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Evaluation of the lipid profile and the effect of obesity and hypertension among Libyan international university students

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Abstract

This work was conducted in order to evaluate the lipid profile among a population of healthy Libyan International University students and to characterize an eventual association with obesity and hypertension. A total of 110 students (37 male and 73 female) took part in this study. Their body mass index, waist circumference, and blood pressure were measured by standard methods. Lipid profile, including total cholesterol, triglyceride, high-density lipoprotein, and low-density lipoprotein, was measured and assessed using an Erba biochemistry analyzer. The overall prevalence of dyslipidemia among students was 15.7%. A moderate risk associated with high-density lipoprotein and low-density lipoprotein levels (31.8% and 13.6%, respectively) was the main prevalent figure of lipid profile. Only 4.5% and 3.6% of students presented high-risk levels of high-density lipoprotein and low-density lipoprotein respectively. The prevalence of central obesity (20.9%) and hypertension (40%) was significantly associated with student gender and more prevalent in females. Waist circumference was significantly associated with high-density lipoprotein levels. There was no significant association of hypertension and body mass index with either the student's gender or lipid profile. Young people who have a moderate-risk lipid profile may also have a high prevalence of obesity and hypertension. Interventions targeting the high incidence of obesity and hypertension among students will reduce the rise of lipid profile abnormalities and dyslipidemia in the general adult population.

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Introduction

In addition to the well-established correlation between elevated levels of triglyceride (TG) and atherosclerotic cardiovascular disease, a lipid profile's anomalies, particularly elevated total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and low high-density lipoprotein cholesterol (HDL-C), are regarded as significant risks of complications associated with cardiovascular disease (Bashir *et al.*, 2024; Cardoso-Saldaña *et al.,* 2024).

Over the past few decades, the prevalence of dyslipidemia, a metabolic disorder caused by lipid abnormalities, has increased significantly (Bamba and Rader, 2007). Consequently, cardiovascular disease has become the foremost cause of mortality worldwide (Pirillo *et al.*, 2021; McAloon *et al.*, 2016).

Cardiovascular complications and lipid abnormalities are associated with additional factors such as hypertension and obesity (Manios *et al.*, 2002). Numerous studies had illustrated a strong contribution of lipid abnormalities such as elevated total cholesterol levels, triglycerides, and low-density lipoproteins (LDL) to the development and progression of hypertension (Pirillo *et al.*, 2021). This trend is associated with other metabolic disorders such as obesity, which can be measured by body mass index (BMI), waist circumference (WC), or waist-hip ratio (WHR) according the National Cholesterol Education Program (NCEP).

In Libya, the prevalence of non-communicable diseases has increased dramatically in the last 30 years, which presents a serious problem and is challenging to the Libyan health care system (Altajori and Elshrek, 2017). 63.5% of Libyan adults were overweight or obese, according to a national survey carried out in 2008 and 2009 (Elmehdawi and Albarsha, 2012). Adult obesity in Libya increased fast reaching a prevalence of 75.3% (Lemamsha *et al.*, 2019). The stepwise survey done by the Libyan Cardiac Society and National Centre for Disease Control is alarming about the percentage of hypertension being 40.6% (Beaney *et al.*, 2020).

To the best of our knowledge, although adult people were the subject of several studies regarding these diseases, there were no illuminating studies about the group of young Libyan students.

Therefore, characterizing lipid profile abnormalities, dyslipidemia prevalence, and its related risk factors in this special population of young people will be important to enhance awareness and mitigate related health complications. For this reason, the current study was carried out to assess the lipid profiles in relation to hypertension and obesity among university students at the Libyan International University (LIMU).

Materials and methods

This descriptive cross-sectional study was conducted over six months, from February to July 2024, among 110 Libyan International University students (37 male and 73 female) aged between 18 and 22 years. All subjects signed informed consent to provide their personal information. All participants declare that they are in good health, they didn't suffer previously from any health complications, and they are not using any medication. The study was approved by the Libyan International University ethics committee (Certificate Reference No: AMS-2024-00182 to the project No 1-G-00214).

Measurements and definitions

Blood samples and biochemical analysis

The blood samples were collected after a 12-hour fasting period, and serum was immediately obtained by blood centrifugation at 3000 rpm for 15 min. All analyses (total cholesterol, triglycerides, and HDL-C and LDL-C) were assessed in the biochemistry laboratory of the LIMU University by an Erba biochemistry analyzer (Erba, Mannheim, Germany) using commercially available standard kits. Dyslipidemia was diagnosed according to the criteria of the NCEP-ATP III Guidelines, 2002, and ESC/EAS guidelines for the management of dyslipidemias, 2011. Lipid profile risk levels of each participant were categorized into the followings.

Total cholesterol: Without risk (<200 mg/dL), moderate risk (200–239 mg/dL) and high risk (≥240 mg/dL).

Triglycerides: Without risk (<150 mg/dL), moderate risk (150–199 mg/dL) and high risk (≥200 mg/dL).

Cholesterol HDL: Without risk (≥60 mg/dL), moderate risk (40 to 60 mg/dL) and high risk (<40 mg/dL) and

Cholesterol LDL: Without risk (<100 mg/dL), moderate risk (100–129 mg/dL), high risk (levels ≥130 mg/dL)

Anthropometric measurements

Height and weight were measured according to a standardized protocol in the study population, with subjects wearing light clothing and no shoes. Body mass index (BMI) was calculated by dividing weight in kilograms by height in square meters (kg/m2) using criteria of World Health Organization (WHO). Normal weight was defined as 18.5 kg/m2 <BMI< 24.9 kg/m2, overweight was defined as 25.0 kg/m2 <BMI< 30.0 kg/m2, and obesity was defined as BMI ≥ 30 kg/m2 (Elmehdawi and Albarsha, 2012; Lemamsha *et al.*, 2019).

The waist circumference (WC) was measured in the horizontal plane at the midpoint between the lowest rib and the iliac crest. Central obesity was defined as a WC ≥ 94 cm in men and ≥80 cm in women (WHO, 2011).

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured to the nearest 5 mmHg with a mercury sphygmomanometer, with subjects in a supine position and having relaxed for 5 minutes. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg (Huang *et al.*, 2024).

Data analysis

Data were analyzed using the statistical package for social sciences (IBM SPSS, version 26). Frequencies and percentages were utilized to present different parameters. Chi-square test was employed to determine the relationship between the student's gender, BMI, WC and hypertension with blood lipid profile. *P-value* < 0.05 was considered significant.

Results

Prevalence of alteration in the lipid profile among student

Table 1 illustrates the prevalence (%) of the risk levels for each lipid profile variable and its distribution according to sex. Overall, a normal level of TC (<200 mg/dL) was observed in 93.6% of students (35 male vs. 68 female). The main profile at moderate risk was recorded with HDL-C (31.8%) and LDL-C (13.6%) levels; it was more expressed in females than males. 4.5% and 3.6% of students were at high risk regarding levels of HDL-C and LDL-C, respectively. Dyslipidemia was recorded in 17 students (5 male vs. 12 female) with a prevalence of 15.5%. There was no association between gender and lipid profile distribution.

Table 1. Lipid profile among Libyan international university students

Variable	Prevalence	Sex		P-value
	Total (110)	Male (37)	Female (73)	
Dyslipidemia	17 (15.5%)	5 (4.5%)	12 (10.9%)	0.68
Total cholesterol				
Without risk (<200 mg/dL)	103 (93.6%)	35 (31.8%)	68 (61.8%)	
Moderate risk (200–239 mg/dL)	7 (6.4%)	2 (1.8%)	5 (4.5%)	
High risk (≥240 mg/dL)	0 (0%)	0 (0%)	0 (0%)	0.79
Triglycerides				
Without risk (<150 mg/dL)	105 (95.5%)	36 (32.7%)	69 (62.7%)	
Moderate risk (150–199 mg/dL)	5 (4.5%)	1 (0.9%)	4 (3.6%)	
High risk (≥200 mg/dL)	0 (0%)	0 (0%)	0 (0%)	0.50
Cholesterol HDL				
Without risk (≥ 60 mg/dL)	70 (63.6%)	19 (17.3%)	51 (46.4%)	
Moderate risk (40 mg/dL to 60 mg/dL)	35 (31.8%)	16 (14.5%)	19 (17.3%)	
High risk (<40 mg/dL)	5 (4.5%)	2 (1.8%)	3 (2.7%)	0.15

Cholesterol LDL				
Without risk (<100 mg/dL)	91 (82.7%)	34 (30.9%)	57 (51.8%)	
Moderate risk (100–129 mg/dL)	15 (13.6%)	3 (2.7%)	12 (10.9%)	
High risk (≥130 mg/dL)	4 (3.6%)	0 (0%)	4 (3.6%)	0.14

P-values are obtained from Chi-square test. TC: Total Cholesterol; TG: Triglyceride; LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein

Table 2. Comparison of the prevalence of central obesity, BMI and hypertension between male and female students

Variable	Total (110)	Sex		P-value
		Male (37)	Female (73)	
Central obesity				
Without	87 (79.1%)	36 (41.4%)	51 (58.6%)	
With	23 (20.9%)	1 (4.3%)	22 (95.7%)	0.001
Body mass index				
Normal weight	11 (10.0%)	4 (36.4%)	7 (63.6%)	
Overweight	41 (37.3%)	15 (36.6%)	26 (63.4%)	
Obese	58 (52.7%)	18 (31.0%)	40 (69.0%)	0.83
Blood pressure				
Hypertension	44 (40%)	9 (42.4%)	35 (57.6%)	
No hypertension	66 (60.0%)	28 (42.4%)	38 (57.6%)	0.017

P-values are obtained from Chi-square test.

Table 3. Effects of Blood pressure on lipid profile among students

Variable	Blood pressure		P-value
	Without hypertension (n=66)	With hypertension (n=44)	
Total cholesterol			
Without risk (<200 mg/dL)	63 (57.3%)	40 (36.4%)	
Moderate risk (200–239 mg/dL)	3 (2.7%)	4 (3.6%)	
High risk (≥240 mg/dL)	0 (0%)	0 (0%)	0.33
Triglycerides			
Without risk (<150 mg/dL)	62 (56.4%)	43 (39.1%)	
Moderate risk (150–199 mg/dL)	4 (3.6%)	1 (0.9%)	
High risk (≥200 mg/dL)	0 (0%)	0 (0%)	0.35
Cholesterol HDL			
Without risk (≥ 60 mg/dL)	39 (35.5%)	31 (28.2%)	
Moderate risk (40 mg/dL to 60 mg/dL)	24 (21.8%)	11 (10.0%)	
High risk (<40 mg/dL)	3 (2.7%)	2 (1.8%)	0.44
Cholesterol LDL			
Without risk (<100 mg/dL)	55 (50%)	36 (32.7%)	
Moderate risk (100–129 mg/dL)	10 (9.1%)	5 (4.5%)	
High risk (≥130 mg/dL)	3 (2.7%)	1 (0.9%)	0.31

P-values are obtained from Chi-square test. TC: Total cholesterol; TG: Triglyceride; LDL: Low density lipoprotein; HDL: High density lipoprotein; n: number.

Prevalence of obesity and hypertension among students

According to Table 2, 20.9% of students had a central obesity; 95.7% of them were female and 4.3% were male ($p = 0.001$). Among students, the prevalence of normal weight, overweight, and obesity was 10%, 37.3%, and 52.7%, respectively, without significant correlation to the student's gender. Hypertension was present with a prevalence of 40% and more expressed in females than in males ($p = 0.017$).

Effect of blood pressure on lipid profile

Table 3 shows that overall; the majority of hypertensive students had a lipid profile without risk and revealed the absence of a significant effect of hypertension on lipid profile in the studied population.

Table 4. Effects of waist circumference on lipid profile among students

Variable	Waist circumference		P-value	Body mass index			P-value
	Without central obesity (n=87)	With central obesity (n=23)		Normal weight (n=11)	Overweight (n=41)	Obese (n=58)	
Total cholesterol							
Without risk (<200 mg/dL)	80 (72.7%)	23 (20.9%)		11 (10%)	37 (33.6%)	55 (50%)	
Moderate risk (200–239 mg/dL)	7 (6.4%)	0 (0%)		0 (0%)	4 (3.6%)	3 (2.7%)	
High risk (≥240 mg/dL)	0 (0%)	0 (0%)	0.16	0 (0%)	0 (0%)	0 (0%)	0.42
Triglycerides							
Without risk (<150 mg/dL)	84 (76.4%)	21 (19.1%)		11 (10%)	38 (34.5%)	56 (50.9%)	
Moderate risk (150–199 mg/dL)	3 (2.7%)	2 (1.8%)		0 (0%)	3 (2.7%)	2 (1.8%)	
High risk (≥200 mg/dL)	0 (0%)	0 (0%)	0.28	0 (0%)	0 (0%)	0 (0%)	0.49
Cholesterol HDL							
Without risk (≥ 60 mg/dL)	50 (45.5%)	20 (18.2%)		8 (7.3%)	21 (19.1%)	41 (37.3%)	
Moderate risk (40 mg/dL to 60 mg/dL)	32 (29.1%)	3 (2.7%)		3 (2.7%)	18 (16.4%)	14 (12.7%)	
High risk (<40 mg/dL)	5 (4.5%)	0 (0%)	0.03	0 (0%)	2 (1.8%)	3 (2.7%)	0.27
Cholesterol LDL							
Without risk (<100 mg/dL)	72 (65.5%)	19 (17.3%)		4 (3.6%)	5 (4.5%)	50 (45.5%)	
Moderate risk (100–129 mg/dL)	12 (13.8%)	4 (2.7%)		4 (21.1%)	7 (36.8%)	6 (5.5%)	
High risk (≥130 mg/dL)	3 (2.7%)	1 (0.9%)	0.98	0 (0%)	2 (1.8%)	2 (1.8%)	0.21

Effect of central obesity and BMI on lipid profile

Table 4 shows that WC significantly affects HDL-C levels (p = 0.03). 18.2% of students (n = 20) with central obesity had normal HDL-C levels. 2.7% (n = 3) had central obesity and a moderate risk of HDL-C. There was no significant impact of BM and WC on the other student lipid profile parameters.

Discussion

Young people with lipid profile anomalies have a serious risk for cardiovascular diseases. The present research is going to provide, for the first time in the Libyan population, information regarding the serum lipid levels among a group of university students.

This study discovered that 15.5% of students had dyslipidemia even though 93.6% of them had normal TC levels, which is close to the rate reported in other studies done among college students in Kuwait (AlMajed *et al.*, 2011). In several Arab countries, students presented a high prevalence of dyslipidemia especially hypercholesterolemia: Iraq, Egypt and Saudi Arabia (Al-Sabah *et al*, 2014; Abdel Wahed *et al.*, 2016; Hamam, 2017). The prevalence of 15.5% among our students seems to be encouraged when compared to the global prevalence of 39% for high total cholesterol estimated in adults by the WHO regions (AlMuhaidib *et al.*, 2022).

Abnormal levels (Table 1) of HDL-C and LDL-C (31.8% and 13.6%, respectively) linked to a moderate risk were the main prevalent figure of lipid profile compared to TC and TG. Students at LIMU University had a similar incidence of high risked LDL-C to students at Taif University in Saudi Arabia, who likewise had a high prevalence of low HDL-C (46.3%) (Hamam, 2017).

The second important finding of this work was the high prevalence of obesity according to BMI index (52.7%), central obesity assessed by WC (20.9%), and hypertension (40%) among LIMU students. Central obesity ($P = 0.001$) and hypertension ($P = 0.017$) were significantly more prevalent in female students

compared to males. While it is often known that hypertension is overall more common in males, recent studies have shown significant differences in the prevalence of hypertension in males and females (Connelly *et al.*, 2022). The high prevalence of hypertension among Libyan students (57.6% female vs. 42.4% male), reported in this work, lines with the systematic analysis conducted by Mills *et al.* to study hypertension in participants from 90 countries grouped by income. Women in middle- and low-income countries were more likely to have hypertension in all age categories (Mills *et al.*, 2016).

Even though the prevalence of hypertension in LIMU students seems to be higher than previously reported in college students from Congo (Wanghi *et al.*, 2019) and Iran (Mansouri *et al.*, 2020), it was agreed with the data recorded in Indian students (Hansaram and Jafar, 2024).

Middle- and low-income countries, including Libya, currently face a rapid increase in non-communicable disease risk factors, including overweight and obesity (Bollyky *et al.*, 2017; Popkin *et al.*, 2020). Previous studies conducted in the Libyan population agreed with the low prevalence of normal weight (11%) compared to overweight (37.3%) and obesity (52.7%) revealed in this work (Elmehdawi and Albarsha, 2012; Lemamsha *et al.*, 2019).

WC was substantially linked to low HDL-C levels ($p = 0.03$). The remaining correlations between the lipid profile and central obesity, hypertension, and BMI index were not statistically significant. The revealed association between abdominal adiposity and HDL-C levels, through this work, agreed with findings of other studies (Erem *et al.*, 2008; Abdel Wahed *et al.*, 2016). Furthermore, it was shown that low HDL-C levels were associated with weight gain during the first year of university attendance, a transition period that influences student's lifestyles (Perusse *et al.*, 2010). Additionally, the university transition period can lead to the establishment of lifelong health behaviors. In the United States, studies showed that 75% of students were unaware that 69% of them had hypertension (Kessler and Rayman, 2024).

Conclusion

This is the first exploration of lipid profiles among students conducted at Libyan International University. Although there was an encouraging prevalence of dyslipidemia and lipid abnormalities, there was an unexpectedly greater rate of hypertension and obesity. It is as if obesity and hypertension are increased during the study period to anticipate the rise of lipid disorders in the adult general population.

Recommendations

It is necessary to enlarge the sample size of the studied population, since this work was restricted to a small number of students from a single university, and to investigate additional factors that may be influencing student life, such as sports, habits, smoking, stress, etc. Lack of awareness and the unhealthy lifestyle may be the main causes of obesity and hypertension among students. More preventive measures including health care education should ameliorate the incidence of obesity and hypertension to protect young people against cardiac risk factors.

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