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Assessment of cut-off for average glucose metabolic index-a new scoring for pre-diabetes: Evaluated among population of South Gujarat

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Abstract

Background: Diabetes mellitus is evaluated through fasting serum glucose, HbA1c, glucose tolerance test. We are also using scoring system like HOMA IR and METS IR scoring for detecting pre-diabetes and insulin resistance. But recent studies found that these scoring are not consistent and not useful in day to day clinical basis and also it doesn't evaluate underlying insulin deficiency or beta cell dysfunction simultaneously.

Objectives: 1. To determine cut-offs for Average Glucose Metabolic Index = BMR/(15.5*FASTING GLUCOSE) among population in South Gujarat., 2. To determine the association of the AGMI with BMI.

Methods: The study population is people attending Niramaya Health camp in tertiary care hospital in Surat, South Gujarat. Sample size is 122 young adults aged between 18 years and 45 years. The individuals are evaluated for pulse rate, blood pressure, fasting blood glucose, lipid profile, mode of adipose distribution, BMI and questionnaire were done for addictive habits, eating habits, physical activity and other comorbidities. The data collected is tabulated. Each parameter are plotted in graph for evaluating coefficient of association with AGMI. Mean value of AGMI is calculated and +/-2SD is taken as normal higher and lower cut-offs.

Results: From the study we have found that reference range for the AGMI is 1-1.2 kcal/min in males and 0.8-1 kcal/min in females. AGMI is not associated with BMI, with coefficient of correlation 0.0159.

Conclusion: AGMI is very useful to identify individuals with metabolic dysfunction. It is more simple and affordable than current HOMA IR and METS IR to compare overall glucose metabolism taking into consideration the overlapping effect of insulin resistance and beta cell dysfunction as pathology for diabetes. Also we have found that BMI is not associated with AGMI. However the current study can be scaled up in sample size to get more precise reference interval.

Conflicts of Interest: The author declares that there is no involvement of any third party funding or interest in this research.

Keywords: Average glucose metabolic index, insulin resistance, beta cell dysfunction, BMI

Introduction

In the tenth edition of IDF reporting it was found that the prevalence of Diabetes mellitus in the world is around 9% (537 million adults) in 2021 [1]. Also 541 million people are found to be having decreased glucose tolerance. In Diabetes Atlas 10th edition it was given that one in six pregnancy is prone to Hyperglycaemia in pregnancy and also 45 % of diabetes in the world are undiagnosed which is mostly Type 2 .So we require a more advanced method for diagnosing Diabetes. Diabetes have become a threat to low and middle income countries and also India So it requires multipronged strategy to tackle it efficiently [2].

Fasting Blood Glucose is the first parameter that is used to diagnose diabetes. HbA1c is glycated haemoglobin percentage which suggests elevated blood glucose level in the blood for prolonged periods for approximately 3-6 months. Glucose tolerance test helps us to determine the type of diabetes in patients. But we need screening test to detect diabetes early in pre diabetic stage so that we can treat it early

HOMA IR scoring evaluate Insulin resistance in prediabetis individuals but it has its own limitations [4, 5, 6]. Fasting Blood glucose and insulin are measure at a particular point of time and it can vary over time.

The validity of HOMA IR should be carefully evaluated in individuals with low BMI, beta cell dysfunction and patients on oral hypoglycaemic drugs. Other scoring available is METS IR, QUICKI, and SPICE IR scoring which are not usually used clinically, because these are not having well defined cut-offs for comparison and also they focus mostly in insulin activity and resistance [6]. Insulin test is costly in low and middle income countries and rural areas .Treatment of hyperglycaemia in pregnancy also need early diagnosis and intervention [7].

Hypolemmal is a danger in diabetic patients on insulin and oral hypoglycaemic drugs which requires accurate assessment of dosage for prevention [8]. Basal Metabolic Rate is widely accepted parameter to evaluate daily requirement of calorie per day in both men and women. We are using BMR and FBS to come up with a simple formula to screen diabetes early.

Treatment of hyperglycaemia in pregnancy also need early diagnosis and intervention.

Methods and Materials

Study populations

The study is conducted at the New Civil Hospital, Surat, which is located in the South Gujarat region. It is a government hospital and so patients from faraway areas consult the hospital for treatment. Our study population included people attending Niramaya health camp which is conducted to screen for prevalence of any health condition in the Police officers of the Surat District. Our sample size is 122. The study population include individuals aging from 18 years till 45 years of both sexes .No one is excluded from the study.

Statistical analysis

The Formula for Average Glucose Metabolic Index is given by,

$$AGMI = BMR/(15.5*FBS)$$

We have evaluated the population, collected the general details including age by questionnaire and the height and weight is measured. We also collected details of FBS from the laboratory reports. BMR is calculated by:

Mifflin-St Jeor Equation

For Men:

BMR = (10 × weight in kg) + (6.25 × height in cm)-(5 × age in years) + 5

For Women:

BMR = (10 × weight in kg) + (6.25 × height in cm)-(5 × age in years)-161

Mean value of AGMI is calculated from the collected data and 2 standard deviations above and below the mean is taken as the reference interval.

The calculated BMI is plotted against AGMI to determine the coefficient of determination.

Ethical considerations

We had taken approval from Ethical committee of Government Medical college, Surat to conduct cross sectional study on patients consulting in New Civil Hospital to evaluate risk factors of Diabetes.

All the participants were informed about the study. The study is a cross sectional study and the data were collected through questionnaire.

Results

From the study we could come to mean value for Average Glucose Metabolic Index (AGMI). We calculated the value separately for males and females. We found that reference range for AGMI in South Gujarat population is 0.8-1 kcal/min in females and 1-1.2 kcal/min in males.

We got mean value as 1.1 kcal/min in males with standard deviation of 0.1 and 1 kcal/min in females with standard deviation of 0.1.

Baseline characteristics

Table 1: Clinical and laboratory characteristics of the study in males

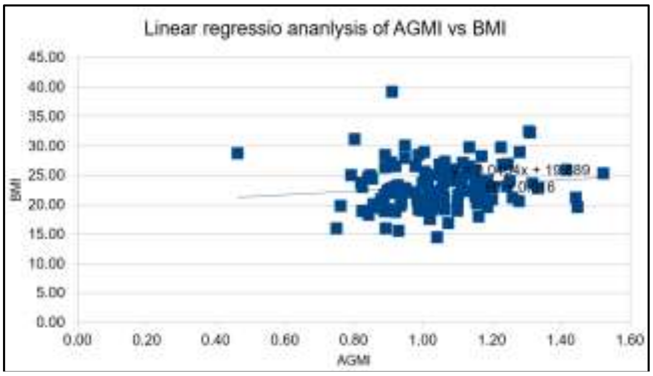
Characteristics	Mean value	Reference unit
Males	79	individuals
Age	32+/-6	years
Height	1.7+/-0.06	m
Weight	67.53+/-10.09	kg
BMI	23.43+/-4.01	kg/m^2
WC	33.11+/-2.94	inch
Cholesterol	202.22+/-37.14	mg/dL
Triglycerides	136+/-92.79	mg/dL
LDL	122.78+/-30.28	mg/dL
HDL	53.56+/-8.46	mg/dL
FBS	93.03+/-10.78	mg/dL
Systolic BP	115.51+/-9.12	mmHg
Diastolic BP	73.56+/-7.61	mmHg
BMR	1582.9+/-104.6	kcal/day
AGMI	1.1+/-0.1	kcal/min

Table 2: Clinical and laboratory characteristics of the study in females

Characteristics	Mean value	Reference unit
Females	43	individuals
Age	30.41+/-6.07	years
Height	1.60+/-0.04	m
Weight	57.27+/-9.76	kg
BMI	22.38+/-3.57	kg/m^2
WC	31.50+/-2.70	inch
Cholesterol	186.24+/-32.94	mg/dL
Triglycerides	86.58+/-33.96	mg/dL
LDL	112.68+/-33.47	mg/dL
HDL	57.70+/-10.25	mg/dL
FBS	90.48+/-14.89	mg/dL
Systolic BP	111.86+/-5.64	mmHg
Diastolic BP	72.27+/-6.19	mmHg
BMR	1424.97+/-105.83	kcal/day
AGMI	0.9+/-0.1	kcal/min

Abbreviations: BMI Body mass index, HDL high-density lipoprotein, LDL Low-density lipoprotein, AGMI-Average Glucose Metabolic Index, BMR Basal Metabolic Rate, FBS Fasting Blood Sugar, WC-waist circumference

Next objective was to find if AGMI is associated with BMI. And we have found that BMI is not associated with AGMI with coefficient of determination value 0.0159



Abbreviations: BMI Body mass index, AGMI Average Glucose Metabolic Index

Graph 1: Linear regression analysis to find any association of BMI with Average Glucose Metabolic Index

Conclusions

Average Glucose Metabolic Index helps to compare the metabolic rate in POV of FBS and BMR. BMR is calculated as the Metabolic rate at the sedentary state or rest. So individuals with high AGMI will be having either high BMR or the person may be having low FBS. An individual with high AGMI will be more prone to hypoglycaemia. And an individual with low AGMI is more prone to hyperglycaemia or diabetes. So AGMI can be used as a tool to predict diabetes and screen pre-diabetes in undiagnosed population. AGMI is not associated with BMI. So BMI cannot be used to determine the chance of diabetes in an individual. AGMI can also be used to predict chance of hyperglycaemia in pregnancy and also insulin and OHD dose calculation.

Abbreviations

BMI: Body mass index
HbA1c: Glycated haemoglobin
HOMA-IR: Homeostasis model assessment for insulin resistance
HDL: High-density lipoprotein
LDL: Low-density lipoprotein
QUICKI: Quantitative insulin sensitivity check index
T2DM: Type 2 diabetes mellitus
AGMI: Average Glucose Metabolic Index
METS-IR: Metabolic Score for Insulin Resistance
BMR: Basal Metabolic Rate
FBS: Fasting Blood Sugar
WC: Waist circumference
BP: Blood Pressure

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All the authors contributed equally in the research. The author declare that there is no third part funding or interest in the study.
Approval is taken from Ethical committee of Government Medical College, Surat to conduct cross sectional study on patients consulting in New Civil Hospital to evaluate risk factors of Diabetes.
All the participants were informed about the study. The study is a cross sectional study and the data were collected through questionnaire.

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