

## Research Article

# The association between indices of obesity and common clinical measures in adults with and without type 2 diabetes

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## ABSTRACT

**Background:** The aim of this study was to determine the differences amongst the anthropometric measurements, lipid profile, blood pressure and body shape in diabetics as well as non-diabetics.

**Methods:** This was a cross-sectional study comprised of 309 subjects with 91 males and 218 females. Of this, there were 217 diabetics and 92 non-diabetics. The sample was taken from three hospitals in Trinidad. Lipid profile and blood pressure were taken from each facility's physician's notes while anthropometric measurements were taken from the patients themselves.

**Results:** The diabetic group had elevated body mass index and waist to hip ratios were significant ( $P < 0.05$ ) when compared to non-diabetics. There was no significant association of lipid profile, blood pressure, waist circumference and waist to height ratios between diabetics and non-diabetics. As age increased, the prevalence of type 2 diabetes mellitus was more common. Out of 217 diabetics, 173 were of East Indian descent. With regards to gender, more males were found to be diabetics resulting from having an android body shape as compared to females (gynoid body shape).

**Conclusion:** It was found that of all the anthropometric measurements used, waist to hip ratio was found to be the most effective indicator of type 2 diabetes mellitus in Trinidadians, while body mass index was found to be the least effective indicator.

**Keywords:** Obesity, Waist to hip ratio, Body mass index

## INTRODUCTION

Diabetes mellitus is a group of metabolic diseases characterized by elevated blood glucose levels resulting from defects in insulin secretion, insulin action or both.<sup>1</sup> Type 2 diabetes mellitus is more prevalent, as the risk of developing it is predominantly dependent on the type of lifestyle individuals adopt.<sup>2</sup> As such, it can be controlled by modifying lifestyle risk factors. Therefore with early

detection via screening and intervention the success rate for control is high. "It is disclosed that the numbers affected with the disease in T&T represent an adult diabetes prevalence of around 12-13 percent".<sup>3</sup> It can be seen, that some connection between the predisposing factors of both diabetes mellitus and cardiovascular disease exists and these factors can be observed through assessment of body mass index, lipid profile and blood pressure of the patients.<sup>4</sup> Furthermore, other factors must

be taken into consideration such as belly shape (pattern of abdominal fat distribution), anthropometric measurements as well as age and ethnicity. Hence, it can be seen that for proper risk assessment to be done, it is first important to observe and understand any disparities between the afore mentioned factors in both diabetic and non-diabetic individuals and the role they play in increasing a person's risk for development of type 2 diabetes. Our objectives of this study is to design a questionnaire to collect information about age, ethnicity, body mass index, lipid profiles, blood pressure and body shape in control and diabetic patients. We also aimed to compare the efficacy of different anthropometric measures in risk assessment of type 2 diabetes mellitus.

**METHODS**

The subjects selected for this cross sectional study were with and without type 2 diabetes, of East Indian and Afro-Trinidadian descents who attended clinics at Eric Williams medical sciences complex, Chaguanas health facility and San Fernando general hospital. The data for blood pressure and lipid profile collected for this investigation was via examination of medical records from a seven year period, commencing 2007 and ending 2014.

Body mass index, height, waist and hip circumferences were measured as per the standard procedures. Appropriate data was recorded via data collection forms which included the subject's age, sex, ethnicity, body mass index, lipid profile (total cholesterol, HDL, LDL, TAGs), anthropometric measurements, blood pressure, smoking (in terms of packs per day) and alcohol history (consumption frequency and amounts) and past medical history.

**Statistical analysis**

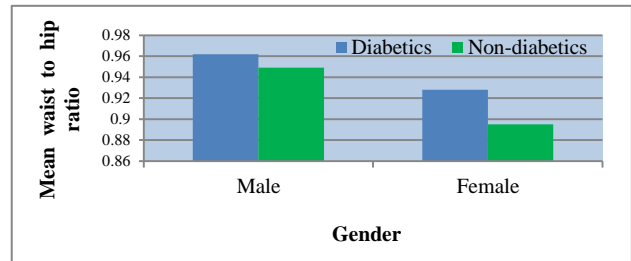
All collected data were analyzed using IBM SPSS Software version 19. Mean differences for interval scale variables (body mass index, waist circumference etc.) between diabetic and non-diabetic groups were analyzed using T-tests and cross tabulations on SPSS Software. A P value of <0.05 was considered statistically significant.

**RESULTS**

Males and females have significantly higher waist to hip ratios of  $0.962 \pm 0.072$  and  $0.928 \pm 0.062$  when compared to their non-diabetic counterparts with  $0.949 \pm 0.047$  and  $0.895 \pm 0.058$ . This is confirmed by a significant P value of 0.02 (Figure 1). There was no significant association of lipid profile, blood pressure, waist circumference and waist to height ratios between diabetics and non-diabetics (Tables 1 and 2).

Of the three factors waist to hip ratio was found to be the best indicator of type 2 diabetes mellitus (with an area under the curve of 0.598 and standard error of 0.035).

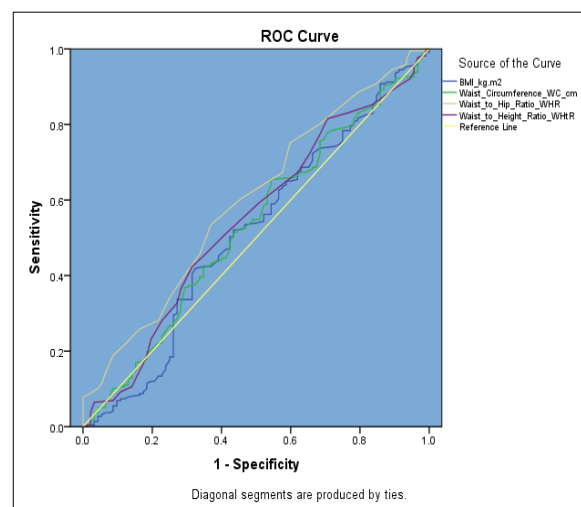
Waist to height ratio had an area under the curve of 0.547 with standard error of 0.036 making it the second best indicator followed by waist circumference which had an area of 0.530 and standard error of 0.036. Body mass index was found to be the weakest indicator with an area under the curve of 0.514 and standard error of 0.037 (Figure 2).



**Figure 1: The waist to hip ratios of the diabetics and non-diabetics.**

**Table 1: Shows the lipid profiles among the diabetic and non-diabetic subjects.**

mg/dl	Diabetic status		Total	P value
	Diabetic	Non-diabetic		
<b>Total cholesterol</b>				
Desirable (<240)	184	75	259	0.501
High (≥240)	33	17	50	
<b>LDL</b>				
Desirable (<160)	181	74	255	0.517
High (≥160)	36	18	54	
<b>HDL</b>				
Low (<40)	65	22	87	0.333
Good (≥40)	152	70	222	
<b>Triglycerides</b>				
Desirable (<200)	164	75	239	0.45
High (≥200)	49	17	66	



**Figure 2: ROC curve showing areas under the curve for each anthropometric measurement.**

**Table 2: Comparison of demographics and common clinical measures in diabetics and non-diabetics.**

	Diabetic	Non-diabetic
<b>Ethnicity (count)</b>		
Indo-Trini	173	67
Afro-Trini	44	25
<b>Gender (count)</b>		
Male	61	30
Female	156	62
<b>Body shape (count)</b>		
Male		
Apple	31	16
Pear	30	14
Female		
Apple	39	4
Pear	117	58
<b>BP systolic</b>	136.96	137.13
<b>BMI</b>	28.94	29.34
<b>Waist circumference</b>	100.74	99.96
<b>Waist-hip ratio</b>	0.94	0.91
<b>Waist-height ratio</b>	0.62	0.62
<b>TCHOL to HDL</b>	4.53	4.47
<b>LDL to HDL</b>	2.76	2.73

## DISCUSSION

The findings of the study indicate that the diabetic group had a higher mean value for waist-to-hip ratio 0.94 ( $\pm$  SE 0.07), as compared to non-diabetics. These results were consistent with previous studies.<sup>5</sup> There were generally a greater number of Indo-Trinidadians as compared to Afro-Trinidadians, with most of the Indo-Trinidadians being diabetic. This is attributed to genetics and lifestyle and this is consistent with work done by HS Sandhu et al.<sup>6</sup> When comparing body shapes there were more android shapes in the diabetic group. Therefore, “this abdominal fat distribution (android)” predisposes individuals, in particular males, to a higher risk of developing type 2 diabetes mellitus.<sup>6</sup> Both groups showed similar ranges for blood pressure within the normal range and this can be explained by; the patients, who were hypertensive, were being treated with medication over a long period, thus regulating their blood pressure to normal or near normal levels.

Lipid profile of patients examined in this study focused on four main constituents: Total cholesterol, LDL, HDL and Triglycerides (TAGs). In a previous study (the Framingham heart study), done by Arshag D. Mooradian, the prevalence of high LDL cholesterol levels in men and women with diabetes mellitus did not differ significantly from the rates in non-diabetic men and women. The prevalence of high plasma triglyceride levels in individuals with diabetes mellitus was significantly higher than in those without diabetes mellitus. In addition, the prevalence of low HDL cholesterol in diabetics was almost two times that of non-diabetics.

Hence there is an increased prevalence of low HDL cholesterol level, but no significant difference in total cholesterol and LDL cholesterol, which was consistent with the findings in this study.<sup>7</sup>

With respect to anthropometric measurements, there was a significant relationship between waist to hip ratio and diabetic status, making it an excellent indicator for the risk of developing type 2 diabetes mellitus. The mean waist to hip ratio value exceeded the safe range for waist to hip ratio, putting most of the subjects in the high risk category and/or at a risk of developing type 2 diabetes mellitus.<sup>8,9</sup>

## CONCLUSIONS

Indices of obesity (anthropometric measurements) and elevated levels of triglycerides are associated with Trinidadian type 2 diabetic subjects with regards to age, gender and ethnicity. There was no significant difference found in blood pressure and other components of lipid profiles among type 2 diabetics and non-diabetics. Indo-Trinidadians, specifically males who possess an android belly shape are at a higher risk of developing type 2 diabetes mellitus. Of all measurements taken, waist to hip ratio was found to be the most superior in determining risk of the development of type 2 diabetes mellitus, followed by waist to height ratio, then waist circumference and lastly body mass index being the least accurate indicator.

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