Original Research Article

A study of waist circumference and waist-hip ratio as markers of type 2 diabetes mellitus in an urban population of district Bareilly

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ABSTRACT

Background: Type 2 diabetes mellitus belongs to a group of diseases labelled as lifestyle diseases and is on the rise in Asians especially Indians. Hence finding bio-markers is important to warn people and create awareness. Aim of the present study is to estimate waist-hip ratio, waist circumference in type 2 diabetic patients with respect to gender.
Methods: A cross-sectional, community based study was conducted from February 2014 to February 2015 among adults in the age group of 30 year and above residing in area covered under UHTC of Bareilly City. A simple random sampling technique was adopted to achieve the desired sample size. 640 is the sample size came out to be by applying $3.8 \ 4PQ/d2$ formula. Subject's waist circumference, waist-hip ratio was measured in study samples. House to house survey was done for collecting data. Data tabulated and subjected to statistical analysis.
Results: Prevalence of DM and IFG was more in those who were having high waist circumference and the association was also found to be statistically significant. The association was also found statistically significant between male high waist hip ratio and Diabetes Mellitus but no association was seen between female's high waist-hip ratio and Diabetes Mellitus.
Conclusions: High waist circumference can be a screening procedure for DM individuals in both sexes, but the same scenario we haven't seen in high waist hip ratio among females and prevalence of DM. Appropriate waist circumference and waist-to-hip ratio values are complex because they are likely influenced by gender and other factors.

Keywords: Gender, Hip, Diabetes, Waist

INTRODUCTION

Diabetes mellitus is growing rapidly worldwide and it is reaching epidemic proportions.[1,2] It is estimated that there are currently 285 million people with diabetes worldwide and this number is set to increase up to 438 million by the year 2030.[3] The major proportion of this increase is estimated to be accounted by the developing countries, where the disorder predominantly affects younger adults in the economically productive age group. India has earned the dubious reputation of being the diabetic capital of the world having 50.8 million estimated Indians living with diabetes mellitus in 2010.[4] India is currently facing a doubly burdensome epidemiologic transition, further propelled by a demographic transition.[4] 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 is there. 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.[5] Aim of the present study is to estimate waist-hip ratio, waist circumference in the study population and their relationship with type 2 diabetic patients with respect to gender.

METHODS

A cross-sectional, community based study was conducted from February 2014 to February 2015 among adults in the age group of 30 year and above residing in area covered under UHTC of Bareilly City.

The study conducted by Anjana et al in 2011, prevalence of diabetes and pre-diabetes in urban and rural India.[4] The study revealed that overall prevalence of diabetes in Chandigarh was 14.2% in urban area. Chandigarh, a city of North India, the prevalence was 14.2% in urban areas and in the rural areas, the prevalence was 8.3%. So, Chandigarh was considered for calculating the sample size. The sample size was calculated by using the following formula,

$$n = \frac{3.84\,PQ}{d2}$$

Where, p=14.2; q=85.8; d=20% of P.

Sample size thus yielded was 580. Adding a figure of 10% i.e. 58 to it for non-respondent, the total figure came out to be 638 which were rounded off to 640. So the sample size required for the study was found to be 640. The study subjects consisted of males and females in the age group of 30 years and above and belonging to Bareilly city. The present study was carried out in area covered under Urban Health Training Centre. UHTC which covered both slum area and non-slum area. 1 slum area was selected and 1 non-slum area was selected through simple random sampling for obtaining desired sample size. Anthropometric measurements done according to WHO guidelines to every study individuals. Ethical clearances were taken from the institution. Waist and hip circumferences were measured by using flexible not stretchable tape to an accuracy of 0.1 cm. Waist circumference is measured at the midpoint between the lower border of rib cage and the iliac crest. Hip

circumference was measured by taking the largest circumference around the hip. Waist-hip ratio (WHR) is an approximate index of intra-abdominal fat mass and body fat. WHR>1.0 in men and >0.85 in women indicates abdominal fat accumulation and high waist hip ratio. House to house survey was done and information about the purpose of study was given to all study subjects and a verbal consent was taken from them, before filling the questionnaire. Houses were selected using simple random sampling. All eligible individuals in the visited house were included in the study.

Statistical analysis

Data tabulated and subjected to statistical analysis using Microsoft excel and SPSS 16.0. Anthropometric characteristics were tabulated as descriptive statistics, group statistics explained by frequency and percentages, Chi-square test and independent samples test.

RESULTS

Out of total (n=640) individuals studied, in which 313 were males and 327 were females. 48.9% males and 51.1% females respectively.

Table 1 shows the prevalence of diabetes mellitus in males (16.6%) was high in comparison to females (13.7%), but there was no such great difference in impaired fasting glucose in males (9.9%) and females (9.1%). The gender has no significant association with diabetes (Table 1).

Table 1: Association of diabetes mellitus and impaired fasting glucose with gender.

Gender	Diabetic (%)	Impair fasting glucose (%)	Normal (%)	Total
Male	52 (16.6)	31 (9.9)	230 (73.4)	313
Female	45 (13.7)	30 (9.1)	252 (77.0)	327
Total	97 (15.2)	61 (9.5)	482 (75.3)	640

Chi-square value=1.22 df=2, p value=0.543.

Table 2: Sex wise distribution of study subjects according to their waist circumference.

Waist circumfe-rence	Male (%)	Female (%)	Total (%)	P value
High	53 (8.2)	136 (21.2)	189 (29.5)	0.000
Normal	260 (40.6)	191 (29.8)	451 (70.4)	0.457
Total	313 (48.9)	327 (51.0)	640 (100.0)	0.433

Table 2 shows that 189 (29.5%) subjects was having high waist circumference whereas 451 (70.4%) have normal waist circumference among whole study population. Out of total individuals having high waist circumference, it was seen that females were having high waist

circumference 136 (21.2%) as compared to males 53 (8.2%), while 260 (40.6%) males and 191 (29.8%) females having normal waist circumference. With the help of z test, the difference of proportion between males and females came out to be statistically significant (p=0.000) in high waist circumference category, while it was insignificant in its counterpart as well as in total (Table 2).

Table 3 shows that 189 individuals were having high waist circumference out of them 47 (24.9%) had been diagnosed as diabetic, 23 (12.1%) as IFG and 119 (62.9%) were normal. Whereas 451 were having normal waist circumference, out of them 50 (11.0%) were diagnosed as diabetic 38 (8.4%) were having IFG and 363 (80.4%) were normal. It can be clearly seen that prevalence of DM and IFG was more in those who were having high waist circumference and the association was also found statistically significant with high waist circumference and diabetes mellitus. Thus, high waist circumference can be a good predictor for screening of diabetes mellitus (Table 3).

Table 3: Association between waist circumference and prevalence of diabetes mellitus and impaired fasting glucose.

Waist circumference	Diabetes Mellitus (%)	Impaired Fasting Glucose (%)	Normal (%)	Total (%)
High	47 (24.9)	23 (12.1)	119 (62.9)	189
Normal	50 (11.0)	38 (8.4)	363 (80.4)	451
Total	97 (15.2)	61 (9.5)	482 (75.3)	640

Chi-square value=24.079, df=2, p=0.000005.

Table 4 shows that both males and females who were having high waist circumference those were having high prevalence of diabetes mellitus (24.5%, 22.8% respectively) as compared to having normal waist circumference. Similar trend was seen in prevalence of IFG, among males those were having high waist circumference they were having higher percentage of IFG individuals (20.8%) as compared those having normal waist circumference and same scenario was scene among females. The association was also found statistically significant with high waist circumference among male and females and diabetes mellitus (Table 4).

Table 5 shows that 341 (53.2%) subjects was having high waist hip-ratio whereas 299 (46.8%) were having normal waist hip ratio among whole study population. Out of total individuals having high waist-hip ratio it was seen that females were having high waist-hip ratio 264 (80.8%) as compared to males 77 (24.7%). This difference was three times higher among females than males. 236 (75.3%) males and 63 (19.2%) females was having normal waist circumference. With the help of z test, the difference of proportion between males and females came out to be statistically significant (p=0.00), (p=0.00) in high waist-hip ratio and normal waist-hip ratio category respectively, while it was insignificant in its total (Table 5).

Table 6 shows that 341 individuals were having high waist hip ratio out of that of 59 (17.3%) were diagnosed diabetic, 37 (10.9%) as IFG and 245 (71.9%) were normal. Whereas, 299 were having normal waist hip ratio out of that 38 (12.8%) were diagnosed as diabetic, 24 (8.0%) as IFG and 237 (79.2%) were normal. It can be seen that prevalence of DM and IFG was more in those who were having high waist-hip ratio. However this difference was statistically insignificant (Table 6).

Table 4: Association between waist circumference, diabetes mellitus and impaired fasting glucose among males and females.

Waist circumference		Diabetes mellitus (%)	Impaired fasting glucose (%)	Normal (%)	Total (%)
Males	Normal	39 (15.0)	21 (8.0)	200 (76.9)	260 (83.0)
	High	13 (24.5)	11 (20.8)	29 (54.8)	53 (16.9)
Chi-square value=12.249, df=2, p=0.002					
Female	Normal	16 (8.3)	13 (6.9)	162 (84.9)	191 (58.4)
	High	31 (22.8)	17 (12.5)	88 (64.8)	136 (41.5)
Chi-square value=18.497, df=2, p=0.000					

Table 5: Sex wise distribution of study subjects based on WHR.

WHR	Male (%)	Female (%)	Total (%)	P value
High	77 (24.7)	264 (80.8)	341 (53.2)	0.00
Normal	236 (75.3)	63 (19.2)	299 (46.8)	0.00
Total	313 (48.9)	327 (51.0)	640 (100)	0.43

Table 7 shows that both males and females who were having high waist hip ratio those were having high prevalence of diabetes mellitus (27.2%, 14.3% respectively) as compared to having normal waist circumference.

Table 6: Association between waist-hip ratio and diabetes mellitus and impaired fasting glucose among study subjects.

WHR	Diabetes mellitus (%)	Impaired fasting glucose (%)	Normal (%)	Total (%)
High	59 (17.3)	37 (10.9)	245 (71.9)	341 (53.2)
Normal	38 (12.8)	24 (8.0)	237 (79.2)	299 (46.8)

Chi-square value=4.714, df=2, p value=0.09

Table 7: Association of WHR with diabetes mellitus among males and females.

WHR		Diabetes mellitus (%)	Impaired fasting glucose (%)	Normal (%)	Total (%)
Male	Normal	31 (13.1)	21 (8.9%)	184 (77.9)	236 (75.3)
	High	21 (27.2)	9 (11.7%)	47 (61.0)	77 (24.6)
	Chi-square value=9.71, df=2, p=0.0077				
Female	Normal	9 (14.2)	6 (9.5)	48 (76.1)	63 (19.2)
	High	38 (14.3)	25 (9.4)	201 (76.1)	264 (80.8)
	Chi-square value=0.001, df=2, p=0.999				

Related trend was seen in prevalence of IFG, among males those were having high waist hip ratio they were having higher percentage of IFG individuals (11.7%) as compared those having normal waist circumference and same scenario was scene among females. The association was found statistically significant between male high WHR males and diabetes mellitus but no association was seen between female's high WHR and diabetes mellitus (Table 7).

DISCUSSION

Over weight and obesity are common health conditions. Body mass index, waist circumference are the commonly used parameters to evaluate obesity. This presentation is not intended to be comprehensive, but to provide an overview of the available research. There are large differences in body composition in men and women, with women having more body fat. Fat distribution also differs with gender, with men having a relatively more central distribution of fat. These differences begin early in life and become more apparent in puberty due to changes in sex hormone levels. In both, men and women, waist and waist-to-hip ratio increase with age. Currently there is no universal agreement on the cut points to define a healthy waist circumference, and none of the common guidelines are age-specific.[6] In present study both males and females who were having high waist circumference those were having high prevalence of diabetes mellitus. Likewise similar trend was seen in prevalence of IFG, among males those were having high waist circumference and same scenario was scene among females. Present study found statistically significant with high waist circumference among gender and diabetes mellitus. Thought through consequence by Ford et al reported that waist circumference is larger in males compared with females and larger in older adults compared with younger adults up to the age of 70.[7] Although the trends in men and women were similar in respect to age, women had a smaller mean waist circumference than men in every age category.[6] Furthermore, similar differences in waist circumference between genders were observed in non-Caucasian populations. Data representative of the Hong Kong Chinese working population showed a 5.9 cm larger waist among men compared with women, data from a Mexican population showed males had a 5.4 cm greater mean waist circumference than females.[8,9] In addition, BMI and waist circumference are highly correlated, and gender and age associations with BMI, body composition and fat depot distribution are all pertinent to waist circumference. Although associated with other anthropometric measures, waist circumference remains a simple and valid marker of abdominal and visceral fat.[6] In present study, males and females who were having high WHR those were having high prevalence of diabetes mellitus as compared to having normal waist circumference. Same patterns were seen in prevalence of IFG, among males those were having high WHR similar situation was scene among females. The association was found statistically significant between male high WHR and diabetes mellitus but no association was seen between females high WHR and diabetes mellitus. Moreover, in both gender waist and WHR increase with aging and waist-to-hip ratio was larger with increasing BMI and age in both men and women. However, changes WHR with changes in weight differed by gender.[10] Comparable values for women were 3.3 cm and 3.6 cm. These changes resulted in weight change in men having a larger effect on WHR than in women, and WHR increased by 0.0073 in men.[6] Jayawardena in 2012 concluded in his study that higher BMI and high WHR had increased risk of diabetes mellitus.[11] The current practice of using separate waist cut-points by gender is appropriate. Although waist circumference increases with age, so does the risk of many chronic diseases. An evaluation of the need for age-specific waist cut-points in adults would need to consider disease risk.[6]

CONCLUSION

Appropriate waist circumference and waist-to-hip ratio values are complex because they are likely influenced by gender, race/ethnicity, age, BMI and other factors. This intriguing finding paves the way for larger studies to confirm this finding and explore the possibility of increased waist circumference and waist-to-hip ratio as one of the causes of diabetes mellitus.

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