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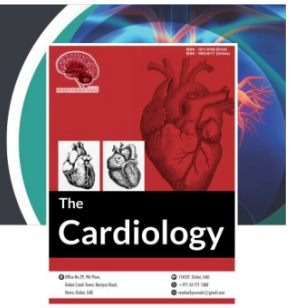

Relationship of Body Mass Index with Blood Pressure Levels Among Sudanese Adults Living in Khartoum State

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Abstract: The blood pressure (systolic and diastolic) has been found to increase with increased weight. This relationship is well advocated in many solid researches around the world. However, the relationship does not account to a cause and effect relation, the increment in the body weight may only raise the risk of increasing blood pressure. The objective of this study is to investigate the relationship between the body mass index and blood pressure levels in healthy Sudanese population residing in Khartoum state. A cross sectional study was conducted during July-August, 2016 in Khartoum state on a sample size of 200 subjects adult males/females of ages between 20-60 years and who were not known to be hypertensive. All the participants were assessed by a questionnaire covering age, gender, physical activity, daily salt intake and smoking history. Blood pressure was measured using the manual sphygmomanometer. Weight was measure using the standard scale. BMI was calculated according to the formula Weight (kg)/[height (m)]^2. Correlations between the variables were estimated and $p<0.05$ was considered statistically significant. There is a significant positive relationship between the BMI and the systolic blood pressure ($p = 0.01$), the statistical analysis also showed a significant positive relationship between the BMI and the diastolic blood pressure ($p = 0.01$). This study has demonstrated that the association between the body mass index and the blood pressure is significant. However, further studies on a larger sample size is required, so as to establish a mathematical formula to predict the blood pressure given the body mass index. There is positive correlation between systolic, diastolic blood pressure and BMI. Increased blood pressure was seen in individuals with higher BMI when compared with individuals with lower BMI.

INTRODUCTION

Blood Pressure (BP) is regulated by activity in the autonomic nervous system. Obesity is associated with sympathetic activation and is the leading risk factor for development of hypertension[1].

Hypertension is one of the most common medical disorders and data from observational studies have demonstrated increasing risk of stroke, myocardial infarction, cardiovascular death, site specific cancer and all-cause mortality associated with high blood pressure[2-4] sThere is a positive association between measures of obesity and blood pressure in both developed and less developed countries[5].

BMI is defined as body mass index which is a value calculated using the height and weight of the person. BMI ranging from 18-25 is considered as normal. Obesity and overweight in the age around adolescence are the global problems on the rise especially very common in developingcountries. Obesity is evolving as one of the major burdens as it results in many chronic diseases[6].

Globally, high Blood Pressure (BP) is estimated to cause 7.1 million deaths, about 13% of the total. About 62% of cerebrovascular disease and 49% of ischemic heart disease are attributable to suboptimal BP (systolic 4115mm Hg). Overweight and obesity increase the risks of high BP, coronary heart disease, ischemic stroke, type II diabetes mellitus and certain cancers. Worldwide about 58% of diabetes mellitus and 21% of ischemic heart disease are attributable to BMI above 21[7]. Not only physical activity but also other lifestyle factors are associated with hypertension, most notably body weight [8, 9].

Cross sectional and observational studies have documented a positive association between blood pressure and body weight[10] and blood pressure increases over time among subjects who experience weight gain[11].

There is an increasing trend in both blood pressure and body mass index in the recent years. Studies on general population have demonstrated that the prevalence of hypertension in overweight subjects is more when compared to that in normal subjects[12]. Some studies state that blood pressure does not increase in obese patients, instead high blood pressure was stated in subjects who are underweight[13]. The neighborhood environment may also influence on the food habits which leads to increased BP and BMI[14].

Hypertension in Africa is a widespread problem of immense economic importance because of its high prevalence in urban areas; it's frequent under diagnosis, and the severity of its complications[15].

It is becoming a public health emergency worldwide, especially in developing countries where studies have projected an increase by 80% in the number of hypertensive by the year 2025. In Africa, >30 million people have hypertension. World health Organization (WHO) predicts that if nothing is done about it, by 2020 three quarters of all deaths in Africa will be attributable to hypertension[15]. About 10-20 million people in sub-Saharan Africa may have hypertension and that treatment could prevent around 250000 deaths each year[16]. Regional differences in the prevalence of hypertension within countries have been identified[16] In Sudan, hypertension had a prevalence of 20.1 % .Un-diagnosed hypertension is detected in 38.2% of population in two towns in Northern Sudan[16]. In rural population in Sudan the hypertension prevalence is 23.3 19.9, 17.3% in central, Northern and eastern Sudan, respectively[16].

MATERIALS AND METHODS

This is an analytical, cross-sectional community based study performed in Khartoum state capital of Sudan during 2016 in Sudanese healthy individuals (males and females)between the 20-60 years old who were not known hypertensive. The study included 200 adults randomly (107 males and 93 of the female gender). Ethical Approval of this study was obtained from the National Ribat University (NRU). Questionnaire Interviews with all participants were done covering basic information about age, gender, daily salt intake, smokingand physical activity. Physical examination of the blood pressure, height, weight and calculation of body mass index was done for every case based on the formula:

- Weight (kg)/[height (m)] ^{2}

Inclusion criteria:
- Sudanese adult males and females
- hNot known hypertensive

Exclusion criteria:
- Refusal of participating in the study
- Age blew 20 or above 60 years

All the data collected in this study was analyzed using the SPSS (Statistical Package for Social Sciences) computer program Version 16, (t-test for mean and p value for significance). $P<0.05$ was considered statistically significant.

RESULTS

In this study blood pressure and BMI were measured in 200 adults in Khartoum state. The age of the individuals ranged 20 and 60 years 53.5% of the participants were males; the majority of the participants (34.5%) were in the range of 30-39 age wise. The BMI was found to be within the normal range (18.5-25) for most of the individuals (50%). About 1.5% of the

Table 1: Body mass Index in relation to the blood pressure - body mass index and the Systolic BP

BMI	Hyper-tensive	Normo-tensive	Pre Hyper-tensive	Hypo-tensive	Total
Under-weight	0	1	2	0	3
Normal	1	47	47	5	100
Over-weight 67	0	23	36	8	67
Obese	0	4	21	5	30
Total	1	75	106	18	200

Table 2: BMI in relation to diastolic blood pressure

	Diastolic pressure ranges			
BMI	Hyper-tensive	Pre Hyper-tensive	Normo-tensive	Total
Under-weigh	1	2	0	3
Normalweight	22	57	21	100
Over-weight	11	30	26	67
Obese	3	14	13	30
Total	37	103	60	200

individuals were underweight (BMI<18). About 33.5% of the individuals were overweight (BMI = 25-29.9) and only15% were obese (BMI>29.9). It is worth noting that 21.5% of males were obese as opposed to only 7.5% obese females according to the BMI.

The individuals were considered hypertensive when the systolic blood pressure was equal or >140 mm Hg and/or diastolic blood pressure was equal or >90 mm Hg. When blood pressure was compared to the gender difference, 46% of females were pre hypertensive as far as the systolic pressure is concerned and only 3.4% were actually hypertensive whereas 58.8% of the male counterparts were pre hypertensive and <15% had an elevated systolic in the range of hypertension (Table 1).

Regarding the diastolic blood pressure, the majority of the females were pre hypertensive (59.1%) and most of the males were hypertensive (45.8%) and only 11.8% of females were hypertensive (Table 2)

Diastolic hypotension was not encountered in this study: Cases were found in this study to have a normal body mass index, yet they have either high systolic or high diastolic (Fig. 1 and 2) we suggest that this phenomenon would be a result of other factors (genetic, environmental ,...,) which were not under the scope of the study, might as well be genetic. When age is taken in comparison to the systolic pressure, the age range of 20-29 had 18 cases out 65 in the pre hypertensive zone as opposed to only 18 cases from the age 50-59 zone.

When diastolic pressure was taken against the age, 32 pre hypertensives and 17 hypertensives from the 20-29 age category whereas 17 cases pre hypertensive and only 10 cases were hypertensive in age range of 50-59. Bivariate correlation analysis was conducted on the relationship between the BMI and systolic blood pressure as well as between the BMI and the diastolic blood pressure. The p value of BMI and systolic pressure is 0.01 and it is statistically significant. The p value of BMI and the diastolic blood pressure is 0.01 which is also

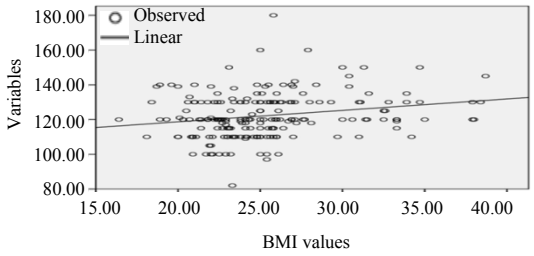

Fig. 1: Line representation of the BMI and systolic blood pressure relationship

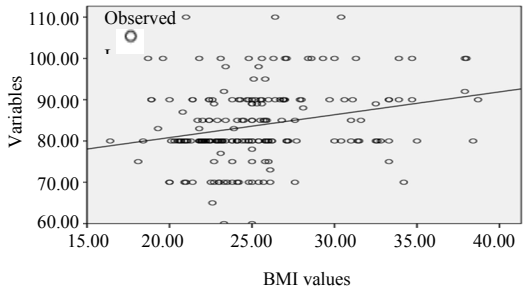

Fig. 2: The graphical dependency of the diastolic blood pressure on the BMI

statistically significant. The statistical pearson correlation2-tailed test for significance is showing significance at the 0.01 level The pearson correlation test for significance is displaying a level of 0.01 which is considered statistically significant.

The graphs (Fig. 1 and 2) show the upwardtrend in the diastolic blood pressure (the dependent variable) in accordance to the body mass index (the independent variable).

DISCUSSION

The purpose of this study was to investigate the dependency of blood pressure on the body mass index. The study covered some factors that might influence the

blood pressure such as dietary salt intake, smoking, age, exercise hours and past or current history of drugs. The main concern was the nature of the BMI effect on the blood pressure. A primary finding was that the relationship was linear in nature (the more the BMI, the more the blood pressure, both systolic and diastolic). This magnitude of the results should come as no surprise due to the fact that BMI is one of the factors that lead to an increment in blood pressure.

This study had some limitations, first of which is that the blood pressure was assessed in a single visit which might lead to overestimation. Secondly, the study is not designed to explore other factors, most importantly, genetic makeup which might reverse the BMI-BP correlation. Our results also reflected the relationship between the age and the blood pressure and it is noteworthy that the bulk of individuals with prehypertension (both systolic and diastolic) were between the ages of 20 and 40. This finding was consistent with the studydone in Cameron where it showed that high blood pressure was common among the young, ages 25-39 years[15].

Some studies like the one done across Ethiopia, Vietnam and Indonesia in 2007 (in contrary to our results) suggested that severe underweight was in fact associated with increased blood pressure[7].

The prevalence of hypertension and obesity is low in this study compared to other studies[17] but that study in particular investigated the prevalence in diabetic patients. The study done in Norway, 2011, investigated the relationship between BMI, the physical status represented as the CardioRespiratory Fitness (CRF) and the blood pressure. They found out that obesity as a known risk factor for high blood pressure was counteracted by the physical fitness (CRF)[18].

However, they suggest that the BMI might be more relevant than CRF in determining the systolic blood pressure. In our study, the BMI has a direct equal influence on both systolic and diastolic pressure.

CONCLUSION

The study concludes that there is a strong correlation between the BMI and both the systolic and diastolic blood pressures taken separately. Correlation was observed between blood pressure and BMI with a p value of 0.01 in regards to both the systolic blood pressure and diastolic pressures which is considered statistically significant. An increment in blood pressure was observed in individuals with higher BMI when compared to those with low and normal BMI. If the blood pressure depends on the BMI, then the guidelines for classification of normal blood pressure, pre hypertension and hypertension should take into account the BMI. This assumption needs a larger scale study to derive an equation of the normal BP according to the BMI.

REFERENCES

Boris, A.K.G., Y.M.C. Huguette, N.J. Laure and J.E. Oben, 2010. The effect of body weight on the incidence and prevalence of hypertension in Yaounde. J. Diabetes Endocrinol., 1: 006-012.

Cappuccio, F.P., S.M. Kerry, A. Adeyemo, A. Luke and A.G.B. Amoah *et al.*, 2009. Body size and blood pressure. Epidemiol., 19: 38-46.

Dubowitz, T., M. Ghosh-Dastidar, C. Eibner, M.E. Slaughter and M. Fernandes et al., 2011. The women's health initiative: The food environment, neighborhood socioeconomic status, BMI and blood pressure. Obesity, 20: 862-871.

Elfaki, A., 2015. Prevalence of hypertension and obesity among Sudanese patients with type 2 diabetes mellitus. Sky J. Med. Sci., 4: 020-022.

Elhuda, D., R. Mohammed and M. Ahmed, 2016. Hypertension among women in Tiraira Madani, rural Sudan: Prevalence and risk factors, 2014. Int. J. Med. Health Res., 2: 1-10.

Emaus, A., M.B. Veierod, S. Tretli, S.E. Finstad and R. Selmer et al., 2009. Metabolic profile, physical activity, and mortality in breast cancer patients. Breast Can. Res. Treat, 121: 651-660.

Emaus, A., T. Wilsgaard, A.S. Furberg and I. Thune, 2016. Blood pressure, cardiorespiratory fitness and body mass: Results from the Tromso activity study. Nor. Epidemiol., 20: 189-197.

Erdine, S., S.N. Aran, 2004. Current status of hypertension control around the world. Clin. Exp. Hypertens, 26: 731-738.

Gelber, R.P., J.M. Gaziano, J.E. Manson, J.E. Buring and H.D. Sesso, 2007. A prospective study of body mass index and the risk of developing hypertension in men. Am. J. Hypertens., 20: 370-377.

Genovesi, S., L. Antolini, M. Gallieni, A. Aiello and S.K.B. Mandal et al., 2010. High prevalence of hypertension in normal and underweight Indian children. J. Hypertens., 29: 217-221.

Hajjar, I. and T.A. Kotchen, 2003. Trends in prevalence, awareness, treatment and control of hypertension in the United States, 1988-2000. J. Am. Med. Assoc., 290: 199-206.

Huang, Z., W.C. Willett, J.E. Manson, B. Rossner, M.J. Stamper, F.E. Speizer and G.A. Colditz, 1998. Body weight, weight change, and risk of hypertension in women. Ann. Int. Med., 128: 81-88.

Kotchen, T.A., 2010. Obesity-related hypertension: epidemiology, pathophysiology, and clinical management. Am. J. Hypertens., 23: 1170-1178.

Ravisankar, P., K. Udupa and E.S. Prakash, 2005. Correlation between body mass index and blood pressure indices, handgrip strength and handgrip endurance in underweight, normal weight and overweight adolescents. Indian J. Physiol. Pharmacol., 49: 455-561.

Tesfaye, F., N.G. Nawi, H. Van Minh, P. Byass, Y. Berhane, R. Bonita and S. Wall, 2007. Association between body mass index and blood pressure across three populations in Africa and Asia. J. Human Hypertension, 21: 28-37.

Varshitha, A., 2015. Comparison of blood pressure and BMI in college students. J. Pharm. Sci. Res., 7: 849-851.

WHO, 2000. Preventing Chronic Diseases: A Vital Investment. World Health Organization, Geneva.

Wilsgaard, T., H. Schirmer and E. Arnesen, 2003. Impact of body weight on blood pressure with a focus on sex differences. Arch. Intern. Med., 160: 2847-2853.