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Original Research Article

Neck circumference as a risk indicator for type 2 diabetes mellitus: a community based cross-sectional study

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ABSTRACT

Background: Diabetes mellitus is a metabolic syndrome due to insulin deficiency, characterized by hyperglycaemia. Indian diabetes risk score (IDRS) is the most commonly used one to determine the risk status. However there is lot of inconvenience and possible errors in measuring the waist circumference to determine the IDRS, hence the study was planned to evaluate if neck circumference could replace waist circumference in determining the diabetes risk.
Methods: This cross sectional study was conducted among 300 study participants fulfilling the eligible criteria. Socio-demographic variables, parameters required for determining the IDRS was assessed, in addition, neck circumference (NC) was measured using standard protocol. Another risk score was calculated by replacing waist circumference (WC) with neck circumference and scoring was named as IDRS-NC. Pearson correlation and Wilcoxan sign rank test was done to find out the relationship between WC and NC and also to determine if IDRS-NC could replace IDRS.
Results: Out of 300 study population, majority of the participants are in the age group of <35 years 129 (43%) and around 2/3rd of the participants were females. Among the study participants proportion of participants belonging to low risk, medium risk and high risk assessed using IDRS and IDRS-NC was 18.7%, 41%, 40.3% and 31.7%, 38%, 30.3% respectively. There was a strong positive correlation (r=0.837) between the neck circumference and waist circumference. Wilcoxan sign rank test was significant between the 2 scores having a p value of <0.05.
Conclusions: In our study there was a positive correlation between neck circumference and waist circumference.

Keywords: Indian diabetes risk score, IDRS-NC, Wilcoxan sign rank test

INTRODUCTION

Diabetes mellitus is a metabolic syndrome due to insulin deficiency, characterized by hyperglycemia. The fasting blood glucose value of ≥126 mg/dl and/or postprandial blood glucose value of more than 200 mg/dl, by oral glucose tolerance test is the diagnostic cut-off for diabetes.[1] WHO projects that diabetes will be the seventh leading cause of death in 2030.[2] As per 2015 data, India had 69.2 million people living with diabetes (8.7%) as per the 2015 data, of which, more than 36 million people were undiagnosed.[3] Various validated risk scores, like diabetes risk score by American Diabetes Association (ADA), Finnish diabetes risk scores have been developed across the world, to address the population at risk and to intervene at the earliest. In India, a similar score called Indian diabetes risk score (IDRS), considering 4 parameters, which includes age, family history, waist circumference and physical activity was developed as a screening tool.[4,5] On measuring the waist circumference, there is high possibility of measurement error, especially in overweight and obese patients due to difficulty in locating anatomical landmarks. It was also noted that female population are hesitating to measure waist circumference.[6] From the recent studies, it was evident

that, neck circumference had a strong positive correlation with waist circumference.[7,8] Similarly, it was also found that, change in the neck circumference was associated with change in abdominal visceral fat.[9]

However, only few studies have been carried out in India, using the neck circumference as a screening tool for diabetes. With the above background, the study was planned to determine whether neck circumference could replace waist circumference in Indian diabetes risk score (IDRS) and can be used as a screening tool for diabetes, in order to overcome various errors related to measurement of waist circumference. With the above background the study was planned with the following objectives to screen the study population for the risk of developing diabetes mellitus using neck circumference and Indian diabetes risk score (IDRS), to analyze the relationship between neck circumference and waist circumference and to assess whether neck circumference could replace waist circumference in IDRS.

METHODS

This cross sectional study was conducted in rural field practice area of Tagore Medical College and hospital, Chennai for a period of 2 months (October and November , 2018) .The sample of 300 was obtained using the formula $4pq/d^2$, where p=35, q=65, absolute precision (d)=6%, non-response rate=15, the required sample size came as 291 which is rounded to 300, hence sample size=300.[10] The study population was selected by simple random sampling method, those aged above 18 years, either males or females, not a known case of diabetes mellitus residing in rural field practice area were included. Pregnant women, mentally challenged, seriously bed ridden patients those with ascites, goiter were excluded

After getting the IEC, the study was conducted using a structured, content validated questionnaire was used. Socio-demographic variables, family history of DM, physical activity was obtained. Waist circumference was measured by making the subject stand with feet close together, arms at the side. Subject was made relaxed, and the measurements were taken at the end of a normal expiration. It was measured at the midpoint between the lower margin of the least palpable rib and the top of the iliac crest, using a stretch-resistant tape. Each measurement was repeated twice; if the measurements are within 1 cm of one another, the average was calculated. If the difference between the two measurements exceeds 1 cm, the two measurements was repeated. Proportion of population at risk was determined by IDRS score. Neck circumference was measured using the same tape in the midway of the neck, between mid-cervical spine and mid anterior neck, within 1 mm. In men with a laryngeal prominence (Adam's apple), it was measured just below the prominence. Neck circumference values above the cut-off values of 37 and 34 cm for men and women respectively, are considered to be abnormal.[10] In order to replace the waist circumference in IDRS score by neck circumference, scoring was also given to neck circumference. The IDRS score was calculated by replacing the circumference with neck circumference and termed as IDRS-NC in our present study.

Table 1: Scoring for neck circumference.[10]

Neck circumference	Scoring
Neck circumference <34 cm [female], <37 [male] [reference]	0
Neck circumference ≥34-37 cm [female], ≥37-40 cm [male]	10
Neck circumference ≥38 cm [female], ≥41 [male]	20

RESULTS

Among the 300 study population, majority of the participants are in the age group of <35 years 129 (43%) and most of them are females 175 (58.4%). More than half of them were Hindu, 169 (56.3%) and nearly one-third of them belonged to high socio-economic class of Class I 111 (37%) according to modified Kuppusamy scale classification (Table 3).

Table 2: Indian diabetes risk score.[11]

Particulars	Scores
Age (in years)	
<35	0
35-49	20
≥50	30
Abdominal obesity	
Waist circumference<80 cm [female] , <90 [male] [reference]	0
Waist circumference ≥80-89 cm [female], ≥90-99 cm [male] waist circumference ≥90 cm	10
[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

Continued.

Particulars	Scores
Family history	
No family history [reference]	0
Either parent	10
Both parents	20

Minimum score: 0; Maximum score: 100; Subjects with an IDRS of <30 was categorized as low risk, 30-50 as medium risk and those with ≥60 as high risk for diabetes.

Table 3: Distribution of participants based on socio-demographic parameters (n=300).

Parameters	Frequency N (%)
Age (in years)	
<35	129 (43)
35-49	95 (31.6)
≥50	76 (25.4)
Sex	
Males	125 (41.6)
Females	175 (58.4)
Religion	
Hindu	169 (56.3)
Christian	94 (31.3)
Muslim	37 (12.4)
Socio-economic class	
Class I	111 (37)
Class II	74 (24.6)
Class III	69 (23)
Class IV	37 (12.3)
Class V	9 (3.1)

It was observed that nearly 2/3rd of the participants had no family history of diabetes mellitus 57% and only 15% of them had family history in both the parents. When the level of physical activity was determined, it was observed that, nearly 61% of the participants were doing regular exercise or strenuous work followed by 28% and 11% of them doing regular exercise and strenous work and no exercise and sedentary activity respectively.

Among the 125 male paricipants, nearly half 66 (52.5%), of them had WC≥90-99 and even among the female participants, around half (53.1%) of them had waist circumference ≥90 cm. of Among the 125 male participants, the proportion of men with very high neck circumference of ≥41 cm was 14.4%, whereas in females, 12.5% of them showed neck circumference of ≥38 cm (Table 4).

Table 4: Distribution of risk factors of type 2 diabetes mellitus (n=300).

Variables	Frequency N (%)
Family history (n=300)	
No family history	170 (57)
Either parent	84 (28)
Both the parents	46 (15)
Level of physical activity(n=300)	
Regular exercise and strenuous work	85 (28)
Regular exercise or strenuous work	182 (61)
No exercise and sedentary activity	33 (11)
Abdominal obesity	
Males (n=125)	
<90 cm	32 (25.6)
≥90-99 cm	66 (52.5)
≥100 cm	27 (21.5)

Continued.

Variables	Frequency N (%)
Females (n=175)	
<80 cm	20 (11.4)
≥80-89 cm	65 (35.4)
≥90 cm	93 (53.1)
Neck circumference males (n=125)	
≥41 cm	18 (14.4)
≥37-40 cm	24 (19.2)
<37 cm	83 (66.4)
Neck circumference females (n=175)	
≥38 cm	22 (12.6)
≥34-37 cm	50 (28.5)
<34 cm	103(58.9)

The proportion of participants having high risk of diabetes mellitus was more with IDRS than with IDRS-NC, which was 40.3% and 30.3% respectively (Table 5). On assessing the correlation between the 2 scores it was noted that, there is a positive relationship between neck circumference and waist circumference, with the r value of 0.837 and it was found statistically significant, having a p value of <0.0001 [Figure 1]. However having a p value of <0.05 determined by Wilcoxan sign rank test, it states that IDRS cannot be replaced by IDRS-NC as the test result rejects null hypothesis (H_0) (Table 5).

Table 5: Comparison of IDRS score with IDRS-NC.

Risk	IDRS N (%)	IDRS-NC N (%)	Wilcoxan sign rank test	Significance
Low risk	56 (18.7)	95 (31.7)		
Medium risk	123 (41)	114 (38)	T statistic: 341; critical value: 434	0.001
High risk	121 (40.3)	91 (30.3)		

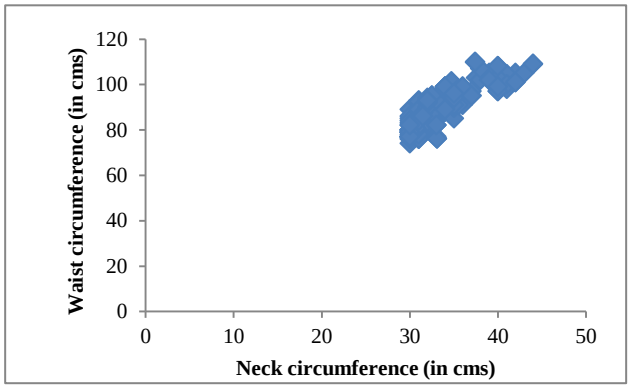

Figure 1: Correlation of neck circumference with waist circumference (n=300).

DISCUSSION

Our community based cross sectional study among 300 participants classified most of the participants under medium risk of diabetes mellitus which was determined by both IDRS and IDRS-NC, which was similar to the study conducted at rural Karnataka, which showed higher proportion of moderate risk than the low and high risk groups.[12] Another study conducted by Nagalingam et al among urban population also had higher proportion of medium risk population (45%) than the other risk groups.[13] The prevalence of abdominal obesity in the present study was 21.5% in males and 53.1% in females. A large scale meta data analysis of cross sectional and longitudinal surveys conducted by Jacobsen et al, suggested that the WHO cut off points for abdominal obesity are gender specific however, the prevalence of abdominal obesity was lower in men than in women, which was similar to our present study difference.[14] A cross-sectional survey among 15,364 participants aged above 15 years and older, conducted in China, also showed prevalence of abdominal obesity higher among males (8.6%) than females (11.3%).[15] There are already many supporting studies and trials suggesting the waist circumference as a measure of abdominal fat accumulation but recent studies done in developing and developed countries support the evidence of neck circumference as a measure of overweight and obesity among adults and also in children with the above available cut off values. Neck circumference (NC) has been shown to be an indicator of central adiposity. A population-based study of 2847 Han children aged 7-12 years, showed the prevalence of overweight and obesity in boys was 18.0% and 26.0% and 11.7% and 15.7% for girls. The mean NC in boys was significantly greater than in girls (29.2±3.1 cm vs 28.1±2.8 cm, p<0.001). NC was significantly correlated with age, BMI and waist circumference in both boys and girls.[16] Similar study conducted among female college students showed that WC, NC and BF (%) were significantly positively related to obesity and NC, WC were found to be independently associated with obesity.[17] A study conducted by Kumar et al in rural India done among 203 adults showed that BMI correlated with NC and weight among both men and women.[18] Our study also explains that there is a positive

correlation between neck circumference and waist circumference and based on the r value the relationship was found to be strongly positive having r as 0.837 and it was found statistically significant, having a p value of <0.0001. Similarly the study conducted by Karki there was a strong positive Pearson correlation of neck circumference with waist circumference was found in both male and females(r=0.64 in male and r=0.86 in female).[8] In spite of the neck circumference having a strongly positive correlation with the waist circumference, it was not able to replace the waist circumference in Indian diabetes risk score. However various other studies, conducted in different parts of the world, have proved that neck circumference is replaceable for waist circumference and is a simple and best measure of central obesity.[19,20]

CONCLUSION

Our community based cross sectional study classified most of the participants under medium risk of diabetes mellitus which was determined by both IDRS and IDRS-NC. And also this study found out that there is a positive correlation between neck circumference and waist circumference which could replace the IDRS risk score with neck circumference.

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