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A study of anthropometric profile of diabetic and non-diabetic women

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Abstract

A total random sample size of 493 women in the age group of ≥ 20 years representing rural and urban area of Ludhiana district. The anthropometric measurements were taken of all the subjects to determine its relationship with type 2 diabetes. It was found that the mean body weight, mean waist circumference, mean hip circumference and mean body mass index (BMI) of rural and urban diabetic women was significantly higher ($p \leq 0.01$) as compared to rural and urban non diabetic women. It indicates that anthropometric parameters are a modifiable risk factors of type 2 diabetes. Hence, it is recommended that individuals who have or not have diabetes should be motivated through counseling to keep themselves physically active to maintain their body weight, waist/hip circumference and BMI in normal/ reference range to prevent and manage diabetes.

Keywords: Type 2 diabetes, waist circumference, hip circumference, body mass index

Introduction

Since diabetes is occurring at an early age, so the individuals are facing various diabetic complications due to the longer disease duration (Mohan *et al.* 2013) ^[9]. A study has reported that diabetes control worsened in individuals with longer duration of diabetes (9.9 ± 5.5 years) with neuropathy (24.6%), renal problems (21.1%) cardiovascular complications (23.6%), retinopathy (16.6%) and foot ulcers (5.5%) (Ramachandran *et al.* 2001 and Mohan *et al.* 2013) ^[11, 9]. Poor glycaemic control is also a factor observed in the diabetic population of India, (Unnikrishnan *et al.* 2007) ^[15] which is responsible for micro, as well as macrovascular conditions that comes with diabetes, and can incline diabetic individuals to other complications like diabetic myonecrosis (Rastogi *et al.* 2011) ^[13] and muscle infarction (Iyer *et al.* 2011).

Implementing lifestyle intervention has been a challenge across the globe, has poor long-term compliance and involves extensive use of human resources. These challenges are perhaps far greater in countries with limited population awareness like India. India who has more than 1.25 billion population, 9 per cent people have diabetes, 10-14 per cent has pre-diabetes and has, the highest rate of progression to T2DM globally (Anjana *et al.* 2011a) ^[1], compounded by scarcity of doctors/physicians (0.7/ 1,000 population), pitiable health infrastructure and out-of-pocket health expenditure (Golechha 2015) ^[3], is not well equipped to manage this grave socio-economic crisis (Dutta and Mukhopadhyay 2016) ^[2].

Obesity is on the rise which eventually leads to diabetes. Though India has lower overweight and obesity rates, still it has a higher prevalence of diabetes as compared to the countries in the west. It shows that diabetes can occur at even lower body mass index (BMI) in Indians as compared to Europeans (Mohan and Deepa 2006 and Rao *et al.* 2011) ^[8, 12]. Therefore, comparatively lean Indian adults, who have a lower BMI can be at equal risk of diabetes as those who are obese (Zargar *et al.* 2000) ^[18]. Furthermore, Indians are genetically predisposed to the development of coronary artery disease due to dyslipidaemia and low levels of high-density lipoproteins. These determinants make Indians more prone to development of the complications of diabetes at an early age (20-40 years) compared with Caucasians (>50 years) and indicate that diabetes must be carefully screened and monitored regardless of patient age within India (Misra and Khurana 2011) ^[7].

Though many studies have been conducted within the country but there is no or very few studies conducted on assessing the anthropometric profile of the diabetic and non diabetic subjects.

The studies already been conducted may also have some potential error due to the heterogeneity of the Indians with respect to ethnicity, culture, socio-economic settings, mean that they may not give accurate estimates for the whole country.

There are many determinants that affect the prevalence of diabetes in the country and to identify those factors is necessary to bring down mortality and financial burden over India. The present study was planned with the objective to examine the relationship of diabetes mellitus with various anthropometric parameters of women.

Material and Methods

The sampling design used for the study was 30 cluster multi-stage sampling.

A total of 30 locations from Ludhiana district were selected targeting adult women. In the next stage of sampling 12 blocks of Ludhiana district were selected. From each block two villages (total of 24 villages) and 6 locations from the urban area were selected in order to have a total random sample size of 493 women in the age group ≥ 20 years, representing the rural and urban areas of Ludhiana.

Anthropometric Measurements

Basic anthropometric parameters such as Weight, height, hip circumference and waist circumference were taken using standard methods (Jelliffe 1966) [4] and Body Mass Index

(BMI) and Waist to Hip ratio (WHR) as derived indicators of abdominal obesity were calculated.

Derived anthropometric measurements

Body Mass Index (BMI)

Body mass index for the subjects was estimated using formula given by WHO expert consultation (2004) [16].

Body mass index (kg/m^2) = Weight in kilograms / (Height in meters) [2].

Range of BMI of Asians (kg/m^2)

< 18.5
18.5-22.99
23-24.99
25-29.9
30
30-40
40.1-50
>50

Nutritional status

Underweight
Normal
Overweight
Pre-Obese
Obese
Obese grade I
Obese grade II
Obese grade III

Waist to Hip Ratio (WHR)

Following formula was used to calculate waist and hip ratio:

$$\text{Waist and hip ratio} = \frac{\text{Waist circumference (cm)}}{\text{Hip circumference (cm)}}$$

A reference value of ≥ 0.85 for waist and hip ratio was taken for women (WHO 2008) [17].

Anthropometric measurements

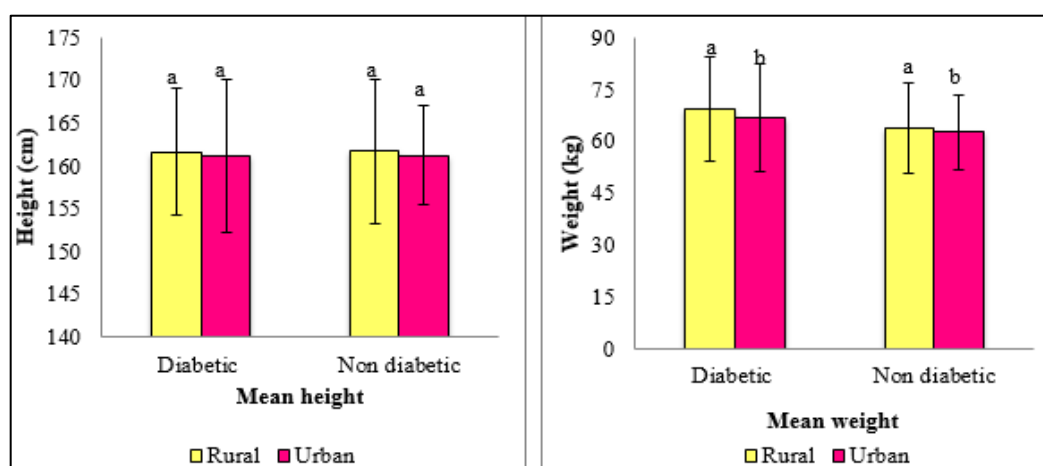
The anthropometric measurements of diabetic and non diabetic women are given in Table 1 (Fig. 1).

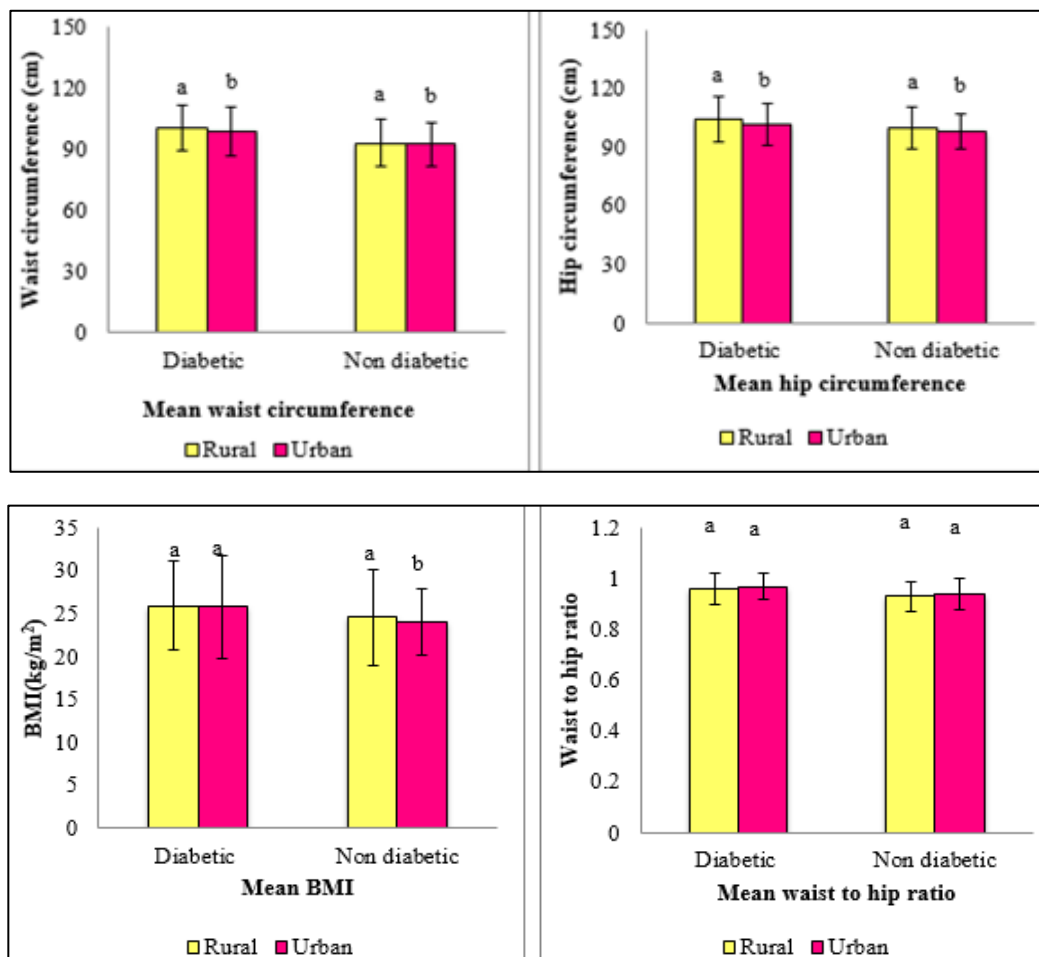
Table 1: Anthropometric measurements of women

Basic Anthropometric measurements		Rural		t-value	Urban		t-value
		Diabetic (n=153)	Non diabetic (n=238)		Diabetic (n=39)	Non diabetic (n=63)	
Height, cm	Range	125-186	125-185	0.76 ^{NS}	125-184	124-183	0.23 ^{NS}
	Mean±SE	161.68±0.60	161.74±0.55		161.16±1.43	161.21±0.73	
Weight, kg	Range	40-110	32-106	52.40 ^{***}	38-124	42-84	14.30 ^{***}
	Mean±SE	69.58±1.22	63.96±0.84		66.81±2.51	62.61±1.38	
Waist circumference, cm	Range	76-130	56-132	75.62 ^{***}	78.74-127	71.12-114.3	23.67 ^{***}
	Mean±SE	100.07±0.91	92.89±0.73		98.47±1.92	92.17±1.36	
Hip circumference, cm	Range	83.82-142.24	48.26-134.62	48.36 ^{***}	78.74-127	78.74-116.84	14.86 ^{***}
	Mean±SE	104.59±0.94	99.97±0.71		101.80±1.70	98.11±1.14	
Derived Anthropometric measurements							
Body Mass Index, kg/m²	Range	14.8-41.6	13-51.6	20.84 ^{***}	14.6-51.3	17.2-35.0	9.52 ^{***}
	Mean±SE	25.94±0.42	24.58±0.36		25.78±0.97	24.06±0.49	
Waist/Hip ratio	Range	0.8-1.1	0.79-1.16	3.71 ^{***}	0.87-1.1	0.78-1.10	1.47 ^{NS}
	Mean±SE	0.96±0.01	0.93±0.00		0.97±0.01	0.94±0.01	

Values represent Mean \pm SE

*** Significant at 1% NS-Non Significant





Bars with same alphabets do not differ significantly.

Fig 1: Anthropometric measurements of diabetic and non-diabetic women

Height

The average height of rural diabetic and non-diabetic women ranged from 125-186 and 125-185 cm respectively. The mean height of rural diabetic and non-diabetic women was 161.68 cm and 161.74 cm, respectively. The height of urban diabetic and non-diabetic women ranged from 125-184 and 124-183 cm, respectively. The mean height of rural diabetic and non-diabetic women was 161.16 cm and 161.21 cm, respectively. Similar average height (161cm) has been reported by Kapoor (2010) [6] and Neetu (2014) [10].

Weight

The average body weight of rural diabetic and non-diabetic women ranged from 40-110kg and 32-106 kg, respectively. The average body weight of rural diabetic women was significantly higher ($p \leq 0.01$) (69.58 kg) as compared to non-diabetic subjects (63.96 kg). The body weight of urban diabetic and non-diabetic women ranged from 38-124 kg and 42-84 kg, respectively. The average body weight of urban diabetic women was significantly ($p \leq 0.01$) higher (66.81 kg) as compared to non-diabetic subjects (62.61 kg). Kapoor (2010) [6] has reported 70.19 kg average weight of diabetic females.

Waist circumference

The average waist circumference of rural diabetic and non-diabetic women ranged from 76-130 cm and 56-132 cm, respectively. The average waist circumference of rural diabetic women was (100.07 cm) significantly ($p \leq 0.01$) higher when compared to rural non-diabetic women (92.89cm).

The waist circumference of urban diabetic and non-diabetic women ranged from 78.74-127 cm and 71.12-114.3 cm, respectively. The average waist circumference of urban diabetic women was (98.47 cm) significantly ($p \leq 0.01$) higher when compared to urban non-diabetic women (92.17 cm). Neetu (2014) [10] has reported 105.32 cm waist circumference among women of similar age.

Hip circumference

The average hip circumference of rural diabetic and non-diabetic women ranged from 83.82-142.24 cm and 48.26-134.62 cm, respectively. The average hip circumference of rural diabetic women was (104.59 cm) significantly higher ($p \leq 0.01$) as compared to rural non-diabetic women (99.97 cm).

The hip circumference of urban diabetic and non-diabetic women ranged from 78.74-127 cm and 78.74-116.84 cm, respectively.

The average hip circumference of urban diabetic women was (101.80 cm) significantly higher ($p \leq 0.01$) as compared to urban non-diabetic women (98.11 cm). Neetu (2014) [10] has reported 104.23 cm hip circumference among diabetic women.

Derived anthropometric measurements of diabetic and non-diabetic women

Body mass index

The average BMI of rural diabetic and non-diabetic women ranged from 14.8-41.6 kg/m² and 13-51.6 kg/m², respectively. The average BMI of rural diabetic women was significantly ($p \leq 0.01$) higher (25.94 kg/m²) as compared to rural non

diabetic women (24.58 kg/m²). The BMI of urban diabetic and non-diabetic women ranged from 14.6-51.3 kg/m² and 17.2-35.0 kg/m², respectively. The average BMI of urban diabetic women was significantly ($p \leq 0.01$) higher (25.78 kg/m²) as compared to rural non diabetic men (24.06 kg/m²). The average BMI 27.44 kg/m² among middle aged diabetic women has been reported by Kapoor (2010) [6].

Waist to hip ratio

The WHR of rural diabetic and non-diabetic women ranged from 0.8-1.1 and 0.79-1.16, respectively. The average waist to hip ratio of rural diabetic women was significantly higher (0.96) as compared to rural non diabetic women (0.93). The WHR of urban diabetic and non-diabetic women ranged from 0.87-1.1 and 0.78-1.10, respectively. The average waist to hip ratio of urban diabetic and non-diabetic men was 0.97 and 0.94, respectively.

Body Mass Index (BMI) of rural and urban women

Body Mass Index of rural and urban women is given in Table 2 (Fig. 2). It was seen that significantly higher number of rural non diabetic women (12%) were underweight as compared to rural diabetic women (5%). It was found that 27 per cent rural diabetic women and 25 per cent non diabetic women were in the normal weight category. 13 per cent rural diabetic women and 21 per cent rural non diabetic women were overweight. It was observed that significantly higher number (18%) of rural diabetic women were in obesity grade

I category as compared to rural non diabetic subjects (11%) while 2 per cent rural diabetic and 2 per cent non diabetic women were in obesity grade II category.

Among urban women, 5 per cent diabetic and 5 per cent non diabetic women were under weight. It was found that 23 per cent urban diabetic women and 40 per cent non diabetic women were in the normal weight category while 26 per cent urban diabetic and 113 per cent non diabetic women were overweight. It was observed that 10 per cent urban diabetic and 5 per cent urban non diabetic women were in obesity grade I category.

Studies have clearly indicated that obesity has role in the progression of diabetes. The obesity leads to diabetes by making defects in insulin secretion which in turn leads to simultaneous increase in insulin resistance (Shobha and Deepali 2016) [14]. This mechanism connects obesity with diabetes is the adipose tissue especially the visceral fat which is deposited in the abdominal area and it can alter the metabolism by increasing the release of proinflammatory markers, fatty acids, glycerol which decrease the sensitivity of insulin. This insulin insensitivity with failure of pancreas to release insulin constitutes the development of Type 2 diabetes (Kahn *et al.* 2006) [5]. Present study showed that diabetes mellitus prevalence was high among pre obese (28% rural and 29% urban) and obese grade I subjects (26% rural and 22% urban). It was also evident that risk of age adjusted diabetes mellitus starts to increase with the BMI in females.

Table 2: Body mass index of rural and urban women

BMI (kg/m ²)	Category	Rural		Z value	Urban		Z value
		Diabetic (n=153)	Non diabetic (n=238)		Diabetic (n=39)	Non diabetic (n=63)	
<18.5	Underweight	8(5)	29(12)	2.29**	2(5)	3(5)	0.08 ^{NS}
18.5-22.99	Normal	42(27)	60(25)	0.49 ^{NS}	9(23)	25(40)	1.73*
23-24.99	Overweight	20(13)	50(21)	2.00**	10(26)	8(13)	1.67*
25-29.9	Pre-Obese	53(35)	69(29)	1.18 ^{NS}	13(33)	24(38)	0.49 ^{NS}
30	Obese	-	-	-	-	-	-
30-40	Grade I	27(18)	26(11)	1.90*	4(10)	3(5)	1.07 ^{NS}
40.1-50	Grade II	3(2)	4(2)	0.20 ^{NS}	-	-	-
>50	Grade III	-	-	-	1(3)	-	1.28 ^{NS}

Figures in parenthesis represent percentages.

*Significant at 10%; **Significant at 5%; *** Significant at 1%; NS-Non Significant

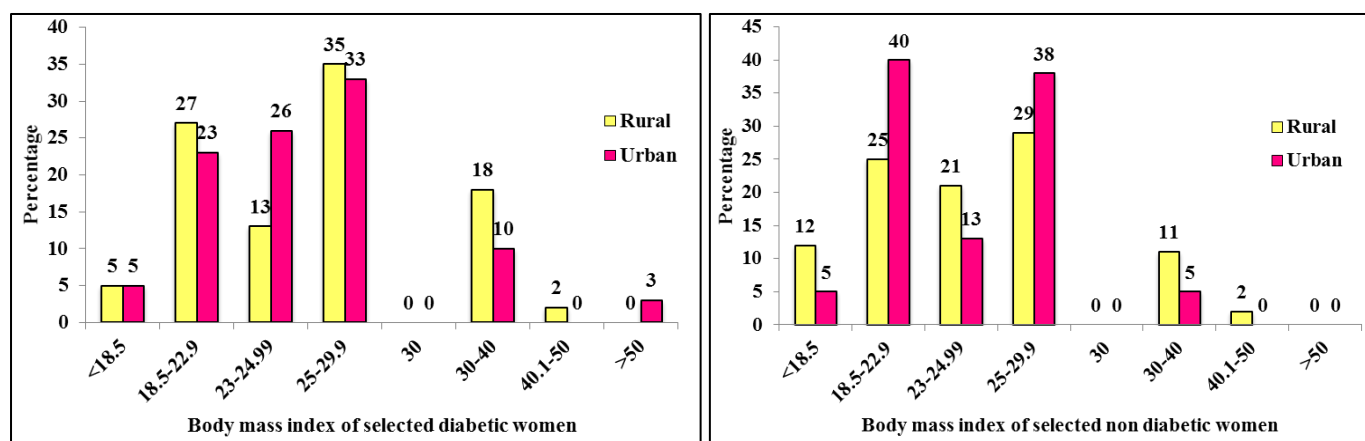


Fig 2: Body mass index (BMI) of rural and urban women

Conclusion

The average body weight of rural and urban diabetic women was significantly higher ($p \leq 0.01$) (69.58 kg and 66.81 kg respectively) as compared to rural and urban non diabetic women (63.96 and 62.61 kg, respectively). Similarly, the waist and hip circumference of diabetic women was significantly

higher ($p \leq 0.01$) as compared to non diabetic women. Derived anthropometric measurements of diabetic and non diabetic women showed that the average BMI of rural and urban diabetic women was significantly ($p \leq 0.01$) higher (25.94 and 25.79 kg/m²) as compared to rural and urban non diabetic women (24.58 and 24.06 kg/m²). The average waist to hip

ratio of rural diabetic women was significantly higher (0.96) as compared to rural non diabetic women (0.93). Hence, it is indicated that diabetic women have significantly higher body weight, hip circumference, waist circumference, WHR and BMI. So they should be made aware to keep themselves physically active to maintain their body weight, waist/hip circumference and BMI in normal/ reference range to prevent and manage diabetes.

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