ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 03, 2024

Original research article

EFFECT OF PHYSICAL TRAINING ON ARTERIAL STIFFNESS INDEX AMONG UNDERGRADUATE MBBS STUDENTS

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Abstract

Background: Arterial stiffness is defined as a vascular phenotype caused by the changes in the walls of large arteries, due to the loss of elasticity of vessel walls. It is recognized as an independent predictor of cardiovascular morbidity and mortality. Exercise training is considered part of a healthy lifestyle that induces a series of physiological, morphological, and functional adaptations on the cardiovascular system that may vary depending on the influence of several factors. There are multiple benefits of physical exercise and high-performance sports, but there is a possibility that these activities lead to an increase of the Arterial Stiffness index and decrease the elasticity of the vessels. Thus, there is a need to know the changes in the vascular condition, associated with high-performance sports in medical students.

Objectives:

1. To determine the effect of exercise training on arterial stiffness among Undergraduate MBBS students.
2. To determine the effect of gender on arterial stiffness among Undergraduate MBBS student.

Materials and Methods: A Cross sectional Study was conducted among 249 MBBS students aged 18 to 24 years to determine effect of exercise training on arterial stiffness. Kolmogorov-Smirnov test and Shapiro test was used to check the normality of the data. One way ANOVA or Kruskal Wallis test was performed to determine whether there is any significant difference in the average value of Stiffness Index between the different levels of physical activity.

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Results: Arterial stiffness scores were statistically significantly higher in physical category 1 (6.84 ± 0.85) compared to category 3 (6.5± 0.62, p = 0.014). There is no statistically significant difference in mean scores of arterial stiffness between male (6.7 ± 0.64) and female category (6.69 ± 0.89) p=0.411.

Conclusion: Majority of the students comes under active and healthy group, with higher stiffness index.

Keywords: Arterial stiffness, physical training

Introduction

Cardiovascular disease (CVD) is among the leading cause of mortality for both men and women. Arterial stiffness progressively increases with age and is considered as an independent index of CVD. There are evidence suggesting that sex differences contribute to the age-related arterial stiffness [1]. The assessment of the arterial pulse plays an important role in the clinical examination. Years back it was recognized that changes in the pulse pattern were indicators of CVD. Nowadays it is possible to assess the important risk markers for the cardiovascular disease. Among the various indicators, the reflection index (RI) and arterial stiffness index (ASI) have been widely accepted. The RI relates to the vascular tone and the ASI refers to the stiffness of large arteries. As age advances, ASI value increases because of various factors like age, environmental changes, and genetic factors. The mechanisms of degeneration and rupture of elastic fibres, with collagen replacement, intimal hypertrophy, necrosis of the smooth muscle of the middle layer and fibrosis and inflammation phenomena contribute to a process of wall adaptation. As a result, certain physical properties, such as distensibility and capacitance are affected that contributes to a decrease in arterial elasticity and thus increases the vessel wall rigidity, which influences the course of CVD [2].

Review of litertaure

Advancing age and arteriosclerosis of arterial walls increases the ASI. Information on arterial stiffness is important because it has been considered as an independent risk factor for future cardiovascular events. It is a major feature in organ damage. Various non-invasive arterial parameters have been established to be biomarkers of arterial stiffness [3]. A study conducted by Wang Z found gender related differences plays an important role in pathogenesis and progression of atherosclerosis. Gender is an independent and important factor in arterial structure and elastic properties and females were more prone for the progression of arterial stiffness. Gender is an independent determinant in both the arterial structural and elastic aspects. Females appeared more vulnerable to the progression of arterial stiffening [4].

A study by Mendelsohn ME, Karas RH explained the protective effects of estrogen on cardiovascular system. Premenopausal women are protected against the development of cardiovascular diseases when compared to age-matched men. The hormone estrogen acts through two estrogen receptors (ER): ERα and ERβ. After puberty, arterial stiffness decreases in females and increases in males, which indicates the role of sex hormone effects on vascular stiffness [5].

A regular aerobic exercise enhances the endothelial and vascular functions. Recent studies have shown that young adult's physical work capacity is associated with arterial

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 03, 2024

stiffness and have long-term protective influences on the development of cardiovascular disease. Thus, it is necessary to promote or to maintain regular exercise as age advances. It is found that regular aerobic exercise improves arterial stiffness, by reducing the oxidative stress and inflammation, and promotes alterations in collagen and elastin content as age advances [1].

A study by Vandercappellen EJ found that on engaging in higher intensity physical activity, regardless of the weekly pattern, may be an important strategy to reduce the risk of cardiovascular disease [6]. Aerobic exercise training reduces arterial stiffness through the production of nitric oxide, a potent vasodilator, by vascular endothelial cells [7].

Measurement of arterial stiffness is simple non-invasive tool to recognize the vascular abnormality even before the appearance of clinical manifestation. Thus, it helps to identify those who are at risk for cardiovascular disorders and prevent the adverse consequences.

Research Question: Is there any effect of exercise training on arterial stiffness index among young healthy adults?

Objectives

1. To determine the effect of exercise training on arterial stiffness among medical students.
2. To determine the effect of gender on arterial stiffness among medical students.

Methodology

Setting: Department of Physiology, MOSC Medical College, Kolenchery.

Study design: Cross sectional Study.

Study period: 1 year.

Study population and sample size: 249 MBBS students.

Inclusion criteria: Undergraduate MBBS students of age ≥ 18 years. No history of any systemic disease, smoking, tobacco chewing, alcohol consumption. Participants who gave informed consent.

Exclusion criteria: Students with known history of Cardio-respiratory disorders.

Study procedure

- Institutional Ethical clearance was obtained. Detailed procedure of the non-invasive technique was explained to students after obtaining their informed consent.
- International Physical Activity Questionnaire, Dimitru, 1997 assesses the intensity of physical activity and sitting time that people do as part of their daily lives and comprises a set of questionnaires. It is used to assess health-related physical fitness.
- There are 3 items: Intensity-5 levels, Time-4 levels, Frequency-5 levels, where 1 is the lowest level and 4 or 5 is the maximum level. The subject is asked to mark one level for each item.
- The value is obtained by multiplying all these 3 values and the result could be between 1 (poor, sedentary) and 100 points (excellent, active lifestyle).
- Based on the physical activity students were divided into 3 category.
- **Category 1:** > 60 active and healthy and physical activity very good.

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- **Category 2:** 40-60 acceptable and physical activity good.
- **Category 3:** < 40 insufficiently active and physical activity weak.
- The Pulse Volume was recorded by Pulse Transducer and Student Physiograph.
- The pulse transducer was connected to the subject by wrapping it around the index fingertip of left hand and the other end of the transducer was connected to the coupler.
- The physiograph stimulator (one pulse/sec) was connected to the physiograph and adjusted to record the time base.
- The console mains were put on desired paper speed (5mm/sec) and sensitivity (10mV). Each person has at least three measurements, recorded for 30 seconds, taken 1 minute apart and an average is calculated and used for the analysis. The digital volume pulse waveform consists of Early systolic peak

a) Which results from an increase in digital blood volume from a pressure wave transmitted from the left ventricle to the finger along a direct path. The second peak.
b) Occurs in diastole and is formed by pressure waves reflected back up to the aorta and then to the finger.

The time between the systolic and diastolic peaks (peak to peak time, PPT) is time taken for the pressure wave to travel from the aorta to the lower body, and then as a reflected wave back up to the aorta to the finger. This path length is proportional to the subject's height (h). Stiffness Index: h/PPT. The height of the subjects was recorded by standard methods.

Statistical analysis: All the categorical variables was summarised using frequency and percentage. Quantitative variables was summarized using mean and SD. Normality assumption else using Median and IQR [Q 1, Q 3]. Kolmogorov-Smirnov test and Shapiro test was used to check the normality of the data. One way ANOVA or Kruskal Wallis test was performed to determine whether there is any significant difference in the average value of Stiffness Index between the different levels of physical activity. Independent sample t-test/u-test was performed to determine whether there is any difference in Stiffness Index among male and female based on normality. $p<0.05$ is considered as significant. The entire analysis was performed using SPSS and EZR software.

Result

- In this study MBBS students aged 18 to 24 years were included. Out of 249 students, 66% were females and 34% were males.
- There was a statistically significant difference between categories based on physical activity as determined by one-way ANOVA $F(2,282) = 3.98$, $p = 0.02$).
- It was revealed that the arterial stiffness scores were statistically significantly higher in physical category 1 (6.84 ± 0.85) compared to category 3 (6.5 ± 0.62, $p = 0.014$).
- There was no statistically significant difference between the category 1(6.84 ± 0.85) and category 2 (6.7 ± 0.97, $p = 0.67$).
- This study also found there is no statistically significant difference in mean scores

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 03, 2024

of arterial stiffness between male (6.7 ± 0.64) and female category (6.69 ± 0.89), p=0.411.

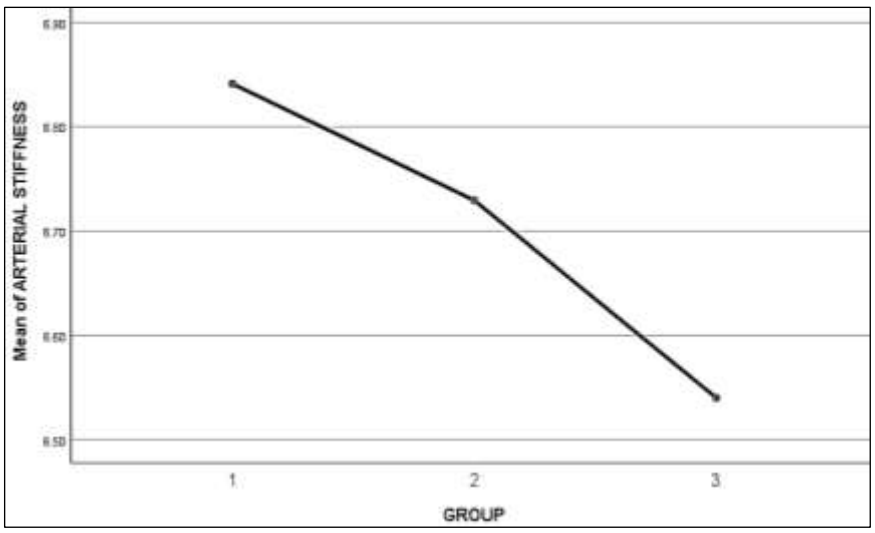
- **Category 1:** 46%.
- **Category 2:** 19%.
- **Category 3:** 35%.

Table 1: Division of subjects based on physical activity

SCORING	RATING	PHYSICAL ACTIVITY
>60	ACTIVE AND HEALTHY	VERY GOOD
41-60	ACCEPTABLE	GOOD
≤40	INSUFFICIENTLY ACTIVE	WEAK

Table 2: Anova

Variables	Mean difference	Lower bound Interval for mean	Upper bound Interval for mean	Standard error
Category 1	6.8413	6.6950	6.9875	0.07392
Category 2	6.7294	6.4649	6.9940	0.13190
Category 3	6.5401	6.4161	6.6641	0.06249



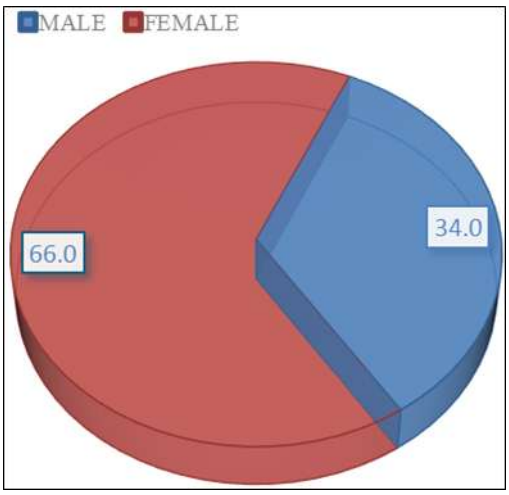
Graph 1: Relation between Physical activity and arterial stiffness index

t-Test

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 03, 2024

Table 3: Effect of Gender on arterial stiffness index

Gender	Mean	Standard Deviation
Male	6.7706	0.64277
Female	6.6870	0.88723



Discussion

The present study was conducted to assess the arterial wall stiffness by using a non-invasive technique-student physiograph. There was a statistically significant difference between categories as determined by one-way ANOVA F(2,282) = 3.98, p = 0.02). It was revealed that the arterial stiffness scores was statistically significantly higher in physical category 1 (6.84 ± 0.85) compared to category 3 (6.5± 0.62, p = 0.014). There was no statistically significant difference between the category 1(6.84 ± 0.85) and category 2 (6.7 ± 0.97, p = 0.67). This study also found there is no statistically significant difference in mean scores of arterial stiffness between male (6.7 ± 0.64) and female category (6.69 ± 0.89) t(283), p=0.411.

In a study conducted by Sánchez et, characteristics of nutritional and vascular states in high-performance athletes and medical students were compared. It was found that there was increased blood pressure and better nutritional state in athletes, compared with students. There was also a decrease in arterial stiffness in high-performance athletes; thus, suggesting that high-performance activity, can reduce the risk for cardiovascular diseases [2].

Another study conducted by Schäfer C, found that unhealthy lifestyle has a negative impactive on cardiovascular system a resulting in endothelial dysfunction which on long term leads to arterial stiffening. Regular aerobic exercise can prevent the development of Cardiovacsular diseases and can also improve the endothelial and vascular function [8].

A Study conducted by Iurciuc S found that exercise training delays the arterial stiffening. Regular physical activity of lower intensity and duration has shown a decrease in mortality rate. Lifestyle changes like weight reduction and regular physical exercise, are recommended at least 30 min for 5 to 7 days per week [9].

Vascular endothelial cells has a significant role in the regulation of vascular activity by

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 03, 2024

producing vasoactive substances like endothelin-1 and nitric oxide. Strength training exercises could cause increases in plasma norepinephrine concentrations, leading to chronically elevated sympathetic adrenergic vasoconstrictor tone and associated arterial stiffness which is consistent with the inference received from this study [10].

Conclusion

In present study, majority of the students comes under in the group of sufficiently active, with high stiffness index which can lead to cardiovascular complications in mere future and more prone for arterial stiffness. Although many invasive techniques are present, in this study, a non-invasive method of calculating Arterial Stiffness Index is used, which can routinely be used to screen those who are at low and intermediate risk for cardiovascular disorders.

Recommendations

Arterial stiffness should be seen as complimentary to risk factors including blood pressure and should be considered when making treatment decisions.

This study will help in establishing this relationship between the arterial stiffness and physical activity and can be established as routine investigation for various heart diseases especially in young adults.

Conflict of interest: Nil.

Funding: Nil.

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