

**CLINICAL AND BIOCHEMICAL PROFILE OF LEAN BODY WEIGHT TYPE 2 DIABETICS, NORMAL WEIGHT AND OBESE DIABETICS**S. Krishnamoorthy<sup>1</sup>, J. Giridhar Muthu<sup>2</sup>, S. R. Ramakrishnan<sup>3</sup>, L. Suja<sup>4</sup>**HOW TO CITE THIS ARTICLE:**

S. Krishnamoorthy, J. Giridhar Muthu, S. R. Ramakrishnan, L. Suja. "Clinical and Biochemical Profile of Lean Body Weight Type 2 Diabetics, Normal Weight and Obese Diabetics". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 71, September 03; Page: 12397-12413, DOI: 10.14260/jemds/2015/1788

**ABSTRACT: BACKGROUND:** Diabetes is a group of metabolic disorders with a phenomenal increase in developing countries like India.<sup>1</sup> When we compare the clinical profile in developed countries we find there is a remarkable difference in developing countries. In Asia the proportion of lean diabetics are relatively more when compared to developed countries.<sup>2</sup> Hence it is worth comparing the clinical and biochemical profile in lean diabetic, normal and obese type 2 diabetic patients in our population.<sup>3</sup> **OBJECTIVE:** To study and compare the clinical profile in lean type 2 diabetic patients compared to normal and obese diabetics by age, sex, family history and anthropometry. We also compared the biochemical profile in lean type 2 diabetic patients with normal and obese diabetics by estimation of blood glucose, urea, serum creatinine, glycosylated hemoglobin and lipid profile. **MATERIALS AND METHODS:** Observational study of 1070 patients was conducted in our hospital between June 2011 to July 2013. We have selected patients aged 30 years and older diabetics from outpatient and inpatient departments of our hospital and compared age, sex, family history, anthropometry, blood glucose, urea, serum creatinine, glycosylated hemoglobin and lipid profile. **RESULTS:** There is a statistical significant relationship between age, FBS and BMI. Lean diabetic patients were more in the age group between 41 to 50, whereas there is no statistical significant relationship between sex, HbA1C, diastolic blood pressure, HDL and BMI. There is a statistical significant relationship between family history, skin fold thickness, waist hip ratio, systolic blood pressure, total cholesterol, triglycerides and BMI. PPBS and LDL were statistically significant in normal weight diabetics. We also found there is a significant relationship between pulmonary tuberculosis and lean diabetics. **CONCLUSION:** Majority of type 2 diabetic patients in our population are having normal weight with lean body weight diabetics contributing to 10.6% which is relatively a greater proportion when compared to developed countries.<sup>4,5</sup> Lean diabetics have more severe fasting hyperglycemia, poor metabolic control and are prone for infections like pulmonary tuberculosis. Most of the lean diabetic patients required insulin much earlier than other group of diabetics.

**KEYWORDS:** Lean diabetics, Fasting hyperglycemia, Body mass index.

**INTRODUCTION:** Diabetes mellitus is characterized by impaired insulin secretion, insulin resistance, excessive hepatic glucose production, abnormal fat & protein metabolism and a constellation of chronic complications.<sup>6,7,8</sup> It is a worldwide health crisis. The prevalence has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 382 million in 2013 with 46% of diabetics go undiagnosed. Based on current trends, it is predicted that 592 million individuals will have diabetes by year 2035. The incidence of diabetes is showing an alarming rise in developing countries, particularly in India. 60-80% of diabetics in developed countries were obese, whereas in India we find that clinical profile of diabetes is different.<sup>9</sup> Most of the patients attending our diabetic outpatient department are not obese as defined by existing parameters such as BMI.

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Interestingly, almost 80% of our Type 2 diabetic patients are non-obese where as 60% to 80% of diabetics in western countries are obese.<sup>10</sup> There is a wide spectrum in the presentation, treatment & complications among different groups of diabetics. Hence it is worth studying and comparing profiles of lean, normal weight & obese type 2 diabetics.

**MATERIALS AND METHODS:** We conducted an observational study in 1070 patients with type 2 diabetes mellitus who were attending our outpatient department as well as inpatients in our hospital from June 2011 to July 2013.

**SELECTION OF CASES:** Cases included in the study were adults aged above 30 and above having T2 DM. Those thousand and seventy patients were divided into three groups based on Body Mass Index (BMI).<sup>11</sup>

- Group A: BMI <18.5Kg/m<sup>2</sup> (Lean Body Weight Type 2 DM).
- Group B: BMI 18.5-24.9Kg/m<sup>2</sup> (Normal Weight Type 2 DM).
- Group C: BMI >25 Kg/m<sup>2</sup> (Obese Type 2 DM).

**Exclusion Criteria;** for cases,

1. Presence of active pulmonary tuberculosis history.
2. Presence of other chronic illnesses that could affect body weight like chronic liver and chronic kidney disease.
3. Type 2 Diabetes patients with Age of onset less than 30 years.
4. History wise, particularly in lean patients those who were normal or obese at the time of presentation, now lost the body weight significantly after type 2 Diabetes mellitus detection.
5. Patient with history of Cancer, cachexia and HIV.

A careful detailed history was taken from each person, i.e. age of onset, duration, any positive family history, dietary pattern, presenting complaints—at the time of diagnosis etc. Detailed examination was done for all the 1070 patients to find out various complications and biochemically, blood glucose (Both fasting and postprandial), blood urea, serum creatinine, HbA1C were analysed in all the three groups

### **METHODS:**

1. Height (In meter), Weight (In kg) measured in all patients and BMI (Body Mass Index) was calculated based on the formula  $BMI = \frac{Wt \text{ in Kg}}{(HT)^2}$ .<sup>12</sup>
2. Waist hip Ratio (W/H Ratio),<sup>12</sup> 'Waist Circumference' measured at midpoint between the costal margin and anterior superior iliac spine. Hip Measurement taken as maximum diameter at the greater trochanter. Waist/Hip Ratio (WHR) was calculated in each case. Waist Hip ratio was considered abnormal if >0.95 for males and >0.8 for females.
3. Skin Fold Thickness (SFT):<sup>12</sup> Skin Fold Thickness was measured at standard sites such as the Biceps, Triceps, infra scapular, and supra iliac region using a Harpenden Caliper or similar device. Triceps skin fold midway between acromion process and olecranon process was used in our study.

Fasting, postprandial glucose, HbA1C, fasting lipid profile and other relevant investigations were done in each case.

**Definitions and Cut Off values for the study;****1. Body Mass Index (BMI):**

- 18.5-24.9 (kg/m<sup>2</sup>) – normal value
- < 18.5 (kg/m<sup>2</sup>) – lean body weight
- ≥ 25 (kg/m<sup>2</sup>) – obese body weight

**Waist Hip Ratio:** <sup>12</sup>

- > 0.8 – is taken as abnormal value in female.
- >0.95 in male as abnormal value.

**Skin Fold Thickness (SFT)** <sup>12</sup> (in mm):

- > 12.5 – abnormal in male.
- > 16.5 – abnormal in female.

**Fasting Hyperglycemia (FBS):**<sup>13</sup>

- It means 8 hours of fasting overnight and abnormal if more than 126mg%

**Post prandial Hyperglycemia (PPBS):**<sup>13</sup>

- Measured at 2 hours after the meals and abnormal if more than 200 mg%

**Lipid Profile:**<sup>14</sup>

- Test was done after 8 hours overnight fasting.

**Normal Value Range;**

- Total cholesterol 150-200 mg%.
- Triglyceride 75-150 mg%.
- HDL 30-60 mg%.
- VLDL 20-40 mg%.
- LDL<100 mg%.

**HbA1C – Glycosylated Hemoglobin;** It was measured by high performance liquid Chromatography:

- <6.5-normal.
- 5.7-6.4- pre diabetic.
- >6.5-diabetic.

**Ethical Committee Approval;** The present study was approved by the Ethical committee of our hospital.

**Statistical Analysis:** Statistical Analysis of data was done by using the software statistical percentage for social science for Windows (Ver-17).

Frequencies, Percentages, Range, Median, Mean, S.D. and 'p' values were calculated using this package.

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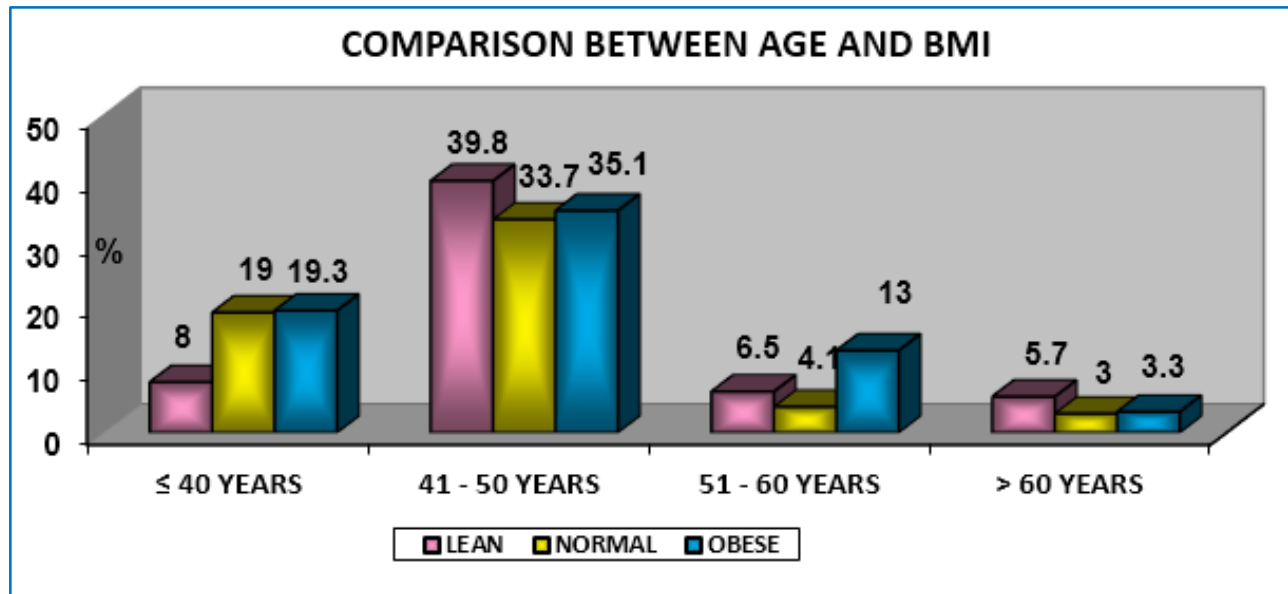
**OBSERVATION AND RESULTS:** A total of 1070 patients were selected after excluding the patients using the exclusion criteria mentioned above. Initially they were divided into three groups based on BMI.

AGE GROUP * BMI Crosstabulation						
			BMI			Total
			LEAN	NORMAL	OBESE	
AGE GROUP	<_ 40 YEARS	Count	9	107	76	192
		% within BMI	8.0%	19.0%	19.3%	17.9%
	41 - 50 YEARS	Count	45	190	138	373
		% within BMI	39.8%	33.7%	35.1%	34.9%
	51 - 60 YEARS	Count	30	136	52	218
		% within BMI	26.5%	24.1%	13.2%	20.4%
	> 60 YEARS	Count	29	131	127	287
		% within BMI	25.7%	23.2%	32.3%	26.8%
Total		Count	113	564	393	1070
		% within BMI	100.0%	100.0%	100.0%	100.0%

**Table1.** Age wise distribution of various groups of diabetic patients

Out of the total 1070 patients, 113 diabetics (10.6%) were belonging to lean group.

**Figure 1.** This diagram represents Age wise distribution of various groups of diabetic patients.



**Fig. 1**

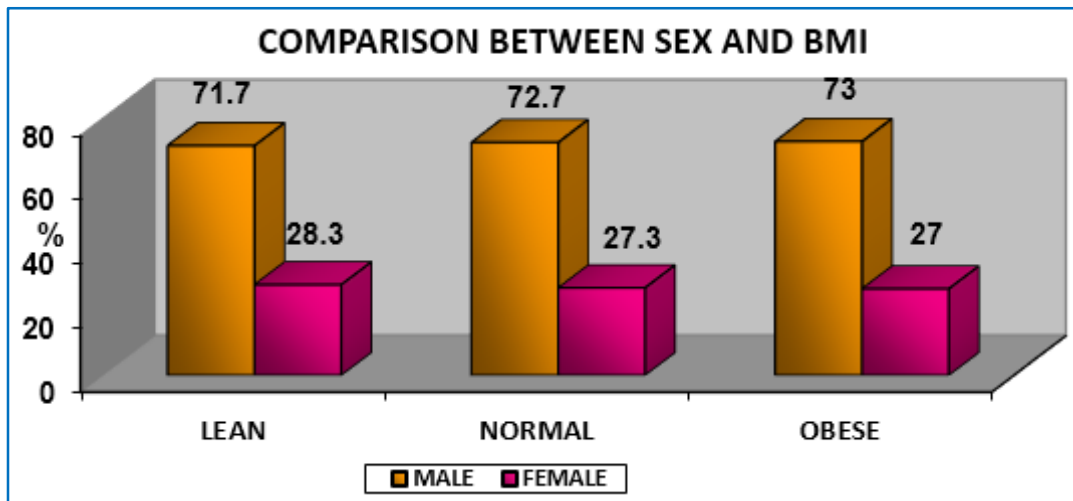
There is statistical significant relationship between age and BMI. Lean patients are more in the age group between 41-50 years (p value of 0.001).

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<b>SEX * BMI Crosstabulation</b>						
			BMI			Total
			LEAN	NORMAL	OBESE	
SEX	MALE	Count	81	410	287	778
		% within BMI	71.7%	72.7%	73.0%	72.7%
	FEMALE	Count	32	154	106	292
		% within BMI	28.3%	27.3%	27.0%	27.3%
Total	Count		113	564	393	1070
	% within BMI		100.0%	100.0%	100.0%	100.0%

**Table 2.** Division of patients based on sex

**Figure 2:** Sex wise distribution of patients.



**Fig. 2**

There is no statistical significant relationship between sex and BMI.

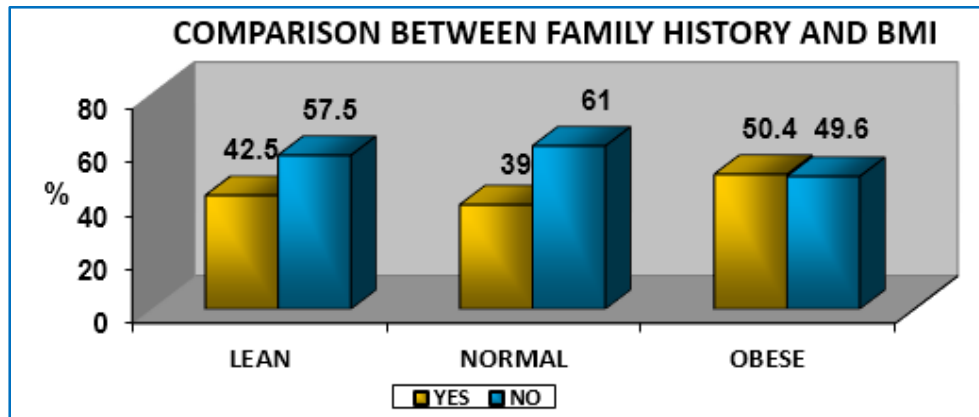
### Family History and BMI:

<b>Crosstab</b>						
			BMI			Total
			LEAN	NORMAL	OBESE	
FAMILY HISTORY	YES	Count	48	220	198	466
		% within BMI	42.5%	39.0%	50.4%	43.6%
	NO	Count	65	344	195	604
		% within BMI	57.5%	61.0%	49.6%	56.4%
Total	Count		113	564	393	1070
	% within BMI		100.0%	100.0%	100.0%	100.0%

**Table 3.** Association of family history in various groups

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**Figure 3.** Association of family history in various groups



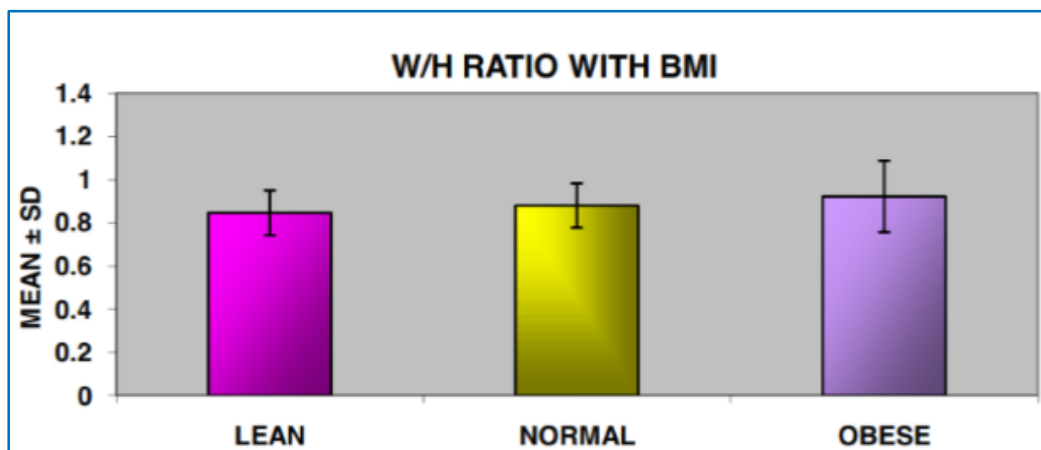
**Fig. 3**

There is statistically significant relationship between family history and BMI. Family history is more in obese group (p value 0.002).

W/H RATIO	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
LEAN	113	.846	.1038	.0098	.827	.865	.6	1.0
NORMAL	564	.880	.1026	.0043	.872	.889	.6	1.0
OBESE	393	.922	.1654	.0083	.905	.938	.7	1.5
Total	1070	.892	.1317	.0040	.884	.900	.6	1.5

**Table 4.** Waist hip ratio in various groups

**Figure 4.** Waist hip ratio in various groups



**Fig. 4**

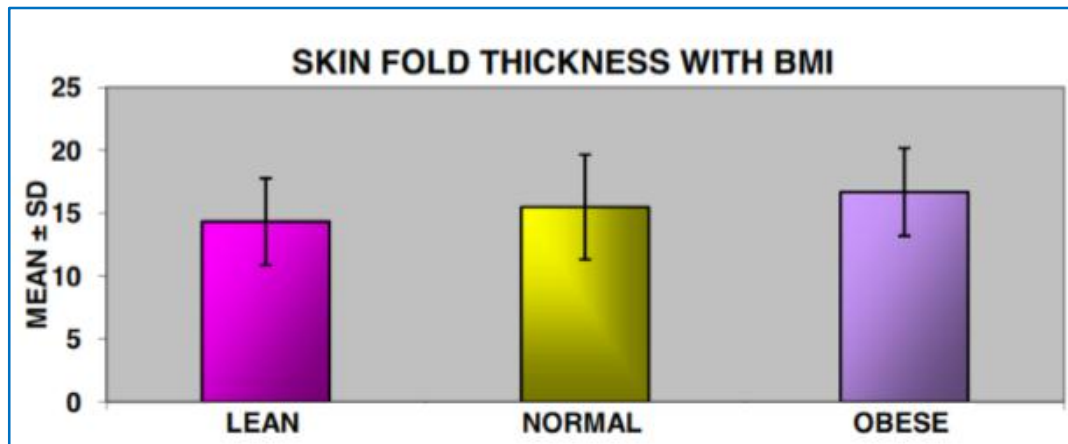
There is statistical significance between waist hip ratio and BMI. W/H ratio is more in obese group.

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<b>SKIN FOLD THICKNESS AND BMI</b>									
SF THICKNESS									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	14.32	3.452	.325	13.68	14.96	8	24	
NORMAL	564	15.48	4.127	.174	15.14	15.82	8	26	
OBESE	393	16.68	3.490	.176	16.33	17.03	10	24	
Total	1070	15.80	3.906	.119	15.56	16.03	8	26	

**Table 5.** Skin fold thickness in various groups

**Figure 5.** Skin fold thickness in various groups.



**Fig. 5**

There is statistical significance between skin fold thickness and BMI.  
Skin fold thickness is more in obese group.

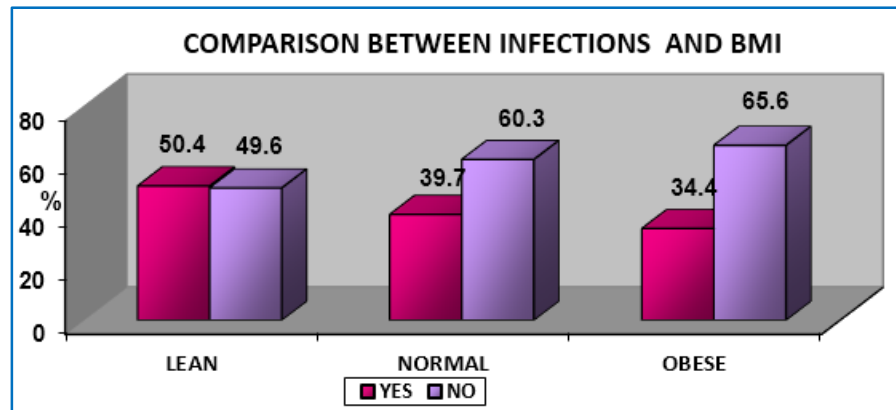
<b>INFECTIONS * BMI Crosstabulation</b>						
			BMI			Total
			LEAN	NORMAL	OBESE	
INFECTIONS	YES	Count	57	224	135	416
		% within BMI	50.4%	39.7%	34.4%	38.9%
	NO	Count	56	340	258	654
		% within BMI	49.6%	60.3%	65.6%	61.1%
Total		Count	113	564	393	1070
		% within BMI	100.0%	100.0%	100.0%	100.0%

**Table 6.** Frequency of infections in various groups of diabetics



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**Figure 6.** Diagram represents association of infections in various groups.



**Fig. 6**

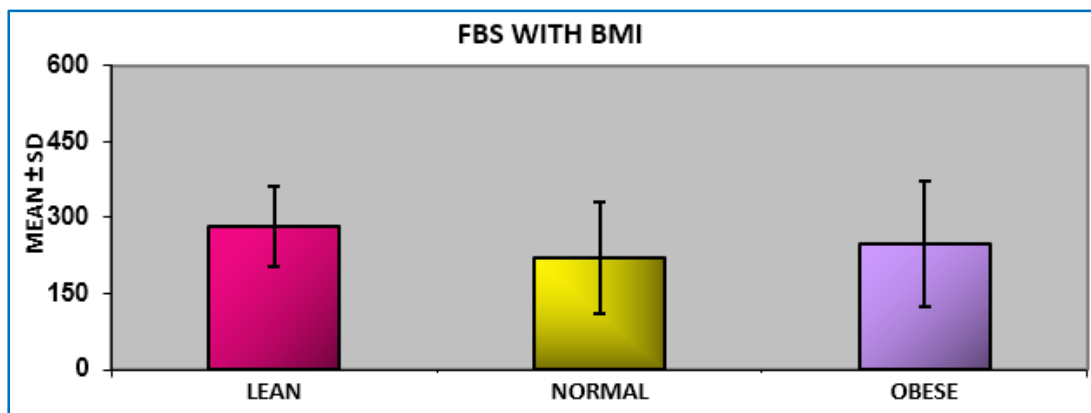
There is a statistical significance between infections and BMI. Infections are more in lean group (p value-0.007).

### Fasting blood sugar and BMI.

FBS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
LEAN	113	282.99	80.451	7.568	268.00	297.99	78	440
NORMAL	564	221.67	110.066	4.635	212.57	230.78	70	440
OBESE	393	247.34	124.950	6.303	234.94	259.73	60	440
Total	1070	237.57	114.760	3.508	230.69	244.46	60	440

**Table 7.** Blood sugar values (FBS) in various groups

**Figure 7.** Blood sugar values (FBS) in various groups.



**Fig. 7**



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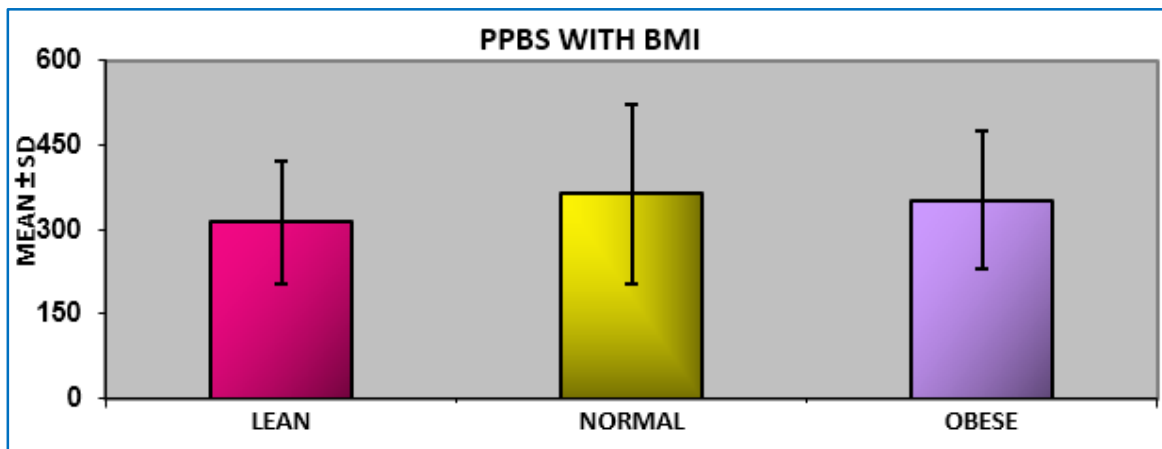
There is a strong statistical significance between FBS and BMI. FBS values are more in the lean group (p value 0.000) when compared to normal & obese diabetics.

### Postprandial blood sugar and BMI:

PPBS								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
LEAN	113	312.63	109.520	10.303	292.21	333.04	126	580
NORMAL	564	363.51	160.915	6.776	350.20	376.82	128	650
OBESE	393	351.60	122.603	6.184	339.44	363.76	126	600
Total	1070	353.76	143.655	4.392	345.15	362.38	126	650

**Table 8.** Blood sugar values (PPBS) in various groups.

**Figure 8.** Blood sugar values (PPBS) in various groups.



**Fig. 8**

There is statistical significance between PPBS and BMI. PPBS more in normal group (p value 0.002).

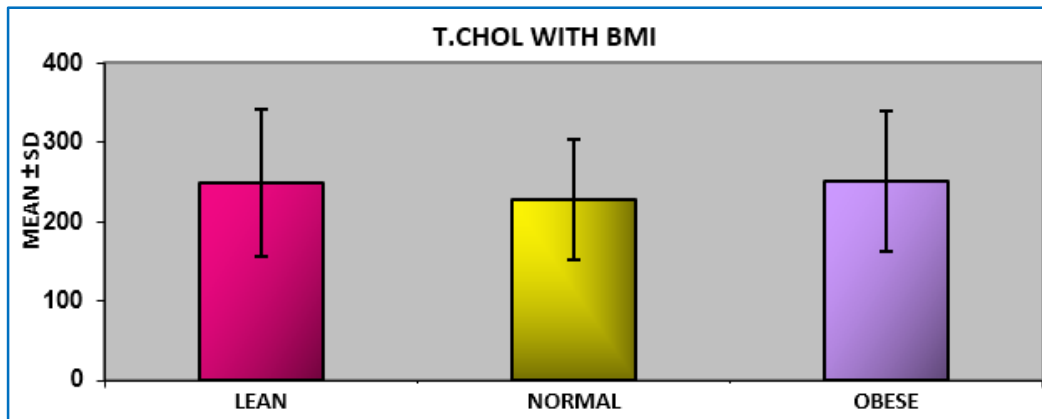
### Total cholesterol and BMI:

F.CHOL Descriptives									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	249.15	93.069	8.755	231.80	266.50	110	384	
NORMAL	564	228.16	75.662	3.186	221.90	234.42	110	380	
OBESSE	393	251.80	88.401	4.459	243.03	260.56	110	384	
Total	1070	239.06	83.194	2.543	234.07	244.05	110	384	

**Table 9.** Cholesterol levels in various groups.

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**Figure 9.** Cholesterol levels in various groups.



**Fig. 9**

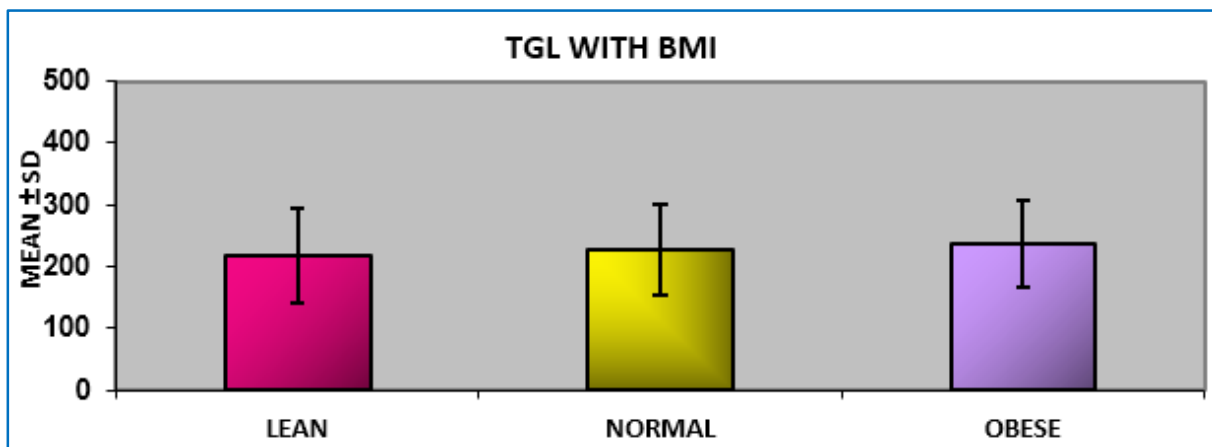
There is a statistical significance between total cholesterol and BMI. Total cholesterol values are more in obese group (p value 0.000).

### Triglyceride and BMI:

TGL								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
LEAN	113	217.10	76.052	7.154	202.92	231.27	94	380
NORMAL	564	228.00	73.310	3.087	221.94	234.07	95	327
OBESE	393	237.96	70.593	3.561	230.96	244.96	94	380
Total	1070	230.51	72.847	2.227	226.14	234.88	94	380

**Table 10.** Triglyceride levels in various groups.

**Figure 10.** Triglyceride levels in various groups.



**Fig. 10**

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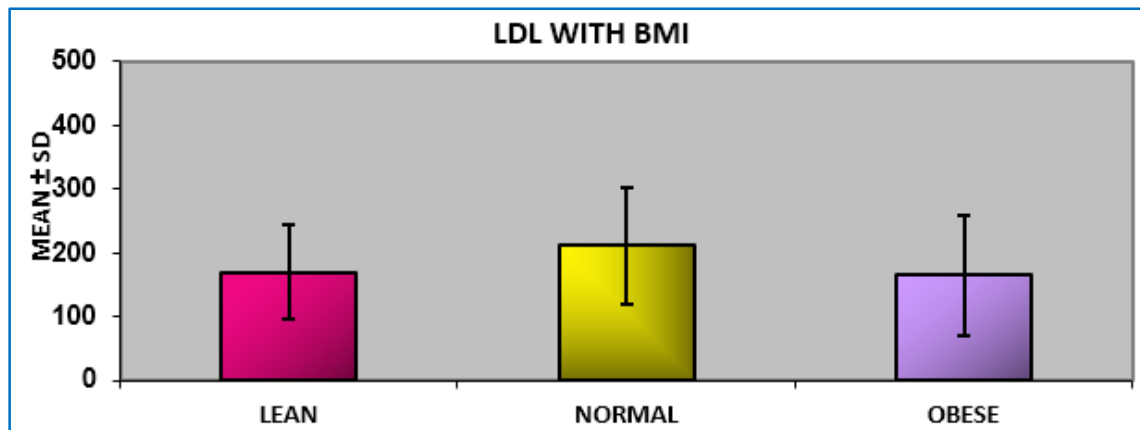
There is statistical significance between TGL and BMI.  
TGL levels are more in obese group (p value 0.013).

### LDL cholesterol and BMI:

LDL									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	169.64	75.096	7.064	155.64	183.63	40	320	
NORMAL	564	210.84	92.207	3.883	203.21	218.46	40	340	
OBESE	393	164.41	94.178	4.751	155.07	173.75	40	320	
Total	1070	189.43	93.991	2.873	183.80	195.07	40	340	

**Table 11.** LDL values in various groups

**Figure 11.** LDL levels in various groups.



**Fig. 11**

There is statistical significance between LDL and BMI.  
LDL values are more in normal group (p value 0.000).

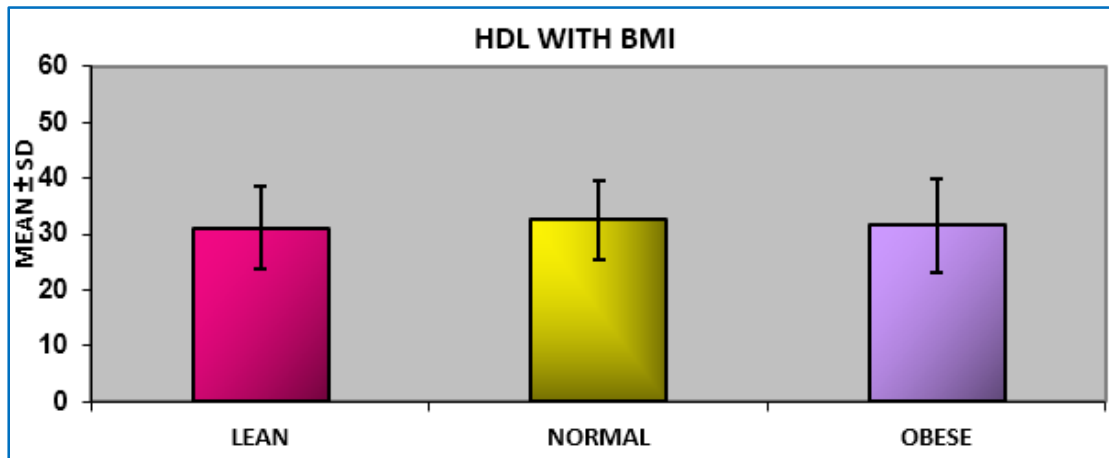
### HDL cholesterol and BMI

HDL									
Descriptives									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	31.17	7.536	.709	29.76	32.57	14	45	
NORMAL	564	32.60	7.067	.298	32.01	33.18	14	45	
OBESSE	393	34.30	7.222	.364	33.58	35.01	14	45	
Total	1070	33.07	7.241	.221	32.63	33.50	14	45	

**Table 12.** HDL values in various groups

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**Figure 12.** HDL levels in various groups.



**Fig. 12**

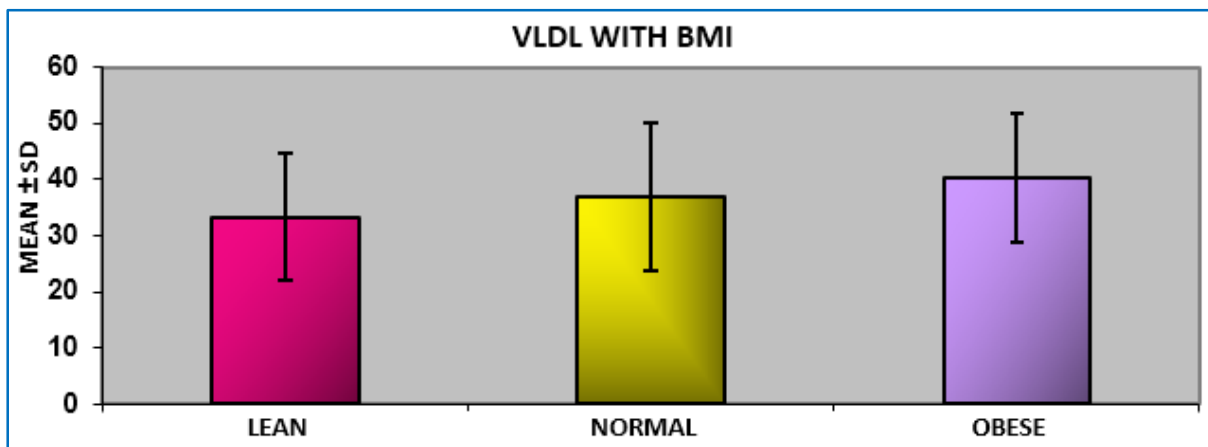
There is no statistical significance between HDL and BMI.

### VLDL cholesterol and BMI

VLDL		Descriptives							
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	42.57	14.109	1.327	39.94	45.20	20	65	
NORMAL	564	36.88	13.147	.554	35.79	37.96	20	65	
OBESE	393	40.35	11.465	.578	39.21	41.49	20	65	
Total	1070	38.75	12.822	.392	37.99	39.52	20	65	

**Table 13.** VLDL values in various groups

**Figure 13.** VLDL levels in various groups.



**Fig. 13**

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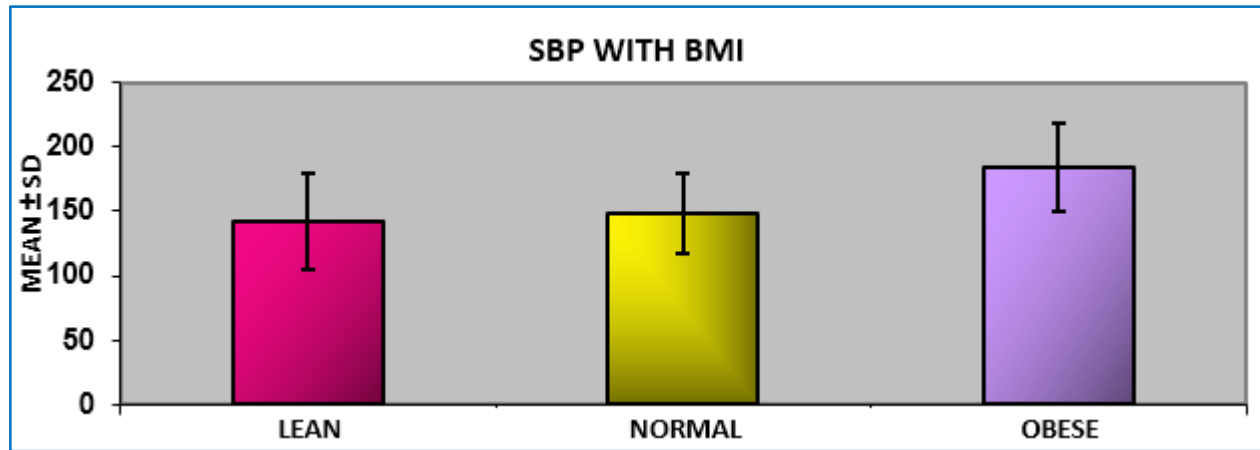
There is statistical significance between VLDL and BMI.  
VLDL more in obese group (p value 0.000).

### SYSTOLIC BP and BMI:

SBP									
Descriptives									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	142.21	37.886	3.564	135.15	149.27	90	224	
NORMAL	564	148.93	31.086	1.309	146.36	151.50	90	220	
OBESE	393	183.74	34.342	1.732	180.33	187.14	90	224	
Total	1070	161.01	37.363	1.142	158.76	163.25	90	224	

**Table 14.** Systolic blood pressure values in various groups

**Figure 14.** Systolic blood pressure values in various groups.



**Fig. 14**

There is statistical significance between systolic blood pressure and BMI. Systolic BP more in obese group

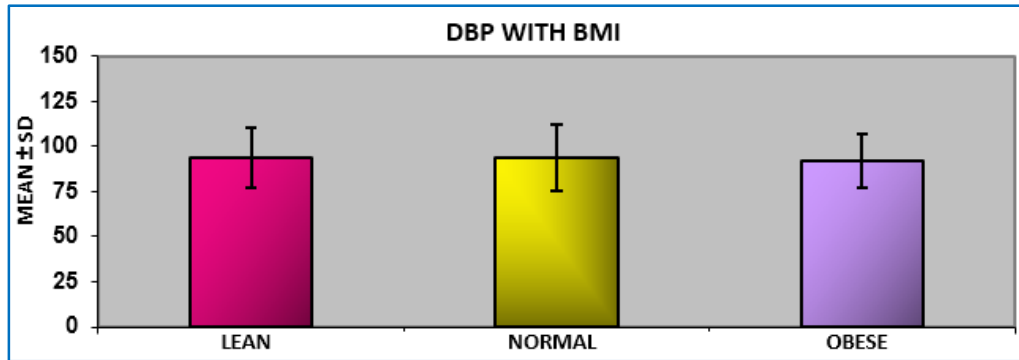
### DIASTOLIC BP and BMI:

DBP									
Descriptives									
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	
					Lower Bound	Upper Bound			
LEAN	113	93.80	16.431	1.546	90.73	96.86	60	120	
NORMAL	564	93.76	18.148	.764	92.25	95.26	60	120	
OBESE	393	91.91	14.956	.754	90.43	93.39	60	120	
Total	1070	93.08	16.869	.516	92.07	94.09	60	120	

**Table 15.** Diastolic blood pressure values in various groups

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**Figure 15.** Diastolic blood pressure values in various groups.



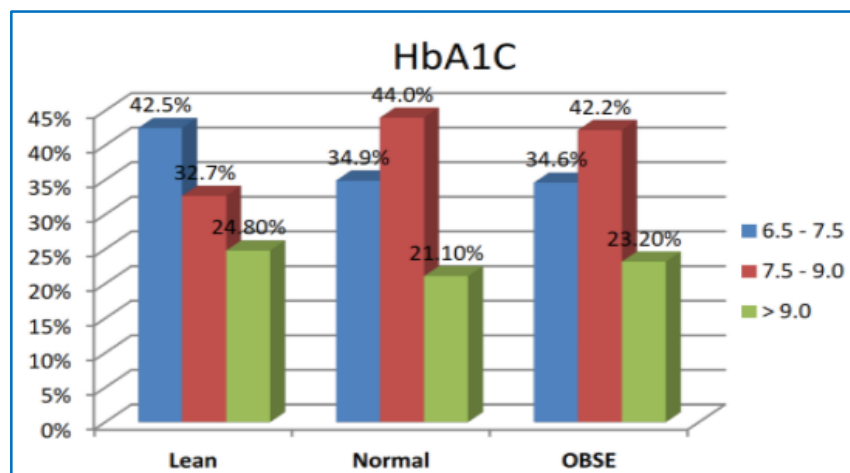
**Fig 15**

There is no statistical significance between DBP and BMI.

BMI * HBA1c Crosstabulation						
			HBA1c			Total
			6.5 - 7.5	7.5 - 9.0	> 9.0	
BMI	LEAN	Count	48	37	28	113
		% within BMI	42.5%	32.7%	24.8%	100.0%
	NORMAL	Count	197	248	119	564
		% within BMI	34.9%	44.0%	21.1%	100.0%
	OBESE	Count	136	166	91	393
		% within BMI	34.6%	42.2%	23.2%	100.0%
Total	Count		381	451	238	1070
	% within BMI		35.6%	42.1%	22.2%	100.0%

**Table 16.** HbA1C values in various groups

**Figure 16.** HbA1C values in various groups.



**Fig 16**

There is no statistical significance between HbA1C and BMI.

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**DISCUSSION:** Diabetes Mellitus is an age old affliction of man and is the most common metabolic disorder all over the World. The incidence of Diabetes is showing an alarming rise in developing countries, particularly in India. Most of the diabetics in developed countries are obese. However in India we have a significant number of diabetics who are either normal weight or even underweight (lean).

Our study included thousand seventy patients. Among 1070 patients, 778 are males and 292 are females. Majority of patients that is 564 patients (52.7%) belong to normal weight, 393 patients (36.7%) belong to obese and 113 patients (10.6%) belong to lean body weight.

**1. Age:** In our study, we found that there is particular age group for lean diabetics. There is statistical significance between age and BMI. 39.8% of lean diabetics belong to 41-50 years of age, 33.7% of normal weight patients between 41 and 50 years, and 35.1% of obese patients belong to 41-50 years of age group.

**2. Sex:** There is no statistical significant relationship exist between sex and BMI in our study as male preponderance is noted in all groups.

**3. Family History:** There is statistical significance between family history and BMI. Family history of diabetes is present only in 42.5% of lean diabetics, when compared to 39% in normal weight and 50.4% in obese diabetics. So there is less incidence of family history present among normal weight diabetics.

**4. Waist Hip Ratio and BMI:** There is a linear increase in number of patients having abnormal Waist Hip ratio with increase in BMI. Statistical significance present with BMI and waist hip ratio. Among 1070 patients studied, obese people predominantly have abnormal Waist Hip ratio. Even though 10.6% (113) of diabetic's patients are lean based on BMI, 18 among them are having abnormal Waist hip ratio. So, Waist hip ratio is a better indicator than BMI for assessment of obesity. Skin fold thickness also increases as the BMI increases.

**Infections:** In our study, 50.4% of lean patients with type 2 diabetes presented with infections as compared to 39.7% in normal and 34.4% in obese patients. Values are statistically significant ( $p$  value = 0.007). Majority of the lean diabetics in our study group presented with infections especially pulmonary tuberculosis.

**Glycemic Control:** Lean diabetics have more severe hyperglycemia with poor metabolic control. Lean persons have higher fasting blood sugar (mean 282.99) levels than obese and normal weight type 2 diabetes patients. Postprandial values are higher in normal type 2 DM patients. In lean patients about 25% people have HbA1C >9 as against 21% and 23% in normal weight & obese diabetics.

**Lipid Profile:**<sup>15</sup> Regarding lipid profile of type 2 diabetes patients, lean diabetics have low triglycerides (mean 217) when compared to normal (mean 228) and obese (mean 237) which is statistically significant<sup>15</sup>. Lean group has low VLDL (mean 33.27) compared to normal (mean 36.88) and obese (mean 40.35) which is also statistically significant. Total cholesterol values in obese



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diabetics are more (mean 251.80) as compared to normal (mean 228.16) and (249.15) in lean patients. LDL value in normal weight diabetics (mean 210.84) is more as compared to lean diabetics (mean 169.64) and in obese diabetics (mean 164.41). HD values and different groups are not statistically significant.

Our study has limitations, as it was hospital based in the tertiary care setting. Incidence of complications might be higher compared to general population or primary care setting and it was an observational study. We did not do insulin level assay, C peptide levels and GAD Antibodies in our lean diabetics due to financial constraints.

In conclusion, type 2 diabetic patients need not always obese. Majority (52.7%) belongs to normal weight and significant number (10.6%) of patients are lean in our study. Thus, lean body type 2DM patients appear to be a distinct variety and a great deal of emphasis is to be given on its clinical profile and natural history.

**CONCLUSION:** Majority of type 2 diabetes patients in our population are having normal weight (52.7%) and lean body weight (10.6%). Lean diabetics have more severe hyperglycemia and poor metabolic control. They are more prone for infections. Hence we conclude that early initiation of insulin in lean type 2 diabetics is expected to achieve good glycemic control and to prevent future complications.

### REFERENCES:

1. Mohan V, Vijayaprabha R, Rema M, et al. Clinical profile of lean NIDDM in South India. *Diabetes Res ClinPract* 1997; 38:101-8.
2. Chan JC et al: diabetes in Asia; epidemiology, risk factors and pathophysiology; *JAMA* 301; 2129, 2009.
3. Gohel DR, Desai VK, M.P. Shah Medical College, Janmagar. Clinical Profile of Lean Body weight type 2 DM patients in comparison with obese and Non-obese. *Type 2 DM Patients. JAPI* Dec 2003; Vol 51
4. Tripathy BB, Kar BC. Observations on clinical patterns of diabetes mellitus in India. *Diabetes* 1965; 14: 404-12.
5. Mohan V, Vijayaprabha R, Rema M, Premalatha G, Poongothai S, Deepa et al Madras Diabetes Research Foundation, India. Clinical profile of lean NIDDM in south India. *Diabetes Res ClinPract* 1998 Aug; 41(2):149-50.
6. 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.
7. Weir GC, Leahy JL. Pathogenesis of non-insulin dependent (Type II) diabetes mellitus. In: *Joslin's Diabetes Mellitus 13th edition*. Lea & Febiger: Philadelphia, PA, 1994 Kanan K. Lean Type II diabetes mellitus – a distinct entity. In: Kapur A (ed.) *Proceedings of the second Novo – Nordisk diabetes update*. Health Care Communication, Bombay, 1993'147- 151.
8. Weir GC, Leahy JL. Pathogenesis of non-insulin dependent (Type II) diabetes mellitus. In: *Joslin's Diabetes Mellitus 13th edition*. Lea & Febiger: Philadelphia, PA, 1994; 242-3.
9. Nigam A Lean – NIDDM a definite entity: In: Das S (ed) *Brochure on problems, practical aspects*. Publications and questionnaire. International workshop on types of diabetes peculiar to the tropics, Cuttack 1995: 54-6.

## ORIGINAL ARTICLE

10. Das S. Low body weight NIDDM: An independent entity. In: Das AK (ed) Medicine Update, Assoc Phys India, Mumbai, 1998; 595-602.
11. Prabhu Mukhyaprana M. Clinical Profile of Type 2 Diabetes Mellitus and Body Mass Index – Is There any correlation? Calicut Medical Journal 2004; 2(4): e3
12. Kanan K. Lean Type II diabetes mellitus – a distinct entity. In: Kapur A (ed.) Proceedings of the second Novo – Nordisk diabetes update. Health Care Communication, Bombay, 1993' 147-151.
13. American Diabetes Association – Clinical Practice and Recommendations 2002. Diabetes Care. 27: 51, 2004.
14. Das S, Lipid profiles – standards and interpretations. In: Kapur A (ed) Proceedings of the Novo – Nordisk Diabetes update 1995. Health Care Communication, Bombay 1995; 107-15.
15. Das S, Tripathy BB, Samal KC, et al. Plasma lipids and lipoprotein cholesterol in undernourished diabetic subjects and adults with protein energy malnutrition. Diabetes Care 1984; 7: 579-86.

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