Journal of Applied Life Sciences International
2(3): 107-112, 2015; Article no.JALSI.2015.011
ISSN: 2394-1103

SCIENCEDOMAIN *international*
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Gender and Height in Relation to Blood Pressure and Heart Rate of Medical Students of University of Abuja

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Authors' contributions

This work was carried out in collaboration between all authors. Author JOO designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author MOE managed the literature searches, analyses of the data and author IA collected the experimental data in the laboratory. All authors read and approved the final manuscript.

Article Information

DOI:10.9734/JALSI/2015/14387
Editor(s):
(1) Shahla Alalaf, Department of Obstetrics and Gynaecology, College of Medicine, Hawler Medical University, Iraq.
(2) Leung Ping-Chung, Centre for Clinical Trials on Chinese Medicine, Institute of Chinese Medicine, The Chinese University of Hong Kong (CUHK), Hong Kong.
Reviewers:
(1) Anonymous, USA.
(2) Anonymous, India.
(3) Anonymous, Nigeria.
(4) Anonymous, Russia.
Complete Peer review History: http://www.sciencedomain.org/review-history.php?iid=879&id=40&aid=7965

Original Research Article

Received 29th September 2014
Accepted 19th January 2015
Published 31st January 2015

ABSTRACT

Aims: The study was carried out to evaluate the effect of gender and height on blood pressure and heart rate of young adults.
Study Design: A cross-sectional study.
Place and Duration of Study: Ninety one (91) medical students aged 18-30 years at University of Abuja, Nigeria were recruited in May 2012 for this study.
Methodology: The selected study population was administered semi-structured self-administered questionnaire. The blood pressure, the pulse rate and the height of the participants were measured in physiology laboratory of University of Abuja medical school. All the readings were taken by one

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researcher to ensure uniformity.
Results: The systolic blood pressure increased significantly with diastolic blood pressure. There was positive correlation between blood pressure and heart rate in males, though not statistically significant, while in females a negative correlation was observed. Males had higher systolic and diastolic blood pressure while females had higher heart rate. The blood pressure and heart rate increased with increasing height in males but both reduced with increasing height in females. BMI was positively associated with increase in blood pressure and reduction in heart rate for both sexes.
Conclusion: This study found that systolic blood pressure increased significantly with diastolic blood pressure and BMI was positively associated with height, increase in blood pressure and reduction in heart rate for both sexes.

Keywords: Systolic blood pressure; diastolic blood pressure; heart rate; height; gender; BMI.

1. INTRODUCTION

In both the developed and the developing countries, systemic hypertension exists and remains a health problem. Systemic hypertension is a common disorder, if not effectively treated, increases the risk of coronary thrombosis, strokes and other associated diseases [1]. Persistently raised arterial blood pressure leads to hypertrophy of the left ventricle and remodeling of resistance arteries, with narrowing of the lumen, predisposing to atherosclerosis. Most cases of systemic hypertension involve no obvious cause but lifestyle may have a role in its development since common anti-hypertensive drugs combined with lifestyle changes lowers blood pressure and reduces the risk of heart attacks and stroke associated with the diseases [1]. There are evidences that heart rate and blood pressure are related at all ages and in both gender [2]. Researchers are always verifying documented facts and exploring gray areas in an attempt to break new grounds or to add to already known facts. We have chosen to engage in this research to evaluate the effect of gender and height on blood pressure and heart rate of undergraduate medical students. Though there are established relationships between blood pressure/heart rate and parameters like age, gender and height [3], establishing these in this environment would authenticate the facts in blacks/Nigerians.

2. MATERIALS AND METHODS

The study took place in University of Abuja, Abuja, Nigeria. It is a Federal University situated in the Federal capital territory of Nigeria. This descriptive cross-sectional study was carried out on the medical students of the University of Abuja, Nigeria recruited in May 2012. The selected study population was administered semi-structured self-administered questionnaire.

2.1 Materials

Mercury sphygmomanometer (Accuson®), stethoscope (Littmann® Classic II S.E.), stadiometer (HardikMedi – Tech India) and stop watch.

2.2 Study Population

The study population comprised of 91 students (56 males and 35 females) out of 115 medical students of the college of health sciences, University of Abuja.

2.3 Procedure

An ethical approval was obtained from the Ethical Committee of the university. Before the screening, all necessary information about the research was made known to the participants and a consent form signed by each subject. All the students of the medical school (115) were administered questionnaires and subjects with history of cardiac defects, chest or heart surgery, pregnant females, respiratory diseases and those on drugs as well as those who decided not to participate were excluded from the study. The blood pressure, the pulse rate and the height of the participants were then measured in the physiology laboratory (between 9 am and 12 noon each day). All the readings were taken by one researcher to ensure uniformity.

2.4 Blood Pressure Measurement

The auscultatory method for measurement of blood pressure (BP) with readings taken in millimeters of mercury (mmHg) adhering to the following procedures: A trained researcher took the blood pressure measurement; subject rested for 15 minutes before BP measurement; BP measured with subject seated and the

sphygmomanometer placed on a flat table on the level of the subject's heart; the cuff of the sphygmomanometer placed in the upper 2/3 of the right arm of subject; the diaphragm of the stethoscope for auscultation placed over the mid-cubital fossa; records of 3 BP measurements were taken at 3 minutes intervals and an average of the three measurements recorded as the subjects' blood pressure.

2.5 Heart Rate Measurement

The radial pulse rate was taken after the subjects rested for 15 minutes in seating position and readings expressed in beats per minutes (bpm). Three consecutive readings were taken and the average recorded as the subjects' pulse rate. Pulse measurement was manual by researcher's middle and index fingers placed over the radial artery that is the lateral side of the right forearm just proximal to the wrist.

2.6 Height and Weight Measurement

A calibrated stadiometer (for weight and height) was used to measure the subject's height in meters, with participant standing barefooted and upright on the base of the stadiometer. It was also used to measure the subject's weight in kilogram with minimal clothing.

2.7 Determination BMI

The body mass index was calculated from the weight and height measurements by dividing the weight of respondents by the square of their height. The International Obesity Task Force (IOTF) BMI cut off points [4] was used to classify the calculated BMI values. Therefore, Participants with BMI values corresponding to an adult BMI of <25 kg/m^2 were classified as normal weight, participants with BMI values corresponding to an adult BMI of 25 to 29.9 kg/m^2 were classified as overweight, and participants with BMI values corresponding to an adult BMI of 30 kg/m^2 and above were classified as obese.

2.8 Data Analysis

The data was analyzed using the Epi Info statistical software package version 7.0.8.3 (Epi Info, CDC, Atlanta, GA, USA) and Microsoft Windows excel 2010. Pearson correlation was used to find relationships between variables. The level of significance was placed at $P \leq 0.05$.

3. RESULTS AND DISCUSSION

Of the 91 young adult participants only 86 were considered because 5 dropped out in the course of the research.

3.1 Demographic Variables

The study group comprised of 52 males (60.5%) and 34 females (39.5%) subjects. Table 1 shows the age distributions of the subjects.

Table 1. Age distribution of subjects

Age group (years)	Sex		Frequency	Percent (%)
	Male	Female		
<20	1	11	12	13.9
20 - 25	43	23	66	76.7
26 - 30	8	0	8	9.3

3.2 Blood Pressure

Systolic Blood Pressure and Diastolic Blood Pressure in both sexes are shown in Table 2.

3.3 Heart Rate

The mean heart rate was 77±16 bpm for male subjects and 87±11 bpm for female subjects (Table 2). The average heart rate for all subjects was 81±15 bpm.

3.4 Height

The height distribution shows that the average height of the male students is 1.7±0.1 m and 1.6±0.1 m for the female students.

3.4 Weight

The weight distribution of the subjects showed the mean weight of the males to be 68.0±11.0 kg while that of the females was 58.0±9.7 kg.

3.5 Calculated Body Mass Index (BMI)

From the calculated BMI of the study groups, only 1 male subject was underweight, 44 were normal while 7 were overweight. There were no obese male subjects. However, 4 females were underweight, 23 were normal, 2 overweight and 1 was obese. In general, 5 subjects were

underweight, 9 overweight, 1 obese, 67 fell within normal range while the information for the remaining 4 subjects was missing.

3.6 Correlation of Variables

The correlations of the variables (blood pressure, heart rate, height, weight and BMI) in both sexes are as follows.

In all subjects, there was significant positive correlation between arterial systolic blood pressure (SBP) and diastolic blood pressure (DBP) (r = 0.79).

For male respondents alone, there was significant positive correlation between SBP and DBP (r = 0.81).

For the female respondents, there was also a significant positive correlation between SBP and DBP (0.80). Height of females correlated positively with SBP (r = 0.05) but negatively with DBP (r = -0.09), though not significantly. A negative correlation occurred between heart rate and height of the female respondents in this study (r = -0.24). In addition, there was a negative correlation between weight and both DBP (r = -0.01) and heart rate (r = -0.54) in this study.

The BMI relationship with blood pressure was demonstrated through an insignificant correlation on both SBP and DBP in this study In females the BMI correlated positively (r = 0.89) with height. In males also the BMI correlated positively (r = 0.74) with height.

4. DISCUSSION

This study, conducted on the University of Abuja medical students below the age of 30 was to evaluate the relationship between blood pressure and heart rate across gender and height. From the study population of 86 participants, 52 of them were male (60.47%) while 34 were female (39.55%). Most of the participants were within the age range of 20-25 years (76.74%), while others were below 20 years (13.95%) and 26-30 (9.30%). The males were taller with a mean height of 1.74±0.08 m while the females had a mean height of 1.65±0.07 m. This is similar to works of Convertino [3] with males taller than female respondents. The weight distribution showed the males having more weight with average of 67.97±10.75 kg than the females with 57.96±9.70 kg which also is similar to works of Convertino [3] with the same distribution pattern.

The difference in arterial Systolic Blood Pressure of the male and female respondents was not statistically significant. This was not the case in a similar study in Italy [5]; in Columbia [6], and in Los Angeles USA [7] where males were reported to have a higher SBP. The same was the case with arterial Diastolic Blood Pressure of the in male and female respondents (no statistical difference). This is different from the study by Jacquet et al. [7] who found a significant gender difference (elderly females having higher diastolic blood pressure than their male counterparts).

The mean heart rate of females 87.06±11.88 bpm differ significantly from that of the males 76.56±15.76 bpm with about 10.00 bpm higher. This higher heart rate in females is in keeping with the findings of researchers in Italy [5]; Columbia, [6] and Los Angeles USA [7,3]. This finding therefore is in agreement with other developing as well as the developed world (Columbia and Italy/USA respectively).

The correlation coefficients ascertained the connections between the measured parameter; blood pressure, height, and heart rate in male and female respondents. In both sexes, there was a positive and significant correlation between arterial systolic blood pressure (SBP) and diastolic blood pressure (DBP) (r = 0.79). This is consistent with the findings of Ejike et al. [8] who used Pearson's product moment correlation coefficients for the variables and the correlation coefficients showed that systolic blood pressure correlated positively with diastolic blood pressure (r = +0.50, p < 0.01) [8].

Table 2. Blood pressure and heart rate of subjects

Variable	Males (n=52)	Females (n=34)	p value
	Mean ± S.D	Mean ± S.D	
SBP (mmHg)	123 ±17	117±17	0.13
DBP (mmHg)	76±17	77±15	0.76
HR (bpm)	77±16	87±12	0.00*

** indicate significant difference (p is significant when p < 0.05). SBP = Systolic Blood Pressure DBP = Diastolic blood pressure. HR = Heart Rate. S.D =Standard deviation*

For male respondents, there was also a positive significant correlation between SBP and DBP (r = 0.81). SBP and DBP are both positively correlated to heart rate. The finding corroborate the study by Schall et al. [9] who reported that pulse rate and both systolic blood pressure (SBP) and diastolic phase IV blood pressure (DBP) show a positive association throughout adolescence for females (r = 0.16 SBP, r = 0.24 DBP) but not for males (r = -0.06 SBP, r = 0.06 DBP) in blacks in Philadelphia USA [9]. But in males, there was no significant correlation noticed between height and blood pressure or heart rate in this study unlike the findings of Soergel et al. [10] that showed the 50th percentile for 24-hour systolic Arterial BP increased moderately with height, from 103 to 113 mmHg in girls and from 105 to 120 mmHg in boys, in Europeans.

For female respondents, as earlier mentioned, there was a significant positive correlation (r=0.80) between SBP and DBP. But no significant correlation was seen between heart rate and both SBP and DBP. This is contrary to the findings of Schall et al. [9,] and [10], reasons for this could be that the age of respondents was different in our study (much older respondents). Also height of females correlated positively with SBP (r = 0.05) but negatively with DBP (r = -0.09) which is contrary to the findings with a positive but not significant correlation between height and diastolic blood pressure [8]. This difference can be attributed to the age category of the study (older respondents) unlike that in primary school aged respondents in the referred study [8]. A negative correlation occurred between heart rate and height of the female respondents in this study (r = -0.24) and in another study which found that Short stature induces a faster heart rate [11]. This was thought to be so, because the early systolic arrival of reflected waves in short people acts to stiffen the aorta and stiffening lowers the aortic diastolic pressure and, coupled with a shortened diastole, could adversely influence myocardial supply [11]. Moreover, this evidence supports a physiologic hypothesis for the body height–cardiovascular risk association [11]. In addition, there was a negative correlation between weight and both DBP (r = -0.01) and heart rate (r = -0.54) in this study, which is similar to the findings of Hendricks et al. on obese respondents [12].

The BMI and blood pressure do not show strong relationship as was demonstrated in its correlation with both SBP and DBP in this study. But some researchers [13], observed a threshold at 21 kg/m^2 in the relationship between BMI and BP for women but not for men, that contributes to the effort of identifying the mechanisms that underlie this relationship and how they differ by gender. In both female and male, the BMI correlated positively (r = 0.89; and r = 0.74 respectively) with height in this study but in Mandel et al. [14], there was a positive correlation between BMI and height in men (r = 0.02), while the correlation was negative in women (r = -0.05).

One of the limitations of the study is the small sample size. This is because this is a pilot study, the first in the series of such studies to collect pool of data to use in the future. We intend to replicate this study in subsequent sets of medical students coming into this new medical school so that in a few years to come we will a substantive number in the pool. We recommend expanding the study to include other students of the University so we can have a larger sample size and also adding serological studies if fund is available.

5. CONCLUSION

In summary, this study found that systolic blood pressure increased significantly with diastolic blood pressure. Males had higher systolic and diastolic blood pressure while females had higher heart rate. The blood pressure and heart rate increased with increasing height in males but both reduced with increasing height in females. BMI was positively associated with height, increase in blood pressure and reduction in heart rate for both sexes.

CONSENT AND ETHICAL APPROVAL

All the subjects signed informed consent form and told they can freely pull out of the study at any stage without any explanation.

We hereby declare that all experiments have been examined and approved by the ethical committee of University of Abuja and have therefore been performed in accordance with the ethical standards laid down in the 1964 declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history.php?iid=879&id=40&aid=7965