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Original article

Nutritional Status and Associated Factors among Multi-Drug Resistance Tuberculosis Patients in Addis Ababa, Ethiopia, 2022: Retrospective Cohort Study 2016 -2021

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ABSTRACT

Background: Malnutrition and tuberculosis are the main concerns of underdeveloped regions of the world. Undernutrition is related to active tuberculosis disease and a severe form of Multidrug-resistant tuberculosis that increases the risk of death and tuberculosis relapse. **Objectives:** Therefore, this study aimed to assess the nutritional status and associated factors among multidrug-resistant tuberculosis patients in Addis Ababa, Ethiopia, in 2022. **Methods**: A six-year retrospective cohort study was conducted at St. Peter Hospital from January, 1/2016 to January, 1/2021. All multidrug-resistant patients in St. Peter Hospital who started therapy were selected by a simple random sampling method. Eventually, data were entered into EPI-DATA version 3.1 and exported to SPSS version 25.0 for analysis. Descriptive analysis, such as frequency, percentage, and mean, was computed. A logistic regression model was used to measure the association between the nutritional status of MDT-TB patients and independent variables. Bivariate and multivariable regression analysis with 95% CI was employed. Variables found to have a P-value < 0.2 in the binary logistic regression were entered into multivariable analysis, and the strength of association at multivariable analysis was declared at a P-value < 0.05. **Results**: The mean age and standard deviation of the 403 respondents were 32.9±12.2 years. Nearly more than half (54.3%) of participants were male. The Prevalence of malnutrition among Multidrug-resistant tuberculosis (MDR-TB) patients is 61.3% with 95 % CI of 56.8 – 66.5. Being single moms (AOR: 0.26, 95 % CI 0.07-0.91; p = 0.035), married mothers (AOR: 0.28 95 % CI 0.08-1.00; p = 0.05), divorced women (AOR: 0.11 95 % CI 0.03-0.45; p = 0.003), House hold with family size less than four (AOR: 0.55 95% CI 0.31-0.97; p = 0.04), and MDR-TB patients with other medical co morbidity (AOR: 0.20 95% CI 0.13-0.32; p = 0.04) had lower prevalence of malnutrition problem than their counterpart. However, MDR-TB patients with a smoking habit were more likely to have malnutrition problems (AOR: 2.90, 95 % CI 1.31-6.51; p = 0.009). **Conclusion**: Prevalence of malnutrition among MDR-TB was high. Therefore, health care providers of the nutrition department need to focus on addressing awareness creation, advice, facilitation of nutritional support, and supplementation to improve the nutritional status of MDR-TB patients.

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1. INTRODUCTION

Multi-drug resistant tuberculosis (MDR-TB) is a form of tuberculosis that is resistant to two powerful anti-TB first-line drugs, Rifampicin and Isoniazid. MDR-TB has emerged as an epidemic worldwide, with approximately 425,000 new cases expected to occur annually. It is a major global health problem that is increasing with the increase in the number of new cases and challenges with care (Magassouba et al., 2021). Integrating MDR-TB treatments with nutritional assessment, counselling, and support is crucial, as poor nutritional status can exacerbate MDR-TB, leading to advanced disease, increased morbidity, and mortality risk in patients (Podewils et al., 2011).

Malnutrition and tuberculosis are prevalent health issues in developing nations, particularly in low-income countries like Ethiopia. Undernutrition increases the risk of death and relapse, and malnutrition is a primary cause of higher morbidity and mortality rates in MDR-TB patients. Hunger and tuberculosis may be related (Sørensen et al., 2015). The main causes of malnutrition in individuals with multidrug-resistant tuberculosis (MDR-TB) include reduced appetite, food insecurity, infection, and nutritional loss. Other contributing factors include the location of the illness, the sex, the place of residence, intestinal parasites, alcohol use, low educational attainment, the monthly family income, age, height, BMI, family size, and employment status (Seid & Ayele, 2020).

According to an Indian study, 68.6% of MDR-TB patients have poor nutritional status, which emphasises how challenging it is to evaluate the nutritional status of MDR-TB patients globally (Kumar et al., 2014). A study in Boston, USA, found moderate malnutrition (11.1%) and severe malnutrition (58%), while a Tanzanian analysis found 53% malnutrition, and a Guinean cohort study found 64.7% malnutrition in MDR-TB patients (Magassouba et al., 2021). A cross-sectional study in Ethiopia found that 63.2% of MDR-TB patients suffer from malnutrition, while a retrospective study found that 46.8% of patients do(Seid & Ayele, 2020). In the Amahara region, 57.17% of MDR-TB patients also suffer from malnutrition (Feleke et al., 2019).

Ethiopian researchers have studied the frequency, treatment outcomes, and determinants of MDR-TB, finding high prevalence among previously treated TB patients in Ethiopian settings, with prior treatment being the most common predictor of infection (Eshetie et al., 2017) However, neither in Ethiopia nor in other countries is the nutritional state of MDR-TB patients a primary research emphasis. Therefore, this study aimed to assess the nutritional status and associated factors among multidrug-resistant tuberculosis patients at St. Peter Hospital in Addis Ababa, Ethiopia.

2. METHODOLOGY

2.1 Study design and setting

In June 2022, a Retrospective cohort study was conducted at St. Peter's Hospital in Addis Ababa, Ethiopia. There are just two MDR-TB treatment facilities among the thirteen government hospitals in Addis Ababa: St. Peter and ALERT Hospitals. Established in 1961, St. Peter Hospital has been a leading provider of tuberculosis treatment for many years. It is well-known for its exceptional efforts in treating multidrug-resistant tuberculosis (Abate et al., 2012; Tesema et al., 2024).

2.2 Population

The study involved MDR-TB patients at St. Peter Hospital from 2016 to 2021, selected using a simple random sample technique. Patients with poor diagnosis, dead on arrival, incomplete charts, and missing charts from shelf placement were excluded from the study. The sample size is calculated using a single population proportion formula considering the assumption (standard normal distribution or $Z\left(\frac{a}{2}\right)$ = 1.96, CI=95 %, P = 46.8% (Seid & Ayele, 2020) margin of error = 5 %) and adding 10 % sample for missing and incomplete data, then the final sample size was 421 MDR-TB patients. A study was conducted on 403 MDR-TB patient charts from St. Peter Hospital over six years, with 18 cards not included due to incomplete, undiagnosed MDR-TB and absence from shelf placement.

2.3 Data Collection

The study used a data collection checklist derived from previous research, focusing on the nutritional status of MDR-TB Patients and independent variables such as socio-demographic, anthropometric measurements, admission type, co-morbidities, site of infection, treatment-related characteristics, and behavioural factors. Data was extracted from the patients' charts, TB-registration book, patients' progress notes, and the health management information system software. The nutritional status of MDR-TB patients was evaluated from the measured weight and height of patients during admission from the chart. BMI (kg/m^2) was

determined by dividing the weight by the square of the height.

2.4 Definition of variables

Variables like age in years (≤20yrs, 21-30yrs, 31-40yrs, and ≥41yrs), monthly income (≤1000 ETB, 1001-2000 ETB, and ≥2001 ETB), family size (≤4, and ≥5), and BMI (Underweight (<18.5kg/m^2), Normal (18.5-24.9kg/m^2), and Overweight (≥25kg/m^2) grouped for analysis.

2.5 Statistical analysis methods

Data were entered into EpiData version 3.1 and exported to SPSS Software version 25. The data was analyzed and presented using frequencies, percentages, means, and standard deviations, and binary logistic regression analyses. Bivariate and multivariable regression analysis with 95% CI was employed. Variables found to have a P-value< 0.2 in the binary logistic regression were entered into multivariable analysis, and the strength of association at multivariable analysis was declared at a P-value < 0.05.

2.6 Ethical consideration

A letter of support was sent to St. Peter Specialised Hospital by Addis Ababa Medical and Business College with reference number AAMBC/STU/9097/13. The Ethical Review Committee Office (ERCO) of St. Peter Specialised Hospital, with protocol number V293/27/2021, granted ethical approval for the assessment of patient records. This authorisation was received from the Research and Evidence Generation Directorate of St. Peter Specialised Hospital.

3. RESULTS

3.1 General characteristics of the study Population

The study evaluated the charts of 421 MDR-TB patients from January 1, 2016, to January 1, 2021; with 95.7% records were complete and could be used for analysis. However, 4.3% of the charts were not included due to missing, incomplete, undiagnosed, or dead on arrival, with 42.1% missing from the shelf, 26.3% incomplete, 21.1% undiagnosed and 10.5% dead on arrival. The prevalence of malnutrition among MDR-TB patients was 61.3 % with (95% CI 56.8 – 66.5). The study population's mean and standard deviation (SD) age was 32.9 ±12.2 years, with more than one-third (40.4%) of the age group between 21 and 30 years old. The proportion of males in the population was more than half (54.3%), and half of the study population (52.9%) was single. More than two-thirds (70.7%) of the population lives in urban areas. The occupations of 44.7% of the population were merchants. The proportion of people unable to read and write was 25.1%. In terms of respondents' household income, about 45.4% of them earned between 1000 and 2000 ETB per month. Households with a family size of less than four were present in about 76.7% of MDR-TB patients (Table 1).

3.2 Clinical features of MDR-TB patients

There were 28% of MDR-TB patients who also had an HIV/AIDS infection. More than one-third (36.7%) of MDR-TB patients also had upper respiratory tract infection co-morbidities, and nearly two-thirds (62.1%) of them had TB signs and symptoms. Furthermore, over half (55.3%) had co-morbidities with other medical illnesses. More than half (52.9%) of MDR-TB patients were new admissions, and the majority (89.8%) of the patients had pulmonary TB (Table 2).

3.3 Behavioral characteristics, treatments, and treatment outcome of MDR-TB patients

Nearly one-fourth (22.1%) of patients with MDR-TB had a history of alcohol consumption. Three-fourths (74.3%) of MDR-TB patients used a long regimen of anti-TB drugs. Additionally, 66.5% of MDR-TB patients were treated with first-line anti-TB drugs. Overall, the treatment outcomes of MDR-TB patients at St. Peter Specialized Hospital included improvement (82.6%), death (11.4%), and treatment failure (6.0%), respectively.

3.4 Nutritional Status of MDR-TB Patients

The nutritional status of respondents revealed that almost two-thirds (61.3%) of MDR-TB patients had malnutrition (95% CI 56.8–66.5). Of the 247 (61.3%) malnutrition patients, 235 (58.3%) MDR-TB patients were underweight.

3.5 Factors associated with Nutritional status of MDR-TB Bivariable and Multivariable analysis

The nutritional status of MDR-TB in relation to each independent variable was determined by binary logistic analysis. Seven variables (marital status, family size, monthly incomes, other medical co-morbidity, admission type, alcohol consumption, and cigarette smoking) satisfy the multivariable analysis's minimum level of significance (0.2). Marital status, family size, other medical comorbidities, admission type, and smoking cigarettes were all statistically significant and independently associated with the nutritional status of MDR-TB patients (p<0.05) in the multivariable

Table 1: Description of MDR-TB patients at St. Peter Specialized Hospital, Addis Ababa, Ethiopia, 2022.

Variables		N (%)	Nutritional status	
			Malnutrition N (%)	Normal N (%)
Age in years	≤20yrs	50(12.4)	34(68.0)	16(32.0)
	21-30yrs	163(40.4)	102(62.6)	61(37.4)
	31-40yrs	109(27.0)	61(56.0)	48(44.0)
	≥41yrs	81(20.1)	50(61.7)	31(38.3)
Sex	Male	219(54.3)	136(62.1)	83(39.9)
	Female	184(45.7)	111(60.3)	73(39.7)
Residence	Urban	285(70.7)	170(59.6)	115(40.4)
	Rural	118(29.3)	77(65.3)	41(34.7)
Marital status	Single	215(53.3)	135(62.8)	80(37.2)
	Married	132(32.8)	78(59.1)	54(40.9)
	Divorced	40(9.9)	30(75.0)	10(25.0)
	Widowed	16(4.0)	4(25.0)	12(75.0)
Educational status	Literate	302(74.9)	186(61.6)	166(38.4)
	Unable to read and write	101(25.1)	61(60.4)	40(39.6)
Monthly income in birr	≤1000 ETB	104(25.8)	72(69.2)	32(30.8)
	1001-2000ETB	183(45.4)	114(62.3)	69(37.7)
	≥2001ETB	116(28.8)	61(52.6)	55(47.4)
Occupation	Farmer	58(14.4)	31(53.4)	27(46.6)
	Merchant	180(44.7)	108(60.0)	72(40.0)
	Others*	165(40.9)	108(65.5)	57(34.5)
Family size	≤4	88(21.8)	64(72.7)	24(27.3)
	≥5	315(78.2)	183(58.1)	132(41.9)

*Others for occupation status: includes governmental employees, daily labourers, students, and housewives, respectively

analysis of the nutritional status of MDR-TB patients. Marital status: A Single mothers (AOR: 026 95% CI 0.07-0.91; p = 0.035), married mothers (AOR: 0.28 95% CI 0.08-1.00; p = 0.05), and divorced women (AOR: 0.11 95% CI 0.03-0.45; p = 0.003) were less likely to be malnourished than widowed women. Family size: Households with family sizes of less than four were likely to reduce 45% of the risk of malnutrition when compared to those with more than five family members (AOR: 0.55, 95% CI: 0.31-0.97; p = 0.04). Other medical co-morbidities: MDR-TB patients with co-morbidity with other medical conditions have a lower risk of malnutrition as compared to their counterparts (AOR: 0.20, 95% CI: 0.13-0.32; p = 0.001). TB patient admission types: New admissions of MDR-TB patients were found to be nearly two times more likely to develop malnutrition when compared to readmission patients (AOR: 1.64, 95% CI: 1.04–2.58; p = 0.032). Smoking cigarettes: MDR-TB patients who smoke cigarettes have three times higher risk of malnutrition than their counterparts (AOR: 2.90, 95% CI: 1.31-6.51; p = 0.009) (Table 3).

4. DISCUSSION

The aim of this study was to assess the nutritional status and associated factors among multidrug-resistant tuberculosis patients in Addis Ababa, Ethiopia. The study found that the effects of malnutrition and MDR-TB are interrelated and exacerbate each other in various ways. The study revealed that the prevalence of malnutrition among MDR-TB patients was 61.3% with a (95% CI 56.8–66.5). This study is in line with a comparative cross-sectional study conducted in Bahir Dar, Amhara region, Ethiopia. Besides, in another cross-sectional study conducted in Ethiopia, Boston, and the USA, the prevalence of malnutrition among MDR-TB patients was similar to our study. Another retrospective cohort study conducted in Guinea and Amritsar among MDR patients supported the findings of this study. However, the current study on the prevalence of malnutrition among MDR-TB patients is higher than that of studies conducted in Adama Town, the East Shewa Zone, Ethiopia, Hosanna Town, Southern Ethiopia, and Tanzania (Guadie & Assaminew, 2016). This discrepancy may be due to sample size, study period,

Table 2: Clinical features and nutritional status of MDR-TB patients: St. Peter Specialized Hospital, Addis Ababa, Ethiopia, 2022.

Variables		**N (%)**	**Nutritional status**	
			Malnutrition N (%)	**Normal N (%)**
Presence of HIV/AIDS	Yes	113(28.0)	74(65.5)	39(34.5)
	No	290(72.0)	173(59.7)	117(40.3)
Presence of TB signs and symptoms	Yes	343(85.1)	213(62.1)	130(37.9)
	No	60(14.9)	34(56.7)	26(43.3)
Presence of kidney disease	Yes	25(6.2)	16(64.0)	9(36.0)
	No	378(93.8)	231(61.1)	147(38.9)
Presence of DM	Yes	21(5.2)	11(52.4)	10(47.6)
	No	382(94.8)	236(61.8)	146(38.2)
Presence of an intestinal parasite	Yes	88(21.8)	53(60.2)	35(39.8)
	No	315(78.2)	194(61.6)	121(38.4)
Presence of Diarrheal episode	Yes	50(12.4)	34(68.0)	16(32.0)
	No	353(87.6)	213(60.3)	140(39.7)
Presence of URT infection	Yes	148(36.7)	94(63.5)	54(36.5)
	No	255(63.3)	153(60.0)	102(40.0)
Presence of Anaemia	Yes	36(8.9)	26(72.2)	10(27.8)
	No	367(91.1)	221(60.2)	146(39.8)
Other medical comorbidities	Yes	223(55.3)	173(77.6)	50(22.4)
	No	180(44.7)	74(41.1)	106(58.9)
Presence of pulmonary TB	Yes	362(89.8)	226(62.4)	136(37.6)
	No	41(10.2)	21(51.2)	20(48.8)
Presence of extrapulmonary TB	Yes	41(10.2)	21(51.2)	20(48.8)
	No	362(89.8)	226(62.4)	136(37.6)

Note: Other medical diseases include all medical cases except HIV/AIDS, DM, Kidney disease, Intestinal parasite, diarrheal disease (AGE), Urinary tract infection, and anemia

and variation in crop production. In contrast, the prevalence of malnutrition among MDR-TB patients was lower than that reported in a study conducted in India. This difference may be due to sample size and health facility-related issues that currently place more emphasis on routine advice to TB patients on nutrition day-to-day. Additionally, a retrospective study conducted among MDR-TB patients in Addis Ababa for three years was lower than this study (Seid & Ayele, 2020). This may be due to study time and sample size.

This study showed that having a household with a family size of less than four was likely to reduce 45% of the risk of malnutrition compared to those with more than five family members. Similarly, an institution-based cross-sectional study was conducted in Hosanna Town public health facilities in Ethiopia to determine the factors associated with nutritional status. This study reported that family size was associated with undernutrition. Similarly, in a comparative cross-sectional study conducted at Bahir Dar, Amhara regional state, the odds of malnutrition were 15.75-fold higher among TB patients with a large family size, which agrees with findings from India. Households with larger family sizes increase the demand for higher amounts of food, which affects more vulnerable groups of family members. Therefore, patients with TB have less appetite for food and anti-TB drug intake, which is characterised by vomiting, anorexia, and nausea, and are unable to eat appropriately. Moreover, large family sizes decrease household income, leading to a low dietary intake among household members(Gebre et al., 2020).

This study showed that MDR-TB patients who smoked cigarettes had a threefold higher risk of malnutrition than those who did not smoke cigarettes. This is due to the fact that those patients who smoke eat poorly and have poor digestion, storage, use, and excretion of nutrients. This is related to behavioural factors that cause loss of appetite and the probability of developing other opportunistic stressors or depression. The study provides accurate outcome variable measurement with a long follow-up period and large sample size, providing substantial statisticalpower. However, its cross-sectional nature and use of secondary data may result in incomplete information and missed variables. It's crucial to

Table 3: Logistic regression analysis for each explanatory variable to malnutrition among MDR-TB patients: St. Peter Specialized Hospital, Addis Ababa, Ethiopia, 2022

Variables	Response	Nutritional status		Unadjusted ORs (95% CI)	P-value	Adjusted ORs (95% CI)	P-value
		Malnutrition	Normal				
Marital status	Single	135(62.8)	80(37.2)	0.19(0.06-0.63)	0.042	0.26(0.07-0.91)	0.035*
	Married	78(59.1)	54(40.9)	0.23(0.07-0.75)	0.050	0.28(0.08-1.00)	0.050*
	Divorced	30(75.0)	10(25.0)	0.11(0.03-0.42)	0.001	0.11(0.03-0.45)	0.003*
	Widowed	4(25.0)	12(75.0)	1		1	
Family size	<4	64(72.7)	24(27.3)	0.52(0.31-0.87)	0.07	0.55(0.31-0.97)	0.041*
	>5	183(58.1)	132(41.9)	1		1	
Types of admission	New	119(55.9)	94(44.1)	1.63(1.07-2.45)	0.001	1.64(1.04-2.58)	0.032*
	Readmission	128(67.4)	62(32.6)	1			
Others comorbidity	Yes	173(77.6)	50(22.4)	0.20(0.13-0.31)	0.000	0.20(0.13-0.32)	0.001*
	No	74(41.1)	106(58.9)	1		1	1
Smoke cigarette	Yes	208(58.8)	146(41.2)	2.74(1.32-5.66)	0.000	2.93(1.31-6.51)	0.009*
	No	39(79.6)	10(20.0)	1		1	1

vAORs: Adjusted Odds Ratio; * indicate variables with p-value < 0.05; CI: Confidence interval; 1: Reference

consider these factors when interpreting the study's findings.

5. CONCLUSION

It's noteworthy to discover that in the research area, nearly two-thirds (61.3%) of MDR-TB patients had malnutrition. The study also found that a number of variables, such as marital status, family size, new admission, smoking status, and other medical conditions, were factors that independently predicted malnutrition among MDR-TB patients. The study's authors make a number of recommendations to enhance the prognosis of MDR-TB patients. They recommend that nutritional support, advice, and supplementation are essential for these patients. Additionally, we recommend that nutritional supplementation for widowed mothers be considered during follow-up for MDR-TB treatment. They suggest that more attention and nutritional feeding be given to newly admitted patients with MDR-TB. Lastly, this study's findings suggest that MDR-TB patients should avoid cigarette smoking as much as possible.

Previously known on these topics

- Family size determined the nutritional status of MDR-TB patients
- Smoking cigarettes is interfering with the nutritional status of MDR-TB patients.
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A new finding from this study

- The marital status of MDR-TB is significantly associated with the nutritional status of MDR-TB patients.
- Newly admitted TB patients are more at risk for malnutrition when compared with readmitted TB patients.
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Abbreviations and Acronyms

AAMBC: Addis Ababa Medical and Business Collage; AKI: Acute Kidney Infection; ALERT: African Leprosy Rehabilitation and Training Center; BMI: Body Mass Index; CHF: Congestive Heart Failure; DM: Diabetes Mellitus; DR-TB: Drug Resistance Tuberculosis; ETB: Ethiopia Birr; ET: Ethiopia; HIV: Human Immune Deficiency Virus; HT: Height; HTN: Hypertension; KG/M^2:Kilogram per Meter Square; MDR-TB: Multi Drugs Resistance

Tuberculosis; NCHS: National Center for Health Statistics; PEM: Protein Energy Malnutrition; RR: Rifampicin Resistance; SPH: St.Peter Hospital; SPSH: St.Peter Specialized Hospital; SPSS: Statistical Package for the Social Sciences; WHO: World Health Organization; Wt: Weight; USA: United State of America.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

Declaration of Generative AI

No artificial intelligence (AI) tools were used in the preparation of this manuscript

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