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Original Article

Physiology Section

Comparison of Anthropometric Measurements that Effectively Associated with Non Alcoholic Fatty Liver Disease

K. DEEPALAKSHMI, A. MURALI, ANIL C MATHEW, R. NAGASHREE

ABSTRACT

Objective: To find an anthropometric indicator that can effectively be associated with Non Alcoholic Fatty Liver Disease (NAFLD).

Materials and Methods: This cross sectional study was conducted in PSGIMSR, Coimbatore. A total of 108 subjects were recruited, of whom 57 were diagnosed as NAFLD and 51 as non-NAFLD (control group).The height, body weight, waist and hip circumference were measured, and body mass index (BMI), waist-to-height ratio (WHtR) and waist-to-hip ratio (WHR) were calculated.

Statistical Analysis: Chi-Square test and t-test were employed to assess the statistical significance in qualitative and quantitative data respectively. Multivariate logistic regression analysis was performed to investigate the association between suspected anthropometric risk factors and NAFLD. The anthropometric risk factors considered were adjusted for Age and Gender and BMI, WHR, WHtR were converted into categorical variables. To rank their discriminatory power Area Under Receiver Operating Characteristic analysis was done.

Results: Compared to control group, BMI and WHtR were statistically higher in patients with NAFLD whereas no significant difference was observed in WHR. Logistic regression analysis showed BMI (Odds Ratio (OR) = 6.45, 95% CI; 1.98, .20.99) and WHtR (OR = 4.84, 95% CI 1.24, 18.87) were the two effective indicators associated with NAFLD. BMI had more discriminatory power than WHtR in predicting NAFLD.

Conclusion: We conclude that BMI and WHtR are better anthropometric measure associated with NAFLD.

Keywords: Body mass index, Waist height ratio, Waist hip ratio

INTRODUCTION

Non alcoholic Fatty liver disorder (NAFLD) is a condition in which there is deposition of fat in the parenchyma of liver more than 5-10% of the liver weight seen in people without significant alcohol consumption [1]. The overall prevalence of NAFLD is 15 to 40% in western countries while 9-40% in Asian countries [2]. In two large population-based cohort studies (the Dionysos Study from Italy and the Dallas Heart Study from the USA) the prevalence of NAFLD ranged between 25% and 30% [3,4]. In India prevalence of NAFLD based on the ultrasound in adult population was found to be about 18.9 % [5]. Prevalence of NAFLD in coastal eastern India is estimated 24.5%, which shows that prevalence of NAFLD is increasing in India also [6]. Prevalence of NAFLD has been shown to be associated strongly with excess body weight in central obesity [7]. The incidence of NAFLD is as high as 60-90% in obese subjects, and the prevalence of NASH and hepatic cirrhosis was 20-25% and 2-8%, respectively [8]. NAFLD is also closely related to the age (more than 40 years), male gender, hyperlipidemia, hypertension, and type 2 diabetes [9,10] The other important aspect of NAFLD is that it is not static and the severity widely ranges from simple steatosis to steatohepatitis, advanced fibrosis and cirrhosis, which significantly results in the increase of liver disease-related mortality [11,12]. So early diagnosis and prompt treatment for NAFLD are helpful to block or even reverse the development of hepatic cirrhosis.

It is necessary to identify simple and sensitive indicators for the prediction of NAFLD because liver biopsy, a gold standard procedure in the diagnosis of NAFLD, is an invasive procedure. Even though abdominal ultrasonogram can be used as a screening tool, it cannot be used in large community based screening programs. Since NAFLD is associated with risk factors of obesity, the anthropometric measures like Body Mass Index (BMI), Waist to Hip Ratio (WHR) and Weight Height Ratio (WHtR) could play an important role in the prediction of NAFLD. Body mass index (BMI) is widely used to define obesity. However, it does not take into account the distribution of fat around the body [13]. Height is an important parameter that should be considered before adopting an obesity index, since height may influence the observation of fat accumulation and/

Clinical indicators	Control n = 51	NAFLD n = 57	P value
Age (Years)	46.03(15.24)	46.78(11.26)	0.770
Gender (Male)	68.6%	66.7%	0.828
BMI	22.58(3.37)	27.45(4.04)	P<0.01
WHR	0.91(0.07)	0.92(0.06)	0.355
WHtR	0.51(0.06)	0.59(0.05)	P<0.01

[Table/Fig-1]: Gender, age and anthropometric indicators in NAFLD group and control group (mean ± SD for continuous variables and percentages for categorical variables)

Clinical Indicators		standardization
BMI	Overweight and Obese	BMI of ≥25 kg/m2
	Normal	BMI of <25 kg/m2
WHR	High	WHR ≥0.9 cm (man); WHR of ≥0.8 cm (women)
	normal	WHR of <0.9 cm (man); WHR of <0.8 cm (women)
WHtR	High	WHtR of ≥0.5 cm
	normal	WHtR of <0.5 cm

[Table/Fig-2]: Risk factors and standardization of risk factors

or distribution. An increasing number of papers indicate that the degree of central fat distribution may be more closely tied to metabolic risks than BMI [14] Measurement of the degree of central fat distribution thus appears to be important for the early detection of subsequent health risks, even among those of normal weight [15].

Waist-to-hip ratio is the most popular index for assessing central obesity. Variations in measurement levels, differences in cut off values between men and women and among various ethnic groups, and the possibility of embarrassment to examiners and examinees of different genders when measuring the hip area may be the limitation of its use [16].

Waist height ratio is also a simple but effective index for identifying overweight individuals and those of normal weight who face higher risks because WHtR is easier to measure and calculate than BMI. Boundary value of WHtR ≥ 0.5 indicates increased risk of obesity related diseases for both men and women in all different ethnic groups. WHtR boundaries value can be converted into a consumer-friendly chart and allow the same boundary values for children and adults. Ashwell M et al, proposed that Waist Height Ratio is probably the most convenient and reliable clinical measure more sensitive than Body Mass Index (BMI) [17].

Though some earlier studies in other parts of the country were attempted to compare the anthropometric indicators for the prediction of NAFLD, not much studies were done in India to establish its validity.

Clinical indicators		Adjusted OR	95% CI	P value
Higher age		1.003	0.96-1.03	0.870
BMI	Overweight + obese	6.45	1.98-20.99	P<0.01
	Normal	1		
WHR	High	0.29	0.08-1.02	0.055
	Normal	1		
WHtR	High	4.84	1.24-18.87	P<0.05
	Normal	1		
Sex	Male	1.53	0.55-4.24	0.407
	Female	1		
Cox and Snell R^2 = 0.304				
Nagelkerke R^2 = 0.405				

[Table/Fig-3]: Predictors of NAFLD in the Multivariate logistic regression model

In present study, patients with clinically and radio logically proven NAFLD were recruited, and the three anthropometric indicators including Waist-to-Hip ratio (WHR), Waist-to-Height ratio (WHtR), and Body Mass Index (BMI) were determined. Our study aimed to find out effective anthropometric indicators associated with NAFLD.

MATERIALS AND METHODS

Study Group

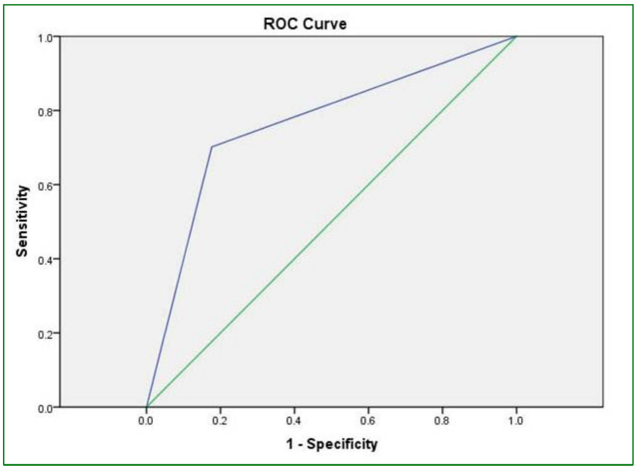
This cross sectional study was carried out during the period of January –March 2013 in PSG Institute of Medical Sciences & Research, Coimbatore. Study population included all patients with age ranging from 30-55 years attending gastroenterology and medicine outpatient clinic. Individuals with radiologically proven non alcoholic fatty liver were recruited as cases. Individuals who have normal liver enzymes and normal liver echotexture by USG were considered as controls. Individuals infected with HBV, HIV or HCV, consuming alcohol >30g/day and on hepatotoxic drugs were excluded. Based on the inclusion and exclusion criteria, 108 subjects were recruited for the study out of which 57 were cases with NAFLD and 51 were controls. We recruited study participants after obtaining clearance from the institutional ethical clearance committee. They were included in the study after obtaining their written consent.

Sample size

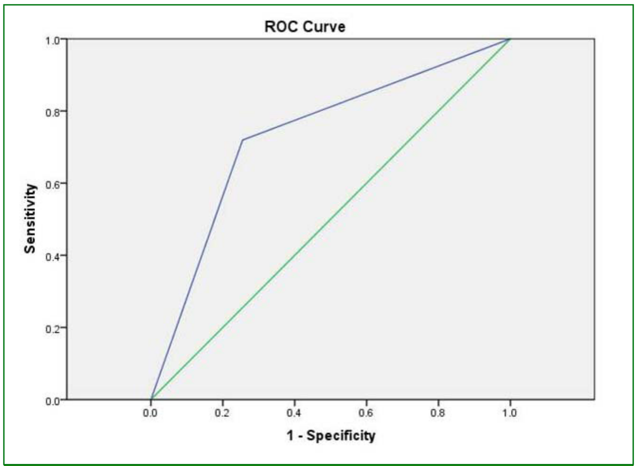
With an expected sensitivity of BMI with NAFLD as 80% and with an allowable error of 8%, the sample size required for this study was estimated as 100

Anthropometric Measurements

Body weight was measured using the standard weighing machine, to the nearest 100 g, with the participant wearing



[Table/Fig-4a]: 1a: ROC curve showing the performance of BMI in predicting NAFLD. The AUC for BMI was 0.763
ROC- reciever-operating characteristic; BMI- body mass index; AUC- area under the curve



[Table/Fig-4b]: ROC curve showing the performance of WHtR in predicting NAFLD. The AUC for WHtR was 0.732
ROC - reciever-operating characteristic; WHtR - waist-to-height ratio; AUC - area under the curve

light clothing. Height (Ht) was measured with a stadiometer to the nearest millimeter, while the participant's head is in the Frankfurt plane. BMI was calculated as weight (kg)/height (m). Waist Circumference (WC) was measured at the midpoint between the highest point of the iliac crest and the lowest part of the costal margin. Hip circumference was measured at most prominent part of the buttocks. Waist Height Ratio is calculated as WC (cm)/height (cm). Waist hip ratio (WHR) was calculated as WC (cm)/HC (cm)

According to WHO classification of adult body weight by BMI in Asian populations, BMI ≥ 25 is considered as overweight [18]. WHtR of ≥ 0.5 was considered as obesity. WHR ≥0.9 in man and ≥0.8 in woman was considered as central obesity.

STATISTICAL ANALYSIS

Statistical analysis was performed with SPSS (19.0 version). Quantitative data were compared with t-test and qualitative data were compared with chi-square test. Multivariate logistic regression analysis was performed to investigate the association between factors and NAFLD in which the BMI, WHR, WHtR were converted into categorical variables and adjusted for age and gender. Cox and Snell R2 and Nagelkerke R2 were used to test the goodness of the model. Regression coefficient was tested using Wald test. ROC curve analysis was then performed and the area under the curve (AUC) was calculated, to rank their discriminatory power. A value of P<0.05 was considered as statistically significant.

RESULTS

General Characteristics: The mean (standard deviation) age was 46.78 ± 11.26 years in NAFLD patients and 46.03 ± 15.24 in non-NAFLD patients showing no significant difference (p = 0.770). In the NAFLD there were 38 (66.7 %) males and 19 (33.3 %) females. In the non NAFLD group, there were 35 (68.6 %) males and 16 (31.4 %) females. There was no marked difference in gender between two groups (p = 0.828). In the NAFLD group BMI (p< 0.01) and WHtR (p<0.01) were significantly higher than those in the control group where as no significant difference was observed between NAFLD and controls with respect to WHR (p = 0.355) [Table/Fig-1]. Risk factors and standardization of risk factors are provided in [Table/Fig-2].

Clinical indicators	Sensitivity	Specificity	Area Under ROC Curve		
			Area	95% CI	P value
BMI	0.702	0.824	0.763	0.670-0.855	<0.001
WHtR	0.719	0.745	0.732	0.635-0.829	P<0.001
BMI+WHtR	0.614	0.843	0.729	0.632-0.825	P<0.001

[Table/Fig-5]: Sensitivity, Specificity and Area under ROC curve of clinical indicators of NAFLD

Multivariate logistic regression analysis which showed BMI (OR = 6.45, 95% CI; 1.98, .20.99) and WHtR (OR = 4.84, 95% CI 1.24, 18.87) were significantly associated with NAFLD [Table/Fig-3]. ROC Curve Analysis of NAFLD showed that BMI (AUC = 0.763) had more discriminatory power than WHtR (AUC = 0.719) in predicting NAFLD [Table/Fig-4a,b,5].

DISCUSSION

In the present study, the degree of obesity represented by BMI, WHtR and WHR were measured and analyzed. The statistical analysis showed BMI and WHtR had advantage on the prediction of NAFLD over WHR. In addition to logistic regression analysis, ROC curve analysis also revealed the same results suggesting that higher BMI and higher WHtR are critical anthropometric indices for the prediction of NAFLD. Studies have shown that both BMI and WHtR are the main anthropometric indices used for the evaluation of metabolic syndrome and coronary artery disease [19]. This can be explained by the fact that obese patients have significantly higher dyslipidemia and insulin resistance which contribute to NAFLD.

In this study, among the three anthropometric indicators (BMI, WHR and WHtR) WHtR had advantage on the association of NAFLD over WHR. These results support the findings of Hsieh et al., [20]. Many investigators have suggested WHtR is an important index that could predict Type 2 diabetes which is associated with cardiovascular and cerebro vascular events [21].

Our study has several limitations. In the present study, although logistic regression was used to adjust the confounding factors including gender, our findings had the tendency to predict NAFLD in males due to higher proportion of males. Further there is evidence showing that prediction of cardiovascular events with the WHtR depends on the gender. In addition, studies on the genetic and environmental factors revealed that morbidity and outcome varied from region and races [22]. Hence our results may not be generalized to other region.

CONCLUSION

BMI and WHtR together found to predict NAFLD in high risk population. The anthropometric measurements that we suggested are simple, non invasive and reliable, however continued large scale studies are necessary to determine their validity on the prediction of NAFLD.

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AUTHOR(S):

1. Dr K. Deepalakshmi
2. Dr A. Murali
3. Dr Anil C Mathew
4. Dr R. Nagashree

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Physiology, PSG Institute of Medical Sciences & Research, Coimbatore, Tamilnadu, India.
2. Professor, Department of Medicine, PSG Institute of Medical Sciences & Research, Coimbatore, Tamilnadu, India.
3. Professor, Department of Community Medicine, PSG Institute of Medical Sciences & Research, Coimbatore, Tamilnadu, India.
4. Professor, Department of Physiology, PSG Institute of Medical Sciences & Research, Coimbatore, Tamilnadu, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. K. Deepalakshmi,
Assistant Professor, Department of Physiology,
PSG Institute of Medical Sciences & Research,
Coimbatore, Tamilnadu, India - 641004, India.
E-mail : deepa61180@yahoo.co.in

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