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Diabetes Risk Prediction Using Indian Diabetes Risk Scoring (IDRS) - A BMI Wise Analysis

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ABSTRACT

Back ground: Obesity is increasing worldwide and WHO has declared obesity as a disease. South Asians are genetically pre disposed to higher body fat deposition and hence more prone to develop NCDs. WHO has put forth additional cut offs of BMI for South Asians as public action points for the prevention of NCDs. The present study aimed at analyzing the diabetes risk using IDRS across BMI categories. **Methods:** This study was conducted through a case-control survey method. Based on WHO cut offs, 8 BMI groups were considered as cases and had 27 participants in each group. For the controls, 15 respondents having normal BMI without NCD s were considered. One more control group was 25 respondents with normal BMI but having NCDs. The data was collected through a structured questionnaire and the data were analyzed based on IDRS. **Results:** The control group had the lowest risk for developing diabetes and the risk increased for the controls with comorbidity group and the overweight and obese groups. For both genders, the risk was peaking at BMI of 30.0-32.49 Kg/m^2, followed by 25.0-27.49Kg/m^2, and 32.5-34.99 Kg/m^2. On average, female participants faced 5% higher risk than males for developing diabetes but the difference was not statistically significant. The correlation of BMI and Visceral fat were statistically significant and body fat percentage had a highly significant influence on diabetes risk. **Conclusion:** Additional cut off points proposed by WHO should be considered as important public action points for the prevention of NCDs.

Keywords: Obesity, WHO cut off points, BMI, IDRS

Introduction

Obesity is increasing worldwide and WHO has declared obesity in itself as a disease since 2002 (Chopra et al, 2002). South Asians are genetically predisposed to have higher body fat and visceral fat deposition even at lower BMI levels. Consequently, these populations are prone to develop non-communicable diseases especially diabetes. The main pathological features for the same are insulin resistance, pancreatic beta cell dysfunction, body composition, biomarkers and genetic risk factors along with lifestyle factors like urbanization

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and migration, dietary transitions and physical inactivity (Shah and Kanaya, 2014). In 2004, WHO had proposed additional cut off points of BMI for south Asians considering this fact. The present study was an attempt to analyze the risk for developing diabetes based on Indian Diabetes Risk Scoring (IDRS) (Mohan et al, 2005), which was developed based on the data of south Indians. The components considered in this tool are age, abdominal obesity, physical activity, and family history of diabetes and the possible score ranged from 0 to 100. Mohan et al in 2007 had highlighted that IDRS can be an effective indicator of metabolic syndrome and cardiovascular risk even among subjects with normal glucose tolerance. In 2008 Mohan et al reported that incidence rates of diabetes and pre diabetes in India are higher compared to other ethnic groups and western populations and that the Indian Diabetes Risk Score (IDRS) is perhaps the best predictor of incident diabetes among Asian Indians. Nandeshwar, et al (2010) also had similar findings from a study at Bhopal. A study conducted among 222 undergraduate students in Mumbai (Bhatia, et al 2014) using IDRS revealed that 1% of them had high and 68% had moderate risk for developing diabetes. Gopalakrishnan et al (2017) had similar observations among medical students in Chennai. Gupta, et in 2010 derived comparable findings from rural Tamil Nadu.

Material and methods

The study was carried out in a case- control survey method using a structured questionnaire from a cross sectional survey of 500 respondents. When distributed based on WHO cutoff points of BMI the limiting group was BMI of 37.5-39.99 Kg/m^2 in which there were 27 participants and hence 27 each were selected from each category of BMI. The data derived was compared with 15 control participants and 25 participants who had normal BMI and had Non-Communicable Diseases (NCD). The anthropometric data and data for developing IDRS was collected using interview method and standard measurement techniques. The energy intake and fat intake were calculated from 24 hour recall.

Study area and period

The data was collected from two hospitals in Trivandrum, Kerala. One was an inpatient center and one was outpatient center. The data was collected between 2015 and 2018. The respondents belonged to southern districts of Kerala.

Inclusion and Exclusion Criteria

Inclusion criteria were- Adult males and females aged 18-65 years and respondents willing to participate in the study. Exclusion criteria were respondents who are Non Resident Indians, who are bedridden, and those not willing to participate in the study. Informed consent was taken before collecting their data.

Sample Size

The control groups had BMI ranging from 18.5-22.99 Kg/m^2. According to WHO cutoffs, there were 8 BMI groups in the overweight and obese groups as mentioned in table 1. As 27 respondents were selected from each category, the sample size for cases was 216, for controls was 15 and for controls with comorbidities was 25. All the three groups together, 256 respondents were studied.

Tools used for the study

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Pre tested structured questionnaire was used to elicit data of the respondents for survey. Selected domains of data from this tool provided the base data for the anthropometric profile and diet recall data.

For calculating diabetes risk, the standard tool of IDRS was used. The scoring guide is given in table 1.

Table 1. The Indian Diabetes Risk Screening Tool

PARTICULARS	**SCORE**
AGE (YEARS)	
<35 (reference)	0
35-49	20
≥50	30
ABDOMINAL OBESITY	
Waist <80 cm (female), <90 cm (male) [reference]	0
Waist ≥80-89 cm (female), ≥90-99 cm (male)	10
Waist ≥90 cm (female), ≥ 100 cm (male)	20
PHYSICAL ACTIVITY	
Exercise (regular)+ strenuous work (reference)	0
Exercise (regular) or strenuous work	20
No exercise and sedentary work	30
FAMILY HISTORY	
No family history (reference)	0
Either parent	10
Both parents	20
MINIMUM SCORE	**0**
MAXIMUM SCORE	**100**

Statistical analysis

Mean distributions, Anova analysis and correlation studies were employed for statistical analysis of the data.

Results and Discussions

The study respondents included 108 males and 148 females and the age ranged between 19-65 years. The main contributors to high scores with IDRS were waist circumference and sedentary behavior whereas the age and family history was not as influential as the other domains. The respondent's data were distributed based on BMI groups for data analysis. Table 2 discusses the BMI wise risk scoring and the percentage of incidence of diabetes.

Table 2. Gender and BMI wise distribution of Mean value of IDRS

BMI group	**Males (n=108)**	**Females (n=148)**	**Total (n=256)**	**Diabetes incidence in**

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				percentage
Controls	38.00	40.00	38.67	0%
Controls with co-morbidities	56.92	62.67	59.68	68%
23.0-24.9 Kg/m^2	54.29	56.15	55.19	56%
25.0-27.49 Kg/m^2	68.00	75.83	71.48	63%
27.5-29.99 Kg/m^2	59.23	70.00	64.81	59%
30.0-32.49 Kg/m^2	74.44	76.67	75.93	59%
32.5-34.99 Kg/m^2	66.36	71.25	69.26	59%
35.0-37.49 Kg/m^2	62.00	63.18	62.96	68%
37.5-39.99 Kg/m^2	55.00	62.86	61.11	37%
≥40.00 Kg/m^2	65.55	63.33	64.07	37%

It can be clearly seen that the normal control group had the lowest mean IDRS score and the values raised from the controls with comorbidity group till the BMI>40 Kg/m^2 group. The risk for developing diabetes was more among females as evidenced by this table in every category of BMI except for the >40 Kg/m^2 group. For both genders, the risk was peaking at BMI of 30.0-32.49 Kg/m^2, followed by 25.0-27.49Kg/m^2, and 32.5-34.99 Kg/m^2. In the controls with comorbidity group, diabetes was the highest contributor to morbidity as 68% of them were already victims. Among over weight and obese group, 35.0-37.49 Kg/m^2 exhibited highest rate of diabetes incidence followed by 25.0-27.49 Kg/m^2.

This data throws light on the fact that additional cut off points fixed by WHO should be considered as points of action for prevention of non-communicable diseases. Anova analysis was carried out to determine whether the difference among males and females were significant.

Table 3. One way Anova of Gender and IDRS

Gender	Mean ±SD	Range	F value	p value
Male (n=108)	61.11±17.79	20-100	3.312	0.070
Female (n=148)	65.15±17.34	20-90		
Total (n=256)	63.45±17.61	20-100		

On analysing table 3 it becomes evident that male respondents had higher range of IDRS score (20-100) but the mean score was less. At the same time, females generated a score ranging from 20-90, but still had higher mean values than male respondents. On average, female participants faced 5% higher risk than males for developing diabetes but the difference was not statistically significant. This may be due to the fact that females tend to have higher waist circumference than males. Many variables like body weight, BMI, body fat percentage, visceral fat percentage, dietary energy consumption and dietary fat

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consumption can influence the risk for developing diabetes and were analysed through correlation studies. Table 4 describes the distribution of the selected variables across the cases and controls and their influence on diabetes risk.

According to Venkatarao et al (2020), using a composite of BMI and waist circumference on IDRS will improve the specificity and accuracy of the tool. A South Asian study in Kerala by Kapoor et al (2020) found out that almost one-third of the population, at high risk for T2D, had normal weight obesity. Gómez-Ambrosi (2011) recommended that assessing body fat percentage may help to diagnose disturbed glucose tolerance beyond information provided by BMI and waist circumference in particular in male subjects with BMI <25 kg/m2 and over the age of 40. Obesity is associated with inflammation in adipose tissue, namely an infiltration and expansion of macrophages, which produce inflammatory cytokines that interfere with insulin signalling, and a loss of protective cells that promote adipose homeostasis (Kohlgruber and Lynch, 2015).

Table 4. Influence of selected variables on Diabetes risk scoring using IDRS

Variable	Cases (Mean±SD)	Controls (Mean±SD)	Controls with Co-morbidities (Mean±SD)	Pearson Coefficient	*p* value
Body weight (Kg)	84.5±18.6	60.5±7.5	58.8±5.9	0.064	0.152
BMI (Kg/m^2)	32.7±6.3	21.6±0.9	21.9±1.1	0.156*	0.006
Body fat percentage	36.9±6.8	23.7±7.4	26.8±7.5	0.263**	0.000
Visceral fat percentage	17.2±7.7	4.9±2.1	6.1±2.2	0.150*	0.008
Energy intake in Kcals/day	1658±450	1953±362	1680±410	-0.027	0.332
Fat intake in g/day	48±16	58±12	33±9	0.054	0.193

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

Normal value of body fat percentage is 8.0-24.9% for males and 21.0-35.9 % for females and for visceral fat percentage is 0-9%. The mean BMI was in the obese range for cases and within normal limits for both control groups. Total body fat percentage and visceral fat percentage were higher than normal values for the cases. Though falling within normal range, controls with comorbidity group had higher percentage body fat and visceral fat percentage than the controls. Interestingly, mean intake of energy and fat was higher for controls than cases and controls with comorbidity. Body fat percentage had highly statistically significant influence on diabetes risk than all other components. The correlation of BMI and Visceral fat had statistically significant influence on diabetes risk. The other tested components did not have significant influence. Body weight and fat intake had a positive influence on diabetes risk but interestingly, energy intake had a negative influence on diabetes risk. This could be due to the fact that controls had higher energy intake than the other two groups.

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Behl and Misra (2017) had opined in a review that obesity characteristics (including ectopic fat) are more adverse in Asian Indians and lead to morbidities at lower BMI levels compared to white Caucasians and so Lifestyle management should be advised at lower limits of BMI and waist circumference.

Conclusions

Additional cut off points proposed by WHO should be considered as important public action points for the prevention of NCDs. Females faced 5% higher risk than males for developing diabetes and hence the nutrition interventions to prevent obesity and thereby diabetes should focus more on imparting education to females considering the fact that females are physiologically prone to deposit more body fat. Correlation studies revealed that total body fat percentage had a stronger influence than visceral fat percentage on increasing diabetes risk.

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