Correlation of Obesity and Hypertension between Normotensive and Hypertension Among Adults

Dr.Laique Imran, Dr. Zunaira Idrees, Dr.Muhammmad Waqas Aslam

Abstract:- *Obesity is an important risk factor for many chronic physical and mental illnesses. Obesity is abnormal or excessive fat accumulation, which means it must be saved for the first time. Obesity and overweight are considered problems in high-income countries. At least 2.8 million people die prematurely each year because of overweight or obesity. Here, he talks about the relationship between obesity, and his determinants of nutrition and health are inconsistent with an editor. Comorbidities include heart disease, obesity, high blood pressure and stroke, certain cancers, non-insulin-dependent diabetes, gallbladder disease, dyslipidemia, osteoarthritis and gout, and lung diseases, including sleep apnea. Obesity is an important risk factor for many chronic physical and mental illnesses. Sodium (HTN or increased), which additionally has hypertension (HBP), is a long-term medical condition that is constantly increasing in blood vessels in blood vessels. This is a deep blood pressure, usually without these miracles. This is an underlying blood pressure, and in the long term, coronary heart disease, stroke, heart failure, atrial fibrillation, peripheral vascular disease, vision loss, chronic kidney disease and madness policies have important risk factors. Mean arterial treatment of hypertension (defined as > 160/100 mmHg) is associated with improved lifespan. At the same time, the effects of treating blood pressures of 130/80 mmHg and 160/100 mmHg were less pronounced, and some comments were found to be uncertain and good. High blood pressure accounts for 16% to 37% of the global sports population.*

Key Words : *Hypertension, high blood pressure (HBP), arterial, Obesity, Normotensive, Adults, HTN*

1. Introduction:

Obesity is an important risk factor for many chronic physical and mental illnesses. The generally accepted view is that being overweight causes similar health problems to obesity, but to a lesser degree Obesity is associated with cardiovascular diseases including angina and myocardial infarction.

A 2002 report concluded that 21% of ischemic heart disease is due to obesity [1] while a 2008 European consensus puts the number at 35%. Having obesity is associated to about 11% of heart failure cases in men and 14% in women. More than 85% of those with hypertension have a BMI greater than 25.The risk of hypertension is 5 times higher in the obese as compared to those of normal weight. A definitive link between obesity and hypertension has been found using animal and clinical studies, which have suggested that there are multiple potential mechanisms for obesity-induced hypertension. These mechanisms include the activation of the sympathetic nervous system as well as the activation of the renin–angiotensin–aldosterone system [2]. The association between hypertension and obesity has been also well described in children. Obesity is associated with increased LDL cholesterol (bad cholesterol) and lowered HDL cholesterol (good cholesterol). Obesity increases one's risk of venous thromboembolism by 2.3 fold. Hypertension (HTN or HT), also known as high blood pressure (HBP), is a long-term medical condition in which the blood pressure in the arteries is persistently elevated. High blood pressure typically does not cause symptoms. Long-term high blood pressure, however, is a major risk factor for coronary artery disease, stroke, heart failure, atrial fibrillation, peripheral vascular disease, vision loss, chronic kidney disease, and dementia.

Severely elevated blood pressure (equal to or greater than a systolic 180 or diastolic of 110) is referred to as a hypertensive crisis. Hypertensive crisis is categorized as either hypertensive urgency or hypertensive emergency, according to the absence or presence of end organ damage, respectively.In hypertensive urgency, there is no evidence of end organ damage resulting from the elevated blood pressure. In these cases, oral medications are used to lower the BP gradually over 24 to 48 hours. [3]

In hypertensive emergency, there is evidence of direct damage to one or more organs. The most affected organs include the brain, kidney, heart and lungs, producing symptoms which may include confusion, drowsiness, chest pain and breathlessness.In hypertensive emergency, the blood pressure must be reduced more rapidly to stop ongoing organ damage, however, there is a lack of randomized controlled trial evidence for this approach.[4]

2. Research Background

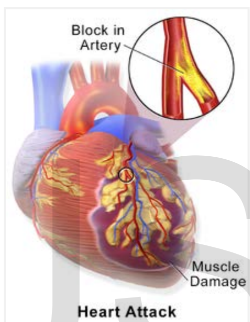
Obesity is a medical condition in which excess body fat has accumulated to an extent that it may have a negative effect on health. People are generally considered obese when their body mass index (BMI), a measurement obtained by dividing a person's weight by the square of the person's height, is over 30 kg/m2; the range 25–30 kg/m2 is defined as overweight. Some East Asian countries use lower values. Obesity increases the likelihood of various diseases and conditions, particularly cardiovascular diseases, type 2 diabetes, obstructive sleep apnea, certain types of cancer, osteoarthritis, and depression.

At least 2.8 million people die each year as a result of being overweight or obese. In fact, the mortality increases with the increasing of the BMI. The highest prevalence of overweight among infants and young children is in upper-middle-income populations, while the fastest rise in overweight is in the lowermiddle-income group . In order to maintain good health, individuals need to stay within the range of 18.5- 24.9 kg/m2 BMI. There is increased risk of co-morbidities for BMIs in the range of 25.0 to 29.9 kg/m2 , very high risk of co-morbidities for a BMI greater than 30 kg/m2 . In the year of 2008, more than 205 million men and 297 million women worldwide were estimated with the condition of obesity. In high income countries there is almost no difference between the number of men and women suffering of obesity, while in lower-middle-income countries or in uppermiddle income countries, obese women are more than double than obese men [5].

2.1 CARDIOLOGICAL

Ischemic heart disease

Obesity is associated with cardiovascular diseases including angina and myocardial infarction. A 2002 report concluded that 21% of ischemic heart disease is due to obesity while a 2008 European consensus puts the number at 35% [6].



Congestive heart failure

Having obesity is associated to about 11% of heart failure cases in men and 14% in women.

High blood pressure

More than 85% of those with hypertension have a BMI greater than 25 [6]. The risk of hypertension is 5 times higher in the obese as compared to those of normal weight. A definitive link between obesity and hypertension has been found using animal and clinical studies, which have suggested that there are multiple potential mechanisms for obesity-induced hypertension. These mechanisms include the activation of the sympathetic nervous system as well as the activation of the renin–angiotensin–aldosterone system [7]. The association between hypertension and obesity has been also well described in children.

Abnormal cholesterol levels

Obesity is associated with increased LDL cholesterol (bad cholesterol) and lowered HDL cholesterol (good cholesterol).

Deep vein thrombosis and pulmonary embolism

Obesity increases one's risk of venous thromboembolism by 2.3 fold [6].

2.22 DERMATOLOGICAL

Obesity is associated with the incidence of stretch marks, acanthosis nigricans, lymphedema, cellulitis, hirsutism, and intertrigo.

Diabetes mellitus

One of the strongest links between obesity and disease is that with type 2 diabetes. These two conditions are so strongly linked that researchers in the 1970s started calling it "diabesity Excess weight is behind 64% of cases of diabetes in men and 77% of cases in women [8].

Gynecomastia

Obesity, according to a 2009 review, can be associated with elevated peripheral conversion of androgens into estrogens in some individuals.

3.HYPERTENSION

Hypertension (HTN or HT), also known as high blood pressure (HBP), is a long-term medical condition in which the blood pressure in the arteries is persistently elevated. High blood pressure typically does not cause symptoms. Long-term high blood pressure, however, is a major risk factor for coronary artery disease, stroke, heart failure, atrial fibrillation, peripheral vascular disease, vision loss, chronic kidney disease, and dementia. [9] The treatment of moderately high arterial blood pressure (defined as >160/100 mmHg) with medications is associated with an improved life expectancy. The effect of treatment of blood pressure between 130/80 mmHg and 160/100 mmHg is less clear, with some reviews finding benefit and others finding unclear benefit.[17] High blood pressure affects between 16 and 37% of the population globally.[5] In 2010 hypertension was believed to have been a factor in 18% of all deaths (9.4 million globally) [10].

3.1 Signs and symptoms

Hypertension is rarely accompanied by symptoms, and its identification is usually through screening, or when seeking healthcare for an unrelated problem. Some people with high blood pressure report headaches (particularly at the back of the head and in the morning), as well as lightheadedness, vertigo, tinnitus (buzzing or hissing in the ears), altered vision or fainting episodes.[20] These symptoms, however, might be related to associated anxiety rather than the high blood pressure itself. On physical examination, hypertension may be associated with the presence of changes in the optic fundus seen by ophthalmoscopy.The severity of the changes typical of hypertensive retinopathy is graded from I to IV; grades I and II may be difficult to differentiate.The severity of the retinopathy correlates roughly with the duration or the severity of the hypertension [11].

3.2 Children

Failure to thrive, seizures, irritability, lack of energy, and difficulty in breathing[32] can be associated with hypertension in newborns and young infants. In older infants and children, hypertension can cause headache, unexplained irritability, fatigue, failure to thrive, blurred vision, nosebleeds, and facial paralysis [12].

4. CAUSES

4.1 Primary hypertension

Hypertension results from a complex interaction of genes and environmental factors. Numerous common genetic variants with small effects on blood pressure have been identified as well as some rare genetic variants with large effects on blood pressure. Also, genome-wide association studies (GWAS) have identified 35 genetic loci related to blood pressure; 12 of these genetic loci influencing blood pressure were newly found. Sentinel SNP for each new genetic locus identified has shown an association with DNA methylation at multiple nearby CpG sites. These sentinel SNP are located within genes related to vascular smooth muscle and renal function. DNA methylation might affect in some way linking common genetic variation to multiple phenotypes even though mechanisms underlying these associations are not understood. Single variant test performed in this study for the 35 sentinel SNP (known and new) showed that genetic variants singly or in aggregate contribute to risk of clinical phenotypes related to high blood pressure.[13]

Blood pressure rises with aging and the risk of becoming hypertensive in later life is considerable. Several environmental factors influence blood pressure. High salt intake raises the blood pressure in salt sensitive individuals; lack of exercise, obesity, and depression[38] can play a role in individual cases. The possible roles of other factors such as caffeine consumption, and vitamin D deficiency are less clear. Insulin resistance, which is common in obesity and is a component of syndrome X (or the metabolic syndrome), is also thought to contribute to hypertension. One review suggests that sugar may play an important role in hypertension and salt is just an innocent bystander. Events in early life, such as low birth weight, maternal smoking, and lack of breastfeeding may be risk factors for adult essentialhypertension, although the mechanisms linking these exposures to adult hypertension remain unclear.[An increased rate of high blood urea has been found in untreated people with hypertension in comparison with people with normal blood pressure, although it is uncertain whether the former plays a causal role or is subsidiary to poor kidney function. Average blood pressure may be higher in the winter than in the summer. [14] Periodontal disease is also associated with high blood pressure.

4.2 Secondary hypertension

Secondary hypertension results from an identifiable cause. Kidney disease is the most common secondary cause of hypertension. Hypertension can also be caused by endocrine conditions, such as Cushing's syndrome, hyperthyroidism, hypothyroidism, acromegaly, Conn's syndrome or hyperaldosteronism, renal artery stenosis (from atherosclerosis or fibromuscular dysplasia), hyperparathyroidism, and pheochromocytoma. Other causes of secondary hypertension include obesity, sleep apnea, pregnancy, coarctation of the aorta, excessive eating of liquorice, excessive drinking of alcohol, and certain prescription medicines, herbal remedies, and illegal drugs such
as cocaine and methamphetamine. Arsenic exposure
through drinking water has been shown to correlate with elevated blood pressure. [15]

A 2018 review found that any alcohol increased blood pressure in males while over one or two drinks increased the risk in females. [16]

5. PATHOPHYSIOLOGY

In most people with established essential hypertension, increased resistance to blood flow (total peripheral resistance) accounts for the high pressure while cardiac output remains normal.There is evidence that some younger people with prehypertension or 'borderline hypertension' have high cardiac output, an elevated heart rate and normal peripheral resistance, termed hyperkinetic borderline hypertension. These individuals develop the typical features of established essential hypertension in later life as their cardiac output falls and peripheral resistance rises with age. Whether this pattern is typical of all people who ultimately develop hypertension is disputed.The increased peripheral resistance in established hypertension is mainly attributable to structural narrowing of small arteries and arterioles, [16] although a reduction in the number or density of capillaries may also contribute.

5.1 Association of Obesity with hypertension.

Overweight is a body mass index between 25.0 to 29.9 kg/m^2 . Obesity is a body mass index of 30 kg/m^2 or higher (1). Obesity and obesity are risk factors for hypertension, dyslipidemia, and diabetes mellitus . The Framingham Study demonstrated that obesity was about twice as prevalent in obese men and in obese women as in men and in women with a normal Metropolitan relative weight . The Framingham Study also demonstrated that both men and women had an increase in blood pressure with increased overweight [17]. Persons in the highest body mass index quartile had a 16 mmHg higher systolic blood pressure and a 9 mmHg higher diastolic blood pressure than persons in the lowest body mass index quartile . In this study, the systolic blood pressure increased 4 mmHg for each 4.5 kg of increased weight . Insurance industry data have also shown a positive relationship between overweight or obesity with hypertension [18].

6. MATERIALS AND METHODS SUBJECTS

The subjects were from the blocks randomly selected from among the 6 communities of Faisalabad, Pakistan in 2017–2018. The inclusion criteria for the participants included: (1) age≥50 years, (2) ability to answer the questionnaire, and (3) living in the selected communities for more than 6 months in the past year. A total of 3,277 residents aged 50 years or older were potentially eligible for this study; however, 1,407 individuals were excluded because they did not provide anthropometric data such as their height, weight, WC, systolic blood pressure (SBP), diastolic blood pressure (DBP), and information about their current use of medications. A total of 1,870 participants were included in the final data analysis.

6.1 Investigation and measurements

All participants were given a standardized medical examination in which their systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured. Blood pressure (BP) was measured in the right arm by trained examiners using a mercury sphygmomanometer according to a standard protocol. Three BP measurements were made, with an interval of from 5 to 15 minutes between measurements, and the average of the three readings was chosen as the BP value for each subject. The anthropometric measurements were taken after the participants had removed their shoes and any heavy clothing or belts. Each subject's height, weight, and WC were measured by trained nurses. The WC was measured at the level midway between the lower rib margin and the iliac crest while the participants breathed out gently. This study was approved by the Ethics Committee of the School of Public Health of Shandong University, and written informed consent of each participant was obtained [19].

7. RESULTS

A total of 1,870 people (600 men and 1,270 women) age 50 years and older participated in this study. The distributions of age, height, weight, BMI, WC, SBP and DBP by gender and comparisons between males and females are summarized in Table 1. The mean age was 64.76±9.09 years for men and 64.45±9.67 years for women; no significant difference in age was found between males and females (P=0.494). The prevalences of hypertension, smoking, alcohol consumption, general obesity calculated in terms of the BMI, central obesity calculated in terms of the WC and each educational level are also listed in Table 1. The results show that height, weight, WC, DBP, the prevalences of general obesity, hypertension, smoking, alcohol consumption and all education levels except the junior high school level were significantly different between males and females (P<0.05)

Table 1

Summary statistics and a comparison of characteristics between genders (mean ± s.d.).

Characteristic	Total (n=1870)	Male (n=600)	Female(n=1270)	P
Age (year)	64.55±9.49	64.76±9.09	64.45±9.67	0.494
Height (cm)	160.96±8.12	169.10±5.88	157.11±5.88	<0.001
Weight (kg)	65.97±10.92	72.35±10.23	62.96±9.89	<0.001
BMI	25.43±3.56	25.27±3.13	25.50±3.74	0.174
WC (cm)	88.72±10.13	91.34±9.30	87.48±10.27	<0.001
SBP (mmHg)	135.04±19.66	135.58±19.08	134.78±19.93	0.410
DBP (mmHg)	83.44±11.44	85.09±11.46	82.66±11.36	<0.001
General obesity, n (%)	395 (21.1)	102 (17.0)	293 (23.1)	0.003
Central obesity, n (%)	1467 (78.4)	467 (77.8)	1000 (78.7)	0.673
Hypertension, *n* (%)	1149 (61.4)	400 (66.7)	749 (59.0)	0.001
Smoking, n (%)	284 (15.2)	236 (39.3)	48 (3.8)	<0.001
Alcohol drinking (%)	216 (11.6)	190 (31.7)	26 (2.0)	<0.001
Educational attainment*				
Uneducated (%)	247 (13.3)	16 (2.7)	231 (18.3)	<0.001
Grade school (%)	348 (18.7)	83 (13.9)	265 (20.9)	<0.001
Junior high school (%)	469 (25.2)	153 (25.7)	316 (25.0)	0.749
Senior high school (%)	629 (33.8)	239 (40.1)	390 (30.8)	<0.001
Junior college and above (%)	168(9.0)	105(17.6)	63 (5.0)	<0.001

BMI, body mass index; WC, waist circumference; SBP, systemic blood pressure; DBP, diastolic blood pressure.
*There were four missing values for men and five missing values for women for educational attainment.

The distributions of age, height, weight, BMI and WC between the hypertensive and normotensive groups are shown in Table 1. The prevalences of general obesity, central obesity, smoking and alcohol consumption are also listed in Table 2. All variables were significantly different between the hypertensive and normotensive groups except the average height and the prevalence of smoking.

Table 2

Summary statistics and a comparison of characteristics between the hypertensive and normotensive groups (mean ±s.d.).

Characteristics	Hypertensive (n=1149)	Normotensive (n=721)
Age (year)	66.01±9.48*	62.23±9.04*
Height (cm)	161.03±8.45	160.84±7.58
Weight (kg)	67.80±11.00*	63.07±10.13*
BMI	26.11±3.57*	24.34±3.27*
WC(cm)	90.91±9.71*	85.22±9.80*
General obesity, n (%)	309(26.9)*	86(11.9)*
Central obesity, n (%)	980(85.3)*	487(67.5)*
Smoking, n (%)	179(15.6)	105(14.6)
Alcohol consumption (%)	148(12.9)*	68(9.4)*

BMI, body mass index; WC, waist circumference; *P<0.05.

8. DISCUSSION

The prevalence of obesity has increased worldwide and has nearly doubled between 1990 and 2018 . A large number of studies have shown that the risk of obesity increases in those with hypertension, and the relationship between obesity and hypertension differs according to age, gender, geographical area and race Thus, in this study, we examined the relationship between obesity and hypertension among people over 50 years of age in Faisalabad, Pakistan. We showed that height, weight, WC, DBP, and the prevalences of general obesity, hypertension, smoking and alcohol consumption were significantly different between males and females, suggesting that gender is a strong confounder. Then subgroup analyses were conducted in males and females in order to intuitively to show and compare the relationships between obesity and hypertension. Perhaps because the women were more willing to comply with the requirements of the survey and the physical examination than men, our final sample included more women than men. [20]

9. CONCLUSIONS

The relationship between hypertension and general obesity was stronger than the relationship between hypertension and either overweight or central obesity in both genders male and females.

10. REFERENCES

[1] Chiolero A, Bovet P, Paradis G, Paccaud F (March 2007). "Has blood pressure increased in children in response to the obesity epidemic?". Pediatrics. 119 (3): 544–53. doi:10.1542/peds.2006-2136. PMID 17332208.

[2] *Perez, MI; Musini, VM; Wright, James M (23 January 2008). "Pharmacological interventions for hypertensive emergencies". The Cochrane Database of Systematic Reviews (1):CD003653.* doi:10.1002/14651858.CD003653. pub3. PMID 18254026.

[3] *Marik PE, Varon J; Varon (June 2007). "Hypertensive crises: challenges and management". Chest. 131 (6): 1949–62. doi:10.1378/chest.06-2490. PMID 17565029. Archived from the original on 4 December 2012.*

[4] Lichtenstein AH, Appel LJ, Brands M, Carnethon M, Daniels S, Franch HA, Franklin B, Kris-Etherton P, Harris WS, Howard B, et al. American Heart Association Nutrition Committee: Diet and lifestyle recommendations revision 2006: A scientific statement from the American Heart Association Nutrition Committee. Circulation. 2006;114:82–96. doi: 10.1161/CIRCULATIONAHA.106.176158.

[5] Dietz WH (2000) Birth weight, socioeconomic class, and adult adiposity among African Americans. Am J Clin Nutr 72(2): 335-336.

[6] Poirier P, Giles TD, Bray GA, et al. (May 2006). "Obesity and cardiovascular disease: pathophysiology, evaluation, and effect of weight loss". Arteriosclerosis, Thrombosis, and Vascular Biology. **26** (5):968–75

[7] Darvall KA, Sam RC, Silverman SH, Bradbury AW, Adam DJ (February 2007). "Obesity and thrombosis". Eur J Vasc Endovasc Surg. 33 (2): 223–33.

[8] Peter G. Kopelman; Ian D. Caterson; Michael J. Stock; William H. Dietz (2005). Clinical obesity in adults and children: In Adults and Children. Blackwell. p. 493.

[9] Levy Lau, DH; Nattel, S; Kalman, JM; Sanders, P (August 2017). "Modifiable Risk Factors and Atrial Fibrillation". Circulation (Review). 136 (6): 583–96.

[10] Campbell, NR; Lackland, DT; Lisheng, L; Niebylski, ML; Nilsson, PM; Zhang, XH (March 2015). "Using the Global Burden of Disease study to assist development of nation-specific fact sheets to promote prevention and control of hypertension and reduction in dietary salt: a resource from the World Hypertension League". Journal of Clinical Hypertension (Greenwich, Conn.). 17 (3): 165–67.

[11] Fisher ND, Williams GH (2005). "Hypertensive vascular disease". In Kasper DL, Braunwald E, Fauci AS, et al. (eds.). *Harrison's Principles of Internal Medicine* (16th ed.). New York, NY: McGraw-Hill. pp. 1463–81.

[12] Dionne JM, Abitbol CL, Flynn JT (January 2012). "Hypertension in infancy: diagnosis, management and outcome". *Pediatr. Nephrol*. **27** (1): 17–32.

[13] Kato, Norihiro; Loh, Marie; Takeuchi, Fumihiko; Verweij, Niek; Wang, Xu; Zhang, Weihua; Kelly, Tanika N.; Saleheen, Danish; Lehne, Benjamin (1 November 2015). "Trans-ancestry genome-wide association study identifies 12 genetic loci influencing blood pressure and implicates a role for DNA methylation". *Nature Genetics*. **47** (11): 1282–93.

[14] *Fares, A (June 2013). "Winter Hypertension: Potential mechanisms". International Journal of Health Sciences. **7** (2): 210–9*.

[15] Abhyankar, LN; Jones, MR; Guallar, E; Navas-Acien, A (April 2012). "Arsenic exposure and hypertension: a systematic review". *Environmental Health Perspectives*. **120** (4): 494–500

[16] Roerecke, Michael; Tobe, Sheldon W.; Kaczorowski, Janusz; Bacon, Simon L.; Vafaei, Afshin; Hasan, Omer S. M.; Krishnan, Rohin J.; Raifu, Amidu O.; Rehm, Jürgen (27 June 2018)

[17] Folkow B (April 1982). "Physiological aspects of primary hypertension". *Physiol. Rev*. **62**(2): 347–504.

[18] Higgins M, Kannel W, Garrison R, et al. Hazards of obesity--the Framingham experience. Acta Med Scand Suppl 1988;723:23-36.

[19] Harsha DW, Bray GA. Weight loss and blood pressure control (pro). Hypertension 2008;51:1420-5. 10.1161/HYPERTENSIONAHA.107.09401

[20] Oda E, Kawai R. (2008) Age-and gender-related differences in correlations between abdominal obesity and obesity-related metabolic risk factors in Japanese. Internal medicine (Tokyo, Japan) 48:497–502.