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Original article

Correlation between Blood Glucose Level and Anthropometric Measurements among University Students at the University of Tripoli

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ABSTRACT

The detection of risk factors associated with type 2 diabetes mellitus (T2DM) at an earlier age may help reduce or even prevent the future outcomes of this disease. To date, there has been no research conducted on university students regarding associated risk factors such as being overweight or obese in Libya. The aim of this study was to determine any correlation between serum glucose level and anthropometric measurements, age and family history of T2DM in students of the University of Tripoli. A cross-sectional study involving a survey questionnaire, anthropometric measurement and blood glucose levels taken from 246 University students (aged 18-43). Recruitment was carried out from July 15 to August 1, 2024 at the research laboratory in the Faulty of Medical Technology at the University of Tripoli. The Pearson correlation test showed a positive correlation between the level of blood glucose and hip circumference [r= 0.139, P= 0.029]. The only other two risk factors that were close to the level of statistically significance were weight [r= 0.115, P= 0.071] and BMI [r= 0.117, P= 0.067]. T2DM might be prevented or mitigated by encouraging young adults in particular to keep hip circumference in the normal range.

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INTRODUCTION

Type 2 diabetes mellitus T2DM was originally thought to be a condition affecting middle-aged and older adults, however, it is now observed even at much younger ages (adolescents and young adults). A multicentre study aimed at monitoring the prevalence of type 2 diabetes in the United States revealed a rise in those aged 10 to 20 [1]. The research that is now available shows that people in their 30s are increasingly likely to have T2DM [2]. Given the prevalence of T2DM in this age group, the majority of university students in Tripoli, Libya is of this age range, and testing this group would be productive in order to understand and treat effectively diabetes within the country. In addition, the International Diabetes Federation (IDF) Diabetes Atlas (10th Edition 2021) has found that in 2021 (for those aged 20-79), 10.5% of the global adult population had diabetes. This prevalence is predicted to increase to 12.2% in 2045 [3].

Poor lifestyle habits—such as sedentary behaviour, reduced physical activity, poor quality of diet, alcohol and smoking consumption, and lack of sleep are linked to obesity, particularly among undergraduate students, who make up a considerable proportion of the young adult population [4–6]. This is further compounded in undergraduate students by

the prevalence of depression and changes in eating behaviours (emotionally driven, uncontrolled, and restrained eating). These lifestyle habits all contribute to higher levels of obesity, especially in the female population at university [7]. Since these are the main causes of the obesity pandemic within the undergraduate population [8], additional studies regarding young Libyan students would be useful, using representative sampling, in order to learn more about obesity prevalence in this specific group. This information will be very helpful in developing measures to combat the obesity epidemic, which is accelerating the prevalence of T2DM in the wider community.

Methods used to monitor excess fat include waist circumference and higher body mass index (BMI). Both of these are strongly associated with the risk of T2DM, but the strength of this association varies between populations [9]. It is commonly accepted that with a BMI of 23 kg/m^2, there is very little likelihood of developing weight-related diabetes. However, once BMI exceeds 29kg/m^2, then the risk of developing diabetes increases substantially. In fact, with a BMI of between 25 and 29 kg/m^2, an individual's risk of developing diabetes is twice as high as those with a BMI of 23 kg/m^2. In addition, having excess weight at a younger age was also associated with a greater risk of diabetes in later life [10].

Another risk factor for developing T2DM is family diabetic history where it has been found to be associated with increased insulin secretion [11] and insulin resistance [12]. This is also evident from the prevalence of T2DM in Caucasians, which rises by 1.4 - 6.1 times the normal rate in those with a history of diabetes in their family [13,14]. Even in a study conducted in non-Caucasian populations, which included 46,239 middle-aged Chinese, there was a definite association found between familial risk factor and incidence of DM. Those with one generation of first-degree family relatives with DM had 2.86 times the normal incidence of diabetes, and those with two generations of first-degree family members with DM had a prevalence of 6.16 times [15]. Similar evidence of family history DM being associated with the incidence of T2DM in young adults has been shown in a study in Korea [16]. A local study [17] where 73% of all diabetic patients had a history of diabetes in their families. All this research shows the importance of including family history of diabetes when public health screening a population in order to identify those suffering from diabetes as early and effectively as possible.

It is obvious that a lack of medical treatment and misunderstanding about T2DM has left many young adults unaware of their diabetes or their risk of developing T2DM in the future [18,19]. Increased awareness and early identification of T2DM risk factors with even modest changes in lifestyle could help delay or even prevent the onset of T2DM in high-risk individuals, according to recent research from public health prevention and intervention programs [19]. Having a higher personal sense of risk is known to result in adopting a healthier lifestyle. Alternatively, a lower personal sense of risk tends to make behavioural interventions by preventive health messages less effective [20].

Therefore, determining the risk perception of college students is crucial, as is implementing mass screening programs and raising awareness of the importance of identifying T2DM risk factors earlier rather than later [19,20]. Improved identification and understanding of metabolic dysfunction in such high-risk populations is crucial for public health, especially since the prevalence of T2DM is rising in young adults. This study aimed to investigate the correlation between Type 2 diabetes risk factors (obesity, family history and age) and blood glucose levels among University of Tripoli students.

METHODS

Study design and setting

In total, 252 university students participated in this study. Of these, 6 were excluded as 4 had diabetes, and 2 of them did not give permission for anthropometric measurements to be taken. The final sample consisted of a total of 246 students, 239 undergraduates and seven post graduate students. Recruitment was carried out from July 15 to August 1, 2024, at the research laboratory in the Faculty of Medical Technology at the University of Tripoli (total student population of approximately 77,033 as of spring 2024). The inclusion criteria for subjects in the study were that they had to be Libyan, in the age group 18–43 years, and students enrolled at the University of Tripoli. Subjects excluded from this study were those who were pregnant or who had been diagnosed with diabetes.

Sample collection and laboratory methods

The survey questionnaire covered a range of topics, including age, gender, diabetes status and family history of diabetes. After the questionnaire had been completed, students had to provide anthropometric measurements such as height (to the nearest 0.1 cm) without shoes. Body weight was measured with electronic weighing scales (to the nearest 0.01 kg). Height and weight were then used to determine the body mass index (BMI) (weight kg/height m^2). Waist and hip circumferences were measured with a non-stretchable tape measure placed in a horizontal position, just above the iliac crest, at the conclusion of a typical expiration. The waist to hip ratio was calculated by dividing the waist circumference by the hip circumference.

To measure glucose levels, two milliliters of venous blood were drawn from each subject in this study in the research laboratory at the Faculty of Medical Technology at the University of Tripoli and placed in a sodium fluoride tube. Samples were transferred to the Diabetes Hospital -Ibn Al-Nafis and the plasma of either random or fasting blood glucose levels were measured by the automatic devices COBAS INTEGRA 400 Plus.

Statistical analysis

The statistical package SPSS version 26.0 (SPSS, IBM® SPSS® Statistics 26) was used for statistical analysis. Statistically significant was defined as a p-value < 0.05.

RESULTS

A total of 246 students participated, the minimum age was 18 years and the maximum age was 43 years. The mean age of the students was 22.69 ± 3.16 years. The mean BMI was 24.39 ± 5.19 kg/m^2, the mean waist/hip ratio was 0.78 ± 0.11, and the mean blood glucose level was found to be 98.71 ± 15.02 mg/dl. Descriptive statistics of the study population are shown in Table 1. The majority of students in this study were females 172 (70%), and only 74 (30%) were males. Figure 1 shows the breakdown of BMI for males and females, respectively, as underweight < 18.5 kg/m^2 (2% and 6%), normal 18.5–24.9 kg/m^2 (15% and 39%), overweight 25–29.9 kg/m^2 (8% and 15%), and obese ≥ to 30 kg/m^2 (5% and 10%).

Table 1. Descriptive statistics of age, standing height, weight, waist circumference, hip circumference, waist/hip ratio, BMI and blood glucose level among selected students of the University of Tripoli.

Student measurements recorded	Minimum	Maximum	Mean	Std. Deviation
Age in years	18.00	43.00	22.69	3.16
Standing Height in meters	1.44	1.93	1.65	0.09
Weight in kg	38.30	132.70	66.96	16.65
Waist circumference in cm	52.00	126.00	77.97	13.37
Hip Circumference in cm	46.00	145.00	100.57	12.79
Waist / hip ratio	0.49	1.98	0.78	0.11
BMI kg/m^2	15.40	44.22	24.39	5.19
Blood glucose levels (mg/dl)	59.00	159.00	98.71	15.02

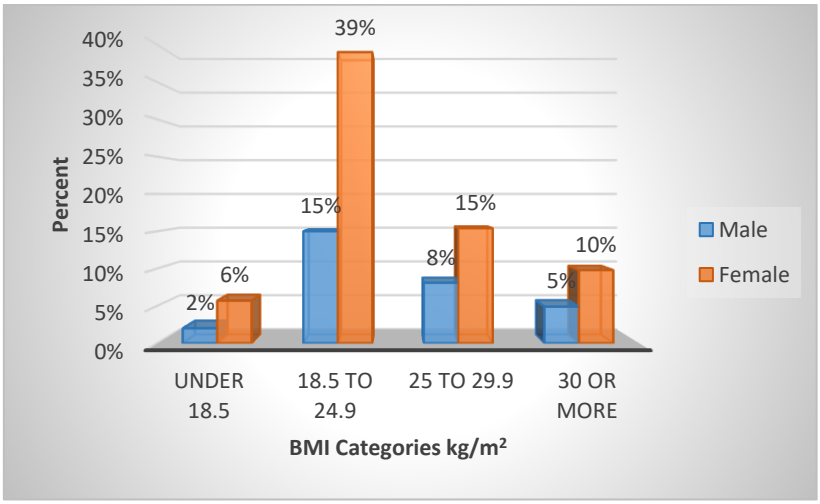

Figure 1. Distribution of student participants in this study giving BMI categories of both genders. More women than men had a higher BMI. 54% of students had a normal BMI. 38% of the students of both genders were either overweight or obese.

The Pearson correlation test showed that the level of blood glucose increased with increasing hip circumference. This positive correlation was statistically significant [r= 0.139, P= 0.029]. The only other two risk factors that were close to the level of statistically significance were weight [r= 0.115, P= 0.071] and BMI [r= 0.117, P= 0.067]. None of the other factors reached statistically significant levels (Table 2).

Table 2. Correlations obtained between risk factors and blood glucose levels among university students using the Pearson correlation test.

Risk Factors	r	p- value
Age in years	0.040	0.537
Standing Height in meters	0.029	0.652
Weight in kg	0.115	0.071
Waist circumference in cm	0.093	0.146
hip circumference in cm	0.139*	0.029
Waist / hip Ratio	-0.034	0.590
BMI kg/m^2	0.117	0.067
Age in years	0.040	0.537

The level of significance between mean blood glucose levels and risk factor categories: gender, age, family history of T2DM and BMI of students was examined (as shown in Table 3 below), and none of these factors were found to reach a statistically significant level. The mean blood glucose level of male students was 99.34 ± 13.8 mg/dl, and the mean blood glucose level of female students was 98.44 ± 15.55. mg/dl. The difference of mean blood glucose levels between male and female students was statistically insignificant with p value 0.215. Students were divided into three age groups (18-20 years, 21-23 years and 24-43 years). 36 students were in the age group 18-20 years, 161 were aged between 21-23 years, and 49 students were aged between 24-43 years. In the age group 18-20 years, the mean blood glucose level was 103.16 ± 17.58 mg/dl. In the age group 21-23 years, the mean blood glucose level was 97.37 ± 14.81 mg/dl, and in the age group 24-43 years, the mean blood glucose level was 99.86 ± 13.16 mg/dl. The difference of mean blood glucose levels between the three different age groups was statistically insignificant with p value 0.747. Most of the students 184 (74.8%) involved in this study had no family history of T2DM, and 62 (25.2%) of students had a family history of T2DM. Mean blood glucose level was 99.65 ± 14.76 mg/dl in students with family history of T2DM and 95.994 ± 15.56 mg/dl without family history of T2DM. The difference between mean blood glucose levels between both groups was statistically insignificant with p value 0.962. In the BMI underweight category, the mean blood glucose level was 95.94 ± 12.38 mg/dl, in the normal BMI group, the mean blood glucose level was 96.42 ± 14.36 mg/dl, in the overweight BMI group, the mean blood glucose level was 104.01 ± 17.32 mg/dl, and for those with obese BMI, the mean blood glucose level was 100.12 ± 12.68 mg/dl. The difference of mean blood glucose levels between the four different BMI groups was statistically insignificant with p value 0.966.

Table 3 This shows the level of significance between mean blood glucose levels and risk factor categories: gender, age, family history of T2DM and BMI of students. None of these factors were found to reach a statistically significant level.

Risk factors		Number	The Mean ±Std. D. of blood glucose levels (mg/dl)	p- value
Gender	Male	74	99.34 ± 13.8	0.215
	Female	172	98.44 ± 15.55	
Age Categories	18 to 20	36	103.16 ± 17.58	0.747
	21 to 23	161	97.37 ± 14.81	
	24 or more	49	99.86 ± 13.16	
Family history with T2DM	No family history	184	95.994 ± 15.56	0.962
	family history	62	99.65 ± 14.76	
BMI Categories	Under 18.5	19	95.94 ± 12.38	0.966
	18.5 to 24.9	133	96.42 ± 14.36	
	25 to 29.9	58	104.01 ± 17.32	
	30 or more	36	100.12 ± 12.68	

DISCUSSION

Anthropometric parameters can contribute to both the diagnosis and classification of obesity. They play a major role in determining serious health conditions like diabetes mellitus [21]. Anthropometric parameters (waist circumference and hip circumference) are often used to identify those with elevated glucose levels in a high-risk population. The measurement of BMI (Body mass index) and WHR (Waist hip ratio), or simple waist and hip circumference has proven more effective in determining T2DM status than a single anthropometric measure. These results were found to be fairly consistent in diverse ethnic groups of both sexes despite some subtle differences found related to sex and ethnicity.

Other researchers have investigated the associations of anthropometric measures with blood glucose levels in young adults [22], however in Libya, as far as we know, this present study is the first to examine any correlation and comparisons found between anthropometric measures and glucose levels in the student population of the University of Tripoli. This study, found a positive correlation (r=0.139, p= 0.029) between blood glucose levels and hip circumference. This finding is similar to the results obtained by Ojeka in a Nigerian population (r=0.165, p<0.05) [23].

This present study in Libya however found no significant association between BMI and blood glucose levels (r=0.117 , p= 0.067). Similar findings were obtained from research on young adults of age 18-25 in Ayub Medical College, Abbottabad, Pakistan (p=.214, r=-10) [24]. In both these studies there was no correlation found between blood glucose levels and BMI however in another study in a upstate New York college a positive correlation has been observed [25]. Ethnicity can also impact the association between diabetes mellitus and obesity and may result in different levels of association found between the blood glucose levels and obesity observed in different studies [26].

One known risk factor for T2DM is family history. Valdez et al. has found that people without other risk factors who have a moderate to high family history of T2DM may be 2.3–5.5 times more likely to develop the disease than people without a family history [27]. A combination of health advice and healthier lifestyle modifications have been shown to lower the risks of T2DM. Therefore, making this young population more aware of their family history of T2DM could be motivating factor in preventing the future development of this disease. A study by Ha and Caine-Bish [28], indicated that college environments are great places to support healthy behaviour programs, in order to encourage students to increase physical activity levels, choose healthier food, and keep weight within normal healthy limits. Although, some of the university of Tripoli students participating in this study had family history with diabetes, the difference between mean blood glucose levels in both groups (those with or without family history of diabetes) was statistically insignificant with p value 0.962.

In the age group 18-20 years, the mean blood glucose level was 103.16±17.58 mg/dl, which is a higher mean blood glucose level compared to the other age groups. In the age group 21-23 years, the mean blood glucose was 97.37±14.81 mg/dl. This age group has a lower blood glucose mean than the other age groups, despite the majority of participating students being from this age group. And in age group 24 or more years, mean blood glucose was 99.86±13.16 mg/dl. No statistically significant difference was noted between mean blood glucose and the age groups (p= 0.747).

These findings disagree with the results obtained by F. J. Shahi who studied 166 students (male and female) aged 18-24 years at Kabir Medical College Gandhara University Peshawar and Shaikh Zayed Hospital, Lahore in 2017 [29]. A statistically significant (P=0.025) difference of mean blood glucose between both two age groups was observed. Shahi's research showed that in the age group 18-20 years, the mean serum glucose was 126.96±25.68 mg/dl and in age group 21-24 years, the mean serum glucose level was 106.33±9.24 mg/dl.

The strengths of the present study in Libya are the variety of data collected including survey information and anthropometric measurements as well as monitoring blood glucose levels in order to evaluate 2TDM risk. The limitations of this study were that there were more female than male participants and a more balanced gender mix could highlight the T2DM risk associated with gender. In fact, in all the faculties at the University of Tripoli most of the students are females. There was also a small age range involved in this present study and by increasing the number of post graduate students, it would have extended the age range of subjects and allowed age related factors to be better investigated.

CONCLUSION

Findings of current study showed a clear positive correlation between the level of blood glucose and hip circumference. T2DM might be prevented or mitigated by encouraging young adults in particular to keep hip circumference in the normal range.

Acknowledgments

The authors express their gratitude to the study participants for their involvement.

Conflicts of Interest

The authors declare that there are no conflicting or possible conflicts of interest.

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العلاقة بين مستوى سكر الدم والقياسات الانثروبومترية بين طلاب جامعة طرابلس

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المستخلص

الكشف المبكر قد يساعد في اكتشاف عوامل الخطر المرتبطة بمرض السكري من النوع الثاني، قد يساعد في تقليل أو حتى منع النتائج المستقبلية لهذا المرض. حتى الآن، لم يتم إجراء أي بحث على طلاب الجامعات فيما يتعلق بعوامل الخطر المرتبطة مثل زيادة الوزن أو السمنة في ليبيا. . كان الهدف من هذه الدراسة تحديد أي ارتباط بين مستوى الجلوكوز في المصل والقياسات الأنثروبومترية والعمر والتاريخ العائلي لمرض السكري من النوع الثاني (2) لدى طلاب جامعة طرابلس.تم إجراء دراسة مقطعية تتضمن استبيانً وقياسً أنثروبومتريًا ومستويات السكر في الدم مأخوذة من 246 طالبًا جامعيًا (تتراوح أعمارهم بين 18 و 43 عامًا). تم تجميع العينات من الفترة من 15 يوليو إلى 1 أغسطس 2024 في مختبر الأبحاث التابع لكلية التقنية الطبية بجامعة طرابلس. أظهر اختبار ارتباط بيرسون وجود ارتباط إيجابي بين مستوى سكر الدم ومحيط الورك .(r= 0.139, P = 0.029) كان عاملي الخطر الآخرين الوحيدين اللذين كانا قريبين من مستوى الأهمية الإحصائية هما الوزن.(r= 0.115, P = 0.07) يمكن منع مرض السكري من النوع 2 أو التخفيف منه من خلال تشجيع الشباب على وجه الخصوص على الحفاظ على محيط الورك في النطاق الطبيعي.

الكلمات المفتاحية. داء السكري من النوع 2، مؤشر كتلة الجسم، نسبة الخصر إلى الورك.