

Original Research

NUTRITIONAL STATUS OF TUBERCULOSIS CASES BY HIV STATUS AND OTHER FACTORS ASSOCIATED WITH MALNUTRITION IN THREE HIGH TB/HIV BURDEN PROVINCES, KENYA

ABSTRACT

Aim: To determine if nutritional status of TB cases differs by HIV status, and other factors associated with malnutrition in three high TB/HIV burden Provinces in Kenya.

Study design: Cross-sectional survey, July 2010 to May 2011.

Study setting: Three high TB/HIV burden Provinces in Kenya

Study population: Notified TB cases on anti-TB treatment, whose sputum was positive for Acid Fast Bacilli or labeled multi drug resistant.

Sample size: 1,653

Data collection: Structured questionnaire.

Data analysis: The association of malnutrition (under/over nutrition) has been tested using a chi square for categorical variables while student test was used for continuous variable. Factors significantly associated with malnutrition (p value <0.05) were subjected to logistic regression.

Results: The mean age (SD) of HIV negative and positive patients is 33(12) and 35(10) respectively, p -value 0.002. Nutrition status does not differ by HIV status. Living in an urban settings, decreased odds of undernutrition compared to rural residence OR=0.72 (95% CI 0.57 – 0.90). No employment had significantly increased odds of under-nutrition when compared to patients with employment OR=1.71 (95% CI 1.37 – 2.14). Compared to permanent housing, living in semi-permanent house and other type of housing were both 1.4 times likely to suffer from under-nutrition. HIV positive patients had a significantly decreased odds of overnutrition compared with HIV negative patients OR=0.62 (95% CI 0.41 – 0.93). Secondary and primary education compared to tertiary education is associated with a decreased odds of overnutrition, OR= 0.50 (95% CI 0.31- 0.79) and OR=0.49 (95% CI 0.30 – 0.78). Pre-existing medical conditions were not associated to over nutrition in TB patients.

Conclusion: Nutritional status does not differ between HIV negative and positive TB cases. Low socio economic status and education level increases the odds of undernutrition among TB cases.

Key words: Tuberculosis, HIV, Malnutrition, Kenya

INTRODUCTION

A combination of TB, HIV and malnutrition is a triple intertwined tragedy. This unfortunately is commonly seen in low resource settings. In 2012, 40% of Kenyan populace were living below 2 US\$ per day, with 31% under nourished (1); the total number of all forms of TB notified in the year 2012 were 99,159 (2), adult HIV prevalence is 6% (3) and with 39% of TB cases dually infected with HIV(2). Normal nutritional status is characterized by normal health and body functioning systems, including the immune system resisting various infectious diseases like TB (3,4). Malnutrition indicators are assessed using the Body Mass Index (BMI) which is classified as normal if 18.5 to 25, severe underweight, underweight, overweight and obese with BMI's of <16, 16 to 18.5, 25 to 30 and >30 respectively (4). Active TB disease and under-nutrition have been known to lead to "wasting syndrome" (5).

Malnutrition is an important risk factor for the development of TB, it affects cell-mediated immunity which is the principle host defense against TB and leads to secondary immunodeficiency, ultimately increasing the risk of reactivation of latent TB and progression to active disease (6). TB disease is a "consumptive" condition further aggravating the malnourished state (7). TB and HIV leads to further disease dissemination, increased nutritional demands, suppressed appetite, micro and macronutrient mal-absorption and altered metabolism (8). This results in delayed recovery and higher mortality rates (9).

In Kenya TB transmission is primarily driven by a combination of several factors including HIV infection and poverty with all its manifestations which includes poor living conditions, malnutrition and poor access to health care (10, 11). Commencement of anti-tuberculosis therapy reverses the 'catabolic' impact associated with this disease and compliance to therapy. Ironically adverse drug toxicity has been reported in obese TB cases and not in undernourished patients (12).

An important adjuvant strategy in management of TB cases should include nutritional support as a justified intervention to accelerate recovery. Given the high prevalence of HIV infection in the Kenyan populace, this study sought to determine if nutritional status of TB cases differs by HIV status and other factors associated with malnutrition in three high TB/HIV burden Provinces in Kenya.

METHODS

Study Design: Cross-sectional survey carried out between the period July 2010 to May 2011

Study Setting: Three high TB/HIV burden Provinces in Kenya: Nairobi, Nyanza and Rift Valley. According to Kenya Aids Indicator survey of 2007, the HIV prevalence was 14.9 %, 8.8% and 6.3% in Nyanza, Nairobi and Rift Valley respectively, compared to a National average of 7.1% (13). Data from the Kenyan Ministry of Health Division of Leprosy Tuberculosis and Lung Diseases (DLTLD) indicated that the three Provinces collectively contributed 60% of TB burden in Kenya in 2009.

The three Provinces were purposively chosen based on the burden of the disease, general HIV prevalence amongst the TB patients and the burden of MDR TB. All the three Provinces offer similar TB services under the DLTLD while receiving HIV care services under the Kenyan Ministry of Health National Aids Control Program (NASCOP). According to the Kenyan, guidelines, all TB/HIV co-infected patients are started on anti-TB treatment and anti-retroviral therapy if not already on anti-retroviral therapy.

Study population: The study participants were notified TB cases on anti-TB treatment whose sputum was positive for Acid Fast Bacilli or labeled MDR Multi Drug Resistant based on Central Reference Laboratory culture reports for Drug Susceptibility Tests. Patients registered in the district TB registers, were above 18 years of age, were of sound mind and gave informed consent were included in the study. Patients who had completed TB treatment were excluded from the study.

Sampling procedure and sample size: Multi stage sampling was used to identify the districts, health facilities from the three Provinces where patients were randomly selected from the district register. The framework adopted was established from all the reporting districts together with the associated number of smear positive cases notified in the year 2009, using a simple random sampling with finite population correction factor formula a sample size of (1,892) was obtained with 20% addition for non-response included. Districts sampled proportionately allocated to the three regions with a high burden of notified TB cases. In each region, the districts were allocated randomly with each district being assigned equal number of units and units/patients randomly selected from the district register, and interviews conducted to those who consented. Since MDR TB cases notified are few, all MDR TB patients who consent and met criteria of enrolment were recruited into the study.

Data collection: Pre-tested structured questionnaire was used to collect data. Data from the questionnaires was transferred to an access database. No patient identifiers were collected. The field coordinator verified 6% of randomly selected filled questionnaires.

Data variables: The following variables were collected: District based notified smear positive: age, sex, socio economic status, education, height, weight, residence (rural or urban), alcohol intake, cigarette smoking, distance to health facility from home, other chronic illnesses, marital status, HIV status and type of housing.

A variable for the exposure of interest nutritional status was generated from the BMI computed from the weight and height data collected in the bio-data section. Persons with a BMI of <18.5 were classified as being under nourished, $18.5 - 25$ as being normal while those with a BMI of ≥ 25 were classified as over-nourished.

Data analysis: Data was doubled entered to a prepared access database by trained data entry clerks, after which cleaning and coding was carried out with data quality assurance checked at all levels, while ensuring confidentiality. We present socio-

demographic data stratified by HIV status, since TB and HIV often co-exist and both influence the nutritional status of patients. However, for risk factors of malnutrition, we present results stratified by under nutrition and over nutrition with associations being undertaken against the normal nutrition with each strata above.

We report descriptive statistics and missing data quantified with respect to the nutritional status for all patient characteristics and other risk factors for malnutrition. The absolute count and accompanying proportions are reported for categorical data while the mean and standard deviation have been reported for age.

The association of malnutrition (under/over nutrition) has been tested using a chi square for categorical variables while student test was used for continuous variable. Explanatory factors that were identified to be significantly associated with malnutrition (p value <0.05) for each nutrition strata when compared normal nutritional status were taken forward for a logistic regression to test the magnitude of association for each of the categories.

For the logistic regression analysis the odds ratio, accompanying 95% confidence intervals and wald test p values (two-tailed) was reported.

All analysis was done using STATA version 11 (STATA Corp, Texas, USA)

Ethical considerations: This study was approved by the Scientific Steering Committee and I Ethical Review Committee at Kenya Medical Research Institute (KEMRI).

Results

A total of 1,653 (87% of calculated sample size) TB cases were eligible for this study. The mean age (SD) of HIV negative and positive patients is 33(12) and 35(10) respectively, p-value 0.002. There are more male than female patients 60% (415/734) and 63% (337/564) in the HIV negative and positive group respectively. By HIV status, the following socio-economic characteristics were significantly different between HIV negative and positive patients: age group, sex, province of origin, education, marital status, type of housing, water source and employment (table 1).

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Table 1: Socio-economic characteristics by HIV status of TB cases who underwent nutrition assessment in three high TB/HIV provinces, July 2010 to May 2011, Kenya

Socio-economic variable	HIV status		p-value
	Negative(N=1065) n(%)	positive (N=588) n(%)	
Age Mean(SD)	33(12)	35(10)	0.002
Age group in years 0-14	7(1)	0(0)	<0.001
15-24	251(25)	78(14)	
25-34	376(38)	208(38)	
35-44	209(21)	168(31)	
45-54	79(8)	63(12)	
55-64	40(4)	20(4)	
>65	28(3)	5(1)	
Sex Female	362(35)	281(51)	<0.001
Male	662(65)	274(49)	
Residence Rural	489(48)	297(53)	0.081
Urban	532(52)	269(48)	
Province of origin Nairobi	377(35)	157(27)	<0.001
Nyanza	274(26)	298(51)	
Rift Valley	414(39)	133(23)	
Education College/tertiary education	171(16)	58(10)	<0.001
Secondary School	410(39)	212(36)	
Primary School	373(35)	284(49)	
No Schooling	107(10)	30(5)	
Marital Status Married	607(57)	348(59)	<0.001
Single	376(36)	122(21)	
Divorced/Separated	35(3)	47(8)	
Widowed	42(4)	70(12)	
Type of housing Permanent	436(41)	194(33)	0.014
Semi-permanent	518(49)	322(55)	
Other	102(10)	64(11)	
Missing	9(1)	8(1)	
Water Source Borehole/well	169(16)	110(19)	0.009
Stream/river	288(27)	173(30)	
Tap water	552(52)	258(44)	
Other	48(5)	44(8)	
Missing	5(1)	2(0.3)	
Employment No	495(47)	299(51)	0.032
Yes	562(53)	289(49)	
Missing	4(0.4)	0(0)	

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178 Presence of other medical conditions (diabetes, hypertension and renal failure) were
 179 significantly different between HIV negative and positive patients, p-value <0.001. Body
 180 mass index, type of TB, alcohol intake and cigarette smoking were not different between
 181 HIV negative and positive patients (table 2).

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Table 2: Clinical characteristics by HIV status of TB cases who underwent nutrition assessment in three high TB/HIV provinces, July 2010 to May 2011, Kenya

Clinical characteristic variable	HIV status		p-value
	Negative (N=1065) n(%)	positive (N=588) n(%)	
Body Mass Index (BMI) <16 (Severely underweight) 16-18.5 (Underweight) 18.5-25 (Normal) 25-30(Overweight) >30 (Obese)	68(8) 221(26) 418(49) 106(13) 36(4)	28(6) 113(25) 241(53) 67(15) 9(2)	0.097
Type of TB MDR TB New Smear Positive	22(2) 985(98)	16(3) 542(97)	0.401
Other Medical Conditions None Diabetes Hypertension Renal Failure Other Missing	966(91) 8(1) 14(1) 2(0.2) 42(4) 30(3)	264(45) 6(1) 13(2) 2(0.3) 269(46) 31(5)	<0.001
Alcohol intake No Yes Missing	813(77) 241(23) 9(1)	460(78) 126(21) 2(0.3)	0.255
Cigarette Smoking No Yes Missing	927(88) 90(9) 41(4)	505(86) 55(9) 27(5)	0.793

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Socio-economic factors associated with under nutrition are age group, residence, Province of origin, education, marital status, type of housing, water source and employment. On the other hand factors associated with over nutrition are age, Province of origin and education. Both patients with under nutrition and over nutrition are more likely to be from 25-34 year age group, be male, be married and use tap water. Patients with under nutrition are more likely to reside in rural areas, originate from Rift Valley province, had primary school as the highest level of education, live in semi-permanent housing and not in formal employment. Patients with over nutrition are more likely to reside in urban areas, originate from Nairobi province, had secondary school as the highest level of education, live in permanent housing and in formal employment (table 3).

Table 3: Association between socio-economic characteristics and nutrition status of TB cases who underwent nutrition assessment in three high TB/HIV provinces, July 2010 to May 2011, Kenya

Socio-economic variable	Nutrition status					p-value
	Normal Nutrition (N=734) n(%)		under nutrition (N=564) n(%)	p-value		
Age Mean(SD)	33(11)		33(13)	0.840		0.056
Age group 0-14	2(0.3)		5(1)	0.009		0.166
15-24	148(21)		138(26)			
25-34	284(41)		177(33)			
35-44	169(24)		126(24)			
45-54	50(7)		50(9)			
55-64	31(5)		19(4)			
≥65	10(1)		18(3)			
Sex Female	278(40)		202(38)	0.346		0.429
Male	415(60)		337(63)			
Residence Rural	322(46)		293(54)	0.004		0.413
Urban	385(55)		252(46)			
Province of origin Nairobi	277(38)		172(31)	0.003		0.006
Nyanza	227(31)		167(30)			
Rift Valley	230(31)		225(40)			
Education College/tertiary education	103(14)		66(12)	0.013		0.011
Secondary School	297(41)		192(34)			
Primary School	283(39)		247(44)			
No Schooling	50(7)		56(10)			
Marital status Married	437(60)		307(55)	0.028		0.350
Single	218(30)		187(33)			
Divorced/Separated	43(6)		24(4)			
Widowed	34(5)		43(8)			
Type of housing Permanent	306(42)		193(34)	0.055		0.328
Semi-permanent	353(48)		305(54)			
Other	69(9)		60(11)			
Missing	4(1)		6(1)			
Water source Bore hole/well	109(15)		99(18)	0.003		0.297
Stream/River	170(23)		170(30)			
Tap Water	401(55)		266(47)			
Other	50(7)		24(4)			
Missing	2(0.3)		4(1)			
Employment No	314(43)		317(56)	0.000		0.488
Yes	416(57)		245(44)			
Missing	2(0.3)		0(0)			

232 The following clinical characteristics were not found to be significantly associated to
 233 under nutrition: HIV status, type of TB, having other medical conditions, alcohol intake
 234 and cigarette smoking. Being HIV negative and other medical conditions were found to
 235 be significantly associated with over nutrition. Type of TB, alcohol intake and cigarette
 236 smoking were not associated with over nutrition (table 4).

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Table 4: Association between clinical characteristics and nutrition status of TB cases who underwent nutrition assessment in three high TB/HIV provinces, July 2010 to May 2011, Kenya

Clinical characteristics variables	Nutrition status					p-value
	normal Nutrition (N=734) n(%)		under nutrition (N=564) n(%)	p-value		
HIV status Negative Positive	418(64) 241(37)		327(65) 180(36)	0.707	104(74) 37(26)	0.019
Type of TB MDR TB New Smear Positive	17(2) 677(98)		11(2) 532(98)	0.619	6(4) 148(96)	0.317
Medical conditions None Diabetes Hypertension Renal Failure Other Missing	555(76) 6(1) 13(2) 3(0.4) 126(17) 29(4)		441(78) 5(1) 8(1) 2(0.4) 91(16) 16(3)	0.862	126(79) 5(3) 5(3) 1(1) 19(12) 3(2)	0.050
Alcohol intake No Yes Missing	573(78) 156(21) 4(1)		415(74) 144(26) 5(1)	0.170	131(82) 27(17) 1(1)	0.477
Cigarette smoking No Yes Missing	631(86) 68(9) 33(5)		494(88) 47(8) 23(4)	0.688	142(89) 9(6) 8(5)	0.340

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Although there was a decreased odds of under nutrition in all age groups when compared to the age group 0-14 years, there was no significant difference across the groups. Place of residence was significantly (p value=0.004) associated with under nutrition among those living in urban settings, with a decreased odds of 0.72 (95% CI 0.57 – 0.90) compared to rural residence. With tertiary education as the reference group none of the schooling levels were significantly different; however there was a suggestive trend on increased odds of under-nutrition with every decrease in level of education. No employment had significantly increased odds 1.71 (95% CI 1.37 – 2.14) of under-nutrition when compared to patients with employment. Compared to permanent housing, living in semi-permanent house and other type of housing were both 1.4 times likely to suffer from under-nutrition. In regard to factors associated to over nutrition, HIV positive patients had a significantly decreased odds of 0.62 (95% CI 0.41 – 0.93) compared with HIV negative patients as the reference group. In contrast to under nutrition, lower levels of education were associated with a decreased risk of over nutrition with patients who have secondary and primary education having a significantly decreased odds of 0.50 (95% CI 0.31- 0.79) and 0.49 (95% CI 0.30 – 0.78) respectively when compared to tertiary level education. Pre-existing medical conditions were not associated with over nutrition in TB patients (table 5).

Table 5: Risk factors associated with malnutrition in TB cases who underwent nutrition assessment in three high TB/HIV provinces, July 2010 to May 2011, Kenya

		odds ratio	95% CI		P-value
			lower	Upper	
<i>Risk factors associated with under nutrition</i>					
Age group	0-14	(base)			<0.009
	15-24	0.37	0.07	1.95	
	25-34	0.25	0.05	1.30	
	35-44	0.30	0.06	1.56	
	45-54	0.40	0.07	2.16	
	55-64	0.25	0.04	1.39	
	>65	0.72	0.12	4.41	
Residence	Rural	(base)			0.004
	Urban	0.72	0.57	0.90	
Education	College/tertiary education	(base)			0.013
	Secondary School	1.01	0.71	1.44	
	Primary school	1.36	0.96	1.94	
	No Schooling	1.75	1.07	2.86	
Marital status	Married	(base)			0.029
	Single	1.22	0.96	1.56	
	Divorced/Separated	0.79	0.47	1.34	
	Widowed	1.80	1.12	2.89	
Employment	Yes	(base)			<0.001
	No	1.71	1.37	2.14	
	Missing	0.85	0.15	4.67	
Type of housing	Permanent	(base)			0.055
	Semi-permanent	1.37	1.08	1.74	
	Other	1.38	0.93	2.04	
	Missing	1.59	0.50	4.99	
Water source	Tap water	(base)			0.003
	Borehole/well	1.37	1.00	1.87	
	Stream/river	1.51	1.16	1.96	
	Other	0.72	0.43	1.21	
	Missing	3.02	0.55	16.58	
<i>Risk factors associated with over nutrition</i>					
HIV status	Negative	(base)			0.017
	Positive	0.62	0.41	0.93	
Education	College/tertiary education	(base)			0.017
	Secondary School	0.50	0.31	0.79	
	Primary school	0.49	0.30	0.78	
	No Schooling	0.58	0.27	1.23	
Medical conditions	None	(base)			0.073
	Diabetes	3.67	1.1	12.2	
	Hypertension	1.69	0.59	4.83	
	Renal Failure	1.47	0.15	14.23	
	Other	0.66	0.40	1.12	
	Missing	0.46	0.14	1.52	

Discussion

This study found out that, nutritional status does not differ between HIV negative and positive TB cases. Among TB cases, living in an urban setting is associated with decreased odds of undernutrition, while declining level of education, unemployment, living in semi-permanent and other housing increased odds of undernutrition. Being HIV positive and having lower levels of education are associated with decreased odds of overnutrition among TB cases.

The finding that nutrition status does not differ by HIV status, can be attributed to the fact that TB/HIV co-infected patients according to the Kenyan Ministry of Health guidelines, are started on anti retroviral therapy if not already on anti retroviral therapy, improving their immune status and becoming immunologically similar to uninfected counterparts. In addition, in the advent of wide spread use of anti retroviral therapy in Kenya, HIV has become a chronic disease, and patients have both clinical and immunological improvement (14).

Living in an urban setting is associated with decreased odds of undernutrition. A study in Guatemala, demonstrated that people residing in urban areas have a higher level of protein and calorie intake, and a more diversified diet than their rural counterparts (15). It can also be attributed to the fact most people in urban settings are involved in some form of gainful employment and therefore have the power to purchase food. Low socio-economic status is a key factor in increasing the odds of undernutrition in our population. This is not surprising because, low socio-economic status has been shown to be directly linked to undernutrition (16)

The main limitation of this study is the lack of enough sample size to determine the association between other medical conditions with nutrition status of TB cases. Missing data was minimal and did not affect the results. However, this study has pointed out risk factors relating to multidimensional poverty index (17) being associated with malnutrition among TB cases, which will be used to guide policy development and raise hypothesis for more analytical studies.

Since this study was carried out in routine setting, findings can be generalized to other Kenyan Provinces and other developing countries with high TB and HIV burden.

Conclusion

Nutritional status does not differ between HIV negative and positive TB cases. Low socio economic status and low level of education increases the odds of undernutrition among TB cases. TB programs should develop guidelines to identify high risk TB cases for nutritional support as an integral adjuvant therapy.

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