Original Article

Association of anthropometric indices of obesity with diabetes, hypertension and dyslipidemia

Javed Ahmed Phulpoto

Department of Medicine, Ghulam Mohammad Mahar Medical College, Sukkur, Pakistan

Objective: To study the association of selected established anthropometric indices of obesity viz body mass index (BMI), Waist circumference (WC) and waist-hip ratio (WHR) with diabetes, hypertension and dyslipidemia in population residing at Sukkur, Pakistan.

Methodology: In this cross sectional descriptive study, participants were selected from out-patients setting of Medicine at Ghulam Mohammad Mahar Medical college teaching hospital, Sukkur through consecutive sampling from July 2011 to June 2012. Structured Questionnaire, anthropometric measurements and bio-chemical tests were administered to 369 participants.

Results: WC was associated with hypertension, diabetes and dyslipidemia in male and dyslipidemia in female. WHR showed association with dyslipidemia in female while BMI with hypertension (male) and dyslipidemia (female).

Conclusion: Waist circumference as obesity index may have a more reliable association with of cardiovascular disease risk factors viz. hypertension, diabetes and dyslipidemia among general population compared with BMI and WHR. (Rawal Med J 2013;38:100-103).

Key Words: Abdominal obesity, anthropometry, body mass index, waist circumference.

INTRODUCTION

Obesity has emerged as a 'global epidemic'. It has affected both developed and developing nations with same intensity, Pakistan being no exception. National Family Health Survey revealed that 14.8% women and 12.1% men are obese in India.[1] In addition to initiating the process of numerous co-morbidities; obese people are more likely to develop hypertension, type 2 diabetes and dyslipidemia which together further compound their risk for heart disease and stroke. Obesity is essentially an imbalance of body fat in terms of its quantity and distribution. Numerous techniques are available to estimate body composition and fat distribution.

Multi-compartment models, such as underwater weighing, dilution techniques and dual-energy X-ray absorptiometry (DEXA) are all reliable methods to obtain accurate measurement of total body fat. However, because of the inferior cost effectiveness of such modalities to time-honored anthropometric techniques, these methods are not practical for routine clinical use. Among anthropometric measurements, Body Mass Index (BMI) has been extensively used in clinical practice to screen obesity, yet the validity of this index as a measure of obesity is doubtful, especially in light of emerging evidence.[2] Recent studies show that abdominal fat distribution rather than generalized obesity is associated with increased risk of cardiovascular disease.[3,4] There is lack of representative data regarding the profile of native Sindhis with diabetes, hypertension and dyslipidemia and their association with measures of general and abdominal obesity; hence this study was conducted to identify this association.

METHODOLOGY

The study is a hospital-based cross sectional descriptive study conducted in a tertiary care setting from the July 2011 to June 2012. Study population comprised of individuals aged 20 years and above attending the out-patient department of Medicine at a teaching Hospital of Sukkur, Sindh, Pakistan. Participants were chosen through consecutive sampling. Critically ill patients presenting with medical emergencies like myocardial infarction, patients with known secondary cause of hypertension, hyperglycemia or dyslipidemia, subjects with pregnancy and ascites were excluded from the study.

After obtaining informed consent, a pretested structured questionnaire was administered and information regarding socio-demographic status, past & family history of diabetes, hypertension & dyslipidemia, addiction, physical activity, diet was collected. Physical activity was assessed by using standard WHO criteria.[5] The anthropometric measurements were taken as per WHO Technical report series on anthropometric measurement.[5] Body mass index (BMI) was calculated as weight (kg)/height^2 (m^2).[6] Waist circumference (WC) was measured waist-hip ratio (WHR) was calculated.

Central adiposity was defined as WC greater than 90 cm for men & 80 cm for women. WHR above 0-95 for males and 0-8 in case of females was taken as cut-off for central adiposity.[7] Adhering to standard guidelines, blood pressure measurement readings were taken participants were declared as hypertensive if their systolic blood pressure was above 140mm Hg or diastolic blood pressure above 90mm Hg or if they were taking antihypertensive therapy.[8] Fasting plasma glucose level and lipid profile were measured. Subjects having fasting plasma glucose level above 125 mg/dl for 2 or more readings were considered to have diabetes.[9]

Total cholesterol was estimated with the ferric chloride method[10] and triglycerides by method described by Rosenberg and Gottfried.11 was used for the determination of triglyceride level. After precipitation of very low-density lipoprotein cholesterol and low-density lipoprotein cholesterol (LDL-c) from the serum by phosphotungstic acid and magnesium chloride, the supernatant was taken and HDL-c estimation performed by the method described for Total cholesterol. The value of LDL-c was calculated using Friedwald's equation. The presence of abnormal lipid levels being defined as Total cholesterol > 200mg/dL or LDL > 130mg/dL or HDL < 40mg/dL or TG > 200mg/dL or if they were under treatment for dyslipidemia.[10] Data was analyzed with Epi-info version 3.0.6. Descriptive statistics were calculated. Pearson's Chi-square (X^2) test and Z test of proportions were used as tests of significance.

RESULTS

Out of the 369 participants, 192 (52.03%) were males, age group 40-50 years contributed maximum subjects (118; 31.98%) followed by age groups 30-40 years (Table 1). There was no significant male to female difference. A positive family history was detected in 10/62 hypertensives, 9/26 diabetics and 9/109 dyslipidemic subjects but the significant association was found only with diabetes (z=2.39; p=0.17). On grouping the participants, as per the status of physical activity 86/112 (76.78%) sedentary workers were found to suffer from at least one of the studied disease contrast to 76/130 (58.46%) moderate and 35/127 (27.55%) heavy workers. In this study, addiction to smoking (39/109, z=2.33; p=0.020) was found to be significantly associated with dyslipidemia out of the three diseases.

Table 1. Diabetes, hypertension and dyslipidemia in relation to age and sex distribution of the study group.

Age Group (in Years)	Diabetes (%) Present	Hypertension (%) Present	Dyslipidemia (%) Present
20-30 (n=41)	2(7.69%) M=1, F=1	2(3.22%) M=2, F=Nil	4(3.67%) M=2, F=2
30-40 (n=94)	6(23.1%) M=4, F=2	10(16.1%) M=6, F=4	18(16.5%) M=10, F=8
40-50 (n=118)	7(26.9%) M=4, F=3	18(29%) M=10, F=8	37(34%) M=21, F=16
50-60 (n=71)	6(23.1%) M=3, F=3	18(29%) M=9, F=9	27(24.8%) M=15, F=12
>60 (n=45)	5(19.03%) M=3, F=2	14(22.58%) M=8, F=6	23(21.10%) M=14, F=9
All ages (N=369, M=192, F=177)	26 M=15(57.7%) F=11(42.3%)	62 M=35(56.4%) F=27(43.6%)	109 M=61(56%) F=48(44%)

Table 2 shows the association of BMI, WC and WHR with diabetes, hypertension and dyslipidemia. The BMI>30 was significantly related only with hypertension (z=2.33; p=0.020) in males and dyslipidemia (z=3.32; p=0.001) in females, while no significant association could be derived with diabetes in both sexes.

Table 2. Association of anthropometric indices - Body Mass Index (BMI), Waist Circumference (WC) and Waist Hip Ratio (WHR) with diabetes, hypertension and dyslipidemia.

		Cut-off Values	Diabetes		Hypertension		Dyslipidemia	
			Present	Absent	Present	Absent	Present	Absent
Male (n=192)	BMI	<30kg/m^2	10(5.2)	125(65.1)	19(9.9)	116(60.4)	49(25.5)	86(44.8)
		>30kg/m^2	5(2.6)	52(27.1)	17(8.8)	40(20.9)	12(6.3)	45(23.4)
	WC	<90 cm	6(3.1)	108(56.3)	19(9.9)	115(59.9)	36(18.7)	98(51.0)
		>90 cm	9(4.7)	49(25.5)	16(8.3)	42(28.9)	25(13.0)	33(17.3)
	WHR	<0.95	10(5.2)	146(76.0)	27(14.0)	129(67.2)	47(24.5)	109(56.8)
		>0.95	5(2.6)	31(16.2)	8(4.2)	28(14.6)	14(7.3)	22(11.4)
Female (n=177)	BMI	<30kg/m^2	7(3.9)	123(69.5)	17(9.6)	113(63.8)	26(14.7)	104(58.7)
		>30kg/m^2	4(2.3)	43(24.3)	10(5.6)	37(21.0)	22(12.4)	25(14.1)
	WC	<80 cm	4(2.3)	113(63.8)	14(7.9)	103(58.2)	27(15.3)	90(50.8)
		>80 cm	7(3.9)	53(30.0)	13(7.3)	47(26.6)	24(13.6)	36(20.3)
	WHR	<0.95	6(3.4)	118(66.7)	20(11.3)	104(58.8)	28(15.8)	96(54.2)
		>0.95	5(2.8)	48(27.1)	7(3.9)	46(26.0)	20(11.3)	33(18.7)

58/192 (30.20%) males and 60/177 (33.90%) females were defined as obese with reference to WC. Obese male participants showed significant association to all three disease namely- diabetes (z=2.17; p=0.030), hypertension (z=2.03; p=0.04) and dyslipidemia (z=2.15; p=0.031) while it was associated significantly with dyslipidemia (z=2.28; p=0.023) in females, but no significant association could be proved with hypertension and diabetes.

WHR >0.95 was detected in 36/192 (18.75%) males and >0.80 in 53/177 (29.94%) females. This index was not found to be significantly associated with any of the three diseases under study in males. The increased waist-hip ratio in females was significantly associated with dyslipidemia (z=1.98; p=0.047) only.

DISCUSSION

The present study showed a significant association of BMI with hypertension in males and dyslipidemia in females but no association with diabetes in both sexes. BMI is traditionally being honored as benchmark to detect obesity, but there are several limitations of this index like inability to distinguish body fat distribution (abdominal and overall obesity), its cut-off points being derived from studies on population of Caucasian origin and recent evidence that even Asians with low BMI values are afflicted with diabetes and hypertension; hinders its validity in all ethnic groups.

Our findings are consistent with several other studies. In a comparative study of anthropometric indices to predict mortality among adult, BMI was reported as a poor predictor as compared to others.[11] Other studies also declared the superseding of other indices over BMI.[12,13] A study from China found BMI to be a better predictor of cardiovascular disease and diabetes and further concluded that measurement of both WC and BMI may be better predictor than BMI or WC alone.[14]

WHR was not associated significantly with any disease under study in males but dyslipidemic females showed significant association with it. In comparison, WC was found to be the only anthropometric index significantly associated with all three disorders in males and dyslipidemia in females. With regards to evaluation of WC and WHR as predictors of metabolic disturbances and the risk of cardiovascular diseases, results have been inconsistent. Several studies are in favor of WC as a stronger predictor for metabolic risk factors and cardiovascular disease as compared to WHR.[15,16] On the other hand there are studies that found WHR to be superior to WC.[17-19] These observations led to further studies that investigated the separate contributions of waist and hip circumferences to disease risk-metabolic disturbances, type 2 diabetes and cardiovascular disease.[20-23] The study was

hospital based, and a community based cohort with representative sample is required to identify a sensitive and contextual marker which may enable to intervene in pre-pathogenesis phase and to detect at earliest the cardiovascular morbidities.

CONCLUSION

In conclusion, waist circumference appears as more accommodative marker of obesity to detect hypertension, diabetes and dyslipidemia.

Conflict of Interest: None declared
Corresponding author email: jphulpoto@yahoo.com
Rec. Date: Nov 24, 2012 Accept Date: Jan 01, 2013

REFERENCES

1. Key Indicators for India from NFHS-3. http://www.nfhsindia.org/pdf/India.pdf, Nov 2007, Dec 2007
2. Romero-Corral A, Somers VK, Sierra-Johnson J, Thomas RJ, Collazo- Clavell ML, Korinek J, et al. Accuracy of body mass index in diagnosing obesity in the adult general population. Int J Obes (Lond) 2008;32:959-66.
3. Banerji MA, Faridi N, Atluri R, Caiken RL, Lebovitz HE. Body composition, visceral fat, leptin, and insulin resistance in Asian Indian men. J Clin Endocrinol Metab 1999;84:137-44.
4. Despres JP, Lemieux I. Abdominal obesity and metabolic syndrome. Nature 2006; 444:881-7.
5. Global Physical Activity Surveillance Questionnaire. http://www.who.int/chp/steps/GPAQ/en/
6. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser 2000;894:i-xii, 1-253.
7. Alberti KG, Zimmet P, Shaw J. IDF Epidemiology Task Force Consensus Group. The metabolic syndrome- a new worldwide definition. Lancet 2005;366:1059-62.
8. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al; The Seventh Report of the Joint National Committee on prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA 2003;289:2560-72.
9. American Diabetes Association. Standards of Medical Care in Diabetes-2007. Diabetes Care 2007; 30 Suppl 1:S4-S41.
10. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). JAMA 2001;285:2486-97.
11. Visscher TL, Seidell JC, Molarius A, van der Kuip D, Hofman A, Witteman JC. A comparison of body mass index, waist- hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. Int J Obes Relat Metab Disord 2001;25:1730-5.
12. Schneider HJ, Friedrich N, Klotsche J, Pieper L, Nauch M, John U, et al. The predictive value of different measures of obesity for incident cardiovascular events and mortality. J Clin Endocrinol Metab 2010;95:1777-85.
13. Zhu S, Wang Z, Heshka S, Heo M, Faith MS, Heymsfield SB. Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: Clinical action thresholds. Am J Clin Nutr 2002;76:743-9.
14. Ying X, Song ZY, Zhao CJ, Jiang Y. Body mass index, waist circumference, and cardio-metabolic risk factors in young and middle-aged Chinese women. J Zhejiang Univ Sci B 2010;11:639-46.
15. Onat A, Avci GS, Barlan MM, Uyarel H, Uzunlar B, Sansoy V. Measures of abdominal obesity assessed for visceral adiposity and relation to coronary risk. Int J Obes Relat Metab Disord 2004;28:1018-25.
16. Wi M, Gaskill SP, Haffner SM, Stern MP. Waist circumference as the best predictor of non-insulin dependent diabetes mellitus (NIDDM) compared to body mass index, waist/hip ratio and other anthropometric measurements in Mexican Americans a 7- year prospective study. Obes Res 1997;5:16-23.
17. Silventoinen K, Jousilahti P, Vartiainen E, Tuomilehto J. Appropriateness of anthropometric obesity indicators in assessment of coronary heart disease risk among Finnish men and women. Scand J Public Health 2003;31:283-90.
18. de Vegt F, Dekker JM, Jager A, Hienkens E, Kostense PJ, Stehouwer CD, et al. Relation of impaired fasting and post load glucose with incident type 2 diabetes in a Dutch population: The Hoorn Study. JAMA 2001;285:2109-13.
19. Folsom AR, Kushi LH, Anderson KE, Mink PJ, Olson JE, Hong CP, et al. Associations of general and abdominal obesity with multiple health outcomes in older women: the lowa women's Health Study. Arch Intern Med 2000;160:2117-28.
20. Snijder MB, Zimmet PZ, Visser M, Dekker JM, Sidell JC, Shaw JE. Independent association of hip circumference with metabolic profile in different ethnic groups. Obes Res 2004;12:1370-4.
21. Snijder MB, Dekker JM, Visser M, Yudkin JS, Stehouwer CD, Bouter LM, et al. Larger thigh and hip circumferences are associated with better glucose tolerance: The Hoorn study. Obes Res 2003;11:104-11.
22. Seidell JC, Perusse L, Despres JP, Bouchard C. Waist and hip circumferences have independent and opposite effects on cardiovascular disease risk factors: the Quebec Family Study. Am J Clin Nutr 2001;74:315-21.
23. Snijder MB, Zimmet PZ, Visser M, Dekker JM, Seidell JC, Shaw JE. Independent and opposite associations of waist and hip circumferences with diabetes, hypertension and dyslipidemia: the Aus Diab Study. Int J Obes Relat Metab Disor 2004;28:402-9.