Original Research Article

International Physiology
Volume 7 Number 2 May - August 2019
DOI: https://dx.doi.org/10.21088/ip.2347.1506.7219.3

Relation of Obesity With Ambulatory Arterial Stiffness Index in healthy Young Adult Males

Jawahar L Agarwal[1], Sumit Garg[2]

Author Affiliation

[1]Professor & Head, [2]Associate Professor, Department of Physiology, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh 245304, India.

Corresponding Author

Sumit Garg, Associate Professor, Department of Physiology, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh 245304, India.

E-mail: sumitgargdr@gmail.com

Received on: 24.07.2019

Accepted on: 22.08.2019

Abstract

Objectives: 1. To correlate BMI with Ambulatory Arterial Stiffness Index (AASI) 2. To correlate Waist Circumference with AASI 3. To correlate body fat percentage with AASI 4. To determine the best predictor of AASI amongst the obesity parameters *Methodology:* 30 healthy young adults of age between 20 to 35 years were enrolled in the study. Subjects with any H/o hypertension, cardiovascular, renal disorders were excluded. Body mass index (BMI) was calculated as body weight/height^2 (kg/m^2). Waist circumference (WC) was measured midway between lower rib margin and anterior superior iliac spine. Skinfold thickness was measured using Harpendent skinfold calipers at four sites viz triceps, biceps, subscapular and suprailiac. Body-fat percentage was calculated using Durnin-Womersley formula. 24 hours Ambulatory Blood Pressure was measured using Contec Ambulatory Blood Pressure Monitor (AMBP). AASI was calculated by the formula one minus the regression slope of diastolic BP over systolic BP. *Results:* There was a positive correlation between AASI and BMI, WC and fat percentage with correlation coefficients of 0.715 ($p < 0.01$), 0.735 ($p < 0.01$) and 0.646 ($p < 0.01$) respectively. Since the WC had strongest correlation with AASI, WC can be considered as the strongest predictor of AASI. *Conclusion:* AASI is a predictor of arterial stiffness. As the BMI, WC and fat % the AASI increases. Amongst them WC had the strongest relation with AASI. Increase in AASI predispose to peripheral arterial diseases including coronary artery disease, cerebral vascular disease. So, controlling obesity is a must to prevent peripheral arterial diseases.

Keywords: AASI; BMI; Waist circumference; Body fat percentage.

How to cite this article:

Jawahar L Agarwal, Garg Sumit, Relation of Obesity With Ambulatory Arterial Stiffness Index in healthy Young Adult Males. International Physiology. 2019;7(2):67–70.

Introduction

Recently lot of research is going on Arterial stiffness.[1] It is recognized as an important measure of target organ damage and a potent predictor of cardiovascular morbidity and mortality.[2] The ambulatory arterial stiffness index (AASI) as assessed by ambulatory blood pressure monitoring (ABPM) gained importance as an important predictor of future risk of cardiovascular diseases specially stroke.[3]

AASI is defined as 1 minus the regression slope

of diastolic on systolic BP values derived from a 24 h ABPM recording. Thus, AASI indicates that systolic and diastolic BP are related to each other. It can be because of the hemodynamic properties of arteries and arterial stiffness is an important contributor. It is said that if we compare a compliant artery with a stiff artery, the diastolic BP increases more than the systolic BP.[4] A lot of research has been done on the mechanisms by which AASI estimates the cardiovascular risk. Now the AASI is being commonly used in clinical practice.[4]

In the past, many studies suggested that the incidence of certain types of CV diseases, particularly coronary heart disease and stroke, was greater in heavier individuals, but only a few proposed that any obesity index makes an additional contribution to risk once the levels of coexisting risk factors such as dyslipidemia, hypertension, insulin resistance, glucose intolerance, and type 2 diabetes had been taken into account.[5]

In India, there is an increasing prevalence of obesity in urban youth population which has caused them to fall in the category of high risk of cardiovascular diseases. A major factor contributing to obesity and hence cardiovascular risk is the sedentary lifestyle adopted by the children and young adults these days. Both obesity and sedentary lifestyle has caused an increase in the early occurrence of impaired lipid profile & glucose tolerance and arterial stiffness in early adulthood. There are studies suggesting that the process of atherosclerosis is initiated at an early age and which may lead to serious consequences.[6] So, the present study was designed to investigate the relationship of obesity parameters with Ambulatory Arterial stiffness index.

Objectives

1. To correlate BMI with Ambulatory Arterial Stiffness Index (AASI)
2. To correlate Waist Circumference with AASI
3. To correlate body fat percentage with AASI
4. To determine the best predictor of AASI amongst the obesity parameters

Methodology

The present study was conducted in the Department of Physiology of Saraswathi Institute of Medical Sciences, Hapur from the month March 2017 to July 2017. A convenient sample of 30 healthy young adult males who volunteered for the study were enrolled after taking written informed consent from all the subjects. Ethical clearance was obtained from Institutional Ethical Committee. Subjects with any H/o hypertension, cardiovascular, respiratory or renal disorders, smokers and alcoholics were excluded from the study.

The subjects were supposed to report to the Department of Physiology at 10.30 am. Their Weight, Height, WC and Skin fold thickness were measured and measurement of Ambulatory BP recording was started by 11 am. The subjects were supposed to tie the cuff of Ambulatory BP monitor for 24 hours even during their sleep. As disturbed sleep may not decrease the sympathetic activity in the body and hence may not result in decrease in BP during sleep. The subjects who complained of disturbed sleep at night were also excluded from the study

Anthropometry

Body weight was recorded (to nearest 0.5 kg) in all subjects, in erect position without shoes and wearing only light indoor clothes, with a mechanical scale. Height was measured to the nearest 1 cm and body mass index (BMI) was calculated as body weight/ height^2 (kg/m^2). Waist circumference was measured midway between the lower rib cage margin and the anterior superior iliac spine. Skinfold thickness was measured using skinfold calipers to the nearest 1 mm. Triceps and biceps skinfold thicknesses was measured midway between the acromion process of scapula and the olecranon process. Subscapular skinfold thickness was measured at the inferior angle of scapula in midaxillary line and suprailiac skinfold thickness measured just above the highest point of iliac crest. Body fat percentage was calculated using Durnin-Womersley formula.[7]

Ambulatory Arterial Stiffness Index

Subjects were allowed to sit quietly for 15 min prior to assessment of BP; three consecutive measurements were made 5 min apart, and baseline BP taken as mean of the three readings. 24 hours Ambulatory Blood Pressure was measured using Contec Ambulatory Blood Pressure Monitor (AMBP). The cuff of AMBP was tied on non-dominant arm. Subjects morning wake up time and night bed time was noted. AMBP was set to measure BP every 15 min during daytime and every 30 min in night time while sleeping. AASI was calculated by the formula one minus the regression slope of diastolic BP over systolic BP.[8]

Results

There was a positive correlation between AASI and BMI, WC and fat percentage with correlation coefficients of 0.715 ($p < 0.01$), 0.735 ($p < 0.01$) and 0.646 ($p < 0.01$) respectively. Since the WC had strongest correlation with AASI, WC can be considered as the strongest predictor of AASI. (Fig. 1).

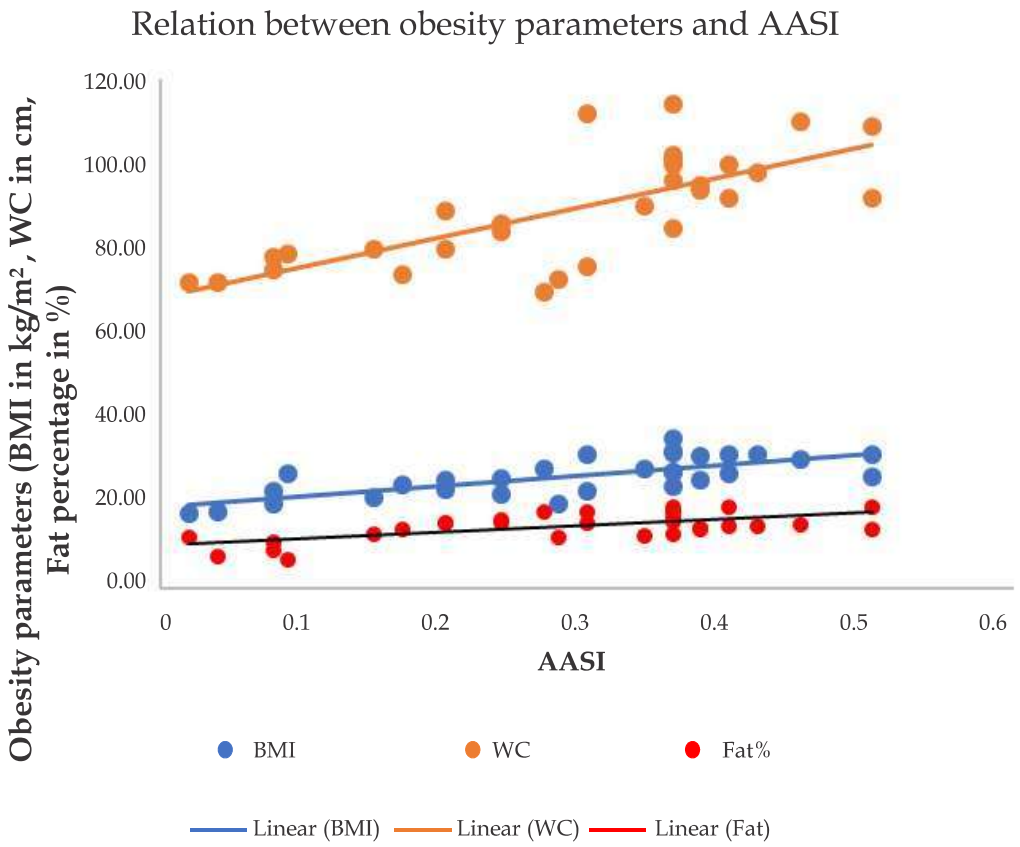

Fig. 1:

Discussion

Our study showed a positive correlation between AASI and obesity parameters like BMI, WC and Body fat percentage which means that as obesity increases the Ambulatory arterial stiffness index increases. As discussed above ambulatory arterial stiffness index is a reliable predictor of arterial stiffness. An increase in AASI means increase in arterial stiffness. Several studies have shown similar results.

There existed a positive association between pulse wave velocity and all adiposity measures. Increased obesity was associated with higher pulse wave velocity, another important index showing arterial stiffening, in adolescent age group. This may increase the CVD risk in obese for future. This association was independent of age and ethnicity.[9] The diameter and stiffness of muscular arteries increased with increased BMI. In elastic arteries, the relationship between arterial stiffness and BMI was more complex and varied with sex and age.[10]

Visceral adipocytes have an elevated lipolytic activity that results in increased free fatty acids release in the portal vein with an accumulation (liver, pancreas, and muscles) that contributes to insulin resistance. Furthermore, other mechanisms could be involved, such as increases in circulating proinflammatory cytokines or leptin. It has been found that obese individuals have high levels of circulating leptin and it has been found to be related with decrease in arterial elasticity. In addition to hypothalamic receptors, receptors for leptin have been observed on the vascular endothelium and on smooth muscle cells. Accordingly, leptin is said to exert influence on vessel tone and growth and, in

cell culture, stimulate proliferation and migration of vascular smooth muscle. In addition, it can induce oxidative stress in endothelial cells, which results in the transcription of oxidant-sensitive genes that participate in atherogenesis. Another mechanism may be due to a complex relation that exists between adiposity, BP, ANS and arterial stiffness. Excess adiposity may modulate sympatho-vagal balance by stimulating sympathetic nervous system which can increase the tone in vessels and hence increase the BP. As a result, this elevation in BP again stiffening of arteries occur that may further augment BP.[11,12]

Our study also showed waist circumference correlated strongest with AASI. A study done in children and adolescents also showed that high obesity parameters (in terms of higher body fat and higher waist circumference) are associated with enhanced arterial stiffening in Indian children and adolescents. Waist circumference was found to be a sensitive predictor of increased stiffness in children.[6]

Another study done in middle aged showed that WC was better associated with arterial stiffness (assessed by PWV) as compared to BMI.[13] Another study showed adiposity was a robust predictor of aortic stiffening in the presence and absence of co-occurring metabolic risk factors and inflammation. General and central obesity and fat mass percent were equally predictive of aortic stiffening.[14]

Conclusion

AASI is a predictor of arterial stiffness. As the BMI, WC and fat % increases, the AASI increases. Amongst them WC had the strongest relation with AASI. Increase in AASI predispose to peripheral arterial diseases including coronary artery disease, cerebral vascular disease. Ambulatory BP monitoring is a novel, cheap and non-invasive method to determine arterial stiffness which is a predictor of future peripheral arterial diseases. It may be used to assess the AASI in obese to know the risk of peripheral arterial diseases in them, so that, the preventive measures can be undertaken.

Key message: Weight management is important to prevent the arterial stiffness and thus peripheral vascular diseases.

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