Original Research Article

A study of waist circumference, waist-hip ratio as markers of type 2 diabetes mellitus and their correlation with family history of diabetes

Vijayashree S. Gokhale*, Nilesh Jagdale, Tanvi Batra, Shipra Gulati

Department of Medicine, Dr. D.Y. Patil, Medical College, Pimpri, Pune, Maharashtra, India

*Correspondence:
Dr. Vijayashree S. Gokhale,
E-mail: gokhale.vijayashree@gmail.com

ABSTRACT

Background: Type 2 Diabetes, is almost an 'epidemic' in India. A lot has to be done to prevent or at least postpone its onset. Hence finding bio-markers is important to warn people and create awareness. In India people pay a lot of importance to Family History, and though a positive family history, may predict Diabetes, we wanted to study its correlation to other bio-markers.
Methods: Waist circumference, Waist hip ratio was measured in 184 Type 2 Diabetes patients .And history of Diabetes in mother, father or both was recorded .Data tabulated and subjected to statistical analysis.
Results: Of the total number (n=184) type 2 diabetes patients studied, males were 93, females 91. 74.2 % males and 83.5 % females had a waist circumference above cut-off (90 cms for males and 80cms for females). 35 males and 42 females had a family history of diabetes. Of these, Father was diabetic in 16 males and 16 females, while mother was diabetic in 19 males and 26 females.
Conclusions: Waist circumference and waist hip ratio above cut-off values emerged as common positive findings in majority of type 2 diabetic patients. Family history, individually as Paternal or Maternal Diabetes did not show statistically significant correlation with waist circumference or Waist-hip ratio.

Keywords: Family history, Hip, Maternal, Paternal, Waist

INTRODUCTION

Type 2 diabetes mellitus belongs to a group of diseases labelled as 'lifestyle diseases' and is on the rise in Asians especially Indians. Besides morbidity due to its complications, Type 2 diabetes Mellitus carries a high risk of Myocardial infarction, Stroke and premature death. Thus every effort must be made to prevent or postpone this disease by spreading awareness, risk stratification, early diagnosis, and regular treatment. Waist circumference and waist-hip ratio are markers of Abdominal Obesity. In Asians and especially Indians, Abdominal Obesity is more pronounced. Hence BMI can give false negative results. Asians with normal BMI may have more than normal abdominal obesity! Thus the choice of waist circumference and waist-hip ratio, in present study. In 2003 WHO laid down guidelines for screening of type 2 diabetes mellitus, risk factors which included Waist-hip ratio and waist circumference, as important risk predictors of type 2 Diabetes Mellitus. Family history of diabetes is given a lot of importance in India, and patients rely on it to predict Diabetes. Individually it is a risk factor, though not the only one and absence of Family history does not guarantee freedom from developing diabetes!

Aims and objectives

- To study the waist-hip ratio, waist circumference in type 2 diabetic patients (n=184)

- Compare with 'cutoffs' in other studies
- Correlate with Family history of Paternal/Maternal Diabetes in male/female patients of Type2 Diabetes

METHODS

A total of 184 patients attending diabetes OPD of a Medical college Hospital in semi-urban Maharashtra were selected and subjected to anthropometric measurements according to WHO guidelines. Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest ,using a stretch resistant tape that provided a constant 100g tension. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor. Family history with specification, of mother or father or both diabetic was recorded. Data tabulated. Anthropometric characteristics were tabulated as descriptive statistics, group statistics explained by frequency and percentages, Chi square test, independent samples test. The anthropometric characteristics were further correlated with positive family history of diabetes in father and mother.

RESULTS

35 males and 42 females had a family history of diabetes. Of these, Father was diabetic in 16 males and 16 females, while mother was diabetic in 19 males and 26 females. Correlation of waist circumference, WHR, in males/females with family history of diabetes in father / mother was not significant.

Table 1: Anthropometric characteristics (waist & hip circumference).

Descriptive statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Waist circumf.	184	38	131	93.48	11.784
Hip circumf.	184	72	189	99.90	12.330

Table 2: Anthropometric characteristics (Waist, Hip & WHR).

Group Statistics							
	Sex	N	Mean	Std. Deviation	Std. Error Mean	T test	P value
Waist (cm)	Male	93	94.76	9.881	1.025	1.489	0.138
	Female	91	92.18	13.383	1.403		
Hip (cm)	Male	93	97.81	12.178	1.263	-2.353	0.020
	Female	91	102.03	12.181	1.277		
WHR	Male	93	0.97409	0.086906	0.009012	4.978	0.000
	Female	91	0.90568	0.099215	0.010401		

Of the total number (n=184) type 2 diabetes patients studied, males were 93, females 91; P values of Hip circumference and WHR in both males and females are significant.

Table 3: Anthropometric characteristics (Waist circumference * Sex cross tabulation).

Waist circumference * Sex cross tabulation			
		No.	Total
Male	>90 cm	69 (74.2%)	93 (100%)
	<90cm	24 (25.8%)	
Female	>80cm	76 (83.5%)	91 (100%)
	<80cm	15 (16.5%)	

74.2 % males and 83.5 % females had a waist circumference above cut-off.

Table 4: Anthropometric characteristics (WHR / Sex Cross tabulation).

WHR / Sex Cross tabulation			
		No.	Total
Male	>0.9	80 (93%)	86 (100%)
	≤0.9	6 (7%)	
Female	>0.8	70 (90.9%)	77 (100%)
	≤0.8	7 (9.1%)	

80 males and 70 females had a waist-hip ratio above cut-off.

Table 5: Anthropometric characteristics (Crosstab).

Crosstab			Sex		Total
			Male	Female	
WHR	<= 0.75	Count	2	3	5
		% within Sex	2.3%	3.9%	3.1%
	0.76 - 0.79	Count	0	4	4
		% within Sex	0.0%	5.2%	2.5%
	0.80 - 0.84	Count	1	8	9
		% within Sex	1.2%	10.4%	5.5%
	0.85 - 0.89	Count	3	19	22
		% within Sex	3.5%	24.7%	13.5%
	0.90 - 0.94	Count	16	17	33
		% within Sex	18.6%	22.1%	20.2%
	0.95 - 0.99	Count	27	14	41
		% within Sex	31.4%	18.2%	25.2%
	> 1.00	Count	37	12	49
		% within Sex	43.0%	15.6%	30.1%
Total		Count	86	77	163
		% within Sex	100.0%	100.0%	100.0%

Chi square test: 37.806, df = 6, p value = 0.000

Table 6: Anthropometric characteristics correlated with positive family history (Family history in father).

Waist circumference family history in father Cross tabulation			
	Family history in father		Total
	Yes	No	
>90 in males >80 in females	26	116	142
≤ 90 in males ≤ 80 in females	6	36	42
Total	32	151	184

Chi square test: 0.387, df=1, p value= 0.5339, odd ratio: 1.357 (CI: 0.5177-3.555)

Table 7: Anthropometric characteristics correlated with positive family history (Family history in mother).

Waist circumference family history in mother Crosstabulation			
	Family history in mother		Total
	Yes	No	
>90 in males >80 in females	37	106	143
≤ 90 in males ≤ 80 in females	7	34	41
Total	44	139	184

Chi square test: 1.406, df=1, p value= 0.2364, odd ratio: 1.712 (CI: 0.699 – 4.191)

DISCUSSION

In present study of type 2 diabetes patients, waist circumference, and waist-hip ratio was above cut off in majority, both males and females, thus emerging as an important marker.

This parameter of abdominal obesity has been widely studied all over the world. In the USA, as early as 1992 and 1997 studies established a link between waist circumference and type 2 diabetes.[1,2] In the Carribean Islands, people of African origin, like Nigerians, Jamaicans and African-Americans were studied, by Okosun IS, et al. and were found to have a high risk of hypertension and high fasting blood sugar.

Mexican population was studied by Berber A, et al reporting a high cut off of BMI of 25.2 to26.6, and 90cms

and 85 cms as cutoff waist circumference for prediction of type 2 diabetes mellitus.[4] In 2003 WHO laid down guidelines for screening for diabetes mellitus in which most important measurements were Waist circumference and Waist hip ratio, and the correct method of measurement Snehalata C, et al in a study from India defined waist and hip circumference cutoff values for Asian Indian Adults and also the correct way to measure the same.[5,6] Another Indian study by Misra A, et al not only gave cutoffs but also action levels : action level 1 for Asian Indians : WC >78cms for men and >72cms for women…should be advised to avoid weight gain and maintain increased physical activity.[7]

Table 8: Anthropometric characteristics correlated with positive family history (F/h father and mother).

		F/h father (mean ± SD)		T test applied
		Yes	No	P value
Male	Total no	16	77	
	Waist circum.	96.31 ± 6.38	94.70 ±9.88	0.53
	WHR	0.99 ± 0.05	0.97 ±0.08	0.3399
Female	Total no	16	75	
	Waist circumf.	93.25 ± 11.94	92.48 ±12.31	0.8199
	WHR	0.88 ± 0.07	0.92 ±0.08	0.0672
		F/h mother (mean ± SD)		
		Yes	No	
Male	Total no	19	74	
	Waist circumference	98.11 ± 11.6	94.22 ±8.67	0.1074
	WHR	1 ± 0.06	0.97 ±0.08	0.1302
Female	Total no	26	65	
	Waist circumf.	95.34 ± 13.74	91.52 ±11.44	0.1782
	WHR	0.91 ± 0.08	0.91 ± 0.09	>0.9999

Level 2: WC>90cm for men, >80cms for women, must seek medical advice for weight management. Chinese adults were studied by Wildman RP, et al.[8] Tunisians by Bouguerra R, et al and both included waist circumference as a predictor of Diabetes.[9] Diaz VA, et al in a study in England studied various ethnic groups separately, while Vazquez G, et al published a meta-analysis, and Huxley R, et al found that waist circumference, waist hip ratio rather than BMI was a better predictor of diabetes.[10-12]

Huxley R, et al studied Asians and gave cutoffs: BMI 23.7, WC 85, WHR 0.90 in men; BMI 24.5, WC80, WHR 0.8 in females.[12] In 2009, Delavari A, et al gave cutoffs for Metabolic Syndrome in Middle east population, as WC of 89cms in males and 91cms for females.[13] QiaoQ, et al in their meta-analysis of Asian cohorts: Chinese, Japanese, Indian, Mongolian and Filipinos concluded that BMI, WC and WHR were predictors of type 2 diabetes.[14]

Family History of Diabetes in parents is a predictor of, Type 2 Diabetes. In present study, out of 184 patients, family history in parent was positive in 77 patients. We went a step further and, found 35 patients (16 males and 19 females) had a Diabetic Father, and 42 patients (16 males and 26) females had a Diabetic Mother. Family history of diabetes in father and mother were separately correlated with waist circumference and waist-hip ratio in males and females. However no significant correlation was found.

From 1992 to 2005 the CDC conducted study for "prevention of chronic disease', and found family History to be a significant risk of type 2 diabetes mellitus in adult US population, and recommended its inclusion in all history recording of patients of diabetes.[15] In 2006, in a US based study , with higher incidence of positive family history in Afro-Americans Hariri S, et al. found that this parameter was not only a good predictor, but also associated with risk awareness and could be used for risk reduction.[16]

In 2007 in another US population study Valdez R, et al concluded that the influence of Family History as a variable on prevalence of type 2 diabetes is graded.[17]

Rane PR, et al, found that young Asian adults (18-25 years), with positive family history of type 2 diabetes had higher BMI, Waist circumference and waist-hip ratio, and hence could be warned of early onset diabetes.[18]

In July 2016, National Institutes of Health (NIH) published results of a large ongoing study titled "Genetics of Type 2 Diabetes. Revealed in unprecedented detail." which again did establish family History as a risk factor, but did not correlate it with other risk factors.[1]

CONCLUSION

Present study did show, majority of our type 2 diabetic patients having waist circumference and waist hip ratio, above cutoff values for Asians. However in present study, Family History of Diabetes in Father or Mother did not show any significant correlation with these anthropometric parameters in Male or Female Type 2 diabetic patients.

Clinical implications

In Diabetic clinics across India, besides weight & height, measurements waist circumference, hip circumference, and deriving waist hip ratio would be a very valuable and cost-effective measurement for preventing diabetes and monitoring established diabetes. Family History is an established risk factor. Young Indian adults with family history of diabetes, could be warned to watch their waist circumference, along with weight in their endeavor to prevent or at least postpone type 2 Diabetes Mellitus.

ACKNOWLEDGEMENTS

REFERENCES

1. Cassano PA, Rosner B, Vokonas PS, Weiss ST. Obesity and body fat distribution in relation to the incidence of non-insulin-dependent diabetes mellitus. A prospective cohort study of men in the normative aging study. Am J Epidemiol. 1992;136(12):1474-86.
2. Carey VJ, Walters EE, Colditz GA, Solomon CG, Willett WC, Rosner BA, et al. Body fat distribution and risk of non-insulin-dependent diabetes mellitus in women. The Nurses' Health Study. Am J Epidemiol. 1997;145(7):614-9.
3. Okosun IS, Cooper RS, Rotimi CN, Osotimehin B, Forrester T. Association of waist circumference with risk of hypertension and type 2 diabetes in Nigerians, Jamaicans, and African-Americans. Diabetes Care. 1998;21(11):1836-42.
4. Berber A, Gómez-Santos R, Fanghänel G, Sánchez-Reyes L. Anthropometric indexes in the prediction of type 2 diabetes mellitus, hypertension and dyslipidaemia in a Mexican population. Int J Obes Relat Metab Disord. 2001;25(12):1794-9.
5. WHO. Screening for type 2 diabetes: Report of a WHO and IDF meeting. Geneva, World Health Organization (WHO), 2003.
6. Snehalatha C, Viswanathan V, Ramachandran A. Cutoff Values forNormal Anthropometric Variables in Asian Indian Adults. Diabetes Care. 2003;26(5):1380-4.
7. Misra A, Vikram NK, Gupta R, Pandey RM, Wasir JS, Gupta VP. Waist circumference cutoff points and action levels for Asian Indians for identification of abdominal obesity. Int J Obes (Lond). 2006;30(1):106-11.
8. Wildman RP, Gu D, Reynolds K, Duan X, He J. Appropriate body mass index and waist circumference cutoffs for categorization of overweight and central adiposity among Chinese adults. Am J Clin Nutr. 2004;80(5):1129-36.
9. Bouguerra R, Alberti H, Smida H, Salem LB, Rayana CB, El Atti J, et al. Waist circumference cut-off points for identification of abdominal obesity among the Tunisian adult population. Diabetes Obes Metab. 2007;9(6):859-68.
10. Diaz VA, Mainous AG 3rd, Baker R, Carnemolla M, Majeed A. How does ethnicity affect the association between obesity and diabetes? Diabet Med. 2007;24(11):1199-204.
11. Vazquez G, Duval S, Jacobs DR Jr, Silventoinen K. Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: a meta-analysis. Epidemiol Rev. 2007;29:115-28.
12. Huxley R, Barzi F, Lee CM, Lear S, Shaw J, Lam TH, Caterson I, et al. Waist circumference thresholds provide an accurate and widely applicable method for the discrimination of diabetes. Diabetes Care. 2007;30(12):3116-8.
13. Delavari A, Forouzanfar MH, Alikhani S, Sharifian A, Kelishadi R. First nationwide study of the prevalence of the metabolic syndrome and optimal cutoff points of waist circumference in the Middle East: the national survey of risk factors for noncommunicable diseases of Iran. Diabetes Care. 2009;32(6):1092-7.
14. Qiao Q, Nyamdorj R. Is the association of type II diabetes with waist circumference or waist-to-hip ratio stronger than that with body mass index? Eur J Clin Nutr. 2010;64(1):30-4.
15. Annis AM, Caulder MS, Cook ML, Duquette D. Family history, diabetes, and other demographic and risk factors among participants of the National Health and Nutrition Examination Survey 1999–2002.
16. Hariri S, Yoon PW, Qureshi N, Valdez R, Scheuner MT, Khoury MJ. Family History of Type 2 Diabetes: A population based screening tool for prevention Genetics in Medicine. 2006;8:102-8.
17. Valdez R, Yoon PW, Liu T, Khoury MJ. Family History and Prevalence of Diabetes in the U.S. Population. Diabetes Care. 2007;30(10):2517-22.
18. Rane PR, Gadkari JV. A Study of Anthropometric indices of young adults with family history of diabetes. IJBAP. 2012;1(1):137.
19. Genetics of type 2 diabetes revealed in unprecedented detail. Available at :https://www.nih.gov/ news-events/ news-releases/ genetics -type-2-diabetes-revealed-unprecedented-detail. National Institutes of Health (NIH).