

Impact Of Strength And Endurance Training On Body Composition And Physical Fitness Of University Students

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Abstract

Introduction: Positive effect of physical activities upon the physical and mental health have been established. Prime objectives of engagement in regular physical activities has always been the promotion of health and performance. Physiologically speaking, the body used to hard physical exertion is less likely to face any hardship in doing any strenuous physical activity for an extended period of time. This adaptation process is natural and the more a person is used to hard physical exertion the better they cope with different types of demanding situations. **Objective:** To assess the effect of strength and endurance training upon body composition and physical fitness of the young male students of the University of Lahore. **Hypothesis:** The study was undertaken with the hypothesis that strength and endurance training will have significant effect upon the body composition and physical fitness of the young male students. **Methodology:** Population of the research study comprised of eleven male students from the University of Lahore, having age between 23-27 ($x=24.09\pm1.30$). **Results:** Results of the study have confirmed significant changes particularly in the fat volume by 3.76% and water content by 3.32%. With reference to different components included in the EUROFIT test results of the study show 56.62% ($p=0.01$) better performance in the hanging from the bar, 45.62% improvement in the sit and reach activity ($p=0.003$), 15.65% improvement in the performance of sit-ups ($p=0.007$). Similarly, in standing broad jump, 7.55% improvement was recorded and in the shuttle run of 10 x 5 m, 3.72% ($p=0.003$) improvement was shown.

Keywords: Physical Activity, Fitness, Body, Composition, Training, Benefit.

Introduction

Scientific development and technological advancement has changed the traditional

pattern of living of human beings. On one hand, it has remarkably added to the ease and comfort of humanity and, simultaneously on the other hand, it has adversely affected the overall working capacity, quality and competency of the people in terms of physical performance (Kudryavtsev et al. 2018). Resultantly, abundance of surplus time and energy has caused the man idle and lazy and has subsequently rendered him prone to obesity like different types of fatal ailments. The only way to get rid of this type of situation without causing hurt to the health is to introduce regular routine of the recommended amount of physical activities in the daily schedule of life. In perspectives of health, 150 minutes of moderate intensity or 75 minutes of strenuous physical activity per week is recommended for the upkeep and maintenance of health (World Health Organization, 2010).

With reference to the overall performance and physical competency of the body, the role of composition of the body carries paramount significance. Principal ingredients constituting structure of the body comprises of the bones, muscles and fats. Alongside the effective of strength and endurance training, vitality of the body composition also has key role in this regard. Natural attribute of strength, agility, joint flexibility, sustainability of the muscles are the key factors having positive role in enhancing the level and quality of physical fitness (Rybakova et al., 2020).

In addition to the above, the role of proper diet, rest and sleep is also indispensable in regards to the maintenance and improvement of the physical fitness. The role of diet is similar to that of fueling an engine to promptly cope with the workload efficiently. The sense of physical fitness reflects much more than normal capacity of the body for discharging the routine functioning of the everyday life Guijarro-Romero et al. (2020). In case, proper nutrients in line with the routine physical engagement are deficient in the diet of a person and s/he is subject to following heavy routine of activities, their performance will be impaired and health

deteriorated. As a matter of fact, need of body as well as healthful living for rest and sleep has been amongst its initial requirements and it has been recognized fact that a healthy young person spends around one third of the total life in sleeping (Furman et al., 2018). Need and vitality of the proper rest and sleep have been globally established, however, on account of lack of knowledge, its biological phenomenon is yet to be understood (Tomschi et al., 2018). Health professionals and psychologists unanimously agree to the significant role of sleep in prompt functioning of the body (Winter, 2018). Branco et al. (2015) have confirmed that achieving the target of a standard level of competency and physical fitness is directly subject to the physical attributes of the body, availability of proper diet, healthy lifestyle and conducive environment for proper sleep.

Positive effect of physical activities upon the physical and mental health have been well documented (Strohle, 2009). Promotion of health and performance have been amongst the prime objectives of engagement in regular physical activities Schuch et al. 2014; Sawicki and Suchý, 2017; Sawicki, 2018). Physiologically speaking, the body used to hard physical exertion is less likely to face any hardship in doing any strenuous physical activity for an extended period of time. This adaptation process is natural and the more a person is used to hard physical exertion the better they cope with different types of demanding situations (Staron et al., 1994). The process of adaptation takes place in the context of bone mass, muscles mass, fat mass and improves the overall level of capacity, competency in shape of physical fitness Garber et al. (2011). According to Rýžková et al. (2018) the quality and output of the physical fitness are mostly subject to the nature, intensity, frequency and duration of physical engagement.

Strength and endurance training have the distinction that they play significant role in attaining the required adaptive result as they are vital in improving cardiovascular and

cardiorespiratory fitness (Höltké, 2003; Schjerve et al., 2008). As a matter of fact, strength and endurance training are inevitable for each other; having optimum endurance training is subject to the existence of enough muscular strength (Krüger, 2011).

Literature Review

Right from the biomechanical perspectives, strength and endurance activities pertain to the different types of activities, which cause to contract the muscles in response to counter and resist the outer force. A number of previous studies have confirmed the diverse positive effects of the strength and endurance training, which improves strength of the muscles and alternately reflects in the overall functioning of the muscles (Mayorga-Vega et al., 2016). Strength and endurance training play significant role in healthy life and improvement of the physical output of the body in terms of strength and endurance and resultantly dominating performance in the field of sports (Syeda, Rehman, Saifullah, Khan, 2013). A number of studies have confirmed the role of strength and endurance training in enhancing the muscular strength which is vital in a wide range of sports activities.

People from all age groups and both genders can attain outstanding performance in the areas of endurance, strength, coordination and flexibility following vigorous strength and endurance training (Greenlee et al. 2017; Phillips et al. 2017). Endorsing the same stance Tomschi et al. (2018); Weiss (2010) and Cassemiro et al. (2017) have confirmed the positive role of mixed method of training comprising aerobic and anaerobic activities in the improvement of strength and cardiovascular endurance among the players. Development of physical fitness is a comprehensive phenomenon involving multiple aspects of the physical attributes and characteristics of the body. Hennig (2020) and Thiel (2018) claim that for the improvement of strength and endurance, a set of high intensity exercises followed for a shorter period of time offering short interval for rest, is the most

practical and productive method of training. It refers to the High Intensity Interval Training (HIIT) having proficiency in improving strength, as well as endurance and burning extra fats of the body. Increase in the duration and intensity of the activity determines the level of improvement of strength and endurance. Expert agree that duration of the session of training should be between 15 to 20 minutes or even longer to determines the quality and level of endurance training. The most vital point in this regard is that involvement of the complete body including its all parts is imperative for achieving the desired objective. The period of the complete training course and frequency of the training schedule also need to be taken into consideration and in this regard, experts recommend to offer a programme comprising of at least four weeks with a execution frequency of two to three times per week (Seiler, 2010; Stöggl and Sperlich, 2015). However, having notable results in terms of improving the level and quality of physical fitness, the role of duration and frequency is second to none; the longer and frequent are the duration and frequency of the training programme, the better are the output and vice versa. Research has confirmed that strength and endurance training schedule followed for a period of six weeks has yielded very positive and promising results in improving overall fitness and muscular strength of the body (Furman et al., 2018). The same stance has already been confirmed in other studies as Froböse (2014) also endorse the above findings emphasizing upon the factor focus upon the weight of the body rather than to use outer loads etc.

Literature endorses the potential benefits of physical activities with reference to health and performance of the body. Participation in physical activities promotes growth, makes the bones and muscles strong and improves cardiovascular performance. As a matter of common observation, active people happen to have been relaxed, they have cool temperaments and are less likely to become a victim of unnecessary

stress or any other types of worries. Physical engagement either in the form of normal physical exertion or in the shape of strength training improves muscles mass, muscular output and overall capacity of the body Guijarro-Romero et al. (2020). Similarly the role of regular physical activities is well established in terms of wellbeing and physical competency (Winter, 2018).

An experimental research study of six-week duration was conducted to assess the effect of strength and endurance training upon body composition and physical fitness of the young male students of the University of Lahore. Sole focus of the study was to observe changes in terms of improvement or otherwise in the physical fitness level and body composition of the respondents. Main aspects of composition of the body taken into consideration were muscle mass, bone mass, fats volume and basal metabolic rate. Explosive strength of the lower limbs, body balance, agility, cardio-respiratory endurance, strength endurance of the upper limbs and strength of the trunk muscles were analyzed during the study for physical fitness. The focal point of the study was to find answer

to the only question that, whether six-week strength and endurance training will have any effect upon the body composition and improve the physical fitness of the young male university students?

Methodology

Participants

Population of the research study comprised of eleven male students from the University of Lahore, having age between 23-27 ($x=24.09\pm1.30$). In the initial stage of the study, body composition measurement of the respondents was performed followed by the EUROFIT physical fitness test to measure their level of performance (Rybakova et al., 2020). EUROFIT test comprised of the speed test, agility, static strength, functional strength, balance, jumping, trunk strength and multi-grade shuttle run tests. Strength and endurance training schedule was followed for six weeks, post treatment measurement was taken to evaluate any variation in the body composition and physical fitness of the respondents. Table 1 below has the detail of the complete training plan.

Table 1. Six-weeks Work-plan of the Strength and Endurance Training

Days of the week	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
1 st week		Turbo		HIIT		Full-body	
2 nd week	Full-body		Full-body		HIIT		Turbo
3 rd week		HIIT		Turbo		Full-body	
4 th week	Full-body		HIIT		HIIT		Turbo
5 th week		HIIT		Full-body		Turbo	
6 th week	Turbo		HIIT		Turbo		Full-body

Throughout the weeklong training schedule, each participant spent between 130 to 175 minutes doing exercises and each type of the training protocol was followed seven times on

each alternate day. Whereas, duration of the complete training programme was around 15 hours. Main components of the complete

training consisted of the following three types of training:

1. Full-Body Training; comprised of four slabs of three different activities and two repetitions
2. Turbo Training; comprised of four slabs of three different activities and three repetitions
3. HIIT Training; comprised of four slabs of three different activities and four repetitions

Data Collection

Measurements of the Body Composition and Fitness tests

In the beginning, TANITA BC-1000 scale was used for the analysis of the body composition of the respondents. Muscle mass, bone mass, fats volume, water content percentage and basal metabolic rate were measured in perspectives of body composition. Direct observation method was employed for the collection of data. Prior to the start of different tests, respondents were informed about the method of measurement and the way of their performance. Following the components of the EUROFIT physical fitness test, the researcher selected the below mentioned different items for the evaluation of performance:

- Balance test (standing on balancing board on one foot),
- Jumping test (standing long jump),
- Agility test (Sit and Reach test),
- Static force test (compression of dynamometer using hand),
- Functional strength test of upper limbs (hanging on the bar),
- Running resistance test (quick running bursts), and
- Running speed test (Ten repetitions of Running for 5-metre distance),

- Trunk strength (Total number of sit-ups done in a half minute)

Experiment

After anthropometric measurements and body composition analysis of the respondents, different items of the EUROFIT fitness test were subsequently conducted to measure the level of physical fitness. As a whole, respondents passed through the following three different training protocols:

1. “Full-Body” Test, comprising of the exercises of moderate intensity for burning extra fats, strengthening the body as a whole and improving the level of physical fitness.
2. “Turbo Training”, comprised of high intensity activities, joining strength exercises and cardio resulting in burning of fats, strengthening muscles and improving physical fitness.
3. “HIIT”, it too is aimed at building fitness, burning fats and increasing metabolism.

The training schedule was devised for a six-week duration and respondents were required to follow the training schedule on alternate days of the week. Respondents performed 3-4 sessions of training a week. Out of the three main training protocols, the “Full-body” protocol took 48-50 minutes, “HIIT” lasted in 30-35 minutes and “Turbo protocol took 50-55 minutes. In all the three protocols, 10 minutes and 4 minutes were allocated for warming-up and cooling-down activities respectively.

Results

Coefficient of variation, Standard deviation and Mean were calculated for analyzing the main parameters. All the changes are reflected at significance level at $p < 0.05$. Body composition analysis was the first task on part of the researcher. Muscle mass, bone mass, fats volume, water content and basal metabolic rate were the main elements measured for body composition. Analysis has shown significant changes particularly in the fat volume by 3.76% and water content by 3.32%. Detail of the analysis regarding body composition is presented below in table 2.

Table 2. Showing figures of the Pre (1st Test) and Post (2nd Test) regarding changes in different components of body composition.

Components of Body Composition	1st Test			2nd Test			Level of Difference between 1st and 2nd Test
	X	SD	CV	X	SD	CV	
Muscle mass (kg)	44.15	4.55	10.12	44.23	4.22	9.45	0.88 Not Sig.
Bone mass (kg)	3.12	0.30	9.55	3.48	0.30	9.8	1.18 Not Sig.
Fat Volume (%)	27.32	9.15	38.82	26.34	8.78	37.55	3.76*
Basal metabolic rate (kcal)	1407	138.22	11.28	1408.73	149.63	12.22	0.58 Not Sig.
Total water content (%)	52.57	7.23	13.26	53.42	7.42	12.66	3.32*

It is worth mentioning to add that the role of diet plays significant role in perspectives of variation in the body composition and in the

present case this aspect was not taken into consideration therefore non-significant results are reflected in the table above.

Table 3. Showing figures of the Pre-test (1st Test) and Post-test (2nd Test) regarding changes in respect of the level of Physical Fitness of the respondents through EUROFIT Training protocol

Components of Training	1st Test			2nd Test			Level of Difference between 1st & 2nd Test (%)
	X	SD	CV	X	SD	CV	
Standing Broad Jump (cm)	158.65	23.56	14.87	168.42	21.83	13.19	7.55 ***
Hanging (Seconds)	7.36	8.10	110.42	10.35	11.3	99.37	56.62
Sit-ups	20.32	4.12	16.48	23.67	3.54	12.23	15.65 **
Balance (Seconds)	22.44	14.6	64.36	46.36	21.84	48.22	110.2
Shuttle run 10 x 5m (Seconds)	22.43	1.83	10.02	21.38	1.99	10.47	3.72
Sit and Reach (cm)	9.23	4.87	48.52	13.25	3.92	23.45	45.62

Key: Significant differences: *p<0.05; **p<0.01; ***p<0.001; NS – non-significant differences.

Results of the different items included in the EUROFIT test show 56.62% (p=0.01) better performance in the hanging from the bar, 45.62% improvement was observed in the sit

and reach activity ($p=0.003$), 15.65% improvement was noted in the performance of sit-ups ($p=0.007$), in standing broad jump, 7.55% improvement was recorded, 3.72% ($p=0.003$) improvement was shown in the shuttle run of 10 x 5 m

Discussion

The role of physical activities has been well documented in the maintenance & promotion of health, improvement of efficiency of the body, longevity of life and overall wellbeing Rýžková et al. (2018). Different studies have confirmed that participation in physical activities has been pro-health (Syeda, Rehman, Saifullah, Khan, 2013). Organized physical activities are offered in form of different types of training for the improvement of physical fitness and performance of the players. Sole objective of the study was determine the effect of six weeks long strength and endurance training upon body composition and physical fitness level of the university students. Findings of the study has confirmed that six weeks long strength and endurance training upon body composition of the respondents by increasing the percentage of the muscles mass, and decreasing the body fats. Findings of the study has further confirmed difference in the results of the 1st test and 2nd test with slight increase in the muscle mass by 0.97%. Colado et al. (2012) and Campbell et al. (1994) have also confirmed association between strength and endurance training and its positive effect upon improvement in the muscle mass and decrease in the body fat. Similarly, as a result of strength training, Jozsi et al. (1999) Rýžková et al. (2018) have confirmed in their studies a significant increase in the muscular strength and considerable reduction in the body weight (fats). Their studies have further affirmed that strength and endurance training has significantly improved the level of physical fitness of the respondents in perspectives of explosive power and strength of the upper limb, trunk muscles, shoulder girdle and lower limb while highly significant improvement by 108.19%, 54.57% and 44.62% was noted in the balance, strength of the upper limb and agility

of the body. Gießing (2006) and Tomschi et al. (2018) have found that strength and endurance training has significant effect in improving the muscular strength, body balance and agility. Guijarro-Romero et al. (2020) have confirmed that physical fitness of the respondents significantly improved after taking part in the strength and endurance training. The present study has shown that properly organized programme of physical activities has the capacity and potential of improving the physical attributes of the respondents. Many fold benefits of training programme can be obtained if other aspects of healthful living like diet, rest, sleep and social environment are taken into consideration (Mayorga-Vega et al., 2016; and Winter, 2018).

Conclusions

Keeping in view findings of the present study, the following conclusions have been formulated:

1. It has been concluded that six-week long strength and endurance training has shown positive changes in terms of reduction in the body fats and increase in the muscle mass of the respondents.
2. It has been concluded that six-week long strength and endurance training has confirmed that the overall level of physical fitness has been improved with regards to different components like upper limb, trunk muscles, balance, agility, shoulder girdle and lower limb tested during the study.
3. Population for this study comprised of the young university male students and it is recommended for the future research that blended population of both genders comprising of different age groups should be conducted, so that its findings could be generalized for wider population.

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