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Association between body anthropometric parameters and indices of cardiac autonomic function among apparently healthy young adults

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ABSTRACT

Background: Anthropometric parameters are useful for indexing cardiovascular variables. **Objectives:** This study aimed at determining the association between anthropometric parameters and autonomic cardiovascular indices (ACIs) among young adults. **Materials and Methods:** It was a cross-sectional descriptive study involving 204 healthy young adults who were residents of Ile-Ife. The weight (kg) and height (m) were measured with health scale while body mass index and body surface area were calculated using Quetelet index and Mosteller formula, respectively. Each participant was evaluated through a battery of procedures; systolic blood pressure (SBP) response to standing, diastolic blood pressure (DBP) response to sustained handgrip (SH), resting heart rate (RHR), heart rate (HR) variability during Valsalva maneuver, deep breathing, and change of posture while the ACIs were derived as outcome of the procedures. The relationship between the anthropometry and ACI was determined by correlation. **Results:** Height positively correlated with SBP response to posture ($r = 0.107$, $P = 0.128$), DBP response to SH ($r = 0.143$, $P = 0.041$), and heart rate response to deep breathing (HDB) ($r = 0.043$, $P = 0.540$). Height negatively correlated with Valsalva ratio ($r = -0.022$, $P = 0.759$), 30:15 ratio ($r = -0.009$, $P = 0.902$), and RHR (-0.152, $P = 0.030$). Weight correlated positively with postural change in SBP ($r = 0.096$, $P = 0.172$), DBP response to SH ($r = 0.091$, $P = 0.197$), and 30:15 ratio ($r = 0.005$, $P = 0.948$). Weight negatively correlated with HR response to deep breathing ($r = -0.114$, $P = 0.105$) and RHR ($r = -0.153$, $P = 0.029$). **Conclusion:** Anthropometric parameters correlated weakly with most indices of cardiac autonomic function except RHR.

Key Words: Anthropometry, association, cardiac autonomic function, young adults

Introduction

Anthropometric parameters are very useful in public health policy development, clinical decision-making, health risk

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assessment profiling, drug prescription, fluid requirement, and disease diagnosis.[1] There are evidences to suggest that anthropometric parameters vary with age, sex, ethnicity, and race. The ethnic and racial diversity plays a significant role in influencing anthropometric dimensions.[1,2] However, the most commonly assessed anthropometric parameters are weight, height, body mass index (BMI) or Quetelet index, body surface area (BSA), and waist/abdominal circumference. The global epidemic of overweight and obesity termed "globesity" is the major public health problem in developed as well as developing world. Recent study conducted among young adult Nigerians by Ogunlade and Asafa in 2015 showed that more than one in every eight young adults were either overweight or obese.[3] Overweight and obesity accounted for as many as 15-30% of deaths from coronary heart disease and 65-75% of new cases of type 2 diabetes mellitus.[4] Overweight is the second risk factor for type 2 diabetes mellitus.[5] The risk of sudden cardiac death with increasing weight was reported in a Framingham study.[6] Overweight and obesity result from an energy surplus over time that is stored in the body as fat. How genetic and environmental factors contribute to overweight and obesity is not well understood.[3,7] Height and BSA usually play a significant role in influencing cardiovascular variables, especially left ventricular mass (LMV) is such, as their anthropometric parameters were used for indexing LMV.[8,9] Data are sparse with regard to association between body anthropometric parameters and cardiac autonomic function (CAF) indices among Africans. This study aimed at determining the association between anthropometric parameters and autonomic cardiovascular indices (ACIs) among young adults.

Materials and Methods

This study was carried out at the Department of Physiological Sciences, Obafemi Awolowo University, Ile-Ife. It was a cross-sectional descriptive study involving 204 apparently healthy adults between the ages of 18 and 40 years. Selection was done by convenient sample technique. The target population was the residents of Obafemi Awolowo University community, Ile-Ife, Nigeria. Ethical clearance was obtained from Ethics and Research Committee of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife. Volunteers who consented to participate in the study were informed about the CAF tests through an enlightenment talk and then subjected to clinical screening procedure. The clinical screening entailed history taking and physical examination. During this time, the subjects were evaluated to exclude cardiovascular diseases. The blood pressure (BP) (in millimeters of mercury), weight (kg), and height (m and cm) were measured using digital sphygmomanometer (The Lumiscope Company, Inc., China), ZT120 Health Scale, and stadiometer, respectively. The BMI was calculated from height (m) and weight (kg)[10] and BSA was calculated from the weight (kg) and height (cm) using Mosteller formula.[11] All subjects were confirmed to have normal sinus rhythm by electrocardiography (ECG). The tests were performed after 5 min of relaxation. No intake of coffee, tobacco, alcohol, and medications were allowed 24 h before the tests. Subjects also had resting ECG recorded to exclude asymptomatic cardiac rhythm disorder. Each participant performed CAF tests consisting of BP response to standing, BP response to sustained handgrip (SH), heart rate (HR) response to Valsalva maneuver, HR variation with deep breathing, and HR response to standing. The data obtained were analyzed using SPSS version 17.0 software. Relationship between nominal and categorical variables was determined by Pearson's correlation coefficient and Chi-square test. $P < 0.05$ was taken as statistically significant.

Results

A total of 204 young adults (98 men, 106 women) between the ages of 18 and 40 years participated in the study. The mean age in years, weight in kilogram, height in meters, BMI in kg/m^2, and BSA in m^2 ± standard deviation of the participants were 22.45 ± 4.86, 59.86 ± 10.05, 1.66 ± 0.08, 21.08 ± 3.41, and 1.66 ± 0.16, respectively.

Height positively correlated with systolic blood pressure (SBP) response to posture, diastolic blood pressure (DBP) response to SH, tachycardia ratio, bradycardia ratio, and HDB, but negatively correlated with Valsalva ratio, 30:15 ratio, and resting HR (RHR). Weight positively correlated with postural change in SBP, DBP response to SH at 30% of maximum voluntary contraction, Valsalva ratio, bradycardia ratio, and 30:15 ratio, but negatively correlated with tachycardia ratio, HR response to deep breathing, and RHR [Table 1]. Height significantly correlated with DBP response to SH ($r = 0.143$, $P = 0.041$). RHR showed a significant correlation to height ($r = -0.152$, $P = 0.030$) and weight ($r = -0.153$, $P = 0.029$).

Pearson's correlation coefficient was computed to assess the relationship between BMI or BSA and ACIs. BMI positively correlated with SBP response to change of posture, Valsalva ratio, bradycardia ratio, and 30:15 ratio, but negatively correlated with DBP response to SH, tachycardia ratio, RHR, and HR response to deep breathing. BSA positively correlated with postural change in SBP, DBP response to SH, Valsalva ratio, bradycardia ratio, and 30:15 ratio, but negatively correlated with tachycardia ratio, HR responses to deep breathing, and RHR [Table 2]. BMI significantly correlated with tachycardia ratio ($r = -0.147$, $P = 0.036$) and HR response to deep breathing ($r = -0.153$, $P = 0.029$) whereas BSA significantly correlated with RHR ($r = -0.182$, $P = 0.009$).

Discussion

The BP response mainly reflects sympathetic tone whereas the HR response mainly reflects parasympathetic tone. In this present study, height positively correlated with postural change in SBP, DBP response to SH, tachycardia and bradycardia ratios. Height negatively correlated with Valsalva ratio, 30:15 ratio, and RHR. Weight positively correlated with postural change in SBP, DBP response to SH, Valsalva ratio, bradycardia ratio, and 30:15 ratio. Weight negatively correlated with tachycardia ratio, HR changes with respiration, and RHR. Moreover, BMI positively correlated with postural change in SBP, Valsalva ratio, bradycardia ratio, and 30:15 ratio. BMI negatively correlated with DBP response to SH, tachycardia ratio, RHR, and HR response to deep breathing. BSA positively correlated with postural change in SBP, DBP response to SH, Valsalva ratio, bradycardia ratio, and 30:15 ratio. BSA negatively correlated with tachycardia ratio, HR changes with respiration, and RHR. These findings supported an association (weak) between anthropometry and tones of autonomic system (sympathetic and parasympathetic). This was in concordance with the findings of Sztajzel *et al*., 2009[12] who reported a significant association between obesity and HR variability in women. Similarly, Peterson *et al*. in 1988[13] reported depressions in sympathetic and parasympathetic activity which were significantly but weakly associated with increasing percentages of body fat. Davy and Orr, 2009,[14] also described relationship between sympathetic activity and weight changes while emphasizing the role of sympathetic nervous system in the regulation of metabolic and cardiovascular homeostasis.

Table 1: Association between height or weight and autonomic cardiovascular indices

ACI	Height (m)		Weight (kg)	
	r	*P*	r	*P*
SBP response to CP	0.107	0.128	0.096	0.172
DBP response to SH	0.143	0.041*	0.091	0.197
Valsalva ratio	−0.022	0.759	0.095	0.179
Tachycardia ratio	0.043	0.546	−0.097	0.169
Bradycardia ratio	0.026	0.715	0.039	0.582
Heart rate response to deep breathing	0.043	0.540	−0.114	0.105
30:15 ratio (PTI)	−0.009	0.902	0.005	0.948
Resting heart rate	−0.152	0.030*	−0.153	0.029*

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, CP: Change of posture, SH: Sustained handgrip, PTI: Postural tachycardia index, ACI: Autonomic cardiovascular indices, *Statistically significant at *P*-value <0.05

Table 2: Association between body mass index or body surface area and autonomic cardiovascular indices

ACI	BMI		BSA	
	r	*P*	r	*P*
SBP response to CP	0.025	0.718	0.111	0.113
DBP response to SH	−0.001	0.988	0.119	0.090
Valsalva ratio	0.136	0.053	0.073	0.296
Tachycardia ratio	−0.147	0.036*	−0.072	0.303
Bradycardia ratio	0.033	0.644	0.036	0.607
Heart rate response to deep breathing	−0.153	0.029*	−0.086	0.219
E:I ratio	−0.105	0.136	0.036	0.608
30:15 ratio (PTI)	0.013	0.854	0.003	0.965
Resting heart rate	−0.080	0.255	−0.182	0.009*

BSA: Body surface area, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, CP: Change of posture, SH: Sustained handgrip, PTI: Postural tachycardia index, ACI: Autonomic cardiovascular indices, BMI: Body mass index, *Statistically significant at *P*-value <0.05

In the evaluation of altered CAF across different levels of BMI among 1437 participants (underweight = 74, normal weight = 588, overweight = 313, obesity Class 1 = 390 and Class II = 72), it was observed that CAF altered significantly among overweight and obesity toward increase in sympathetic tone and a decrease in parasympathetic modulation of the heart. Underweight was not apparently associated with a significant alteration in CAF.[15] No previous study revealed that CAF tests had been indexed based on the body anthropometric measures. This may be so because of the weak association between the anthropometric parameters and the ACIs as demonstrated in this study.

Conclusion

This study demonstrated that weight, height, BMI, and BSA correlated weakly with most of the indices of CAF, as such may not need indexation in young adults.

Limitations of the study

This study was primarily limited by the age group (18-40 years) recruited for evaluation. Increasing the range of the age group to involve middle aged and elderly could have been more appropriate, especially since the incidence of ailments that affect autonomic nervous system increases with age. Doing this will require more financial and time commitments as majority of the participants may drop out of the study at screening stage due to the presence of cardiovascular diseases in the age group above 40 years.

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Conflicts of interest

There are no conflicts of interest.

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