Association of Body Mass Index, Waist/hip Ratio with Dyslipidemia in Obese Males: A Case-Control Study

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Abstract

Background; Obesity is described as an abnormal regulation of body weight systems represented by an increase or disorder in the accumulation of lipids , these changes are considered the major risk factors for the occurrence of atherosclerotic cardiovascular events. The aim of this study was to investigate the relation between BMI,W/H ratio as independent risk factors for the progression of dyslipidemia among obese males. **Methods;** 650 apparently healthy Iraqi males, 300 obese and 350 non-obese were recruited. Anthropometric properties and lipid profile were determined **Results;** The study exhibits a significant linear positive correlation between total cholesterol (TC), triglyceride (TG), low-density lipoprotein cholesterol (LDL-c) and BMI, W/H ratio and a significantly negative correlation between high density lipoprotein cholesterol (HDL-c) and BMI, W/H ratio among study population. **Conclusion;** The study revealed a significant correlation between BMI, W/H ratio and dyslipidemia in obese males.

Keywords: Obesity, BMI, lipid profile, dyslipidemia

Introduction

Dyslipidemia was considered a metabolic abnormality characterized by alteration of the plasma lipids levels, which is represented by a decrease in the plasma levels of high-density lipoprotein cholesterol (HDL-c) and increases in the plasma levels of triglycerides (TG), total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-c) as mentioned in several literature [1-3]. Lipids, such as triglycerides or cholesterol, are absorbed from the intestines and are transported throughout the body via lipoproteins for steroid and energy production or bile acid formation. Major contributors to these pathways are cholesterol, triglycerides, LDL-c and

HDL -c. An imbalance of any of these factors can lead to dyslipidemia [4]. Obesity is a complex disease involving the imbalance between intake of food and energy dissipation [5]. Accordingly, lipid accumulation has elevated the risk of developing related diseases, such as cardiovascular, arthritis, diabetes, disease, hypertension, and even cancer also elevated [6]. Whilst, it is difficult to estimate the quantity of the lipid in the body directly thus, it is commonly calculated by an indirect method through measurement of BMI (body mass index) that has been shown to correlate with the amount of fat in the body of most persons, for the purposes of research and practical clinical, overweight and obesity are widely represented by BMI, estimated by dividing the weight in kilograms by height represented in meters squared. This performs a way for calculation of weight (relative), adjusted for height and also provides a method to distinguish both between and within populations [7]. The perfect BMI range is between 18.5 to 24.9. while overweight is described as a BMI range of 25 to 29.9 kg/m2 and a value of 30 kg/m2 or higher is considered obese. A BMI above 40 indicates extremely obese [8]. Obesity is linked with excess fat mass in the body. Therefore, individuals who are not suffering from peripheral obesity might be centrally obese with high body fat distributed commonly in the abdominal area. In individuals with central obesity, adipose tissue secretes larger amounts of non-esterified fatty acids, glycerol, pro-inflammatory cytokines and hormones that lead to insulin resistance. The majority of deaths associated with increased BMI are due to cardiovascular system problems [9].

Materials and Methods

Subjects and study design

A case-control study includes 650 apparently healthy Iraqi males 300 obese and 350 non-obese males was established at the Department of Biochemistry in Collage of Medicine / University of Kufa, this study was performed between the beginning of December 2020 and the end of December 2021. This study was approved by medical ethical committee in the Kufa medical college. information has been recorded using face-to-face survey questions, in order to get knowledge about their weight, age, height, drug therapy, exercise and history of lipid abnormality. Body mass index was estimated according to the equation BMI = weight in kg / height in m^2. The individuals with BMI range between 18.5 and 24.9 was considered as control subjects while with BMI equal to or more than 30 was defined as obese subjects. The criteria for inclusion of the study subjects (obese and non-obese) were apparently healthy males with no evidence of any chronic illness, including hepatic and renal or thyroid. blood samples were collected in order to be used for the measurement of lipid levels and within 24 h from sample collection.

Estimation of Plasma Lipids concentration

Quantitative lipids analyses were identified on fasting obese and non-obese males. serum TG, TC, and HDL-c were calculated using enzymatic colorimetric methods (Biolabo/France), while measurement of LDL-c concentration was performed by Friedewald equation [10].

Statistical Analysis

Data analyzed using IBM SPSS statistics version 24. The data were summarised descriptively by mean ± S.D, two-sample t-test measurement was applied for comparison between non-obese and obese groups. The correlation between different variables were detected using Pearson correlation coefficient.

Results

The mean ± SD serum concentration of TC, TG and LDL-c were significantly increase among obese compared with the non-obese individuals (P value < 0.001) While the HDL-c concentrations were increase significantly in non-obese compared to that of obese individuals (P-value < 0.001). This suggests the direct relation between the abnormality in the lipids levels and obesity which might affect the levels of these parameters. Regarding BMI, the obese group was significantly associated with high BMI (P-value < 0.00001) compared with the non-obese group Table 1.

Table 1: Biochemical and Anthropometrical Parameters

Parameters	**Obese n = 300**	**Nonobese n = 350**	**P-value**
Age (years)	41.26 ± 5.88	40.96 ± 6.44	NS
BMI (kg/m^2)	32.10 ± 2.76	23.48 ± 2.11	< 0.00001
W/H	1.03 ± 0.04	0.87 ± 0.05	< 0.00001
TC	4.62 ± 0.61	4.21± 0.77	< 0.00001
TG	1.84 ± 0.54	1.42 ± 0.59	< 0.00001
HDL-c	0.81 ± 0.17	0.90 ± 0.14	< 0.0001
LDL-c	2.73 ± 0.54	2.4 ± 0.44	< 0.00001

SD = standard deviation, *P < 0.05, NS = not significant, TG = triglyceride, TC = total cholesterol, LDL-c = low-density lipoprotein cholesterol, HDL-c = high-density lipoprotein cholesterol, BMI= body mass index

Association of BMI with lipid profile among the study population

Regarding to the relationship between BMI and lipid parameters among 650 participant males, the overall examination of data demonstrated that TC, TG and LDL-c were significantly correlated with BMI, Pearson Correlation value (0.249**. 0.265** 0.297**) respectively and P value (< 0.001) whereas HDL-c correlated negatively and significantly with the BMI, Pearson Correlation (-0.222**) and (P value = < 0.001) Table 2, Figure 1.

Table 2: correlation between BMI, W/H ratio and lipid parameters in the study population

		TG	LDL-c	HDL-c	TC
BMI	Pearson Correlation	0.265**	0.297**	-0.222**	0.249**
	Significant	< 0.001	< 0.001	< 0.001	< 0.001
	Number	469	469	469	469
W/H	Pearson Correlation	0.265**	0.308**	-0.256**	0.271**
	Significant	< 0.001	< 0.001	< 0.001	< 0.001
	Number	469	469	469	469

**Correlation is significant at the 0.01 level, TG ; triglyceride, TC ; total cholesterol, LDL-c ; low-density lipoprotein cholesterol, HDL-c; high-density lipoprotein cholesterol, BMI; body mass index

Concerning with the association between W/H ratio and lipid parameters among 650 participant males, the analysis of data demonstrated that TC, TG and LDL-c were significantly and positively correlated with W/H ratio, Pearson Correlation (0.271** 0.265** 0.308**) respectively and P value (< 0.001) while HDL-c correlated negatively and significantly with the W/H ratio, Pearson Correlation (-0.256**) and (P value= < 0.001) Figure 2.

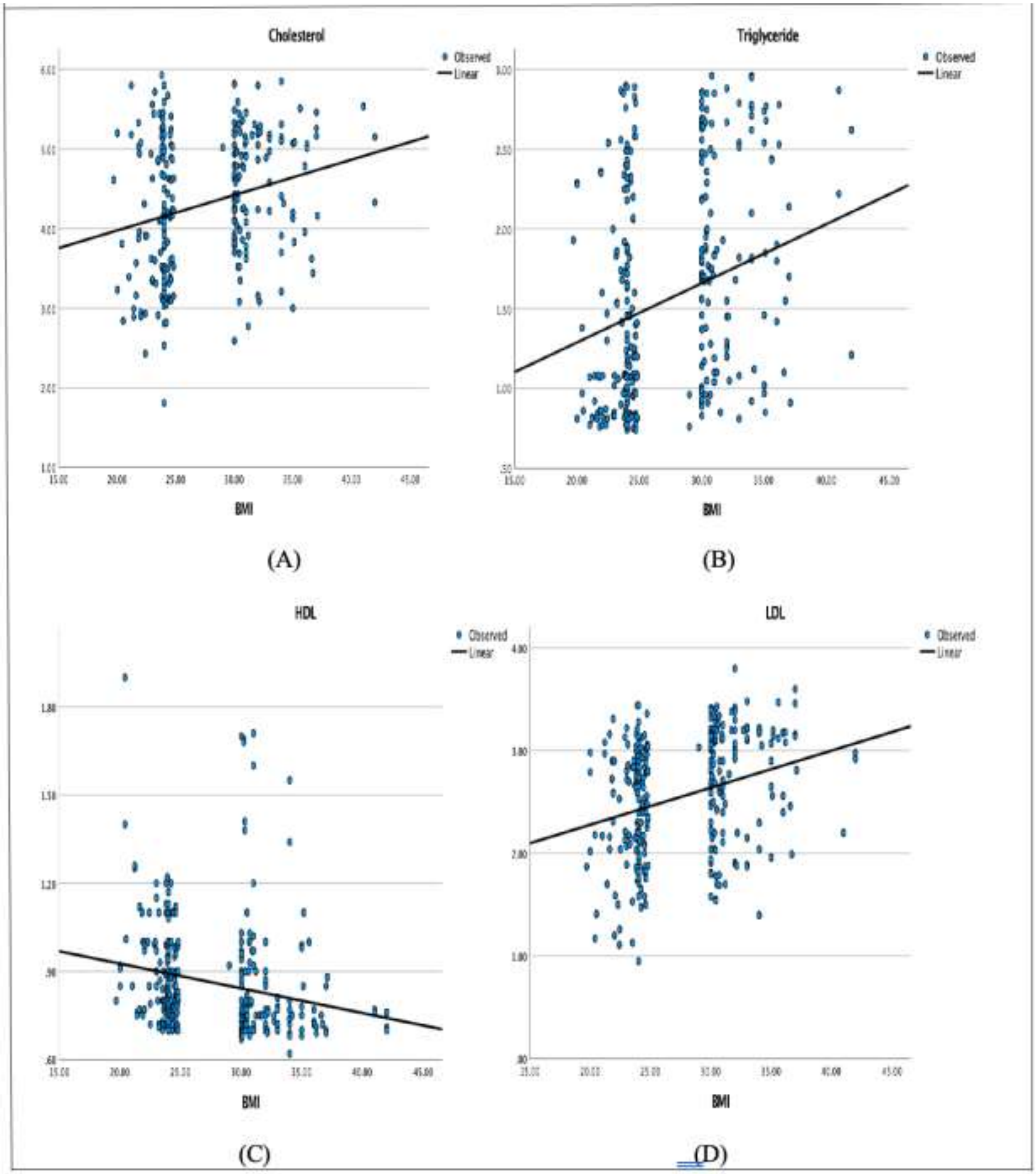

Figure 1: Correlation between BMI and lipid parameters in the study population

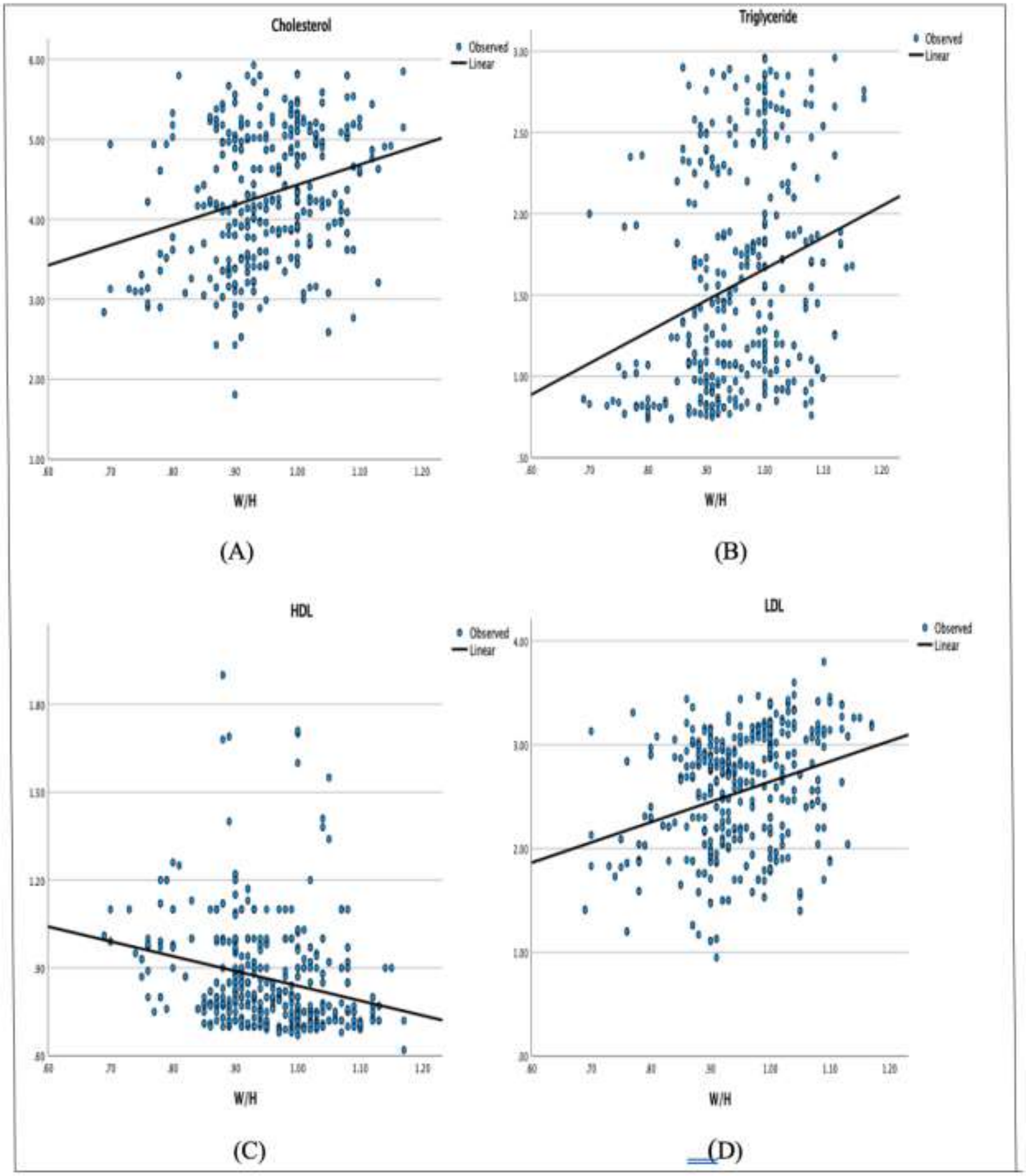

Figure 2: Correlation between W/H Ratio and lipid parameters in the study population

Linear regression analyses between BMI, W/H ratio versus lipid parameters

Linear regression analyses were achieved to examine the independent contribution of BMI and W/H ratio with the impairment in lipid parameters Table 3. BMI was applied as first independent variable and W/H ratio was used as a second independent variable to compare the relationship between BMI, W/H ratio with lipid parameters. The results demonstrating a significant association between BMI, W/H ratio and lipid parameters in ANOVA test p value (0 < 001). BMI significantly predicted TC, TG, LDL-c, HDL-c, AIP and R square referred (0.049 to 0.088) of the variation in lipid parameters. W/H ratio significantly predicted TC, TG, LDL-c, HDL-c, AIP and R square explained (0.066 to 0.095) of the variation in these parameters [28][29].

Table 3: Linear regression analyses between BMI, W/H ratio versus lipid parameters

Dependent variable	Independent variable BMI.			Independent variable W/H ratio		
Lipid parameters	R Square	Standardized Coefficients Beta	Sig.	R Square	Standardized Coefficients Beta	Sig.
TC mmol/l	0.062	0.249	0 < 001	0.073	0.271	0 < 001
TG mmol/l	0.070	0.265	0 < 001	0.070	0.265	0 < 001
LDL-c mmol/l	0.088	0.297	0 < 001	0.095	0.308	0 < 001
HDL-c mmol/l	0.049	-0.222	0 < 001	0.066	-0.256	0 < 001
AIP mmol/l	0.087	0.295	0 < 001	0.088	0.297	0 < 001

TG ; triglyceride, TC ; total cholesterol, LDL-c ; low-density lipoprotein cholesterol, HDL-c ; high-density lipoprotein cholesterol, W/H;waist/hip ratio, BMI; body mass index

Discussion

Obesity and overweight are now on the rise and have been a global epidemic increasing in rate [30][31]. As such, it involves public health problems, including the danger of developing related disorders like hypertension, diabetes, and heart disease. Obesity can be described as an imbalance between energy intake and energy expenditure that results when the energy intake exceeds the energy expenditure [11]. Several studies demonstrate the role of obesity as an essential indicator for the evolution of cardiovascular disease, however, it shows that great effect in regard to obesity inducing dyslipidemia [12-14]. In our study, all obese individuals had increased lipid levels compared with non-obese individuals. Fasting serum concentrations of TC, TG and LDL-c tended to be significantly higher in obese ($p < 0.001$) when compared with non-obese males, While HDL-c significantly lowers in obese than in non-obese males. The association between hyperlipidaemia and obesity is well determined and this association contribute to the risk of cardiovascular disease [15]. For dyslipidemia within obese group, Hypertriglyceridemia considered as a main reason for lipid abnormalities since it will result from impaired in the clearance of the TG rich lipoprotein in chylomicron and VLDL-c. Hence, the VLDL-c and LDL delipidation processes also impaired that give rise to increased levels of remnant lipoproteins and LDL-c [16].

Anthropometric analysis has been related to several health diseases [17]. BMI is one of the mainly used parameters to assess obesity in general, While the W/H ratio has been used to reflect the body fat distribution [18]. In our study, the correlation between BMI and TC is a linear positive correlation, the Pearson's correlation value of 0.249**. which shows a significant association between them, P value (< 0.001). This indicates that when the mean BMI value increase, the mean TC increases as well Table 2. Gayathri B *et al* [19] revealed that there was a linear positive correlation between TC and BMI. Similarly, the correlation between TG, LDL-c and BMI is a linear positive correlation, the Pearson's correlation value 0.265** 0.297** respectively P value (< 0.001). On the other hand, the correlation between HDL-c and BMI reveals a negative correlation (-0.222**) and (P value = < 0.001). This demonstrates that there is a reverse correlation between HDL-c levels and BMI. Interestingly, Yu Y *et al* (2020) [20] reported that an inverse association was found between HDL-c levels and stroke only when the BMI < 24 kg/m^2. The distribution of fat in the body tissue has been indicated in the estimation of obesity risks due to the metabolic changes between subcutaneous and abdominal adipose tissue [21]. In spite of several studies on the relationship between anthropometric parameters and lipid levels [22-24], the preferable anthropometric indicator for the location of fat stays controversial. These controversies may be due to the differences in the distribution of fat among different age and ethnic groups. In the present study, the correlation between W/H ratio and TC, TG and LDL-c levels was a linear positive correlation, the Pearson's correlation value (0.271** 0.265** 0.308**) respectively which show a significant association between them, P value (< 0.001).

This indicates that when the mean W/H ratio value increase, the mean TC, TG and LDL-c levels increase as well Table 2. Whereas, the correlation between W/H and HDL exhibits a negative correlation, Pearson's correlation value (-0.256**) and (P value = < 0.001). This indicates that there is a reverse correlation between HDL-c levels and the W/H ratio. Our study exhibits that measurement of relative central obesity which is represented by the W/H ratio in Iraqi males is more strongly correlated with the risk of dyslipidemia than BMI. W/H ratio confers a greater Pearson Correlation value than BMI Table 2; additionally, Linear regression analyses achieved to examine the independent risk contribution of BMI and W/H ratio with alteration in lipid parameters supported these findings since R square and Beta Coefficients values were higher regarding W/H ratio R square (0.066 to 0.095) compared with R square and Beta Coefficients values for BMI R square (0.049 to 0.088). In addition, a significant association was found Table 3. W/H ratio compared to BMI may be used as a superior measure of dyslipidemia. This reveals that BMI alone must not be used as a target for high-risk subjects with obesity-associated dyslipidemia. Furthermore, our study is consistent with several previous studies which have suggested that measurement of the W/H ratio is the best indicator of obesity-associated dyslipidemia than BMI [25-27].

Conclusion

In conclusion, the study reached the important finding that there was a significant association between BMI, W/H ratio as a dangerous independent risk factor for the progression of dyslipidemia in obese males.

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