Prevalence of dyslipidemia among students of a Yemeni University

Mohammed A. Al-Duais, PhD a, b and Yahya S. Al-Awthan, PhD a

a Department of Biochemistry, Faculty of Science, University of Tabuk, Tabuk, KSA
b Department of Biology, Faculty of Science, Ibb University, Ibb, Yemen

Received 1 October 2018; revised 25 December 2018; accepted 26 December 2018; Available online 30 January 2019

Abstract

The mean age of the studied cohort was 19.8 ± 1.8 years; 48.3% were men and 51.7% were women. The mean age for female students was 18.8 ± 1.8 years; 51.7% were men and 48.3% were women. The mean age for male students was 21.7 ± 1.8 years; 48.3% were men and 51.7% were women.

Objective: To estimate the prevalence of dyslipidemia and patterns of lipid profile and associated factors among Yemeni university students.

Methods: This cross-sectional study included 240 Yemeni students (116 males and 124 females) at Ibb University. The students were randomly selected from various faculties of the university. Demographic and clinical data were collected from all participants. Fasting blood specimens were collected from all students for measurement of serum levels of total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C). The criteria of the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III) were used.

Results: The mean age of the studied cohort was 19.8 ± 1.8 years; 48.3% were men and 51.7% were women.
women. About 56.7% of the participants were from rural areas. Qat chewers and cigarette smokers comprised 63.3% and 6.7% of the cohort, respectively. No obese students were found in this study; however, 11.7% were overweight. The overall prevalence of dyslipidemia, hypercholesterolemia, hypertriglyceridemia, high LDL-C, and low HDL-C among the participating students were 86.7%, 21.7%, 23.8%, 31.7%, and 81.7%, respectively. Mixed hyperlipidemia was present in 8.8% of the students. The prevalence of isolated hypercholesterolemia, hypertriglyceridemia, and low HDL-C was 12.9%, 15%, and 70%, respectively. Dyslipidemia was significantly associated with male sex, increasing age, urban residence, and medical and natural science faculties. In contrast, smoking, qat chewing, physical activity, and the consumption of fast food, fruits and vegetables, and fish were not significantly associated with dyslipidemia.

Conclusion: To our knowledge, this is the first human study conducted at Ibb University during wartime in Yemen. Dyslipidemia was highly prevalent among healthy Yemeni university students in Ibb city. Low HDL-C was the most prevalent type of dyslipidemia, followed by increased levels of LDL-C. Gender, age, residence, and type of faculty were also closely related to dyslipidemia. These results indicate the need for specialized programs to determine blood lipid levels and initiate intervention programs to reduce the prevalence and prevent the complications of dyslipidemia among Yemeni university students.

Keywords: Dyslipidemia; Hypercholesterolemia; Hypertriglyceridemia; Ibb; Students

© 2019 The Authors. Production and hosting by Elsevier Ltd on behalf of Taibah University. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Introduction

Dyslipidemia is defined as elevated levels of cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG), as well as lower plasma levels of high-density lipoprotein cholesterol (HDL-C). These increases can occur either singly or in combination.1,2 Dyslipidemia is associated with atherosclerosis and increases the risk of cardiovascular disease (CVD).3 According to the World Health Organization (WHO), 17.7 million people die annually from CVD4 and approximately one-third of global deaths are attributable to CVD and stroke.5,6 Dyslipidemia in adulthood increases the prevalence of CVD later on in life.7 Cholesterol levels at 22 years of age can predict the rate of CVD development over the ensuing 30–40 years.8 The treatment of dyslipidemia as a modifiable risk factor of CVD has been shown to reduce the incidence of CVD morbidity and mortality.9 For every 38.6 mg/dL reduction in LDL-C level, the annual rate of major vascular events decreases by one-fifth.10 CVD also represents a considerable economic burden to society. In the USA, the direct annual costs of CVD are projected to triple between 2010 and 2030, while the healthcare costs related to CVD represented 9% of the total healthcare expenditure across the European Union in 2009.11,12 Dyslipidemia is also prevalent in the Arab Countries. The CVD-associated mortality rate in the Middle East (ME) is one of the highest in the world.13 According to WHO, the CVD mortality in Yemen accounts for 21% of total deaths among all ages of both sexes.14 The Ibb governorate is located in the inland south of Yemen. It has an area of 6484 km² and an estimated population of around 2,560,000, making it the most densely populated governorate in Yemen. It has 20 districts.15 Ibb city is the capital of the governorate. Despite the war conditions in the country in the last three years, Ibb city remains one of the most secure and stable cities in the country, which explains the large wave of displacement from other provinces. To our knowledge, no previous study has measured the prevalence of dyslipidemia among university students in Ibb governorate. Therefore, this study aimed to estimate the prevalence of dyslipidemia and patterns of serum lipid profiles and associated risk factors among Yemeni students at Ibb University.

Materials and Methods

Population sample

This cross-sectional study was carried out at Ibb University in Ibb city, Yemen, between February 1 and June 2018. Ibb University is a state university in Yemen with ten faculties including more than 10,000 students (60% males and 40% females) originating from across the country. Data were collected using a predesigned interviewing schedule. Stratified random sampling was used to include students from the first to the last academic years. Students were selected using a clustering technique inside each faculty for each academic year. Students in the faculties are usually divided into small sections for practical and tutorial lessons. Each section includes from 10 to 30 students. One or two clusters were randomly selected in each academic year. The study sample was statistically calculated based on a 21% prevalence of CVD in Yemen according to WHO non-communicable diseases (NCD) country profiles.14 A significance level 0.05 and power of 90% were used. The estimated sample size was 180. A total of 300 students aged 17–25 years, were chosen randomly from five faculties (Science, Education, Dentistry, Engineering, and Arts). The inclusion criteria of the study were apparently healthy Yemeni university students (male or female) 17–25 years of age who agreed to participate in the study. A total of 240 students (116 males and 124 females) completed the study and were included in the final analysis. Students who refused to participate and those with hypertension, diabetes mellitus, and kidney diseases were excluded. Pregnant women, nursing mothers, or students receiving medications that could affect serum lipid profiles were not included. Students were asked to fast for 10–14 h prior to the time of blood collection. Ethical approval of the study was obtained from the ethical committee of Ibb University. The study conformed to the ethical standards of the Declaration of Helsinki. Written informed consent was obtained from each participant upon his/her agreement to participate in the study. Administrative approvals were also obtained.
Data collection and measurements

A written document explaining the aim of the study was prepared by the researchers. Participant students were asked to fast for 10–14 h at the time of the interview. Each participant visited the university clinic twice. During the first visit, the questionnaire was completed and clinical and physical measurements were performed. The second visit included the collection of blood samples and completion of deficient data. Personal data such as sex, age, and martial state were collected. Data regarding health and dietary habits (Qat chewing, smoking, frequency of fast food consumption, physical exercise, and vegetable and fruit consumption) were also collected. Height and weight were measured twice using a calibrated height—weight scale with the subjects standing in bare feet while wearing light clothing; the average values of the two measurements were then calculated. Body mass index (BMI) was calculated as the weight (kg) divided by the square of the height (m). Waist circumference (WC) was measured twice on standing participants at the midpoint between the lower edge of the costal arch and the upper edge of the iliac crest, with means calculated. Blood pressure was recorded by physicians using a sphygmomanometer after a 5-min sitting rest, with the average of three readings calculated. Venous blood samples were collected from each student after a 10–14-h fast. The samples were centrifuged immediately and stored at −70 °C until biochemical analysis. The samples were analyzed for total cholesterol (TC), triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and high-density lipoprotein cholesterol (HDL-C) levels. Spinreact diagnostic enzymatic kits (Spain) were used. A spectrophotometer made by Spectronic Company (USA) was used.

Definitions of variables

According to the criteria of the National Cholesterol Education Program-Adult Treatment Panel III (NCEP-ATP III),16 dyslipidemia was defined as follows:

**Hypertriglyceridemia:** TG levels ≥150 mg/dL; hypercholesterolemia: TC ≥200 mg/dL; high LDL-C: levels ≥130 mg/dL; low HDL-C: levels <40 mg/dL. Isolated hypercholesterolemia was defined as a total cholesterol ≥200 mg/dL and TG <150 mg/dL; isolated hypertriglyceridemia was defined as serum TG ≥150 mg/dL and total cholesterol <200 mg/dL; mixed hyperlipidemia was defined as TG ≥150 mg/dL and total cholesterol ≥200 mg/dL; isolated low HDL-C was defined as HDL-C ≤50 mg/dL in women and ≤40 mg/dL in men without hypertriglyceridemia or hypercholesterolemia. Overweight was defined as BMI ≥25.0 kg/m² and <30.0 kg/m², while obesity was defined as BMI ≥30 kg/m². Central obesity was defined as a WC ≥102 cm in men and ≥82 in women.19

Qat chewers were defined as those who chewed qat for 4–6 h daily, usually in the afternoon, four times per week.20 Hypertension was defined as systolic blood pressure ≥140 mmHg and diastolic blood pressure ≥90 mmHg.21 Smoking was classified in terms of current smokers or non-smokers. Regular physical activity was defined as participation in moderate or vigorous activity for ≥30 min/day at least five days per week.22 Frequent fast consumption was defined as the consumption of foods like pizza, fried chicken, and hamburger at least three times per week.23

Statistical analysis

Data were collected, coded, and entered into an IBM-compatible computer using IBM SPSS Statistics for Windows, version 22.0. The results were presented as frequencies and percentages for qualitative data and as means and standard deviation for quantitative variables. Chi-square tests were used to assess the association of dyslipidemia with qualitative variables. Statistical significance was defined for $P$-values < 0.05.

Results

Among the 300 initial participants in the study, 60 were excluded for incomplete data. The personal data of the

| Table 1: General characteristics of the participating students. | Variables | Levels | Number (Percent) 240 |
|---------------------------------------------------------------|-----------|--------|---------------------|
| **Sex**                                                      | Male      | 116 [48.3%] |
|                                                             | Female    | 124 [51.7%] |
| **Age (years)**                                              | <20       | 36 [15%]  |
|                                                             | ≥20       | 204 [85%]  |
| **Faculty**                                                  | Medicine  | 24 [10%]  |
|                                                             | Natural Science | 168 [70%] |
|                                                             | Social Science | 48 [20%] |
| **Residence**                                                | Rural     | 136 [56.7%] |
|                                                             | Urban     | 104 [43.3%] |
| **Weight**                                                   | Normal    | 212 [88.3%] |
|                                                             | Obese     | 0 (0%)    |
|                                                             | Overweight | 28 [11.7%] |
| **Exercise**                                                 | None      | 212 [88.3%] |
|                                                             | Regular   | 16 [6.7%]  |
|                                                             | Regular   | 12 [5%]    |
| **Smoking**                                                  | Yes       | 224 [93.3%] |
|                                                             | No        | 16 [6.7%]  |
| **Qat consumption**                                          | Yes       | 152 [63.3%] |
|                                                             | No        | 88 [36.7%]  |
| **Fast food**                                                | Seldom    | 82 [34.2%] |
|                                                             | Daily     | 100 [41.7%] |
|                                                             | Seldom    | 124 [51.7%] |
| **Fruits and vegetables**                                    | Seldom    | 88 [36.7%] |
|                                                             | Daily     | 28 [11.6%] |
| **Fish**                                                     | Seldom    | 216 [90%]  |
|                                                             | Daily     | 20 [8.3%]  |
|                                                             | Daily     | 4 [1.7%]   |

| Table 2: Anthropometric parameters of the study participants according to sex. | Male (n = 116) | Female (n = 124) | Total (N = 240) | P-value |
|------------------------------------------------------------------------------|-------------|-----------------|----------------|--------|
| **BMI (kg/m²)**                                                              | 20.92 ± 3.6 | 20.56 ± 3.65    | 20.73 ± 3.63   | 0.53   |
| **WC (cm)**                                                                  | 79.5 ± 13.4 | 71.24 ± 11.8    | 74.20 ± 12.14  | 0.00   |
| **SBP (mmHg)**                                                                | 112.34 ± 8.62 | 106.12 ± 4.46 | 108.24 ± 6.34 | 0.04   |
| **DBP (mmHg)**                                                                | 74.2 ± 6.2  | 70.82 ± 5.8     | 72.56 ± 6.2    | 0.01   |
participating students are shown in Table 1. A total of 240 students (116 males and 124 females) aged 17–25 years (mean: 19.8 ± 1.8 years) were included in this study. Women comprised 51.7% of the participating students. The majority of the participants (56.7%) were from rural areas and 85% of them were ≥20 years of age. Qat chewers and smokers comprised 63.3% and 6.7% of the students, respectively.

Table 1: Demographic characteristics of the study population.

| Characteristic       | Males (n = 116) | Females (n = 124) | Total (N = 240) | P-value |
|----------------------|-----------------|-------------------|-----------------|---------|
| Age (years)          | 19.8 ± 1.8      | 19.8 ± 1.8        | 19.8 ± 1.8      |         |
| Sex                  | 56.7%           | 43.3%             | 51.7%           |         |
| Rural Area           | 56.7%           | 43.3%             | 56.7%           |         |
| Age ≥20 years        | 85%             | 85%               | 85%             |         |

Overweight students represented 11.7% of the population and no students (0%) of both sexes were obese. Students from the faculty of Science comprised 70% of the participants. Only 11.7% of the participants practiced irregular or regular exercise. Daily consumption of fast food, fruits, and fish was reported by 41.7%, 11.7%, and 1.7% of students, respectively.

Table 2 shows the male/female anthropometric parameters of the students. There were no sex differences in BMI, but there was a significant difference in WC (P < 0.05) between male and female students. The mean systolic and diastolic blood pressures were significantly (P < 0.05) higher in male than those in female students.

Table 3 shows the mean lipid profile levels among students according to sex. Male students had higher lipid profile levels compared to those in female students. The mean ± SD of TC, TG, LDL-C, and HDL-C for males were 171.07 ± 46.28, 147.71 ± 65.05, 106.47 ± 45.90, and 35.07 ± 19.41, respectively, and 160.52 ± 42.29, 99.84 ± 37.49, 105.65 ± 58.54, and 34.94 ± 23.47, respectively, for females.

Table 4 examines the prevalence of dyslipidemia among the participating students. Dyslipidemia was highly prevalent (86.7%) among the students, while mixed hyperlipidemia was found only in 8.8% of the subjects. The prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL-C, and low HDL-C was 21.7%, 23.8%, 31.7%, and 81.7% respectively. The prevalence of isolated hypercholesterolemia, isolated hypertriglyceridemia, and isolated low HDL-C was 12.9%, 15%, and 50%, respectively (Figure 1).

Table 5 illustrates the factors associated with dyslipidemia. A significantly higher prevalence of hypercholesterolemia and hypertriglyceridemia was observed in male students compared to those in female students (31% and 49% versus 21.7% and 23.8% respectively).

Figure 1: Venn diagram showed interaction between dyslipidemia types. Three circles: green circle for hypercholesterolemia, yellow circle for hypertriglyceridemia, pink circles for low HDL-C.
12.9% and 6.5% \((P = 0.005)\); while low HDL-C and high LDL-C were more prevalent in female students than in male students (83.9% and 32.3% versus 79.3% and 31%), the difference was not statistically significant. Hypertriglyceridemia was observed in 27.5% of students aged \(\geq 20\) years and was significantly \((P < 0.005)\) associated with this age group, while high LDL-C was significantly associated in those less than 20 years of age \((P < 0.005)\). Hypercholesterolemia, hypertriglyceridemia, and high LDL-C accounted for 30.8%, 31.7%, and 38.5%, respectively, of urban students \((P\)-values: 0.005, 0.01, and 0.04 respectively). Significant differences in the prevalence of dyslipidemia were observed between faculties, with a higher percentage of abnormalities among medical and natural science students (Table 5).

Table 5 also shows the non-significant association of different types of dyslipidemia with normal and overweight students with the exception of low HDL-C, which was significantly associated with body weight \((P < 0.05)\) and accounted for 83.5% and 67.9% of normal and overweight students, respectively. In our study, obesity was not detected among the participating students (Table 5).

Table 6 illustrates the association of dyslipidemia with lifestyle factors and dietary habits. Only low HDL-C-hypalipoproteinemia was significantly associated with smoking \((P = 0.005)\); the other types of dyslipidemia were not significantly associated with smoking and qat chewing (Table 6).

Hypertriglyceridemia was significantly \((P < 0.005)\) associated with physical inactivity and accounted for 68.8% of students practicing irregular exercise. The other types of dyslipidemia were not associated with exercise \((P > 0.05)\). A significant relation between dyslipidemia and fast food

### Table 5: Association of dyslipidemia with demographic characteristics and obesity.

| Demographic     | High TC n = 52 | High TG n = 57 | High LDL-C n = 76 | Low HDL-C n = 196 |
|-----------------|----------------|----------------|-------------------|-------------------|
| Sex Male        | 36 [31.0%]     | 49 [42.2%]     | 36 [31.0%]        | 92 [79.3%]        |
| Female          | 16 [12.9%]     | 8 [6.5%]       | 40 [32.3%]        | 104 [83.9%]       |
| \(P\)-value     | 0.00           | 0.00           | 0.83              | 0.36              |
| Age (years)     |                |                |                   |                   |
| <20             | 8 [22.2%]      | 1 [2.8%]       | 20 [55.6%]        | 32 [88.9%]        |
| \(P\)-value     | 0.93           | 0.00           | 0.00              | 0.22              |
| \(\geq 20\)     | 44 [21.6%]     | 56 [27.5%]     | 56 [27.5%]        | 164 [80.4%]       |
| Residence       |                |                |                   |                   |
| Rural           | 20 [14.7%]     | 24 [17.6%]     | 36 [26.5%]        | 108 [79.4%]       |
| Urban           | 32 [30.8%]     | 33 [31.7%]     | 40 [38.5%]        | 85 [84.6%]        |
| \(P\)-value     | 0.00           | 0.01           | 0.04              | 0.30              |
| Faculty         |                |                |                   |                   |
| Medicine        | 16 [66.7%]     | 5 [20.8%]      | 16 [66.7%]        | 24 [100%]         |
| Natural Science | 36 [21.4%]     | 52 [31.0%]     | 48 [28.6%]        | 124 [73.8%]       |
| Social Science  | 0 [0%]         | 0 [0%]         | 12 [25%]          | 48 [100%]         |
| \(P\)-value     | 0.00           | 0.00           | 0.00              | 0.00              |
| Obesity         |                |                |                   |                   |
| Normal          | 44 [20.8%]     | 52 [24.5%]     | 64 [30.2%]        | 177 [83.5%]       |
| Overweight      | 8 [28.6%]      | 5 [17.9%]      | 12 [42.9%]        | 19 [67.9%]        |
| Obese           | 0 [0%]         | 0 [0%]         | 0 [0%]            | 0 [0%]            |
| \(P\)-value     | 0.34           | 0.43           | 0.17              | 0.04              |

### Table 6: Associations of dyslipidemia with lifestyle factors and dietary habits.

| Lifestyle factor | High TC N = 52 | High TG N = 57 | High LDL-C N = 76 | Low HDL-C N = 196 |
|-----------------|----------------|----------------|-------------------|-------------------|
| Smoking         |                |                |                   |                   |
| No              | 48 [21.4%]     | 53 [23.7%]     | 72 [32.1%]        | 188 [83.9%]       |
| Yes             | 4 [25%]        | 4 [25%]        | 4 [25%]           | 8 [50%]           |
| \(P\)-value     | 0.73           | 0.90           | 0.55              | 0.00              |
| Qat chewing     |                |                |                   |                   |
| No              | 20 [22.7%]     | 28 [31.8%]     | 28 [31.8%]        | 76 [86.4%]        |
| Yes             | 32 [21.1%]     | 41 [27%]       | 48 [31.6%]        | 120 [78.9%]       |
| \(P\)-value     | 0.76           | 0.12           | 0.96              | 0.15              |
| Exercise        |                |                |                   |                   |
| No              | 48 [22.6%]     | 45 [21.2%]     | 69 [32.5%]        | 170 [80.2%]       |
| Irregular       | 2 [12.5%]      | 11 [68.8%]     | 3 [18.8%]         | 16 [100%]         |
| Regular         | 2 [16.5%]      | 1 [8.3%]       | 4 [33.3%]         | 10 [83.3%]        |
| \(P\)-value     | 0.58           | 0.00           | 0.51              | 0.14              |
| Fast food consumption |         |                |                   |                   |
| Seldom          | 18 [22%]       | 17 [20.7%]     | 26 [31.7%]        | 69 [84.1%]        |
| Three times per week | 10 [17.2%] | 5 [8.6%]     | 15 [25.9%]        | 44 [75.9%]        |
| Daily           | 24 [24%]       | 35 [35%]       | 35 [35%]          | 83 [83%]          |
| \(P\)-value     | 0.60           | 0.00           | 0.49              | 0.41              |
| Fruit & vegetable consumption |          |                |                   |                   |
| Seldom          | 24 [19.4%]     | 28 [22.6%]     | 36 [29%]          | 108 [87.1%]       |
| Three times per week | 21 [23.9%] | 21 [23.9%]     | 30 [34.1%]        | 67 [76.1%]        |
| Daily           | 7 [25%]        | 8 [28.6%]      | 10 [35.7%]        | 21 [75%]          |
| \(P\)-value     | 0.60           | 0.79           | 0.65              | 0.07              |
| Fish consumption |                |                |                   |                   |
| Seldom          | 49 [22.7%]     | 49 [22.7%]     | 71 [32.9%]        | 177 [81.9%]       |
| Three times per week | 3 [15%]  | 7 [35%]      | 5 [25%]           | 16 [80%]          |
| Daily           | 0 [0%]         | 1 [25%]        | 0 [0%]            | 3 [75%]           |
| \(P\)-value     | 0.41           | 0.46           | 0.30              | 0.92              |
consumption was observed, with an increased prevalence of hypertriglyceridemia by 35% among students with daily fast food consumption (P = 0.005. No significant association was observed between dyslipidemia and fruit and vegetable and fish consumption (Table 6).

Discussion

Recently, the increasing prevalence of dyslipidemia is a worldwide public health problem. Its prevalence varies widely according to ethnic, socioeconomic, and cultural characteristics. To our knowledge, the current study is the first to examine the prevalence of types of dyslipidemia among Yemeni students at Ibb University. It may be also the first study in Yemen conducted during war conditions. Our results show that 63.3% of the students chewed qat daily. Qat chewing is a highly prevalent habit in Yemen, Ethiopia, and other countries of the Horn of Africa.23 This finding is concordant with those of other studies. Many regional and international studies reported obesity to be a significant risk factor for dyslipidemia.26–31 The absence of obesity in our study is likely related to widespread poverty among Yemeni families, particularly during the last three years of war. Yemen is one of the poorest countries in the Middle East. According to the United Nations (UN), about half of Yemen’s population of about 26.8 million lives below the poverty line.31 Traditional Yemeni food is low in fats and calories. This may also explain the absence of obesity among our students. In addition, the majority of students in this study reported that, due to the high cost of transportation, they leave and return to the university on foot. In other words, students practice daily exercise. Exercise can help promote weight loss and works best when combined with lower-calorie diet.33 Finally, the widespread of qat chewing among Yemeni students may also play a role in the absence of obesity. It is common for Yemeni students to eat a good meal only once a day for lunch. They spend most of their money to buy qat for chewing many hours daily. The students believe that qat improves memory, alertness and clear thinking.34 An interesting finding in the current study was the absence of obesity among Yemeni university students. Our finding is inconsistent with those of other studies. The reported prevalence of qat chewing in Yemen, Ethiopia, and the Jazan region of KSA is 61.12%, 42%, and 28.7%, respectively. Many factors determine about 50% of the variability in HDL-C levels, while acquired factors such as diet, smoking, diabetes mellitus type 2, physical inactivity, and drugs affect the other 50%.46,47 Furthermore, the high prevalence of isolated low HDL-C among populations consuming low-fat diets may be due to decreased apolipoproteins in HDL-C.48,49 Finally, the present study was conducted during war conditions in the country that had lasted for more than three years. Psychological stress is also a risk factor for lipid disorders.50,51 Thus, Yemeni university students are at high risk for developing CVD.52 According to WHO, CVD mortality accounts for 21% of total deaths among all age groups of men and women in Yemen.14

The prevalence of hypercholesterolemia in the current study was 21.7%, much lower than the prevalence in Egyptian,1 Turkish,53 and Jordanian adults.54 In contrast, our result is concordant with a Spanish study.55 However, our figures are much higher than other studies on this age group.24,41 Young adults with hypercholesterolemia have five times the risk of CVD and nine times the risk of myocardial infarction (MI) in the following 30–40 years compared to the risk in young adults with low cholesterol levels.55 The current results revealed hypertriglyceridemia in only 23.8% of students. The Egyptian estimate of hypertriglyceridemia among university students (29.7%) was comparable to that in the current study.56 Desouky et al. reported a 33.6% prevalence of hypertriglyceridemia among Saudi female university students.56 Our results also show the increasing prevalence of dyslipidemia among medical and natural science students compared to those in students from social science faculties. This may be linked to the type of study in these faculties, which may encourage students physical inactivity for long periods of time to read lessons or work on computers. This result is similar to those of another study.8 The current study revealed the insignificant association of dyslipidemia with eating habits and the intake of most of the investigated food, a result consistent with those of previous studies.8,41
Limitations

Our study has some limitations, mainly related to the nature of the study. The data were based on the number of Yemeni university students at one state University and likely do not represent the actual prevalence of dyslipidemia among the whole population. Therefore, we recommend intervention programs for university students at an earlier age through screening, health education, and counseling. Our results provide a foundation for further studies to reduce dyslipidemia prevalence and prevent its complications.

Conclusion

To our knowledge, is the first human study conducted at Ibb University during wartime in Yemen. Dyslipidemia was prevalent among healthy Yemeni university students in Ibb city. Low HDL-C was the most prevalent type of dyslipidemia, followed by increased levels of LDL-C. Gender, age, residence, and type of faculty were associated with dyslipidemia. These results indicate the need for specialized programs for the study of blood lipid levels as well as appropriate intervention programs to reduce the prevalence and prevent complications of dyslipidemia among Yemeni university students.

Source of funding

This work was not funded by any organizations and/or institutions.

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

Ethics approval of the study was obtained from the ethical committee of Ibb University. The whole study was conformed to the ethical standards of the Helsinki Declaration. A written informed consent was taken from each participant upon his/her acceptance to participate in the study. In addition, all administrative approvals were taken. And the Ibb University approval paper will be attached below with this email.

Authors’ contributions

Mohammed Al-Duais designed the plan of the study, designed the methodology, organized, and prepared the initial draft of the paper. Yahya Al-Awthan conducted the study, collected and provided statistical analysis of the results. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Acknowledgments

We are grateful to the study participants for their active cooperation. Special thanks to Azhar Al-Ezzy and Zinab
Sufian from the Department of Biology for their assistance in filling the questioners and collection of the samples.

References

1. Bibbins-Domingo K, Grossman DC, Curry SJ, Davidson KW, Epling JW, García FA, et al., US Preventive Services Task Force. Screening for lipid disorders in children and adolescents: US Preventive Services Task Force recommendation statement. J Am Med Assoc 2016; 316(6): 625–633.
2. Manjunath CN, Rawal JR, Irani PM, Madhu K. Atherogenic dyslipidemia. Indian J Endocrinol Metab 2013; 17(6): 969–976. PubMed PMID: 24381869, Pubmed Central PMCID: PMC3872713, Epub 2014/01/02. eng.
3. Expert Panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents; national heart, lung, and blood institute: expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics 2011; 128: 213–256. http://dx.doi.org/10.1542/peds.2009-2107C.
4. http://www.who.int/cardiovascular_diseases/en/.
5. Townsend N, Nichols M, Scarborough P, Rayner M. Cardiovascular disease in Europe - epidemiological update 2015. Eur Heart J 2015; 36: 2696–2705.
6. GBD 2013 Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015; 385: 117–171.
7. Joshi SR, Anjana RM, Deepa M, Pradeepa R, Bansali A, Dhandania VK, et al. Prevalence of dyslipidemia in urban and rural India: the ICMRINDIAB study. PLoS One 2014; 9(5) e96808.
8. Abdel Wahed WY, El-Khashab K, Hassan SK. Prevalence of Dyslipidemia among Healthy University Students: Fayoum Governorate, Egypt. Epidemiol Biostatistics Public Health 2016; 13(1–9)e11769.
9. Brown BG, Stukovsky KH, ZhaoX-Q. Simultaneous low-density lipoprotein- C lowering and high-density lipoprotein-C elevation for optimum cardiovascular disease prevention with various drug classes, and their combinations: a meta-analysis of 23 randomized lipid trials. Curr Opin Lipidol 2006; 17(6): 631–636.
10. Bugen C, Blackwell L, Emerson J, Holland LE, Reith C, Bhala N, et al. Cholesterol Treatment Trials’ (CTT) Collaboration. Efficacy and safety of more intensive lowering of LDL cholesterol: a meta-analysis of data from 170,000 participants in 26 randomised trials. Lancet 2010; 376(9753): 1670–1681.
11. Heidenreich PA, Trogdon JG, Khavjou OA, Butler J, Dracup K, Ezekowitz MD. Forecasting the future of cardiovascular disease in the United States: a policy statement from the American Heart Association. Circulation 2011; 123: 933–944.
12. Nichols M, Townsend N, Luengo-Fernandez R, Leal J, Gray A, Scarborough P, Rayner M. European cardiovascular disease Statistics, 2012. Brussels: European Heart Network; 2012. https://www.escardio.org/static_file/escardio/Press-media/press-releases/2013/EU-cardiovascular-disease-statistics-2012.pdf.
13. RamahiTM. Cardiovascular disease in the Asia Middle East region: global trends and local implications. Asia Pac J Public Health 2010; 22(3): 835–895.
14. World Health Organization. Non-communicable diseases (NCD) country profiles; 2018. Retrieved 21 August 2018. Available at: http://www.who.int/nmh/countries/yem_en.pdf; 2018.
15. "Statistical Yearbook 2011". Central Statistical Organization. Retrieved 24 February 2013. Available at: https://en.wikipedia.org/wiki/Ibb_Governorate.
16. Expert panel on detection, evaluation, and treatment of high blood cholesterol in adults. Executive summary of the third report of the national cholesterol education program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III). JAMA 2001; 285(19): 2486−2497.

17. Appropriate body mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004; 363: 157−163.

18. Anuurad E, Shiwaku K, Nogi A, Kitajima K, Enkhmaa B, Shimono K, et al. The new BMI criteria for Asians by the regional office for the western pacific region of who are suitable for screening of overweight to prevent metabolic syndrome in elderly Japanese workers. J Occup Health 2003; 45: 335−343.

19. WHO. Waist circumference and Waist−Hip ratio: report of a WHO expert consultation Geneva; 2008. 8−11 December, http://apps.who.int/iris/bitstream/handle/10665/44583/9789241501491_eng.pdf;jsessionid=D2E418D4CBB06D1B15F51ED10FF4A08?sequence=1; 2008.

20. Al-Motarreb A, Al-Habari M, Broadley KJ. Khat chewing, cardiovascular diseases and other internal medical problems: the current situation and directions for future research. J Ethnopharmacol 2010; 132: 540−548.

21. Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7). The seventh report of the joint national committee on the prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. JAMA 2003: 289: 2560−2572.

22. Qi L, Ding X, Tang W, Li Q, Mao D, Wang Y. Prevalence and risk factors associated with dyslipidemia in Chongqing, China. Int J Environ Res Publ Health 2015; 12: 13455−13465.

23. Kassim S, Islam S, Croucher R. Validity and reliability of a severity of dependence scale for khat (SDS-khat). J Ethnopharmacol 2010; 132(3): 570−577.

24. Ali AA. Qat habit in Yemen society; a causative factor for oral periodontal diseases. Int J Environ Res Publ Health 2007; 4(3): 243−247.

25. Teni FS, Surur AS, Hailemariam A, Aye A, Mitiku G, Gurmu AE, et al. Prevalence, reasons, and perceived effects of Khat chewing among students of a college in Gondar town, Northwestern Ethiopia: a cross-sectional study. Ann Med Health Sci Res 2015; 5: 454−460.

26. Mahfouz MS, Rahim BEA, Solan YMH, Makeen AM, Alsanosy RM. Khat Chewing Habits in the Population of the Jazan Region, Saudi Arabia: prevalence and Associated Factors. PLoS One 2015; 10(8):e0134545.

27. Engidawork E. Pharmacological and toxicological effects of catha edulis F. (Khat). Phytother Res 2017; 31(7): 1019−1028.

28. Khader YS, Batieha A, El-Khateeb M, Al Omari M, Ajlouni K. Prevalence of dyslipidemia and its associated factors among Jordanian adults. J Clin Lipidol 2020; 4(1): 53−58.

29. AlMajed HT, AlAttar AT, Sadek AA, AlMuaili TA, AlMutairi OA, Shaqhouli AS, et al. Prevalence of dyslipidemia and obesity among college students in Kuwait. Alexandria J Med 2011; 47: 67−71.

30. Aguilar-Salinas CA, Gomez-Perez FJ, Rull J, Villalpando S, Barquera S, Rojas R. Prevalence of dyslipidemias in the Mexican national health and nutrition survey 2006. Salud Publica Mex 2010; 52(Suppl 1): S44−S53.

31. Sawant AM, Shetty D, Mankeshwar R, Ashafid TF. Prevalence of dyslipidemia in young adult Indian population. J Assoc Phys India 2008; 56: 99−102.

32. World development Indicators 2010. Washington, DC, USA: The World Bank; 2014.

33. U.S. Dept. of Health and Human Services. 2008 physical activity Guidelines for Americans; 2008. January 30, 2012, https://health.gov/paguidelines/pdf/paguide.pdf; 2008.

34. Lemieux AM, Li B, Al’ Absi M. Khat use and appetite: an overview and comparison of amphetamine, khat and cathinone. J Ethnopharmacol 2015; 160: 78−85.

35. Al-Sharafi BA, Gunaid AA. Effect of habitual khat chewing on glycemic control, body mass index, and age at diagnosis of diabetes in patients with type 2 diabetes mellitus in Yemen. Clin Med Insights Endocrinol Diabetes 2015; 8: 47−53.

36. Shawar SM, Al-Bati NA, Al-Mahameed A, Nagalla DS, Obeidat M. Hypercholesterolemia among apparently healthy university students. Oman Med J 2012; 27(4): 274−280.

37. Al-Kaabba AF, Al-Hamdan NA, Ahmed El Tahir, Abdalla AM, Saeed AA, Hamza MA. Prevalence and correlates of dyslipidemia among adults in Saudi Arabia: results from a national survey open. J Endocrine Metabolic Dis 2012; 2: 89−97.

38. Grabauskas V, Miseviciene I, Klumbiene J, Petkeviciene J, Milasauskiene Z, Pieskieviene A, et al. Prevalence of dyslipidemias among Lithuanian rural population (CINDI program). Medicina (Kaunas) 2003; 39(12): 1215−1222.

39. Darroudi S, Saberi-Karimian M, Tayefi M, Arckhi S, Mota-medzadeh Torgabeh A, Seyedzadeh Sani SMR, et al. Prevalence of combined and noncombined dyslipidemia in an Iranian population. J Clin Lab Anal 2018;e22579.

40. Al-Sabah HA, Hussain NH, Ali DT. Dyslipidemia in young adults aged (20-40) years attending Baghdad teaching hospital and Al-mansour primary health care center in Baghdad city. Iraqi Postgrad Med J 2014; 13: 320−327.

41. Hamad F. Dyslipidemia and related risk factors in a Saudi university community. Food Nutr Sci 2017; 8: 56−69.

42. Allam AR, Taha IM, Al-Nozha OM, Sultan E. Nutritional and health status of medical students at a university in Northwestern Saudi Arabia. Saudi Med J 2012; 12: 1296−1303.

43. Ahmed AM, Elabid BH, Elhassan KH, Waggiallah HA. Metabolic syndrome among undergraduate students attending medical clinics for obligatory medical screening. Trop J Pharmaceut Res 2015; 14(2): 317−321.

44. Mula-Abed WA, Chilmeran SK. Prevalence of dyslipidemia in the Iraqi adult population. Saudi Med J 2007; 12: 1868−1874.

45. Asiki G, Murphy GAV, Baisley K, Nsubuga RN, Karabarinde A, Newton R, et al. Prevalence of Dyslipidaemia and Associated Risk Factors in a Rural Population in South-Western Uganda: a Community Based Survey. PLoS One 2015; 10(5):e0126166; http://dx.doi.org/10.1371/journal.pone.0126166.

46. Stone NJ. Secondary causes of hyperlipidemia. Med Clin North Am 1994; 78: 117−141. PMID: 8283927.

47. Khat A, Brunzell JD. Acquired hyperlipidemia (secondary dyslipoproteinemia). Endocrinol Metab Clin N Am 1990; 19: 259−278. PMID: 2192873.

48. Aguilar-Salinas CA, Olazig V, Valles V, Torres JMR, Perez FJG, Rull JA, et al. High prevalence of low HDL cholesterol concentrations and mixed hyperlipidemia in a Mexican nationwide survey. J Lipid Res 2001; 42: 1298−1307. PMID: 11483632.

49. Brinton EA, Eisenberg S, Breslow JL. A low-fat diet decreases cholesterol and apolipoprotein B levels: the JNC 7 report. JAMA 2003; 289: 2560−2567.

50. Assadi SN. What are the effects of psychological stress and physical activity on blood lipid profiles? Medicine (Baltim) 2017; 96(18):e6816.
51. Catalina-Romero C, Calvo E, Sánchez-Chaparro MA, Valdivielso P, Sainz JC, Cabrera M, et al. The relationship between job stress and dyslipidemia. *Scand J Publ Health* 2013; 41(2): 142–149.

52. Bartlett J, Predazzi IM, Williams SM, Bush WS, Kim Y, Havas S, et al. Is isolated low HDL-C a CVD risk factor?: new insights from the framingham offspring study. *Circ Cardiovasc Qual Outcomes* 2016; 9(3): 206–212.

53. Erem C, Hacihasanoglu A, Deger O, Kocak M, Topbas M. Prevalence of dyslipidemia and associated risk factors among Turkish adults: trabzon lipid study. *Endocrine* 2008; 34: 36–51.

54. Bibiloni MM, Salas R, Pons A, Tur JA. Prevalence of dyslipidaemia and associated risk factors among balearic islands adolescents, a mediterranean region. *Eur J Clin Nutr* 2015; 69: 722–728.

55. Washington RL. Interventions to reduce cardiovascular risk factors in children and adolescents. *Am Fam Phys* 1999; 59(8): 2211–2218.

56. Desouky DS, Omar MS, Nemeneani DM, Jabbar J, Tarak-Khan NM. Risk factors of non-communicable diseases among female university students of the health colleges of Taif university. *Int J Med Sci* 2004; 6: 97–107.

How to cite this article: Al-Duais MA, Al-Awthan YS. Prevalence of dyslipidemia among students of a Yemeni University. *J Taibah Univ Med Sc* 2019;14(2):163–171.