Original Article

Relationship of glycemic status with anthropometric measures and body mass index

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Objective: To relate the status of glycemic control with body mass index (BMI) and anthropometric measures of diabetic patients.

Methodology: The study was performed at National Institute of Diabetes and Endocrinology (NIDE), Dow University of Health Sciences, Ojha Campus, Karachi and include 245 diabetic patients. Glycemic control was measured in terms of glycated hemoglobin (HbA1c).

Results: Age range was 40-60 years. There was significant ($p \leq 0.001$) difference in body height, weight and BMI. HbA1c showed the highest set of value distribution with 7.5% or more with total mean of 9.13%. Marginal plot analysis of BMI validated that increase relative risk of disease with reference to BMI indicated the highest patient clustering with HbA1c levels was greater than 7.5% and more.

Conclusion: Increase in HbA1c was directly linked with increase in body weight and BMI in diabetic patients. (Rawal Med J 202;45:46-50).

Keywords: Anthropometric, body mass index, diabetic patients, glycemic, height, weight.

INTRODUCTION

Diabetes mellitus (DM) is distinguished with imbalance homeostasis of glucose which affects the energy yielding metabolism of essential bio-molecules.[1] It is due to the relative/absolute insulin (synthesis/secretion) deficiency i.e., (type I) and/or due to secondary resistance linked with improper insulin action on target receptors (type II).[2] Adult onset (Type II i.e., Non- Insulin - Dependent Diabetes Mellitus;NIDDM) diabetes is the major problem of today with nearly 95% of total global diabetic population.[3] Worldwide, in 2018 there were 451 million individuals of age range 18-99 years with diabetes[4] and the rate of undiagnosed individuals was 49.7%.[4] Similarly, the global mortality through DM was 5 million.[4] These figures were expected to rise to 693 million by the year 2045. In Pakistan, the high weighted diabetic prevalence of greater than 26% was reported in 2018.[5]

The American Diabetes Association (ADA) has prescribed glycated hemoglobin (HbA1c) as a substitute marker to fasting level of blood sugar for the assessment of DM.[6] HbA1c has capacity to mirror the glycemic history of the first few months.[6] Raised HbA1c level has also been linked as an independent factor of risk for coronary heart (CHD) disease and high risk of stroke and consequent mortality.[6] The use of anthropometric markers along with HbA1c were also used as cost-effective and better way to correlate the health status of any individual.[7] Obesity status is easily measured with body mass index (BMI), which reveals the probability of progression of type 2 DM and associated macro-vascular complications.[8,9] Therefore, the aim of the present study was to identify the relation of glycemic status with anthropometric measures and BMI on patients attending diabetes clinic of our tertiary care center.

METHODOLOGY

Recruitment of patients was done through non-probability based purposive sampling method and patients were randomly selected irrespective of gender and race, at National Institute of Diabetes and Endocrinology (NIDE), Dow University of Health Sciences, Ojha Campus, Karachi. The study duration was September 2017 to March 2018. Sample size was computed by adjusting the margin of error at 5%, confidence of intervals at 95%. Population size was at 20000, and response distribution at 50%. The computed sample size was 377.

Patients with age >18 years and history of DM (both type I and II) were included. Pregnant women or subjects less than 17 years of age or younger, any

complications of other co-morbid diseases like any kind of cancer, new onset diabetes after organ transplant, or a recent cardiovascular event within the 3 months prior to study start or any other psychotic illness were excluded from the study. Informed consent was taken from all participants.

Anthropometric measures including body height and weight were measured. Glycemic status was measured in terms of glycated hemoglobin (HbA1c) detected through commercially available Kit (Nycocard Kit, USA).

Statistical analysis: Data were analyzed through SPSS version 22, *Graphpad* prism online Calcs for scientist and Minitab version 17. Regression analysis was conducted through Online *GraphPad* Prism Software, Quick Calcs Online Calculator for scientist. P<0.5 was considered significant.

RESULTS

Total of 245 diabetic patients, (male=121 and female=124) completed the study. While, 53 patients regretted their availability and 42 regretted to provide their blood samples and 37 were found associated with other ailments, therefore, they were excluded. The percent response rate was 65%. Highest frequency of diabetic patients was with age range of 40 to 60 years. Gender based comparative status of anthropometric measure revealed significant ($p \leq 0.001$) difference in body height, weight and in BMI (Table).

Table. Gender based comparative status of age, height, weight, BMI and glycemic control.

Variable	Male patients (n = 121)				
	Age (years)	Body height (cm)	Body weight (kg)	BMI (kg/m^2)	HbA1c
Mean ± S.E.M	52.85±1.16	162.10±0.6	75.25±1.22	27.19±0.3	9.22±0.18
Minimum to maximum	24-87	145-183	50-118	19-41	5.54-13.70
Variable	**Female patients (n = 124)**				
	Age (years)	**Body height (cm)**	**Body weight (kg)**	**BMI (kg/m^2)**	**HbA1c**
Mean ± S.E.M	52.16±0.94	153.72±0.53	68.48±1.11	28.82±0.39	9.04±0.18
Minimum to maximum	23-76	137-170	45-113	18-53	4.5-13.60
*p-value (male to female)	0.643	**0.0001**	**0.0001**	**0.0011**	0.4802

**p - value was estimated by two tailed unpaired t-test*

Fig. 1. Marginal analyses of BMI and HbA1c status of diabetic patients. ***Section (i)*** **marginal plot analysis of BMI and HbA1c.** ***Section (ii)*** **histogram analysis of BMI.** ***Section (iii)*** **histogram analysis of HbA1c.** ***Section (iv)*** **marginal plot analysis of BMI and HbA1c.**

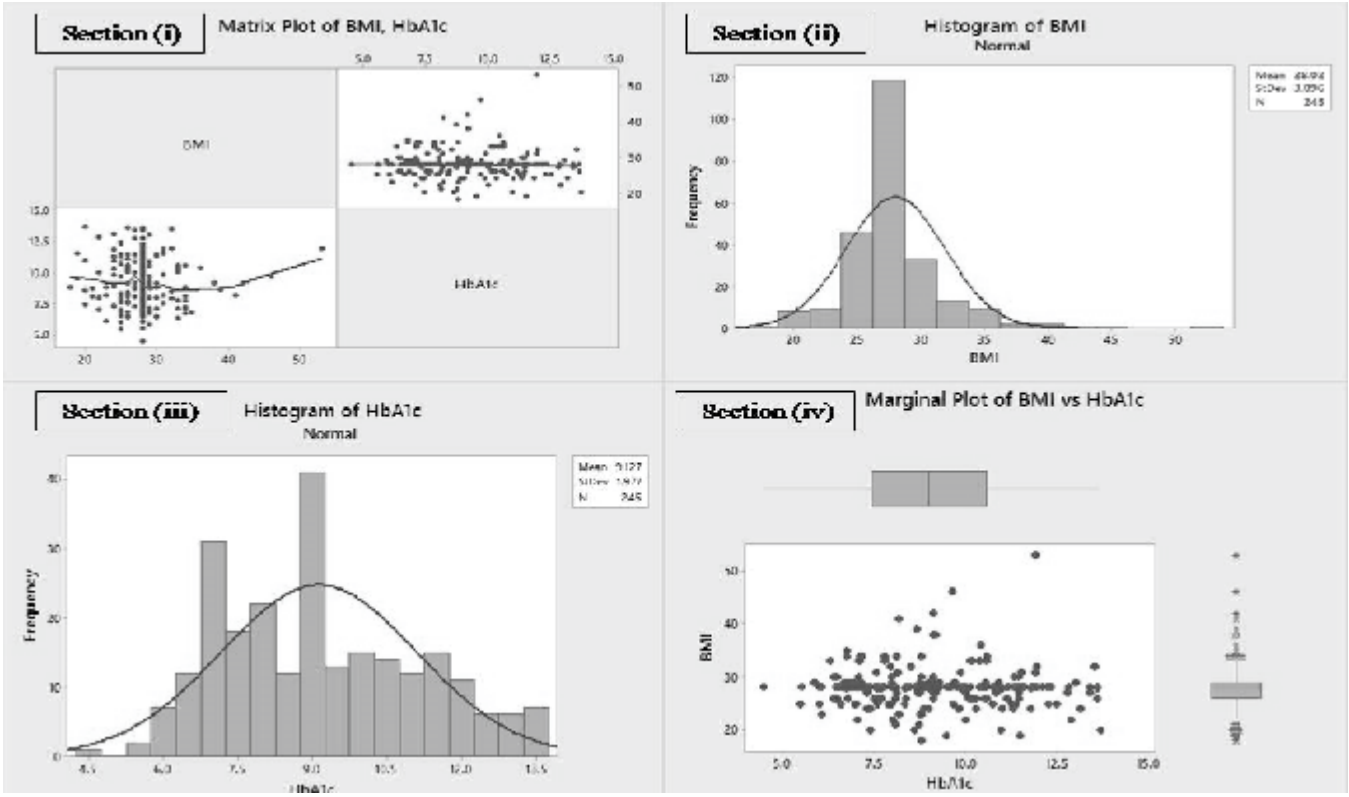
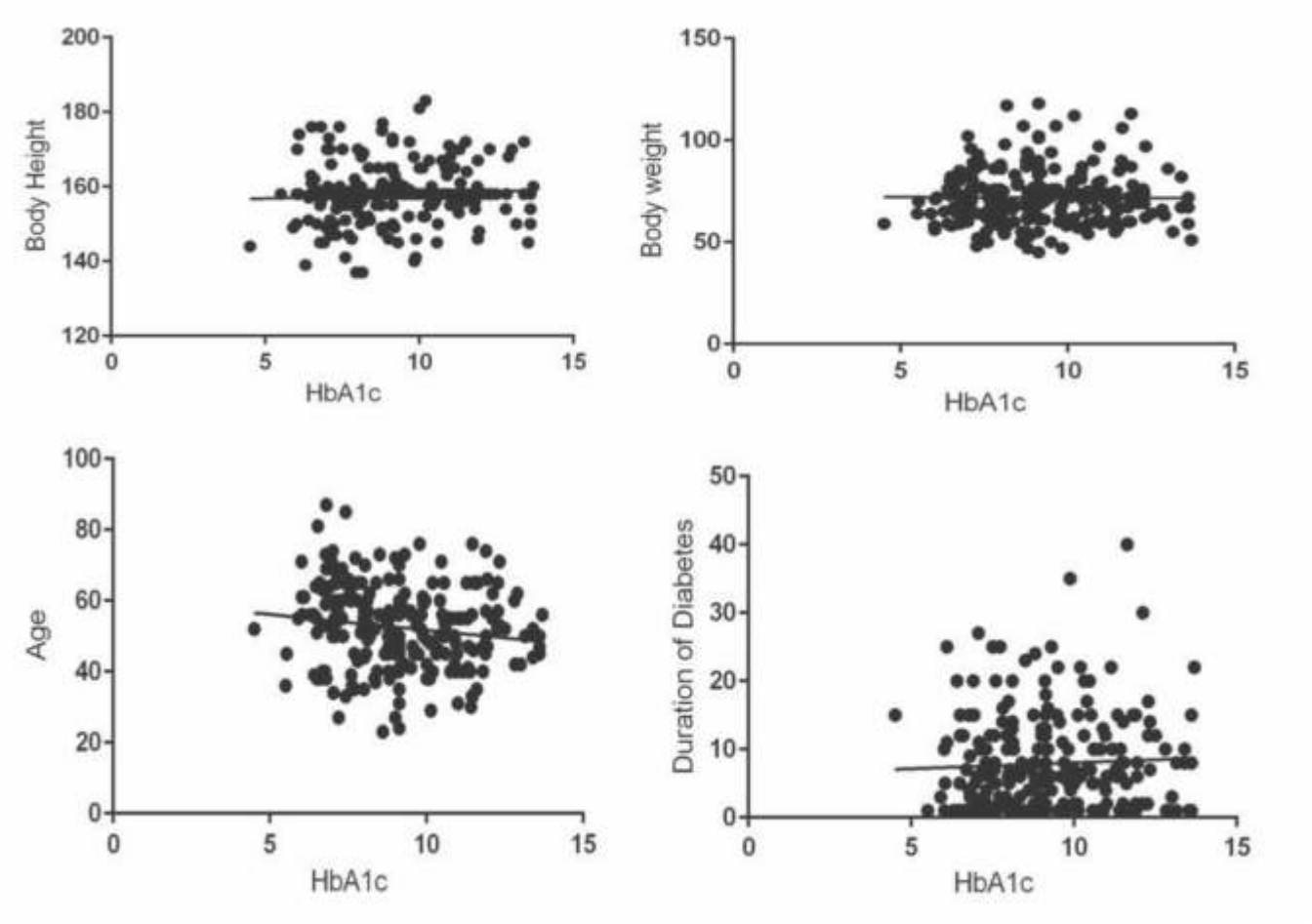


Fig. 2. Regression analyses of HbA1c with anthropometric measures.



Through matrix plot analysis, proper distribution of HbA1c values with relation to BMI was observed. Major clustering of BMI was near to 28 kg/m^2 with value greater and variable with 7% of HbA1c was observed. Matrix plot showed that HbA1c values were greater than 7% in almost majority patients. BMI histogram confirmed the majority value dispersion was with 26 kg/m^2 to further higher range with the total mean value of 28.02 kg/m^2. HbA1c histogram showed the highest set of values distribution with 7.5% or more with the total mean value of 9.127%. Marginal plot analysis of BMI validated the similar pattern, whereas, findings from HbA1c also validated with box-plot (mean) distribution (Fig. 1).

The regression coefficient was calculated in anthropometric measures by setting the HbA1c level as independent (X-axis) variable and body height, weight, age and duration of diabetes values as dependent (Y-axis) variable. Relation of body height, weight and duration of DM with HbA1c showed deviation from horizontal was non-significant. However, relation of parameter of age with HbA1c showed deviation from horizontal was significant (Fig. 2).

DISCUSSION

In country like Pakistan, where the major population mass resides under the poverty line and the access and affordability of health care facilities is not very common to all, anthropometric measurements are always preferred.[7,10] Like this, history of diabetic patients, the pre-onset time or undiagnosed time interval of any individual reflected the unmanaged space spent by individual, and if persistent, converts into diabetes.[11,12] Routine biochemical screening or

endocrine diagnostic assay(s) to investigate the health status of any individual is cost-effective.[13] Therefore, the objective of present work was to relate glycemic status (HbA1c) of diabetic population with the aid of anthropometric measures, at NIDE, Karachi.

The recommendation from ADA clearly describes the criteria for diagnosis of diabetes with the aid of HbA1c, with value greater and equal to 6.5%.[6,13-17] There is strong correlation of fasting plasma glucose level with level of HbA1c and BMI. Age is one the important factor for any individual as in most of the individuals with various ailments the progress of age has direct correlation with the disease propensity.[18] In this work, the maximum patients' age ranged from 40 to 60 years (mean 50). This is the most important time of any individual's life in which various metabolic processes and cellular machinery(s) faced transitional senescent.[7]

Another important aspect of this study was focused on gender based comparison of diabetic patients. Generally, fat deposition (in various tissues of body) is directly associated with an elevated metabolic risk of diseases,[19] more importantly like hypertension,[20] T2DM,[21] and dyslipidemia.[9] In this regard, the current and primary choice of interest as investigational marker from literature was BMI; with various treatment cutoff focuses dependent on the absence or presence of obesity-based comorbid ailments.

There is an incremental association of BMI with risk of being diagnosed with T2DM.[24] The scientific comprehension between body weight and risk of metabolic disease is basic and critical point to better understand the basic pathophysiological processes regarding obesity linked intemperance.[9] We found elevated level of body weight and BMI which had significant difference when compared on gender based status (Table 1). A study reported an increase risk of disease in individual with greater (≥ 25 kg/m^2) values of BMI.[7]

HbA1c is not just a helpful biomarker of long standing glycemic control but an effective indicator of lipid profile.[6,22] Monitoring of HbA1c not only indicates the two-to-three month average glucose level but also have an extra advantage of distinguishing diabetic patients who are at a more serious risk of CVD complications.[6] In present work, the raised HbA1c status in both male and female patients was directly associated with increased body weight and BMI. Thus, in diabetic population, gain in body weight straightly influences the raised BMI which elevates the HbA1c level and enhance the risk of diseases.

Further to this findings, matrix histogram and marginal plot analyses also authenticates the similar above mentioned relation as BMI values ≥ 28 kg/m^{2}resides with greater percentages of glycation. Even a community based research or non-diabetic individuals concluded that raised level of HbA1c was strongly related with risk of CVD and death.[23] Regression based relationship further lends support to the status of glycation found in this work with potential confounders like body heights, weights, age and duration of diabetes.

The following were the limitations of study; sample size of study was small. Cultural and other type of differences amongst participants were not considered.

CONCLUSION

Increase in body weight has straightly influence the BMI, which relates with HbA1c status. The outputs from this work may be useful for further nation-wide extension, authentication, validation and to investigate other types of clinical association(s).

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Conception and design: Syed Muhammad Hasan, Fauzia Imtiaz
Collection and assembly of data: Syed Muhammad Hasan, Akhtar Ali Baloch
Analysis and interpretation of the data: Muhammad Bilal Azmi, Fauzia Imtiaz
Drafting of the article: Muhammad Bilal Azmi, Fauzia Imtiaz
Critical revision of the article for important intellectual content: Fauzia Imtiaz
Statistical expertise: Muhammad Bilal Azmi, Fauzia Imtiaz
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