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Relationship of Body Fat Percentage and Selected Physical Fitness Performances between Overweight and Normal Weight Sedentary Young Male Adults

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Abstract

The main purpose of this study was to examine the relationship between selected physical fitness performance capacities with the degree of body fat percentage between overweight and normal weight sedentary young male adults. Among five hundred forty five (545) voluntarily registered college students' population one hundred twenty (120) subjects, who met the inclusion criteria, were purposely recruited and selected being as subjects to participate in the study from Ethiopia, the capital city of Addis Ababa, in one of the prominent governmental college of Kotebe college of teacher education. The age of the subjects was ranged between 19 to 24 years old. Out of 120 subjects, 90 subjects were sedentary and overweight (grade 1 obese), identified as group one while the remaining 30 subjects were sedentary but normal weight based on the standard classification and criteria of age, sex and body weight. The data for physical performance variables such as cardio respiratory fitness, sit ups, pull ups, standing broad jump and shuttle run were collected through the procedure of American Alliance for health physical education, and recreation (AAHPER) fitness test revised (1976) manual and the body composition (body fat percentage) was gathered at the standard seven different anatomical landmarks identified and recommended by American college of sport medicine (ACSM, 2008). Body density was determined by using the equation of Jackson and Pollock; and percentage body fats (%BF) of the subjects' were computed from body density according to the formula described by (Siri 1961). The results of the present study indicate that all the selected physical fitness components were significantly negatively correlated with body fat percentage (%BF) except shuttle run performance, which was positively correlated with %BF in the case of both groups. The degree of correlation between body fat percentage and fitness variables indicated moderate for both groups. The P-value for percentage body fat and physical performance parameters were significant at 0.05 and 0.01 level for normal weight and overweight groups respectively. It was found that body fat percentage value and physical fitness performances were inversely correlated. It was concluded that leaner subjects perform better than overweight subjects in physical performance activities / capacities which require specifically body movement through space such as running, jumping, and also in sit-ups and pull-ups performances.

Keywords: Sedentary, physical performance, body composition, young male adults.

Introduction

In this highly advanced era everyday life offers fewer opportunities for physical activity, and the resultant sedentary lifestyles have serious consequences on physical fitness and health of the society in general and to the young generation in particular. A sedentary way of life style is an unnatural aberration from our evolutionary constitution and should logically be unhealthy to our species. Modern man is leading a sedentary life, utterly depending on automobiles to ply from home to workplace and back. There is hardly any scope or time for physical activity to combat ahead the risk factors associated to many diseases such as cardiovascular, diabetes, and hypertension and also to keep fit and perform day to day activities. Motorised transport is dominant everywhere and people often try to find the closest parking spot to the door at the supermarket. In some cases now we do not even have to push a trolley up and the aisles of a supermarket, pack bags, and load them in and then out of our car, as we can shop online, only having to move the mouse around the virtual supermarket[1].

Today, university/college students have been obsessed and are also observed spending much of their precious time on face book and sat long hours, engaged in video films, computer and mobile games; as a result, daily energy expenditure has dropped dramatically. These inactive life style (sedentary) habits gradually alter their body composition and as a result they are exposed for a number of hypo kinetic diseases and also deterioration of physical performances. Optimum body weight is required for good physical fitness and health and to perform our day to day activity without undo fatigue.

Physical fitness is a dynamic construct in that it is continually growing and plays an important role to everyday life. 'Physical fitness is the ability to carry out daily tasks with vigour and alertness without undue fatigue and ample energy to enjoy leisure time pursuits and meet unforeseen emergencies.' The assessment of Physical fitness in young adults is crucial either from health or fitness perspective. The measurement or assessment of health-related physical fitness is a fairly common practice by fitness professionals. Fitness test has an important place among young adults in the college. The elements in the American Alliance for Health, Physical Education, and Recreation (AAHPER) Youth fitness test attempt to judge the individual health and performance related physical fitness for several reasons to measure each component of health-related physical fitness. Some of these reasons are as follows: to educate individuals about their current level of health-related physical fitness, to use data from the assessments to individualize exercise programs; to provide baseline and follow-up data, to evaluate exercise programs, to motivate individuals towards more specific action/exercise and help with client's risk[2].

In human, body fat exists in two storage sites, or depotes, namely essential and storage fat.Essential fat is needed for normal physiological function. This type of fat is found within tissues such as muscles, bone marrow, intestines, heart, liver, spleen, kidneys, lungs and lipid-rich tissues of the nervous system. The other major fat depot, storage fat is the fat stored in adipose tissue, mostly just beneath the skin (subcutaneous fat) and around major organs in the body. This fat serves three basic functions. Such as an insulator to retain body heat, energy substrate for metabolism, and padding against physical trauma to the body.Body fat is neither too low nor too much. For example, the immune system is impaired when body fat stores are too low. A reduced ability to fight infections means more interruptions to training and more chance of being sick on race day. For female athletes, there are some very immediate consequences of a low body fat level, including especially a fall in circulating oestrogen levels. This in turn can lead to a loss of bone mass, causing problems for women in later life through an increased risk of bone fracture. Equally, though, performance will suffer if the body fat level is too high[3].

Body composition makes an important contribution to an individual's level of physical fitness. There is an inverse relationship between body fat levels and physical performance. This inverse association indicated that when the degree of body fatness increased physical performance start to decline[4]. Many other studies investigated that the higher the percentage of body fat the poorer the person's performances. This is true for all activities in which the body weight must be moved through space, such as in sprinting and long jumping.It is less important for stationary activities, such as archery and shooting. Relative body fat is a major concern for athletes too[5].

Adding more fat to the body just to increase the athlete's weight and overall size is generally detrimental to performance. For example, in swimming, in contrast to running, a certain amount of fat may have a positive influence on buoyancy; however, a very high relative fat free body weight (FFB) may have a negative influence, including decreased buoyancy, which may increase energy requirement to move the body in water. In general, leanner athletes perform better than their counter parts (athletes having excess body fat) in activity where the body mass must be moved through space. Athletic abilities or sports performance such as speed, endurance, balance, agility, and jumping ability are all negatively affected by a high level of fatness. Thus, Performance, particularly in activities that require one to carry one's body weight over distance, will be facilitated by a large proportion of active tissue (muscle) in relation to a small proportion of inactive tissue that is fat mass[5,6].

The measurement of body composition occurs in a wide variety of fields including sports science, epidemiology, and nutrition and in many branches of biology and medicine. It is measured by the human biologist studying human variation and adaptation and it is being used increasingly in the assessment of nutritional and growth status, fitness assessment, work capacity, disease and its treatment. In human energetic, it is widely used for the standardisation of variables such as basal metabolic rate or physical work capacity, for example, the investigation of the types and scope of adaptation to chronic energy and nutrient deficiency. It is also used to predict later body composition from childhood measures, bone density loss in athletes under heavy training regimes or in the elderly, to assess obesity in children and adults, and to investigate the likely effects of malnutrition[7].

Assessment of body composition ranged from simple and inexpensive field methods to highly complex and expensive laboratory methods/procedures. Methods can be classified on these two parameters as well as the degree of skill needed by the tester, the type of equipment required, the degree of cooperation expected of the subject, and the validity and reliability of the method. Commonly used methods for assessing body composition are hydrostatic weighing, anthropometric, skin fold thickness measurements, and bioelectric impedance measurements [4]. One of the most accurate and indirect means of assessing body composition is hydrostatic weighing. Hydrostatic weighing is also known as underwater weighing, which is often considered as the ''gold standard'' or criterion standard for assessing body composition[3].

Precision in measurement is very important. The reliability and validity of test instruments are crucial. By its nature all types of callipers do not have the same features or characters, some may be simple and used for teaching purpose while others are used for research purpose. Body composition determined from skin fold measurements correlates well (r = 0.70–0.90) when body composition determined by hydro densitometry which is the 'gold standard'[8].

A number of empirical studies have examined and revealed that body composition (percentage body fat) plays great role in physical performance capacities [9-11]. Recognize this in view; the objective of present study was to find out whether selected physical performances (cardio respiratory fitness, sit ups, pull ups, standing broad jump and shuttle run) were affected by the degree of body fatness or not in sedentary overweight young male subjects as compared to young male normal weight subjects and as a result to impart realistic knowledge to physical educators, health professionals, college students, college curriculum designers and developers, parents and to all governmental and non-governmental pertinent bodies which is directly or indirectly promote and work on the allied area of health, fitness and wellness.

Material and Methods

The data for the current study was gathered from the prominent governmental college of Kotebe College of Teacher Education in Addis Ababa the capital city of Ethiopia in August during the year 2011. Among five hundred forty five voluntarily registered college students' population one hundred twenty subjects, who met the inclusion criteria, were recruited and selected being as subjects and participated in the study. Out of 120 subjects, 90 subjects were sedentary overweight (grade 1 obese), and identified as group one while the remaining 30 subjects were sedentary but normal weight and categorized as group two. Groups were categorized according to the standard classification criteria of age, sex and body weight[2,12].

Recruiting Criteria: The following inclusion criteria were incorporated as an instrument to screen and select subjects before considered them as participants of the study.

Sedentary: Subjects who did not participate in any previous organized/ structured physical exercise program for at least one year before the start of this study were recruited as subjects. Subjects who fulfilled the Physical activity readiness questionnaire (PAR-Q) were selected. The PAR-Q was prepared by American College of Sport Medicine and all procedures were conducted on the basis and recommendations stated by[2].

Healthy: Subjects who qualified the Health History Questionnaire (HHQ) were selected. The questionnaire was carefully designed by the American College of Sport Medicine, and all procedures of the current study were conducted on the basis and recommendations stated by[2].

Sex and Age: Young male adults whose age ranged between 19 to 24 years were selected as subject.

Body Mass Index (BMI): Subjects which had BMI were ranged from 18.50 to 24.99 kg/m^2 for normal weight groups and ≥25 and ≤29.99 kg/m^2 for overweight (Grade 1 obese) groups were selected. The classification of subjects as normal weight and overweight was done on the basis of the BMI classification criteria recommended by [2, 3].

Procedures: All the data were gathered in an organized manner, anthropometry variables such as body weight were measured with a calibrated balanced beam scale with barefooted; measurements were rounded up to the next 0.1 kg. Height, in an upright position without shoes was measured using a stadiometer, rounding up to the nearest 0.1 meter. Standard Harpenden skin fold calliper (Model CE marked 93/42/EEC; Batty International, Burgess Hill, West Sussex, UK) which has been accepted for the purpose of research work at the field situation were used for subcutaneous fat assessment procedure.

The skin fold thickness was measured to the nearest 0.2 mm within the first three consecutive days by the same skilled person in order to ensure the accuracy and consistency of the data in the college gymnasium. The selection of anatomical landmarks for measuring subcutaneous body fat (chest, midaxillary, triceps, subscapular, abdominal, suprailium, and thigh) was done on the basis of the recommendations of American College of Sport Medicine Health-related Physical Fitness Assessment Manual[2]. All measurements were taken on the right side of the body (for consistency purpose). Both body densities and percentage body fat (%BF) of the subjects' were determined and computed using the equations described by[13,14] respectively. This procedure is also supported and recommended by[2,12,15].

The physical performance assessment procedures such as pull-ups, sit-ups, standing broad jump and shuttle run tests were conducted on the next two days after completing the body composition test, and finally cardio respiratory fitness (12 minute cooper run/walk test) was administered in a standard 400m track filed, marked with running lanes and cones at the last three consecutive days of after completing the first two tests. The main justification for giving priority in assessing body composition to be first and make in a separate day than the physical performance tests were due to the possible accumulation of extracellular fluid (edema) in the subcutaneous tissue followed by exercise. All tests of physical performance variables were conducted according to the rule and procedure set by the revised American Alliance for Health, Physical Education, and Recreation Youth Fitness Test Manual[16].

Statestical Analyses: Descriptive statistics including means, standard deviations, minimum, maximum and ranges were computed for all selected test variables. Pearson's product-movement coefficient of correlations (r) was used to test the association between percentage body fat and fitness characteristics. A value of $P < 0.05$ was considered as significant. The results of the study were also analysed by an independent *t*-test to compare and contrast all the selected physical fitness variables between the two groups (group one and two).

Results and Discussion

The results of the present study have been presented in the following tables as follows: table-1 and table-2 depict descriptive statistics of overweight and normal weight sedentary college men respectively.

Table-1
Means, Standard Deviations, Minimum, Maximum and Ranges of Percentage Body Fat levels and Selected Physical Performance Capacities in Sedentary Overweight College Men

Variables	Tests	Means ± SD	Min.	Max.	Range	Unit
Weight	Body Weight	79.9222 ±4.50026	74.00	94.00	20.00	Kg
Height	Standing height	170.5333 ±3.32576	166.00	181.00	15.00	cm
BMI	Body weight/obesity	27.4686 ±0.88637	25.06	29.75	4.69	Kg/m^2
Subcutaneous body fat	Skin fold thickness	15.3374 ±0.87591	14.00	17.36	3.36	mm
Cardio respiratory fitness	12 min run/walk (cooper test)	1764.5556 ±102.29019	1460.00	1940.00	480.00	meter
Abdominal strength and endurance	Sit ups	21.4778 ±5.80435	11.00	34.00	23.00	number
Arm and shoulder strength and endurance	Pull ups	8.0889 ±2.82701	4.00	15.00	11.00	number
Explosive leg power	Standing broad Jump	6.0698 ±0.49136	5.50	7.50	2.00	feet
Speed and agility	Shuttle Run	11.4833 ±0.74143	10.10	12.70	2.60	second

Table-2
Means, Standard Deviations, Minimum, Maximum and Ranges of Degree of Percentage Body Fat levels and Selected Physical Performance Capacities in Sedentary Normal Weight College Men

Variables	Tests	Means ± SD	Min.	Max.	Range	Unit
Weight	Body Weight	59.7333 ±4.18481	53	72	19	Kg
Height	Standing height	173.400 ±5.41772	166	185	19	cm
BMI	Body weight/obesity	19.8950 ±1.31213	18.50	23.51	5.01	Kg/m^2
Body fat	Skin fold thickness	10.3353 ±1.50178	7.60	12.17	4.57	mm
Cardio respiratory fitness	12 min Run/walk (cooper test)	1842.00 ±72.29887	1660	1950	290	meter
Abdominal strength and endurance	Sit ups	24.0000 ± 5.27192	12	35	23	number
Arm and shoulder strength and endurance	Pull ups	9.400 ±2.71141	4	15	11	number
Explosive leg power	Standing broad Jump	6.5657 ±0.88631	5.50	8.08	2.58	feet
Speed and agility	Shuttle Run	10.8300 ±0.58907	10.10	12.50	2.40	second

The mean score value of table -1 and table -2, for overweight and normal weight groups respectively revealed that in all the five physical performance test score the normal weight groups scored better performance as it is compared to their counter parts (overweight groups). These results indicated that under normal condition (when both groups are sedentary and obtained no especial treatment of any previous or current exposure of structured exercise intervention) degree of percentage body fat negatively affects physical performance and the leaner group perform moderately in a better way than the overweight groups.

Table-3
Relationship between selected physical performance capacities and body fat percentage (%BF) in normal (N=30) and overweight (N= 90) subjects respectively

Selected Physical Performance Variables					
Groups , and % BF	**12 mint. Run-walk test**	**Sit-ups**	**Pull-Ups**	**Standing Broad Jump**	**Shuttle Run**
Normal Weight **%BF**	- 0.363* (P = 0.049)	- 0.371* (P = 0.043)	- 0.425* (P = 0.019)	- 0.407* (P = 0.025)	0.374* (P = 0.042)
Over Weight, **% BF**	- 0.374** (P = 0.000)	- 0.385** (P = 0.000)	- 0.365** (P = 0.000)	- 0.359** (P = 0.001)	0.331** (P = 0.001)

*Significant at the 0.05 level (2-tailed), * * Significant at the 0.01 level (2-tailed)

Table-4
Shows independent t-test of body fat percentage and physical performances characteristics between normal weight (N= 30) and overweight weight (N=90) sedentary subjects

No	Group	Performance Test-Item	F-value	t-value	df	Sig.	95% confidence interval of the difference
1	Normal wt. Vs. over wt.	Cooper 12 mint. run/walk (m)	6.221	3.868	118	0.000	38.11935 to 118.10287
2	Normal wt. Vs. over wt	Sit-ups(1 mint)	1.205	2.107	118	0.037	0.15173 to 4.89272
3	Normal wt. Vs. over wt	Pull-ups(n)	0.387	2.222	118	0.028	0.14257 to 2.47965
4	Normal wt. Vs. over wt	Standing Broad Jump (ft)	26.331	3.840	118	0.006	0.24018 to 0.75159
5	Normal wt. Vs. over wt	Shuttle Run(s)	8.614	-4.383	118	0.000	-0.94850 to -0.35816

*Significant (P< 0.05) Note: wt = weight, Vs= versus, mint. = minute, m= meter, n= number, ft= feet, s = second, df = degrees of freedom and Sig. = significance.

Table-3 shows the correlation between selected physical performance capacities such as cardio respiratory fitness, sit-ups, pull ups, standing broad jump and shuttle run with percentage body fat (%BF) of the normal (N=30) and overweight (N= 90) subjects respectively. This table also elucidates the correlation between percentage body fat versus the five physical performance capacities within their groups. With its limitation, in this study the result found in the correlation enabled for the researcher to determine if one variable (percentage body fat, in this case) causes a change in a second variable (selected physical performances in this case).As precisely demonstrated in the same table the percentage body fat value of each group was compared to their own physical performance parameters in order to examine the type and strength of association existed between the two variables (body fatness with performances).

All fitness variables except shuttle run were significantly negatively correlated with percentage body fat (%BF) in the case of both groups. The degree of correlation indicates moderate for normal weight groups and for overweight groups respectively. The P-value for percent body fat and physical performance parameters are significant at the level of 0.05 and 0.01 level for normal weight and overweight groups respectively. This clearly shows that there is an inverse relationship between the degrees of body fat and selected physical performance test scores.

Table-4 shows the comparison of physical performance scores between normal and overweight subjects. As it is clearly demonstrated from the F-value and also t-value of both groups a significant difference was observed in all physical performance capacity between the two groups which had different degree of body fatness. Previous studies regarding to level of body fatness and fitness were investigated and supported that the higher the percentage of body fat the poorer the subjects' performances would be.

Conclusion

College is a favourable environment to develop and exchange cultural, social, physical and academic calibre among students. The values of all educational domains such as cognitive, affective and psychomotor have equal importance to shape young adults in the college life. Physical fitness is a dynamic process and should be taken as an integral part to our life; however, it is impossible to bank fitness. Total fitness is indispensible in every aspect of life, only excel in academic achievement may not be guaranty to be a whole person and to lead a better way of life. From the above mentioned results and discussion, it can therefore be concluded that physical fitness performances such as in running and jumping activities, and also in sit-ups and pull-ups performances which need body weight movement through space were influenced by body fatness in sedentary college age male subjects. This implied that whenever the amount of body fat increased, interestingly the physical performances efficiency became decline. It was also specifically observed that cardio respiratory fitness, sit ups, pull ups and standing broad jump test scores of the subjects were negatively moderately correlated with percent body fat while shuttle run test score showed a positive association with the degree of body fatness. Even though the determinants of physical performances are many and complex, the degree of percentage body fat level which was possessed among participants can serve as a good indicator of physical performance achievement.

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