THE ASSOCIATION BETWEEN ARTERIAL STIFFNESS AND LOW MUSCLE STRENGTH IN OBESE SUBJECTS: A CASE -CONTROL STUDY

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ABSTRACT

AIM: The aim of the present study is to compare the arterial stiffness and muscle strength among obese subjects and healthy subjects.

METHODS: A total of 80 participants were included with age groups between 18-30 yrs . Arterial stiffness was assessed by PWV and augmentation index . For assessing the muscle strength Digital hand grip dynamometer were used.

RESULTS: Pulse wave velocity had a significantly association in obese subjects. Augmentation index had significantly higher in obese adult compare to non-obese adult. Handgrip strength was inversely associated with PWV. HGS had a positive correlation with the obese subject compare to non obese young adult.

CONCLUSION: Poor health outcomes are linked to both low handgrip strength and higher arterial stiffness. Increased arterial stiffness was closely tied with body mass index, showing that adult obesity negatively affects vascular adaptability.

KEYWORDS: PWV (pulse wave velocity), Augmentation index (ALX), Hand Grip Strength (HGS).

INTRODUCTION

About 40% of the body weight is made up of skeletal muscle, which is necessary for conducting daily physical activities. It may be possible to lower the risk of injury and fall, which could result in physical impairments, a poor quality of life, and even death, with sufficient muscle strength and flexibility. Muscle mass and function are connected concepts .At rest muscle receives roughly 15% of cardiac output and during activity percentage of cardiac output increases.[1]

Therefore, for muscle to perform well there must be a sufficient blood supply. In a recent study, Jeon et al. discussed the importance of vascular function in the growth of musc le mass. Poor vascular function has been found to interfere with the transport of oxygen and nutri ents to the muscles, impairg muscle protein synthesis and changing mitochondrial activity.[2]

Due to the ease of access and low cost of assessing grip strength, handgrip strength is a desirable option for a biomarker of ageing. Handgrip strength serves as a proxy for overall muscular strength. Low handgrip strength is linked to a variety of detrimental health outcomes, including major adverse cardiovascular events (MACE), incident CVD, frailty, reduced quality of life, prolonged hospital stays, disability, cognitive decline, decreased renal function, and premature mortality, to name a few.[3]

Among other things, the processes underlying the link between handgrip strength and cardiovascular disease are still unknown. Skeletal muscle and the vascular system are strongly related, despite their link not being immediately apparent. [4] The physiological and functional range of skeletal muscle is extensive roles. Skeletal muscle serves the obvious purpose of facilitating movement, but it is also the main site of storage. The body's principal consumer of glucose, a source of protein storage, and crucial in metabolic disorders such as diabetes.[5]

Therefore, among other things, a sufficient supply of nutrients is necessary for healthy muscles. There is strong proof that there is a connection between healthy skeletal muscle and vascular function.[6]Muscle mass loss may be influenced by both quantitative and qualitative alterations in the microvasculature function. For instance, it has been proposed that endothelial dysfunction could lead to lower flow as a result of micro vascular muscle fiber atrophy could result from dysfunction and decreased microcirculation. [7]

Pulse wave velocity (PWV), which is regarded as the gold standard parameter of non-invasively determined arterial stiffness [8], can be used to measure arterial stiffness. Pathological arterial stiffness has been linked in numerous studies, including met analyses and systematic reviews, to ageing, cognitive decline, cardiovascular disease, and both conventional and novel CV risk factors. PWV is a powerful predictor of cardiovascular events and all-cause mortality, similar to handgrip strength. [9]

The American College of Sports Medicine (ACSM) and other medical associations recommend increased physical activity by engaging in a variety of exercises as the initial course of action. Exercises like aerobic, dynamic resistance, and isometric resistance exercises have all been shown to be the most effective non-pharmacological methods for lowering blood pressure in people with hypertension.[10]

It has been established that arterial stiffness is a new biomarker for vascular injury in young people. Blood pressure progression is accelerated in normal people with increased arterial stiffness [11].

METHODOLOGY:

- **PLACE OF STUDY:** The present study was conducted in Department of physiology, Index Medical College, Malwanchal university, Indore (M.P) . Study procedure was approved by the institutional ethical and research committee of the college.
- **STUDY DESIGN :** CASE -CONTROL STUDY
- **SAMPLE SIZE:** Total number of participants are 80 . Which were divided into 2 groups .(obese and healthy subject)

INCLUSION AND EXCLUSION CRITERIA

INCLUSION CRITERIA (STUDY GROUP)

- obese adult of age (18-35yrs),BMI should be >30kg/m^2

INCLUSION CRITERIA (CONTROL GROUP)

- Adult of age (18-35yrs),BMI should be 18.5-25 kg/m^2

EXCLUSION CRITERIA (STUDY GROUP & CONTROL GROUP)

- History of diabetes mellitus,
- History of hypertension,
- History of cardiovascular disease,
- History of peripheral vascular disease,
- Gestational diabetes,
- Any current and past aspirin or hormone replacements therapy, autoimmune disease , acute and chronic infections, hepatic diseases was also excluded . Any disease that can alter the cardio vascular health.

PROCEDURE:

- **Patient preparation:** After explaining exact experimental procedure. After taking consent, Filling all documents and Questionniare. Firstly all anthropometric measurement will be taken . After 5 min rest ,arterial stiffness is tested by using periscope .

- **BMI Assessment:** height and weight were measured with participants wearing light-weight clothes and without shoes.

  BMI was calculated as: **BMI**= WEIGHT(kg) / HEIGHT(m)2

1. **ARTERIAL STIFFNESS PARAMETERS**:The standardized protocol involved measurement of arterial stiffness parameters using periscope, a non-invasive automatic device, based on oscillometric method (Periscope, Genesis Medical Systems, India).All recordings were made in supine position. Avoided operator bias as the device is fully automated; it displays the results by itself. All vascular parameter printed for each limb.

2. **ISOMETRIC EXERCISE:** Using the Digital hand grip dynamometer (CAMRY EH: 101), each subject performed three sustained isometric contractions .Subject asked to hold the dynamometer in dominant hand with full grip of it. Then instruct him to close his eyes and compress the handle with maximum effort.

Fig no 1. **MEASURING HANDGRIP DYNAMOMETER**

STATISTICAL ANALYSIS

The result are presented in Mean±SD. All the Physiological parameters were compared by using independent t-test between cases and control. All the analysis was carried out by using Statistical Package for Social Sciences (SPSS) version 22.

RESULT:

Table 1: Descriptive statistics of Age and gender variables of young adult in Obese and Non-obese group

Variable	Categories	Obese group (n=40)		Non-Obese Group (n=40)	
		Frequency	Percentage	Frequency	Percentage
Gender	Female	19	47.5	18	45
	Male	21	52.5	22	55
Age	Mean ± SD	25.28 ± 3.105		26.00 ± 2.909	

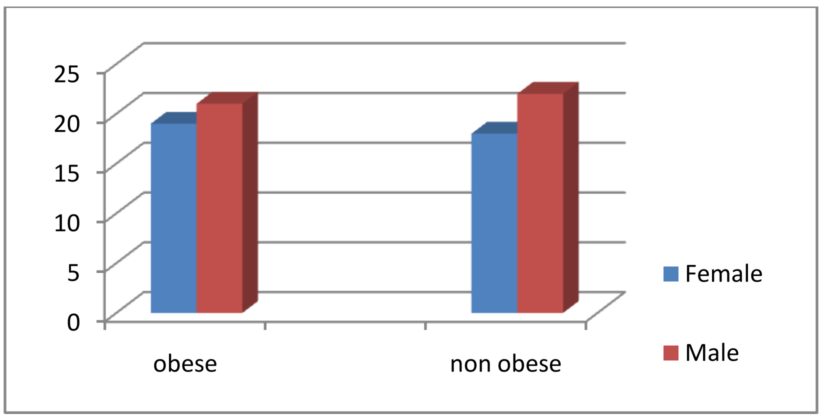

Fig. no2.Descriptive statistics of gender of obese and non obese healthy young adult.

Object 1: To investigate the changes in arterial stiffness by evaluation of arterial stiffness index and pulse wave velocity in young adult obese and compare with the non obese subject.

Table 2: Compare between obese and non-obese patients in arterial stiffness by evaluation of Augmentation Index and pulse wave velocity in young adult.

Arterial stiffness	Obese group (Mean ± SD)	Non-Obese Group (Mean ± SD)	P-value*
BMI (Kgm^2)	31.545 ± 1.069	22.195 ± 1.584	0.001
RT BAPWV	1310.347 ± 197.203	1170.987 ± 114.374	0.001
LT BAPWV	1389.857 ± 234.654	1241.337 ± 55.484	0.001
ALX	11.78 ± 7.141	5.18 ± 2.659	0.001

*Independent t test used for two group comparison

Table 2 show that compare between obese and non-obese patients in arterial stiffness by evaluation of Augmentation index and pulse wave velocity in young adult. There was statistical significance difference obese and non-obese patients in BMI with P=0.001; Right brachial pulse wave velocity with P=0.001; Left brachial pulse wave velocity with P=0.001; Augmentation index with P=0.001. Obese patients had greater mean value than Non-obese patients.

Object: 2. to study the effect of hand grip exercise on arterial stiffness in young adult obese and healthy young adults.

Table 3: Compare between obese and non-obese patients in hand grip exercise on arterial stiffness in young adult

Arterial stiffness	Obese group (Mean ± SD)	Non-Obese Group (Mean ± SD)	P-value*
HGS	32.083 ± 4.355	41.733 ± 4.748	0.001

*Independent t test used for two group comparison

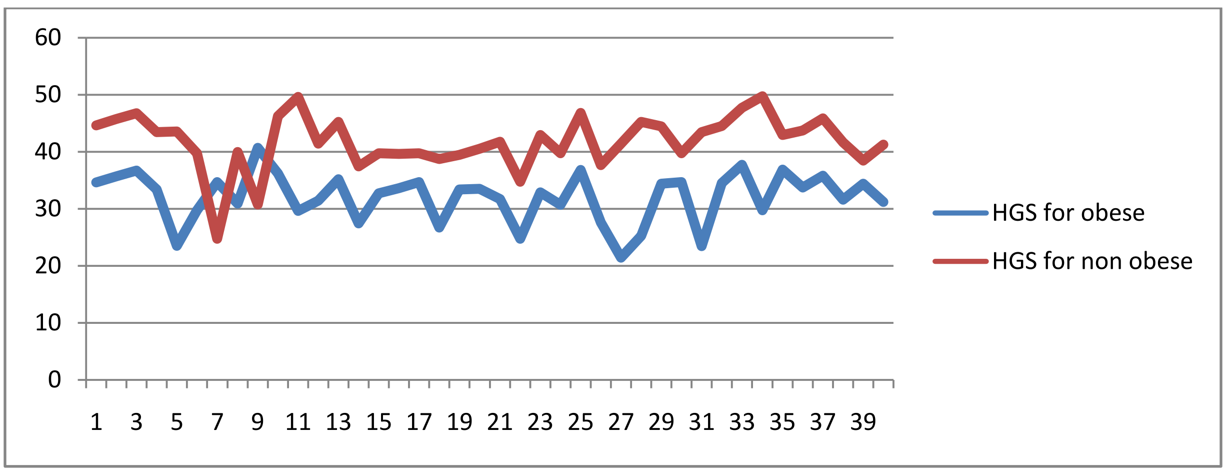

Fig.no 3. Line graph showing comparison between hand grip strength of obese and non obese young adult.

Table 3- show that compare between obese and non-obese patients in hand grip exercise on arterial stiffness in young adult. There was statistical significance difference obese and non-obese patients in hand grip exercise with P=0.001. Non-Obese patients had greater mean value than obese patients.

DISCUSSION:

The ability of an artery to expand and contract in response to the contraction and relaxation of the heart is known as arterial compliance. This allows blood to transition from a pulsatile and intermittent form to a steady laminar flow. A greater AS(Arterial stiffness) results in more blood flow resistance and a heavier burden for the left ventricle. Blood pressure went raised as a result, and atherosclerosis growth was accelerated. Age and atherosclerosis are the two main causes of AS. The arterial wall's increased collagen content and decreased elastin tissue cause the artery to stiffen. Along with structural alterations, AS may also be caused by an increase in local vasoconstrictors like endothelin-1 (ET-1) or a decrease in vasodilators like nitric oxide (NO). These modulators have a crucial role in the regulation of vascular activity and are released by vascular endothelial cells. An essential characteristic of endothelial dysfunction (ED) is poor NO production.[12]

In this study it was found that if a person having excess fat in younger age ,they are having higher risk of arterial stiffness. There are a number of mechanisms that could account for this association. First off, an increase in AS may decrease basal limb blood flow, which could result in less oxygen and nutrients being delivered to the muscles and a decrease in muscle mass .Along the arterial system, AS is also linked to elevated reflected wave, systolic blood pressure, and pulse pressure, which might result in small vessel injury . Secondly, The amount of muscle itself may have an impact on AS. This comprises lipid infiltration causes the release of endorphins in the muscles cytokines of inflammation.[13]

In present study it was found that Augmentation index in obese subject have a positive correlation with the obese subject. It is significantly higher in obese. Arterial stiffness and endothelial dysfunction might serve as mediators of the relationship link cardiovascular events and muscle strength. The hardening of the arteries the disappearance of the arteries elastic qualities of the aorta is a characteristic of normal vascular ageing, but may be accelerated in a number of ways. Pulse wave velocity (PWV), which is regarded as the gold standard parameter of non-invasively determined arterial stiffness, can be used to measure arterial stiffness.[14]

Pathological arterial stiffness has been linked in numerous studies, including metanalyses and systematic reviews to ageing, cognitive decline, cardiovascular disease and both conventional and novel CV risk factors. PWV is a powerful predictor of cardiovascular events and all-cause mortality, similar to handgrip strength.[15]In this study also it was found that PWV have a significantly higher value in obese subject while comparing with the non obese subjects.

Recent findings from the Wakayama Study in community-dwelling older adults (72years) without manifest cardiovascular disease showed that HGS progressively decreased with an increase in brachial-ankle PWV (baPWV) level. Same result was found in this study also that HGS is decreased in with increase in PWV in the obese subject comparing with non obese adults. However, other studies have found no association between arterial stiffness and muscular strength.[16]Another study that involved 1002 Chinese community-dwelling adults over the age of 65 found a substantial correlation between handgrip strength and PWV, but only in men. Other studies that looked at hypertension patients were unable to confirm this correlation.[17]

CONCLUSION :

The inverse relationship between handgrip strength and PWV suggests that arterial stiffness and poor handgrip strength are related. The missing link between poor handgrip strength and higher cardiovascular morbidity and mortality may be vascular stiffness.

Ethical Approval: - The study was approved by the Ethical Committee of Index Medical College, Malwanchal University Indore, M.P. -India.

Source of Funding: - Not applicable

Conflict of interest: - The authors declare that they have no known competing financial

Interests or personal relationships that could have appeared to influence the work reported in this paper.

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