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Correlation between Anthropometric Measurements and Serum Cholesterol Among Undergraduate Students at the University of Tripoli

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ABSTRACT
The incidence of Type 2 diabetes mellitus (T2DM) across all age groups has increased sharply due to changes in lifestyle in populations around the world. The growing prevalence of this disease, in recent decades, is now recognised as a global epidemic and an important public health issue. Therefore, this study aimed to investigate the correlation between anthropometric measurements and FBS, TC, and HDL-C levels. A cross-sectional study involving a survey questionnaire, anthropometric measurements, and 5 mL of venous blood was drawn from 117 University students (aged 17-30) in the University Infirmary. FBS, TC, and HDL-C levels were measured by an automatic device, COBAS INTEGRA 400 plus, in Shaara Zawiya Hospital laboratory. 45.3% of the students were found to be overweight or obese, and HDL-C was negatively correlated with weight (r= -0.391, P= 0.0001), BMI (r -0.456, P = 0.0001), waist circumference (r = -0.344, P =0.001), and hip circumference (r = -0.343, P = 0.001). Use of anthropometric measurements has proven very simple and effective in identifying decreases in HDL-C levels in overweight or obese individuals, in a relatively young population, which in turn may help in early identification of metabolic disorders.

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INTRODUCTION

The eating habits of Libyans are gradually changing as a result of many factors such as the country's economic expansion, decline in physical labour, and rise in popularity of fast food. These factors, among others, could be contributing to the likelihood of rising obesity levels among the Libyan population. Being overweight or obese combined with unhealthy lifestyle choices can lead to dyslipidaemia and high blood pressure, all of which are closely correlated to a person's risk of developing type 2 diabetes (T2DM) and Cardiovascular disease (CVD) in the future (1). Recent studies in Tripoli, Libya (2024) found that 46.7% of Libyan T2DM patients were obese (2). Another study, in the same location, last year found that the average weight of T2DM patients (83.4 kg), was significantly higher than the mean of controls (76.8 kg) with a p< 0.001(3). 70% of college students are likely to gain weight during their first year of study, according to some research (4). By the time they have completed their senior undergraduate year, there is are noticeable increase in the prevalence of obesity (5).

The incidence of Type 2 diabetes mellitus (T2DM) across all age groups has increased sharply due to changes in lifestyle in populations around the world. The growing prevalence of this disease, in recent decades, is now recognised as a global epidemic and an important public health issue (6). A recent study conducted at the University of Tripoli found that 25% of students have a family history of T2DM (7). However, students are not subjected to annual check-ups and testing for levels of blood glucose, cholesterol, or blood pressure as a preventative measure. A small number of studies have demonstrated that young students frequently have abnormal lipid profiles and high glucose levels (8). Additionally, because of a lack of health education and little medical intervention, many young adults are ignorant of their risk of developing T2DM, which increases the possibility that complications will arise with time (9). Numerous studies have evaluated the frequency of blood lipid and blood glucose in individuals around the world from all types of occupations, but there are not many studies specifically targeting Libyan college students. Just one previous research conducted at the University of Tripoli in 2024 has studied the correlation between anthropometric measurements and blood glucose levels in 246 Libyan students (7). Further proposed research will include additional blood investigations, serum total cholesterol (TC), and high-density lipoprotein cholesterol (HDL-C) may help to identify and reduce the impact of T2DM in this population.

Given the increased incidence of T2DM in young people, it is imperative for public health authorities to better identify and understand metabolic dysfunction in these high-risk groups. The purpose of this study was to examine the correlation between anthropometric measurements and fasting blood glucose (FBS), TC, and HDL levels. To date, no such studies in a young university population in Libya have been conducted in this field.

METHODS

Study design and setting

In total, 118 university students participated in this study. One student was excluded because they had diabetes, so the final sample consisted of 117 students. Recruitment was conducted from November 24 to December 19, 2024, at the University Infirmary. Students diagnosed with diabetes mellitus were excluded. The inclusion criteria of subjects in this study were that they were Libyan, in the age group 17 to 30 years, and students registered at Tripoli University.

Data and sample collection

The questionnaire used covered a range of topics, including age, gender, and diabetes status. To complete

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the questionnaire, students provided anthropometric measurements, including height (to the nearest 0.1 cm without shoes) and body weight (measured with electronic scales to the nearest 0.01 kg). Height and weight were then used to determine body mass index BMI (weight kg/height m^2). Waist and hip circumferences were measured with a non-extendable tape measure placed horizontally, just above the iliac crest. Finally, the waist-to-hip ratio was calculated by dividing the waist circumference by the hip circumference.
To measure the level of FBS, TC, and HDL-C, 5 mL of venous blood was drawn from each subject in the University Infirmary, and 2 mL of venous blood was placed in a sodium fluoride tube and 3 mL in a plain tube. The samples were transferred to Shaara Zawiya Hospital laboratory, they were measured by an automatic device, COBAS INTEGRA 400 plus.

RESULTS

A total of 117 students participated, and their mean age was 21.96±3.05 years. The mean BMI of the sample, waist circumference, hip circumference, and waist-to-hip ratio of the study participants were determined as 25.39±6.30kg/m^2, 76.31±15.11cm, 96.99±17.46cm, and 0.79±0.06, respectively. The mean FBS, TC, and HDL-C of the study participants were observed as 93.67±13.53 mg/dL, 166.01±31.86 mg/dL, and 49.96±10.25 mg/dL.

Table 1 Anthropometric measurements, age, and levels of FBS, HDL-C, and TC

Student	Min	Max	Mean ±St. D
Age (years)	17	30	21.96 ±3.05
Weight (kg)	40.00	110.0	67.81
Standing Height (m)	1.46	1.89	1.63 ±0.07
BMI (kg/m^2)	15.40	47.20	25.39 ±6.30
Waist	28.00	119.0	76.31±15.11
Hip circumference	36.00	132.0	96.99±17.46
waist/hip ratio	0.62	0.94	0.79±0.06
FBS (mg/dL)	60.80	149.3	93.67±13.53
TC (mg/dL)	107.0	258.0	166.01±31.8
HDL-C (mg/dL)	29.30	92.60	49.96±10.25

The majority of students in this study were females, 103 (88%), with only 14 (12%) males. Figure 1 shows the breakdown of BMI status (underweight< 18.5 kg/m^2, normal 18.5–24.9 kg/m^2, overweight 25–29.9 kg/m^2, and obese ≥ 30 kg/m^2) for males and females. The percentage of underweight male students was 2.5%, while female students was 12%. Students with normal levels of BMI were 5.1% in males and 35 % in females. Those who were found to be overweight were 2.6% male and 11.1% female, and obese students were 1.7% male and 29.9% female.

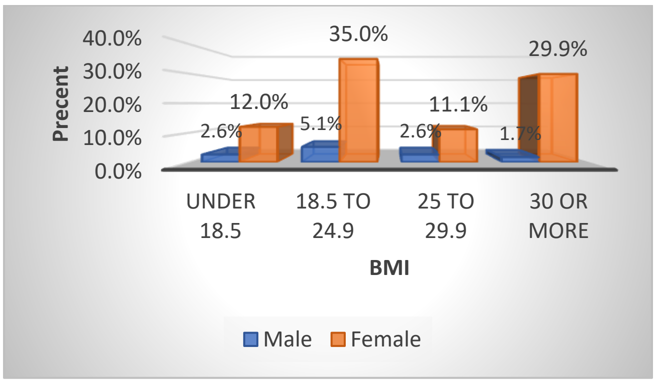

Figure 1: Breakdown of BMI status showing percentages between male and female students

Table 2 shows that no significant correlations were observed between FBS and any of the anthropometric measurements. Moreover, no significant correlations were determined between TC and all the risk factors presented in Table 2, except the waist-to-hip ratio, which is just above the level of significance (r= -0.177, P=0.056). HDL-C was negatively correlated with weight (r= -0.391, P= 0.0001), BMI (r= -0.456, P = 0.0001), waist circumference (r = -0.344, P =0.001), and hip circumference (r = -0.343, P = 0.001).

Table 2. Correlations between anthropometric measurements and FBS, TC, and HDL-C levels

Variable	FBS		TC		HDL-C	
	r	P-value	r	P-value	r	P-value
Weight (kg)	0.051	0.588	0.095	0.308	0.391 **	0.000 1
Length (cm)	0.046	0.619	0.048	0.610	0.112	0.278
BMI (kg/m2)	0.044	0.636	0.097	0.300	0.456 **	0.000 1
Waist circumferenc	0.160	0.084	0.045	0.629	0.344 **	0.001
Hip circumferenc	0.103	0.268	0.031	0.741	0.343 **	0.001
waist/hip ratio%	0.146	0.115	0.177	0.056	0.072	0.484

DISCUSSION

The diagnosis and categorisation of obesity can both benefit from anthropometric measurements. They can be crucial in identifying severe medical disorders like diabetes mellitus (10). In a high-risk group, anthropometric measurements (waist and hip circumference) are frequently employed to detect individuals with higher glucose levels. A single anthropometric measure is not as efficient in identifying T2DM status as the combination of BMI with three other measurements: waist-to-hip ratio, waist, and hip circumference. Despite some minor variations discovered about sex and ethnicity, these findings were found to be reasonably constant among a variety of ethnic groups of both sexes.
In Libya, to date, this present study is the first to examine correlations between anthropometric measures and TC and HDL-C levels in the student population of the University of Tripoli. Previous research on students in Tripoli focused only on the correlation between anthropometric measures and FBS (7) and found no correlation between FBS and BMI (r=0.117, p=0.067). Similar findings were found in this current research (r=0.04, p=0.636). Conversely, a positive association between BMI and FBS has been shown in another study conducted at a college in upstate New York (11). These are two completely different communities, in terms of ethnic origins, cultural habits, and lifestyle choices, which may explain the discrepancies observed. In addition, a strong negative correlation was found in this present study between HDL-C and weight, BMI, waist, and hip circumference (P<0.05). Similar findings were obtained from a study conducted on college male students in Riyadh, Saudi Arabia, where a negative correlation between BMI and HDL-C was also observed (12). However, the Saudi Arabian study found a positive correlation between BMI and TC, which disagreed with the findings obtained from this present study in Tripoli. Although both studies were from Arab nations, they were from different environments and lifestyles, as well as being from an Asian population rather than an African one. In addition, the Saudi Arabian study had a sample size focused only

on men, whereas in the current research in Libya, the majority were female (88%).

Similar results to the present study were obtained in research carried out on 422 students at Marmara University, Istanbul, Turkey (January 2018 and March 2020), which also found that anthropometric measurements were negatively correlated with HDL-C levels (13). This was also confirmed by a study of 883 students from the Faculty of Medical Sciences of the Central University of Ecuador, which showed that BMI was negatively correlated with HDL-C levels (14). Conversely, in a study determining cardiovascular risk factors in 968 university students at São Luís, State of Maranhão, Brazil, BMI and WHR were found to be positively correlated with HDL-C (15). The discrepancy in these findings could be explained by differences in various sample sizes, populations, and lifestyles. Another possible explanation is that the percentage of females in these studies varied considerably, with 88% in the present study, 86% in the Turkish study, 67% in the Ecuador investigation, and 62% in the Brazilian study. The differences may reflect a gender factor in the results.

The impact of obesity on cardiovascular risk begins at an early age, and being overweight during adolescence in particular, is associated with an increased risk of coronary heart disease in both sexes (16). In this present research, more than 45% of students were found to be overweight or obese, which considerably increases the risk of this specific group to heart disease. Therefore, strategies designed to limit cardiovascular risk should address weight reduction and lifestyle changes much earlier, such as during childhood and adolescence.

Given these findings, it is important to understand what changes can be made to mitigate the growing obesity health diseases. Numerous elements influence the cholesterol levels in the blood. Some of them are controllable while others are not. It is possible to change one's diet and activity level to help lower both body weight and cholesterol levels. Despite this, it is impossible to alter inherited genetics or one's age, or sex. Elevated cholesterol levels can be managed through simple dietary changes such as reducing the intake of saturated fats and cholesterol. This can be accomplished by maintaining a high fibre, low-fat diet. It is advised that no more than 10% of calories be derived from saturated fat, an average of 30% of calories or fewer from total fat, and below 300 mg per day of dietary cholesterol (17). The overweight or obese individual, by losing weight, can considerably help reduce low-density lipoprotein cholesterol (LDL-C) levels. Consistent exercise, in such individuals, can also help to increase HDL-C and decrease LDL-C (18).

CONCLUSION

Findings of the present study showed that 45.3% of the students were overweight or obese, and a clear negative correlation between the level of HDL-C and most of the anthropometric measurements. Health initiatives at the university, such as educational interventions, could help promote awareness about obesity and its related diseases, such as T2DM.

Limitations and recommendations

Two of the study's main limitations are the small sample size of 117 students from the University of Tripoli and the imbalance between the numbers of males and females involved. However, it was difficult to convince many students to participate in the research, in particular the males. It is recommended that suitable interventions be taken to reduce obesity in the university setting, and this could include a number of factors, such as, an educational health awareness program specifically aimed at heart and diabetic awareness in the graduate population. In addition, the university environment may lack healthy food options, so cafeterias should provide balanced, low-fat meals rich in fruits and vegetables. Finally, there may be limited opportunities for physical activity, so offering more fitness programs on campus should be encouraged.

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