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A Study of Anthropometric Profile of Diabetic and Non Diabetic Men

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A B S T R A C T

K e y w o r d s Type 2 diabetes, Waist circumference, Hip circumference, Body mass index **Article Info** *Accepted:* 17 September 2020 *Available Online:* 10 October 2020	A total random sample size of 387 subjects was selected 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 if it can be a risk factors of type 2 diabetes. The anthropometric profile of subjects revealed that the mean body weight of rural and urban diabetic men was (78.85kg, 75.58 kg respectively) significantly higher (p≤ 0.01) as compared to rural and urban non diabetic men (72.14 kg and 70.97 kg, respectively). Similarly, the waist and hip circumference of diabetic men was significantly higher (p≤ 0.01) as compared to non diabetic men. Derived anthropometric measurements of diabetic and non diabetic subjects showed that the average BMI of rural and urban diabetic men was significantly (p≤ 0.01) higher (26.82 and 26.71 kg/ m^2) as compared to rural and urban non diabetic men (24.64 and 24.91 kg/ m^2).

Introduction

Diabetes is a fast growing disease that will potentially lead to an epidemic in India (Joshi and Parikh, 2007 and Kumar, 2013). The causes of diabetes in India is increasing due to the factors combined with environmental effects such as obesity is associated with the sedentary lifestyle, urbanization, and increased standard of living. The prevalence of diabetes in the rural area is one-quarter that of the urban area for India and other Indian sub-continent countries such as Bangladesh, Bhutan, Nepal, and Sri Lanka (Wild *et al.,* 2004 and Anjana *et al.,* 2011). Primary results from a community-based study conducted by the ICMR (Indian Council of Medical research) showed that lower proportion of north Indian population is affected by the disease (Chandigarh with 0.12 million, Jharkhand with 0.96 million people) as compared to Maharashtra and Tamil Nadu (9.2 and 4.8 million, respectively) (Anjana *et al.,* 2011). The suggested reason for this

difference could be due to the north Indians being migrant Asians and south Indians being the host populations (Arora *et al.,* 2010).

Factors responsible for diabetes mellitus may be the sedentary lifestyle, decrease in physical activity, increase in calorie and fat intake, history of gestational diabetes and stress. The shift in the age of onset of the diabetes is also observed, it has shifted to younger age population. As young Individuals with diabetes face the complications of diabetes, the economic productivity of this section of society may decline and this will affect the national economic productivity significantly (Yesudian *et al.,* 2014 and Sharma *et al.,* 2016). It could have long-lasting adverse effects on a nation's health.

Though there is an increased prevalence of diabetes within the country but there is no nationwide and very few multi-centric studies being conducted on assessing the prevalence of diabetes mellitus and its complications. The studies which have been conducted may also be prone to some potential error because of the heterogeneity of the Indian population with respect to ethnicity, culture, socio-economic settings, mean that the expectation of regional results may not give accurate estimates for the entire country. There are many determinants that affect the prevalence of diabetes in the country and to identify those factors is necessary to make the possible change, to bring down mortality and financial burden over a developing country like India. The present study was planned with the objective to examine the relationship of diabetes mellitus with various anthropometric parameters of diabetic and non diabetic men.

Materials and Methods

Location of the study

The study was carried out in 12 blocks of Ludhiana district (Punjab).

Selection of the subjects

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 men. 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 387 subjects 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) 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 of the subjects was estimated using formula given by WHO expert consultation (2004).

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

Range of BMI of Asians (kg/m^2)	Nutritional status
< 18.5	Underweight
18.5-22.99	Normal
23-24.99	Overweight
25-29.9	Pre-Obese
30	Obese
30-40	Obese grade I
40.1-50	Obese grade II
>50	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 ≥0.90 for waist and hip ratio was taken for men (WHO 2008).

Anthropometric measurements

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

Height

The average height of the rural diabetic and non diabetic men ranged from 155-189 cm and 151-190cm, respectively. The average height of the rural diabetic and non diabetic men was found 172.08cm and 171.55 cm, respectively. The average height of the urban diabetic and non diabetic men ranged from 153-189 cm and 152-188 cm, respectively. The average height of the urban diabetic and non diabetic men was found 170.05 cm and 171.98 cm, respectively. Neetu (2014) has reported 170.20 cm average height of men suffering from metabolic syndrome whereas Madhu (2014) has given 167.2 cm average height of diabetic men.

Weight

The average body weight of rural diabetic and non diabetic men ranged from 39.8-120 kg and 37-120 kg, respectively. The mean body weight of rural diabetic men was (78.85kg) significantly (p≤ 0.01) higher as compared to non diabetic subjects (72.14 kg). The body weight of urban diabetic and non diabetic men ranged from 54-105 kg and 42- 100 kg, respectively. The average body weight of urban diabetic men was also significantly higher (75.58 kg) (p≤ 0.01) as compared to urban non diabetic subjects (70.97 kg). Madhu (2014) has reported 77.56 kg average weight of diabetic males and Neetu (2014) has reported average weight of men to be 76.50 kg.

Waist circumference

The average waist circumference of rural diabetic and non diabetic men ranged from ranged from 71-130 cm and 69-132cm, respectively. The average waist circumference of rural diabetic men was (102.25 cm) significantly (p≤ 0.01) higher when compared to rural non diabetic men (96.83 cm). The waist circumference of urban diabetic and non diabetic men ranged from 50.8-127 cm and 71.12-124.46 cm, respectively. The average waist circumference of urban diabetic men was (101 cm) significantly (p≤ 0.01) higher when compared to urban non diabetic men (98.88 cm). Neetu (2014) has reported the average waist circumference of diabetic men to be 99.94.

Hip circumference

The average hip circumference of rural diabetic and non diabetic men ranged from 73.66-127 cm and 63.5-124 cm, respectively. The average hip circumference of rural diabetic men was (101.56cm) significantly higher (p≤ 0.01) as compared to rural non diabetic men (96.34 cm). The hip circumference of urban diabetic and non diabetic men ranged from 67.31-121.92 cm and 71.14-125.51 cm, respectively. The average hip circumference of urban diabetic men was (100.43 cm) significantly higher (p≤ 0.01) as compared to urban non diabetic men (97.09 cm). Hip circumference of diabetic men was reported 103.13 cm by Neetu (2014).

Derived anthropometric measurements of diabetic and non diabetic men

Body mass index

The average BMI of rural diabetic and non diabetic men ranged from 14.20-43.70 kg/m^2 and 13-46.60 kg/m^2, respectively. The average BMI of rural diabetic men was significantly (p≤ 0.01) higher (26.82 kg/m^2) as compared to rural non diabetic men (24.64 kg/m^2). The BMI of urban diabetic and non diabetic men ranged from 18.9-43.3 kg/m^2 and 13-41.2 kg/m^2, respectively. The average BMI of urban diabetic men was significantly (p≤ 0.01) higher (26.71 kg/m^2) as compared to rural non diabetic men (24.91 kg/m^2). The average BMI 27.59 kg/m^2 has been reported by Madhu (2014).

Waist to hip ratio

The Waist hip ratio of rural diabetic and non diabetic men ranged from 0.9-1.1 and 0.81 and 1.71, respectively. The average waist to hip ratio of rural diabetic and non diabetic men was 1.01. The WHR of urban diabetic and non diabetic men ranged from 0.8-1.1 and 0.91-1.18, respectively. The average waist to hip ratio of urban diabetic and non diabetic men was 1.01 and 1.02, respectively.

Body Mass Index (BMI) of rural and urban men

Body mass index of men is given in Table 2 (Fig. 2). Higher body mass index has been significantly associated with the diabetes risk. The role of body mass index with the development of diabetes has been well established which is again reinforced by the present study. It was seen that significantly higher number of rural non diabetic men (12%) were underweight as compared to rural diabetic men (4%). It was found that 29 per cent rural diabetic men and 27 per cent non diabetic men were in the normal weight category. 10 per cent rural diabetic men and 18 per cent rural non diabetic men were overweight. It was observed that significantly higher number (26%) of rural diabetic men were in obesity grade I category as compared to rural non diabetic subjects (9%) while 4 per cent rural diabetic and 2 per cent non diabetic men were in obesity grade II category. Among urban men, 5 per cent non diabetic men were under weight. It was found that 28 per cent urban diabetic men and 27 per cent non diabetic men were in the normal weight category while 19 per cent urban diabetic and 18 per cent non diabetic men were overweight. It was observed that significantly higher number (22%) of urban diabetic men were in obesity grade I category as compared to urban non diabetic subjects (7%), while 2 per cent urban diabetic and 2 per cent non diabetic men were in obesity grade II category.

Studies have shown that obesity has role in the development of diabetes. The obesity progresses to diabetes by progressive defect in insulin secretion along with simultaneous rise in insulin resistance (Shobha and Deepali, 2016). The mechanism which links obesity with diabetes is the adipose tissue especially the visceral fat which is deposited in the abdomen 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). It has been evident that the Asian Indians are more susceptible to risk factors like age, adiposity (based on BMI) and central obesity (WHR). The risk of diabetes mellitus was observed to be significant for urban population with BMI more than 23kg/m^2 (Chandalia *et al.,* 1999).

Table.1 Anthropometric measurements of men

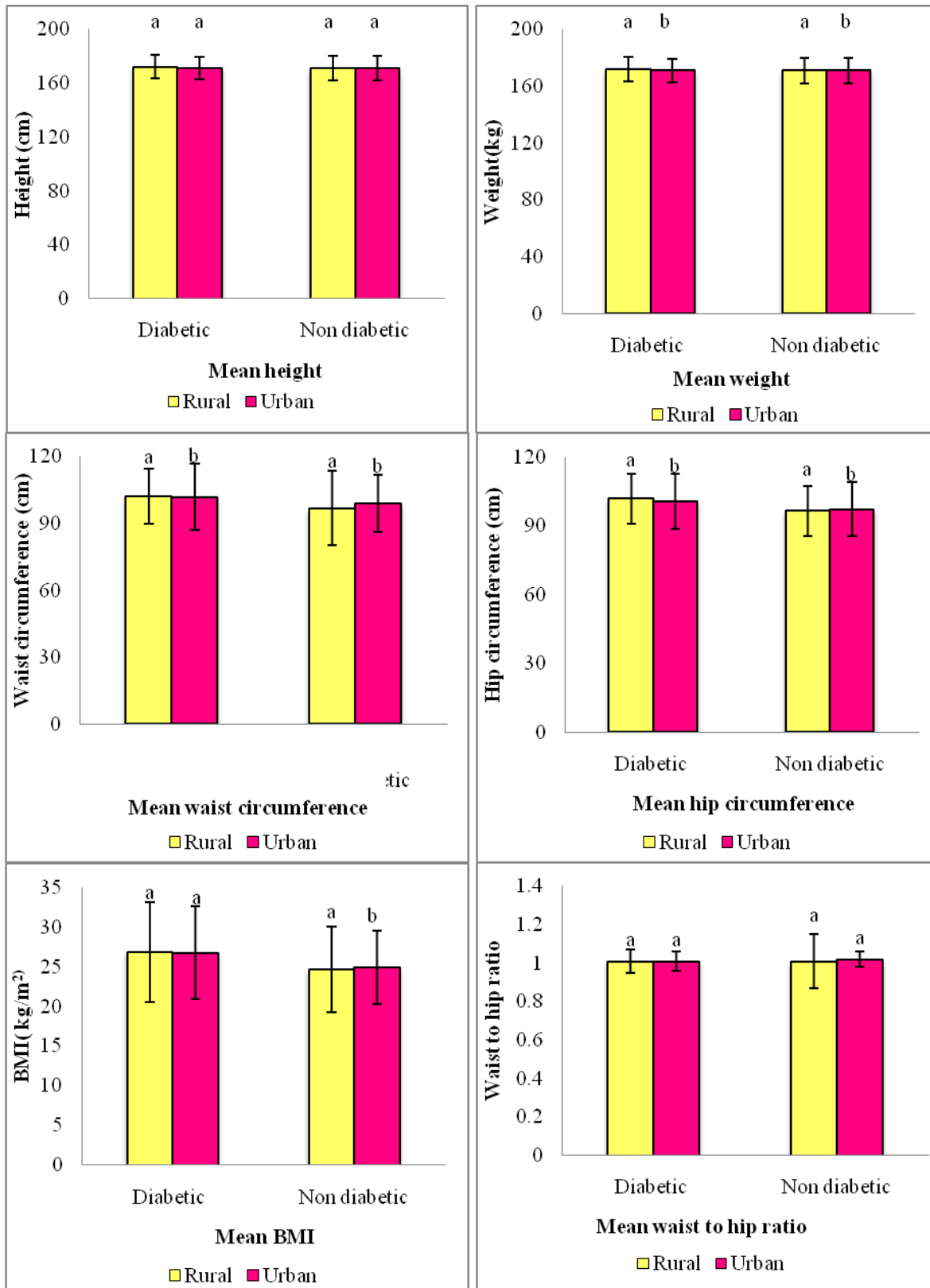| Basic Anthropometric measurements		Rural		t-value	Urban		t-value
		Diabetic (n=101)	Non diabetic (n=172)		Diabetic (n=58)	Non diabetic (n=56)	
Height, cm	Range	155-189	151-190	0.31[NS]	153-189	152-188	0.35[NS]
	Mean±SE	172.08±0.88	171.55±0.69		170.05±1.10	171.98±1.22	
Weight, kg	Range	39.8-120	37-120	44.70[***]	54-105	42-100	18.73[***]
	Mean±SE	78.85±1.63	72.14±1.10		75.58±1.71	70.97±1.74	
Waist circumference, cm	Range	71-130	69-132	38.85[***]	50.8-127	71.12-124.46	11.69[***]
	Mean±SE	102.25±1.22	96.83±1.27		101.84±1.95	98.88±1.71	
Hip circumference, cm	Range	73.66-127	63.5-124	41.90[***]	67.31-121.92	71.14-125.51	14.23[***]
	Mean±SE	101.56±1.08	96.34±0.83		100.43±1.58	97.09±1.56	
Derived Anthropometric measurements							
Body Mass Index, kg/m^2	Range	14.2-43.7	13-46.6	23.48[***]	18.9-43.3	13-41.2	11.58[***]
	Mean±SE	26.82±0.63	24.64±0.41		26.71±0.76	24.91±0.62	
Waist/Hip ratio	Range	0.9-1.1	0.81-1.71	NA	0.8-1.1	0.91-1.18	0.53[NS]
	Mean±SE	1.01±0.01	1.01±0.01		1.01±0.01	1.02±0.01	

Values represent Mean±SE
*Significant at 10%; **Significant at 5%; *** Significant at 1%; NS-Non Significant

**Table.2** Body mass index of diabetic and non diabetic men

BMI (kg/m^2)	Category	Rural		Z value	Urban		Z value
		Diabetic (n=101)	Non diabetic (n=172)		Diabetic (n=58)	Non diabetic (n=56)	
<18.5	Underweight	4(4)	20(12)	2.16**	-	3(5)	1.79*
18.5-22.99	Normal	29(29)	46(27)	0.35^{NS}	16(28)	15(27)	1.71*
23-24.99	Overweight	10(10)	31(18)	1.81*	11(19)	10(18)	1.42^{NS}
25-29.9	Pre-Obese	28(28)	56(33)	0.84^{NS}	17(29)	23(41)	0.28^{NS}
30	Obese	-	-	-	-	-	-
30-40	Grade I	26(26)	16(9)	3.63***	13(22)	4(7)	3.92***
40.1-50	Grade II	4(4)	3(2)	1.12^{NS}	1(2)	1(2)	0.32^{NS}
>50	Grade III	-	-	-	-	-	

Figures in parenthesis represent percentages.
*Significant at 10% level; **Significant at 5% level; *** Significant at 1% level; NS-Non Significant

Fig.1 Anthropometric measurements of diabetic and non diabetic men
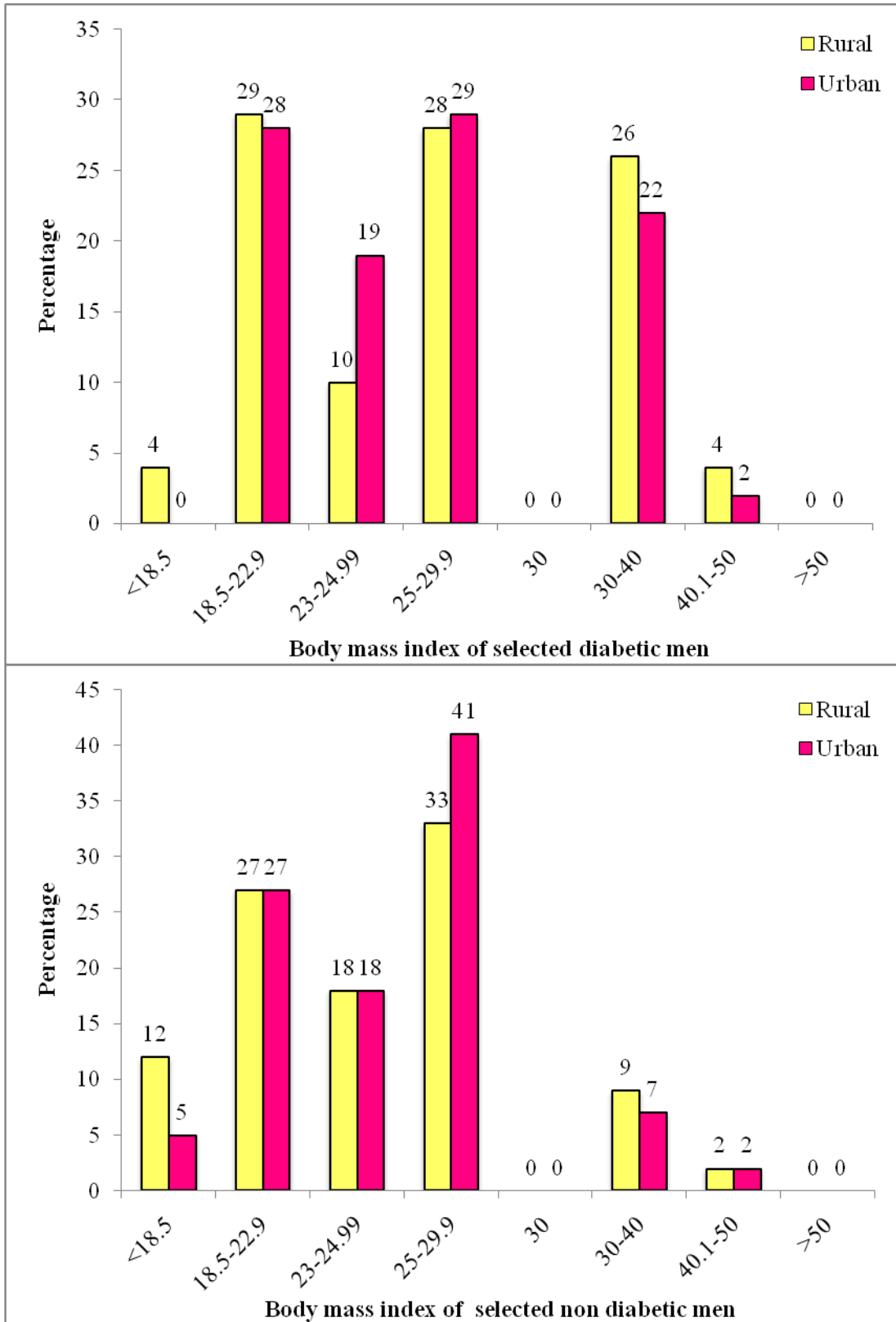
Fig.2 Body mass index (BMI) of rural and urban men

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 both males and females. Also in both areas, present study showed that there was an increasing trend of diabetes mellitus prevalence among men and women.

Resnick *et al.,* (2000) observed that each kg of weight lost annually over 10 years was associated with a 33 per cent lower risk of diabetes in the subsequent 10 years. Snehalatha *et al.,* (2003) reported that generally people get diabetes if their BMI was between 30-31 kg/m^2. Indians can develop diabetes if their BMI is above 25 kg/m^2. The normal cut off value for BMI in Asian Indian adults is <23 kg/m^2 and waist hip ratio is 0.80-0.88. Similarly, Klein *et al.,* (2004) stated that the marked increase in the prevalence of overweight and obesity was responsible for the recent increase in the prevalence of NIDDM.

In conclusion, 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 men was significantly higher (p≤0.01) as compared to rural and urban non diabetic men. It indicates that anthropometric parameters are a modifiable risk factors of type 2 diabetes. It is indicated that people should be encouraged to be 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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