

Chest Radiographic Lateral Soft-Tissue Thickness Changes After Complete Anti-tuberculosis Treatment in Adults

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ABSTRACT

Background: Pulmonary tuberculosis (PTB) has 95–98% of its mortality in developing countries. It is associated with marked weight loss which can be evident at the lateral soft-tissue thickness on chest radiographs. **Objective:** To determine the pattern of lateral soft-tissue thickness changes and gender predisposition on chest radiographs in PTB patients and after complete anti-TB treatment. **Methodology:** This prospective study was conducted over a 6 month period at the Radiology Department of Ahmadu Bello University Teaching Hospital, Zaria. Two hundred adults who were bacteriologically proven to have PTB were consecutively recruited into the study as cases, aged 18–70 years and followed up after 6 months of complete anti-TB treatment and found to be asymptomatic and bacteriologically sputum negative. Their lateral soft-tissue thickness on the chest radiographs was measured. **Results:** The mean and standard deviation of pretreated and posttreated PTB patients was 12.66 ± 2.63 mm and 21.13 ± 2.56 mm, respectively ($P < 0.0001$). However, significant increase is noted in lateral soft-tissue thickness after complete anti-TB treatment ($P < 0.001$) and female sex ($P = 0.001$). **Conclusion:** Lateral soft-tissue thickness reduction was seen in PTB patients and significant increase was observed after complete anti-TB treatment.

Key words: Chest radiograph; lateral soft tissue thickness; normal adults; pre- and post-treated pulmonary tuberculosis patients

Introduction

Pulmonary tuberculosis (PTB) kills an estimated 2–3 million people a year. This amounts to a staggering 5500 people a day with 95–98% of this mortality occurring in developing countries.^[1] It is estimated that between 2000 and 2020, nearly 1 billion people will be newly infected; 200 million people will get sick and 35 million will die from PTB if control is not further strengthened.^[1] For this reason, the World Health Organization declared PTB a global public emergency.^[2] Nigeria ranks the fourth among the 22 high-burden countries in the world. Nigeria had the highest number of new cases in Africa in 2009 with over 300 cases/100,000 populations.^[3]

Progressive weight loss is one of the cardinal features of PTB and shows a reduction in the soft-tissue thickness (subcutaneous fat and muscle layer) of the lateral chest wall in patients with advanced/chronic PTB and other wasting diseases such as chronic infection, chronic diseases (heart and liver), malnutrition, malignancies, malabsorption, and human immunodeficiency virus/acquired immune deficiency syndrome.^[4]

However, significant increase in body weight when the treatment has been effected has been reported.^[4] Previous studies have revealed that there was an increase in the

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soft-tissue thickness of the lateral chest wall in patients with PTB who have received effective treatment and do respond positively to the treatment.^[4]

There is a paucity of data in relation to this study in the northern part of Nigeria which necessitated the conduct of this study to determine the pattern of lateral soft-tissue thickness changes on chest radiograph in PTB and after complete anti-TB treatment.

Materials and Methods

This prospective descriptive study was carried out over a period of 6 months from early July 2012 to early January 2013 at the Department of Radiology, Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, Nigeria. About 70 radiographs were taken daily in the department; out of which, an average of forty is chest radiographs.

The study population was bacteriologically proven PTB individuals aged between 18 and 70 years in their 1st month of anti-TB medications referred from the pulmonary clinic of the ABUTH for chest X-ray. The same PTB subjects were followed up for a period of 6 months having completed anti-TB treatment, who were found to be asymptomatic and bacteriologically sputum negative. Lateral soft-tissue thickness on chest X-ray was obtained at the beginning of treatment and 6 months after completion of treatment on each subject. Patients with extra-PTB, those outside the age range of the study population, and those already receiving anti-TB treatments were excluded from the study.

Minimum sample size was determined using Epi-Info Statistical Software version 3.4 CDC Atlanta Georgia USA 2011 (Centre for Disease Control).^[5] Using a national case detection rate of 20% in bacteriologically confirmed PTB cases,^[6] a 95% confidence level and a statistical power of 80%. The minimum sample size for study group versus control of ratio 1:1 was found as 44:44. However, to increase precision and to allow for easy cross tabulation to establish relationship between variables,^[7] a sample size of 200 was used.

The site of measurement of the lateral soft-tissue thickness was at the junctional zone; “The no man’s land” between the thorax and abdomen, as described by Lagundoye.^[8] This is an area in which the soft tissue runs parallel to the lower ribs at the level where the 9th and 10th posterior ribs make their final curvature forwards from the posterior axillary line.^[8] The average of the measurements of the two sides was recorded in millimeter (mm).

Ethical approval was sought from the Ethics and Research Committee of the ABUTH. In addition, informed oral and written consent were obtained from the participants before enrolling them into the study. Before patients give their

consent, they were informed of the nature and the potential risks of the protocol and their right to refuse to participate in the study.

Data obtained were entered into Statistical Package for Social Sciences (SPSS) software version 17.0 and analyzed (INDUS Nomi, December 2008 IBM Chicago, USA). Paired *t*-test was used to determine the relationship between measured lateral chest wall soft-tissue thickness in pre- and post-treated PTB subjects. For all the above tests, statistical significance was taken at *P* < 0.05.

Results

A total of 200 subjects were recruited for this study. Of the PTB patients, 135 (67.5%) were female and 65 (32.5%) were male with mean age of 39.19 ± 11.89 years (age range of 18–70 years). Majority of the patients were female, aged between 31 and 40 years [Table 1].

Figures 1-4 and Table 2 shows the measurement and values obtained of the lateral soft-tissue thickness in pulmonary TB patients (pretreatment). It was found to be 12.66 ± 2.63 mm. The maximum mean value of lateral soft-tissue thickness was recorded in the age group 51–60 years.

Table 3 shows variation of total soft-tissue thickness with sex in posttreated PTB subjects. It was found that a significant

Table 1: Distribution of pulmonary tuberculosis patients by age and sex

Age group in years	PTB			
	Male	Percentage	Female	Percentage
≤20	3	1.5	6	3.0
21-30	11	5.5	23	11.5
31-40	20	10.0	46	23.0
41-50	17	8.5	39	19.5
51-60	10	5.0	15	7.5
61-70	4	2.0	6	3.0
Total	65	32.5	135	67.5

PTB – Pulmonary tuberculosis

Table 2: Total lateral soft-tissue thickness in relation to age groups among pulmonary tuberculosis patients

Age group in years	n	Mean±SD (mm)		
		Muscle thickness	Fat thickness	Soft-tissue thickness
<20	9	8.22±1.64	3.00±0.71	11.22±1.79
21-30	34	8.21±1.61	3.56±1.21	11.76±2.50
31-40	66	8.86±1.61	3.88±1.51	12.74±2.68
41-50	56	8.64±1.88	4.34±1.28	12.98±2.54
51-60	25	9.60±1.00	4.40±1.29	14.00±1.73
61-70	10	7.20±2.35	4.10±2.23	11.30±3.83
Total	200	8.67±1.73	3.99±1.43	12.66±2.63

SD – Standard deviation

Table 3: Lateral soft-tissue thickness

Sex	Pretreated PTB			Posttreated PTB		
	MT*	FT*	LSTT*	MT*	FT*	LSTT*
Female	9.99±1.39	9.20±1.62	19.19±2.50	9.47±1.30	11.69±1.27	21.13±2.56
Male	10.08±1.25	9.29±1.88	19.37±2.65	9.58±1.13	10.42±1.57	20.12±2.26
P	0.653	0.721	0.647	0.533	0.001	0.005

*Mean±SD (mm). MT – Muscle thickness; FT – Fat thickness; LSTT – Lateral soft-tissue thickness; SD – Standard deviation; PTB – Pulmonary tuberculosis

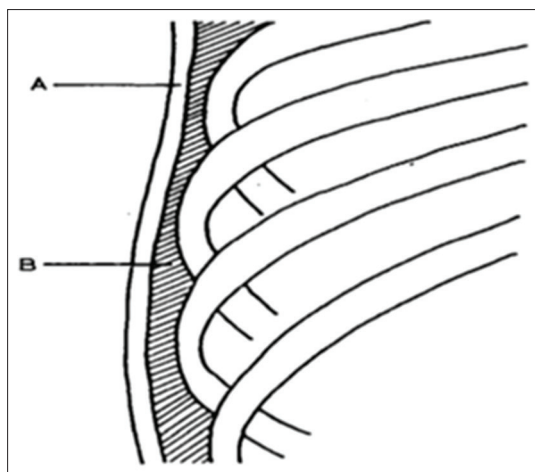


Figure 1: Chest radiograph sketch of the two component layers (A, B) making up the total soft-tissue thickness (t) of the lateral chest wall in healthy subjects. A = Subcutaneous fat layer B = Muscle layer, A + B = Total soft tissue thickness

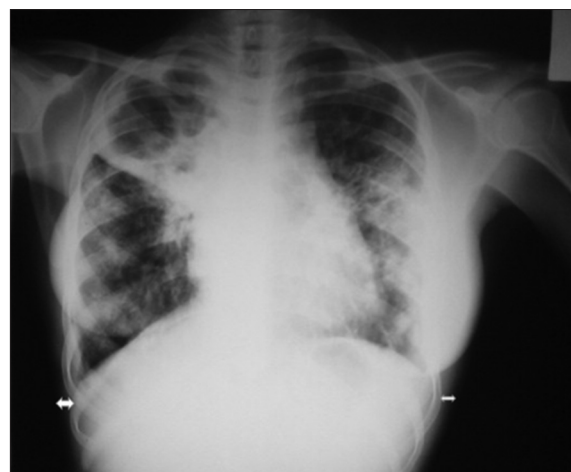


Figure 2: Frontal chest radiograph showing pulmonary Tuberculosis right apical cavity with lateral soft tissue loss evidenced by marked muscle layer thinning (represented by double headed white arrows on both sides) and absent fat layer

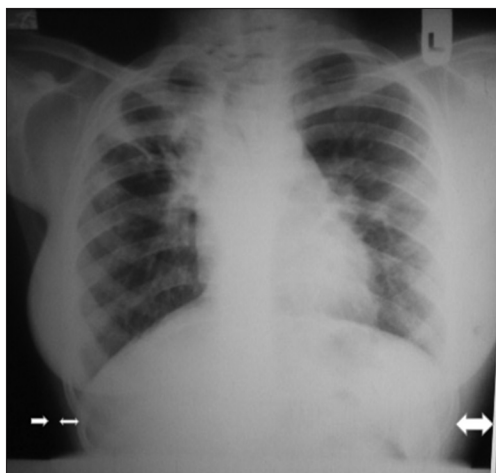


Figure 3: Frontal chest radiograph showing increased lateral soft tissue thickness evidenced by thick muscles layer (represented by thick double headed white arrow on the left side) and thick fat layer (represented by radiolucent line between two white arrows heads on the right side)

increase in fat and total soft-tissue thickness more marked in females than in males which was statistically significant $P < 0.001$ and $P = 0.005$, respectively.

Discussion

A total of 200 subjects were studied comprising 135 (67.5%) females and 65 (32.5%) males with a mean age of

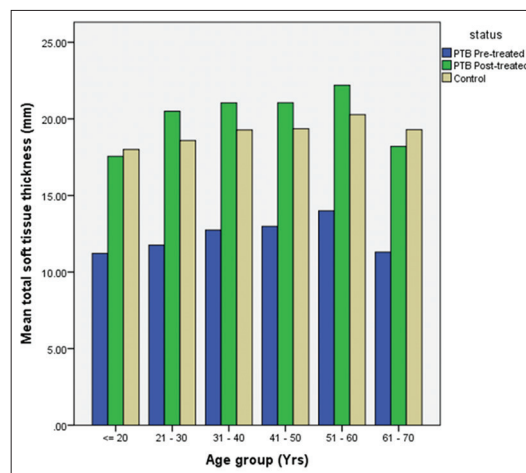


Figure 4: Bar chart representing mean lateral soft tissue thickness of pre-treated (blue bars) post treated (green bars) pulmonary tuberculosis patients and controls (light brown bars) among different age groups

39.12 ± 11.89 years and range of 18–70 years. The highest frequency of 66 subjects was observed in the 31–40 years age group; out of which, 46 were females. In addition, it reflects the nature of our demographic structures. The results of Nigeria Demographic and Health Survey 2008 showed that the household population has a greater number of younger people than older people.^[9] The broad base of the population pyramid indicates that Nigeria's population is young probably due to low life expectancy.^[9]

In addition, PTB is commonly seen in reproductive age group 18–59 years in a study by Leung^[10] and William^[11] in USA. Furthermore, Nwanko *et al.*^[12] found high prevalence of PTB among 21–30 years in Kano, Nigeria. Chigbu and Iroegbu^[13] recorded high prevalence of PTB patients within 18–50 years of age in Aba, Eastern Nigeria. This was similar to what was recorded by Oladigbo^[14] in 2004, studied 203 PTB children and adult, found an age range of 11–40 years with mean age of 29.69 years. This was similar to the present study. This is probably as result of the fact that they are able-bodied men and women with higher exposure to the environment.^[13]

This study used lateral soft-tissue thickness which comprised of muscle and subcutaneous fat thickness as seen on plain chest radiograph to evaluate wasting in PTB similar to the method performed by Lagundoye in 1974^[8] in pediatric patients with kwashiorkor and Oladigbo in 2004^[14] at Ile-Ife in PTB patients.

Oladigbo recorded a mean value for muscle, fat, and total soft-tissue thickness of 8.13 ± 2.85 , 6.59 ± 2.6 , and 14.72 ± 5.22 mm, respectively, for PTB patients, which were higher compared to what were recorded in this study. This could be due to premorbid regional human physical and genetic composition. In addition, low economic status and poverty are higher in Northern Nigeria in comparison to those in Southern Nigeria.^[15] Genetic predisposition could probably be a reason for different physical feature. However, both studies showed marked fat tissue thickness loss.

Lagundoye and Oladigbo's studies revealed that in children with kwashiorkor and PTB in adults respectively, the reduction in fat thickness outpaced that of muscle thickness. This is similar to what was recorded in the present study where muscle and fat thickness layers measured 8.67 ± 1.73 mm and 3.99 ± 1.42 mm, respectively.

In addition, Oladigbo found that a significant increase in the fat and total soft-tissue thickness in posttreatment PTB subjects and recorded 14.47 ± 6.09 mm and 25.20 ± 8.55 mm, respectively. These findings were similar to what was recorded in this study.

In general, there was a significant reduction in the lateral chest wall soft-tissue thickness recorded in PTB patients. However, a significant increase in body weight and total soft-tissue thickness were recorded after complete anti-TB treatment. Although these findings are encouraging in terms of the efficacy of treatment, earlier researchers have alerted that weight gain during treatment may be mostly due to accumulated fat mass.^[16]

Conclusion

The lateral soft-tissue thickness (muscle and fat) was generally reduced in PTB and significant increase in lateral soft-tissue

thickness was observed after complete anti-TB treatment. The clinical implication of this study is that the lateral soft-tissue thickness of the lateral chest wall can be used as an index for evaluating wasting on chest radiographs and also for monitoring response/recovery in patients with PTB on or after anti-TB treatment.

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Conflicts of interest

There are no conflicts of interest.

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