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Full Length Review Article

EFFECT OF BODY MASS INDEX ON MICROVASCULAR COMPLICATIONS OF TYPE II DIABETES MELLITUS

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This study is conducted in the Endocrinology clinic and Physiology Department of PCMSand RC, Bhopal (India). About 113 patients of Type-2 diabetes mellitus are selected according to inclusion criteria of which 23 are excluded .In this study the trends of micro vascular complications of type-2 Diabetes mellitus with increasing BMI is monitored. We observed that the prevalence of nephropathy and retinopathy increased with increase in BMI which was in accordance with findings of previous researchers. There is some contrasting findings in neuropathy which may be due to less number of cases with neuropathic complications.

Key words:

INTRODUCTION

There is a world-wide increase in the prevalence of Diabetes Mellitus and it is associated with an increase in obesity .The prevalence of Diabetes is rapidly rising all over the Globe to an alarming rate. In India alone 31.7 million were affected in year 2000 and is expected to reach 79.44 million by the year 2030.India leads the world with largest number of Diabetic subjects. Diabetes mellitus is one of the fastest growing chronic disease in world and India the "Diabetes capital of the world" is home to estimated 46 million people.[2] The maximum burden of society of Diabetes is particularly contributed to type-2 Diabetes mellitus. Type-2 Diabetes accounts for about 90% cases of Diabetes.[3] and most of the increase in Type-2 Diabetes paralleling the incidence of Obesity.

Diabetes is associated with high morbidity and mortality due to its macro vascular and micro vascular complications like Myocardial Infarction, Hypertension, Stroke, Peripheral Vascular Disease, Neuropathy, Nephropathy and Retinopathy. Type II Diabetes Mellitus is usually preceded by years of undiagnosed hyperglycemia. According to a study at the time of first diagnosis, 8 % already have cardiovascular disease, 37 % have retinopathy, 18 % have microalbuminuria and 2.3 % have neuropathy. Thus, Diabetes is a burden on health resources (Martina Tomic *et al*., 2003). According to some studies about 2/3rd diabetics are over weight or obese. Obesity itself is a widespread public health problem. Obesity is an independent risk factor for cardiovascular diseases and Diabetes Mellitus due to release of pro-inflammatory cytokines from adipose tissue. Studies have shown a co-relation of obesity with neuropathy and nephropathy as well.

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Numerous studies have been done on cardiovascular complications and autonomic dysfunctions in Diabetes Mellitus. However, the studies related to neuropathic and other micro vascular complications of Diabetes Mellitus need to be focused in relation to over-weight and obesity. Thus, it is important to study the effect of increasing BMI and co-existing obesity on neuropathic and micro vascular complications of Diabetes Mellitus.

Review of Literature

Two National survey datas by Baysi, Chapman and Grandy found prevalence of Diabetes mellitus across all ranges of BMI but increased with higher BMI (Bays *et al*., 2007). Straub *et al. ?* reported that obesity influences sensorimotor and autonomic neuropathic late complications of Diabetes mellitus and that body mass control may be an important approach to reduce neuropathic complications (Straub ?). Isojarvi *et al* found a positive association between serum insulin and peripheral nervous system functions (Isojarvi *et al*., 2009). Giacinta Miscio *et al* reported that BMI was significantly correlated to QUICKI (Quantitative Insulin Sensitivity Check Index) (Giancinta Miscio, 2005). Meltem *et al* in their study found high prevalence of microalbumiuria in Diabetic patients (Meltem Col *et al*., 2004). Futoshi Anan *et al* reported that their results were suggestive of association of Diabeic retinopathy with depressed cardiovascular autonomic functions and insulin resistance (Futoshi Anan *et al*., 2009). Adler AI *et al* in united kingdom prospective diabetes study (UKPDS) found that patients should be treated to the lowest safe glucose level that can be obtained to prevent or control diabetic nephropathy (Adler AI *et al*., 2003).

Research Question

Is there a correlation between Body Mass Index (BMI) and neuropathic and other microvascular complications of Type II Diabetes Mellitus.

Aims and Objectives

- To study the prevalence of overweight and obesity in elderly diabetic patients.
- To study some epidemiological factors associated with overweight and obese elderly diabetic patients.
- To study the association between 'Body Mass Index (BMI)' and 'Nerve Conduction Study, Renal function and Ophthalmological Morbidities' in elderly diabetic patients.
- To give suitable recommendations based on study findings.

MATERIALS AND METHODS

***Study Area*:** Study will be conducted in the Endocrinology clinic and Physiology Department of a Medical College.
***Study Population*:** Patients of Type II Diabetes Mellitus attending the clinic.
***Study Design*:** Cross Sectional Study
***Study Period*:** From November 2011 to September 2012.
***Sample*:** 113 Type-2 diabetics as per selection criteria, attending the clinic during the study period.
***Statistical Analysis*:** Epi Info Statistical Software and other statistical tests, as required.
***Inclusion Criteria*:** Patients of Type II Diabetes Mellitus having ≥ 10 year diabetic age attending the clinic included in the study during the study period.

***Exclusion Criteria*:**

- Severely ill or hospitalized patients.
- Patients not consenting for the study.
- Patients with history of chronic smoking and alcoholism.

Methodology

The proposed study will be conducted in the endocrinology clinic of a tertiary care hospital. Patients attending the clinic will be included in the study. All the cases attending this clinic will be selected in the study after careful selection as per inclusion and exclusion criteria. The patients selected will be asked to get their 'Fasting and Post prandial Blood Sugar' done. Based on their report, only those cases having their present 'Blood Sugar Reports' within normal range, will be requested to report to the Laboratory of Department of Physiology. These patients will be examined in a separate room.

Patient's complete information regarding profile will be taken in pretested questionnaire format after taking consent. Patients will also be interviewed regarding his/ her treatment history, daily activity, life style and routine food habits. Dietary attern of the patients will be studied with the help of 24-hour recall method. The anthropometric measurements of the subjects will also be done. Weight will be recorded (to an accuracy of 0.5 kg) for each patient, with patient standing erect without any support and without shoes using standardized weighing scale. Height- Each patient will be asked to stand on a flat surface after removal of shoes with the feet parallel and with the heels, buttocks, shoulders and the back of the head touching the upright wall. The head of the patient will be positioned so that it is held comfortably erect, with the lower border of orbit of the eye in the same horizontal plane as the external canal of the ear with the arms hanging loosely by the sides. Then height will be measured with the help of marking scale made on upright wall (to an accuracy of 1 cm).

Body Mass Index (BMI): BMI = Weight (kg)/ Height (m^2)

BMI Sensitivity index: 73.7%.
BMI Specificity index: 72.5%.
Classification according to BMI:
Underweight < 18.50 kg/m^2
Normal 18.50 – 24.99 kg/m^2
Overweight: ≥ 25.00 kg/m^2
Pre-Obese- 25 – 29.99 kg/m^2
Obese class I- 30 – 34.99 kg/m^2
Obese class II- 35–39.99 kg/m^2
Obese class III- ≥40.00 kg/m^2

Waist Hip Ratio: Waist circumference will be measured at the level midway between the lower rib margin and the iliac crest, at the umbilicus, with patient breathing out gently. Hip circumference will be measured at the maximum width over the buttocks at level of the greater trochanters. From waist and hip circumference, the waist to hip ratio will be calculated. *Blood Pressure, Nerve Conduction Test, Urine Test and*

Fundoscopy: A recording the Blood Pressure of the patient will be taken by a Mercury Sphygmomanometer in the supine position after 10 minutes of rest. Thereafter, the Nerve Conduction Test of the patient will be done by 'Neuroperfect EMG 2000'Thereafter the patient will be asked to get the urine test for urine albumin and fundoscopy examination done. The reports of these tests will be recorded on the case record form.

Nerve Conduction Test: The subject is asked to lie down in supine position while maintaining the room temperature around 25 degreecelsius. Nerve conduction study is carried out for median, ulnar, tibial, common peroneal and sural nerves. Interpretation of results shall be done based on latency, amplitude and conduction velocity of each nerve under this study.

Observation and result: The study was carried out on 90 Diabetes type II subjects. They were divided according to the WHO classification of BMI and four categories were formed viz. A, B, C and D. The observations are depicted in tables and charts. The statistical analysis includes mean, standard deviation, Chi square and unpaired student t-test.

Table 1. General characteristics of study subjects (n=90)

	Number (Percentage)
Gender	
Male	71(78.89%)
Female	19 (21.11 %)
Urban resident	63(70.00%)
Rural resident	27(30.00%)
Sedentary lifestyle	80(88.89%)

Table 1. Shows general characteristics of study subjects. More than3/4th of the study subjects (78.89%) are male.
Majority among study subjects belong to urban area (70.00%) and have sedentary lifestyle (88.89%).

Table 3. Categorization of study subjects according to observed BMI (n=90)

WHO Classification *	BMI Category	BMI (Mean ±SD)	Number (Percentage)
Normal weight	A	22.06 ± 2.27	25(27.78 %)
Pre-obese	B	27.77 ± 1.53	30(33.33 %)
Obese Class I	C	32.32 ±1.71	23(25.56 %)
Obese Class II	D	37.32 ± 1.65	12(13.33 %)

*WHO Classification of BMI as per *Annexure I*

Table 3. Shows the distribution of study subjects for their BMI as per WHO classification of BMI. Majority of the subjects belong to Pre-obese group (33.3%) followed by normal weight persons (27.8%). Obese Class I and Obese Class II collectively represent 38.9% of the study population. Around $3/4^{th}$ of the study subjects (72.2%) were overweight and belonged to Pre-obese and Obese subjects.

Table 7. Microvascular complication among BMI categories of study subjects (n=90)

	Retinopathy	Nephropathy	Neuropathy
A(n= 25)	2 (8.00 %)	7(28%)	6(24%)
B (n= 30)	10(33.33%)	8(26.67%)	5(16.67%)
C (n= 23)	11(47.83%)	15(65.22%)	7(30.43%)
D(n=12)	8 (66.67 %)	5 (41.67%)	3(25%)
Total (n=90)	31(34.44 %)	35(38.89 %)	21(23.33 %)

Table 7. Shows distribution of microvascular complications namely retinopathy, nephropathy and neuropath among study subjects. It is observed that there are 8% retinopathy cases in subgroup A which increases with BMI to 33.33 % and 47 % respectively in group B and C with highest percentage in group D (66 %). Nephropathy was highest in group C, followed by group D. Group A and B had almost equal percentage with nephropathy. Neuropathy cases were nearly equal in A, C and D

Diabetic Retinopathy

A total of 31(34.44 %) subjects had diabetic retinopathy (DR). The prevalence was highest in subgroup D (66 %), followed by C, B and A in that order (Table 7). The correlation of BMI and diabetic retinopathy was highly significant ($p < 0.0001$).

Diabetic nephropathy

A total of 35(38.89 %) subjects had diabetic nephropathy (DN). The prevalence was highest in subgroup C (65 %), followed by D, A and B in that order. The association of BMI and diabetic retinopathy was significant ($p = 0.001$).

Diabetic Neuropathy

A total of 21(23 %) subjects had diabetic neuropathy. The prevalence was highest in subgroup C (30 %), followed by D, A and B in that order (Table 7). The association of BMI and diabetic neuropathy was not significant ($p =0.187$).

The reason may be a lower incidence of neuropathy in the study subjects as compared to other microvascular complications of retinopathy and nephropathy. The most common microvascular complication we came across in our study was nephropathy at 35%. It was followed by retinopathy at 31 % and neuropathy at 21 % was least common.

Conclusion and Recommendations

- There was a significant association of neuropathy with systolic blood pressure, Diastolic blood pressure and fasting blood glucose level. Depending on the conclusions drawn from this study we make following recommendations to prevent, decrease or delay the occurrence of micro vascular complications that Type II diabetes mellitus patients are prone to:
- Diabetes type II patients must observe their weight to keep their BMI in normal limits.
- They must increase the level of physical activity.
- They must monitor their blood pressure and keep it within normal limits as recommended for diabetics by proper medications and lifestyle modifications.

Conclusion and Recommendations The conclusions drawn were as follows:

- An increasing trend of prevalence of nephropathy and retinopathy with increasing BMI was observed which is in accordance with findings of previous researchers.
- There was a significant association of retinopathy with age, BMI, systolic blood pressure, Diastolic blood pressure, blood glucose level both fasting and postprandial
- There was a significant association of nephropathy with age, BMI, systolic blood pressure and Diastolic blood pressure.
- We observed that the prevalence of nephropathy and retinopathy increased with increase in BMI which was in accordance with findings of previous researchers. We found that there was a significant association of retinopathy with age and BMI.

Ethical Considerations

Blood sugar, Urine albumin, Fundoscopy and Nerve conduction study will be done in Diabetic patients. Voluntary informed written consent will be taken from each patient and subjects will be free to withdraw at any point of study. Ethical issues will be cleared and permission will be taken from RAC and Ethical committee before conducting the study.

REFERENCES

Adler AI, Stevens, R.J., Manley, S.E., Bilous, R.W., Cull, C.A. and Holman, R.R. 2003. Development and progression of nephropathy in type 2 diabetes: the United Kingdom Prospective Diabetes Study (UKPDS 64). *Kidney Int.*, 63:225–232,

Bays, H.E., Chapman, R.H. and Grandy, S. 2007 May. The relationship of body mass index to diabetes mellitus, hypertension and dyslipidaemia: comparison of data from two national surveys; *International Journal of Clinical Practice*, 61(5):737-47.

Futoshi Anan, Masaki Takayuki, Naohiko Takahashi, Mikiko Nakagawa, Nobuoki Eshima, Tetsunori Saikawa and Hironobu Yoshimatsu 2009. Diabetic retinopathy is associated with insulin resistance and cardiovascular autonomic dysfunction in type 2 diabetic patients. The Japanese Society of Hypertension: 32, 299-305.

Giancinta Miscio, Giulia Guastamacchia, Amelia Brunani, Lorenzo Priano, Silvia Baudo and Alessandro Mauro. 2005. Obesity and peripheral neuropathy risk : a dangerous liason: *Journal of Peripheral Nervous System*, 10:354-358

Isojarvi, H., Kallio, M., Korpelainen, R., Kaikkonen, K., Jamsa, T., Keinanen, S. and Kiukaanniemi. 2009. High insulin levels are positively associated with peripheral nervous system function. *Acto. Neural Scand*, 119: 107-112.

Martina Tomic, Tamara Poljicanin, Ivana Pavlic-Renar and Zeljko Metelko, 2003. Obesity–A risk factor for microvascularand neuropathic complications in Diabetes?.Diabetologia Croatica, 4a:32-2.

Meltem Col, Esin Ocaktan, Oya Ozdemir, Ayse Yalcin and Arslan Tuncbilek 2004. Microalbuminuria: prevalence in hypertensive and diabetics.Acta Medica Austriaca: 31/1: 23-29.

Straub, R. H., 'Impact of obesity on Neuropathic late complication in NIDDM'; Internet.

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