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Performance Of Waist-To-Height Ratio in Comparison to Indian Diabetic Risk Score and BMI As a Screening Tool for Diabetes Mellitus Among Participants in A Teaching Hospital in South Karnataka: A Cross-Sectional Study.

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ABSTRACT

Diabetes is a rising epidemic. Hence, it is of high priority to screen the population to add quality of life years using the best tool. **Aim:** To identify, if Waist to Height ratio (WHtR) is a better indicator for evaluating the risk of developing Diabetes Mellitus (DM) by comparing with BMI and Indian Diabetes Risk Score (IDRS). **Method:** A cross-sectional study done by using a validated questionnaire and measuring blood pressure and GRBS. Area under curves were generated for IDRS, BMI and WHtR with those already diagnosed with DM. **Result:**This study had 55% (166) females. Average age of participants was 40.38±14.37 years and 12.3% (37) of them are diabetic. Their mean BMI, WHtR and IDRS were 24.95±4.85, 0.52±0.09 and 42.16±19.15 respectively. AUC for IDRS, WHtR and BMI were 0.785, 0.787 and 0.673 respectively and all were found to be statistically significant. **Conclusion**: Since IDRS and Wt-HR have similar AUC values in better acceptable range than BMI,they can be considered equally good. WHtR had high sensitivity, hence, can be used as an alternate screening method as it is non-invasive, hence, easily acceptable, and affordable for mass screening for early diagnosis of high-risk cases for counseling them for repeated blood sugar monitoring periodically

Keywords: diabetes mellitus, Waist to Height ratio, Indian Diabetes Risk Score, BMI

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INTRODUCTION

The prevalence of diabetes in India has risen in such a way that India is now the 'diabetes capital of the world' [1]. According to the information given by International Diabetes Federation, the number of people worldwide suffering from diabetes may hike upto 552 million by 2030 [2]. Diabetes mellitus (DM) has a long latent asymptomatic period of almost seven years. Before diagnosis it can be screened in community in a patient-friendly approach to reveal the actual burden of the disease [3]. Surveys have revealed that the persisting ratio of previously undiagnosed to known cases of diabetes is 1:2 in India. Such undiagnosed diabetes mellitus cases can lead to complications in the kidney, blood vessels, eyes, nerves, and brain [4]. Therefore, the planning of strategies for prevention and early diagnosis of diabetes needs to be more aggressive.

Obesity is the main risk factor behind the epidemic of type 2 diabetes in both developed and developing countries [5]. The best adiposity index that reflects diabetes risk remains unclear [6]. These indices help classify individuals based on their risk of developing diabetes and identify if they can be benefited from timely interventions [7]. Waist circumference (WC) and Waist to Height ratio (WHtR) are correlating more with visceral fat which has a greater association with developing type 2 diabetes than Body Mass Index (BMI) which reflects the total body mass [8]. Measurement of BMI and WC are age-dependent in children and adolescents which requires referring to a table for cut-off values. Therefore, an adiposity index which is easy to use and reliable was WHtR [9]. It was helpful to use in a clinical set-up and public health settings with the message- "Keep your WC to less than half of your Height" [10].

Various countries have developed risk scores for assessing and preventing diabetes. The Madras Diabetes Research Foundation (MDRS) devised the Indian Diabetes Risk Score (IDRS) considering the age, abdominal obesity of the individual, family history of diabetes and physical activity status without any invasive procedure for screening population at higher risk of developing diabetes in future [11]. Nuguwela MD et al. have evaluated the performance of IDRS in different ethnic groups[12]. As per the study by Mohan V et al., MDRF-IDRS can predict incident diabetes, coronary artery disease, metabolic syndrome, non-alcoholic fatty liver disease and sleep disorders also [13].

Many systemic reviews and meta-analyses revealed the predictive value of WHtR. However, there is a scarcity of studies comparing the performance of WHtR with IDRS and BMI. Hence, this is our attempt to analyze the predictive value of different anthropometric measurements for developing diabetes in our population.

MATERIALS AND METHODS

This study was conducted in a tertiary care hospital in South India. Samples were collected from individuals who voluntarily participated in an awareness program held on behalf of World Diabetes Day, on December 1st 2022 at the hospital. A total of 301 participants shared their details regarding age, family history of diabetes mellitus and physical activity. Waist circumference was measured with minimum clothing during the end of respiration at the mid-point between the lower rib cage and the highest point of the iliac crest. Height of participants was measured after removing shoes, by standing straight with back flat against the wall and chin parallel to the floor. By using a ruler, the wall was marked and measured from the ground with the help of measuring tape. Weight was noted in the weighing machine which was calibrated. Systolic Blood Pressure and Diastolic Blood Pressure were checked in the resting state. With the help of a glucometer, GeneralRandom Blood Sugar (GRBS) values were collected.GRBS < 140 mg/dl was considered as normal and ≥140 mg/dl was taken as hyperglycemia to classify participants as diabetics or not[14]. By using the above data, the BMI, WHtR and MDRF-IDRS ratio were calculated. BMI is calculated by dividing weight (kilogram) by height (meters squared). Asian and South Asian population were categorized as overweight if BMI was above 22.9 and 24.9 kg/m^{2}respectively [15]. A cut-off value of 0.5 was applied on WHtRto categorize participants [16]. IDRS tool employed in this study is developed by Madras Diabetes Research Foundation (MDRS) [11].

Statistical Analysis

Statistical analysis was done using SPSS software version 23. Categorical variables are presented as frequency and proportion whereas continuous variables as mean and standard deviation. Association of BMI, Wt-HR and IDRS with the presence of DM was tested using independent t-test. Cut-offs were noted from Receiver Operating Characteristics (ROC) curve in discussion with subject experts and diagnostic accuracy was quantified.

RESULTS

Out of the 301 participants, 166 (55.1%) were females and 135 (44.9%) were males. In this study, 12.3% (37) of the participants were diabetic. Of those who had a family history of diabetes mellitus, 15.6% had a diabetic father and 8% of participants had a diabetic mother and only 5% of the study population had both parents' diabetic.

While coming to physical activity, 189 (62.8%) participants indulged in mild form of physical activity while 111(36.9%) and only 1(0.3%) was into moderate to strenuous work respectively.

Table 1: Baseline characteristics of participants (N= 301)

Parameters	Mean ± Standard deviation
Age (years)	40.38 ±14.37
Systolic BP (mmHg)	121.82 ±18.16
Diastolic BP (mmHg)	70.23 ±11.53
GRBS (mg/dl)	127.31 ± 57.89
Height (cm)	161.42 ±9.33
Weight (kg)	65.12 ±1
WC (cm)	85 ±14.82
BMI (kg/m^2)	24.95 ±4.85
WHtR	0.52 ±0.09
IDRS	42.16 ±19.15

Table 2 shows a comparison of BMI, IDRS and Wt-HR with the presence of diabetes mellitus. The average IDRS was higher (60±17.48) among participants already diagnosed with diabetes compared to non-diabetic (39.55±18.07). This was shown to be a statistically significant (p-value <0.05). Association of BMI and WHtR with presence of diabeteswere also found to be statistically significant with p=0.001 and p<0.05 respectively.

Table 2: Comparison of BMI, IDRS and Wt-HR with the presence of diabetes mellitus. (N=301)

Variables	Presence of Diabetes	N	Mean	Standard Deviation	P value
IDRS	No	264	39.55	18.07	<0.05
	Yes	37	60	17.48	
BMI (kg/m^2)	No	264	24.61	4.73	0.001
	Yes	37	27.34	5.08	
Wt-HR	No	264	0.51	0.09	<0.05
	Yes	37	0.6	0.08	

*Independent T-test

Figure 1 and Table 3 shows the ROC curve and AUC measurables respectively which illustrate the sensitivity and specificity of comparing BMI, IDRS and WHtR for the prediction of diabetes mellitus.

Figure 1: Receiver operating characteristic (ROC) curves comparing BMI, IDRS and WHtR for prediction of diabetes mellitus. (N=301)

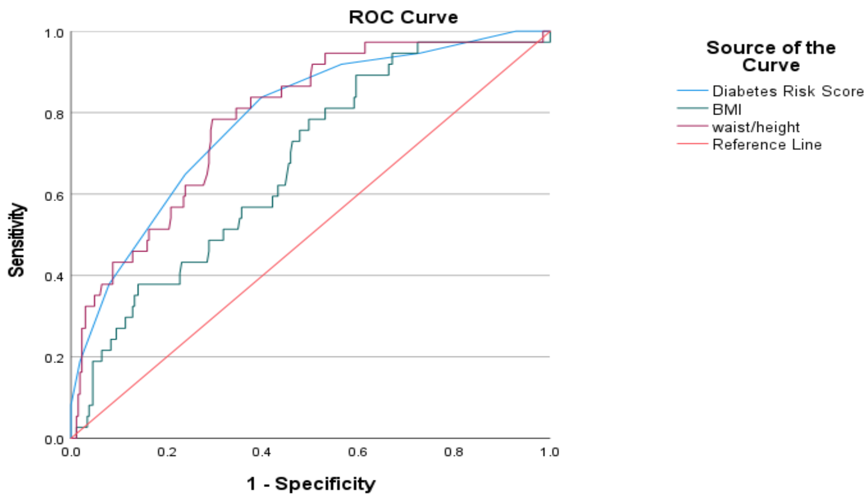

Table 3: Area Under ROC curve for BMI, IDRS and WHtR for diabetes mellitus. (N=301)

Variable	Area	Confidence Interval		P value
		Lower Bound	Upper Bound	
IDRS	0.785	0.709	0.862	<0.05
BMI	0.673	0.587	0.759	0.001
Wt-HR	0.787	0.712	0.862	<0.05

In Table 4, Sensitivity, specificity, positive predictive value, and negative predictive value with an accuracy of BMI, IDRS and WHtR for diabetes mellitus are shown.

Table 4: Sensitivity, specificity, positive and negative predictive values with an accuracy of BMI, IDRS andWHtR for diabetes mellitus. (N=301)

Variable	BMI (Asian)	IDRS (cut-off 60)	IDRS (cut-off 40)	Wt-HR (cut-off 0.5)	Wt-HR (cut-off 0.54)
Sensitivity(%)	81.1	64.9	91.8	97.3	83.8
Specificity(%)	41.3	76.1	43.5	36.7	58.7
Positive predictive value(%)	16.2	27.6	18.5	17.7	21.3
Negative predictive value(%)	94	93.9	97.4	99	96.5
Accuracy(%)	46.1	74.7	51	44.1	59.2

DISCUSSION

The mean BMI, WHtR and IDRS were 24.95±4.85, 0.52±0.09 and 42.16±19.15 respectively in our study. Calculating BMI with a cut-off 22.9, showed sensitivity of 81.1% and specificity of 41.3% in our study population. According to a study by Rai N et al., it was shown that since BMI is a measure of general adiposity, it was not the best obesity index to predict diabetes with sensitivity of 83.3% and specificity of 61.7% when compared to WHtR and WC [17]. In a Chinese study, when the cut-off point was 0.5 for Wt-HR as in ours, the sensitivity and specificity were 71.11% and 57.96% [18]. This study had a better sensitivity of 97.3% and specificity of 38.3% compared to them.It was identified that IDRS has an optimal cut-off of 40, giving a sensitivity of 91.8% and specificity of 43.5% rather than with cut-off 60 having 64.8% sensitivity and 76.1% specificity. But in a study by Dudeja P et al.,the sensitivity and specificity of IDRS to predict the risk of DM are shown as 95.12% and 28.95% respectively even with a score ≥60 [19].

Larger the area under the ROC curve (AUC) better is the performance of the tool to identify individuals with disease. The AUC for BMI is 0.673 and IDRS is 0.785 and Wt-HR is 0.787 for prediction of DM which is also statistically significant ($p<0.05$).

Since IDRS and Wt-HR have similar AUC values which fall under the better acceptable range than BMI, both can be considered equally good. It is easy to obtain WHtR in community settings which may help us to counsel people to lose a few centimeters of WC to reduce the risk of diabetes.

Limitation

Although 12.3% were known diabetics, newly diagnosed diabetics were not confirmed with second test in the camp. Diagnosis was made based on a single sample.

CONCLUSION

According to our study, Wt-HR and IDRS have better sensitivity and specificity with AUC greater than BMI which makes them equally good screening tool for diabetes. Such easy-to-administer, non-invasive methods that maintain adequate sensitivity are easily acceptable and affordable for mass screening for early diagnosis of high-risk cases that can delay or eradicate complications which might compromise a patient's quality of life. Such approaches to population help in convincing people to undergo blood sugar tests like glucose tolerance test (GTT) especially people under the age of 40 as well as very old from developing countries who presume that they cannot get diabetes as they never had it before. Also, an additional advantage of reducing the economic burden on lower-income countries which occurs due to the cost of health care services can be achieved.

Conflicts Of Interest: The authors have no conflict of interest

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