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A CROSS-SECTIONAL RESEARCH TO DOCUMENT THE ASSOCIATION OF ARTERIAL STIFFENING WITH OBESITY, ADIPOSITY AND RELATED CONTEMPORARY CARDIOMETABOLIC INDICATORS

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Abstract:

Background: *Prediction of cardiovascular disease (CVD) has issues among obese adolescents because of the lack of the validation of metabolic and adiposity markers. Pulse wave velocity (PWV) can potentially arrest the enhanced CVD risk as an arterial stiffening proxy.*

Objectives: *The research was aimed to investigate the correlation between conventional metabolic factors, adiposity and PWV among a population with (BMI >95th centile).*

Patients and Methods: *This cross-sectional research was carried out at Sir Ganga Ram Hospital. Lahore (August 2018 to March 2019). Total 174 adolescents with (BMI > 95th centile) with an age bracket of (12 – 19) years were included in the research. The research sample consisted of 63% females and 37% males with further ethnic distribution of 66 white (38%), 53 black (30%), 36 South Asian (21%) and 19 mixed/other (11%). We did not include patients with genetic disorders, endocrine issues and chronic medical issues except asthma. Bioimpedance was used to measure BMI z-score, fat mass index and waist z-score; whereas, sagittal abdominal dimension, resting blood pressure and cardiometabolic blood tests were also collected. Single operator documented measurements of Carotid radial PWV.*

Results: *PWV has no relation with pubertal; whereas, it has a relation with age. PWV has a positive correlation with adiposity (zBMI, FMI, waist z-score and SAD). BP and PWV have no correlation; whereas, few correlations were existing with cardiometabolic blood. There was robust relation between adiposity and PWV measures in order to adjust in multivariable models excluding SAD. Patients with SD values of zBMI (>2.5 & >3.5) showed increased PWV average with greater overlap between the groups.*

Conclusions: *Our population showed an increase in the adiposity which has a positive relation with arterial stiffness; however, segregation through severity level was not reliable. The lack of correlations between blood pressure, arterial stiffness and cardiometabolic blood compromises the factors of reliability which predict the chances of CVD among obese adolescents.*

Keywords: *Cardiovascular Disease (CVD), Metabolic, Adiposity, Pulse Wave Velocity (PWV), Obesity, Ethnicity and Cardiometabolic.*

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INTRODUCTION:

An increasing trend of obesity in both young and children has posed a challenge to decide which needs to be treated through medical interventions and which require weight loss programmes [1, 2]. BMI classification is currently used for weight loss interventions and to assess the CVD onset among patients for further treatment [3, 4]. Different cut-offs have been defined by various organizations about obesity which validate and predict CVD onset [5, 6]. Various studies have focused on usefulness of these values which can capture metabolic syndrome, hypertension, CVD risk and dyslipidemia [7 – 11]. Limited evidence is available to support the vitality of such metabolic risk factors which can predict CVD for present and future perspective [12 – 15]. Clinical setting can difficultly predict CVD among young obese cases [16, 17].

Current CVD risk factors can also be explored among obese adolescents through PWV [18 – 22]. Greater PWV is reported among obese children and young population in comparison to non-obese controls [23]. Variable outcomes have also been reported in numerous studies about the association of PWV and adiposity among children and adolescents of both overweight and health status [24 – 26]. In this research a cross-sectional community sample with obesity was assessed for the possible correlation of contemporary arterial stiffening through pulse wave velocity with various adiposity measures, conventional metabolic risk indicators, blood pressure, ethnicity and pubertal status. Our hypothesis states that increase in the arterial stiffness will also affect the increase in the adiposity. It will also correlate positively with CVD risk factors particularly blood pressure. Prediction of cardiovascular disease (CVD) has issues among obese adolescents because of the lack of the validation of metabolic and adiposity markers. Pulse wave velocity (PWV) can potentially arrest the enhanced CVD risk as an arterial stiffening proxy. The research was aimed to investigate correlation between conventional metabolic factors, adiposity and PWV among a population with (BMI >95th centile).

MATERIALS AND METHODS:

This cross-sectional research was carried out at Sir Ganga Ram Hospital. Lahore (August 2018 to March 2019). Total 174 adolescents with (BMI > 95th centile) with an age bracket of (12 – 19) years were included in the research. The research sample consisted of 63% females and 37% males with further ethnic distribution of 66 white (38%), 53 black (30%), 36 South Asian (21%) and 19 mixed/other (11%). We did not include patients with genetic disorders, endocrine issues and chronic medical issues except asthma. Bioimpedance was used to measure BMI z-score, fat mass index and waist z-score; whereas, sagittal abdominal dimension, resting blood pressure and cardiometabolic blood tests were also collected. Single operator documented measurements of Carotid radial PWV. Baseline parameters were taken from those who led a healthy lifestyle and eating habits were also healthy among obese adolescents. Ethical review permission was also taken before commencement of research. Research outcomes were assessed for Age (Years), Weight (Kg), Height (cm), Height z, BMI, zBMI, Waist (cm), Waist-z, SAD (cm), FMI, Systolic BP (mm Hg), Systolic BPz, Diastolic BP (mm Hg), Diastolic BPz, Cholesterol (mmol/L), Triglycerides (mmol/L), ALT (mmol/L), HDL (mmol/L), HbA1c (%), HOMA-IR, Fasting Insulin, Fasting Glucose and PWV, Female (Ref Male), Pubertal Stage Pre/early, Pubertal Mid, Ethnicity (Ref white), Ethnicity (Black), Ethnicity (South Asian), Ethnicity (Mixed other), Current smoker, Ever Smoked, Height z, zBMI, Fat Mass Index, Waist z, SAD, Systolic z, Diastolic z, Cholesterol, High Cholesterol Vs Low, HDL, Low Vs High HDL, Triglycerides, Abnormal Triglycerides vs normal, ALT, Fasting Glucose, HbA1c, Fasting Insulin, Abnormal vs normal insulin, HOMA-IR and Abnormal vs normal HOMA-IR.

Data were cleaned for various variables for assessment. Features of population were described through number, mean, standard variation, median and IQR. Outcomes were also assessed through Stata software and tabulated.

RESULTS:

PWV has no relation with pubertal; whereas, it has a relation with age. PWV has a positive correlation with adiposity (zBMI, FMI, waist z-score and SAD). BP and PWV have no correlation; whereas, few correlations were existing with cardiometabolic blood. There was robust relation between adiposity and PWV measures in order to adjust in multivariable models excluding SAD. Patients with SD values of zBMI (>2.5 & >3.5) showed increased PWV average with greater overlap between the groups.

Detailed outcomes about continuous variables with respect males and females (number, mean, median, standard deviation and IQR), univariable regression analyses and multivariate analyses of pulse wave velocity.

Table – I show the outcomes analysis of Age (Years), Weight (Kg), Height (cm), Height z, BMI, zBMI, Waist (cm), Waist-z, SAD (cm), FMI, Systolic BP (mm Hg), Systolic BPz, Diastolic BP (mm Hg), Diastolic BPz, Cholesterol (mmol/L), Triglycerides (mmol/L), ALT (mmol/L), HDL (mmol/L), HbA1c (%), HOMA-IR, Fasting Insulin and Fasting Glucose and PWV.

Table – I: Continuous variables with respect to gender

Variables	Males					Females					All Subjects				
	No	Mean	Median	SD	IQR	No	Mean	Median	SD	IQR	No	Mean	Median	SD	IQR
Age (Years)	65		15		3.2	109		15.6		2.9	174		15.3		3.2
Weight (Kg)	65		87.4		23	109		85.4		20.6	174		86.2		22
Height (cm)	65	168.4		9.6	13.2	109	164.3		6.5		174	165.8		8.1	
Height z	65	0.39		0.88		109	0.52		1		174	0.47		0.96	
BMI	65		30.9		5.9	109		32.5		6.1	174		32		6.1
zBMI	65	2.83		0.47		109	2.78		0.59		174	2.8		0.55	
Waist (cm)	65		101		15	109		95.4		17	174		99		15.9
Waist-z	65	2.97		0.51		109	3.68		0.68		174	3.45		0.72	
SAD (cm)	57	23.1		3.2		102	22.3		3.5		159	22.6		3.4	
FMI	63	12.5		4		108	15		3.6		171	14.1		3.89	
Systolic BP (mm Hg)	63	109		10		109	106		10		172	107		10	
Systolic BPz	63	-1.05		1.03		109	-1.09		1.08		172	-1.07		1.06	
Diastolic BP (mm Hg)	63	53		9		109	54		10		172	54		9	
Diastolic BPz	63	4.5				109					172				
Cholesterol (mmol/L)	65			0.9		109	4.3		0.8		174	4.4		0.8	
Triglycerides (mmol/L)	64		1.1		0.6	109		0.9		0.6	173		1		0.6
ALT (mmol/L)	65		32		27	109		24		13	174		26		16
HDL (mmol/L)	62		1.1		0.4	108		1.1		0.3	171		1.1		0.3
HbA1c (%)	62		5.5		0.5	105		5.4		0.4	167		5.4		0.5
HOMA-IR	65		3		2.9	108		2.4		2.1	173		2.6		2.6
Fasting Insulin	65		15		14.1	109		12.1		10.5	174		13		11.1
Fasting Glucose	65		4.6		0.6	108		4.4		0.45	173		4.4		0.5
PWV	54	7.3		1.1		92	7.1		1.2		146	7.1		1.2	

Table – II shows outcomes about Age, Female (Reef Male), Pubertal Stage Pre/early, Pubertal Mid, Ethnicity (Ref white), Ethnicity (Black), Ethnicity (South Asian), Ethnicity (Mixed other), Current smoker,
Ever Smoked, Height z, zBMI, Fat Mass Index, Waist z, SAD, Systolic z, Diastolic z, Cholesterol, High Cholesterol Vs Low, HDL, Low Vs High HDL, Triglycerides, Abnormal Triglycerides vs normal, ALT, Fasting Glucose, HbA1c, Fasting Insulin, Abnormal vs normal insulin, HOMA-IR and Abnormal vs normal HOMA-IR.

Table – II: Univariable regression analyses

	Number	Coefficient	β	P-Value
Age	146	0.12	0.22	<0.01
Female (Reef Male)	146	-0.19	-0.08	0.34
Pubertal Stage Pre/early	146	-0.15	0.01	0.68
Pubertal Mid	146	-0.12	0.61	0.67
Ethnicity (Ref white)	146	0		
Ethnicity (Black)	146	0.42	0.17	0.07
Ethnicity (South Asian)	146	0.67	0.23	0.01
Ethnicity (Mixed other)	146	0.18	0.05	0.6
Current smoker	146	0.27	0.07	0.43
Ever Smoked	146	0.15	0.06	0.47
Height z	146	-0.13	-0.11	0.18
zBMI	146	0.44	0.2	0.01
Fat Mass Index	144	0.05	0.18	0.03
Waist z	146	0.27	0.17	0.04
SAD	132	0.06	0.18	0.04
Systolic z	146	0.02	0.02	0.83
Diastolic z	146	0.08	0.08	0.33
Cholesterol	146	0.16	0.12	0.16
High Cholesterol Vs Low	146	-0.35	-0.11	0.2
HDL	146	0.16	0.03	0.68
Low Vs High HDL	142	-0.63	-0.17	0.04
Triglycerides	145	0.24	0.13	0.13
Abnormal Triglycerides vs normal	145	0.52	0.17	0.04
ALT	146	0.01	0.14	0.08
Fasting Glucose	146	0.04	0.02	0.86
HbA1c	146	0.23	0.07	0.38
Fasting Insulin	146	0.01	0.06	0.5
Abnormal vs normal insulin	146	0.17		0.5
HOMA-IR	146	0.01	0.01	0.76
Abnormal vs normal HOMA-IR	146	0.03	0.01	0.91

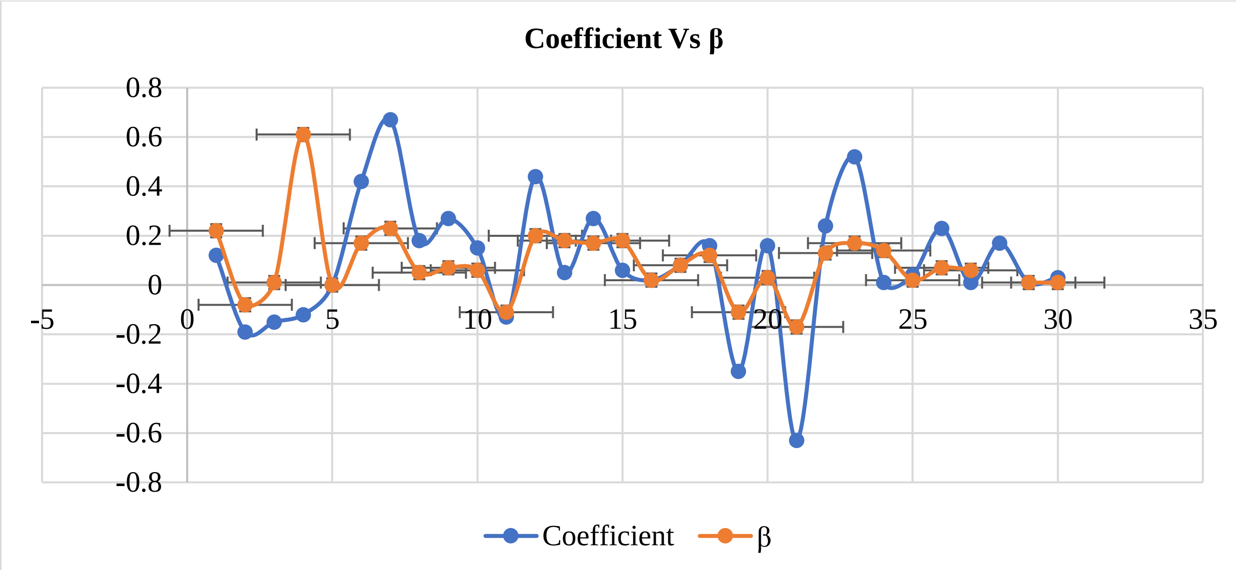

Table – III: Multivariable analyses of PMV

	Number	Coefficient	95% CI	P-Value
zBMI	145	0.49	0.14 - 0.84	0.006
Waist-z	145	0.26	0.01 - 0.52	0.04
FMI	144	0.05	0.01 - 0.10	0.002
SAD	131	0.05	0.13 - 0.10	0.13

DISCUSSION:

A positive correlation was found between adiposity and arterial stiffness among obese population which also included waist circumference and central adiposity. This correlation was not associated with ethnicity and age. Small variation was reported in the difference of PWV among partitioning subjects by zBMI levels [27]. However, a positive relationship between PWV and zBMI and substantial PWV overlap between groups. Thus, the ability of the classification of severe obesity constitutes with respect to pathological processes is very much limited. These outcomes also provide vital information which is helpful for the clinicians, adolescents and families for a better comprehension of CVD risk factors within clinical and community settings. Various other new findings are also provided in our research. There were few correlations between conventional cardiometabolic markers and PWV, especially for standard blood pressure. Our findings are not in agreement with a study carried out on obese children with increased PWV than those who were just obese [28]. The hypertension was low among our population which is also compared low among other obese adolescents' population, non-ambulatory validation and high blood pressure with unclear PWV which is unclear [29 – 32]. Evidence also supports that adiposity influences on the vasculature resulting in hypertension [31]. Outcomes also report that large scale research studies are required for better understanding of association between adiposity, arterial stiffening and blood pressure. No association was reported puberty stage and pulse wave velocity. PWV also increased with an increase in the age factor.

The increase in BMI was associated with an increase in PWV (1:0.5) which is equivalent to PWV (0.4 SD) change. We controlled out data through carotid-radial instead of aortic approach. However, the data extracted from adults also suggested an increase in the arterial stiffening especially for extreme scores of zBMI. Weight loss can be obtained through healthy lifestyle which also reduces pulse wave velocity [32]. We limited our PWV measurements to carotid-radial region in order to avoid burden from obese participants. Recent trials also suggest that pulse wave velocity may also variate by anatomical region [33].

CONCLUSIONS:

Our population showed an increase in the adiposity which has a positive relation with arterial stiffness; however, segregation through severity level was not reliable. The lack of correlations between blood pressure, arterial stiffness and cardiometabolic blood compromises the factors of reliability which predict the chances of CVD among obese adolescents. Conventional cardiometabolic indicators (dyslipidemia and hypertension) need careful interpretation, especially in the course of pharmacological treatments. More research work will even clarify the interdependence of various variables.

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