Fat Distribution after a Conditioning Programme in Males & Females

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Abstract

The purpose of this study was to examine the distribution of subcutaneous fat in young adult physically active males (N=50) and females (N=50) aged 18-24 years, before and after a 90 day's conditioning programme-consisting of exercises targeted to improve flexibility, strength, and cardiorespiratory endurance. The results show that the distribution pattern of subcutaneous fat in the form of skinfold thickness in males is subscapular (maximal) followed by calf, triceps, suprailiac, biceps (minimal) and in females suprailiac (maximal) followed by triceps, subscapular, calf and biceps (minimal). The subcutaneous skinfold thickness from the observed body sites significantly decreased (except subscapular in females) with the progression of a conditioning programme but it could not change the preconditioning distribution pattern of subcutaneous fat in both males and females. Whereas the body Fat% significantly decreased (before 23.87±3.20 & after 20.86±2.41) and the LBM% significantly increased (before 76.00±3.20 & after 79.14±2.80) only in females after a conditioning programme. These findings indicate that a conditioning programme on the one hand lowers the total body fat by mobilizing and using the subcutaneous fat and on the other hand increases the total lean body mass [LBM] both in males and females.

Key Words: **LBM, Subcutaneous Fat, Skinfolds, Bioelectrical Impedance**

Introduction:

Conditioning programme related changes in body composition are of increasing interest because they hold important implications for nutritional status, functional capacity, and risk for chronic diseases. Typically, there is an increase in body weight from ages 20 to 50 yr, followed by a modest decline after age 70 yrs *(Borkan et al., 1983 and Silver et al., 1993)*. Fat free body mass (or Lean Body Mass [LBM]) has been reported to decline by 25 to 30% between ages 30 and 70 yr *(Fleg and Lakatta, 1988; Flynn et al., 1989; Grimby and Saltin, 1983; Smith & Serfass, 1981)* in conjunction with an increase in fat mass. Decreases in work capacity *(Shock, 1962)* and muscular strength *(Flynn et al., 1989; Grimby and Saltin, 1983; Smith and Serfass, 1981)* with aging, associated with these changes in body composition, could affect the ability to perform daily activities such as walking *(Bassey et al., 1992)* and lifting *(Jette and Branch, 1981)*. Ultimately, these could result in decreased mobility and a decline in the health and physical performance capabilities of an individual.

The accumulation of body fat with aging tends to be distributed in a typical pattern for males *(Schwartz et al., 1990)* a large part of the increase occurs at the central sites, in the Omentum, and in the organs in which fat replaces parenchyma *(Kenney, 1985)*. Subcutaneous fat tends to be lost peripherally from the limbs but increases in the trunk *(Despres et al., 1990 and Kohrt et al., 1992).* There is evidence that increases in fat mass especially the central depots, may be associated with greater risk for chronic diseases and metabolic disorders such as hypercholesterolemia, insulin resistance, atherosclerosis, hypertension, and diabetes *(Despres et al., 1990).*

Previous studies *(Schwartz et al., 1990 and Kohrt et al., 1992)* have compared body composition parameters in young groups versus an older group. One problem with this research design is that it does not allow for examination of patterns or trends over the whole age range in both males and females. It is of interest, therefore, first to see the patterns in subcutaneous fat distribution with adequate representation of subjects from young age 18-24 years of both males and females before the start of a conditioning programme, secondly to observe whether the conditioning programme brought any change in the distribution pattern of subcutaneous fat and thirdly, to investigate the magnitude of change in the total body Fat% and LBM% at the end of the conditioning programme in both males and females.

Materials and Methods:

Subjects: Fifty males and fifty females apparently healthy, from 18 to 24 yr of age volunteered as subjects. The subjects were physically active but not involved in any specific physical training programme.

Method*:* The body weight and subcutaneous skinfolds from selected sites (biceps, triceps, subscapular, suprailiac and calf) was measured before and after the completion of first and second mesocycle of the conditioning programme using standard techniques given by *Tanner et al (1981).* Body composition was determined with the help of bioelectrical impedance analysis with a RJL system BIA-106 spectrum analyzer using the standardized protocol described in the user reference manual (RJL systems, Detroit, MI, 1987).

Design of the Conditioning Programme

The conditioning programme lasted for 90 days and comprised of two mesocycles, of 45 days each. The first mesocycle consisted of exercises targeted to improve static flexibility and cardio-respiratory endurance while the second mesocycle included those exercises, which could improve dynamic flexibility, muscular strength and endurance. The exercise regimen was administrated to the subjects in the morning, five days a week and the duration of each session was kept about 45 minutes.

Testing Protocol

The body weight, selected skinfold thickness, Fat% and LBM% were recorded at the following stages: -

Pre-Test [PT] - before the start of a conditioning programme.

Post-Test I [PT-I] - after the completion of first mesocycle (45days).

Post-Test II [PT-II] - after the completion of second mesocycle (90days).

Effort was made, wherever possible for keeping the timing of the day of measurement of pre and post conditioning tests same for each subject.

Statistical Analysis:

The data was statistically analyzed by using the SPSS X software. Means are expressed as mean ± standard deviation (SD). The ANOVA and Scheffe Post hoc tests were used to derive the results. A significant level of 0.05 was applied in all statistical analysis.

Results:

Among the measured body sites for skinfold thickness in the males during pre test, the thickest followed by the thinnest pads of subcutaneous fat were found in the sub scapular (9.10mm) then followed by calf (8.91mm), triceps (7.06mm), suprailiac (5.51mm) and the biceps (4.94mm) regions, and in case of females, these were found in the suprailiac (16.83mm), triceps (14.46mm), subscapular (13.53mm), calf (12.78mm) and the biceps (5.86mm) regions respectively during the pre conditioning (Table 1). In terms of percentage, maximum subcutaneous fat mobilization was noticed from the calf region (34.56%) followed by subscapular (31.97%), biceps (26.51%), triceps (25.07%), suprailiac (22.50%) in males and in case of females the triceps (11.27%) was followed by subscapular (11.08%), suprailiac (10.33%), calf (10.01%) and biceps (8.36%) at the end of a second mesocycle that is after 90 days.

It is also found that the subcutaneous skinfold thickness value on various body sites is more in females than in males before as well as after the conditioning programme but when percentage of maximum subcutaneous fat mobilization was compared between the pre test and post-test II then the magnitude of mobilization was more in males than in females.

Table 1 Descriptive Statistics of Subjects - Mean (standard deviation)

Variable (s)	Pre Test		Post Test-I		Post Test-II	
	Male	Female	Male	Female	Male	Female
Biceps Skin fold (mm)	4.94 ± 0.05	5.86 ± 0.82	3.8 ± 0.47	5.78 ± 0.71	3.63 ± 0.44	5.37 ± 0.66
Triceps Skin fold (mm)	7.06 ± 1.57	14.46 ± 2.64	6.13 ± 1.12	14.12 ± 2.58	5.29 ± 0.91	12.83 ± 2.62
Sub Scapular Skin fold (mm)	9.10 ± 2.29	13.53 ± 3.43	7.86 ± 1.66	13.26 ± 3.37	6.19 ± 1.32	12.03 ± 3.53
Suprailiac Skin fold (mm)	5.51 ± 1.68	16.83 ± 3.32	4.87 ± 1.09	16.50 ± 3.26	4.27 ± 0.74	15.09 ± 3.17
Calf Skin fold (mm)	8.91 ± 2.95	12.78 ± 1.56	7.53 ± 2.08	12.47 ± 1.56	5.83 ± 1.30	11.50 ± 1.74
Body weight (Kg)	62.31 ± 6.53	50.72 ± 3.60	60.23 ± 6.75	48.89 ± 3.69	61.27 ± 6.61	50.05 ± 3.48
LBM%	80.16 ± 5.50	76.13 ± 3.20	81.51 ± 5.65	77.62 ± 2.89	82.3 ± 5.44	79.14 ± 2.80
FAT%	19.83 ± 5.50	23.87 ± 3.20	18.48 ± 5.63	22.37 ± 2.89	17.7 ± 5.36	20.86 ± 2.41

After the completion of first mesocycle, there was a decrease in the mean value of total body weight both in males (from 62.31 Kg to 60.23 kg) and females (50.72 Kg to 48.89 Kg) (Table 1). But at the end of second mesocycle the total body weight was found to increase (from 60.23 Kg [during post test I] to 61.27 in males and from 48.89 Kg [during post test I] to 50.05 Kg in females). In spite of this increase in the mean value of total body weight, it was still lower than the pre test value. On the other hand, LBM % increased after the completion of first mesocycle (from 80.16% to 81.51% in males and 76.13% to 77.62% in females) and this trend of increase was persisted till the end of second mesocycle (from 81.51% to

82.3% in males and 77.62% to 79.14% in females)

In terms of percentage, after the end of the conditioning programme total body weight & Fat% decreased by 1.66% & 2.13% and LBM % increased by 1.14% in males and in case of females body weight and body Fat% decreased by 1.32% & 3.01% and LBM% increased by 3.01% but in spite of this decrease in the total body weight, the contribution of LBM % increased & that of Fat% decreased with the progression of a conditioning programme & the net effect was a gain in the total body weight at the end of second mesocycle.

Table 2 Analysis of Variance of Skin folds, Fat%, LBM% and Body Weight

Variable (s)		**Sum of Squares**		**F**	
		Male	Female	Male	Female
Biceps	Between Groups	6.81	6.93	7.41*	6.38*
	Within Groups	67.55	79.76		
Triceps	Between Groups	78.21	74.39	25.580*	5.42*
	Within Groups	224.72	1007.11		
Subscapular	Between Groups	213.54	63.80	32.75*	2.68
	Within Groups	479.25	1748.67		
Suprailiac	Between Groups	38.21	85.68	12.52*	4.04*
	Within Groups	224.20	1557.66		
Calf	Between Groups	237.46	44.67	24.06*	8.42*
	Within Groups	725.19	389.75		
Body weight	Between Groups	108.36	85.32	1.23	3.29*
	Within Groups	6475.23	1902.13		
LBM%	Between Groups	116.94	244.69	1.90	15.01*
	Within Groups	4509.29	1198.03		
FAT%	Between Groups	115.84	226.20	1.91	13.84*
	Within Groups	4453.74	1200.82		

*The mean difference is significant at the .05 level.

Table 2 shows one-way analysis of variance of skinfold thickness, Fat%, LBM %, and total body weight of males and females. It was found that a difference in the mean of body weight, Fat% & LBM% in males after the conditioning programme between pre test and post-test groups but these differences were not statistical significant. But the differences in the mean of five skinfold thickness (biceps, triceps, subscapular, suprailiac & calf) in males after the conditioning programme between various groups was statistically significant.

In case of females, there were statistically significant differences in the mean of skinfold thickness (except subscapular), Fat%, LBM %, and total body weight after the conditioning programme between pre test and post-test groups.

Table 3 Scheffe Post -hoc multiple comparisons of Skin folds, Fat%, LBM% and Body Weight

Variable (s)	Pre Test vs. Post Test-I		Pre Test vs. Post Test-II		Post Test-I vs. Post Test-II	
	Male	Female	Male	Female	Male	Female
Biceps	0.34*	0.07	0.51*	0.49*	0.16	0.41*
Triceps	0.92*	0.33	1.76*	1.63*	0.84*	1.29*
Subscapular	1.240*	0.27	2.91*	1.50	1.67*	1.22
Suprailiac	0.642*	0.33	1.23*	1.74*	0.59	1.41
Calf	1.372*	0.31	3.07*	1.28*	1.70*	0.96*
Body weight	2.082	1.82*	1.04	0.67	-1.04	-1.15
LBM%	-1.352	1.61*	-2.13	3.12*	-0.78	1.51*
FAT%	1.392	1.49*	2.11	3.00*	0.72	1.51*

* The mean difference is significant at the .05 level

Post hoc comparisons of females (Table3) indicate that the differences in biceps occurred between the pre test & post test II and post test I & post test II group. The same was true for triceps and calf, while in case of suprailiac the difference occurred only between pre test & post test II. In addition to this, the difference in body weight occurred between the pre test & post test I group. The differences in Fat% and LBM% occurred between pre test & post test I, pre test & post test II, and post test I & post test II group.

Post hoc comparison of males (Table 3) indicates that significant difference in the bicep skin fold thickness occurred only between the pre-test & post-test I and pre-test & post-test II .The same was true for suprailiac site, while in the case of triceps, subscapular, and calf sites significant difference occurred between all the groups i.e. the pre-test & post-test I; pre-test & post-test II and post-test I & post-test II.

Discussion:

Reduction of fat from the trunk and extremity regions observed both in males and females in the present investigation agrees with the findings of many other researchers, who have also reported mobilisation of fat from the trunk and extremity areas as a result of aerobic exercise paradigm. Preferential loss of fat from the abdominal and trunk subcutaneous regions over the extremity regions especially the lower extremity, has been reported by *Hayer et al., (1988)* and *Kohrt et al., (1992),* who also observed 10% greater fat loss from the trunk subcutaneous region than the peripheral fat in men who participated in aerobic training. A number of other investigators have also reported a greater loss of trunk and abdominal subcutaneous fat after aerobic training *(Despres et al., 1991; Schwartz et al., 1991 and Kohrt et al., 1992).* According to them, increase in lipoprotein lipase activity may be responsible for fat mobilisation during aerobic exercise programme.

The greater impact of second mesocycle of a conditioning programme both in males and females in decreasing the thickness of skinfolds of the trunk and extremity region over the first mesocycle may be ascribed to the specific type of direct exercises of the trunk group of muscles (stretching and strengthening exercises) included in the exercise paradigm.

In the present study in males the differences in the body weight, LBM% and Fat% after a conditioning programme was not statistical significance, the reason for this may be a decrease in the total body weight after first mesocycle & after second mesocycle it was observed to increase but still the value of total body weight was lower as compared to pre-test value. This fluctuation in the total body weight during the conditioning programme may be due to the changes in the daily dietary intake and increased energy expenditure imposed through planned exercise programme administered to the subjects. Moreover, the mean values of total body weight & Fat% of the male subjects in this study were in the acceptable range before the start of a conditioning programme as per the norms of *Lohman (1992),* but as soon as these subjects started participating in the conditioning programme, their energy expenditure increased along with wear and tear of the muscles, and the body tried to adjust metabolic balance of fats and proteins. In this process stress may be increased on both fats and proteins metabolism. Thus may cause a slight decrease in both fat and LBM contents. This may be further explained on the findings of many investigators who have reported different responses in muscle protein metabolism depending upon the type of exercise for example muscle protein synthesis has been shown to be stimulated by resistance exercise as long as the intensity of exercise is enough to challenge the muscles *(Chesley et al, 1992; Farrell et al; 1999; Phillips et al, 1999 and Tipton & Wolfe, 2001).* Resistance exercise causes increase in muscle protein breakdown but not as much as protein synthesis *(Biolo, 1995 and Phillips et al, 1999).* The relationship between these two parameters (rate of muscle protein synthesis and muscle protein breakdown) represents the metabolic basis of muscle growth. Keeping in view the physiological principles of strength training, this change seems to be in accordance as the second phase of training comprised of exercises, which were targeted to improve dynamic flexibility, muscular strength and endurance. Stressing of muscles as is followed in the present study might have lead to hypertrophy of the muscles after the completion of a conditioning programme both in males and females by adding mass to it.

In summary, the results show that the distribution pattern of subcutaneous fat in the form of skinfold thickness in males is subscapular (maximal) followed calf, triceps, suprailiac, biceps (minimal) and in females' suprailiac (maximal) followed by triceps, subscapular, calf and biceps (minimal). The conditioning programme could not change the preconditioning distribution pattern of subcutaneous fat in both males and females. However a three months conditioning programme significantly lowers the subcutaneous skinfold thickness of various body sites (except subscapular region in females) in both males and females while Fat% significantly decreased and LBM% significantly increased in females only It is therefore logically correct to state that adoption of exercise programmes as a part of daily routine offer the greatest advantage to humans (for both physical active & sedentary) in improving the body composition and thus can help in countering the development of a number of diseases such as diabetes, hypertension and disturbed lipid profiles that increase the risk of cardiovascular diseases and therefore offer the best in terms of health benefits.

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