ORIGINAL ARTICLE

A Study of Changes in the Body Composition Components in the Patients with Pulmonary Tuberculosis

G Sharma, MSPT*, S Koley, PhD*., J S Sandhu, MS*, N C Kajal, MD, S Jorawar, MD****

*Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar - 143 005, Punjab, India, **District Tuberculosis Centre and Hospital, Amrtisar, India

SUMMARY

The present study deals with the analysis of body composition components of 86 randomly selected patients with confirmed pulmonary tuberculosis aged 16- 70 years collected from the District Tuberculosis Centre and Hospital, Amritsar. An adequate number of controls were also taken for comparison. The findings of the present study showed highly significant differences ($p \leq 0.001$) in all the twelve kinanthropometric variables except height. When the data was further analyzed between sputum negative and sputum positive patients with pulmonary tuberculosis, highly significant differences ($p \leq 0.001$) were found only in total body fat and statistically significant differences ($p \leq 0.05$) were observed in weight, chest circumference in normal position, abdominal circumference, right calf and buttock circumferences. It may be concluded that TB patients were more malnourished than normal people. Thus, special nutritional care should be taken to the TB patients to give them a better quality of life.

KEY WORDS:
Body composition components, Patients with pulmonary tuberculosis, Sputum positive, Sputum negative

INTRODUCTION

Over centuries, tuberculosis (TB) had been referred to as 'consumption' as its cause was not known. Perhaps, it was referred to as such because it consumes the patients slowly. In 1993, the WHO declared tuberculosis to be a "global health emergency". In India, even though the National Tuberculosis Control Programme was established in 1962 it has not achieved its goal. The revised National Tuberculosis Control Programme was introduced in 1993 in a phased manner. India has about 10-12 million TB patients and every year nearly 1.5 million new cases are added and half a million patients die from TB. Pulmonary TB is a chronic infectious disease characterized by prolonged cough, haemoptysis, chest pain and dyspnoea. Systemic manifestations include fever, malaise, anorexia, weight loss, weakness and night sweats. Reports are available on relationships of patients with pulmonary TB and BMI[1], anthropometry[2], body composition components[3-5], haematological parameters[6], nutritional status[7-11] and socioeconomic status[12]. Though in India, pulmonary TB is frequent, not much is available in the literature on body composition status of Indian patients with pulmonary TB, especially in the north India. To fulfill the lacunae of knowledge the present study was planned.

In the present study, twelve kinanthropometric variables and body composition components were taken to access the body composition status in patients with pulmonary TB and controls.

MATERIALS AND METHODS

A total of 86 randomly selected confirmed cases of pulmonary tuberculosis aged 16-70 years taken from the District Tuberculosis Centre and Hospital, Amritsar, India were considered for the present study. The subjects were basically hospital based. As it was a cross sectional study, we incorporated the subjects randomly in the study those who gave their consents in the six wards and OPD of the District TB Hospital, Amritsar, Punjab, India. An adequate number of controls (n=40) was also taken for comparison from the same place matching age, sex, socio – economic status, ethnicity etc., except the disease condition (Table I). Twelve kinanthropometric variables viz. height, weight, body mass index, right upper arm circumference, forearm circumference, chest circumference in normal position, abdomen circumference, mid thigh circumference, right calf circumference, buttock circumference, total body fat and total lean body mass were measured for the present study. Percent body fat was calculated with the help of girth measurement (right upper arm, forearm, abdomen and buttock circumferences) as described by McArdle *et al.*[13]. The rest of the measurements were taken according to the method described by Weiner and Lourie[14]. As the data was parametric and different subject design in nature, student's t test was used for the comparisons of twelve kinanthropometric variables between patients and controls. To estimate inter and intra group differences, one way analysis of variance (ANOVA) test was also used.

RESULTS

Table II shows the mean values and standard deviations of twelve kinanthropometric variables in patients with pulmonary TB and controls. TB patients have lesser mean values in all twelve kinanthropometric variables showing statistically significant differences ($p \leq 0.05$) in height ($t=2.60$) and highly significant differences ($p \leq 0.001$) in weight ($t=18.95$), BMI ($t=17.35$), right upper arm circumference ($t=16.23$), right forearm circumference ($t=12.53$), chest circumference normal ($t=13.09$), abdomen circumference($t=14.17$), mid thigh circumference ($t=16.56$), right calf circumference ($t=16.28$), buttock circumference ($t=20.29$), total body fat ($t=15.74$) and total lean body mass ($t=12.93$).

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Corresponding Author: Shyamal Koley, Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar - 143 005, Punjab, India
Email: drkoley@yahoo.co.uk

Table I: Distribution of demographic characteristics of TB cohort and control cohort

Characteristics	TB cohort (n=86)	Control cohort (n=40)	P
Age (mean years)	35.17	37.22	P>0.05 (NS)
Age group			
16-25 years	20.93 (18)	20.00 (08)	P>0.05(NS)
26-40 years	52.32 (45)	52.50 (21)	P>0.05(NS)
41-60 years	22.09 (19)	22.50 (09)	P>0.05(NS)
61-70 years	04.65 (04)	05.00 (02)	P>0.05(NS)
Ethnicity			
Hindu	80.23 (69)	80.00 (32)	P>0.05 (NS)
Sikhs	19.77 (17)	20.00 (08)	P>0.05 (NS)
% male	100	100	

Table II: Mean values and standard deviations of twelve kinanthropometric variables in patients with pulmonary tuberculosis and controls

Variables	Tuberculosis Patients (n=86)		Controls (n=40)		t values
	Mean	S.D.	Mean	S.D.	
Height (cm)	166.86	±6.06	169.77	± 5.41	2.60*
Weight (kg)	44.63	±6.15	71.90	± 9.87	18.95***
BMI	15.86	±2.39	25.01	± 3.42	17.35***
Rt. upper arm circum (cm)	20.03	±2.16	26.79	± 2.20	16.23***
Rt. forearm circum (cm)	21.29	±2.12	26.01	± 1.58	12.53***
Chest circum (normal) (cm)	79.63	±3.72	92.16	± 7.03	13.09***
Abdomen circum (cm)	67.01	±5.83	89.10	±11.70	14.17***
Mid thigh circum (cm)	32.91	±4.01	45.65	± 4.04	16.56***
Rt. calf circum (cm)	25.87	±2.69	34.32	± 2.77	16.28***
Buttock circum (cm)	75.10	±4.98	97.62	± 7.27	20.29***
Total body fat (Kg)	6.29	±2.17	18.65	± 6.58	15.74***
Total lean body mass (Kg)	38.11	±5.04	53.36	± 8.08	12.93***

* indicates p≤ 0.05; *** indicates p≤0.001; Circum = Circumference.

Table III: Mean values and standard deviations of twelve kinanthropometric variables in sputum negative and sputum positive patients with pulmonary tuberculosis

Variables	Sputum Negative Tuberculosis Patients (n=41)		Sputum Positive Tuberculosis Patients (n=45)		t values
	Mean	S.D.	Mean	S.D.	
Height (cm)	167.91	±5.95	165.90	±6.06	1.55
Weight (kg)	46.62	±6.04	42.81	±5.73	3.00*
BMI	16.19	±2.92	15.56	±1.77	1.21
Rt. upper arm circum (cm)	20.47	±2.18	19.64	±2.09	1.79
Rt. forearm circum (cm)	21.48	±2.38	21.11	±1.87	0.82
Chest circum (normal) (cm)	80.63	±3.67	78.72	±3.56	2.45*
Abdomen circum (cm)	68.36	±4.91	65.79	±6.36	2.08*
Mid thigh circum (cm)	33.49	±4.97	32.39	±3.26	1.28
Rt. calf circum (cm)	26.50	±3.16	25.29	±2.04	2.14*
Buttock circum (cm)	76.55	±5.85	73.78	±3.61	2.66*
Total body fat (kg)	7.45	±1.76	5.23	±1.97	5.48***
Total lean body mass (kg)	38.89	±4.89	37.40	±5.12	1.37

* indicates p≤ 0.05; *** indicates p≤0.001; Circum = Circumference

Table IV: One way analysis of variance of five kinanthropometric variables between pulmonary tuberculosis patients and controls

Variables	Combination	Sum of Squares	df	Mean Square	F	P
Height (cm)	Between groups	318.59	2	159.25	4.69	0.11
	Within groups	4174.10	123	33.94		
	Total	4492.59	125			
Weight (kg)	Between groups	20617.58	2	10308.79	189.19	0.001
	Within groups	6702.14	123	54.49		
	Total	27319.72	125			
BMI	Between groups	2292.83	2	1146.42	151.12	0.001
	Within groups	933.11	123	7.59		
	Total	3225.94	125			
Total body fat (kg)	Between groups	4277.39	2	2138.69	132.68	.001
	Within groups	1982.67	123	16.12		
	Total	6260.06	125			
Total lean body mass (kg)	Between groups	6392.65	2	3196.32	84.39	.001
	Within groups	4658.82	123	37.88		
	Total	11051.47	125			

Table V: One way analysis of variance of seven circumferential variables between pulmonary tuberculosis patients and controls

Variables	Combination	Sum of Squares	df	Mean Square	F	P
Rt. upper arm circumference (cm)	Between groups	1259.45	2	629.72	135.60	.001
	Within groups	571.23	123	4.64		
	Total	1830.67	125			
Rt. forearm circumference (cm)	Between groups	612.03	2	306.02	78.82	.001
	Within groups	477.56	123	3.88		
	Total	1089.59	125			
Chest circumference (normal) (cm)	Between groups	4367.24	2	2183.62	88.75	.001
	Within groups	3026.33	123	24.60		
	Total	7393.57	125			
Abdomen circumference (cm)	Between groups	13464.71	2	6732.36	102.45	.001
	Within groups	8082.74	123	65.71		
	Total	21547.45	125			
Mid thigh circumference (cm)	Between groups	4454.53	2	2227.26	138.56	.001
	Within groups	1977.14	123	16.07		
	Total	6431.67	125			
Rt. calf circumference (cm)	Between groups	1984.73	2	992.36	138.37	.001
	Within groups	882.11	123	7.17		
	Total	2866.84	125			
Buttock circumference (cm)	Between groups	14011.98	2	7005.99	215.08	.001
	Within groups	4006.58	123	32.59		
	Total	18018.56	125			

Table VI: One way analysis of variance of five kinanthropometric variables between sputum negative and sputum positive patients with pulmonary tuberculosis.

Variables	Combination	Sum of Squares	df	Mean Square	F	P
	Between groups	86.63	1	86.63	2.40	.125
Height (cm)	Within groups	3031.42	84	36.09		
	Total	3118.05	85			
	Between groups	311.56	1	311.56	9.02	.004
Weight (kg)	Within groups	2900.53	84	34.53		
	Total	3212.09	85			
	Between groups	8.37	1	8.37	1.47	.23
BMI	Within groups	477.96	84	5.69		
	Total	486.32	85			
Total body fat (kg)	Between groups	105.62	1	105.62	30.06	.001
	Within groups	295.62	84	3.51		
	Total	400.80	85			
Total lean body mass (kg)	Between groups	47.83	1	47.83	35.57	.171
	Within groups	2110.72	84	25.13		
	Total	2158.55	85			

Table VII: One way analysis of variance of seven circumferential variables between sputum negative and sputum positive patients with pulmonary tuberculosis

Variables	Combination	Sum of Squares	df	Mean Square	F	P
Rt. upper arm circumference (cm)	Between groups	14.55	1	14.55	3.20	.08
	Within groups	382.12	84	4.55		
	Total	396.67	85			
Rt. forearm circumference (cm)	Between groups	3.08	1	3.08	0.68	0.41
	Within groups	379.66	84	4.52		
	Total	382.74	85			
Chest circumference (normal) (cm)	Between groups	78.40	1	78.40	6.00	0.02
	Within groups	1097.14	84	13.06		
	Total	1175.54	85			
Abdomen circumference (cm)	Between groups	141.15	1	141.15	4.32	0.04
	Within groups	2746.66	84	32.70		
	Total	2887.80	85			
Mid thigh circumference (cm)	Between groups	26.02	1	26.02	1.63	0.20
	Within groups	1340.32	84	15.96		
	Total	1366.34	85			
Rt. calf circumference (cm)	Between groups	31.84	1	31.84	4.59	0.03
	Within groups	581.99	84	6.93		
	Total	613.83	85			
Buttock circumference (cm)	Between groups	163.75	1	163.75	7.08	0.001
	Within groups	1942.39	84	23.12		
	Total	2106.14	85			

When the patients with pulmonary TB were further analyzed depending upon their smear status (Table III), it was found that sputum negative patients have higher mean values in all the twelve kinanthropometric variables projecting highly significant differences ($p \leq 0.001$) in total body fat ($t=5.48$) and statistically significant differences ($p \leq 0.05$) in weight ($t=3.00$), chest circumference normal ($t=2.45$), abdomen circumference ($t=2.08$), right calf circumference($t=2.14$) and buttock circumference ($t=2.66$).

One way analysis of variance of five kinanthropometric variables and seven circumferential measurements between TB patients and controls is shown in Table IV and V. Highly significant ($p \leq 0.001$) differences were noted in all the variables viz. height ($F=4.69$), weight ($F=189.19$), BMI ($F=151.12$), total body fat ($F=132.68$), total lean body mass ($F=84.39$), right upper arm circumference ($F=135.60$), right forearm circumference ($F=78.82$),chest circumference normal ($F=88.75$), abdomen circumference ($F=102.45$), mid thigh circumference ($F=138.56$), right calf circumference ($F=138.37$) and buttock circumference ($F=215.08$).

Table VI and VII show one way analysis of variance of five kinanthropometric variables and seven circumferential measurements between sputum negative and sputum positive patients with pulmonary TB. Statistically significant ($p \leq 0.05$) differences were noted in weight ($F=9.02$), chest circumference normal ($F=6.00$), abdomen circumference ($F=4.32$), right calf circumference ($F=4.59$) and highly significant ($p \leq 0.001$) between group differences were noted in total body fat ($F=30.06$) and buttock circumference ($F=7.08$).

DISCUSSION

The results of the present study indicate highly significant differences ($p \leq 0.001$) in almost all the parameters between patients with pulmonary TB and controls due to massive wasting of muscle mass and fat mass in patients with pulmonary TB. The reduction of muscle mass and fat mass caused the reduction in body weight and BMI as well. It also affects the normal growth of an individual. Excessive wasting of muscle mass and fat mass caused marked reduction in percent body fat in patients than controls. Nonetheless, the reduction in total body fat and total lean body mass was also the resultant of wasting of muscle and fat mass. Karyadi *et al.*[8] reported that TB patients had significantly lower body mass index, skinfold thickness (triceps, biceps, subscapular and suprailiac), mid upper arm circumference and proportion of body fat. Van Lattow *et al.*[15] studied the relationship between malnutrition and severity of lung disease in human immunodeficiency virus (HIV) positive and negative adults with pulmonary TB. They concluded that the severity of lung disease in adults with pulmonary TB was associated with the extent of malnutrition, as reflected by body mass index and body composition components using bioelectrical impedance analysis. Metcalfe [16] studied in this direction and stated that patients with TB had significantly lower nutritional status than controls.

When the comparisons of all these twelve parameters were made between sputum negative and sputum positive patients with pulmonary TB, it was found that sputum negative patients had considerably more body weight, total body fat and four circumferential variables highlighting recovery from TB and subsequent gathering of mostly fat mass. The findings of present study also supported the reports of Schwenk *et al.*[7]

CONCLUSION

The findings of the present study show that TB patients are more malnourished than the normal persons. So, more care should be taken towards improving dietary status of the TB patients to give them a better quality of life.

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