-24.99	61	58.7		
Underweight: BMI = 17.0-18.49	41	39.4		
Over weight: BMI >25.0-29.99	2	1.9		
Classification of nutritional status defined by BMI <18.5kg/m2 (n=41)				
Undernutrition status				
Severe thinness	8	7.7		
Moderate thinness	8	7.7		
Mid thinness	25	24.0		
Anthropometric data				
Measurements	Median	Standard deviation	Minimum	Maximum
Weight	52.1	7.4,	36	72
Height	164.5	8.0	148	185
BMI	19.2	2.6	13.2	29.7
BMI, body mass index				

Odds ratios for the factors associated with undernutrition

In the bivariate logistic regression analysis, female adult patients aged 35-44 years (OR 16, 95% CI 1.88-136.44, $p=0.011$), and those 45-54 years (OR 17.23, 95% CI 1.99-148.92, $p=0.010$), had significantly higher odds of undernutrition, compared with those aged 55 years and above (Table 4). HIV infection (4.12, 95% CI 1.00-16.97, $p=0.050$) was also associated with increased odds of undernutrition compared to those without HIV infection. In addition, adult female TB patients with reduced meals (OR 8.46, 95% CI 1.05-68.29, $p=0.045$) were associated with higher odds of undernutrition (Table 4).

Table 4. Univariate analysis showing the risk factors for low body mass index (BMI) among women TB patients undergoing anti-TB treatment at central Health Regional District, Ouagadougou.

Variables	Category	Odds Ratio	CI (95%)	P-value
TB patient characteristics				
Age-group	15-24 vs >55	10.00	0.99-100.61	0.051
	25-34 vs >55	8.73	0.92-82.96	0.059
	35-44 vs >55	16.00	1.88-136.44	0.011*
	45-54 vs >55	17.23	1.99-148.92	0.010*
Education	No formal education vs High school	0.39	0.03-4.55	0.448
	Primary/ Secondary vs High school	0.26	0.02-3.10	0.289
Marital Status	Married vs Divorced/Widowed	1.45	0.34-6.20	0.619
	Not married vs Divorced/Widowed	0.80	0.13-4.87	0.809
Occupation	self-employed vs Employed	1.36	0.35-5.24	0.655
	Unemployed vs Employed	1.27	0.33-4.79	0.728
Income	<100000	1.62	0.52-5.02	0.405
	>100000	0 (0.0)	1	
Residence Area	Urban		1	
	Rural	0.97	0.34-2.76	0.959
Dietary information				
Eating frequency per day	1-2 vs 3-4	2.39	0.62-9.27	0.208
Meal balanced	Yes, vs no	6.67	0.81-54.77	0.077
Meals reduced	Yes, vs no	8.46	1.05-68.29	0.045*
Nutrition Care	Yes, vs no	1.54	0.70-3.41	0.282
Dietary Counselling	Yes, vs no	1.31	0.11-14.95	0.827
Health conditions				
Passive exposition	Yes, vs no	1.50	0.68-3.34	0.319
Duration anti-TB	<4 weeks vs >4 weeks	1.63	0.49-5.45	0.429
Eating problem	Yes, vs no	0.42	0.07-2.60	0.348
HIV infection	Yes, vs no	4.12	1.00-16.97	0.050*
Anxiety	Yes, vs no	1.55	0.70-3.44	0.277

OR= Odds Ratio, CI= confident interval, 1= Reference class, *= $P<0.05$



Table 4. Multivariate analysis showing the risk factors for low body mass index (BMI) among women TB patients undergoing anti-TB treatment at central Health Regional District, Ouagadougou

Variables	Category	Adjusted OR	CI (95%)	P-value
TB patient characteristics				
Age-group	15-24 vs >55	8.00	0.76-84.27	0.083
	25-34 vs >55	7.711	0.78-76.15	0.080
	35-44 vs >55	16.73	1.89-147.81	0.011*
	45-54 vs >55	16.05	1.82-141.35	0.012*
Dietary information				
Meals reduced	Yes, vs no	11.14	1.24-99.72	0.031*
Health conditions				
HIV infection	Yes, vs no	3.65	0.79-16.94	0.098

AOR= adjusted odds ratio, *=P<0.05

Multivariate analysis

In the results of a simple bivariate logistic regression model as displayed in Table 4, age, HIV infection and reduced meals were associated with undernutrition at a significance level of $p < 0.05$. These variables were included in the multiple logistic regression model. After adjusting for these variables, the adjusted OR (aOR) of undernutrition in subjects aged 35-44 years was 16.73 (95% CI: 1.89-147.81, $p = 0.011$), compared to those aged 55 years and above. The aOR for those with reduced food intake (in terms of the amount of meals per day) compared to those with adequate food intake was 11.14 (95% CI: 1.24-99.72, $p = 0.031$). However, we did not observe significant associations between HIV infection (aOR 3.65, 95% CI 0.79-16.94, $p = 0.096$) and the odds of having undernutrition in the adjusted model (Table 4).

4. DISCUSSION

This study showed that in female TB patients undergoing anti-TB treatment in Ouagadougou, Burkina Faso, 39.4% suffered from undernutrition, and 1.9% were overweight during the two first months. Our findings highlighted that adult age, and reduced meals in terms of the amount of meals taken were independent risk factors associated with undernutrition in female patients with TB. Several previous studies have also reported a high prevalence of undernutrition among adult female TB populations in other countries (Metcalf et al., 2004; Das et al., 2018; Bhargava et al, 2013; Ren et al., 2019).

The effect of TB on low BMI might differ between age group in women patients with TB. Some previous studies conducted in Asia Pacific countries revealed that undernutrition was higher (71%) in most females TB subjects aged > 18 years (Das et al., 2018) and in rural central India, 80% of females with TB aged 15-49 had moderate to severe undernutrition (BMI < 17.0 kg/m²) at the time of treatment was initiated in India (Bhargava et al., 2013). Both studies show higher levels of undernutrition than our findings. Another study conducted in India reported that females with TB were more likely to have severe undernutrition (BMI < 11 kg/m²), and more than half (55.4%) of all TB cases among women were attributed to undernutrition in the age group of 15-49 years. In addition, more than half of women with TB continued to be moderately to severely undernourished at the end of successful treatment in age group of 15-49 years (Bhargava et al., 2014). In Sri Lanka both males and females TB patients were significantly suffering from malnutrition at diagnosis and start of treatment (Metcalf et al., 2004). In China, 58.4% of female patients with TB had insufficient daily protein intake (Ren et al., 2019).

In Sub-Saharan African regions, previous studies revealed that 38% of females with TB have undernutrition in Kenya (Sitienei et al., 2014) than our findings. In addition, the odds of undernutrition were 2.56 higher than male (AOR: 0.39 [95% CI; 0.25 -0. 56]) in Ethiopia (Feleke et al., 2019).

The differences across these findings may be due to the socio-economic and demographic factors, the time when the studies were carried out, area settings and severity of the disease. Our investigation, including previous studies, were not nationally representative, and were based on data from a single hospital. The high prevalence of undernutrition reported in the present study may reflect the low socioeconomic and demographic background of females with TB as shown in Tables 1 and 2. Despite the discrepancy in the estimated prevalence rates among the studies, all studies reported a high prevalence among adult female TB patients, indicating that undernutrition among females still remain a serious public health's threat problem, particularly in countries with a high burden of TB and low income countries.

The findings of the present study showed that patients aged 35-44 years and 45-54 years were independently associated with undernutrition in female patients with TB. Our findings were inconsistent with previous studies from Tanzania who reported that undernutrition in women with TB was associated with age ≤ 20 years (Villamor et al, 2006) while another study done in India shown that more than one third of females and males between 15-49 years were undernourished (Bhargava et al, 2013). A possible reason is that TB mostly affects females in their economically productive active aged 15-54 (WHO, 2019, tb_women). It has been reported previously that unemployment, and poverty were more susceptible to food insecurity and wasting among both sexes' adult TB patients (WHO, tb_women; 2019; Ren et al., 2019).

Moreover, the influence of TB might proportionately affect physical work ability of women, compromising productivity capacity and financial ruin of female patients with poor nutritional status (Allotey, 2008) making them more vulnerable to economic burden increasing, poverty and nutritional status aggravation. In this, study the highest rate of undernutrition (36.6 %) was among adult women age groups (35-44 years), while 44.2% did not have a formal education, 40.8 % were unemployed and 85.6% had low monthly income. These conditions predisposing to impoverishment aggravation, and further nutritional status deterioration. Because the relationship

between TB and poverty has long been described as the lack of social and economic benefits. The reasons pointed out by previous studies were socioeconomic and living conditions (Ren et al., 2019; Villamor et al., 2006), unemployment and poverty were more susceptible to food insecurity and wasting. A study conducted in Ghana reported that young patients usually, have a strong immunity condition than older patients that may contribute to their ability of rapid recovery from stress due to illness and nutritional status (Dodor, 2009). Underweight among adult with TB could be also due to the poor circulating levels of some micronutrients and altered metabolism (Cupta et al., 2009). Which could be more detrimental for the adult persons and can greatly increasing weight lost, lean reserves and other adverse effects.

This study found that the majority of adult females TB patients experienced meals reduced and consumed insufficient food intake in term of the amount of dietary energy required per day which was independently associated with undernutrition in female patients with TB. The key consideration is that TB is a wasting disease commonly associated with anorexia and illness (Metcalf et al., 2004). TB patients are expected to have undernutrition at baseline compared to the subjects without TB disease. It is also fundamental to consider the reduction of meals intake due to the poverty among the major causes of undernutrition particularly in sub-Saharan African regions (Villamor et al., 2006), included socio-demographic factors.

A previous study conducted in Tanzania revealed that the number of household assets was reported among female TB patients (Villamor et al., 2006). Compared with previous studies from other settings, undernutrition in women with TB was associated with unemployment and inadequate daily food intakes in China (Ren et al., 2019), lower education (Jimenez-Corona, et al., 2006, Long et al., 2001, Johansson et al., 2000). However, some evidences from previous studies report that lower BMI in females with TB is commonly associated with illness, such as anorexia, and gastrointestinal disorders (Metcalf, 2004; Das et al., 2018). Because undernutrition in TB patients could also due to both a lack of adequate food intake and its absorption.

In this present study BMI appeared to be lower in HIV coinfecting females compared to those without HIV coinfecting females, but this association was only marginally significant after adjustment for other variables ($p = 0.09$). Our findings were inconsistent with a study conducted in Dar es Salaam (Tanzania) who revealed that BMI of HIV coinfecting TB females were much lower and was protective factor (Villamor et al., 2006). HIV infection is a wasting disease and a major determinant for development of TB that can negatively affects nutritional status of patients with TB (Gupta et al., 2009). Resulting from the nutrients intake and metabolic impaired, and immune system compromised. Moreover, the high rate of anxiety detected in women with TB in this study may be due to the social stigma and fear of the disease (Long et al., 2001; Johansson et al., 2000). Females gender particularly in low resource settings interact with low

demographic determinants of patients and women's empowerment.

Strengths and limitations

Our study initiated in assessment prevalence and factors associated with undernutrition among female patients with TB was the first study in Burkina Faso to compare age differential of adult and elder female patients with TB. This study has also some limitations. Firstly, most of the study subjects received TB treatments more than 4 weeks during the study period. Secondly, the present study was conducted using a face-to-face interview, this is might have resulted in an underestimation of the prevalence of undernutrition among TB patients, because nutrition status commonly may improve over time of TB treatment. Thirdly, information was collected by self-reported questionnaires, which may not be accurate for the items measuring particularly regarding alcohol consumption and subjective feelings as anxiety. This study may not be national representative. Our investigation, was not nationally representative because of the inclusion of only one regional health district. However, the strength of this study was that the study subjects consisted of patients from five district health facilities rather than a single hospital. As the potential correlates of undernutrition, such as socio-demographic characteristics, nutrition information, and health status. Therefore, further researches are required to improve the quality of live.

CONCLUSION

The findings of our study revealed that the prevalence of undernutrition is especially higher among adult females with TB. The highest rate of undernutrition was observed among adult females' age groups (35-44 years). This is indicating that undernutrition is a serious problem among females in their economically and reproductive age. Most of them were unemployed, and 85.6% had low monthly income. Therefore, further researches are required to improve the quality of live.

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Conflicts of interest

The authors declare that they have no conflicts of interest concerning the reduction of this paper.

Authors' contributions

All authors were involved in the conceptualization and the design of this manuscript. All authors provided critical input for data analyses and manuscript. All authors have read and approved the final version for submission.

Consent for publication

There no individual details, images nor videos used in this study. The data of the participant will keep confidential.

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