Original Article

Relationship between Serum Amylase and Lipase with Body Mass Index in under 30 Years Old Diabetic Patients

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Abstract

Background: Diabetes mellitus (DM) is becoming more common in young people, and the etiopathogenesis may involve a synergistic interaction between exocrine and endocrine pancreatic dysfunction. Low serum amylase and lipase levels indicate widespread pancreatic damage and are associated with diabetes.

Aim: This study aimed to observe the level of amylase and lipase in under 30 diabetic patients and to correlate them with body mass index (BMI).

Materials and methods: This cross-sectional study encompassed 55 under 30 diabetic subjects [age 23.51±4.32 years, BMI 23.31±5.50 kg/m^2; mean±SD] diagnosed on basis of American Diabetes Association (ADA) criteria. Serum amylase and lipase were measured by AMY and LIPL methods respectively. Glucose was measured by glucose oxidase and HbA_1C by high-performance liquid chromatography (HPLC) methods.

Results: About 15% subjects had low level of serum amylase and 35% of serum lipase. Mean serum amylase and lipase was 44.78±4.06 U/L and 112.09±10.41 U/L respectively. There was no statistically significant difference of either serum amylase or lipase among the BMI categories. (underweight vs. normal vs. overweight vs. obese: 46.57±36.61 vs. 47.91±37.96 vs. 39.59±15.48 vs. 45.25±29.68 U/L, p =0.862); (underweight vs. normal vs. overweight vs. obese: 113.14±91.18 vs. 117.61±80.34 vs. 102.76±71.31 vs.115.13±81.46 U/L, p = 0.948) respectively. However, fasting plasma glucose (13.36±7.08 vs. 12.83±4.96 mmol/L, mean±SD; p=0.047) showed statistically significant and relatively higher value in the group having low lipase level. Neither amylase nor lipase correlated with any of the variables as fasting plasma glucose, 2 hour plasma glucose and BMI (p=NS for all). However, though amylase did not show any correlation with HbA_1C (r=0.174, p=0.203), serum lipase showed significant correlation with HbA_1C (r=0.302, p=0.025).

Conclusions: No significant correlation found between serum amylase and lipase with BMI of the study subjects. HbA1c had only significant positive correlation with serum lipase but not with serum amylase.

Keywords: Diabetes mellitus, Body Mass Index (BMI), serum amylase and serum lipase.

Introduction

Diabetes mellitus (DM) is a common clinical problem over the world. The prevalence is increasing due to the growing problem of obesity.[1] Type 2 DM is related with the interaction between genetic, environmental and behavioral risk factors.[2]

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Received Date : 05 September, 2020
Accepted Date : 09 January, 2021

Elevated serum amylase, an exocrine enzyme that is produced by pancreatic acinar cells, levels are widely used as screening test for acute pancreatitis in clinical practice.[3] For many years, low serum amylase was thought to reflect diffuse pancreatic destruction secondary to advanced pancreatic diseases, such as chronic pancreatitis.[4] Disturbance of serum amylase is associated with insulin deficiency in patients with Type 1 diabetes and, less commonly, with Type 2 diabetes.[5] Moreover, serum amylase levels are also elevated in other conditions, including diabetic ketoacidosis[6] and renal insufficiency.[7] Low serum amylase levels are observed in individuals with chronic pancreatitis.[8] Recent studies showed that the serum amylase levels may be associated with endocrine and metabolic diseases.[5] Low serum amylase levels were associated with increased risks of metabolic abnormalities,

metabolic syndrome and diabetes. A previous study by Muneyuki et al. of asymptomatic middle-aged adults showed that low serum amylase levels were associated with decreased basal insulin levels and insulin secretion, as well as increased insulin resistance.[9] Serum lipase is also related with DM. Quiros et al.[6] have reported that the secretion of lipase is hampered with decreased level of insulin.

Metabolic syndrome (MetS) and body mass index (BMI) are established independent risk factors in the development of diabetes.[10] Obesity consists of heterogeneous phenotypes resulting from interplay between genetic and environmental factors.[11] Increased BMI has been associated with metabolic and cardiovascular risk factors including diabetes, hypertension, dyslipidemia, but there is increasing evidence that sub-phenotypes of obesity exist that appear to deviate from the standard dose response relationship between increased BMI and its adverse clinical outcomes.[12] It has been shown that the normal-weight/MetS phenotype is associated with a three- to fourfold higher risk for diabetes as compared with control subjects.[13] On the other hand, metabolically healthy but obese or obese/without MetS individuals, have been identified who, despite having BMI exceeding 30 kg/m^2, are relatively insulin sensitive and have a rather favorable cardiovascular risk profile with a three- to fourfold lower risk for diabetes as compared with obese insulin-resistant individuals.[14] There has been, however, no consensus regarding the definitions of obese/without MetS and the existence of a healthy obese phenotype based on the definition of absence of MetS has been questioned.[15] The aim of the present study was to evaluate the relation of serum amylase and lipase with body mass index (BMI).

Materials and Methods

This cross-sectional observational study was carried out in the Department of Endocrinology, Bangabandhu Sheikh Mujib Medical University (BSMMU) over a period of 18 month between September 2015 to February 2017.

Ethics: The study protocol was approved by Institutional Review Board, BSMMU (No. BSMMU 2015/2745). Informed written consent was taken from each participant.

Study design: Fifty-five patients with DM less than 30 years of age were included by consecutive purposive sampling in this study. Patients with gestational diabetes mellitus, other specific types of DM (except FCPD) and those with co-morbidities like CLD, CKD were excluded from the study. Data were collected using pre-tested semi-structured questionnaire. Participants were asked about their socio-demographic status. Height, weight, waist circumference and blood pressure of each participant were measured as per standard procedures.

Biochemical analysis: About 5 ml venous blood was taken from each subject in a test tube maintaining all aseptic precaution. Serum was separated by centrifugation at 3200 rpm for 10 minutes and was stored at department of Endocrinology under -20^0 C until assay for serum amylase and lipase. Serum amylase and lipase were measured by AMY and LPIL method respectively, glucose was measured by Hexokinase/G-6-PDH method and HbA_1C was measured by high-performance liquid chromatography (HPLC) method in the department of biochemistry, BSMMU.

Operational definition: DM was defined as patient fulfilling ADA (American Diabetes Asssociation) 2015 criteria {fasting plasma glucose ≥ 7.0 mmol/L, 2-hour plasma glucose after 75 gm OGTT (oral glucose tolerance test) ≥ 11.1 mmol/L, HbA1c ≥6.5% or in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥ 11.1 mmol/L.

Normal level of Serum amylase was defined as 25-115 U/L and Serum lipase as 73-393 U/L. (Ref. Chavez RG. U.S. Patent 4,963,479)

Sample size calculation: The minimum sample size calculated was 55 using the formula, for cross sectional study (Steves K. Thompson). The standard deviation (SD) of amylase (σ) was 9.16 [Yadav, 2013]. 95% confidence interval (z) and 5% margin of error (d) were used.

Statistical analysis: Statistical analyses were performed by using window based computer software SPSS-22 (Statistical Packages for Social Sciences) (SPSS Inc, Chicago, IL, USA). Quantitative data were expressed as mean, standard deviation, standard error and qualitative data were expressed as frequency and percentage. Association between categorical variables socioeconomical status, family history of DM & duration of DM were analyzed by chi-square test and continuous variables age, BMI, Waist circumference, waist/hip ratio, SBP, DBP, FPG, 2 hour plasma glucose, HbA1c, serum amylase & serum lipase were analyzed by t-test & ANOVA test. Correlation was done by Pearson's correlation test. For all statistical tests, we considered p value <0.05 as statistically significant and 95% confidence limit was taken.

Results

In our study population, the mean age was 23.51±4.32 years, BMI was 23.31±5.50 kg/m^2, waist circumference was 81.11±12.40 cm and waist hip ratio was 0.89±0.04 (all mean±SD). Males were more than females (54.5% vs. 45.5%) with 63.6% having family history of Diabetes mellitus. Acanthosis nigricans was present in 33%. Mean systolic BP was (115±16) mm of Hg and diastolic BP was (77±9) mm of Hg (mean±SD). Fasting plasma glucose, 2-hr plasma glucose and HbA1c were (13.02±5.72) mmol/L, (19.61±7.49) mmol/L and (9.95±3.06)% respectively (mean±SD) (Table 1).

There was no statistically significant difference of either serum amylase (underweight vs. normal vs. overweight vs. obese: 46.57±36.61 vs. 47.91±37.96 vs. 39.59±15.48 vs. 45.25±29.68 U/L, p =0.862) or lipase (underweight vs. normal vs. overweight vs. obese: 113.14±91.18 vs. 117.61±80.34 vs. 102.76±71.31 vs.115.13±81.46 U/L, p = 0.948) among the BMI categories (Table 2).

Comparison of clinical variables between low and normal level of serum amylase group showed no statistical significant difference between two groups for age (p=0.269), BMI (p=0.638), waist circumference (p=0.502), waist/hip ratio (p=0.116), systolic BP (p=0.721), diastolic BP (p=0.924), fasting plasma glucose (13.35±6.54 vs. 12.96±5.64 mmol/L, mean ± SD; p=0.879), 2 hour plasma glucose (18.51±5.59 vs.19.77±7.78 mmol/L, mean ± SD; p=0.611), HbA_1C (9.48±2.71 vs. 10.03±3.14, mean ± SD; p=0.620), socioeconomic status (p=0.530) and family history of DM (p=0.944). Only duration of diabetes which was relatively lower with most of the subjects having normal amylase (70.9%, 39/55; p= 0.059) (Table 3).

Comparison of clinical variables between low and normal level of serum lipase group was found no statistically significant difference between two groups for age (p=0.104), BMI (p=0.411), waist circumference (p=0.288), waist/hip ratio (p=0.875), duration of DM (p=0.303), systolic BP (p=0.184), diastolic BP (p=0.282), 2 hour plasma glucose (21.43±9.14 vs. 18.45±6.55 mmol/L, mean ± SD; p=0.288), HbA_1C (9.98±3.16 vs. 9.93±3.05, mean ± SD; p=0.947), Socioeconomic status (p=0.423) and family history of DM (p= NS). However, fasting plasma glucose (13.36±7.08 vs. 12.83±4.96 mmol/L, mean ± SD; p=0.047) showed statistically significant and relatively higher value in the group having low lipase level (Table 4).

Correlation showed neither amylase nor lipase correlated with any of the variables as fasting plasma glucose, 2 hour plasma glucose and BMI (p=NS for all). However, though amylase did not show any correlation with HbA_1C (r=0.174,p=0.203), Serum lipase showed significant correlation with HbA_1C (r=0.302, p=0.025) (Table 5).

Table 1: Base line Characteristics of study subjects (n=55)

Characteristics		Frequency (%)
Age (mean ± SD, years)		23.51±4.32
BMI (mean ± SD, Kg/m^2)		23.31±5.50
Waist circumference (mean ± SD, cm)		81.11±12.40
Waist hip ratio		0.89±0.04
Gender		
	Male	30 (54.5%)
	Female	25 (45.5%)
Family history of DM		35 (63.6%)
Acanthosis nigricans		18 (32.7%)
Systolic BP (mean ± SD, mm of Hg)		115±16
Diastolic BP (mean ± SD, mm of Hg)		77 ±9
Fasting plasma glucose (mmol/L)		13.02±5.72
2-h plasma glucose (mmol/L)		19.61±7.49
HbA1c (%)		9.95±3.06

(Within parenthesis are percentages over column total)

Table 2: Serum amylase and lipase among study subjects according to BMI status (n=55)

Variables	N (%)	S. amylase (U/L) [Mean±SD]	S. lipase (U/L) [Mean±SD]
Total	55 (100)	44.78±4.06	112.09±10.41
Underweight	7 (12.7)	46.57±36.61	113.14±91.18
Normal	23 (41.8)	47.91±37.96	117.61±80.34
Overweight	17 (30.9)	39.59±15.48	102.76±71.31
Obese	8 (14.5)	45.25±29.68	115.13±81.46
p-value		0.862	0.948

Comparison was done by One-way ANOVA

Table 3: Comparison of clinical and biochemical characteristics between low versus normal level of serum amylase group (n=55)

Characters		Group		p-value
		S. Amylase (Low) <25 U/L	S. Amylase (Normal) 25-115U/L	
Age (year)		21.38±5.73	23.87±3.99	0.269
BMI (kg/m2)		22.32±6.32	23.48±5.40	0.638
Waist Circumference		78.00±13.83	81.64±12.22	0.502
Waist/Hip ratio		0.91±0.03	0.89±0.02	0.116
Duration of DM	<1 year	4(7.3%)	39(70.9%)	0.059
	>1 year	4(7.3%)	8(14.5%)	
Systolic blood pressure		113.75±9.16	115.21±16.45	0.721
Diastolic blood pressure		76.25±9.16	76.60±9.56	0.924
Fasting plasma glucose (mmol/L)		13.35±6.54	12.96±5.64	0.879
2 hr Plasma glucose (mmol/L)		18.51±5.59	19.77±7.78	0.611
HbA1c (%)		9.48±2.71	10.03±3.14	0.620
Family history of DM		5(9.1%)	30(54.5%)	0.942

Data were expressed as mean±SD; frequency, percentages.
Comparison was done by Student's t test for quantitative data and Chi-Square test for qualitative data.

Table 4: Comparison of clinical and biochemical characteristics between low versus normal level of serum lipase group (n=55)

Characters		Group		p-value
		S. lipase (Low) <73 U/L	S. lipase (Normal) 73-393 U/L	
Age (year)		22.05±5.11	24.28±3.68	0.104
BMI (kg/m2)		22.44±5.70	23.76±5.41	0.411
Waist Circumference		78.63±12.35	82.42±12.39	0.288
Waist/Hip ratio		0.89±0.04	0.89±0.04	0.875
Duration of DM	<1 year	13(23.6%)	30(54.5%)	0.303
	>1 year	6(10.9%)	6(10.9%)	
Systolic blood pressure		11.32±13.92	116.94±16.18	0.186
Diastolic blood pressure		74.74±8.41	77.50±9.89	0.282
Fasting plasma glucose (mmol/L)		13.36±7.08	12.83±4.96	0.047
2 hr Plasma glucose (mmol/L)		21.43±9.14	18.75±6.55	0.288
HbA1c (%)		9.98±3.16	9.93±3.05	0.947
Family history of DM		12(21.8%)	23(41.8%)	1.000

Data were expressed as mean±SD; frequency, percentages.
Comparison was done by Student's t test for quantitative data and Chi-Square test for qualitative data.

Table 5: Correlations of Serum amylase and Serum lipase with clinical and biochemical parameters

	r-value	p-value
S. amylase vs. FPG	-0.003	0.981
S .amylase vs. 2h-PG	-0.061	0.667
S. amylase vs. HbA1c	0.174	0.203
S.amylase vs. BMI	-0.148	0.281
S. lipase vs. FPG	0.125	0.362
S. lipase vs. 2h-PG	-0.005	0.969
S. lipase vs. HbA1c	0.302	0.025
S. lipase vs. BMI	-0.077	0.579

By Pearson's correlation test;
r=Pearson's correlation coefficient.

Discussion:

Diabetes mellitus is a common clinical problem over the world with increasing prevalence in all age group. The rising trend of this disorder in our young population is a major concern and the etiopathogenesis implicating the intricate interplay between exocrine and endocrine pancreatic function in an ongoing area of research. Recent studies showed that the serum amylase and lipase levels may be associated with increased risks of metabolic abnormalities, metabolic syndrome and diabetes.

Metabolic syndrome (MetS) and body mass index (BMI) are established independent risk factors in the development of diabetes which reflects the present study results.[13] The baseline characteristics of our study subjects like mean BMI in the overweight category, positive family history of DM in a significant number of them, absence of history of diabetic emergency or typical symptomology of FCPD suggest that DM in our young population is quite different from that found in previous literature and they could be contributed to either type-2 or other categories of DM that needs to be established from large scale population based study in the future.

There was no statistically significant difference of serum amylase and lipase among the BMI categories. However other researchers like Muneyuki et al.[9] observed significant correlation between Serum amylase was with BMI that is dissimilar to our finding. About 15% subjects had low level of serum amylase and 35% of serum lipase found in our study. Muneyuki et al.[9] found less number of study subjects had low serum amylase.

No significant difference was found between the low and normal amylase groups for age, BMI, waist circumference, waist/hip ratio, systolic BP, diastolic BP, fasting plasma glucose, 2 hour plasma glucose, HbA1c, socioeconomic status and family history of DM but duration of diabetes which was relatively lower with most of the subjects having normal amylase. Muneyuki et al.[9] found significant difference in BMI between low and normal level of serum amylase. But they did not find significant difference in systolic BP, diastolic BP, age, HbA1c & fasting plasma glucose between low and normal level of serum amylase.

Similarly, there were no statistically significant difference between low and normal level of lipase group for age, BMI, waist circumference, waist/hip ratio, duration of DM, systolic BP, diastolic BP, 2 hour plasma glucose, HbA_1c, socioeconomic status and family history of DM. However, fasting plasma glucose showed significant and relatively higher value in the group having low lipase level.

Fasting plasma glucose had negative correlation with serum amylase and positive correlation with serum lipase but not statistically significant. Other study found significant negative correlation of FPG with serum lipase and serum amylase[16] and also found positive significant correlation of serum lipase with FPG.[17]

BMI had negative correlation with both serum amylase and serum lipase but not statistically significant in our study. On the contrary, others found significant negative correlation between serum amylase and BMI.[10]

In present study, 2 hour Plasma Glucose had no significant negative correlation with both serum amylase and serum lipase. Surrogate measures of insulin secretion and insulin sensitivity have been derived from the oral glucose tolerance test (OGTT).

In our study, HbA1c had positive correlation with serum amylase which was not statistically significant but HbA1c had a significant positive correlation with serum lipase. Similar study found positive significant correlation of serum lipase with FPG[17]. Another study, concluded that in type 2 Diabetes mellitus, wherever the blood glucose level was higher, the serum amylase activity was found to be significantly lower[18] which was consistent with the present study.

Conclusion

Serum amylase and lipase were found to be relatively normal in under 30 young diabetic and no significant correlation with BMI. HbA1c had a significant positive correlation with serum lipase but no correlation with serum amylase. Further evaluation encompassing wide scale population is needed to explore the matter clearly.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors kindly acknowledge the contribution of Department of Microbiology, BSMMU for their technical help and Study on diabetes in young (SODY) group, BSMMU for their overall support.

Funding

This work was supported as research grant by Research and Development, BSMMU and SODY group, BSMMU.

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