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Weight Gain and Associated Factors among Adult Tuberculosis Patients on Treatment in Northwest Ethiopia: A Longitudinal Study

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Abstract

Introduction: Ethiopia remains one of the highest tuberculosis burden countries in the world and tuberculosis is one of the most pressing health problems. Weight gain in the course of Anti tuberculosis treatment is indicator of improved nutritional status and treatment success.

Objectives: To assess weight gain and associated factors among adult tuberculosis patients on directly observed treatment short-course in Northwest Ethiopia.

Methods: Institution based longitudinal study was conducted from March 1 to August 28, 2013 at tuberculosis units in Gondar town and surrounding community. Simple random sampling technique was used to select 407 patients. Data were collected using structured questionnaire and anthropometric measurement was performed. Data were entered in to EPI-INFO version 3.5.1 and analysed using SPSS version 20 software. Multiple linear regression models were used to see effect of factors on weight gain among adult tuberculosis patients.

Results: A total of 384 patients were participated in the study. The mean (± SD) body weights (in kg) for the patients were 45.9 ± 7.4, 48.9 ± 7.4 and 51.1 ± 7.4 at diagnosis, after two months and end of six months treatments respectively. The mean (± SD) weight gain was 5.2 kgs (95% CI: 4.83, 5.54), ± 3.55, at the end of 6th-month's treatments. Meal frequency four and above (ß 1.886) and being literate (ß 1.286) have shown positive association with weight gain, whereas previous tuberculosis treatment (ß -1.652) showed negative association with weight gain of study patients.

Conclusion: Two-third of tuberculosis patients was underweight at the time of diagnosis. However, after initiation of anti- tuberculosis drug there were significant increments in weight gain. The weight gain of patients was affected by educational status, history of previous tuberculosis treatment and meal frequency per day. Education of tuberculosis patients about drug adherence and adequate food intake during therapy is mandatory.

Keywords: Adult; Patients; Tuberculosis; Weight gain; Ethiopia

Introduction

Tuberculosis (TB) remains a major global public health problem [1]. One-third of the world's population, and 50% of adults in sub-Saharan Africa, South Asia, and South- East Asia, are infected, representing an enormous pool of individuals at risk for developing tuberculosis [2].

In 20102011 the Ethiopian national TB prevalence survey showed that Ethiopia ranked as 7th high tuberculosis burden country in the world with an estimated incidence of all forms of tuberculosis; 258 new cases out of 100,000 populations per year and ranked 3rd high tuberculosis burden in Africa [3].

People with low socioeconomic status tend to live in crowded conditions that are conducive for increasing transmission of the tubercle bacilli. Thus, it brings a result of a higher incidence of tuberculosis among such people [4]. Malnutrition, socio-cultural, economic factors, poor sanitation and lack of awareness makes people more susceptible to tuberculosis infection [5].

People with tuberculosis are often malnourished, and malnourished people are at higher risk of developing tuberculosis as their immune system is decreasing [6]. The association between tuberculosis and malnutrition is well recognized; tuberculosis can lead to malnutrition and malnutrition may predispose to tuberculosis [7].

The prevalence of underweight is more common with tuberculosis than non-tuberculosis patients [8]. Mean weight of tuberculosis patients at diagnosis was significantly lower in persons who relapsed than in those who did not [9].

Tuberculosis patients often suffer from severe weight loss, which is considered to be immunosuppressive and a major determinant of severity in outcome of disease [10]. A change in BMI was observed after two months of starting treatment which was significantly associated with age group, marital status, employment status, educational level and a belief in avoiding certain food types [4].

Directly Observed Therapy Short Course (DOTS) is internationally approved tuberculosis control strategy has been implemented with tuberculosis programs, which has had cost-effective results and high treatment success rate [11]. Directly observed therapy short course is the cornerstone of a patient-centred approach to treatment to maximize the likelihood of completion of therapy [12].

Weight gain is frequently used as part of the assessment of a patient's response to DOTS and it is a predictor of good clinical outcome [13,14]. Successful tuberculosis treatment is associated with weight recovery and nutritional improvement as compared to baseline status, in studies reported in Northeast India [5].

In the current study the weight of the patients has been taken at different times - at diagnosis, end of two month and end of six month treatment is an important component to assess the progress of patients. The relationship between the change of body weight among patients during DOTS treatment and other factors such as socio-economic demographic characteristics, nutritional related characteristics, tuberculosis category, smoking and drinking habits has never been studied in Gondar town and the surrounding community yet.

The objective of this study is to assess weight gain and associated factors among adult tuberculosis patients on DOTS.

Materials and Methods

An institution based longitudinal study was conducted from March 1, 2013 to August 28, 2013 in order to assess weight gain and associated factors among adult tuberculosis patients on Directly Observed Treatment Short-Course (DOTS), in Gondar town and surrounding community.

Gondar which is located 727 km far from Addis Ababa, capital of Ethiopia. There are about eight Governmental health centres, one referral hospital and one private hospital providing anti-tuberculosis treatment in Gondar town and In North Gondar Zone, there are about 364 health institutions, among these, 124 are Governmental health centres.

All adult tuberculosis patients from tuberculosis units in health institutions of Gondar town and surrounding community whose ages were above 15 years old were the source population. Those patients who were above 15 years of age and who were registered on December 1, 2012 to February 28/2013 were included in this study.

Sample size calculation was computed using criteria used to estimate two mean population formula. Mean weight, at diagnosis, end of two months and end of six months treatment, and also standard deviation, which was taken from a study in Peru 2011. This study was on weight variation over time and its association with tuberculosis treatment outcome, mean difference, M1=54.7 kg, M2=56.8 kg, M3=58.7 kg and the standard deviation, S1=8.3, S2=8.5 and S3=8.7 [15]. The sample size was calculated with 95% level of Confidence Interval (CI), with 80% power with different assumptions. By taking the largest sample size, assuming a 10% non-response rate; the final sample size was 407 Tuberculosis patients on treatment.

Ten health institutions were selected using simple random sampling technique. By considering the proportion to their tuberculosis patient's population the total sample size was distributed to the selected health institutions then select the study patients' using computer generated random number by entering patient's card numbers. Ten trained data collectors who had diploma in clinical nursing were used to interview patients using a structured questionnaire. Document review was done on Patient's weight at registration, HIV status, sputum type, TB category and type of TB was reviewed by the principal investigator.

Weight was measured using a standard Seca weighing scale (Germany) with graduation 0.1 kg and measuring range up to 150 kg. The scale pointer was calibrated at zero before taking measurement. Measurement of weight was recorded to the nearest 0.1 kg. Weight changes were calculated as the differences between weights measured at diagnosis and end of 2-months intensive phase and end of 6-months. Mean weight change was from baseline to end of treatments (6 months). Height was measured using the stadio meter and recorded to the nearest 0.1 cm. The quality of data was maintained by training of the data collectors and supervisors. The questionnaire was pretested ensure clarity and completeness.

The data was cleaned, coded and entered in to EPI-INFO version 3.5.1 and exported to SPSS version 20 statistical package for further analysis. After data exploration, to cheek normality assumption by using box plots and histogram were used to check for linearity and outliers, then multiple linear regression model was fitted to identify factors that affect weight gain. Tables and figures were used to present variables. Mean and standard deviation of patient's body weight were calculated at diagnosis, 2nd month and 6th month. Body mass index was also calculated.

Multiple linear regressions were made to identify the association between the explanatory and response variables. The association between dependent and independent variables were considered using 95% confidence interval and p-value <0.05 was considered as significant.

Ethical considerations

Ethical clearance was obtained from ethical review board of University of Gondar and permission was obtained from North Gondar Zonal Health office, Gondar city administration health office and official letter of cooperation was obtained from the respective health institutions. Informed consent was obtained from adult tuberculosis patients and also taken from the parents or guardians with their patient's age less than 18 years old. Confidentiality of the information was ensured. Patients were told on full freedom to withdraw and to refuse at any time during the data collection process.

Results and Discussion

Socio-demographic and Economic Characteristics

A total of 384 tuberculosis patients were participates in the study giving response rate of 94.3%. Eight (1.96%) patients were lost to follow up before the end of the treatment, 10(2.5%) transferred to other health institutions and 5(1.22%) had died. Out of the total tuberculosis patients, 207(53.9) were male and 123 (32%) of patients were in 15-24 age groups.

The mean age of the study patients was 33.5 (SD ± 14.7) years. Among all study patients, majority of them 257 (66.9%) were urban dwellers, 44.0% were married and 63% were Literate. Most of the patients 166 (43.2%) had medium income [Table 1].

Variable	Frequency	Percent

Sex		
Female	177	46.1
Male	207	53.9
Age group		
15-24	123	32
25-34	109	28.4
35-44	76	19.8
> 45	76	19.8
Education		
Illiterate	142	37
Literate	242	63
Marital status		
Single	158	41.1
Married	169	44
Divorced	39	10.2
Widowed	18	4.7
Residence		
Urban	257	66.9
Rural	127	33.1
Wealth index		
Poor	110	28.7
Medium	166	43.2
Rich	108	28.1

Table 1: Socio demographic characteristics of adult tuberculosis patients on Directly Observed Treatment Short- Course (DOTS), in Gondar town and surrounding community, North West Ethiopia, 2013. (n=384)

Health related characteristics of patients

Among all study patients 178(46.4%) were pulmonary tuberculosis patient's and the rest were extra pulmonary tuberculosis patients. Majority (86.5%) of the patients were new cases and 106 (27.6%) were patients with other co-morbidity. About 49 (12.8%) of the patients were currently drink alcohol. Ten (2.6%) were currently smoke tobacco and 98 (25.5 %) were HIV positive. Two hundred seventy four (71.4%) of the patients were with BMI <18.5 before starting anti-tuberculosis drug but only 126 (32.8%) were BMI <18.5 at the end of treatment [Table 2].

The current study revealed that 71.4% of tuberculosis patients were found to be with chronic energy deficiency (BMI <18.5 kg/m^2) before starting treatment. The prevalence of Chronic energy deficiency which is measured in low BMI <18.5 was higher when compared with studies conducted in Peru (21%), Malawi (61%), Northeast India (64.5%), Indonesia (64%), North Karnataka India (62.2%) and Uganda (62%) [5,16-20].

Variable	Frequency	Percent
Type of TB		
Extra pulmonary TB	206	53.6
Pulmonary TB	178	46.4
sputum smear type		
Positive	109	61.2
Negative	69	38.8
TB patients Category		
New case	332	86.5
Pervious History of Rx	52	13.5
Co-morbidity with TB		
Yes	106	27.6
NO	278	72.4
Alcoholic		
Yes	49	12.8
No	335	87.2
Smoking		
Yes	10	2.6
No	374	97.4
HIV status		
Positive	98	25.5
Negative	286	74.5
Base line BMI		
<18.5	274	71.4
≥ 18.5	110	28.6
BMI at end of treatment		
< 18.5	126	32.8
≥ 18.5	258	67.2

Table 2: Health related characteristics of adult tuberculosis patients on Directly Observed Treatment Short - Course (DOTS), in Gondar town and surrounding community, North West Ethiopia, 2013 (n=384).

Dietary Intake Related Characteristics of the Patients

For majority 350 (91.1%) of the study patient's type of food in the household was cereals. Only 34 (8.9%) had other diets. The meal frequency 289 (75.3%) of the study patients was three times per a day. One hundred seventy one (44.5%) patients did not take egg per a week and 109 (28.4%) were taking egg once per a week [Table 3].

Variable	Frequency	Percent
Type of food of in the Household		

cereals	350	91.1
Others*	34	8.9
Meal Frequency per day		
Once	11	2.9
Two times	55	14.3
Three times	289	75.2
four and above	29	7.6
Frequency of egg intake per week		
No intake	154	40.1
Once	93	24.2
Two times	74	19.3
Three times and above	63	16.4
Frequency of meat intake per week		
No intake	171	44.5
Once	109	28.4
Two times	53	13.8
Three times and above	51	13.3
Other*: meat, milk, Fish, Chicken, egg, fruits, vegetable, legumes, oilseeds, and Tubers		

Table 3: Dietary intake related characteristics of adult tuberculosis patients on Directly Observed Treatment Short- Course (DOTS), in Gondar town and surrounding community, North West Ethiopia, 2013 (n=384).

BMI and Weight change over time during follow-up

In the current study the mean weight of tuberculosis patients at the time of registration was found to be 45.92 ± 7.43 kg (95% CI: 45.17, 46.66). This figure is lower than studies done in Vietnam (46.3 kg), Northeast India (46.8 kg) and Peru (54.7 kg) [5,15,21]. However, this finding is higher when also compared to other similar studies done in Malaysia (41.7 kg) and India (42 kg) [22,23].

The lower mean weight in the current study may be due to patients are from low socioeconomic status who received insufficient dietary intakes and poor quality diets. They might be also more vulnerable to food insecurity and inadequate dietary intake of macronutrients and micronutrients.

This study showed that the mean weight gain (in kg) of patients was found to be 5.2 kg (95% CI: 4.83,5.54), ± 3.55, at the end of 6th-months follow-up treatments. This finding is lower than studies conducted in Tanzania which was 6.9 kg (95% CI: 6.36, 7.41) and Guinea-Bissau, which was 5.7 kg [24,25]. There were consistent finding of mean weight gain in studies conducted in Malaysia (5.43 kg) and Indonesia (4.9 kg) [23,24]. However, this finding is higher when compared with other similar study done in India (3.2 kg) [22].

This mean weight gain difference could be due to lack of adequate nutritional care and support for patients during tuberculosis treatment. Delay in tuberculosis diagnosis and time to start treatment could affect the mean weight gain of patients. The other possible reason for this difference could be the difference in socioeconomic status and health care service delivery system.

The Mean BMI at registration in this study was found to be 17.4 ± 2.45 kg/m^2 Which is lower when compared with studies conducted in Ghana (18.7 kg/m^2), Indonesia (18.1 kg/m^2) and Tanzania (18.2 kg/m^2) [4,25,26]. At the end of six months institution of chemotherapy, there was a gradual improvement in nutritional status of patients. The mean BMI for the patients was raised to 19.4 ± 2.44 kg/m^2, a change of 11.5%. [Table 4]

Subjects	**Weight(kg) Mean ± SD**	**BMI(kg/m^2) Mean ± SD**	****Weight gain Mean ± SD**
Baseline***	45.9 ± 7.43	17.4 ± 2.45	
Two months****	48.9 ± 7.40	18.6 ± 2.38	3 (± 3.18)
End (six months)*****	51.1 ± 7.44	19.4 ± 2.44	5.2 (± 3.55)
Average weight gain which was calculated by subtracting values from baseline weight Baseline*: before starting treatment; Two months****: end of two months treatment; End (six months)*****: end of treatment.			

Table 4: Weight and BMI change over time during follow-up of adult tuberculosis patients on Directly Observed Treatment Short- course (DOTS), in Gondar town and surrounding community, Northwest Ethiopia, 2013 (n=384)

Factors associated with weight gain among tuberculosis patients

P-values after paired sample t- test		
Parameters	**Baseline vs. Two months**	**Baseline vs. six months.**
Body Weight (Kgs)	<0.001*	<0.001*
*Paired sample t- test result between the two groups the means differed significantly from each other (body weight was progressively increasing during the course of treatment)		

Table 5: Results of paired sample test between the two subgroups

Variables	**Coefficients**	**Std.error**	**P=value**	**95% C.I for B**
Sex				
female	-0.245	0.387	0.528	(-1.007, 0.517)
Ref – male				
Residence				
Urban	-0.984	0.523	0.061	(-2.013, 0.044)
Ref – rural				
Education				
literate	1.286	0.429	0.003*	(0.443, 2.129)
Ref –illiterate				
Marital status				
married	-0.502	0.424	0.238	(-1.336, 0.333)

divorced	0.748	0.675	0.268	(-0.579, 2.075)
widowed	-0.969	0.92	0.293	(-2.778, 0.840)
Ref – single				
Wealth index				
medium	0.216	0.474	0.649	(-0.716, 1.147)
rich	0.068	0.528	0.374	(-0.569, 1.509)
Ref – poor				
TB category				
history of treatment	-1.652	0.542	0.002*	(-2.718, -0.587)
Ref – new case				
HIV status				
Positive	-0.177	0.435	0.684	(-1.032, 0.678)
Ref – negative				
Family support during TB Rx				
no change	-0.22	0.412	0.594	(-1.030, 0.590)
less support	-0.589	0.749	0.433	(-2.062, 0.885)
Ref – more support				
Frequency of meals per a day				
one times	-0.862	1.118	0.441	(-3.061, 1.337)
two times	0.629	0.514	0.222	(-0.381, 1.639)
four and above	1.886	0.665	0.005*	(0.579, 3.193)
Ref – three times				
B – Regression co-efficient, S.E- Standard error, CI- confidence interval. *statistically significant				

Table 6: Factors associated with weight gain among tuberculosis patients on Directly Observed Treatment Short- Course (DOTS), in Gondar town and surrounding community, Northwest Ethiopia, 2013(n=384)

The p-value for the Regression model F test was <0.001. The model was with significance value in the ANOVA table and we can conclude that these nine independent variables which are fitted in the multiple linear regressions together predict the percentage of weight gain attributed to tuberculosis patients. Literate and meal frequency four and above per day and history of tuberculosis treatments were significantly associated with weight gain. Literate and meal frequency four and above per day were positively associated with weight gain. Previously TB treatments were negatively associated with weight gain of tuberculosis patients [Table 6].

Previous TB treatment showed a negative association with weight gain in the current study. Previous history of receiving anti tuberculosis treatment has decreased weight gain by 1.652 kg (95%Cl: -2.718, -0.587) as compared to a new case of tuberculosis patients. This finding is consistent with a study done in south India [27].

The reason could be due to previous history of tuberculosis treatment might cause bacterial infections and have a chance to develop mutations resistant to the most potent tuberculosis drugs. As a result, it reduces drug sensitivity of the bacteria that leads to a decreased treatment success rate which could possibly lead to not gaining weight. Those patients with previous history of tuberculosis treatment may also Exposed to other opportunistic infectious diseases that can lead to decreased weight gain.

Educational status of tuberculosis patient was also one of the variables which showed variability in weight gain among adult tuberculosis patients. Literate patients increases weight gain by 1.286 kg (95% CI: 0.443, 2.129) as compared to illiterates at the end of anti TB treatment.

The current study is consistent with the study done in Ghana in which changes in BMI was significantly associated with education in Tuberculosis patients [4].

This could be due to the fact that literates have a better awareness on importance of continuous intake of drugs and better adhere to medications, and those literates might be in a better socio economic status and able to take balanced and adequate food.

Meal frequency was another factor which showed significant association with weight gain. Those patients having meal frequencies of four times and above per day increased weight gain by 1.89 kg when compared with those having meal frequency of three times per a day (95% CI: 0.579, 3.193) at end of anti TB treatment.

This finding is consistent with study done in New Zealand on relationships between frequency of meals and BMI [28]. This may be due to more frequent intake of diet build body lean tissue and fat which will correct nutritional deficiencies and able to enhance the impact of tuberculosis treatment by supporting body immune system and better weight gain.

Limitations of the Study

The study did not present accurate data for caloric intake of patients. The study also compare proportions using BMI cut of points across varying demographic characteristics.

Conclusion and Recommendation

The mean weight gain of tuberculosis patients at the end of treatment was low. However, there was a progressive increment in weight gain during the course of treatment when compared to baseline status of body weights. TB treatment history, Educational status and meal frequency four and above per day found to be important determinants of weight gain in tuberculosis patients who were on DOTS. Promotion of increased meal frequency and supporting nutritional supplementation for patients under the DOTS program is recommended to improve the rate of body weight gain. Patients on DOTS should also counselled on importance of taking anti tuberculosis drugs properly.

Operational definitions

Wealth index: It is calculated using principal component analysis and categorized as poor, medium and rich. The wealth index places

individual households on a continuous scale of relative wealth. Each household asset for which information is collected is assign a weight or factor score generated through principal components analysis. The resulting asset scores standardized in relation to a standard normal distribution with a mean of zero and a standard deviation of one. These standardized scores were used to create the break points that define wealth tertiles consider as: poor, middle and rich.

Urban and Rural area: Rural and Urban classification is depending upon the concentration of people in the particular community based on the density of the human-established structures there. The number of residents is higher in an urban area, whereas the number of residents is less in a rural area. The density of human-established structures is high in the case of an urban area. Cities and towns constitute urban areas. Whereas Villages and hamlets constitute rural areas

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