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Original Article

Influence of Physical Activity on Health-Related Fitness in Young Adults: An Observational Research

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Abstract

Background: Health-related fitness directly depends on the level of physical activity of the individual. Inactivity contributes to around 3.3% of all deaths, making the lack of exercise and sedentary lifestyles among the young generation a current source of concern. There is a paucity of research on the association between PA and health-related physical fitness among young people. In the perspective of this, the objective of this research was to find out the effect of PA levels on physical fitness in healthy adults.

Methodology: A total of 419 students between the ages of 18 and 25 participated in this cross-sectional survey. The "Global Physical Activity Questionnaire (GPAQ)" was used to evaluate the PA. Their body fat percentage was measured using a skin fold caliper, followed by measurement of VO_2max using a gas analyzer and hand grip strength and endurance assessment with the help of a computerized dynamometer. For statistical analysis, Karl Pearson's correlation coefficients and the ANOVA test were utilized.

Results: PA was positively correlated with VO2 max (r=0.429), and handgrip strength (r=0.408) while negatively correlated with body fat % (r=-.315). VO2 max, body fat, and hand grip strength differ significantly amongst participants having different physical activity levels. (p-value =<0.05)

Conclusion: This research concludes that PA is associated with physical fitness. PA will lead to a definite improvement in overall physical fitness. With the help of the results of this study, young adults can be motivated for physical fitness.

Keywords: Cardiorespiratory Fitness; Hand Grip Strength; Maximal Oxygen Uptake (VO2 Max); Physical Activity; Physical Fitness.

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Introduction:

Health fitness is characterized as having the capacity to do simple tasks with power and consciousness without becoming exhausted and the tendency and capability related to having a decreased risk of developing persistent illnesses and dying prematurely.[1] Five elements of fitness are included in fitness for health.[1]There are many factors such as age, gender, diet, physical activity (exercise), illness, fatigue, stress, medication, and the environment that influence the development of physical fitness, but regular physical activity is crucial for reaching an ideal fitness level.[2] The degree of physical activity a person engages in directly affects their health-related fitness.[3]

There has been a global decrease in the quantity of physical exercise performed by people of all ages in recent years. Adults' daily physical activity tends to decline as a result of a more sedentary lifestyle brought on by increased computerization, mechanization, and convenient transportation.[4] Because of the deposition of extra adipose tissue, especially in the visceral region, this condition makes it more likely that several metabolic illnesses would manifest at a young age.[5]Due to its crucial role in lowering the symptoms of illnesses including diabetes, obesity, and heart disease, as well as in maintaining general health, fitness among adults has become extremely important to understand. There is a need for adults to evaluate their level of physical activity and fitness. In literature, only a few studies[6,7] have previously examined all the components of fitness that relate to health together. Therefore, this study was designed with the intention of examining multiple aspects of fitness relevant to health in different physical activity categories. Using estimated VO2 max, handgrip strength, and percentage body fat, we can assess a person's fitness level and promote physical activity and lifestyle modifications for the foremost avoidance of cardiovascular and metabolic problems. Therefore, the main objective is to identify the components of health-related physical fitness in different categories of physical activity among young adults.

Material and Methods: This cross-sectional study was performed from January 2019 to March 2020 with the agreement of the Institutional Ethics Board. A total of 600 students, who appeared to be in good health and were between the ages of 18 and 25 were examined using a simple random method. The sample size (419) was calculated on the basis of the prevalence of "45.6%" physically fit people in the ICMR-INDIAB(2014) research.[8]

Using a simple random method, subjects of either sex were selected based on the following inclusion and exclusion criteria: Healthy young individuals between the ages of 18 and 25 (students) who are willing to consent are the inclusion criteria (male & female).Those with chronic illnesses such as hypertension, diabetes, coronary artery disease, cerebral vascular disease, asthma, emphysema, bronchitis, and muscular-skeletal conditions such as carpal tunnel syndrome, scoliosis, and rheumatoid arthritis were eliminated from the study.

Anthropometric data included height, weight, and skin-fold thickness, which were measured in accordance with the 'National Health and Nutrition Examination Survey''(NHANES).[9]Body fat percentage was determined using skin-fold measurements taken from four sites, including the biceps, triceps, sub-scapular, and supra-iliac using the Harpenden skin-fold caliper and calculated using the Durnin and Womersley (1974) body fat percentage chart[10] Using the Global Physical Activity Questionnaire, determine your level of physical activity (GPAQ). GPAQ has 16 questions and three domains for gathering data on physical activity involvement (P1-P16)[11] VO2 max was directly measured using the Gas Analyzer from AD Instruments (model-ML206).[12]. The subjects had to exercise on a treadmill wearing a mask while airflow is being recorded on the monitor display through a Gas analyzer (Figure 1). The hand grip strength and endurance were measured using a 'digital physiograph' (model-MLT004/ST Grip Force).[9,13]. As shown in Figure 2 the subjects were a hand grip strength measurement with values displayed on the monitor.

Figure 1. Procedure for recording of maximal oxygen consumption using the gas Analyzer AD Instrument (ML-206)

Figure 2: Measurement of Maximal handgrip strength

Statistical analysis: Data are presented as mean ± SD for statistical analysis. The Kolmogorov-Smirnov test was used to determine whether the result variables were normal. The differences between the averages of age, BMI, body fat percentage, VO2 max, and handgrip strength and endurance in various physical activity categories were determined using the one-way ANOVA test (inactive, active, and highly active). To determine the relationship between physical activity and other aspects of health-related physical fitness, the Karl Pearson correlation coefficient was used. The significance limit was selected at $p< 0.05$.

Results: 419 students who appeared to be in good health participated in the current investigation (275 males and 144 females).

Table 1. Demographics and physiological parameters of participants.

	Gender	**Mean**	**t**	**p-value**
Age	M	20.34±2.02	0.575	0.566
	F	20.22±2.02		
Body weight (kg)	M	65.45±9.68	11.659	<0.00
	F	54.28±8.54		
Height (cm)	M	172.70±5.61	22.165	<0.00
	F	159.99±5.50		
BMI (kg/m^2)	M	21.94±2.99	2.332	<0.02
	F	21.21±3.09		
Physical activity (METs)	M	1433.82±721.98	7.994	<0.00
	F	909.58±431.74		

* p-value: Probability-value, p-value<0.05 (significant), p-value > 0.05 (non-significant)

Table 1 depicts a comparative analysis of study parameters among male and female participants. The result shows that significant differences were found in weight, height, BMI, and physical activity.

Table 2: Significant differences in VO2 max (ml/kg/min), Body fat, and Hand Grip strength (kg) amongst participants having different physical activity status using ANOVA.

		Sum of Squares		Mean Square	F	Sig.
VO2 max (ml/kg/min) Direct method	Between Groups	5498.90	2	2749.454	51.921	.000
	Within Groups	22028.89	416	52.954		
	Total	27527.80	418			
dy fat%	Between Groups	1740.25	2	870.129	21.816	.000
	Within Groups	16592.09	416	39.885		
	Total	18332.35	418			
Dominant grip strength (kg)	Between Groups	3107.49	2	1553.749	20.021	.000
	Within Groups	32283.50	416	77.605		
	Total	35390.99	418			
Non-D grip strength (kg)	Between Groups	2698.19	2	1349.100	19.888	.000
	Within Groups	28219.13	416	67.834		
	Total	30917.33	418			

Table 3: Comparison of Significant differences in VO2 max (ml/kg/min), Body fat, and Hand Grip strength (kg) amongst participants having different physical activity status using the Robust Tests of Equality of Means:

Robust tests of equality of means					
		Statistic[s]	df1	df2	Sig.
VO2max(ml/kg/min)	Welch	51.371	2	180.731	.000
dyfat%	Welch	22.893	2	174.909	.000

HGS (kg) -hand)	Welch	19.770	2	188.238	.000
HGS(kg) on-D hand)	Welch	19.645	2	184.900	.000

To Test whether there is a significant mean Difference for VO2 max (ml/kg/min), Body fat %, and Hand Grip strength (kg) in dominant and non-dominant hands do not differ significantly amongst respondents having different physical activity status. Test of Homogeneity of Variances reveals Unequal Variance Assumed for means VO2max(ml/kg/min), body fat %, and handgrip strength.
The p-value for all the variables in ANOVA and Welch Test were found to be 0.00 i.e., less than the significant value of 0.05. Thus, an alternate hypothesis is accepted. This means VO2 max (ml/kg/min), Bodyfat%, and HGS (kg) (both hands) differ significantly amongst respondents having different physical activity status.

Table 4: Descriptive Statistical analysis of various parameters of male participants in different physical activity levels

Parameters	**Inactive (32)**	**Active (70)**	**Highly active (173)**	
	Mean±SD	**Mean±SD**	**Mean±SD**	**p-value**
Age	20.75±2.35	19.80±3.13	20.36±1.95	0.566
Body weight (kg)	66.69±8.78	65.70±9.64	65.12±9.89	0.531
Height (cm)	173.06±5.68	172.04±5.34	172.91±5.72	0.512
BMI (kg/m^2)	22.25±2.67	22.21±3.04	21.77±3.03	0.02
Body fat %	15.97±5.04	15.27±5.33	13.93±4.34	0.00
Physical activity (METs)	420.63±73.17	861.14±164.70	1852.95±563.36	0.00
VO2 max(ml/kg/min) Direct method	41.88±7.46	42.71±6.66	47.22±6.94	0.00
Hand Grip strength (kg) (Dominant hand)	41.15±6.78	40.55±6.88	42.00±7.85	0.00
Hand Grip strength (kg) (non-dominant hand)	36.08±5.82	34.66±6.34	36.07±7.31	0.00
Static endurance (sec)	16.35±6.28	15.08±5.32	17.36±6.43	0.03
Dynamic endurance (sec)	136.38±27.02	136.76±24.25	136.28±27.64	0.59

Table 4 shows a descriptive statistical analysis of male participants having different physical activity levels. VO2 max (ml/kg/min), bodyfat%, hand Grip strength(kg) in dominant & non-dominant hands, and static endurance significantly differ amongst male participants having different physical activity status (<0.05).

Table 5: Descriptive Statistical analysis of various parameters of female participants having different physical activity levels.

Parameters	Inactive (29)	Active (86)	Highly active (29)	p-value
	Mean±SD	Mean±SD	Mean±SD	
Age	21.07±2.32	20.22±1.95	19.38±1.54	0.76
weight (kg)	55.21±8.94	53.72±8.32	55.03±8.93	0.69
Height (cm)	160.14±6.49	159.98±5.19	159.90±5.51	0.51
BMI (kg/m^2)	21.55±3.01	21.00±3.08	21.52±3.24	0.00
Body fat %	23.00±5.52	22.72±6.62	22.96±6.09	0.00
Physical activity (METs)	412.41±101.41	849.53±158.60	1584.83±355.07	0.00
VO2 max(ml/kg/min) Direct method	35.14±5.24	35.23±5.33	37.75±4.88	0.00
Hand Grip strength (kg) (Dominant hand)	29.12±4.57	30.19±7.61	31.06±7.91	0.01
Hand Grip strength (kg) (non-dominant hand)	24.02±4.53	24.64±6.87	24.20±6.45	0.59
Static endurance (sec)	15.82±4.64	16.18±5.76	16.86±5.24	0.88
Dynamic endurance(sec)	130.03±28.55	132.06±31.47	139.24±26.97	0.04

Table 5 shows a descriptive statistical analysis of female participants having different physical activity levels.VO2 max (ml/kg/min), body fat, handgrip strength(kg) in the dominant hand, and dynamic endurance significantly differ amongst female participants having different physical activity status (<0.05).

Table 6: Pearson's correlation between health-related physical fitness and physical activity

		BMI (kg/m^2)	Body fat %	VO2 max (ml/kg/min)	Hand Grip strength (kg)	Static endurance (sec)	Dynamic endurance (sec)
Physical activity (METs)	Pearson Correlation	-.035	-.315	.429	.408	.097	.023
	Sig. (2-tailed)	.478	.000	.000	.000	.047	.644
	N	419	419	419	419	419	419

Table 6 Shows Pearson's correlation between health-related physical fitness components and physical activity. Physical activity was moderate positively correlated with VO2 max, and handgrip strength (r= .429, .408) while negative correlated with body fat % (r= - 0.315)

Discussion: The purpose of the current study was to examine the elements of physical fitness in various categories of physical activity as well as the relationships of physical activity with VO2 max, handgrip strength, and body fat percentage among young adults.

This is similar to a study by Mungreiphy NK et al[14], which found that male and female BMI were 21.23.66 and 21.12.26kg/m2, respectively, the mean body mass index (BMI) for male and female participants in the present study was 21.94±2.99 and 21.21±3.09 kg/m2, respectively. As opposed to the results of the present investigation, Chhabra P et al[15] revealed that the BMI of males and females was 19.51±3.53 and 19.61±1.6kg/m2, respectively. The mean physical activity levels of the male and female subjects in the current study were 1433.82±721.98 and 909.58±431.74 METs, respectively. It was discovered that there was a significant difference ($p < 0.05$) between the two groups in terms of physical activity, with the male group being more active. The results of this study coincide with the findings published by Singh A et al[16] reported that higher levels of activity in males 1500±60.89 METs compared to females 820±47.52 METs.

This study demonstrates that age and BMI were no different in the various physical activity categories, which was similar to the findings of Zanovec et al.[17], who found no statistically significant difference between the mean age and BMI across physical activity categories. VO2 max (ml/kg/min), body fat%, HGS(kg) in both hands, and static endurance significantly differ amongst male participants having different physical activity statuses (<0.05), which is similar to a study carried out by Davarzani S. et al[18] found that physical activity level is related to VO2 max, muscle strength, and body composition. Another study by Sultoni J et al[19], found no significant (>0.05) differences in VO2 max, BMI, and body fat % but subjects with high physical activity had better muscle strength and endurance. The highest BMI, body fat percentage, and hand grip strength were found in the physically inactive participants in this study, at 22.25 kg/m2, 15.95 kg/m2, and 36.07 kg/m, respectively. This result is comparable to one from a study by Sogut M et al.[20], which found BMI, body fat percentage, and hand grip strength at 23.50 kg/m2, 13.5 kg/m2, and 47.5 kg/m, respectively. In this study, the most physically active participants had VO2 max values of 47.22±6.94 ml/kg/min, which is comparable to a study by Natraj M. et al[21] that found that people with the highest levels of physical activity had VO2 max values of 46.55±7.59 ml/kg/min. The

physiology behind this, exercise causes vascular and cardiac changes, such as cardiac hypertrophy, an improvement in cardiac output, and oxygen-carrying capacity.[22]

In this study it was shown that there were no statistically significant differences in age, BMI (p-value >0.05) while VO2 max (ml/kg/min), body fat %, HGS (kg) in both hands or static endurance among female participants with varying physical activity status Similar to earlier studies[18,19,23]. Similar to a study by Sogut M, et al[20], which discovered that BMI and body fat%, 23.05±4.2 kg/m2, 27.6±8.1% respectively, the physically inactive participants in this study had the highest BMI and body fat% at 21.55±3.01 kg/m2 and 23.00±5.52%.In this study, physically active participants have the highest dominant hand grip strength is 30.19±7.61 kg & highly active participants have the highest VO2 max direct is 37.75±4.88 ml/kg/min, which is comparable to a study conducted by Kumar M, et al[24], reported that BMI and endurance (34.7 ± 21.54 sec) highest in physical inactive & VO2 max (45.73±2.44 ml/kg/min) highest in highly active & hand grip strength (20.93±5.23 kg) is highest in active female. The physiology behind this is that as muscle mass develops and increases with physical activity, muscle strength improves. Strength training causes muscular hypertrophy in both type I & II muscle fibers.[25]

The results of this study as displayed in Table 6, shows that there was a Pearson correlation between the various study population factors. A moderate and positive relationship between physical activity and VO2 max (r=0.429, p=0.00) is consistent with findings from other studies by Shete et al[26] and Maulana GF et al[27] that established an association between physical activity level and aerobic respiratory fitness. A study by Natraj M, et al[21], on the other hand, found no connection between physical activity and cardio-respiratory fitness in the 18–25 age range. The physiology underlying this is that exercise or physical activity raises VO2max by boosting cardiac output, increasing secondary stroke volume, and raising the arterio-venous O2 gradient. All of these procedures enhance the muscle's ability to extract oxygen.[28] According to the research, a moderate and positive association of physical activity with hand grip strength (r=0.417, p=0.00)was found, which is similar to a study by Fthima AV, et al[29], there is a relationship between physical activity level and muscle strength. The physiology underlying this is that sustained, vigorous physical exercise causes muscle mass to expand, which improves muscle strength in physically active individuals while also reducing fat mass.[30] Koley S. et al.[31], on the other hand, found that sedentary subjects had considerably higher handgrip strength than active ones. Comparable to research by Yadav G et al[32], which demonstrated a negative association between physical activity and body fat percentage (r= -0.315), the study population showed a moderate and negative correlation of physical activity with body fat percentage (r=-0.16).

Conclusion: The current study finds that physical activity is positively associated with both muscular and cardio-respiratory fitness and adversely associated with a person's body fat percentage. The results of the current study revealed that encouraging physical exercise improves physical fitness and body composition. However, adults' body fat percentage, cardio-respiratory fitness, and muscular fitness may be accurately predicted by physical activity. Using estimated VO2 max, handgrip strength, and percentage body fat, we can assess a person's fitness level and promote physical activity and lifestyle modifications for the foremost avoidance of cardiovascular and metabolic problems.

Limitations: The study's sample size was limited, and not all age groups may apply the findings. Hence, more research should be done using larger sample sizes and a variety of age groups.

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Conflicts of interest: The manuscript's contents have been reviewed by all authors and there are no conflicting financial interests to disclose.

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