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 (β 1.886) and being literate (β 1.286) have shown positive association with weight gain, whereas previous tuberculosis treatment (β -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% 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 |
|----------|-----------|---------|

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Sex

|          | Frequency | Percent |
|----------|-----------|---------|
| Female   | 177       | 46.1    |
| Male     | 207       | 53.9    |

Age group

| Age Group | Frequency | Percent |
|-----------|-----------|---------|
| 15-24     | 123       | 32      |
| 25-34     | 109       | 28.4    |
| 35-44     | 76        | 19.8    |
| > 45      | 76        | 19.8    |

Education

| Education | Frequency | Percent |
|-----------|-----------|---------|
| Illiterate| 142       | 37      |
| Literate  | 242       | 63      |

Marital status

| Marital Status | Frequency | Percent |
|----------------|-----------|---------|
| Single         | 158       | 41.1    |
| Married        | 169       | 44      |
| Divorced       | 39        | 10.2    |
| Widowed        | 18        | 4.7     |

Residence

| Residence | Frequency | Percent |
|-----------|-----------|---------|
| Urban     | 257       | 66.9    |
| Rural     | 127       | 33.1    |

Wealth index

| Wealth Index | Frequency | Percent |
|--------------|-----------|---------|
| Poor         | 110       | 28.7    |
| Medium       | 186       | 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/m²) 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].

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].
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).

| Meal Frequency per day | Cereals | Others* |
|------------------------|---------|---------|
| 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 | Once | Two times | Three times and above |
|----------------------------------|-----------|------|-----------|-----------------------|
|                                  | 154       | 93   | 74        | 63                    |

| Frequency of meat intake per week | No intake | Once | Two times | Three times and above |
|----------------------------------|-----------|------|-----------|-----------------------|
|                                  | 171       | 109  | 53        | 51                    |

Other*: meat, milk, Fish, Chicken, egg, fruits, vegetable, legumes, oilseeds, and Tubers

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)

| Subjects | Weight(kg) Mean ± SD | BMI(kg/m²) 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.

Factors associated with weight gain among tuberculosis patients

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

| 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)
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 found to be important determinants of 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 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

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)

|                | Divorced | Widowed | Ref – single |
|----------------|----------|---------|--------------|
|                | 0.748    | -0.969  | 0.675        |
|                | 0.268    | 0.92    | 0.293        |
|                | (-0.579,2.075) | (-2.778, 0.840) |          |
| Wealth index   |          |         |              |
| medium         | 0.216    | 0.542   | 0.002*       |
| rich           | 0.068    | 0.528   | 0.374        |
| Ref – poor     |          |         |              |
| TB category    |          |         |              |
| history of     | -1.652   | 0.542   | 0.002*       |
| treatment      |          |         | (-2.718,-0.587) |
| Ref – new case |          |         |              |
| HIV status     |          |         |              |
| Positive       | -0.177   | 0.435   | 0.684        |
| Ref – negative |          |         | (-1.032, 0.678) |
| Family support during TB Rx |          |         |              |
| no change      | -0.22    | 0.412   | 0.594        |
| less support   | -0.589   | 0.749   | 0.433        |
| Ref – more support |         |         | (-2.062, 0.885) |
| Frequency of meals per a day |          |         |              |
| one times      | -0.862   | 1.118   | 0.441        |
| two times      | 0.629    | 0.514   | 0.222        |
| four and above | 1.886    | 0.685   | 0.005*       |
| Ref – three times |         |         | (0.579, 3.193) |

B = Regression co-efficient, S.E- Standard error, CI- confidence interval, *statistically significant.
individual households on a continuous scale of relative wealth. Each household asset for which information is collected is assigned 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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