PREDICTION OF RISK FOR CARDIOVASCULAR DISEASE FROM FASTING AND POST-PRANDIAL HYPERGLYCEMIA AND SIMPLE ANTHROPOMETRIC INDICES IN YOUNG ADULTS

Physiology

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ABSTRACT

INTRODUCTION: In this study, we aimed to correlate simple anthropometric indices and blood sugar level in young adults to predict the likelihood of cardiovascular disease.

MATERIAL AND METHODS: Cross-sectional study was conducted on a total of 60 students (aged 18-27 years) of first professional MBBS. Student's unpaired t-test was employed for data analysis.

RESULTS: Fasting blood sugar level was significantly raised (p<0.05) in "at risk" males according to WC criteria. As per WHR criteria, pp blood sugar level was significantly raised in males "at risk" level. As per WHtR, both fasting and pp blood sugar levels were significantly increased in males "at risk" level.

CONCLUSION: Our study suggested that simple anthropometric measurements can help in predicting the onset of CVD in younger age group.

KEYWORDS:

Waist circumference, Waist Hip Ratio, Waist Height Ratio, post-prandial blood sugar, Hip circumference.

INTRODUCTION

Anthropometry provides the single most portable, universally applicable, inexpensive and non-invasive technique for assessing the size, proportions and composition of the human body. It reflects both health and nutritional status and predicts performance, health and survival. As such, it is a valuable, but currently underused, tool for guiding public health policy and clinical decisions.

Today, CVD accounts for approximately 30% of deaths worldwide, including nearly 40% in high-income countries and about 28% in low- and middle-income countries. The huge burden of CVD in the Indian subcontinent is the consequence of the large population and the high prevalence of CVD risk factors. The risk factors may be classified into two: behavioural risk factors which include tobacco use, diet, physical inactivity, and metabolic risk factors which include lipid levels (hypertriglyceridemia and low HDL cholesterol), hypertension, obesity and diabetes mellitus.

Impaired fasting glucose (IFG) is a frequent glycemic disorder in the general population and is considered as a pre-diabetic state. IFG has received increasing attention in recent years, not only because it is an intermediate stage in the development of diabetes and cardiovascular diseases (CVDs), but also because it is associated with increased risk of all-cause death and CVD mortality. IFG has thus come to be considered as a potential indicator of preventive importance for diabetes and CVDs.

Waist circumference has been shown to be the best simple measure of both intra-abdominal fat mass and total fat.

The waist-to-height ratio (WHtR) is an alternative anthropometric index of central obesity that has also been shown to denote cardiometabolic risk among individuals who are not obese according to other anthropometric indices. WHtR can identify adults at cardiometabolic risk, even when such individuals are categorized as 'healthy' or 'normal' according to BMI or WC.

Thus, the aim of our present study is to make a comparison between blood sugar level and anthropometric measurements in young healthy males and females.

MATERIAL AND METHODS

The present study was conducted in healthy medical students of first professional M.B.B.S. (n = 60) with 30 males (n = 30) and 30 females (n = 30) of 18 to 27 years age group at G.S.V.M. Medical College, Kanpur. Height, Weight, Waist Circumference (WC) and Hip Circumference (HC) of each subject were recorded and Waist - Hip Ratio (WHR) and Waist-Height Ratio (WHtR) were calculated. A fasting and 2 hour post-prandial venous blood samples were drawn from each subject for blood sugar assay.

The subjects were divided into following groups:
According to WC:
Males with WC < 94 cm: "Below risk level" males
Males with WC ≥ 94 cm: "At risk level" males
Females with WC < 80 cm: "Below risk level" females
Females with WC ≥ 80 cm: "At risk level" females

According to WHR:
Males with WHR < 0.90: "Below risk level" males
Males with WHR ≥ 0.90: "At risk level" males
Females with WHR < 0.85: "Below risk level" females
Females with WHR ≥ 0.85: "At risk level" females

According to WHtR:
Adults with WHtR < 0.5: "Below risk level" adults
Adults with WHtR ≥ 0.5: "At risk level" adults

Blood sugar levels were done by Biochemical Autoanalyser 'VITA LAB SELECTRA E' at the 24 hour emergency pathology lab using Enzymatic – colorimetric – Trinder – End Point method (Glucose oxidase and glucose peroxidase method). Normal reference value taken as 75 - 100 mg/dl (4.2 - 5.6 mmol/L).

STATISTICAL ANALYSIS

"SPSS statistical package for Windows version 16". Mean, standard deviation and Student's unpaired "t"-test were used to compare quantitative data. Correlation coefficient was used to compare continuous variables. The level of significance used was at 5% confidence limit (p<0.05).

RESULTS

BLOOD SUGAR LEVEL ACCORDING TO WAIST CIRCUMFERENCE(WC) :

It was found that in males "below risk level" (WC < 94 cm), fasting blood sugar ranged from 80 to 102 mg/dl with mean and SD of 90.46 ± 6.46 and in males "at risk level" (WC ≥ 94 cm), fasting blood sugar ranged from 90 to 108 mg/dl with mean and SD of 100.00 ± 7.48. Fasting blood sugar level was increased in males "at risk level" as compared to males "below risk level" and the difference was statistically significant (p < 0.05). Post Prandial blood sugar level was also increased in males "at risk level" as compared to males "below risk level" but the difference was not statistically significant (p > 0.05). In females, no significant findings were obtained.

Table 1: BLOOD SUGAR LEVEL (mg/dl) ACCORDING TO WAIST CIRCUMFERENCE

	MALES		FEMALES	
	"BELOW RISK LEVEL" n=26	"AT RISK LEVEL" n=4	"BELOW RISK LEVEL" n=22	"AT RISK LEVEL" n=8
FASTING SUGAR	90.46±6.46	100.00±7.48*	89.56±5.95	88.25±3.88
PP SUGAR	106.35±11.21	132.25±39.48	106.77±11.41	108.00±2.90

Normal fasting sugar level= 100-125 mg/dl, Normal pp sugar level= <200 mg/dl (* Significant, p < 0.05)

BLOOD SUGAR LEVEL ACCORDING TO WAIST HIP RATIO(WHR):

It was found that in males "below risk level" (WHR < 0.9), post prandial blood sugar level ranged from 89 to 119 mg/dl with mean and SD of 102.86 ± 9.37 and in males at risk level (WC ≥ 0.9),post prandial blood sugar ranged from 96 to 184 mg/dl with mean and SD of 115.88 ± 22.72. Post-prandial blood sugar level was increased in males "at risk level" as compared to males "below risk level" and the difference was statistically significant (p < 0.05). Fasting blood sugar level was also increased in males "at risk level" as compared to males "below risk level" but the difference was not statistically significant (p > 0.05).

In females, the variation in values of fasting and post-prandial blood sugar was not statistically significant (p > 0.05).

Table 2: BLOOD SUGAR LEVEL (mg/dl) ACCORDING TO WAIST HIP RATIO

	MALES	FEMALES		
	"BELOW RISK LEVEL" n=14	"AT RISK LEVEL" n=16	"BELOW RISK LEVEL" n=23	"AT RISK LEVEL" n=7
FASTING SUGAR	89.79±6.97	93.44±7.28	89.61±5.91	87.86±3.48
PP SUGAR	102.86±9.37	115.88±22.72*	107.39±10.95	106.14±9.72

Normal fasting sugar level= 100-125 mg/dl
Normal pp sugar level= <200 mg/dl
(* Significant, p < 0.05)

BLOOD SUGAR LEVEL ACCORDING TO WAIST HEIGHT RATIO(WHtR):

It was found that in males "below risk level" (WHtR < 0.5), fasting blood sugar level ranged from 80 to 101 mg/dl with mean and SD of 89.17 ± 5.85 and in males "at risk level" (WHtR ≥ 0.5), fasting blood sugar ranged from 81 to 108 mg/dl with mean and SD of 95.58 ± 7.67. Fasting blood sugar level was increased in males "at risk level" as compared to males "below risk level" and the difference was statistically significant (p < 0.05).

In males "below risk level" (WHtR < 0.5), post-prandial blood sugar level ranged from 89 to 116 mg/dl with mean and SD of 101.56 ± 7.42 and in males "at risk level" (WHtR ≥ 0.5),post-prandial blood sugar ranged from 98 to 184 mg/dl with mean and SD of 122.17±23.65. The post-prandial blood sugar level was increased in males "at risk level" as compared to males "below risk level" and this difference was also statistically significant (p < 0.05).

But in females, the variation in values of fasting and post-prandial blood sugar were not statistically significant (p > 0.05).

Table 3: BLOOD SUGAR LEVEL (mg/dl) ACCORDING TO WAIST HEIGHT RATIO

	MALES	FEMALES		
	"BELOW RISK LEVEL" n=18	"AT RISK LEVEL" n=12	"BELOW RISK LEVEL" n=19	"AT RISK LEVEL" n=11
FASTING SUGAR	89.17±5.85	95.58±7.67*	89.58±6.37	88.55±3.47
PP SUGAR	101.56±7.42	122.17±23.65*	104.74±9.42	111.18±11.51

Normal fasting sugar level= 100-125 mg/dl, Normal pp sugar level= <200 mg/dl (* Significant, p < 0.05)

Waist circumference was positively correlated with blood sugar level, both fasting (r = 0.226) and post-prandial (r = 0.356). The correlation was found to be highly significant with post-prandial blood sugar level (p < 0.01). Waist Hip Ratio was positively correlated with fasting blood sugar (r = 0.120) and post-prandial blood sugar level (r = 0.028). None of these correlations were statistically significant (p > 0.05).

Lastly, Waist Height Ratio was positively correlated with fasting (0.148) and post-prandial blood sugar level (0.310).The correlation between Waist Height Ratio and post-prandial blood sugar was statistically significant (p < 0.05).

Table 4: CORRELATION COEFFICIENTS ANALYSIS

	WC	WHR	WHtR
Fasting Sugar	0.226	0.120	0.148
PP Sugar	0.356**	0.028	0.310*

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

DISCUSSION

In our study, we found that fasting blood sugar level was significantly increased (p < 0.05) in males "at risk level" according to waist circumference (WC ≥ 94 cm) as compared to males "below risk level" (WC < 94 cm). Similar to this, Qian et al. (2010) found a significant association between WC and fasting plasma glucose but this was in both males and females. This may be due to their large sample size of 1944 subjects. Similar findings of association between WC and fasting plasma glucose were reported by Li et al. (2013), Ghosh et al. (2004), Palacios et al. (2011), Dalton et al. 2003), Hardiman et al. (2009). Contrary to our finding, Ghosh et al. (2004) found WC to be a predictor of VLDL cholesterol besides fasting plasma glucose. Hu et al. (2000) found triglyceride to be raised in high WC subjects. Ito et al. (2004) and Palacios et al. (2011) also observed that LDL cholesterol rises with a rise in WC.

Post-prandial blood sugar level was increased in males "at risk level" according to waist hip ratio (WHR ≥ 0.9), as compared to males "below risk level" (WHR < 0.9), and the difference found was statistically significant (p < 0.05). McKeigue et al. (1991) and Mohan et al. (2003) similarly found increase in glucose intolerance with increase in WHR. Chien et al. (2004) also observed that fasting blood sugar level was affected by high WHR. But contrary to this, Misra et al. (2006) reported that post-prandial blood sugar level was raised in subjects with high WHR. Hardiman et al. (2009) observed that there was no association between blood glucose level and WHR and Ghosh et al. (2004) found WHR to be associated with fasting plasma glucose level which was again different from our result. The difference in the results may be due to their larger and wide spectrum groups of all ages.

We found that according to Waist-Height Ratio (WHtR) , blood sugar level, both fasting and post-prandial, increased in males "at risk level" (WHtR ≥ 0.5) as compared to males "below risk level" (WHtR < 0.5) and the difference was statistically significant (p < 0.05 Thus, our finding of increase of post-prandial and fasting blood sugar level with increment in WHtR in males was supported by Wai et al. (2012) who also found WHtR to be significantly associated with raised fasting blood glucose level in males. Same result was reported by Patil et al. (2011), Li et al. (2013) who found this association in both males and females. Sayeed et al. (2003) found that WHtR proved a valuable obesity index for predicting diabetes, hypertension and lipidemia. Westphal et al. (2006) also found WHtR as main predictor of metabolic risk. Ghrakhanlou et al. (2012) similarly found WHtR to be predicting blood glucose levels in males. In contrast to our findings, Chien et al. (2004) found levels of fasting blood sugar derangement associated with adverse Waist-Hip Ratio, rather than Waist-Height Ratio. Ko et al. (1997) also contrarily found both fasting and post-prandial blood sugar levels to be governed by BMI, WHR and WC.

The correlation of WC with post-prandial blood sugar (p < 0.01) was statistically highly significant.The positive correlation of WC with post-prandial blood sugar level was reported by Misra et al. (2006). The correlation between WHtR and post-prandial blood sugar level was found to be just significant (p < 0.05). Contrary to this, Patil et al. (2011) and Wai et al. (2012) found a positive significant correlation

between WHtR and fasting blood sugar level, which may be due to inclusion of subjects of middle and higher age group (≥ 45 years old) which is quite different from ours.

CONCLUSION

In our study, anthropometric indices nevertheless provided useful information on cardiovascular risk factors, although at various degrees of importance. Thus, this study suggested that simple anthropometric measurements can help in predicting the onset of cardiovascular disease in younger age group and thus provide a preclinical screening method for the mass population and spreading awareness of the subclinical prelude to cardio-vascular disease.

Thus, further long term studies with larger sample size would be needed to ascertain and provide cardio-vascular disease screening.

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