



BMI (Body mass index) as Risk Factor with Status of Macrovascular and Microvascular Complications Among Patients of Noninsulin Dependent Diabetes Mellitus (NIDDM)

First and Corresponding Author: Dr. Sweta T. Gamit, Ex Assistant Professor, Department of Medicine, Government Medical College, Surat, INDIA.

Address: 206, Pancham Residency, Opp. Karan Park Row House, Kalpnachawlamarg, adajan, Surat -395009, INDIA.

Email: drswetagamit30@gmail.com

Second Author: Dr. Amit L. Gamit, Associate Professor, Department of Medicine, Government Medical College, Surat, INDIA.

Third Author: Dr. Parul Bhatt, Ex. Associate Professor, Department of Medicine, Government Medical College, Surat, INDIA.

Fourth Author: Dr. Chintan Gamit, Tutor, Department of Community Medicine, Government Medical College, Surat, INDIA.

Fifth Author: Dr. Vipul P. Chaudhari, Associate Professor, Department of Community Medicine, Government Medical College, Surat, INDIA.

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Abstract

Background: Type-2 diabetes mellitus has increased exponentially in urban populations and that even the underprivileged are not exempt. Changing societal structures and lifestyles are accelerating it. Proximate causes for this epidemic are excessive consumption of calories and declining physical activity, which leads to increasing in obesity, especially central obesity.

Material & Methods: Across sectional study was conducted from October 2010 to October 2012. Macrovascular and microvascular complications prevalence were compared in 3 subgroups based on BMI. 120 cases were studied. **Results:** Out of 120 patients 88 (73.33%) are male and 32 (26.66%) are female. Most common age period in which prevalence of diabetes found in each sub groups is 40-59years. In obese patients, 20(50%) are hypertensive and out of them 12 (30%) and 8(20%) are in JNC Class 1 and 2 respectively. Obese patients with macrovascular complications(hypertension,IHD,CV stroke) are more as compared to those of lean and IBW groups. More than half 64 (53.33%) study population reported with peripheral Neuropathy. Near about half 56(46.7%) reported with retinopathy. **Conclusion:** Microvascular complications like peripheral neuropathy, Retinopathy are most common and independently associated with NIDDM. Microvascular complications are much higher than macrovascular complications in Type 2 DM-lean(BMI <18.5).

Key Words: macrovascular complication, microvascular complications, noninsulin dependent diabetes mellitus (NIDDM), BMI(Body mass index)

Introduction: Type 2 Diabetes mellitus is one of the modern pandemics. Diabetes today is an important single disease in the medical specialty and a chronic illness that requires continuing medical care and ongoing patient self-management education and support to prevent acute complications and to reduce the risk of long-term complication.^[1]

Epidemiologic studies reveal that the prevalence of type 2 diabetes mellitus has increased exponentially in urban populations and that even the underprivileged are not exempt. Changing societal structures and lifestyles are accelerating the epidemic of Diabetes mellitus in South Asian countries. Proximate causes for this epidemic are excessive consumption of calories and declining physical activity, which leads to increasing in obesity, especially truncal obesity (high waist to hip ratio). Interaction of genetic predisposition, environmental influences, and multiple risk factors initiates a cascade that culminates in DM.^[2]

Weight plays a central role in the etiology and pathology of type 2 diabetes. The increased risk for type 2 diabetes in individuals with obesity is considerable. Lower Body mass index thresholds for overweight and obesity have been proposed for the Asia-Pacific region since this population appears to be at-risk at lower body weights for glucose and lipid abnormalities^[3,4] Interestingly, almost 80% of Indian Type 2 diabetic patients are non-obese whereas 60–80% of such diabetics in the West are obese. Clinical pattern and phenotype profile of patients with Type 2 diabetes (T2DM) are very different in India as well as in certain developing countries of Asia and Africa as compared to the West.^[5]

Increased visceral fat in Indians lead to dyslipidemia, increased insulin resistance even with lesser Body Mass Index (BMI) as compared to western population^[6]. Studies in different parts of India has shown that Type 2 DM-lean patients had a marked lower incidence of hypertension, CAD, nephropathy and higher prevalence of retinopathy and a markedly higher incidence of peripheral neuropathy and infections.^[7,8]

Material And Methods

This cross sectional study was carried out among purposively selected 120 patients of type 2 diabetes mellitus at Department of Medicine, New Civil Hospital, Surat during October 2010 to October 2012.

Inclusions Criteria:

1. K/C/O type-2 DM both male & female.
2. Age > 18 years.

Exclusions Criteria:

1. Freshly detected case of type 2 Diabetes
2. Patient who had abrupt onset of Diabetes with acute weight loss or require insulin at the time of diagnosis.
3. Patients with diseases of exocrine pancreas- pancreatitis, pancreatectomy, neoplasia, cystic fibrosis, hemochromatosis, fibrocalculous pancreatopathy (FCPD).
4. Patients with endocrinopathies- acromegaly, cushing's syndrome, glucagonoma, pheochromocytoma, hyperthyroidism, somatostatinoma, aldosteronoma.
5. Gestational diabetes mellitus (GDM)

History and Clinical Examination:

The detailed history was taken of patients enrolled in study. All findings were recorded on predesigned questionnaire.

General examination was carried out looking for pallor, icterus, cyanosis, clubbing, koilonychias, neck veins engorgement, lymphadenopathy and back and spine abnormality. Signs of insulin resistance and atherosclerosis ie. Acanthosis nigricans, Arcussenilis, xanthoma, xanthelesma, locomotor brachialis, thickendveseels, carotid bruit. Patients were

screened for peripheral neuropathy by using Michigan neuropathy screening score. Body mass index was calculated in kg/m² and based on BMI, the patients were divided into the following groups: Lean: BMI of < 18.5, IBW (Ideal body weight): BMI of 18.5-24.9, Obese: BMI of ≥ 25. Minimum 40 patients were taken on each group.

Thorough **systemic examination** of cardiovascular system, elementary system, respiratory system and nervous system including fundus examination was done.

Following laboratory investigations were carried out:

Haemogram, Urine analysis, Fasting blood glucose, 2 hour Post prandial blood glucose level, Serum creatinine, Lipid profile, Electrocardiogram, Chest x ray and USG abdomen in required cases.

The data was collected and analyzed statistically.

Results

Table 1: Distribution of study population according to age, sex of having Type 2 Diabetes.

	LEAN (n= 40)	IBW (n= 40)	OBESE (n= 40)
SEX			
Male	29(72.5%)	32(80%)	27(67.5%)
Female	11(27.5%)	8(20%)	13(32.5%)
AGE (YEARS)			
18-39	5(12.5%)	5(12.5%)	2(5%)
40-59	23(57.5%)	22(55%)	19(47.5%)
≥60	12(30%)	13(32.5%)	19(47.5%)

Out of 120 patients 88 (73.33%) are male and 32 (26.66%) are female. In lean group, out of 40 patients 29(72.5%) are male and 11 (27.5%) are female. In IBW group, out of 40 patients 32(80%) are male and 8 (20%) are female. In Obese group, out of 40 patients 27(67.5%) are male and 13(32.5%) are female.

Above table shows, most common age period in which prevalence of diabetes found in each sub groups is 40-59years.

Higher diabetes risk is found in early age group 18-39yrs is 12.5% in lean & IBW as compared to 5% in obese. while there is no significant difference between 3 sub group at the age between 40-59yrs- 57.5%, 55%, 47.5% respectively.

In our study, higher diabetes risk is found in early age group 18-39yrs because of weight gain in early adulthood is related to a higher risk of type 2 diabetes than was later weight gain in both normal and overweight.

Table: 2 Distribution of study population according to macrovascular and microvascular complications among (NIDDM).

	LEAN No (%)	IBW No (%)	OBESE No (%)
MACROVASCULAR COMPLICATIONS			
Hypertention (mm of Hg)			
<140/90	25(62.5)	31(77.5)	20(50)
JNC 1(140/90-159/99)	10(25.0)	5(12.5)	12(30)
JNC class 2(≥160/100)	5(12.5)	4 (10.0)	8(20.0)
Ischemic Heart Disease (IHD)			
Present	7 (17.5)	7 (17.5)	16 (40.0)
Absent	33 (82.5)	33 (82.5)	24 (60.0)
Cerebrovascular Stroke			

Present	2 (5.0)	1 (2.5)	10 (25.0)
Absent	38 (95.0)	39 (97.5)	30 (75.0)
MICROVASCULAR COMPLICATIONS			
Neuropathy (MNS)			
< 2 (Absent)	13 (32.5)	20 (50.0)	23 (57.5)
≥ 2 (present)	27 (67.5)	20 (50.0)	17 (42.5)
Dilated Fundus			
Within Normal Limits	16 (40.0)	23 (57.5)	25 (62.5)
Retinopathy(present)	24 (60.0)	17 (42.5)	15 (37.5)
Nephropathy			
Present	14(35.0)	6(15)	3(7.5)
absent	26(65.0)	34(85)	37(92.5)

Severity of hypertension in study population: In Obese patients only 20 (50%) are hypertensive and out of them 12 (30%) and 8(20%) are in JNC class 1 and 2 respectively.

In lean subgroup 7 patients (13%), in IBW 7 patients (17.5%) and in obese group 16 (40%) patients are having ischemic heart disease. So numbers of obese patients with IHD are more as compared to those of lean and IBW groups.

In study population 13 patients are having cerebrovascular stroke (10.83%). Out of them 2 are in lean and 10 are in obese group and 1 patient is from IBW group.

Peripheral Neuropathy (MNS \geq 2) is present in 64(53.33%) patients in study population. Thus it is a most common complication in our study.

In lean subgroup 27 patients (67.5%) are having peripheral neuropathy as compared to 20 (50%) in IBW and 17(42.5%) in obese subgroups.

Retinopathy present in total 56 (46.7%) patients. Out of them 24(60%) are lean, 17 (42.5%) are in IBW group and 15 (37.5%) are obese.

Out of all lean patients 60% are having diabetic retinopathy where as in obese group 37.5% are having this complication.

Nephropathy present in total 23(19.16%) patients. Out of them 14(35%) are lean, 6 (15%) are in IBW group and 3 (7.5%) are obese.

Discussion

The prevalence of type 2 diabetes mellitus is rapidly rising all over the globe at an alarming rate^[1]. Over the past 30 years, the status of diabetes has changed from being considered as a mild disorder of the elderly to one of the major causes of morbidity and mortality affecting the youth and middle aged people. 60 % to 80% of the diabetics in developed countries are obese whereas in India most patients fall in normal weight group and some even lean^[8]. Since obesity does contribute in a considerable way to complications of diabetes, it is worthwhile to study if BMI has any implications on the complications of type 2 diabetes mellitus^[9].

In our study, out of 120 patients, 40 patients are divided in each subgroup according to their BMI. Out of 120 patients 88 (73%) are males and 32 (27%) are females. Table:1] In IBW and lean groups, there is a male predominance as compare to obese. Male predominance had been reported in the lean and IBW in previous studies conducted by V.Mohan^[10]. In our study, male predominance has been observed which is explained by male having habit of tobacco chewing, smoking, alcoholism, more predispose to stress.

Most common age period in which prevalence of diabetes found in each sub groups is 40-59years.

Higher diabetes risk is found in early age group 18-39yrs is 12.5% in lean & IBW as compared to 5% in obese. While there is no significant difference between 3 sub group at the age between 40-59yrs- 57.5%, 55%, 47.5% respectively.

Study done by Anja Scheienkiewitz-POstdam Study^{1,2,3},⁽¹¹⁾ observation was weight gain in early adulthood between 25-40yrs is related to a higher risk and earlier onset of type 2 diabetes than is weight gain between 40 and 55yrs of age.

In our study, higher diabetes risk is found in early age group 18-39yrs because of weight gain in early adulthood is related to a higher risk of type 2 diabetes than was later weight gain in both normal and overweight.⁽¹¹⁾

Excess abdominal fat, assessed by measurement of waist circumference is independently associated with higher risk for diabetes mellitus and cardiovascular disease.⁽¹³⁾

Obesity is associated with a number of risk factors for cardiovascular disease, including hypertension, insulin resistance and diabetes mellitus, dyslipidemia⁽¹⁴⁾.

Above table shows, Low prevalence of macro vascular complications in lean than IBW and obese is less obesity.^(12,16)

Study done by A.B.Dudekula⁽¹⁷⁾ reported similar observation incidence of hypertension in lean was 16.2%, where as it was 33.8% in IBW, 61.5% in obese.

Study done by V. Mohan⁽¹⁰⁾ reported similar observation incidence of IHD among female lean was 14%, where as it was 18.4% in IBW, 16% in obese. Among male lean was 13.3%, where as it was 11% in IBW, 9.5% in obese.

Type 2 DM with inherent peculiarities of insulin kinetics in the liver along with altered profile and behavior of key enzymes related to carbohydrate metabolism which are marked by excess extraction of insulin in hepatic bed, hyperactive cytochrome system and non-suppressible glucokinase activity. These peculiarities are reflected in the peripheral circulation as states of low circulating levels of insulin, hyperglycemia, dyslipidemia without low HDL, raised triglycerides, low plasma homocystiene and BMI<19 make these less prone to develop macro vascular complications⁽¹⁸⁾.

In our study observed that prevalence of macro vascular complications are more in obese as compare to lean and IBW. Obesity is associated with an atherogenic lipid profile; with increased LDL cholesterol, VLDL, and TG; and with decreased HDL cholesterol and decreased levels of the vascular protective adipokines adiponectin. Obesity induced hypertension is associated with increased peripheral resistance, increased sympathetic tone, increased salt sensitivity, and insulin mediated salt retention⁽¹⁹⁾.

Above table shows, micro vascular complications are much higher than macro vascular complications in Lean as compared to IBW and Obese. Neuropathy 27(67.5%) is commonest micro vascular complication^(20,18) followed by Retinopathy 24(60%), Nephropathy 14(35%)

Mohan et al.⁽¹⁰⁾ in their study, also found a higher prevalence of microvascular complications in Lean as compared to IBW and Obese.

Mukhyaparna et al.⁽¹²⁾ reported 35%, 27%, 6.6% prevalence of Neuropathy, Retinopathy, Nephropathy respectively.

Sinharoy et al.⁽¹⁵⁾ reported 32%, 28%, 28% prevalence of Neuropathy, Retinopathy, Nephropathy respectively.

Prevalance of microvascular complications among lean type 2 diabetics are related to duration of diabetes and poor glycemic control^(12,15,17). Hyperglycemia serve as the initial trigger for complications of diabetes⁽¹⁹⁾. Chronic hyper glycaemia leads to effect of soluble factors (growth factors, angiotensin-II, endothelin, AGEs), hemodynamic alteration in renal microcirculation and structural changes in glomerulus leads to DM nephropathy. Hyperglycemia leads to increased production of reactive oxygen species or superoxide in the mitochondria lead to microvascular complications among lean type 2 diabetics. Peripheral Neuropathy (MNS>2) is present in 64(53.33%) patients in total study population. Thus it is a most common complication in our study.

Conclusions

There is no significant difference in age of onset of type 2 diabetes mellitus. There is no significant difference in duration of disease (p value-<0.46) in 3 subgroups. Prevalence of macro vascular complications are more in obese as compare to lean and IBW As obesity is associated with an atherogenic lipid profile and metabolic syndrome. Prevalence of Micro vascular complication is more in lean as compare to IBW and obese groups are related to duration of diabetes and poor glycemic control.

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References

1. International Diabetes Federation Diabetes Atlas. Unwin N, Whiting D, Gan D, Jacqmain O, Ghyoot G, editors. IDF Diabetes Atlas. 4th ed. Belgium: International Diabetes Federation; 2009. P. 11-3.
2. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27:1047-53 Popkin BM.
3. The Shift in Stages of the Nutrition Transition in the Developing World Differs from Past Experiences!. *Public Health Nutr* 2002;5:205-14.
4. Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, *et al.* Secular trends in the prevalence of diabetes and impaired glucose tolerance in urban South India-the Chennai Urban Rural Epidemiology Study (CURES-17). *Diabetologia* 2006;49:1175-8.
5. Ramachandran A, Snehalatha C, Vijay V. Low risk threshold for acquired diabetogenic factors in Asian Indians. *Diabetes Res ClinPract* 2004;25:189-95.
6. Nakagami T, Qiao Q, Carstensen B, Nhr-Hansen C, Hu G, Tuomilehto J, *et al.* Age, body mass index and type 2 diabetes association modified by ethnicity. *Diabetologia* 2003;46:1063-70.
7. Epidemiology of type 2 diabetes: Indian scenario; V. Mohan, S. Sandeep, R. Deepa, B. Shah* & C. Varghese; *Indian J Med Res* 125, March 2007, pp 217-230
8. Alberti KGMM, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1. Diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabet Med* 1998;15:539-53.
9. Insulin resistance. A multifaceted syndrome responsible for NIDDM, obesity, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease. AU DeFronzo RA; Ferrannini E *SO Diabetes Care* 1991 Mar;14(3):173-94.
10. Mohan V, Vijayaprabha R, Rema M, Premlatha G, Poongothai S, Deepa R, *et al.* Clinical profile of lean NIDDM in South India. *Diabetes Res ClinPract* 1997;38:101-8.
11. Anja Schienkiewitz, Mattas B Schulze, Kurt Hoffman, Anja Kroke, and Heiner Boeing, Body mass index history and risk of type 2 diabetes: results from the European Prospective Investigation in to cancer and Nutrition (EPIC)-Postdam study 1'2'3. *Am I Clin Nutr* August 2006 Vol.84 no.2 427-433.
12. Prabhu MU khyaprana, sudhavidyasagar, Shashikiran U; clinical profile of type 3 diabetes mellitus and body mass index-is there any correlation? *Calicut Med J* 2004;2:e3
13. Maria I. Schimdt, Bruce B. Duncan, Luis H. Canani, C Korohal, L Chambless; Association of Waist-Hip Ratio with Diabetes Mellitus: *Diabetes Care*, Volume 16, number 7, July 1992.

14. KopelmanPG. Obesity as a medical problem. *Nature* 2000;404:635-43.
15. A study on clinical and biochemical profile of low body weight type 2 diabetes mellitus.;Sinharoy,Mandal, Chakrabarti,Paul,;JIMA,vol 106,no 11,nov.2008.p.747-49
16. Punyakit Deb Barma, Salam Ranabir, Lallan Prasad, and ThangjamPremchandSingh.Clinical and biochemical profile of lean type 2 diabetes mellitus *Indian J EndocrinolMetab.* 2011 July;15(Supp11):S40-S43.
17. A. B. Dudekula, JesothLaluNaik and KSN Reddy;correlation between blood sugars and body mass index with blood pressure among the type 2 Diabetic adults: *Asian J.exp. boil. Sci.*vol 3(2) 2012:378-383.
18. Low bodyweight Type 2 diabetes in India: Clinical characteristicsandpathophysiology ;Sidhartha Das, Vivian Fonseca ,; *Diabetes & Metabolic Syndrome: Clinical Research & Reviews* 3 (2009) 60–66.
19. Harrison’s principles of internal medicine eighteenth edition (628,2980)
20. Das S. Identity of lean-NIDDM: clinical, metabolic and hormonal status. In:Kochupillai N, editor. *Advances in endocrinology metabolism and diabetes*,vol. 2. Delhi, India: Macmillan; 1994. p. 42–53.