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Mild Positive Correlation between BMI and Pulse Wave Velocity in Adult Male: An Observational Study

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Abstract

Studies suggested obesity results in cardio-vascular disease (CVD) risk which is also associated with increased pulse wave velocity (PWV). We performed this study in western Rajasthan, India to assess association between Body Mass Index (BMI) and PWV. Seventy seven healthy non-smoker, male participant, age 20 to 40 years, examined for BMI. Right and Left brachial ankle (ba) PWV, Carotid-Femoral (cf) PWV and Augmentation Index at Heart Rate 75/min (AIx@HR75) as indices of arterial stiffness are measured non-invasively using an oscillometeric device PeriScope. Pearson's Correlation Coefficients (r) between BMI and indices of arterial stiffness were found 0.356, 0.219, 0.316 and r=0.31 for Right ba PWV, Left ba PWV, CF PWV and AIx@HR75 respectively. All Simple linear regressions were significantly correlated ($p<0.05$) except between BMI and Left ba PWV ($p>0.05$). The present study concluded PWVs and BMI is mild to moderately associate in male adult of western Rajasthan.

Keywords: Arterial stiffness, BMI, Pulse Wave Velocity, PWV, Periscope.

Introduction

Throughout the history of mankind, increase in weight has been viewed as an indicator of well-being and health. When energy intake exceeds energy expenditure, the excess energy is stored as fat in the body. In India, lifestyle has been profoundly influencing by the improved standard of living, high income, and affordable health care. Food is plentiful and affordable; most homes are equipped with house-hold appliances that provide efficiency as well as comfort; motor vehicles are now used as means of transport for even the shortest of distances, house maids are affordable, and long hot summers restrict outdoor activities. These all probably contribute to become obese.

WHO definition of overweight is Body Mass Index (BMI) greater than or equal to 25 kg/m^2 and obesity is BMI greater than or equal to 30kg/m^2.[1] Although according to Consensus Statement for Diagnosis of Obesity For Asian Indian population it is 23 and 25 kg/m^2 respectively.[2] Obesity can adversely affect many body systems as well as behavior.

In last decade, it has been shown in adults [3,4,5] as well as in children [6] that individuals with obesity have an increase in aortic stiffness. There are various indices of arterial stiffness such as elastic modulus, arterial distensibility, arterial compliance, PWV, Augmentation index (AIx), and Arterial Stiffness index(ASI) are available. [7] Out of these PWV, AIx are ASI are widely

accepted and recommended markers for measure arterial stiffness. [8]

We could not find any study, analyzing association between BMI and PWV in western Rajasthan. So to fill the gap in scientific knowledge we did the present study.

Material and Method

In this cross sectional study all 77 participants gave a written informed consent to participate. After obtaining Institutional ethical committee clearance, Age 20 to 40 years adult male, native and resident of Western Rajasthan, BMI not more 30 kg/m^2, apparently healthy for at least one week were included in this study. Smokers, history of Cardio-vascular attacks, medical conditions influencing degree of obesity such as thyroid disease, chronic medications and medication or regime for weight reduction were excluded.BMI was calculated by dividing the participant's weight in kilograms by the square of his height in meters. Weight and Height of participants were measured by calibrated electrical weighing Scale and Calibrated Stadiometer respectively. Indices of Arterial Stiffness viz. PWV & AIx@HR75 are measured by PeriScope (RMS, India) based on Oscillometeric Method in morning in fasting condition with 8 to 10 hours over night sound sleep. It records arterial Blood pressure (BP), arterial pressure Waveform non-invasively through Cuffs Wrapped on all four limbs. Simultaneously it records Electrocardiogram (ECG) by 4 leads applied to four limbs. Time taken by pressure wave to reach limbs is calculated by time point recording of R Wave of ECG and foot of arterial pressure Waveform. The system software of this device supports sophisticated digital signal-processing algorithm to calculate all the results. It calculates right and left ba PWV, cf-PWV, Arterial Stiffness Index (ASI), Ankle Brachial Index (ABI) & Augmentation Index (AIx) and estimated Aix@HR75. Participants were asked to refrain from drinking caffeine containing beverages 12 hrs before the test. They were also informed not to speak or sleep during the procedure. All subjects were explained about the procedure to be undertaken and written consent was obtained from all the subjects prior to the study.Results were statistically analyzed using Data Analysis ToolPak in Microsoft Excel. Pearson's Correlation Coefficients were analyzed between parameters and performed simple linear regression. "t" test is applied to test the correlations.

Result and Discussion

All data are stratified in 3 BMI groups. Group A having BMI less than 22.9 Kg/m2, group B have 23 to 24.9kg/m2 and group C have BMI more than 25 kg/m2. Table 1 is showing descriptive statistics in these 3 groups. Systolic Blood Pressure (SBP) , DBP and PP were found significantly higher in group B as compare to group A but not significantly higher in group C as compare to group B. whereas we could not find significant difference between group A and B as well as between B and C in terms of arterial stiffness. However cf- PWV was significantly higher in group C as compare to A ($p < 0.05$). We observed mild to moderate correlation between BMI and cf PWV (r=0.316) and Aix@HR75 (r=0.310) in simple linear regression between BMI and indices of arterial stiffness.(Fig.1) Almost similar results found in various studies. R. Niruba et al (2016) concluded moderate correlations (r) which were 0.564 and 0.437 (p<.05) respectively in 50 male subjects. [9]

Groups / Parameters	Group A BMI<22.9 N= 28 mean±SD	Group B BMI 23-24.9 N= 23 mean±SD	Group C BMI 25-30 N= 26 mean±SD	p Value between Group A & B	p Value between Group B & C	p Value between Group A & C
BMI (In Kg/m2)	21.01±1.80	23.82±0.58	26.88±1.39	<.01 HS	<.01 HS	<.01 HS
Age(in Yrs)	31.46±4.45	30.09±7.08	31.815.10	0.40 NS	0.33 NS	0.79 NS
Weight (in Kg)	60.51±6.30	69.27±5.79	77.90±8.35	<.01 HS	<.01 HS	<.01 HS
Height (in Cm)	169.61±4.48	170.41±6.67	170.04±6.74	0.61 NS	0.85 NS	0.79 NS
Systolic BP(mmHg)	128.29±16.81	137.57±9.22	140.31±10.14	<.05 S	0.33 NS	<.01 HS
Diastolic BP (mmHg)	73.79±7.19	80.26±7.69	81.77±7.71	<.01 HS	0.50 NS	<.01 HS
Rt baPWV (cm/sec)	1248.56±151.96	1341.74±180.67	1367.43±135.72	0.05 NS	0.57 NS	<.01 HS
Lt baPWV (cm/sec)	1213.15±174.83	1261.60±157.22	1299.32±175.27	0.31 NS	0.43 NS	0.08 NS
C-F PWV(cm/sec)	792.34±128.02	851.35±130.49	877.78±106.31	0.11 NS	0.44 NS	<.05 S
AIx (%)	12.54±7.57	17.52±4.87	17.54±5.91	<.01 HS	0.99 NS	<.01 HS
Aix@HR75(%)	13.89±8.78	17.61±6.32	15.54±6.41	0.10 NS	0.26 NS	0.44 NS

Note: - NS = Not Significant, S = Significant, HS = Highly Significant
P value by student's t test, <0.01 HS, <0.05 S

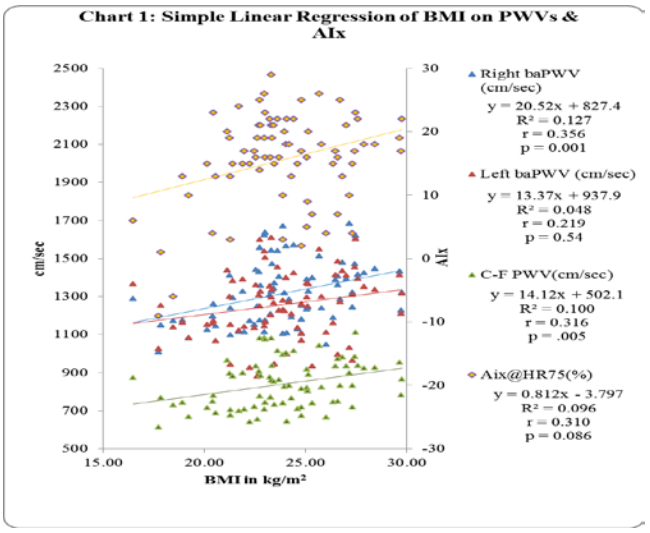

Fig.1 Simple Linear Regression of BMI on PWVs & AIx. Abbreviation in text.

Pundit D.S. et al (2014) performed study on healthy adolescent subjects of India and observed moderate association between BMI and cf PWV (r= 0.5, p<0.05). [10] Wildman R. et al (2003) observed mild association (r=0.370) in 186 young adults of Pennsylvania. [4] These studies, including present study, indicate it is mild to moderate correlation between generalized obesity and arterial stiffness. Reduction of weight can improve the elasticity in vessels as stated in studies by alvarez et al (2002) [11] and Abate et al (2001), [12] that after weight loss, the increased stiffness is reversed in parallel with reduction of heart rate which might be due to neural sympathetic over-activity.

The present study has been interpreted within the context of its limitations. We did not assess body fat but used anthropometric measures to estimate adiposity. We did not exclude the effect of hypertension on arterial stiffness. Blood pressure and distensiblity of arterial system are inversely proportional and influences each other. [13,14] Our sample size was not large enough to be stratified in age groups.

Conclusion

It is concluded in this study that arteries are stiffer in obese male adults of western Rajasthan as compare to normal persons that's why there is moderate association between BMI and PWV. Reducing and controlling weight gain can improve the arterial distensibility hence the cardio-vascular risk. This non-invasive method can be a good screening test for calculating risk in obese individuals.

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