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Effect of a Conditioning Program on Subcutaneous Fat and LBM% in Males Aged 18-24 Years

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ABSTRACT This study examined the effect of a three-month conditioning program-consisting of exercises targeted to improve flexibility, strength, and cardiorespiratory endurance, on Subcutaneous Fat and Lean Body Mass percent (LBM %) in fifty (N=50) physically active males aged 18-24 years. Bioelectrical Impedance Analysis was used for total body composition assessment and subcutaneous fat distribution was measured with the help of skinfold thickness from selected body sites (Biceps, Triceps, Subscapular, Suprailiac, and Calf). On an average most deposition of fat was noticed in the Subscapular site followed by Calf, Triceps, Suprailiac and Biceps regions in that order before the start of a conditioning program. Conditioning program caused a significant reduction in the subcutaneous fat deposition at all sites after the completion of first mesocycle of 45 days as well as after the second mesocycle (next 45 days of conditioning). However the conditioning program of 90 days failed to change the distribution pattern of subcutaneous fat in the observed sites. On the body composition front, the mean values of total body fat percent demonstrated a decrease after the conditioning program (before 19.83 ± 5.50 and after 17.7 ± 5.36) but this decrease was not statistical significant ($P<0.05$). Similarly, the mean values of total body LBM% demonstrated increase after a conditioning program (before 80.16 ± 5.50 and after 82.3 ± 5.44) but again this increase was also not statistical significant. These findings indicate that a conditioning program on the one hand statistically significantly lowers skinfold thickness by mobilizing and using the stored fat (subcutaneous) from various sites and on the other hand although there was a difference in the mean values of total body Fat Percent and total LBM percent after a conditioning but that difference was not statistical significant.

INTRODUCTION

The distribution of subcutaneous fat thickness in the human body has been well documented and has been shown to be influenced by age, gender, and nutrition. Typically, there is an increase in body weight from ages 20 to 50 years, followed by a moderate decline after age 70 year (Borkan et al., 1983 and Silver et al., 1993). LBM or fat free body mass has been reported to decline by 25% to 30% between ages 30 and 70 years (Smith and Serfass, 1981; Grimby and Saltin, 1983; Fleg and Lakatta, 1988 and Flynn et al., 1989) in conjunction with an increase in fat mass. The accumulation of body fat with aging tends to be distributed in a typical pattern (Schwartz et al., 1990): a large part of the increase occurs at the central sites, in omentum and in the organs in which fat replaces parenchyma (Kenney, 1985). Subcutaneous fat tends to be lost peripherally from the limbs but increase in the trunk (Despres et al., 1990 and Kohrt et al., 1992). There is evidence that increase in fat mass may be associated with greater risk for chronic diseases and metabolic disorders such as hypertension, and diabetes (Despres et al., 1990). The changes in body composition that is an increase in fat mass and loss of LBM is reported to lead to decrease in work capacity (Shock, 1962), muscular strength (Smith and Serfass, 1981; Grimby and Saltin, 1983; Flynn et al., 1989) and these can effect the ability to perform daily activities, such as walking (Bassey et al., 1992) and lifting (Jette and Branch, 1981). Ultimately, changes in physiological function and body composition can possibly result in decreased mobility and a decline in the health and physical performance capabilities of an individual. Due to increasing health awareness a large section of the population especially the young adults have started implementing exercise program with an aim to achieve fitness and optimal body composition profile.

Although, many studies (Maresh, 1963; Malina and Johnston, 1967a; Malina and Johnston, 1967 b; Maresh, 1967; Tanner et al., 1981) have reported the pattern of fat deposition and muscle thickness at particular sites in both sexes but the information of the effect of a fairly long duration conditioning program in physically active Indian Males on the fat distribution on the major skinfold sites along with total body Fat percent, and the total LBM percent is insufficient.

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The purpose of this study was primarily to investigate the effect of a conditioning program in males aged 18-24 years on (i) the subcutaneous fat distribution (skinfold thickness) and (ii) total body fat percent and in the LBM percent.

MATERIALS AND METHODS

Fifty healthy physically active male students of Indira Gandhi Institute of Physical Education and Sports Science, New Delhi ranging in age from 18 to 24 years volunteered as subjects. The subjects were asked to participate in a three-month conditioning program because of their interest to improve flexibility, muscular strength, and cardiorespiratory endurance. Prior to the conditioning program the subjects followed a strict 4-hour preparticipation protocol that prohibited workouts and ingestion of caffeine or alcohol or smoking.

All data were collected in the Natural / Medical Sciences laboratory at the Indira Gandhi Institute of Physical Education & Sport Sciences, New Delhi. To control for the effects of eating or drinking, and exercising, subjects were asked to refrain from eating or drinking for at least 2 hour and from exercising and drinking alcohol for 24 hour before data collection.

Height, body weight, 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 program using standard techniques given by Tanner et al. (1981). Body composition was determined with the help of bioelectrical impedance analysis with a RJL systems BIA-106 spectrum analyzer using the standardized protocol described in the user reference manual (RJL systems, Detroit, MI, 1987).

Design of Conditioning Program: The conditioning program 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 Protocols: The height, weight, selected skinfold thickness, fat percent and LBM percent were recorded at the following stages:

Pre Test i.e. before the start of a conditioning program.

Post Test – I that is after the completion of first mesocycle (45days)

Post Test –II that is 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.

Data analysis, using SPSS-X software involved the computation of descriptive statistics (Mean ± SD) to describe the physical characteristics of the subjects. Differences among different groups concerning skinfold thicknesses, and body composition were assessed by using a repeated-measure one-way analysis of variance (ANOVA). Post hoc comparisons were accomplished using Scheffe. The probability level accepted for statistical significance was set at $p<0.05$.

RESULTS

The physical characteristics of the subjects who participated in this study are shown in Table 1. The Means and SDs of skinfold thickness of five sites, body fat percent, LBM percent and total body weights before, during and after the conditioning program are presented in Table 1.

Among all the measured sites the thickest and the thinnest pads of subcutaneous fat were found in the sub scapular (9.10mm) and the biceps (4.94mm) regions respectively during the pre conditioning state.

After the completion of first mesocycle , there was a decrease in the mean value of total body weight (from 62.31 Kg to 60.23 kg). Similarly, a trend of decrease was observed in the various skinfold thickness and body fat percent, and this trend of decrease was observed to continue till the end of second mesocycle except in the case of total body weight, which was found to increase from the post test-1 value (from 60.23 Kg to 61.27 Kg). 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, the mean LBM percent increased after the completion of first mesocycle (from 80.16% to 81.51%) and this trend of increase was persisted till the end of second mesocycle (from 81.51% to 82.3%). But

Table 1: Mean value of various physical characteristics of males

Variables	*Pre Test*	*Post test-I*	*Post Test-II*
Age (years)	20.2 ± 1.37	20.4 ± 1.38	20.5 ± 1.39
Bodyweight (Kg)	62.31 ± 6.53	60.23 ± 6.75	61.27 ± 6.61
Height (cm)	169.17 ± 5.24	169.19 ± 5.25	169.18 ± 5.27
Biceps Skin fold (mm)	4.94 ± 0.05	3.8 ± 0.47	3.63 ± 0.44
Triceps Skin fold (mm)	7.06 ± 1.57	6.13 ± 1.12	5.29 ± 0.91
Sub Scapular Skin fold (mm)	9.10 ± 2.29	7.86 ± 1.66	6.19 ± 1.32
Suprailiac Skin fold (mm)	5.51 ± 1.68	4.87 ± 1.09	4.27 ± 0.74
Calf Skin fold (mm)	8.91 ± 2.95	7.53 ± 2.08	5.83 ± 1.30
Lean Body Mass (%)	80.16 ± 5.50	81.51 ± 5.65	82.3 ± 5.44
Body Fat (%)	19.83 ± 5.50	18.48 ± 5.63	17.7 ± 5.36

when a comparison was made between the absolute values of total body weight, and their components (i.e. LBM & Fat) it was found that after the completion of first mesocycle, total body weight decreased by 2.08 Kg out of which 1.22 Kg came from the fat compartment and the rest i.e. 0.85 Kg from the lean body mass. While after the completion of second mesocycle, total body weight decreased by 1.04 Kg. The net reduction in body weight (1.04 Kg) was observed to be achieved by losing 1.51 Kg of fat and a gain of 0.48 Kg in the lean tissues.

It is clear from the results described above that after first mesocycle total body weight, LBM % & body fat% decreased by 3.33%, 1.68% and 6.80% respectively but in spite of this trend of decrease the contribution of LBM % towards the total body weight increased and that of fat% decreased with the progression of a conditioning program & the net effect was a gain in the total body weight at the end of second mesocycle.

Table 2 shows one-way analysis of variance of skinfold thickness, fat percent, LBM percent, and total body weight. There was a difference in the mean value of body weight, fat% & LBM% after the conditioning program between pre test and posttest groups but these differences were not statistical significant. The differences in the mean value of five skinfold thickness (biceps, triceps, subscapular, suprailiac and calf) after the conditioning program between various groups were statistically significant.

Post hoc comparison (Table 3) indicated that significant difference in the bicep skin fold thickness occurred only between the pretest & posttest-I and pretest & posttest-II while no significant mean difference was recorded between posttest-I & posttest-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 pretest and posttest-I; pretest & posttest-II and posttest-I and posttest-II.

Generally all the subcutaneous skinfold thickness from the various body sites decreased from pre test to post test-II groups. This trend of decrease suggests that mobilization of subcutaneous fat occurred with the progression of a conditioning program but it could not change the

Table 2: Analysis of variance of skin folds, fat%, LBM% and body weight of males

Variables		*Sum of squares*	*F*
Biceps	Between Groups	6.812	7.412*
	Within Groups	67.552	
Triceps	Between Groups	78.210	25.580*
	Within Groups	224.720	
Subscapular	Between Groups	213.549	32.751*
	Within Groups	479.251	
Suprailiac	Between Groups	38.212	12.526*
	Within Groups	224.209	
Calf	Between Groups	237.463	24.067*
	Within Groups	725.195	
LBM%	Between Groups	116.946	1.906
	Within Groups	4509.298	
Fat%	Between Groups	115.844	1.912
	Within Groups	4453.742	
Body Weight	Between Groups	108.368	1.230
	Within Groups	6475.231	

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

Table 3: Scheffe Post -hoc multiple comparisons of skin folds, fat%, LBM% and body weight among different groups of males

Variables	*Pre Test vs. Post Test-I*	*Pre Test vs. Post Test-II*	*Post Test-I vs. Post Test-II*
Biceps	0.344*	0.512*	0.168
Triceps	0.928*	1.768*	0.840*
Subscapular	1.240*	2.912*	1.672*
Suprailiac	0.642*	1.236*	0.594
Calf	1.372*	3.076*	1.704*
Lbm%	-1.352	-2.138	-0.786
Fat%	1.392	2.118	0.726
Body Weight	2.082	1.040	-1.042

* The Mean Difference Is Significant At The .05 Level

preconditioning distribution pattern of subcutaneous fat in the observed sites. On the other hand the mean value of body fat percent decreased and LBM percent increased as the conditioning program progressed.

DISCUSSION

There are only a few studies on the changes in body fat and distribution in males to exercise. This is an important area because the pattern of fat distribution and the amount of fat possessed by an individual plays a very vital role in determining the proneness to many degenerative diseases e.g. excessive fat deposition in abdominal area is reportedly linked with a number of cardiovascular diseases. Very few investigators have tried to explore the effectivity of exercise program on fat reduction from various body sites. In the present investigation an attempt has been made to evaluate the effects of two types of exercise regimens administered in succession in the form of two mesocycles to physically active males on their ability to mobilize fat from the various body regions. After the completion of the first mesocycle of 45 days of the conditioning program a general pattern of reduction of skinfold thickness at various body sites was observed in the present study. In terms of percentage (Fig. 1), maximum amount of fat reduction has been noticed from the bicep region (23.08%) followed by calf (15.49%), sub scapular (13.63%), triceps (13.17%), suprailiac (11.62%) respectively. It was further observed that with the continuation of the conditioning program, the reduction of skinfold thickness continued but with varying magnitude as observed after the completion of the second mesocycle of the conditioning program. In the calf and subscapular regions the percentage reduction in fat was found to be of greater magnitude during the second mesocycle as compared to the first mesocycle. However in rest of the body regions except for the biceps, the fat reduction continued during the second mesocycle with the same magnitude as was witnessed at the end of first mesocycle. It is clear from the results that maximum amount of fat reduction both in absolute and relative terms have been noticed during the second mesocycle especially from the calf and subscapular regions. It is pertinent to mention here that second mesocycle of the conditioning program comprised of those exercises, which were aimed to improve dynamic flexibility, muscular strength and endurance of the participants.

Reduction of fat from the trunk region observed in the present investigation agrees with the findings of many other researchers, who have also reported mobilisation of fat from the trunk and abdominal 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 Tremblay 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 program.

The greater impact of second mesocycle of a

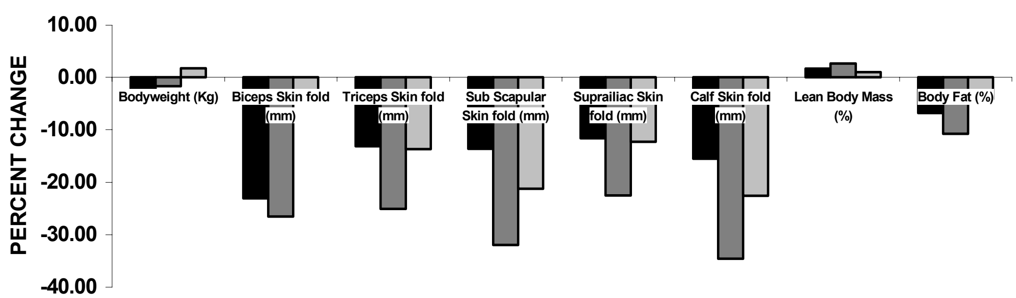

Fig. 1. Change in various skinfold thickness, body weight, LBM% and fat% expressed as percent during different phases of the conditioning program.

conditioning program in decreasing the thickness of skinfolds of the trunk 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.

The differences in the body weight, LBM% and fat% values after a conditioning program 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 1.66% lower as compared to pre-test value. This fluctuation in the total body weight during the conditioning program may be due to the changes in the daily dietary intake and increased energy expenditure imposed through planned exercise program administered to the subjects. Moreover, the mean values of total body weight & fat% of the subjects in this study were in the acceptable range before the start of a conditioning program as per the norms of Lohman (1992), but as soon as these subjects started participating in the conditioning program, 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 increased on both fats and proteins metabolism. Thus causing 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 and 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 follow-ed in the present study might have lead to hypertrophy of the muscles by adding mass to it.

In summary, the results of the present study suggest that a three months conditioning program significantly lowers the subcutaneous fat thicknesses, body fat percent and increase LBM. It is therefore logically correct to state that adoption of exercise programs as a part of daily routine offer the greatest advantage to humans (for both physical active and 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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