British Journal of Medicine & Medical Research
13(8): 1-6, 2016, Article no.BJMMR.23731
ISSN: 2231-0614, NLM ID: 101570965

SCIENCEDOMAIN *international*
www.sciencedomain.org

Elevated Body Mass Index and Waist Circumference Induced Hypertension is not Significantly Reversed by Oral Administration of Antihypertensive Agent

Akinwumi T. Ogundajo[1*], Modupe F. Asaolu[1] and Ridwan T. Oladipo[2]

[1]Department of Biochemistry, Ekiti State University, Ado- Ekiti, Ekiti State, Nigeria.
[2]Department of Chemical Pathology, Obafemi Awolowo University Teaching Hospital Complex, Wesley Guild Hospital Unit, Ilesa, Osun State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author ATO designed the study, wrote the protocol, carried out all anthropometric measurements and wrote the first draft of the manuscript. Author MFA managed the literature searches, performed the statistical analysis. While author RTO wrote the final draft of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2016/23731
Editor(s):
(1) Shashank Kumar, Assistant Professor, Center for Biochemistry and Microbial Sciences Central University of Punjab, India.
Reviewers:
(1) Mra Aye, Melaka Manipal Medical College, Malaysia.
(2) Anonymous, University of Firenze, Italy.
(3) Rodrigo Crespo Mosca, Sao Paulo University, Brazil.
Complete Peer review History: http://sciencedomain.org/review-history/13183

Original Research Article

Received 18th December 2015
Accepted 13th January 2016
Published 6th February 2016

ABSTRACT

Aims: This study investigated the effects of elevated body mass index and waist circumference on blood pressure control in hypertensive subjects under a specific antihypertensive agent in comparison with normotensive subjects.
Study Design: One factor quasi-experimental design.
Place and Duration of Study: Department of Biochemistry, Ekiti State University, Ado- Ekiti, Ekiti State, Nigeria. December, 2014-November, 2015.
Methodology: The research subjects and control subjects between ages 31-60 years both male and female subjects were selected. Systolic and diastolic blood pressures were measured using mercury sphygmanometer. The body mass index was calculated as weight in kilograms divided by the square of the height in metres. While the waist circumference was measured at the level of the

**Corresponding author: E-mail: adetap@yahoo.com;*

iliac crests using a flexible tape and passing along the umbilical level of the unclothed abdomen.
Results: Comparing the body mass index and waist circumference of both untreated and treated hypertensive subjects with the normotensive subjects showed a significant increase (P=0.0001).
Conclusion: Elevated body mass index and waist circumference may be a predisposing factor to high blood pressure and resistant to antihypertensive agents. Reducing body mass index and waist circumference may be a way of enhancing effectiveness of antihypertensive agents.

Keywords: Hypertension; antihypertensive agents; body mass index; waist circumference; normotensive; subject.

1. INTRODUCTION

Hypertension is a medical condition characterized by persistent elevation of diastolic or systolic blood pressure above the level of normal blood pressure of 140/90 mmHg [1,2]. Hypertension is currently considered a major public health problem due to its importance as a cardiovascular risk factor. According to World Health Report of 2002, it was said that high blood pressure is the primary or secondary cause of 50% of all cardiovascular diseases worldwide. Researchers have shown growing evidence that prevalence of hypertension is on the increase in most Sub-Saharan African countries including Nigeria [3]. Interestingly, a meta-analysis of prevalence rate of hypertension in Nigerian populations ranged from a minimum of 12.4% to a maximum of 34.8% with a combined prevalence of 22% [4-5]. In the same vein, other studies from Nigeria on the knowledge of risk factors and lifestyle showed that over 4.3 million Nigerians above 15 years were classified as being hypertensive [6-8]. Hypertension has been linked to dietary pattern and other sedentary life style with grave biochemical and metabolically consequences [9-10]. The last few years have witnessed considerable changes in the treatment of high blood pressure in Nigeria with different brands of antihypertensive agents available in Nigeria market. It has been reported that the use of antihypertensive agents tripled and resulted in an eight-fold increase in the pharmaceutical expenditure for these agents in the recent year, yet, many still find it difficult to reduce their blood pressure. Past studies have shown that between 50% and 75% of patients diagnosed with or receiving treatment for hypertension do not have adequate control of their blood pressures [11]. Factors such as central obesity increases risk and constitute a base for the development hypertension [12-17] while body mass index (BMI) is commonly used for monitoring the occurrence of obesity in the population. Due to high prevalence of unhealthy eating habits and lifestyle together with high prevalence of overweight, obesity and increased consumption of different brands of antihypertensive agents by Nigerians, it is important to investigate the relationship between antihypertensive agent consumption; blood pressure control and selected anthropometric measurement especially body mass index and waist circumference. Hence, the need for this study.

2. MATERIALS AND METHODS

2.1 Subjects

The research subjects between ages 31 – 60 years both male and female were selected from Nigerians living in Ilesa metropolis of Osun State and grouped into three. Group one consist 100 essential hypertensive subjects that have been under a specific antihypertensive agent for more than six months, group two consist of 100 essential hypertensive subjects that are not under antihypertensive agent while group three consist of 100 subjects that are not hypertensive and not under any anti hypertensive agent. Exclusion criteria include secondary hypertension and any other pathological case. Four classes of commonly used oral antihypertensive agents' namely diuretic, adrenergic receptor antagonist, Calcium channel blockers and angiotensin-converting enzyme inhibitor were selected for this study. The ethical clearance for this study was obtained from Osun State Hospitals' Management Board Ethics and Research Committee.

2.2 Measurements

Informed consent was obtained from the subjects after the study guidelines had been explained to them before clinical history was obtained using structured questionnaire. Blood pressure was taken from dominant arm after ten minutes of rest using appropriate cut size and mercury sphygmomanometer. Systolic (SP) and diastolic blood (DP) pressures were measured at the first and the fifth keroktoff sound respectively. Three

consecutive measurements were made at an interval of five minutes. The mean SP and DP from the 2nd and 3rd measurement were used for the data analysis. The weight (WGT) was measured to the nearest 0.5kg using a weighing scale with the participant wearing light clothing and removes their foot wears. Height (HGT) was measured to the metre using a stadiometer. The BMI was calculated as weight in kilograms divided by the square of the height in millimeters. The waist circumference was measured at the level of the iliac crests using a flexible tape and passing along the umbilical level of the unclothed abdomen.

2.3 Statistical Analysis

Results are presented as mean± SEM. Statistical significance and difference from control and test values evaluated by Student's t-test. Statistical difference at probability of P= .05 were considered to be significant.

3. RESULTS AND DISCUSSION

The benefits of blood pressure reduction following antihypertensive therapy are no longer questioned but attaining a normal blood SP and DP (≤140 and 90) has been a challenge in some cases. BMI (body mass index) and WC (waist circumference) are used to access overweight and obesity and risk of cardiovascular disease among others. This research study the effect of elevated body mass index and waist circumference on blood pressure control in hypertensive subjects under a specific antihypertensive agent and in hypertensive agents subjects that are not under antihypertensive agent in comparison with normotensive subjects and four commonly used antihypertensive agents were considered namely diuretic, adrenergic receptor antagonist, calcium channel blockers and angiotension converting enzyme inhibitor which must have being administered for minimum of six (6) months. Significant increase (P =.0001) were observed when the BMI, WGT, SBP, DBP, WC and HGT of untreated hypertensive subjects and treated hypertensive subjects were compared with normotensive subjects with the exception of HGT of both male treated (male treated group under angiotensin converting enzyme inhibitor therapy not included) and untreated hypertensive subjects which showed no significant change (P=1.000) (Tables 1 - 5).

Table 1. Anthropometric data of normotensive compared with hypertensive subjects

Indices	Gender			
	Male		Female	
	Normo. (n=50	Hyper. (n=50)	Normo. (n=50)	Hyper. (n=50)
HGT (m)	1.7±0.090	1.7±0.011	1.7±0.009	1.6±0.008*
WGT (kg)	72.5±1.632	81.4±1.752*	72.5±1.632	84.8±1.436*
WC (cm)	77.4±4.326	98.2±1.915*	66.0±5.746	83.5±3.419*
BMI (kg/m^2)	25.2±0.470	29.5±0.692*	26.6±0.420	32.3±0.642*
SP (mmHg)	119.0±1.910	161.4±2.841*	125.4±1.601	153.3±3.164*
DP (mmHg)	80.0±1.127	100.4±2.204*	79.1±1.076	94.5± 1.564*

*Values are mean ± SEM. Significant difference between normotensive and hypertensive group by t-test *P=.0001. HGT=Height, WGT=Weight, WC=Waist circumference, BMI=Body mass index, Normo. = Normotensive, Hyper = Hypertensive, n = sample size, SP = Systolic blood pressure, DP = Diastolic blood Pressure*

Table 2. Anthropometric data of normotensive compared with hypertensive subjects under diuretic therapy

Indices	Gender			
	Male		Female	
	Normo. (n=50)	Hyper. (n=50)	Normo. (n=50)	Hyper. (n=50)
HGT (m)	1.7±0.090	1.7±0.013	1.7±0.009	1.6±0.008*
WGT (kg)	72.5±1.632	82.4±1.793*	72.5±1.632	83.6±1.519*
WC (cm)	77.4±4.326	96.8±2.886*	66.0±5.746	88.9±3.235*
BMI (kg/m^2	25.2±0.470	30.0±0.618*	26.6±0.420	32.0±0.675*
SP (mmHg)	119.0±1.910	149.0±2.310*	125.4±1.601	148.2±2.804*
DP (mmHg)	80.0±1.127	93.1±1.439*	79.1±1.076	91.1± 1.246*

*Values are mean ± SEM. Significant difference between normotensive and hypertensive group by t-test *P=.0001. HGT=Height, WGT=Weight, WC=Waist circumference, BMI=Body mass index, Normo. = Normotensive, Hyper = Hypertensive, n = sample size, SP = Systolic blood pressure, DP = Diastolic blood Pressure*

Table 3. Anthropometric data of normotensive compared with hypertensive subjects under adrenergic receptor antagonist therapy

Indices	Gender			
	Male		Female	
	Normo. (n=50)	Hyper. (n=50)	Normo. (n=50)	Hyper. (n=50)
HGT (m)	1.7±0.090	1.7±0.013	1.70±0.009	1.60±0.007*
WGT (kg)	72.5±1.632	83.6±1.588*	72.5±1.632	85.2±1.278*
WC (cm)	77.4±4.326	96.9±2.021*	66±5.746	82.2±3.798*
BMI (kg/m^2)	25.2±0.470	30.8±0.666*	26.6±0.420	32.5±0.579*
SP (mmHg)	119.0±1.910	153.3±2.523*	125.4±1.601	148.2±2.668*
DP (mmHg)	80.0±1.127	95.9±1.487*	79.1±1.076	94.6± 0.909*

*Values are mean ± SEM. Significant difference between normotensive and hypertensive group by t-test *P=.0001. HGT=Height, WGT=Weight, WC=Waist circumference, BMI=Body mass index, Normo. = Normotensive, Hyper = Hypertensive, n = sample size, SP = Systolic blood pressure, DP = Diastolic blood Pressure*

Table 4. Anthropometric data of normotensive compared with hypertensive subjects under calcium channels blocker therapy

Indices	Gender			
	Male		Female	
	Normo. (n=50)	Hyper. (n=50)	Normo. (n=50)	Hyper. (n=50)
HGT (m)	1.7±0.090	1.7±0.014	1.7±0.009	1.6±0.007*
WGT (kg	72.5±1.632	83.6±1.589*	72.5±1.632	85.1±1.291*
WC (cm)	77.4±4.326	97.4±2.296*	66.0±5.746	81.2±4.087*
BMI (kg/m^2)	25.2±0.470	30.6±0.662*	26.6±0.420	32.5±0.585*
SP (mmHg)	119.0±1.910	148.4±2.012*	125.4±1.601	147.0±2.485*
DP (mmHg)	80.0±1.127	94.3±1.285*	79.1±1.076	92.7± 1.156*

*Values are mean ± SEM. Significant difference between normotensive and hypertensive group by t-test *P=.0001. HGT=Height, WGT=Weight, WC=Waist circumference, BMI=Body mass index, Normo. = Normotensive, Hyper = Hypertensive, n = sample size, SP = Systolic blood pressure, DP = Diastolic blood Pressure*

Table 5. Anthropometric data of normotensive compared with hypertensive subjects under angiotensin converting enzyme inhibitor therapy

Indices	Gender			
	Male		Female	
	Normo. (n=50)	Hyper. (n=50)	Normo. (n=50)	Hyper. (n=50)
HGT (m)	1.7±0.090	1.6±0.001*	1.7±0.009	1.6±0.004*
WGT (kg)	72.5±1.632	80.2±1.781*	72.5±1.632	78.0±1.834*
WC (cm)	77.4±4.326	98.9±2.404*	66.0±5.746	84.9±1.413*
BMI (kg/m^2)	25.2±0.470	30.7±0.788*	26.6±0.420	29.7±0.710*
SP (mmHg)	119.0±1.910	142.3±2.882*	125.4±1.601	142.3±2.048*
DP (mmHg)	80.0±1.127	93.6±1.413*	79.1±1.076	92.2± 0.981*

*Values are mean ± SEM. Significant difference between normotensive and hypertensive group by t-test *P=.0001. HGT=Height, WGT=Weight, WC=Waist circumference, BMI=Body mass index, Normo. = Normotensive, Hyper = Hypertensive, n = sample size, SP = Systolic blood pressure, DP = Diastolic blood Pressure*

The BMI and WC of all hypertensive subjects whether under medication or not fall outside normal range (18.5-24.9 kg/m^2 and 92 cm/80cm for men/women) ranging from over weight to obesity which was in line with other findings [18-19] and this is directly proportional to the SBP and DBP. Also, it was discovered that each of the antihypertensive agent could not reduce the blood pressure to normal range (≤ 140/90 mmHg) and that the weight of each of the hypertensive group whether under medication or not was found significantly increased when compared with normotensive group. This suggests that in the case of essential hypertension, elevated BMI and WC may be a predisposing factor to high blood pressure and resistant to antihypertensive agents effectiveness which support the findings of other researcher [20-22].

4. CONCLUSION

Therefore, it may be concluded that reducing body mass index and waist circumference may a be way of enhancing effectiveness of antihypertensive agent in achieving effective blood pressure control and a non pharmacological way of controlling hypertension.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

ACKNOWLEDGEMENTS

The authors wish to appreciate the technical staff of the Laboratory Unit of the Department of Biochemistry, Ekiti State University, Ado-Ekiti, Ekiti State, Nigeria for their necessary laboratory assistance during the laboratory work of this study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ezekwe CI, Okorie Austin, Ugwu Okechukwu PC, et al. Blood pressure lowering effect of extract of gongronema latifolium. Research Journal of Pharmaceutical Biological and Chemical Sciences. 2014;952-59.
2. Joint National Committee on prevention, detection, evaluation and treatment of high blood pressure (JNC VII report); 2003.
3. Ekpenyong CE, Udokang NE, Akpan EE, et al. Non-communicable diseases and risk factors evaluation In Sub-Saharan Africa: The Nigerian experience. European Journal of Sustainable Development. 2012;1(2):249-270.
4. Ekwunife OI, Aguwa CN. A meta analysis of prevalence rate of hypertension in Nigerian populations. Journal of Public Health and Epidemiology. 2011;3(13):604-607.
5. Ofuya ZM. The incidence of hypertension among a select population of adults in the Niger Delta region of Nigeria. Southeast Asian J Trop Med Public Health. 2007;38:947-9.
6. Aubert L, Bovet P, Gervasoni JP, et al. Knowledge, attitudes and practices on hypertension in a country in epidemiological transition. Hypertension 1998;31:1136-1145.
7. Akikugbe OO. Current epidemiology of hypertension in Nigeria. Arch Ibadan Med 2003;1:3-5.
8. Kannan L, Satyamoorthy TS. An epidemiological study of hypertension in a rural household community. Sri Ramachandra Journal of Medicine. 2009;2(2):9-13.
9. Ogundajo A, Imoru J, Asaolu M. Comparative biochemical and metabolic alteration in newly diagnosed hypertensive and normotensive subjects. Advances in Life Science and Technology. 2015;37:12-17.
10. Belu R, Okoror TA, Iwelunmor J, et al. An overview of cardiovascular risk factor burden in sub-Saharan African countries: A socio-cultural perspective. Global Health. 2009;5:10.
11. Iyalomhe GBS, Iyalomhe SI. Hypertension related knowledge, artitude and life style practices among hypertensive patients in a sub urban Nigeria community. Journal of Public Health and Epidemiology. 2010;2(40):71-77.
12. Janghorbani M, Amini, M. Incidence of metabolic syndrome and its risk factors among type 2 diabetes clinic attenders in Isfahan, Iran. Polish Journal of Endocrinology. 2012;63:372–380.
13. Kocełak P, Chudek J, Olszanecka-Glinianowicz M. Prevalence of metabolic syndrome and insulin resistance in overweight and obese women according to the different diagnostics criteria. Minerva Endocrinologica. 2012;37:247–254.
14. Lottenberg AM, Afonso MS, Lavrador MS. The role of dietary fatty acids in the pathology of metabolic syndrome. The Journal of Nutritional Biochemistry. 2012;23:1027–1040.
15. Rachas A, Raffaitin C, Barberger-Gateau P. Clinical usefulness of the metabolic syndrome for the risk of coronary heart disease does not exceed the sum of its individual components in older men and

women. The Three-City (3C) Study. Heart. 2012;98:650–655.
16. World Health Organisation. WHO Maps: Non-communicable disease trend in all countries, World Health Global Report, World Health Organization; 2011.
17. Anderson GF, PiHman P, Herbert R, et al. Non-communicable chronic diseases in Latin America and Caribbean. U.S Agency for Internal Development (USAID). 2009; 1-55.
18. Fedorova OV, Shapiro JI, Bagrov AY. Endogenous cardiotonic steroids and salt-sensitive hypertension. Biochim Biophys Acta. 2010;1802:1230-1236.
19. Eddouks M, Hebi M, EL Bouhali B, et al. International Journal of Diabetology & Vascular Disease Research. 2015;76-82.
20. Krezesinki JM, Janssens M, Vander-speeten F, et al. Importance of weight loss and sodium restriction in the treatment of mild and moderate essential hypertension. Acta Clin Belg. 1993;48:234–245.
21. Schottal DE, Stunkerd AJ. The effects of weight reduction on blood pressure in 301obese patients. Arch Int Med. 1990; 150:1701–1704.
22. Staessen J, Fagard R, Lijnen P, et al. Body weight, sodium intake and blood pressure. J Hyperten. 1989;7(Suppl. 1):S19–S23.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/13183