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Research Article

Effects of age and sex on autonomic cardiovascular indicies among apparently healthy young adults

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Abstract: Assessment of cardiac autonomic function (CAF) is an important non-invasive investigation in medical practice. This study aimed at assessing the effects of age and sex on autonomic cardiovascular indices. It was a cross-sectional descriptive study involving 204 apparently healthy adults between the ages of 18 and 40years who were residents of Obafemi Awolowo University community, Ile-Ife, Nigeria. Each of the participants performed five non-invasive cardiac autonomic function tests in series after excluding the systemic diseases by clinical evaluation. The five cardiac autonomic function tests were: Systolic Blood Pressure (SBP) response to change of posture (supine to erect), Diastolic Blood Pressure (DBP) response to sustained handgrip at 30% maximum voluntary contraction (MVC), Heart rate response to Valsalva maneouvre, Heart rate responses to Deep Breathing (HDB) and heart rate response to standing. The data obtained was analyzed with SPSS version17.0 software using descriptive statistics, correlation and Student t-test. A p value of < 0.05 was taken as statistically significant. Age was positively correlated with SBP response to posture, DBP response to sustained handgrip, Valsalva ratio and bradycardia ratio. Age was negatively correlated with tachycardia ratio, HDB, 30:15 ratio and resting heart rate. Significant gender difference was demonstrated in resting heart rate ($t= -3.05$, $p = 0.003$) and diastolic blood pressure response to sustained handgrip ($t = 3.40$, $p=0.001$).
Keywords: Sex, Age, Effect, Autonomic cardiovascular indices, healthy, young adults.

INTRODUCTION

Evaluation of CAF is indicated in the management of diseases such as diabetes mellitus, amyloidosis, paraneoplastic neuropathy and acute pan autonomic neuropathy [1, 2]. Patients with syncope, postural orthostatic tachycardia syndrome, hypertensive heart diseases and congestive cardiac failure can also be assessed by cardiac autonomic function tests [3-5]. The goals of autonomic function tests include evaluation of the severity and distribution of autonomic function, diagnosis of limited autonomic neuropathy, diagnosis and evaluation of orthostatic intolerance, monitoring of the course of dysautonomia, monitoring of the response to treatment and research into autonomic dysfunctions [5].

Ageing is associated with alteration of the cardiac autonomic function especially after the age of 40 years. Ageing is also increased dependency on sympathetic control of cardiac responses and reduced vagal responsiveness. The blunted vagal modulation of the heart may be related to altered neural vagal discharge to sinoatrial node or to a change in the functional ability of the cardiac pacemaker itself. Gender differences have been reported in some non-communicable diseases such as hypertension [6-8] which has effect on cardiac autonomic functions. The normal limit of cardiac autonomic indices among young adults in the South-Western Nigeria was described recently [9]. Data were sparse with regards to the effects of age and sex on the autonomic cardiovascular indices among Africans. Hence, this study.

MATERIALS AND METHODS

The study was carried out at the Department of Physiological Sciences, Obafemi Awolowo University, and Ile-Ife. It was a cross-sectional descriptive study involving 204 apparently healthy adults between the ages of 18 and 40years. The target population were the residents of Obafemi Awolowo University community, Ile-Ife, Nigeria. Volunteers who consented to participate in the study were informed about the cardiac autonomic function tests through an enlightenment talk and then subjected to clinical screening procedure. The clinical screening entailed history taking and physical examination, including documentation of their age and sex. The blood pressure (mmHg) assessed using digital sphygmomanometer (Lumiscope). Subjects also had resting electrocardiogram (ECG) recorded to exclude asymptomatic cardiac rhythm disorder. Volunteers who met the inclusion criteria (normal blood pressure <140/90mmHg, asymptomatic for systemic diseases,

non-athletes and normal blood sugar checked by the use of glucometer) participated in the study. Any of the participants on medications such as adrenergic receptor blockers, centrally acting drugs, vasodilator, angiotensin-converting enzyme inhibitors, hypoglycaemic drugs, antidepressant or any other drugs that could interfere with autonomic function were excluded from the study. Each participant undergone cardiac autonomic function tests which comprises of five different procedures namely; Systolic Blood Pressure (SBP) response to change of posture (supine to erect), Diastolic blood pressure (DBP) response to sustained handgrip at 30% maximum voluntary contraction (MVC), Heart rate response to Valsalva Ratio, Heart rate responses to Deep Breathing and Heart rate response to standing using the procedure described by Ogunlade *et al.;* in 2015[9]. The data obtained was analyzed using SPSS version17.0 software using descriptive statistics, correlation and Student t-test. A p value of < 0.05 was taken as statistically significant.

RESULTS

A total of 204 young adults, 98(52%) men and 106(48%) women between the ages of 18 and 40 years completed the study. The mean age of the participants was 22.45±4.86years. The mean age (years) for men and women were 23.72±5.32 and 21.26 ± 4.06 respectively. The distribution of the participants according to age groups (years) ≤ 20, 21-30 and 31-40 were 45.1%, 48.5% and 6.4% respectively. The most frequent age group category was 21-30 years. Age was positively correlated with SBP response to posture, DBP response to sustained handgrip, Valsalva ratio and bradycardia ratio. Age was negatively correlated with tachycardia ratio, HDB, 30:15 ratio and resting heart rate as shown in table 1. Significant gender difference was demonstrated in resting heart rate (t= -3.05, p = 0.003) and diastolic blood pressure response to sustained handgrip (t = 3.40, p=0.001). No statistical significant gender difference in all other autonomic cardiovascular indices in the table 2.

Table 1 Effects of age on ACI

ACI	R	p-value
SBP response to CP	0.112	0.109
DBP response to SH	0.055	0.432
Valsalva ratio	0.145	0.039
Tachycardia ratio	-0.116	0.100
Bradycardia ratio	0.070	0.321
HDB	-0.250	< 0.001*
30:15 ratio(PTI)	-0.123	0.079
Resting HR	-0.119	0.089

N =204, *Significant correlation between HDB and age, ACI- Autonomic Cardiovascular Indices, HDB (beats per minute) - Heart rate response to Deep Breathing (maximum inspiratory heart rate - minimum expiratory heart rate), r-Pearson correlation coefficient, HR-Heart Rate, PTI-Postural tachycardia index, CP- change of posture (supine to erect)
Age was positively correlated with SBP response to posture, DBP response to sustained handgrip, Valsalva ratio and bradycardia ratio. Age was negatively correlated with tachycardia ratio, HDB, 30:15 ratio and resting heart rate.

Table 2: Effects of gender on autonomic cardiovascular indices

ACI	Men (N=98) Mean ± SD	Women (N=106) Mean ± SD	T	p-value
Resting heart rate (bpm)	67.95±11.75	73.08±12.20	-3.05	0.003*
SBP response to CP	-4.92±9.44	-3.65 ±8.92	-0.99	0.352
DBP response to SH	24.33±19.77	16.26±13.76	3.40	0.001*
Valsalva ratio	1.55±0.39	1.55±0.41	-0.10	0.924
Tachycardia ratio	0.81±0.12	0.81±0.14	0.10	0.920
Bradycardia ratio	1.22 ±0.21	1.21 ±0.20	0.17	0.866
HDB	31.50± 9.87	32.12±11.65	-0.41	0.682
30:15 ratio (PTI)	1.41±0.22	1.40±0.37	0.05	0.956

* p value < 0.05, HDB (beats per minute) -Heart rate response to Deep Breathing (maximum inspiratory heart rate - minimum expiratory heart rate), bpm-beats per minute, PTI- Postural tachycardia index, ACI- autonomic cardiovascular indices, CP-change of posture (supine to erect),
SBP-Systolic blood pressure (mmHg), DBP-Diastolic blood pressure (mmHg)

Significant gender difference was demonstrated in resting heart rate (t= -3.05, p = 0.003) and diastolic blood pressure response to sustained handgrip (t = 3.40, p=0.001).

DISCUSSION

The study showed that age was positively correlated with postural change in SBP. This was in contrast with the earlier reports from the study among

Caucasians [10, 11] and in northern Tanzania [12]. Age also have positive correlation with effects of sustained handgrip on DBP, Valsalva ratio and bradycardia ratio. Age was negatively correlated with tachycardia ratio, HDB, 30:15ratio and resting heart rate. Ageing is associated with increased dependency on sympathetic control of cardiac responses and reduced vagal responsiveness. The blunted vagal modulation of the heart may be related to altered neural vagal discharge to sinoatrial node or to a change in the functional ability of the cardiac pacemaker itself [13].

There was no significant gender difference in SBP response to postural change with regards to increase or decrease SBP responses. Also, with regards to the mean value of change in SBP, there was no significant gender difference between men and women. This latter finding was contrary to the findings of Ludwig et al, 2001 which found that absolute fall in SBP in men was higher than women [14]. This may be so in the study because of the small sample size of 12 (6men and 6women) compared with this present study of 98 men and 106 women. Moreover, significant gender differences with autonomic responses were previously described over a wide range of age group (10-88 years) in a previous study [15]. The gender difference was attributed to variability in neuro effector distribution in both sexes [14].

Significant gender difference was found in the DBP response to sustained handgrip. A rise in DBP was higher in men than in women (Table 2). This was consistent with previous studies which described a smaller rise in DBP following isometric exercise in women when compared with their men counterpart [16,17]. It has been observed that the difference in between men and women in response to sustained handgrip was due to higher level of vasoconstrictive reserve and sympathetic flow in men during isometric exercises [17, 18]. The mean resting heart rate (normal limits) of women [73.08±12.20 (55.35-94.00) beats per minute] was significantly higher ($t = -3.05$, $p= 0.003$) than that of men [67.95±11.75 (51.00-86.00) beats per minute]. HDB is one of the most reliable indices of cardiac parasympathetic functions. The HDB during deep breathing was higher in women (32.12 ± 11.65 beats per minute) than in men (30.77 ± 11.98 beats per minute) but the difference was not statistically significant.

In conclusion, among young adult population, age significantly affected heart rate response to deep breathing while sex significantly affected resting heart rate and diastolic blood pressure to sustained hand grip.

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