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Correlation of Waist Circumference with Type 2 Diabetes Mellitus: A Cross-Sectional Study

Pankaj Singh

R.K.D.F Medical College & Hospital, Department of Anatomy, SRK University
Bhopal, Madhya Pradesh, India

Vivekanand

Department of Anatomy, R.K.D.F Medical College & Hospital, India

Abstract---Background: Abdominal obesity in comparison to overall obesity is more important in prediction of type II DM. All such individuals who are more susceptible to such diseases either due to genetic background as their life style, are needed to detect at early point in their life so that necessary measures can be taken for their prevention. Methods: A community based study has been done in middle aged men to collect data for risk assessment of type II DM. For identification of high risk categories various analysis like, calculation of position and negative predictive values, and corresponding 95% ci for eleven different cut off points, with interval of 1cm (92-102cm) has been done for evaluation of waist circumference. Result: In study group of middle age men, those having waist – circumference > 94cm, are more prone to type II DM. Conclusion: Waist circumference is an important parameter for assessment of type II DM. It should be used as a reliable method amongst middle aged men to identify those having high risk of type II DM So that all important prevention should be taken and necessary intervention should be done at earliest.

Keywords---cross-sectional study, diabetes mellitus, middle aged men, type II DM, waist circumference.

Introduction

We all know that now-a- days obesity is very common problem among the population, especially kids and youngster, for which unhealthy food habits and sedentary life style are mainly responsible. Obesity alone is one of the majors risk factor in causing type II DM (1). Amongst which abdominal obesity is more important that over all obesity (also known as body mass index or BMI) (2-4). So, it is very important to detect such individuals who are at high risk so that all the

necessary step required for prevention of disease either in the form of behaviors modification or life style change should be taken as easiest as possible. For future risk assessment of type II DM. various community based studies, screening method, test and investigations can be done (5-6). But in primary health care set up, it is often very difficult to perform such time consuming studies or to perform investigation over some patients who do not want themselves to be the sample population for public health studies. In such condition, a single parameter i.e , to assess abdominal obesity by measuring waist circumference is an easy method to perform and is time saving too (7). Since, the results are population specific, this whole study focuses mainly on the assessment of the predictive value of single waist circumference measurement and this predictive value itself is an important indicator of risk of type II DM (8,9).

Material and Method

In 2019, a cross sectional study was done in RKDR Medical College, Bhopal in which 300 patients having diabetes diagnosed in the diabetic clinic of the medical college were participated.

- Inclusion criteria : The participants who were qualified to participate in the stud should have: - age>30years
 - At least one year duration of having DM
 - Must have clinical determined type II DM on the based of who criteria.
- Exclusion Criteria: Participants excluded from the study are those having
 - Age <30 years
 - Pregnant ladies
 - Lactating mothers
 - Patient on long term steroid therapy
 - Patient with any chronic disease
 - Patient with H/ diseases like Myocardial infarction, hearts failure,
- Type I DM, hypothyroidism, acromegaly, hypogonadism, etc.
- On active drug treatment for obesity
- Anthropometric Parameters – WC is taken as standard parameter for this study. For WC, measurement was taken midway between the inferior angle of rubs and the supra-iliac crest. For measurement, a non-stretchable fiber glass measuring tape was used and measurements were measured to the nearest 1cm. In accordance to WHO expert consultation report on WC and waist to hip ratio. Participant should study up right with both arms in relaxed position at the side, both feet evenly spaced and weight of the body evenly distributed for determination of abdominal obesity, wc > 102cm in men and > 88cm in women was considered in accordance to WHO cut off point and risk of metabolic complications for WC.
- Clinical Parameters - From health record files of each diabetic patient mlues of fasting plasma glucose, was taken. Patent with FPG > 6.1 is impaired fasting glycemia (Ifg). If FPG>7mmoi /it it is considered as hyperglycemia. Uncontrolled diabetes was denoted by both IFG and hyperglycemia from each patient sociodemographic date such as age, gender and duration of diabetes were al so taken.

Result

During the study the value of means wc was 94.99cm and the value was significantly higher in women as compared to men. The abdominal obesity prevalence percentage was 76.47% which was significantly higher in women as compared to men. Participants having uncontrolled DM constitutes 77.65% of both men and women in the study. Among all those uncontrolled DM participants, those having impaired fasting glycemias were 30.30% (n=20) and those having hyperglycemia were 60.70% (n=46). In this study, the mean age of women (56.23 ± 12.30) was higher than men (51.83 ± 11.75) significantly (P=0.007). Among the participants, the mean duration of DM was found to be 5.25 ± 5 years and this value was higher in men as compared to women.

According to the data in table 2, WHR, WC, gender and age shows a significant with WHR (r=0.54, P<0.01), age (r=0.51, P<0.01) and gender (r=0.35, P<0.01). As in the table 3, the relative contribution of the predictor variables of WC was shown by multiple linear regression models. In step 1, gender was a significant predictor of WC as explained by 13% of variance in WC. In step 2, WHR (b=0.44, P<0.01), age (b=0.41, P<0.01) and FPG (b=0.13, P<0.01) were significant predictor of WC and gender was not a significant predictor. As explained by this model the variance in prediction of WC was 48%.

Table 1
Anthropometric and clinical measurements of the study population stratified by gender

Variable	Total (n = 85)	Men (n = 21)	Women (n = 64)	P value
WC (cm)	94.99 ± 14.66	84.16 ± 12.83	98.99 ± 13.89	<0.001
Abdominal obesity				
Yes	65 (76.47%)	18 (28.57%)	59 (92.19%)	<0.001
No	20(23.53%)	15 (71.43%)	5 (7.81%)	
WHR	0.93 ± 0.19	0.69 ± 0.05	1.05 ± 0.16	<0.001
Age (years)	55.19 ± 11.13	51.83±11.75	56.23 ± 12.30	0.007
≤40years	9 (10.59%)	4 (19.05%)	6 (9.38%)	0.076
>40years	76 (89.41%)	17 (80.95%)	58 (90.62%)	
FPG (Mean ± SD)	6.89 ± 2.71	7.89 ± 2.52	6.9 ± 1.99	0.552
Uncontrolled diabetes (%)	66 (77.65%)	16 (76.19%)	50 (78.12%)	0.489
IFG (%)	20 (30.30%)	6 (37.5%)	14 (28%)	0.299
Hyperglycaemia(%)	46 (60.70%)	10 (46.6%)	36 (72%)	
Duration (years)	5.22 ± 4.98	6.28 ± 4.5	4.25 ± 4.01	0.028
≤5 years	56 (65.88%)	12 (57.14%)	44 (68.75%)	≤5 years
>5 years	29 (34.22%)	9 (42.86%)	20 (31.25%)	>5 years

IFG: impaired fasting glycaemia.

Table 2
Pearson correlation coefficient of the study parameters (n= 85)

Variable	WHR	WC	AG	FPG	DD
Gender (GE)	0.62**	0.35**	0.14**	-0.01	-0.16**
WHR (WHR)		0.54**	0.20**	0.1	0.06
WC (WC)			0.51**	0.05	-0.01
Age (AG)				-0.32**	0.01
FPG (FPG)					-0.01

**Correlation is significant at the 0.01 level (2-tailed). WHR: waist-to-hip ratio; WC: waist circumference; AG: Age; FPG: fasting plasma glucose; and DD: diabetes duration.

Table 3
Multiple linear regression predicting waist circumference (n = 85)

Variable	B (SE)	β	95% CI
Setp 1 (constant)	85.16(1.73)		81.74–87.60
Female gender	13.04(1.89)	0.37**	11.13–16.85
Setp 2 (constant)	26.55(8.84)		17.88–53.13
Male versus gender	1.96 (1.99)	0.04	-2.04–5.67
WHR	32.69(4.44)	0.44**	26.25–42.94
Duration	-0.021(0.13)	-0.01	-0.28–0.24
Age (Vears)	0.51 (0.05)	0.41**	0.39–0.63
FPG (m/mol)	0.74 (0.25)	0.13*	0.26–1.13

*2 for Step 1 = 0.14, Step 2 = 0.48 ($P < 0.001$). ** $P < 0.001$, * $P < 0.05$. WHR: waist-to-hip ratio; WC: waist circumference; AG: age; FPG: fasting plasma glucose; and DD: diabetes duration.

Discussion

In this cross sectional study done amongst the patients having type II DM in a outpatient clinic in RDF, a high prevalence of central obesity is shown. Gender, age, FPG, WHC and WC are significantly contribute in increasing waist circumference. Evidence showed 76% prevalence of abdominal obesity which is higher than the prevalence of central obesity that is reported as 31.2% among the healthy population of civil servants in Tamale, Ghana (18). However, these findings concus with the prevalence of central obesity that is 75%in a hospital based study of diabetes patients in Kumasi Ghana (9) and also among southesn India's diabetes patient where the prevalence is 68.1% since central obesity is shown as significant risk factor for type II DM (10). All these study results are not very surprising (11,12). The risk of developing abdominal obesity was significantly higher amongst female which was confirmed by correlation and multiple regression models WHR and WC was strongly predicted by female gender the association b/w female gender and obesity among diabetes was conformed by

several studies (13-16). A cross sectional study among healthy populations was also in agreement of such relationship (17,18-20).

Amongst the factor that influence WC, WHR, age, and FPG comes out as independent positive predictors of WC according to our correlation and multiple linear regression models. According to several studies, age is a strong predictor of WC as a positive relationship was found between the two ($\beta = 0.48$, 95% CI = 0.40 – 0.64, $p < 0.01$) (9, 21-23). A significantly positive prediction is shown between WC and blood glucose in a cross sectional study done amongst the sample of 5882 adults from US 1999 – 2004 National Health and National Examination Survey(24). Person with diabetes have two times more chances of having elevated WC (OR 2.3; 95% CI 1.2-4.6%) and WHR (OR 2.1; 95% CI 1.1-3.95%) as found in a population based survey of prevalence of diabetes and its correlation in a urban slum in a community in Nairobi, Kenya, Ayah et al(25). The most clinically relevant type of body fat is Intra-abdominal adipose tissue and its increase shows strong association with metabolic complications such as type II DM and hyperinsulinemia (26-28). This shows that increased WC have negative influence on blood glucose level. So, one should emphasis more on regular measurement and monitoring of central and abdominal obesity by simple and inexpensive methods for diabetes management to maintain blood glucose level (29). All these finding were taken from studies done under following limitations. No causality was established in this cross sectional study design. Data taken in study such as FPG was obtained from personal health records of diabetes patients. For minimising error all the necessary case was taken but misreporting might have occurred since, Womens were significantly higher than men in the study, the sample size was not well distributed in terms of gender and this affects the representativeness of sample.

Conclusion

According to above study we conclude that in identifying those middle age group men having high risk of diabetes mellitus, a waist circumference greater than 94 was most predictive.

References

1. Eckel RH, Grundy SM, Zimmet PZ: The Metabolic syndrome. *Lancet* 2005, 365:1415–1428.
2. Lean MEJ, Han TS, Morrison CE: Waist circumference as a measure for indicating need for weight management. *BMJ* 1995, 31:158–161.
3. Pouliot MC, Després JP, Lemieux S, Bouchard C, Tremblay A, Nadeau A, Lupien PJ: Waist circumference and abdominal sagittal diameter: best simple anthropometric index of abdominal visceral adipose tissue accumulation and related cardiovascular risk in men and women. *Am J Cardiol* 1994, 73:460–468.
4. McGrae McDermott M: The international Pandemic of Chronic cardiovascular Disease. *JAMA* 2007, 297:1253–1255.
5. Lindström J, Tuomilehto J: The Diabetes Risk Score: A practical tool to predict type 2 diabetes risk. *Diabetes Care* 2003, 26:725–731.

6. Ketola E, Klockars M: Computer-assisted telephone interview (CATI) in primary care. *Family Practice* 1999, 16:179–183.
7. Janiszewski PM, Janssen I, Ross R: Does Waist Circumference Predict Diabetes and cardiovascular Disease beyond Commonly Evaluated cardio metabolic risk Factors? *Diabetes Care* 2007, 30:3105–3109.
8. Balkau B, Deanfield JE, Després JP, Bassand JP, Fox KA, Smith SC Jr, Barter P, Tan CE, Van Gaal L, Wittchen HU, Massien C, Haffner SM: International Day for the Evaluation of Abdominal Obesity (IDEA). A Study of Waist Circumference, Cardiovascular Disease, and Diabetes mellitus in 168000 Primary care patients in 63 Countries. *Circulation* 2007, 116:1942–1951.
9. I. Danquah, G. Bedu-Addo, K. Terpe et al., “Diabetes mellitus type 2 in urban Ghana: characteristics and associated factors,” *BMC Public Health*, vol. 12, no. 1, article 210, 2012.
10. N. Nahar, S. Dubey, A. Joshi, S. Phadnis, and V. Sharma, “Association of anthropometric indices of obesity with diabetes, hypertension and dyslipidemia: a study from central India,” *Indian Journal of Medical Specialities*, vol. 3, no. 1, pp. 6–11, 2012.
11. G. Vazquez, S. Duval, D. R. Jacobs Jr., and K. Silventoinen, “Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis,” *Epidemiologic Reviews*, vol. 29, no. 1, pp. 115–128, 2007.
12. K. M. Rexrode, V. J. Carey, C. H. Hennekens et al., “Abdominal adiposity and coronary heart disease in women,” *Journal of the American Medical Association*, vol. 280, no. 21, pp. 1843–1848, 1998
13. M. Hanefeld, C. Koehler, S. Gallo, I. Benke, and P. Ott, “Impact of the individual components of the metabolic syndrome and their different combinations on the prevalence of atherosclerotic vascular disease in type 2 diabetes: the Diabetes in Germany (DIG) study,” *Cardiovascular Diabetology*, vol. 6, article 13, 2007.
14. S. H. Saydah, J. Fradkin, and C. C. Cowie, “Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes,” *Journal of the American Medical Association*, vol. 291, no. 3, pp. 335–342, 2004.
15. K. G. M. M. Alberti, P. Zimmet, and J. Shaw, “Metabolic syndrome—a new world-wide definition. A consensus statement from the International Diabetes Federation,” *Diabetic Medicine*, vol. 23, no. 5, pp. 469–480, 2006.
16. S. Tamiru and F. Alemseged, “Risk factors for cardiovascular diseases among diabetic patients in southwest Ethiopia,” *Ethiopian Journal of Health Sciences*, vol. 20, no. 2, pp. 121–128, 2010.
17. V. Mogre, P. P. Mwinlenna, and J. Oladele, “Distorted selfperceived weight status and its associated factors among civil servants in Tamale,” *Archives of Public Health*, vol. 71, no. 1, article 30, 2013.
18. D. Maher, L. Waswa, K. Baisley, A. Karabarinde, N. Unwin, and H. Grosskurth, “Distribution of hyperglycaemia and related cardiovascular disease risk factors in low-income countries: a cross-sectional population-based survey in rural Uganda,” *International Journal of Epidemiology*, vol. 40, no. 1, pp. 160–171, 2011.
19. G. A. Shayo and F. M. Mugusi, “Prevalence of obesity and associated risk factors among adults in Kinondoni municipal district, Dar es Salaam Tanzania,” *BMC Public Health*, vol. 11, article 365, 2011.

20. K. W. Wahab, M. U. Sani, B. O. Yusuf, M. Gbadamosi, A. Gbadamosi, and M. I. Yandutse, "Prevalence and determinants of obesity—a cross-sectional study of an adult Northern Nigerian population," *International Archives of Medicine*, vol. 4, no. 1, article 10, 2011.
21. M. E. Díaz Sanchez, S. Jiménez Acosta, R. G. García Roche, M. Bonet Gorbea, and I. Wong Ordoñez, "Overweight, obesity, ~ central adiposity and associated chronic diseases in Cuban adults," *MEDICC Review*, vol. 11, no. 4, pp. 23–28, 2009.
22. T. Puoane, K. Steyn, D. Bradshaw et al., "Obesity in South Africa: the South African Demographic and Health Survey," *Obesity Research*, vol. 10, no. 10, pp. 1038–1048, 2002.
23. C. U. Odenigbo, O. C. Oguejiofor, and U. M. Odenigbo, "Prevalence of abdominal obesity in senior civil servants in Asaba, Nigeria," *Tropical Journal of Medical Research*, vol. 12, no. 2, pp. 1–3, 2008.
24. P. M. Janiszewski, I. Janssen, and R. Ross, "Does waist circumference predict diabetes and cardiovascular disease beyond commonly evaluated cardiometabolic risk factors?" *Diabetes Care*, vol. 30, no. 12, pp. 3105–3109, 2007.
25. R. Ayah, M. D. Joshi, R. Wanjiru et al., "A population-based survey of prevalence of diabetes and correlates in an urban slum community in Nairobi, Kenya," *BMC Public Health*, vol. 13, no. 1, article 371, 2013.
26. S. Mehdad, A. Hamrani, K. El Kari et al., "Body mass index, waist circumference, body fat, fasting blood glucose in a sample of Moroccan adolescents aged 11–17 years," *Journal of Nutrition and Metabolism*, vol. 2012, Article ID 510458, 7 pages, 2012.
27. D. S. Freedman, M. K. Serdula, S. R. Srinivasan, and G. S. Berenson, "Relation of circumferences and skinfold thicknesses to lipid and insulin concentrations in children and adolescents: the Bogalusa Heart Study," *The American Journal of Clinical Nutrition*, vol. 69, no. 2, pp. 308–317, 1999.
28. M. I. Goran and B. A. Gower, "Abdominal obesity and cardiovascular risk in children," *Coronary Artery Disease*, vol. 9, no. 8, pp. 483–487, 1998.
29. N. C. de Souza and E. P. de Oliveira, "Sagittal abdominal diameter shows better correlation with cardiovascular risk factors than waist circumference and BMI," *Journal of Diabetes & Metabolic Disorders*, vol. 12, p. 41, 2013.