



Original Research Article

Cross-sectional study to compare the clinical features in low normal versus high normal plasma glucose levels in euglycemic individuals

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Abstract

Introduction: It has been known that the diagnosis of diabetes should be made early to prevent cardiovascular and other metabolic complications. So far, determination of blood glucose levels has been used to diagnose diabetes. It shows why the glucose-centric definition for diagnosing diabetes that has been used so far could not be applied to the sole diagnosis criteria for a group of patients with such "syndrome".

Materials and Methods: This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July 2016 to August 2017 in 200 individuals and patients having euglycemic status attending General Medicine OPD.

Results: The mean BMI in the low normal group was $23.79 \pm 1.09 \text{ kg/m}^2$ and in the high normal group it was $24.43 \pm 1.26 \text{ kg/m}^2$. The difference was found to be statistically significant ($P < 0.05$). In the low normal group, of the females, 40(80%) were having normal W:H ratio and 10(20%) were having abnormal W:H ratio. In males, only 5(10%) were having abnormal W:H ratio. In the high normal group, in females 15(33.3%) were having abnormal W:H ratio. In males, 19(34.5%) were having abnormal W:H ratio. In 100(100%) patients of both the groups, the fundus findings were found to be normal.

Conclusions: It can be concluded that higher values of BMI, Waist-Hip Ratio and positive family history for diabetes were found more commonly associated with high normal euglycemic group when compared with low normal euglycemic group.

Keywords: Body Mass Index, Euglycemia, Waist Hip Ratio.

Introduction

It has been known that the diagnosis of diabetes should be made early to prevent cardiovascular and other metabolic complications. So far, determination of blood glucose levels has been used to diagnose diabetes. As a matter of fact, some diabetic patients had already had chronic complication at the first time of diagnosis. It shows why the glucose-centric definition for diagnosing diabetes that has been used so far

could not be applied to the sole diagnosis criteria for a group of patients with such "syndrome".

Blood glucose measurements and the cut-off point for diagnosing diabetes have become controversial debates for a long time. In 1979, the National Diabetes Data Group (NDDG) made diagnostic criteria for diabetes, which subsequently have been used for over 2 decades. At that time, the Committee used the cut-off point of blood glucose level based on distribution and it was not

associated with the correlation between blood glucose levels and chronic complication. Diagnosis of diabetes was established when fasting plasma glucose levels (FPG) >140 mg/dl; 2-hour post-prandial blood glucose or 2-hours PPG >200 mg/dl.^[1-5]

Since a long time ago, the experts have realized that determination of cut-off point for diagnosing diabetes will be revised over time with the lower blood glucose levels as the more sensitive diagnosis for detecting the occurring complication.

Materials and Methods

This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July 2016 to August 2017. We included 200 individuals and patients having euglycemic status attending General Medicine OPD, Endocrine OPD and Medicine Wards.

We arbitrarily divided fasting euglycemia into low normal below <85 mg/dl & high normal ranging from 86-100 mg/dl and post prandial euglycemia into low normal ranging from <120 mg/dl and high normal ranging from 121-140 mg/dl. All patients or legally acceptable representative provided written inform consent for participation. The research protocol and informed consent form was approved by scientific review committee.

Inclusion Criteria

- All consenting individuals found to be euglycemic.
- Age group: adult population of 18 – 60 years

Exclusion criteria

- Known case of Diabetes.
- Patients not giving consent.
- Patients on drugs causing hypoglycemia (e.g. Beta-blockers, Haloperidol, Quinidine, MAO inhibitors etc.).
- Patients on drugs causing hyperglycemia (e.g. Corticosteroids, Fluoroquinolones, thiazide and thiazide like drugs etc.).

Patients included in the study were subjected to full history including family history for Diabetes and Hypertension. Then patient is examined clinically and hemodynamically. Blood samples were withdrawn and investigations planned were done and if patient/ individual is found to be euglycemic, he/she is included in the study after his/her consent. Fundus was examined for Diabetic retinopathy changes.

Statistical Methods

Data were prospectively collected and coded prior to analysis using the professional statistical Package for Social Science (SPSS) software. The description of data was in the form of mean (\pm) SD for quantitative data and frequency and proportion for qualitative data. Unpaired 't' test (t) applied was used for comparison between two groups regarding normally distributed (parametric) quantitative data. Results were considered significant if $P < 0.05$.

Results

This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July 2016 to August 2017. We included 200 individuals and patients having euglycemic status.

As shown in table 1, in the low normal group, there were 10(10%) patients in the age group 18-20 years, 21(21%) in the age group 21-30 years, 26(26%) in the age group 31-40 years, 23(23%) in the age group 41-50 years and 20(20%) in the age group 51-60 years. In the high normal group, there were 9(9%) patients in the age group 18-20 years, 25(25%) in the age group 21-30 years, 25(25%) in the age group 31-40 years, 18(18%) in the age group 41-50 years and 23(23%) in the age group 51-60 years. The mean age in the low normal group was 37.55 ± 12.51 years and in the high normal group it was 38.44 ± 2.95 years. The difference was found to be statistically not significant ($P > 0.05$), showing that the age is comparable between the two groups.

Table 1: Distribution of patients according to age

Age Group	Low Normal Group FBS<85, PPBS<120		High Normal Group FBS>85, PPBS>120	
	No.	%	No.	%
18-20 years	10	10.0	9	9.0
21-30 years	21	21.0	25	25.0
31-40 years	26	26.0	25	25.0
41-50 years	23	23.0	18	18.0
51-60 years	20	20.0	23	23.0
Total	100	100.0	100	100.0
Mean ± SD	37.55 ± 12.51		38.44 ± 12.95	
't' value	-0.494, df=198			
P value	0.622, NS			

Unpaired 't' test applied. P value = 0.622, Not significant

As shown in table 2, in the low normal group, there were 50(50%) females and 50(50%) males, while in the high normal group there were 45(45%) female and 55(55%) males. In the low

normal group, in 95(95%) patients there was negative family history for diabetes mellitus, while in 5(5%) patients there was a positive family history for diabetes mellitus.

Table 2: Distribution of patients according to gender

Gender	Low Normal Group FBS<85, PPBS<120		High Normal Group FBS>85, PPBS>120	
	No.	%	No.	%
Female	50	50.0	45	45.0
Male	50	50.0	55	55.0
Total	100	100.0	100	100.0

As shown in table 3, in the low normal group, in 95(95%) patients there was negative family history for diabetes mellitus, while in 5(5%) patients there was a positive family history for diabetes mellitus. In the high normal group, in

85(85%) patients there was negative family history for diabetes mellitus, while in 15(15%) patients there was a positive family history for diabetes mellitus.

Table 3: Distribution of patients according to family history of diabetes mellitus

Family History of Diabetes Mellitus	Low Normal Group FBS<85, PPBS<120		High Normal Group FBS>85, PPBS>120	
	No.	%	No.	%
Negative	95	95.0	85	85.0
Positive	5	5.0	15	15.0
Total	100	100.0	100	100.0

As shown in table 4, in 100(100%) patients of both the groups, the fundus findings were found to be normal.

Table 4: Distribution of patients according to Fundus findings

Fundus findings	Low Normal Group FBS<85, PPBS<120		High Normal Group FBS>85, PPBS>120	
	No.	%	No.	%
Normal	100	100.0	100	100.0
Abnormal	0	0.0	0	0.0
Total	100	100.0	100	100.0

As shown in table 5, distribution of patients according to W:H Ratio. In the females W:H ratio

of <0.85 and in males <0.91 was taken as normal. In the low normal group, in females, 40(80%)

were having normal W:H ratio and 10(20%) were having abnormal W:H ratio. In males, 45(90%) were having normal W:H ratio and only 5(10%) were having abnormal W:H ratio. In the high normal group, in females, 30(66.7%) were having normal W:H ratio and 15(33.3%) were having abnormal W:H ratio. In males, 36(65.5%) were having normal W:H ratio and 19(34.5%) were having abnormal W:H ratio.

Overall in the low normal group, there were 85(85%) patients with normal W:H ratio and

15(15%) with abnormal W:H ratio, in the high normal group, there were 66(66%) patients having normal W:H ratio and 34(34%) were having abnormal W:H ratio. The proportional comparison between the two groups for overall abnormal W:H ratio was found to be statistically significant ($P < 0.05$), showing a higher proportion of patients in the high normal group to be having abnormal W:H ratio in comparison to the low normal group.

Table 5: Distribution of patients according to W:H Ratio

Gender	Normal/ Abnormal	Low Normal Group FBS \leq 85, PPBS \leq 120		High Normal Group FBS $>$ 85, PPBS $>$ 120	
		No.	%	No.	%
Female	Normal	40	80.0	30	66.7
	Abnormal	10	20.0	15	33.3
Male	Normal	45	90.0	36	65.5
	Abnormal	5	10.0	19	34.5
Overall	Normal	85	85.0	66	66.0
	Abnormal	15	15.0	34	34.0
Total		100	100.0	100	100.0

Z (Overall abnormal) = -3.20, P value = 0.001, Significant

As shown in table 6, in the low normal group, there were 89(89%) patients with BMI \leq 25.0 kg/m² and 11(11%) with BMI $>$ 25.0 kg/m². In the high normal group, there were 69(69%) patients with BMI \leq 25.0 kg/m² and 31(31%) with BMI $>$ 25.0 kg/m². The mean BMI in the low normal

group was 23.79 \pm 1.09 kg/m² and in the high normal group it was 24.43 \pm 1.26 kg/m². The difference was found to be statistically significant ($P < 0.05$), showing a higher BMI in the high normal group in comparison to the low normal group.

Table 6: Distribution of patients according to BMI

BMI	Low Normal Group FBS \leq 85, PPBS \leq 120		High Normal Group FBS $>$ 85, PPBS $>$ 120	
	No.	%	No.	%
\leq 25.0 kg/m ²	89	89.0	69	69.0
$>$ 25.0 kg/m ²	11	11.0	31	31.0
Total	100	100.0	100	100.0
Mean \pm SD	23.79 \pm 1.09		24.43 \pm 1.26	
't' value	-3.824, df=198			
P value	0.000*			

Unpaired 't' test applied. P value = 0.000, Significant

Discussion

This cross sectional study was carried out in the department of medicine, M.G.M. Medical College and M.Y. Hospital Indore from July 2016 to August 2017. We included 200 individuals and patients having euglycemic status.

A total number of 200 subjects were selected for the study. We arbitrarily divided fasting euglycemia into low normal below \leq 85 mg/dl & high normal ranging from 86-100 mg/dl and post prandial euglycemia into low normal ranging from \leq 120 mg/dl and high normal ranging from 121-

140 mg/dl. The subjects were divided into 2 groups on the basis of above criteria into low normal and high normal euglycemic state. Each group included 100 cases of low normal and high normal euglycemic status. In each group patients were divided in five age subgroups (18-20, 21-30, 31-40, 41-50, 51-60) in years.

Both groups were compared on various clinical (BMI, Waist-Hip ratio, Fundus examination and Systemic examination). Data evaluation was done using SPSS software. The results were expressed as Mean (standard deviation). The P value was used to compare the different groups.

In our study we found that BMI and Waist-Hip Ratio were on higher side in high normal euglycemic individuals. Diabetic retinopathy changes were not found in any individuals in either of the group and the systemic examination was found to be normal in all individuals. P value was found to be significant in high normal euglycemic group in Waist-Hip Ratio and BMI. Our study showed that the markers of metabolic syndrome like Waist-Hip Ratio and BMI were more in high normal euglycemic individuals suggesting that the individuals in high normal euglycemic group are at risk of developing diabetes and metabolic complications, cardiovascular complications in future.^[6] On the basis of these findings we can advise interventions like – health education, life style modification, weight reduction and restrictions and modifications in dietary Habits to prevent complications of metabolic syndrome. In addition, future screening for diabetes and other complications can be advised. Diabetes is considered a coronary heart disease (CHD)- risk equivalent and it is frequently associated with various other cardiovascular (CV) risk factors.^[7] Approximately, 80% of deaths in patients with diabetes are attributable to cardiovascular disease. According to Global Diabetes Community, obesity is believed to account for 80-85% of the risk of developing type 2 diabetes, while recent research suggests that obese people are up to 80 times more likely to develop type 2 diabetes than

those with a BMI of less than 22. Studies suggest that abdominal fat causes fat cells to release ‘pro-inflammatory’ chemicals, which can make the body less sensitive to the insulin it produces by disrupting the function of insulin responsive cells and their ability to respond to insulin. This is known as insulin resistance - the hallmark of type 2 diabetes. Having excess abdominal fat (i.e. a large waistline) is known as central or abdominal obesity, a particularly high-risk form of obesity. In our study, also BMI and Waist-Hip Ratio were found to be on higher side in high normal euglycemic individuals when compared with low normal euglycemic individuals.

Conclusion

It can be concluded that higher values of BMI, Waist-Hip Ratio and positive family history for diabetes were found more commonly associated with high normal euglycemic group when compared with low normal euglycemic group.

Declaration

Funding: No funding source

Conflict of Interest: Not declared

Ethical Approval: Study was approved by Institutional Review Board.

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