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Research Article

Correlation of Body Mass Index with Waist Circumference, Random Blood Sugar and Dietary Pattern as Predictors of Diabetes Mellitus

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Abstract

The objective of this study is correlation of body mass index with waist circumference, random blood sugar and dietary pattern to predict diabetes in university boys (18-25years). A study of random blood glucose, waist circumference and body mass index of 50 subject's age (18-25years) was carried out. The nutritional dietary pattern of the subjects using the 24 hours dietary recall techniques was done Data was collected with a structured questionnaire. Subjects were measured for waist circumference and weight and height determent for BMI. Estimation of random blood glucose with the help of ACCU- CHECK indicated that all the boys had normal level. Subjects consisted of 50 university boys, the mean participant's average weight is 68.21±9.31kg, average height is 173.76±7.43cm and average BMI 22.50±2.23kg/m^2. Normal BMI (18.5-22.9kg/m2) was found in (48%), underweight (2%), overweight (34%) and obese (16%) of the subject studied. The mean waist circumference of participants is 85.16±6.38cm. The abnormal waist circumference (WC) was observed in 28% (n=14) and normal waist circumference is 72% (n=36) of the subject studied. The mean random blood sugar is 122.88±9.51mg/dl. The random of the subject blood sugar method is 100% normal. The nutrition intake of energy, protein, fat, carbohydrates is there mean of participants is average of energy 1786.41±335.17kcal, protein 62.70±17.4gm, fat 47.18±14.00gm and carbohydrates 256.37±59.38gm. There was a statistically positive correlation between waist circumference, body mass index and random blood sugar . Therefore, waist circumference, non-invasive techniques has a good correlation with BMI and therefore abdominal obesity is a predictor of diabetes.

Keywords: Diabetes mellitus Obesity; Body mass index; Waist circumference; Random blood sugar; Dietary Pattern.

Introduction

Diabetes mellitus is on the rise. No longer a disease of predominantly rich nations, the prevalence of diabetes is steadily increasing everywhere, most markedly in the world's middle-income countries. Unfortunately, in many settings the lack of effective policies to create supportive

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environments for healthy lifestyles and the lack of access to quality health care means that the prevention and treatment of diabetes, particularly for people of modest means, are not being pursued. When diabetes is uncontrolled, it has dire consequences for health and well-being. (WHO Global Health report., 2016)

India is the diabetes capital of the world. Indians are highly susceptible to diabetes and cardiovascular disease with modest over weight, central obesity, and decrease in physical activity. There has been a rapid increase in the prevalence of diabetes and cardiovascular disease in India. (Ramachandran et al., 1992). India had 69.2 million people living with diabetes (8.7%) as per 2015 data of these remained undiagnosed in more than 36 million people. The rising prevalence of diabetes is driven by a combination of factors; rapid urbanization, sedentary lifestyle, unhealthy diet, increasing life expectancy and higher income. (Henkbekedam et al., 2016)

Diabetes mellitus is a clinical condition characterized by increased blood glucose level (hyperglycemia) due to insufficient and inefficient insulin. Insulin is either not produced in sufficient quantity or ineffective in its target tissue. Diabetes mellitus can result in morbidity and mortality related primarily to its associated complications. (Mathers and Loncar, 2006). Diabetes Mellitus (DM) is defined as a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat, and protein metabolism resulting from defects in secretion and insulin actions. Diabetes mellitus is classified into type 1, type 2, and other specific types and gestational. Diabetes mellitus which may be asymptomatic, especially type 2, can be diagnosed by estimating the level of glucose in the blood (Satyanarayana, 2014). Despite the association of obesity with poorer glycemic control and cardiovascular morbidity and mortality less attention has been given to its management relative to the attainment of glycemic targets. Therefore, diabetes mellitus is becoming more and more prevalent in Indian society. (Swami. 1994)

Body mass index (BMI) is a good measure of general adiposity (Mamtani and Kulkarni, 2005). Body mass index (BMI), which relates weight to height, is the most widely used and simple measure of body size, and is frequently used to estimate the prevalence of obesity within a population (WHO MONICA Project, 1988). Body mass index (BMI) and waist circumference are the most widely used measures to define obesity and predict its complications, such as diabetes mellitus (DM) and hypertension. Besides these are non – invasive methods in predicting diabetes mellitus and can be done by any individuals. The relationship between excess weight and diseases has been recognized over time (Visscher and Seidell, 2001). The currently recommended cut-offs of BMI for Asians recommended by WHO include <18.5 underweight, 18.5 - 22.9 kg/m^2 for normal, 23-24.9 kg/m^2 for overweight,25-29.9kg/m^2 pre-obese, >30kg/m^2 obese,30-40kg/m^{2}obese type1(obese),40.1-50kg/m^2 obese type2 (morbid obese), and >50 obese type3 (super obese). BMI applies to most adults 18-65 years. (http/www.gov.in)

Waist circumference is a measurement taken around the abdomen at the level of the umbilicus (belly button). Health experts use waist circumference to screen patients for possible weight-related health problems. Waist circumference is used as a measure of central obesity and it is a modifiable factor that could influence glycaemic control. Waist circumference is also found to be a strong predictor of future glucose control, and may be an inexpensive tool for risk stratification of subject with diabetes (Blaha *et al*., 2008). According to guidelines, cut-offs for waist circumstances will now be 90 cm for Indian men (as opposed to 102 cm globally) and 80 cm for Indian women (as opposed to 88cm globally) (WHO, 1995).

Random glucose test (random blood glucose) is a blood sugar test taken from a non-fasting subject. This test, also called casual blood glucose (CBG), is taken after 2 hours of consumption of a recent meal and therefore has higher reference values than the fasting glucose test. The subjects' random blood sugar is noted by glucometer. For random blood glucose a cut off of >=140 mg/dl is taken as diabetic, levels below140mg/dl are considered as normal (non-diabetic) (Olinto et al., 2004).

The 24-hour hour diet recall interview is a quantitative research method used in nutritional assessment, which asks individuals to recall foods and beverage they consumed in the twenty-four hours prior to the interview. It may be self-administered. Twenty-four hour recalls are easy to use, but do required the use of context specific props for accuracy. Use of props for accurate information on the amounts of food and beverages consumed. (Stein et al., 1994)

The objective of this study is to find a correlation between body mass index, waist circumference, random blood sugar and dietary pattern among the university boys.

Methods

A study of random blood glucose, waist circumference and body mass index of 50 subject's age (18-25years) was carried out. The nutritional dietary pattern of the subjects using the 24 hours dietary recall techniques was done Data was collected with a structured questionnaire. Subjects were measured for waist circumference and weight and height determent for BMI. Estimation of random blood glucose with the help of ACCU- CHECK indicated that all the boys.

Statistical Analysis

Statistics is a science of collection, organization and interpretation of data. It deals with all aspects of this including the planning of the data collection in the term of the design of survey and experiment. Data entry and analysis were done with SPSS 20(Chicago, IL, USA). The frequencies of categorical variables and means of continuous variables were determined. Cross tabulation analysis was carried out to determine the correlation of body mass index with waist circumference, levels with waist circumference, body mass index and waist circumference with random blood glucose and dietary pattern. All P-values less than 0.05 were considered significant. All results are presented as mean (SD) or percentage, where applicable.

Results

The study sample consisted of 50 male university students (18-25 years). The mean age of participants is 22.24±1.53yrs. The subjects were age and sex matched. The participant's average weight is 68.21±9.31kg, average height is 173.76±7.43cm and average BMI 22.50±2.23kg/m^2 and waist circumference is 85.16±6.38cm as shown in Table 1.

Table 1: Demography and Anthropometric data of study subjects**.**

Variables	**Minimum**	**Maximum**	**Mean ± SD**
Age (years)	19.00	25.00	22.24+1.53
Weight (kg)	52.00	90.00	68.21+9.31
Height (cm)	158.00	188.00	173.76+7.43
BMI (kg/m2)	17.53	26.23	22.50+2.23
Waist circumference (cm)	68.00	97.00	85.16+6.38

Among participants 2% were underweight, 48% normal BMI, 34% overweight and 16% were obese, more than 25 BMI as shown in Table 2.

Table 2: BMI Categories

BMI range	**Frequency (F)**	**Percentage (%)**
Underweight <18.5	1	2.0
Normal weight 18.5-22.9	24	48
Over weight 23-24.9	17	34
Obese >25	8	16
Total	50	100

The abnormal waist circumference (WC) was observed in 28% (n=14) and normal waist circumference is 72% (n=36) of the subject studied as shown in Table 3. Correlation between BMI and WC is shown in Fig 1 bar diagram. The random blood sugar is normal in the entire subject studied; the mean random blood sugar is 122.88±9.51mg/dl as shown in Table 4 and 5. Out of out of 50 subjects, 14%vegeterian and 86% non-vegetarian as shown in Table 6.

Table 3: Waist circumference category

	Frequency (F)	**Percentage (%)**
Normal <90 cm	36	72
High >90 cm	14	28
Total	50	100

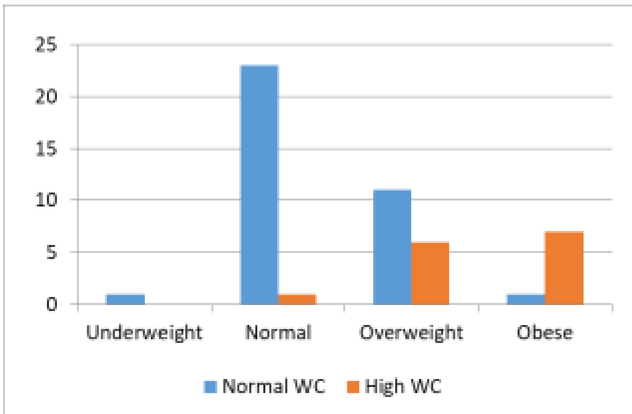

Fig 1: Correlation between BMI and WC

Table 4: Random blood sugars of study subjects.

Parameter	**Minimum**	**Maximum**	**Mean + SD**
RBG (mg/dl)	98.00	138.00	122.88±9.51

Table 5: Random blood sugar category

RBG range	**Frequency**	**Percentage (%)**
Normal range 80-120mg/dl	50	100
Pre-diabetics 120-200mg/dl	0	0
Diabetics >200mg/dl	0	0
Total	50	100

Table 6: Eating habits and food allergy category

Eating habits	**Frequency (f)**	**Percentage (%)**
Vegetarian	7	14
Non- vegetarian	43	86
Food allergy	-	-
Total	50	100

According to type of food intake, average energy is 1786.41 ±335.17 kcal, protein is 62.70 ±17.4 gm, fat is 47.18 ±14.00 gm, carbohydrates is 256.37 ±59.38 as shown in Table 7.

Body mass index had a strong correlation with waist circumference and random blood sugar (P>0.01).Body mass index, waist circumference, random blood sugar had no statistical correlation with energy, protein, fat and carbohydrate (P<0.01). Energy had a strong correlation with protein, fat and carbohydrates (P>0.01). Protein had correlation with fat and carbohydrates (P>0.05). Fat had correlation with carbohydrates (P>0.05) (Table 8).

Table 7: Distribution nutrients intakes of study subjects.

Nutrients	Minimum	Maximum	Mean + SD
Energy (kcal)	1189.56	2536.80	1786.41 ±335.17
Protein (gm.)	37.41	108.90	62.70 ±17.4
Fat (gm.)	19.81	81.00	47.18 ±14.00
Carbohydrates (mg)	145.34	432.71	256.37 ±59.38

Table 8: Correlation of BMI, WC, RBG and Dietary pattern

		Age	BMI	WC	RBG	Energy	Fat	protein	CHO
Age	Pearson Correlation	1	.250	.241	.166	.009	.177	.105	-.086
	Sig. (2-tailed)		.083	.095	.255	.949	.223	.471	.558
BMI	Pearson Correlation	.250	1	.715**	.496**	.166	.032	.145	.095
	Sig. (2-tailed)	.083		.000	.000	.255	.826	.322	.515
WC	Pearson Correlation	.241	.715**	1	.390**	.201	.085	.028	.146
	Sig. (2-tailed)	.095	.000		.006	.166	.561	.850	.316
RBG	Pearson Correlation	.166	.496**	.390**	1	.150	.009	.141	.105
	Sig. (2-tailed)	.255	.000	.006		.302	.952	.333	.471
Energy	Pearson Correlation	.009	.166	.201	.150	1	.550**	.473**	.836**
	Sig. (2-tailed)	.949	.255	.166	.302		.000	.001	.000
Fat	Pearson Correlation	.177	.032	.085	.009	.550**	1	.332*	.295*
	Sig. (2-tailed)	.223	.826	.561	.952	.000		.020	.040
Protein	Pearson Correlation	.105	.145	.028	.141	.473**	.332*	1	.284*
	Sig. (2-tailed)	.471	.322	.850	.333	.001	.020		.048
CHO	Pearson Correlation	-.086	.095	.146	.105	.836**	.295*	.284*	1
	Sig. (2-tailed)	.558	.515	.316	.471	.000	.040	.048	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Conclusion

Of the entire anthropometric measurement waist circumference, a non-invasive technique has a good correlation with BMI and therefore abdominal obesity can be considered a predictor of diabetes. Though the subjects are university boys the results can be extrapolated and applied to any place, even rural. The importance is that even if laboratories for testing blood sugar are not available in the vicinity a simple measuring tape can be used to detect abdominal obesity and therefor predict diabetes. Body mass index or preferably Waist circumference should be routinely checked in clinical practice and epidemiological surveys. There is a need for promotion of a healthy life style, regular exercise and proper nutrition.

Limitation of the Study

The fasting blood sugar is the ideal measure of blood sugar. However, its measurement was not quite feasible in university males as they were un- willing to give a fasting sample of blood. A small sample of university students was taken because of the paucity of time.

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