Research Article

Study of BMI and Waist Hip Ratio of Indians with Type-2 Diabetes Mellitus

Purohit A[1], Tiwari V[2]

[1]Dr Ashish Purohit, Assistant professor, Department of Medicine, L N Medical college, Bhopal, [2]Dr Varsha Tiwari, Senior resident, Department of Pediatrics, L N Medical college, Bhopal, India

Address for correspondence: Dr Varsha Tiwari, Email: dr.varshatiwari021@gmail.com

Abstract

Introduction: Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. UCP2 locus on human chromosome 11 is linked to obesity and hyperinsulinism. **Methods:** A case control study was carried out in the Department of Medicine comprising 50 newly diagnosed type 2 diabetes mellitus patients and 50 healthy controls. All patients and controls were subjected to a detailed history physical examination and investigations. Information on age, sex, body weight, height, waist and hip circumference, and BMI (wt. (kg)/ht. (mtr2)) were obtained. **Results:** The body mass index (BMI) of the study subjects was cases - 23.94 ± 1.83 kg/m2, controls - 22.8 ± 1.38 kg/m2 ($P < 0.001$). Prevalence of an abnormal value of waist-to-hip ratio (WHR) was found to be 46% in the cases. Of the cases, 58% had poor glycemic control. **Discussion and Conclusion:** BMI is strongly and independently associated with the risk of being diagnosed with T2D. We found that, compared with normal BMI, overweight and obesity was statistically significantly associated with the risk of being diagnosed with T2D among individuals without any other prior evidence of T2D, suggests that the disease might be on track of changing its trend or the patients are reporting at a late stage due to health disparities. Central obesity was present in the studied population, with generalized obesity, making the population prone to insulin resistance. The mean values and the prevalence of abnormal values of BMI, WC, and WHR were higher in the cases than in the controls.

Keywords: Body Mass Index, Clinical Profile, Obesity, Type 2 Diabetes

Introduction

Obesity is defined as the presence of excess adipose tissue. A person whose body weight is in excess of standard weight (calculated from BMI & Hip Waist Ratio) is termed as overweight [1]. BMI is strongly associated and independently associated with risk of being diagnosed with type 2 diabetes mellitus. The incremental association of BMI category on the risk of type 2 DM is the stronger for people with higher BMI relative to people with lower BMI [2]. The World Health Organization (WHO) predicts that overweight and obesity may soon replace more traditional public health concerns such as under nutrition and infectious diseases as the most significant cause of poor health. Type 2 diabetes mellitus (T2DM) has been defined as the most prevalent metabolic condition and most prevalent form of diabetes with a tagline as one of the major health problems worldwide [3,4]. The rising prevalence of the disease worldwide makes it a global public health threat with 180 million sufferers [4,5]. It's alarming increase, especially in south east Asia, indicates that more than 60% of the world's diabetic population will be in Asia, with India and China bearing the global diabetic load of more than 75% of the diabetic subjects by year 2025[4,5]. India comprises a largest hub of diabetics, with 31.7 million cases of T2DM and a three-fold rise in disease prevalence rural (2-6%) and urban (5-15%) areas [6].

We need to describe and understand the clinical and biochemical profile of diabetes population, to facilitate early diagnosis and suggest lifestyle modifications to curb the onward progression of the disease [4]. The pre-established micro- and macro vascular complications, which could be checked through early recognition makes diabetes mellitus a major public health concern [4].

We have conducted this study to asses waist hip ratio & BMI in Indian population.

Manuscript received: 9st Aug 2014
Reviewed: 19th Aug 2014
Author Corrected: 6th Sep 2014
Accepted for Publication: 25th Sep 2014

Materials and Methods

Study area

The present case-control study was carried out in the Department of Medicine, J.A. Group of Hospitals, Gwalior, a teaching hospital of the G.R. Medical College, Fifty newly diagnosed, type 2 diabetes mellitus patients and 50 healthy controls were studied.

Inclusion criteria

The American Diabetes Association criteria have been used for selecting the newly diagnosed type-2 diabetes Mellitus patients [7].

Exclusion criteria

Patients on drugs that altered the insulin sensitivity or on oral hypoglycemic agents (insulin, β agonist, prazosin, diuretics, steroids, oral contraceptive pills (OCPs)), having any condition associated with insulin resistance (polycystic ovary syndrome (PCOD), thyrotoxicosis, congestive cardiac failure, chronic renal failure, cirrhosis, pregnancy, or hypertension (JNC 7 stage I hypertension and stage II hypertension), were excluded.

The volunteer study subjects, who satisfied the inclusion and exclusion criteria, were educated regarding the study, its aims ad objectives.

If they were willing to participate in the study, an informed consent was obtained and the subject was taken into the study.

Controls

Fifty healthy volunteers with no family or personal history of diabetes mellitus or hypertension, matched for age and sex, were recruited to serve as controls. Subjects with any history of diabetes mellitus, personal or family history of hypertension, any form of illness, and current use of any form of medication have been excluded from the study.

Collection of data

Consent

An informed consent was obtained from each of the patients prior to the interview.

Clearance from the Institutional Ethical Committee was obtained prior to the advent of study.

All patients and controls were subjected to a detailed history and physical examination and investigations.

Anthropometric, clinical, and biochemical measurements, Information on age, sex, body weight, height, waist and hip circumference, and BMI (wt. (kg)/ht. (mtr2)) were obtained.

The National Cholesterol Education Program guidelines were used for defining dyslipidemia [8].

The Asia-Pacific guidelines for defining the Waist circumference (WC) cut-offs were used [8].

The Indian Council of Medical Research recommendations for Indians-obese if BMI was ≥25 kg/m2 and overweight when BMI was 23-24.9 kg/m2- were used [9].

Good glycemic control, <7%; sub-optimal control, 7-8%; and inadequate control, 8-9% were used for defining the glycemic control.

The National Cholesterol Education Program guidelines were used for defining dyslipidemia [8]. The Asia-Pacific guidelines for defining the Waist circumference (WC) cut-offs were used [8].

Analysis of data

The SPSS 11.5 was used for analyzing the data. The mean and standard deviation was obtained for summarizing the Quantitative variables, while the categorical variables were tabulated using frequencies and percentages.

A student's *t*-test was used for testing continuous variables and a Chi-square test for ordinal variables. A *P* value of less than 0.05 was considered significant.

Results

The mean age of the study subjects was 49.98 ± 8.3 years (female 48.87 ± 8.18 years, male 50.46 ± 8.46 years; $P = 0.53$).

Seventy-six percent (38) of the subjects belonged to the age group of 41-60 years ($P < 0.01$).

The study sample comprised 70% (35) males and 30% (15) females, which was statistically significant ($P < 0.05$).

Table 1: Clinical and biochemical profile of cases and controls

Variables	Cases	Control
age	50.46 ± 8.46	48.87±8.18
Weight(kg)	65.3± 5.52	64.48± 5.99
Height(cm)	164.78± 5.45**	167.78± 4.52
Body mass index(BMI,kg/m2)	23.94±1.83***	22.8± 1.38
Waist circumference	92.42± 9.3**	87.34± 6.57
Waist-hip ratio(WHR)	0.94± 0.06***	0.9± 0.05
Fasting plasma glucose(FPG,mg/dl)	164.1± 54.43****	110.6± 7.07
Postparandial glucose (PPI,mg/dl)	249.46 ±79.5****	130.1± 6.7
Fasting plasma insulin(FPI uIU/ml)	10.54±9.43*	7.43± 2.27
Underweight(<18.5 kg/m2)*** Normal range (18.5-22. 9 kg/m2)	16 (32)	26 (52)
Overweight (23-24.99 kg/m2)	22(44)	24(48)
Obese (≥25 kg/m2)	12 (24)	0
Waist circumference female (15) >80 cm	14 (93.33)	11(73.33)
Waist circumference male (35) >90 cm	17 (48.57)	11 (31.42)

Values are mean±SD numbers (percentage); P*<0.05, **<0.01, ***<0.001, ****<0.0001 compared to control

The clinical and biochemical profiles of the cases and controls have been shown in Table 1. The type 2 diabetics were significantly short-statured with a mean height of 164.78 ± 5.45 cm, as compared to 167.78 ± 4.52 cm for the controls ($P <$ 0.01) [Table 1]. According to the BMI, only 32% (16) of the cases had normal weight, with 44% (22) being overweight. The (BMI) body mass index of the cases was significantly higher (23.94 ± 1.83 kg/m2; $P < 0.001$) as compared to the controls (22.8 ± 1.38 kg/m2). The prevalence of abnormal WHR (Male > 0.95, Female > 0.8) was found to be 46% (23) in the cases and 38% (19) in the controls. The proportion of abnormal WHR was significantly high among the females in both cases (females - 14, 93.3%; male - 9, 25.7%; $P < 0.0001$) and controls (females - 13, 86.6%; male - 6, 17.4%; $P < 0.0001$).

Table 2: Clinical parameters in males and females in the newly diagnosed type2 diabetic subjects

Variables	Female(15)	Male(35)
Age (years)	48.87±8.18	50.46±8.46
Weight (kg)	62.53±4.66*	66.49±5.49
Height (cm)	159.73±4.17****	166.94±4.42
BMI (kg/m2)	24.42 ± 2.15	23.73±1.67
Waist circumference	24.42±2.15	91.8±9.29
WHR	93.87±9.48	0.94±0.05
Cholesterol (mg/dl)	92±0.07	162.57±38.37
HDL (mg/dl)	194.87±63.34*	37.66±7.31
LDL (mg/dl)	45.33±13.72*	108.11±30.98
TG (mg/dl)	126.87±49.01	159.97±63.51
HbA1c%	168.07±53.62	9.39±1.73
FPI (uIU/ml)	11.01±3.12*	9.18±7.53
FPG (mg/dl)	13.71±12.57	157.11±51.07
PPG (mg/dl)	180.4±60.25	244.69±73.16
Hbgm%	260.6±94.53	12.35±1.19
IFG (cases, 100-125 mg/dl)	11.36±1.17**	1(2.85)
Underweight (<18.5 kg/m2)	0	0
Normal range (18.5-22.9 kg/m2)	5 (33.33)	11(31.42)
Overweight (23-24.99 kg/m2)	5 (33.33)	17(48.57)
Obese (≥25-kg/m2)	5 (33.33)	7(20)

Numbers (percentage); P*<0.05, **<0.01, ***<0.001, ****<0.0001, BMI=Body mass index, WHR=Waist-hip ratio, HDL=High density lipoprotein, LDL=Low density lipoprotein, TG=Triglycerides, FPI=Fasting plasma insulin, FPG=Fasting plasma glucose, IFG=Impaired fasting glucose.

The clinical parameters of the male and female newly diagnosed diabetic patients have been shown in Table 2. Diabetic females had a significantly low weight (female 62.53 ± 4.66 kg, male 66.49 ± 5.49 kg; P < 0.05) and height (female 159.73 ± 4.17 cm, male 166.94 ± 4.42 cm; P < 0.0001) as compared to their male counterparts, but had higher BMI (24.42 ± 2.15 kg/m2) as compared to the males (23.73 ± 1.67 kg/m2). There was a significant difference between males and females with respect to the mean cholesterol (male 194.87 ± 63.34 bmg/dl, female 162.57 ± 38.37 mg/dl;P < 0.05), HDL (male 45.33 ± 13.7 mg/dl, female 37.66 ± 7.31 mg/dl; P < 0.05), HbA1c (male 11.01 ± 3.12%, female 9.39 ± 1.73%; P < 0.05), and Hb (male 11.36 ± 1.17 gm%, female 12.35 ± 1.19 gm%; P < 0.01). Very few study subjects (5, 10%) had good glycemic controls (≤7%). A majority of the subjects (29, 58%) had poor glycemic control (>9%). The odds of having poor glycemic control in females was twice more than in males (OR: 2.10; P = 0.49). A nearly significant inverse correlation was found between waist circumferences (WC) and HbA1c (r =−26.45; P = 0.05). An inverse correlation was obtained between the waist-to-hip ratio (W/H) and HbA1c (r =−0.24; P = 0.08), which was not statistically significant.

Table 3: Lipid profile of Cases & Controls

Characteristics	Cases(50)		Controls (50)		Total	
	Male(35)	Female(15)	Male 35	Female 15	Case 5	Controls 50
TC>200 (mg/dl)	4 (11.4)	6 (40)*	2 (5.7)	1 (6.6)	10 (20)	3 (6)
LDL>100(mg/dl)	20 (57.1)	12 (80)	20(57.4)	10 (66.6)	32 (64)***	30 (60)
HDL<40 (mg/dl)	24 (68.5)	6 (40)	7 (20)	3 (20)	30 (60)****	10(20)
TG>150 (mg/dl)	19 (54.2)	8 (53.3)	1 (2.8)	2 (13.3)	27 (54)****	3 (6)
High LDL-c	0	0	14 (40)	6 (40)	0****	20 (40)
Low HDL-c	5 (14.2)	2 (13.2)	1 (2.8)	0	7 (14)	1 (2)
High TG	2 (5.7)	0	0	1 (6.6)	2 (4)	1 (2)
High LDL-c+High TG	3 (8.5)	3(20)	0	1 (6.6)	6 (12)	1 (2)
High LDL-c+Low HDL-c	4 (11.4)	1(6.6)	5 (14.2)	2 (13.2)	5 (10)	7 (14)
High TG+Low HDL-c	4 (11.4)	0	1 (2.8)	0	4 (8)	1 (2)
High TC+ High LDL-c +High TG	2 (5.7)	0	0	0	2(4)	0

The lipid profiles of the study subjects are shown in Table 3. In the lipid profile analysis, the HDL (cases 39.96 ± 10.17 mg/dl, controls 47.64 ± 9.83 mg/dl; *P* < 0.001) and triglyceride values (cases 162.4 ± 60.29 mg/dl, controls 120.6 ± 21.21 mg/dl; *P* < 0.0001) were significantly deranged in the cases as compared to the controls. Prevalence of dyslipidemia was significantly high (*P* = 0.009), 88% in the cases (male-30, 68.1%; female-14, 31.8%; *P* < 0.0001) as compared to 64% in the controls (male-21, 65.6%; female-11, 34.37%; *P* = 0.3). Twelve (92.3%) of the retinopathy cases had one or more types of dyslipidemia, while 7.6% (1) of the retinopathy cases was non-dyslipidemic. Microalbuminuric was found among 22% (11) of the subjects.

Values are mean±SD HDL-C=High-density lipoprotein cholesterol, LDL-c=Low-density lipoprotein cholesterol, TC=Total cholesterol, TG=Triglycerides, Numbers (percentage),

P*<0.05, **<0.01, ***<0.001, ****<0.0001

Discussion

The present study enrolled 50 recently diagnosed type 2 diabetic patients and 50 controls (35 males and 15 females in each group). The mean age of the patients was 49.98 ± 8.3 years. The mean age of the subjects is in accordance with other Indian studies, from 47-50 years [10,11] however, less than that reported by others [3,12].

Only 10% of the subjects had good glycemic control (HbA1c ≤ 7%) with poor glycemic control (HbA1c > 9%) reported in 58% of the cases (females-70% and males-52%). It was very low when compared with various studies reporting a good glycemic control proportion, varying from 31-38% [13, 14]. This low proportion was in accordance with the studies reporting good glycemic control in only 7 to 17.6% of the study subjects [4]. The mean HbA1c of the subjects was 9.95 ± 2.3% (female-11.01 ± 3.12%and male -9.39 ± 1.73%), which was also reported in other studies (7.9 ±1.6 to 13.1 ± 3.1) [10, 15].

Females had a poorer control than there male counterparts, which in contrast to studies reporting better control in females [14]. A significant proportion of the cases were overweight and obese as compared to the controls, with none being underweight. The mean values and the prevalence of abnormal values of BMI, WC, and WHR were higher in the cases than in the controls [15].

The same held true for female cases and controls, as compared to their male counterparts [16,17]. Diabetic females overpower males in the proportion of being obese. High mean of BMI in females despite being significantly low weight and short statured when compared to the males could be explained from the bread-winning responsibility of male, with the male being the gatekeeper for the outside activity of females, confines them to a sedentary lifestyle – the main culprit for being overweight and obese, with decreased insulin sensitivity [18,19].

The high mean of WHR in both the sexes was suggestive of central obesity in this population [16]. A significantly high proportion of abnormal WHR in females was a marker of central obesity and a sedentary lifestyle, a plausible cause of a high mean of BMI in the female subjects forecasts a toll of insulin resistance diabetic female cases in the near future owing to decreased insulin sensitivity [19]. High fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and fasting plasma insulin (FPI) in females, supports the notion of high BMI in the studied females, as even a unit change in BMI significantly increases the risk of developing glucose intolerance. Predominance of a classic symptom in newly diagnosed young diabetics has been reported in previous studies. The lipid profile was significantly deranged in the studied population [11, 14]. Dyslipidemia was present in 88% of the cases, as compared to 66% of the controls.

The proportion of individual dyslipidemia reported in our study was higher than in other studies [16]. Overall the most prevalent form of dyslipidemia was high LDL-c, with low HDL-c among cases and high LDL-c among controls, in contrast to other reports, with certain supportive clues suggesting high LDL-c in diabetics [20-23]. The males were significantly more dyslipidemia than females in both cases and controls. The most prevalent form of dyslipidemia in diabetic males was low HDL-c, while in females it was high LDL-c and high TG. In the control group, for both the genders, high LDL-c was the prevailing condition. In the control group, both the males and females had an equal proportion of derangement for the lipid profile of diabetics. The pattern of dyslipidemia in our study differs from the typical diabetic dyslipidemia (namely, high TG and low HDL with no difference in the level of TC and LDL) as reported in many studies [24].

More than 60% of the patients had low HDL-c with a female predominance for it [16]. A high cardiovascular risk (CV) risk is suggested in this population, as HDL-c is a powerful predictor in diabetes [25]. A high mean of TC, TG, LDL-c, and HDL-c in diabetic females is supported by other studies for LDL-c and TG, but it is different for HDL-c. Reports from Kuwait and Malaysia suggest a worldwide variability in the lipid profile of diabetics reporting of the population at a late stage, therefore, the study may not reflect the whole picture of the problem in the community.

BMI

In present study, 68% type 2 DM patients had BMI ≥ 22.99 kg/m2, 44% T2 DM patients had BMI between 23 to 24.99 kg/m2 (overweight). However 48% control were found to be overweight in present study. 24% cases of T2 DM had BMI in between 25 to 29.99 kg/m2 (obese-I). None of the control was obese. Mean BMI of cases was 23.93±1.83 kg/m2 while mean BMI of controls was 22.79±1.37 kg/mtr2 with P value (.000586) which is statistically significant.

Adamu G Bakari et al. (2005) found mean BMI of 24.9±4.02 kg/m2 in type 2 DM patients while 22.9 ± 4.02kg/m2.in controls which were consistent with the results of our study [26]. Akira Katsuki et al (2001) found

that mean BMI was 26.0±2 kg/m2 in 55 patients of T2 DM [27]. Michael l ganz et al (2014) also found similar association of BMI with risk of type 2 DM [28]. Koichi akiyama et al (2014) The 16q12.2 locus in the first intron of FTO has been robustly associated with BMI and type 2 DM in genome wide associated studies [29].

Waist Hip Ratio

Mean waist Hip ratio in cases of type 2 DM patients was 0.935±0.0549 while in controls was 0.9±0.048 with P Value < .000996 which is statistically significant.

In study of Adamu G Bakari et al. (2005), study mean WHR was 1.03±0.08 in 42 type 2 DM patients [26]. This finding is similar to present study [26].

Conclusions

High BMI and high waist circumference was associated with insulin resistance. It should be measured in all the diabetic patients because it is cheap and easily measurable. It's measurement will help to prevent the development of various complications of diabetes at early stages.

Funding: Nil, **Conflict of interes**t: None
Permission from IRB: Yes

References

1. Jeffrey S.flier, Eleftheria Maratos-Flier, biology of obesity. harrison's principles of internal medicine, 2012;18:622-5.

2. Michael L Ganz1, Neil Wintfeld2, Qian Li1, Veronica Alas1, Jakob Langer2 and Mette Hammer2, association of BMI with risk of type 2 diabetes. Diabetology & Metabolic Syndrome3 april 2014, 6:50 doi:10.1186/ 1758-5996-6-503.

3. Barma PD, Ranabir S, Prasad L, Singh TP. Clinical and biochemical profi le of lean type 2 diabetes mellitus. Indian J Endocrinol Metab. 2011 Jul;15(Suppl 1):S40-3. doi: 10.4103/2230-8210.83061.

4. Patel M1, Patel IM, Patel YM, Rathi SK.A hospital-based observational study of type 2 diabetic subjects from Gujarat, J Health Popul Nutr. 2011 Jun;29(3):265-72.

5. Ramachandran A, Snehalatha C, Shetiy AS, Nanditha A. Trends in prevalence of diabetes in Asian countries. World J Diabetes 2012;3:110-7.

6. Ebrahim S, Kinra S, Bowen L, Andersen E, Ben-Shlomo Y, Lyngdoh T, *et al.* Indian Migration Study Group. The effect of rural-to-urban migration on obesity and diabetes in India: A cross-sectional study. April 27, 2010DOI: 10.1371/journal.pmed.1000268.

7. American Diabetes Association. Standards of medical care in diabetes–2008. Diabetes Care 2008;31 Suppl 1:S12-54.

8. Expert Panel on Detection, Evalution, and Treatment of High Blood Cholesterol in Adults. JAMA 2001;285:2486-97.

9. Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, *et al*. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. J Assoc Physicians India. 2009 Feb;57:163-70.

10. Agrawal RP, Ranka M, Beniwal R, Gothwal SR, Jain GC, Kochar DK, *et al*. Prevalence of micro and macro vascular complications in type 2 diabetes and their risk factors. Int J Diabetes Dev Ctries 2004;24:11-6.

11. Sinharoy K, Mandal L, Chakrabarti S, Paul UK, Bandyopadhyay R, Basu AK. A study on clinical and biochemical profile of low body weight type 2 diabetes mellitus. J Indian Med Assoc 2008;106:747-50.

12. Mukhyaprana MP, Vidyasagar S, Shashikiran J. Clinical prolife of type 2 diabetes mellitus and body mass index. Is there any correlation? Calicut Med J 2004;2:e3.

13. Al-Kaabi J, Al-Maskari F, Saadi H, Afandi B, Parkar H, Nagelkerke N. Assessment of dietary practice among diabetic patients in the United Arab Emirates. Rev Diabet Stud 2008;5:110-5.

14. Asmathulla S., Dr. Ragunathan, Mr. Ramchandar. Assessment of Ischemic Heart Disease and its Risk Factors among Asymptomatic Hospital Visitors.indian journal of biomedical and advanced research2013;vol4,No6

15. Vikram NK, Tandon N, Misra A, Srivastava MC, Pandey RM, Mithal A, *et al*. Correlates of type 2 diabetes mellitus in children, adolescents and young adults in north India: A multisite collaborative case-control study. Diabet Med 2006;23:293-8.

16. Gupta S, Kapse A. Lipid profile pattern in diabetics from central India. Int J Diabetes Dev Ctries 2001;21:138-45.

17. Abdel-Aal NM, Ahmad AT, Froelicher ES, Batieha AM, Hamza MM, Ajlouni KM. Prevalence of

dyslipidemia in patients with type 2 diabetes in Jordan. Saudi Med J 2008;29:1423-8.

18. Singh S, Badaya S. Factors influencing uptake of cervical cancer screening among women in India: A hospital based pilot study. J Community Med Health Educ 2012;2:157.

19. Frank B. Hu, MD; Meir J. Stampfer, MD; Caren Solomon, MD; Simin Liu, MD; Graham A. Colditz, MD; Frank E. Speizer, MD; Walter C. Willett, MD; and JoAnn E. Manson, MD. Physical Activity and Risk for Cardiovascular Events in Diabetic Women 16 January 2001, Vol 134, No. 2. Cited on aug 2014

20. Barnett AH, Dixon AN, Bellary S, Hanif MW, O'Hare JP, Raymond NT,Kumar S. Type 2 diabetes and cardiovascular risk in the UK south Asian community. Diabetologia 2006;49:2234-46.

21. Ramachandran A, Snehalatha C, Satyavani K, Sivasankari S, Vijay V. Metabolic syndrome in urban Asian Indian adults: A population study using modifi ed ATP III criteria. Diabetes Res Clin Pract 2003;60:199-204.

22. Al-Adsani A, Memon A, Suresh A. Pattern and determinants of dyslipidaemia in type 2 diabetes mellitus patients in Kuwait. Acta Diabetol 2004;41:129-35.

23. Grant RW, Meigs JB. Prevalence and treatment of low HDL cholesterol among primary care patients with type 2 diabetes: An unmet challenge for cardiovascular risk reduction. Diabetes Care 2007;30:479-84.

24. Hammoudeh AJ, Haddad J, Al-Mousa E. Is dyslipidemia in Middle Eastern patients with type 2 diabetes mellitus different from that in the west. The Jordan hyperlipidemia and related targets study (JoHARTS-3). Clin Diabetes 2006;5:128-31.

25. Hokanson JE, Austin MA. Plasma triglyceride level is a risk factor for cardiovascular disease independent of high-density lipoprotein cholesterol level: A meta-analysis of population-based prospective studies. J Cardiovasc Risk 1996;3:213-9 .

26. Adamu G Bakari and Geoffrey C Onyemelukwe: Insulin resistance in type 2 diabetic Nigerians. Diabetes & metabolism 2005 13, 24-27.

27. Akira Katsuki, MD, Yasuhiro Sumida, MD Rika Araki Sasaki, MD et al: Homeostasis Model Assessment is a reliable indicator of insulin resistance during follow up of patients with type 2 diabetes, Diabetes care 24:362-365, 2001.

28. Michael L Ganz, Neil Wintfeld, Qian Li, Veronica Alas, Jakob Langer, Mette Hammer. The association of body mass index with the risk of type 2 diabetes: a case–control study nested in an electronic health records system in the United States. Diabetology & Metabolic Syndrome 2014, 6:50

29. Koichi Akiyama, fumihiko Takcuchi, Masato Isono, Sureka Chakrawarthy. Systemic fine mapping of association with BMI and type 2 diabetes at FTO locus by integrating results from multiple ethnic groups. June 30, 2014.

.....

How to cite this article?

Purohit A, Tiwari V. Study of BMI and Waist Hip Ratio of Indians with Type-2 Diabetes Mellitus. *Int J Med Res Rev* 2014;2(6):592- 598. doi:10.17511/ijmrr.2014.i06.14

.....