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ОРИГИНАЛЬНОЕ ИССЛЕДОВАНИЕ

Cardio-respiratory fitness and body fat percentage in young adults

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Abstract. *Relevance.* Maximal oxygen consumption (VO_2max) is the maximum amount of oxygen an individual can breathe in and utilize it to produce energy aerobically. The global epidemic of overweight and obesity –'globesity' is emerging as a public health problem in many parts of the world. Almost 30–65 % of adult urban Indians is either overweight or obese or has abdominal obesity. Recently, cardiovascular ailments are increasing in the younger generation. Low levels of cardiovascular fitness and unfavorable cardiovascular risk profiles are detected in them. Total body fatness and aerobic capacity are frequently used in association with each other and it is often implied that these parameters are strongly inter-related. Both body fatness and status aerobic fitness have been shown to be risk factors for future health outcomes. The aim of this study was to assess the correlation of cardio- respiratory fitness with body fat percentage in young adults. *Materials and Methods.* This was a pilot study conducted in a group of 100 subjects of age group 18 to 25 years. Ethical clearance was obtained from institutional ethical committee and written informed consent were taken from all subjects participated in the study. Following parameters were taken (a) anthropometric parameters, (b) body fat percentage, (c) physical activity level and (d) VO_2max. *Results and Discussion.* The mean ± SD for age, height, weight, global physical activity questionnaire (GPAQ score) and VO_2max was found to be higher in male participants as compared to female participants while BMI was almost equal in both the genders but body fat percentage was higher in female participants. There was positive non-significant correlation of VO_2max with body mass index and global physical activity in female subjects but positive significant in male subjects. And moderate negative correlation between body fat percentage and VO_2max in male and female subjects but not significant ($p > 0.05$). *Conclusion.* Body fat percentage was negatively correlated with maximum oxygenconsumption (VO_2 max).

Key words: body fat percentage, cardio- respiratory fitness, maximal oxygen consumption

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Consent for publication. Written voluntary consent was obtained from the patients for the investigation and publication of relevant medical information according to WMA Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects, 2013.

Ethics approval. Prior to starting the study RUHS College of Medical Jaipur institutional ethical committee clearance was taken.

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Introduction

The greatest amount of oxygen that a person can inhale and use to generate ATP through aerobic means is known as maximal oxygen consumption VO_2max [1]. The amount of oxygen that can be transported from the lungs to the mitochondria to sustain oxidative ATP synthesis is finite [2]. One of the metrics used the most frequently in exercise science is VO_2 max measurement. The measurement of a person's cardio respiratory capacity at a specific level of fitness and oxygen availability is one of the factors that determine how well they will function over an extended period of time [3]. Between 1980 and 2014, the prevalence of obesity on a global scale more than doubled [4]. In many countries around the world, the worldwide epidemic of overweight and obesity, or «globesity,» is becoming a hazard for public health [5]. Almost 30–65 % of adult urban Indians is either overweight or obese or has abdominal obesity [6]. Younger generations are becoming more susceptible to cardiovascular diseases recently. They are found to have low levels of cardiovascular fitness and negative cardiovascular risk profiles. It has grown to be a significant risk factor for the later onset of middle age cardiovascular problems [7]. The terms total body fatness and aerobic capacity are frequently used interchangeably, and it is frequently assumed that these two metrics are closely related. Aerobic fitness level and body fat have both been found to be risk factors for subsequent health consequences. There are very few studies on to see the effect of body fat percentage on cardio-respiratory fitness in young adult population of Rajasthan. So the aim of this study was to assess the correlation of cardio- respiratory fitness (VO_2max) with body fat percentage in young adults.

Material and Methods

One hundred individuals between the ages of 18 and 25 participated in this pilot study at the Department of Physiology, RUHS College of Medical Sciences, Jaipur, India. Duration of study was of 6 months (from October 2019 to March 2020). Subjects were chosen as convenient sampling method for study convenience. Written informed consent was taken from all subjects who participated in the study. And the RUHS College of Medical Sciences, Jaipur institutional ethical committee granted its approval. Subjects of either sex were considered on basis of following inclusion and exclusion criteria. Apparently healthy young adults who agreed to give consent between age 18 to 25 years (students) of both sexes were included. And subjects who were not willing, suffering from hypertension, diabetes, cardio- respiratory and musculoskeletal problems were excluded.

A detailed history followed by thorough general physical and systemic examination was done including anthropometry examination (height and weight) for body mass index (BMI). BMI was calculated by using the formula Body Mass Index = weight (Kg)/Height $(m)^2$.

Following parameters were taken: anthropometric parameters, age, calculated from date and year of birth given by participants [8].

Body Fat Percentage was taken by using Durnin-Womersaly Equation (based on four site skin fold thickness measurement) [9]. A validated skin calliper (Herpenden) was used to quantify skin fold thickness to the nearest 0.01mm.Each measurement was taken three times along the skin's natural lines, and the averages of the three values were recorded. The measurements were taken over the bare skin. The readings were

taken 4seconds after the caliper is applied. All the four readings were added together and the sum was used to calculate body fat% with the help of Durnin-Womersly chart.

And physical activity level assessment using Global physical activity questionnaire (GPAQ) [10]. This survey seeks data on three different types of physical activity participation, or «domains,» including sedentary behavior as well as work-related or occupational physical activity, active commuting to and from destinations, and recreational physical activity during free time. The Metabolic Equivalent of Task (MET), which measures the difference between a person's working and resting metabolic rates, is used to measure how much time is spent engaging in physical activity. For the purposes of this definition, low levels of physical activity are those that total less than 600 MET minutes per week, while high levels are those that total more than 3000 MET minutes per week. The definition of insufficient physical activity is low levels of physical exercise (600 MET minutes per week).Cardio respiratory fitness (VO_2max) assessment using Gas Analyzer (Model-ml206, AD Instruments, Dunedin, New Zealand) [11]. In the morning or two to three hours after their last meal, the subjects were asked to arrive. Prior to the test, the subjects received instructions not to exercise in any way. After that, the test protocol was described and shown to them. They were made to wear a mask which is in turn connected to the equipment via a gas mixing chamber to measure the total amount of gases inhaled and exhaled during the test. following this, the actual test procedure was started i.e. The treadmill grade is increased by 2.5 % every minute until the subject reaches fatigue and is unable to continue the exercise, according to «The treadmill graded exercise test protocol» in which the subject is asked to walk for 3 minutes at level grade, followed by a brisk walk at self-selected speed (between 4.3 and 7.5 mph) at level grade for 3 minutes. Equipment attached to a monitor screen throughout the procedure displays constant maximum oxygen consumption values (VO_2max).

The study's results are reported as mean and «S.D.» Using an unpaired student t-test, data were compared between genders. The association was discovered using Pearson's correlation analysis. The significance level for the «p-value» calculation in the analysis was set at p 0.05 using SPSS version 16.0 (Chicago, Inc., USA).

Results and discussion

As shown in Table 1 above, male participants' mean S.D. values for age, height, weight, GPAQ score, and VO_2 max were greater than female participants' values. BMI was nearly identical in both sexes, but female participants' body fat percentage was higher.

Table 1

Distribution of mean±S.D. of different parameters male and female subjects

Parameters	Male subjects (mean ± S.D.)	Female subjects (mean ± S.D.)	t-value	p-value
Age, years	19.88 ± 1.8	19.02±1.6	1.125	0.131
Height, cm	1.68 ± 0.05	1.59 ± 0.05	11.048	0.001
Weight, kg	64.26 ± 10.35	54.42 ± 9.2	4.262	0.002
BMI	21.47 ± 3.09	21.53 ± 4.7	-0.08	0.46
GPAQ score	1538.35 ± 616.2	957.85 ± 321.75	4.686	0.001
Body fat,%	14.53 ± 3.53	21.09 ± 5.4	-6.935	0.001
VO_2 max	46.83 ± 9.48	35.94 ± 9.8	5.618	0.001

Note: BMI = Body Mass Index, VO_2 max = Maximum Oxygen Consumption.

Table 2

Correlation of VO_2 max with BMI, GPAQ and body fat% in male and female subjects

№	Indexes	r (male)	p-value	r (female)	p-value
1	BMI	0.269	0.02	0.18	0.32
2	GPAQ	0.368	0.04	0.33	0.07
3	Body fat, %	-0.13	0.2	-0.003	0.9

Note: BMI = Body Mass Index, GPAQ = Global Physical Activity Questionnaire, r = Correlation Coefficient.

Table 2 mentioned above shows positive non-significant correlation of VO_2max with BMI and GPAQ in female subjects but positive significant in male subjects. And moderate negative correlation between body fat % and VO_2max in male and female subjects but not significant ($p > 0.05$).

The current cross-sectional pilot study was conducted to determine the relationship between body fat percentage and maximum oxygen consumption (VO_2max).The average age of the 100 individuals in the current study was 19.75 ± 1.7 years, and the average ages of the male subjects (68) and female subjects (32) were 19.88± 1.8 and 19.02 ± 1.6 years, respectively. Male and female individuals' average heights were 1.68 ± 0.05 and 1.59 ± 0.05 meters, respectively. Male and female individuals' average weights were 64.26 ± 10.35 kg and 54.42 ± 9.2 kg, respectively. The mean BMI for the male and female subjects in the current study was 21.47 ± 3.09 and 21.53 ± 4.7 kg/m^2, respectively. This is slightly higher than the BMI of Indian healthy young male and female subjects from another study by Chhabra P. et al., and since all the participants fall into the normal weight category, there is no evidence of a significant difference between them [12]. On the other hand, BMI of females of Delhi and Manipur as studied in another study conducted by Mungreiphy N.K. et al. was same to results found in our study. Similarly BMI of males from Delhi and Manipur also equivalent to that found in our study [13]. The average GPAQ score for the study's male and female participants was respectively 1538.35 ± 616.2 and 957.85 ± 321.75. It shows that most of the subjects fell into the category of physically active people. Singh A. and Purohit B.M. discovered that this age group had relatively little exercise [14]. Mean body fat % of male and female subjects was 14.53 ± 3.53 and 21.09 ± 5.4 respectively.

According to American Council on Exercise (ACE) female have more body fat percentage than male [15]. In the study conducted by Mungreiphy N.K. body fat % in males of Delhi was 17.8 ± 5.99 which is slightly higher than that found in present study [13]. While body fat % of females in present study was higher than observed in earlier study this was 19.6 ± 5.66 [13]. Both the studies support the fact that females have higher body fat % than males. Females have more fat because of physiological differences such as hormones, breasts, and sexual organs [16, 17]. Mean VO_2 max of male and female subjects under the study was 46.83 ± 9.48 and 35.94 ± 9.8 ml/kg/min respectively.

In the present study male participants were having higher VO_2 max level than the female participants of our study. When present data comprised with normative data of study done by Turnley J. (2018) cardio- respiratory fitness were excellent of male subjects and good of female subjects [18]. Similar findings were reported in a different Gujarat study by Shah H. et al. on a young, healthy population. In that study, the mean VO_2 max was 36.12 ± 12.05ml/kg/min, whereas the corresponding values for male and female subjects were 39.5 ± 11.28 and 32.74 ± 12.82 ml/kg/min, respectively. Observations under present were slightly higher than that found in the study by shah but the difference occurred between male and female participants were found in both the studies [19]. Body fat percentage was negatively correlated with VO_2max in present study. Various studies also showed a negative correlation in VO_2 max and body fat percentage [20, 21]. According to the study's correlation findings, people with higher body fat percentages had considerably lower oxygen intake and consequently reduced aerobic ability.

Conclusion

Present study results concluded that body fat percentage was negatively correlated with maximum oxygen consumption (VO_2 max). Our study found that having an ideal body fat percentage is beneficial for having improved aerobic capacity.

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Кардио-респираторная выносливость и процентное содержание жировой ткани в организме молодых людей

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Аннотация. *Актуальность*. Максимальное потребление кислорода (VO_2max) — это максимальное количество кислорода, которое человек может вдохнуть и использовать для производства энергии аэробными методами. Глобальная

эпидемия избыточного веса и ожирения — «глобусность» — становится проблемой общественного здравоохранения во многих частях мира. Почти 30–65 % взрослых городских индийцев имеют избыточный вес, ожирение или абдоминальное ожирение. В последнее время сердечно-сосудистые заболевания увеличиваются в молодом поколении. У них выявляются низкий уровень сердечно-сосудистой подготовленности и неблагоприятные профили сердечно-сосудистого риска. Количество жировой ткани и аэробная способность тесно взаимосвязаны. Было показано, что как ожирение, так и аэробная физическая форма являются факторами риска. Цель исследования состояла в том, чтобы оценить корреляцию сердечно-дыхательной выносливости с процентным содержанием жировой ткани в организме у молодых людей. *Материалы и методы*. Это было пилотное исследование, проведенное в группе из 100 человек в возрасте от 18 до 25 лет. Этическое разрешение было получено от этического комитета Института, и письменное информированное согласие было получено от всех субъектов, участвовавших в исследовании. Были исследованы следующие параметры: (а) антропометрические параметры, (б) процентное содержание жировой ткани в организме, (в) уровень физической активности и (г) VO_2max. *Результаты и обсуждение*. Было обнаружено, что среднее ± стандартное отклонение для возраста, роста, веса, опросника общей физической активности (оценка GPAQ) и VO_2max выше у участников мужского пола по сравнению с участниками женского пола, в то время как индекс массы тела был почти одинаковые для обоих полов, но процент жировой ткани в организме был выше у участниц женского пола. Выявлена положительная недостоверная корреляция VO_2max с индексом массы тела и общей физической активностью у женщин, но положительная значимая у мужчин. Также выявлена умеренная отрицательная корреляция между процентом жира в организме и VO_2max у мужчин и женщин, но не достоверная ($p > 0,05$). *Выводы.* Процентное содержание жировой ткани в организме отрицательно коррелировало с максимальным потреблением кислорода (VO_2max).

Ключевые слова: процентное содержание жировой ткани в организме, кардио-респираторная выносливость, максимальное потребление кислорода

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