International Journal of Recent Advances in Multidisciplinary Research
Vol. 01, Issue 11, pp.091-096 November, 2014

Full Length Review Article

RELATIONSHIP BETWEEN BODY MASS INDEX AND BLOOD PRESSURE AMONG UNIVERSITY STUDENTS IN MAIDUGURI, NIGERIA

***Salamatu Umar Aliyu, Jamilu Tijjani Ahmad, Adetoyeje Y. Oyeyemi**

Department of Medical Rehabilitation (Physiotherapy), College of Medical Sciences University of Maiduguri, Nigeria

ARTICLE INFO

Article History:
Received 27th August, 2014
Received in revised form
20th September, 2014
Accepted 31st October, 2014
Published online 30th November, 2014

Keywords:
Blood Pressure
Body Mass Index
University Students
Relationship

ABSTRACT

The aim of this study was to determine the relationship between BMI and BP (SBP and DBP) among university students in Maiduguri, Nigeria. A sample of convenience was used to recruit participants for this study. Data on gender, height, weight, BMI and BP were obtained using a researcher-developed data form. Blood pressure, height and weight of the participants were measured using standardised procedures. A total of 351 students participated in this study out of which 248 (70.7%) were males and 103 (29.3%) were females with mean height, weight and BMI of 1.70±0.07m, 67.01±12.78kg and 1.71±0.45kg/m^2 respectively. The mean systolic and diastolic blood pressures were 122.86±14.02mmHg and 82.17±9.69mmHg respectively. The study revealed a significant correlation between BMI and BP (SBP and DBP) among the participants ($p<0.01$). Significant correlation between BMI and BP (SBP and DBP) was recorded among male participants, while there was no significant correlation between BMI and BP (SBP and DBP) among female participants. In conclusion, the study found a significant relationship between BMI and BP among the participants. There is a need for Students to be enlightened on the adverse health effects associated with high BMI and high blood pressure.

INTRODUCTION

Body mass index (BMI) is the simplest acceptable tool for determining relative body fatness in both clinical and epidemiological studies and was recommended as universal criterion of overweight and obesity (Prentice and Jebb, 2001; World Health Organization, 2014). Body mass index (BMI) usually defines body fatness as an index of weight relative to height, and is generally considered a valid index of adiposity (Gundogdu, 2008). It has been reported that a BMI above 27.8 and 27.3 kg/m^2 for men and women, respectively, may increase morbidity and mortality (Brown *et al.*, 2000).Obesity is known as one of the most important health problem in the world and its prevalence is increasing rapidly in all ages all over the world (Flores-Huerta *et al.*, 2009; Klein *et al.*, 2002; Nesbitt*et al.*, 2004). Overweight and obesity represent a rapidly growing threat to the healthy populations in an increasing number of countries (Park *et al.*, 2005) and is becoming a global epidemic (WHO, 2000). Overweight and obesity may account for as many as 15-30% of deaths from Coronary Heart Disease (CHD) and 65-75% of new cases of type 2 Diabetes Mellitus (Jousilahti, 1996).

****Corresponding author: Salamatu Umar Aliyu,***
Department of Medical Rehabilitation (Physiotherapy), College of Medical Sciences Universtiy of Maiduguri, Nigeria.

Hypertension is believed to be a significant risk factor of adulthood diseases and unfortunately is getting more prevalent rapidly (Nielsen *et al.*, 2003). It is also associated with overweight and obesity, incidence of stroke, coronary heart disease, congestive heart failure and renal insufficiency (Lauer *et al.*, 1989). Hypertension has been reported in children and adolescents of different populations and is believed to track into adulthood (Young *et al.*, 1993; Ejike *et al.*, 2010; Nwachukwu, 2010). Available data for the past 2 decades suggest that the prevalence of hypertension has decreased in most developed countries, but has increased in several developing countries like Nigeria (Antikainen *et al.*, 2006; Kearney, 2004). Body mass index is positively and independently associated with morbidity and mortality from hypertension, cardiovascular disease, type II diabetes mellitus, and other chronic diseases (Pi-Sunyer, 1993). In Caucasian populations, a strong association has been depicted between BMI and mortality (Stevens *et al.*, 1998). Positive relationship between BMI and BP has also been reported among Asian populations (Tandon, 2006; Kapoor, 2000; Mungreiphy *et al.*, 2011). The relationship between BMI and BP has long been the subject of epidemiological research. However, whether this relationship between BMI and hypertension is linear especially in African adolescents who are currently facing nutritional transition and the health challenges that come with it is still unclear. The present study therefore is

aimed at determining the relationship between BMI and blood pressure among university students in Maiduguri, Nigeria.

MATERIALS AND METHODS

Participants and design

A sample of convenience was used to recruit three hundred and forty (340) male and female Students from College of Medical Sciences University of Maiduguri, Nigeria. The design for this study was a cross sectional survey. The study was carried out between June 2013 and August 2013.

Procedure

The ethical approval of the research and ethical committee of University of Maiduguri Teaching Hospital (UMTH) was sought and obtained before the commencement of this study. A written consent was obtained from each of the participants after explaining the purpose and benefit of the research.Copies of data form were used to obtain and record information about gender, blood pressure, height, weight and BMI of the participants. Blood pressure measurement was taken with a digital sphygmomanometer which was wrapped around the distal part of the left forearm in sitting position. The sphygmomanometer was turn on, the reading of the blood pressure (systolic and diastolic) were recorded on the data form. The blood pressure was taken once. To ensure that the resting blood pressure was captured, the measurement was taken after the participant must have sat quietly for 10 minutes without any work activity (Acree *et al*., 2006). Participants' weights were measured with the participant standing on a balance scale without shoe and any external materials that may increase weight. Clothing was reduced to the minimal. Participant were placed in the anatomical position; head, eyes facing forward and upright position, foot slightly apart and palms of hand facing forward. Weight was recorded by the researcher squatting in front of the scale so as to avoid error due to parallax.

Height was measured using a stadiometer with the participants in standing position without shoes. Participants were placed in anatomical position; head and eyes facing forward. Height was recorded by the researcher standing in front of the participants noting the corresponding level of the vertex of the head on the meter. Body mass index (BMI) was calculated by dividing the participants' weight in kilogram by the square of their height in meter (kg/m^2). The BMI was classified based on World Health Organization criteria, (2000) as underweight if < 18kg/m, normal weight if 18.5-24.9 kg/m, overweight if 25-29.9 and obese if ≥ 30 kg/m.

Statistical Analysis

Descriptive statistics of frequency and percentages were used to describe gender, BMI categories and BP (SBP and DBP) group of the participants. Mean and standard deviation were used to summarize the height, weight, BMI and BP of the participants. Spearman'scorrelation coefficient was used to analyse the relationship between Body mass index and blood pressure among the participants. The level of significance was set at ($p<0.05$).

RESULTS

Physical attributes of the Participants

Three hundred and fifty-one (351) students participated in this study. Where 248 (70.7%) were males and 103 (29.3%) were females. The mean height, weight and BMI of the participants were 1.70±0.07m, 67.01±12.78kg and 23.08±3.98kg/m^2 respectively. With the males having a higher mean height of (1.73±0.06m) and weight (69.2±12.43kg) than the mean height (1.63±0.05m) and weight (61.8±1.22kg) of their female counterparts. The mean BMI of the female participants (23.2±4.32kg/m^2) was found to be higher than the mean BMI of the male participants (23.0±3.85kg/m^2). The result also shows the mean systolic and diastolic blood pressures of the participants to be 122.86±14.02mmHg and 82.17±9.69mmHg respectively. The mean systolic and diastolic BP was found to be higher in male participants (124.3±13.73mmHg and 82.5±9.36mmHg respectively) than their female counterparts (119.5±14.23mmHg and 81.3±10.46mmHg respectively). As shown in Table 1.

Table 1. Physical attributes of the Participants

Variables	Male		Female		Total	
Gender	n	%	n	%		
	248	70.7	103	29.3	351	
	X	±SD	X	±SD	X	±SD
Height (m)	1.7	0.06	1.6	0.05	1.7	0.07
Weight (kg)	69.2	12.43	61.8	1.22	67.01	12.78
BMI (kg/m^2)	23.0	3.85	23.2	4.32	23.1	3.98
BP (mmHg)						
Systolic	124.3	13.73	119.5	14.23	122.9	14.02
Diastolic	82.5	9.36	81.3	10.46	82.2	9.69

Key:
BMI= Body mass index
BP=Blood pressure
n= Number of participants
SD= Standard deviation
X = Mean

Distribution of participants by gender in the different categories of BMI and BP

Table 2 shows that participants with normal BMI reported a higher percentage (70.1%), followed by participants in the overweight category with (16.8%), with (7.1%) of the participants in the obese category. The results reported higher proportion of males (50.1%) than females (20%) in the normal BMI category. The resultalso revealed that females have higher percentage (12.2%) than their male counterparts (4.6%) in the overweight category. The result from systolic blood pressure, shows that higher numbers of the participants were pre-hypertensive (49.3%) and 11.1% were hypertensive. Diastolic blood pressure (DBP) show that higher numbers of the participants were pre-hypertensive (39.9%), 32.8% have normal DBP, 25.1% were hypertensive and (2.3%) of the participants were found to be hypotensive. In all the stages of SBP and DBP male participants have the highest percentage when compared with their female counterparts.

Systolic and diastolic blood pressure of participants in different BMI categories

Table 3 shows the mean values of systolic BP and diastolic BP in different BMI categories.

Table 2. Distribution of participants by gender in different categories of BMI and BP

Variables	Categories	Frequency		Percentage (%)		Total (%)
Gender		Female	male	Female	male	
BMI	Underweight	8	13	2.3	3.7	6
	Normal	70	176	20.0	50.1	70.1
	Overweight	16	43	12.2	4.6	16.8
	Obese	9	16	2.6	4.5	7.1
	N	103	248			
SBP	Hypotension	2	3	0.6	0.8	1.4
	Normal	47	87	13.4	24.8	38.2
	Prehypertension	47	126	13.3	36	49.3
	Hypertension	7	32	2.0	9.1	11.1
	N	103	248			
DBS	Hypotension	3	5	0.9	1.4	2.3
	Normal	36	79	10.3	22.5	32.8
	Pre-hypertension	39	101	11.1	28.8	39.9
	Hypertension	25	63	7.1	18.0	25.1
	N	103	248			

Key:
BMI= Body mass index
SBP = Systolic blood pressure group
DBS = Diastolic blood pressure group
N= Number of participants

Table 3. Systolic and diastolic blood pressure of participants in different BMI categories

BMI Category		Blood pressure (mmHg)			
		Systolic		Diastolic	
	N	X	±SD	X	±SD
Underweight	21	114.9	15.37	78.9	12.08
Normal	246	121.8	13.70	81.6	9.90
Overweight	59	127.3	12.27	84.9	7.75
Obese	25				
		129.4	15.22	84.5	8.61
Total	351	122.9	14.02	82.2	9.69

Key**:**
BMI= Body mass index
N = Number of participants
SD= Standard deviation
X = Mean

Table 4. Relationship between BMI and BP among the participants

		Correlation between BMI and BP		
Variables		BMI	SBP	DBP
Overall	BMI	1.000	0.214**	0.161**
	SBP	0.214**	1.000	0.624**
	DBP	0.161**	0.624**	1.000
Male	BMI	1.000	0.233**	0.186**
	SBP	0.233**	1.000	0.588**
	DBP	0.186**	0.588**	1.000
Female	BMI	1.000	0.178	0.103
	SBP	0.178	1.000	0.711**
	DBP	0.103	0.711**	1.000

**-Correlation is significant at 0.01 level (2-tailed)
BMI = Body mass index
SBP = Systolic blood pressure
DBP = Diastolic blood pressure

Minimum mean systolic BP were found in the underweight category (114.86±15.37) and the maximum mean systolic BP were found among the obese (129.4±15.22) category. While minimum mean diastolic BP were found in the underweight category (78.9±12.02) and the maximum mean diastolic BP were found among the overweight (84.9±7.75) category. The result though not statistically tested showed that mean systolic and diastolic BP increases with increasing BMI level among the participants.

Relationship between body mass index and blood pressure among the participants

Table 4 shows that body mass index and blood pressure (systolic and diastolic blood pressure) were significantly correlated among participants in this study. The result showed a significant positive correlation between BMI with both systolic and diastolic BP ($p<0.01$). It showed that BP increased with increase in BMI. Correlation coefficient showed that

relationship between BMI and systolic BP (0.214) was stronger than that of BMI and diastolic BP (0.161). The body mass index and blood pressure (systolic and diastolic blood pressure) among male participants were significantly correlated ($p<0.05$). Correlation coefficient showed that relationship between BMI and systolic BP (0.233) was stronger than that of BMI and diastolic BP (0.186) among the male participants. The result showed no significant correlation between body mass index and blood pressure (systolic and diastolic blood pressure) among female participants ($p>0.05$).

DISCUSSION

Physical attributes of the Participants

Participants for this study were 351 students, comprising of 248 (70.7%) males and 103 (29.3%) females. The preponderance of male participants could be attributed to the unwillingness of the female participants to participate in the study. This is consistent to a study conducted by Zuhal (2008) on the relationship between body mass index and blood pressure among males and females, which showed that more males (54.4%) than females (45.6%) participated in the study. Also, in a similar study conducted in Nigeria by Ejike *et al.* (2010) showed that more males (51.3%) participated than their female counterparts (48.3%) in their study.

The mean height and weight of the male participants were found to be higher than the mean height and weight of their female counterparts. The difference in weight could be attributed to the difference in bone density, where the bones of males are denser than that of females. The mean BMI of the female participants was found to be higher than the mean BMI of the male participants. Majority of the participants were of normal weight with (16.8%; 7.1%) of them being overweight and obese respectively (Ejike *et al*., 2008). More female participants than male participants were found in the overweight category. The overall BMI characteristics of the participants in this present study is similar to a study by Mungreiphy *et al.* (2011) that determined the relationship between BMI and BP among Tangkhul Naga Tribe in India. The mean systolic and diastolic BP was found to be higher in male participants than their female counterparts this is consistent to the study by Mungreiphy *et al.* (2011). It is also similar to a study conducted by Zuhal (2008) on the relationship between body mass index and blood pressure among males and females. The difference in blood pressure among the male and female participants could be attributed to hormonal differences between males and females.

Relationship between body mass index and blood pressure among the participants

The minimum mean systolic BP were found in the underweight category and the maximum mean systolic BP were found among obese category. While minimum mean diastolic BP were found in the underweight category and the maximum mean diastolic BP were found among overweight category. It showed that mean systolic and diastolic BP increased with increasing BMI level which is consistent to previous studies conducted by Mungreiphy *et al.* (2011), Sanchez-Zamorano *et al.* (2009), Vlajinac *et al.* (2003); Ejike *et al.* (2008). Correlation analyses of BMI with both systolic and diastolic blood pressure showed significant positive correlation among the participants (i.e. an increase in blood pressure with increasing body mass index). Studies conducted on the relationship between body mass index and blood pressure in Asia, Africa, Europe and the United States were found to be similar to this study (Sanchez-Zamorano *et al*., 2009; Vlajinac *et al*., 2003; Kapoor 2000; Ejike *et al*., 2010; Nwachukwu *et al*., 2010). Hernandez *et al*. (2009) also confirmed a positive relationship between body mass index and blood pressure among adolescents. A prospective cohort study held on 22071 individuals in Harvard school also revealed a positive relationship between body mass index and blood pressure (Gelber *et al*., 2007). Cindy *et al*. (2008) also supported the findings of the present study that body mass index and blood pressure are related. Zuhal (2008), found a statistical significant relationship between body mass index and blood pressure.

In the present study, the body mass index and blood pressure (SBP and DBP) among male participants were significantly correlated. This is similar to recent studies by Nanaware *et al*. (2011) and Joan *et al*. (2014) who reported a significant correlation coefficient and association between body mass index and blood pressure (SBP and DBP) among school children and adolescents. It is also similar to the finding of Mungreiphy *et al*. (2011), who reported a significant correlation between body mass index and blood pressure (SBP and DBP) among Tangkhul Naga Tribal Males of Northeast India. The higher number of pre-hypertensive (49.3%) and hypertensive (11.1%) reported in this study might not be unrelated to dietary salt intake and their physical activity levels, both of which are difficult to standardize and measure across these participants as reported in literatures (Akinpelu 1992; Haslam and James, 2005; Lau *et al*., 2007, Ejike *et al*., 2010). More importantly is the nutritional transition experienced in Nigeria coupled with westernisation and lifestyle modification. The body mass index and blood pressure among female participants showed no statistical significant relationship. This is contrary to the findings of Nanaware *et al*. (2011), who showed significant correlation between body mass and blood pressure among a population of school children and adolescents female participants.

Conclusion

The study concludes that a positive and significantrelationship between body mass index and blood pressure (systolic and diastolic blood pressure) among the participants exist. Also a significant relationship between body mass index and blood pressure (systolic and diastolic blood pressure) was observed among male participants. However, no significant relationship between body mass index and blood pressure (systolic and diastolic blood pressure) was observed among the female participants.

Recommendations

The following recommendations were made:

- Life style modification/education is recommended including appropriate diet and physical exercise to ensure healthy weight and blood pressure among students.

- Students should be enlightened on the adverse health effects associated with obesity/overweight and high blood pressure.
- Improving student's knowledge and awareness about nutrition and healthy eating habits may promote healthy body weight management, thereby reducing the risk of obesity and high blood pressure among university students.

Acknowledgments

The researchers wish to take this medium to thank the participants for making this study possible.

REFERENCES

Acree, L.A., Longfors, J., Fjesldstad, A.S., Schank, B., Nickel, K.J., Montogomery, P.S. and Gardner, A.W. 2006. Physical activity is related to quality of life in older adult. *Health and Quality of Life Outcome*, 4:37.

Akinpelu, A.O. 1991. Effects of a 12 Weeks Training Programme on Selected Cardiovascular Parameters in Adult Hypertensive Patients. An Unpublished PhD Thesis of the Department of Physical and Health Education, University of Ibadan.

Antikainen, R.L., Moltchanov, V.A. and Chukwuma, C.S. 2006. WHO MONICA Project. Trends in the prevalence, awareness, treatment and control of hypertension: the WHO MONICA Project. *European Journal of Cardiovascular Prevention Rehabilitation*, 13, 13–29.

Brown, W.J., Mishra, G., Kenardy, J. and Dobson, A. 2000. Relationships between body mass index and well-being in young Australian women. *International Journal of Obesity Related Metabolic Disorders*, 24(10): 1360-8.

Ejike, C.E.C.C., Ugwu, C.E. and Ezeanyika, L.U.S. 2010. Variations in the prevalence of point (pre)hypertension in a Nigerian school-going adolescent population living in a semi-urban and an urban area. *BMC Paediatrics*, 10, 13

Ejike, C.E.C.C., Ugwu, C.E., and Ezeanyika, L.U.S. and Olayemi, T.A. 2008. Blood pressure patterns in relation to geographic area of residence" a cross-sectional study of adolescents in Kogi State, Nigeria. *BMC Public Health*, 8:411

Flores-Huerta, S., Klunder-Klunder, M., Reyes, C.L., and Santos, J.I. 2009. Increase in body mass index and waist circumference is associated with high blood pressure in children and adolescents in Mexico City. *Archives of Medical Research*, 40(3): 208-15.

Gelber, R.P., Gaziano, J.M., Manson, J.E., Buring, J.E., and Sesso, H.D. 2007. A prospective studyof body mass index and the risk of developing hypertension in men. *American Journal of Hypertension*, 20(4): 370-77.

Gundogdu, Z. 2008. Relationship between BMI and blood pressure in girls and boys. *Public Health Nutrition*, 11(10):1085-8.

Haslam, D.W., and James, W.P. 2005. Obesity. *Lancet*, 366 (9492): 1197–209.

Jousilahti, P., Tuomilehto, J., Vartiainen, E., Pekkanen, J., and Puska, P. 1996. Body weight, cardiovascular risk factors, and coronary mortality: 15 year follow-up of middle-aged men and women in Castern Finland. *Circulation*, 93, 1372-79.

Joan, C.l., Malini, C., Alan, S., Stephen, R.D., Ronald, J.P., Benjamin, M., Emily, D.P., Nancy, E.S., Matthew, F.D., Elyse, O.K., Kenneth, F.A., David, J.M., Patric, J.O. and Louise, C.G. 2014. Severe obesity in children: prevalence, persistence and relation to hypertension. *Int. J. PediatrEndorinol*, 1(3).

Kapoor, S.S. 2000. Blood pressure, waist to hip ratio and body mass index among affluent Punjabi girls of Delhi, *ActaMedicaAuxologica*, 32 (3):153–157.

Kearney, P.M., Whelton, M., and Reynolds, K. 2004. Worldwide prevalence of hypertension: a systematic review. *Journal of Hypertension*, 22, 11–19

Klein, S., Wadden, T., and Sugerman, H.J. 2002. AGA technical review on obesity. *Gastroenterology*, 23(3): 882-2.

Lau, D.C., Douketis, J.D., Morrison, K.M., Hramiak, I.M., Sharma, A.M. and Ur, E. 2007. Canadian clinical practice guidelines on the management and prevention of obesity in adults and children summary. *Canadian Medical Association Journal*, 176 (8): S1–13

Lauer, R.M., and Clarke, W.R. 1989. Childhood risk factors for high adult blood pressure: the Muscatine Study. *Paediatrics*, 84(4): 633-41.

Mungreiphy, N.K., Satwanti, K., and Rashmi S. 2011. Association between BMI, Blood Pressure, and Age: Study among Tangkhul Naga Tribal Males of Northeast India. *Journal of Anthropology*, 748147, 6.

Nanaware, N.L., Gavkare, A.M. and Surdi, A.D. 2011. Study of correlation of body mass index and blood pressure in school going children and adolescents. *International Journal of Recent Trends in Science and Technology*, 1, 1, 2249-8109, 20-26.

Nesbitt, S.D., Ashaye, M.O., Stettler, N., Sorof, J.M., Goran, M.I. and Parekh, R. 2004. Overweight as a risk factor in children: a focus on ethnicity. *Ethnicity Dis Winter*, 14(1): 94-110.

Nwachukwu, D.C., Nwagha, U.I., Obikili, E.N., Ejezie, F.E., Okwuosa, C.N., and Nweke, M.L., 2010. Assessment of body mass index and blood pressure among university students in, Enugu, South East, Nigeria. *Nigerian Journal of Medicine*, 19(2): 148-52.

Park, K. 2005. *Park's textbook of preventive and social medicine*, 18th ed. Jabalpur: M/S BandrsidasBhanot, 316-319.

Pi-Sunyer, F.X. 1993. Medical hazards of obesity. *Annual International Medicine*, 119, 655–660.

Prentice, A.M. and Jebb, S.A. 2001. Beyond body mass index. *Obesity Revision*, 141-147.

Sanchez-Zamorano, L.M., Salazar-Martinez, E., Anaya-Ocampo, R., Lazcano-Ponce, E. 2009. Body mass index associated with elevated blood pressure in Mexican school-aged adolescents. *Preview Medicine*, 48(6): 543-48.

Stevens, J., Cai, J., Pamuk, E. R., Williamson, D. F., Thun, M. J. and Wood, J. L. 1998. The effect of age on the association between body-mass index and mortality, *New England Journal of Medicine*, 338 (1): 1–7.

Tandon, K. 2006. Obesity, its distribution pattern and health implications among Khatri population, Ph.D. thesis, Department of Anthropology, University of Delhi, Delhi, India.

Vlajinac, H., Milju, D., Adanja, B., Marinkovi, J. and Sipeti, S. 2003. Blood pressure levels in 7 to 14-year-old Belgrade children. *Journal of Human Hypertension*, 17(11): 761-5.

World Health Organization, 2000. Obesity: Preventing and managing the global epidemic. *WHO technical report series*, No. 894, Geneva.

World Health Organization, 2014. Obesity and overweight.Fact sheet. No 311.Geneva.

Young, L.C., Kuller, L.H., Rutan, G. and Bunker, C. 1993. Longitudinal study of blood pressure changes and determinants from adolescents to middle age. *American Journal of Epidemiology*, 138, 973-83.

Zuhal, G. 2008. Relationship between body mass index and blood pressure in girls and boys. *International Journal of Public Health Nutrition*, 11, 1085-1088.

****