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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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EVALUATION OF VITAMIN K2 IN PATIENTS WITH TYPE 2 DIABETES MELLITUS

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Abstract.

Background and objectives: There is a rising interest in studying the possible therapeutic value of fat-soluble micronutrients like vitamin K2 for preventing or controlling type 2 diabetes mellitus. The present study was designed to evaluate levels of vitamin K2 in patients with type 2 diabetes mellitus.

Patients and Methods: The study enrolled 60 patients with type 2 diabetes mellitus and 30 individuals as a control group. Blood samples were collected from each participant for estimation of vitamin K2 by (ELISA), HbA1c by (Cobas), lipid profile by (colourimetric methods) and calculated BMI.

Results: The mean ± Standard Deviation (SD) of vitamin K2 levels for the type 2 diabetes group were (185.13±30.08) pg /ml, with a highly significant decrease ($p < 0.001$) when compared with the control group (303.91± 58.60) pg /ml. The HbA1c, cholesterol, TG, and LDL-C level for the type 2 diabetes group highly significant increase ($p < 0.001$) when compared with the control while HDL-C decreased when compared with the control group.

Conclusion: The current study concluded that: Vitamin K2 levels showed a highly significant decrease in patients with uncontrolled type 2 diabetes mellitus when compared with those in the control group. Vitamin K2 levels play an important role in improving glycated haemoglobin and lipid profiles in patients with type 2 diabetes mellitus.

Key words. vitamin K, diabetes mellitus, lipid profile, HbA1c.

Introduction.

Diabetes mellitus (DM) is a long-term metabolic disorder marked by high blood sugar levels. It can be caused by a lack of insulin or resistance to insulin's effects on the body's tissues, or both [1]. Diabetes is becoming more common in every region of the world. The Global Diabetes League projects that 536.6 million individuals had diabetes (analyzed or undiscovered) in 2021, rising 46% to 783.2 million by 2045 [2]. Type 1 diabetes mellitus (insulin-dependent), Type 2 diabetes mellitus (insulin-independent), and pregnancy-related diabetes are the three types of diabetes that are diagnosed the most frequently [3].

Diabetes Mellitus Type 1 (T1DM) is an autoimmune disorder that is caused by beta-cell death in the pancreatic islets. The beginning of type 1 diabetes is most common throughout adolescence, namely during the puberty years, but it can happen at any age. In children, it occurs at a rate that is similar across the sexes, but by early adulthood, men are at a higher risk than women of developing the illness. T1DM is one of the most common autoimmune disorders in children and young adults, accounting for 5–10% of all cases of diabetes [4].

Type 2 diabetes mellitus (T2DM) is a common metabolic disease marked by high blood sugar. It is caused by either relative impairment of insulin secretion by pancreatic beta-cells or insulin resistance of the insulin-sensitive tissues.

Type 2 diabetes mellitus accounts for about 90% of diagnosed cases and affects the largest number of adults between the ages of 40 and 59 [5]. One person dies from diabetes-related complications every eight seconds on average throughout the world, indicating that the prevalence of type 2 diabetes (T2D) has reached epidemic proportions around the world. Some people are more likely to develop DMT2 than others, and this risk is influenced by genetics. However, prior studies have revealed that environmental variables including being overweight, not exercising enough, having high fat, poor fibre diet, smoking, and having a low birth weight, might also be crucial components contributing to the development of DMT2. A wide range of symptoms is characterized by the incessant need to urinate, a feeling of persistent thirst, continuous starvation, a lack of energy, and a gradual or rapid change in body weight [6].

Inadequate treatment and management of type 2 diabetes have directly led to persistent morbidities such as cardiovascular disease (CVD), renal disease, blindness, and amputations of the lower limbs, as well as deaths. According to estimates, T2D contributed significantly to roughly 32% of all CVD, 56% of new end-stage renal diseases, and 1.6 million fatalities in 2016 [7]. To reduce the risk of problems associated with type 2 diabetes, careful monitoring of blood glucose levels, food, medication usage, nutritional status, and physical activity is required [7].

In recent years, several studies have highlighted the positive effect that supplementing with vitamin K2 can have on enhancing insulin sensitivity and glucose tolerance, decreasing insulin resistance, and lowering the risk of developing type 2 diabetes. Vitamin K2 enhanced insulin sensitivity by involving the vitamin K-dependent protein osteocalcin, exhibiting anti-inflammatory properties, and having effects that lowered lipid levels [8]. This study aims to evaluate levels of vitamin K2 in patients with type 2 diabetes mellitus.

Materials and Methods.

Study Design: This study is a case-control study conducted in Diyala governorate at Baqubah Teaching Hospital and Balad Ruz General Hospital from the first of January to the end of February 2023, the study included 60 patients with type 2 diabetes mellitus (30 males and 30 females). On the other hand, 30 people as a control group of both sexes (15 males and 15 females) were taken. The ages of the two groups ranged between (30-65) years. All the following tests were conducted on all members of both groups to determine the level of vitamin K2, glycated haemoglobin (HbA1c), lipid profile, and BMI. Through a direct interview with them, all participants provided their informed consent to take part in the study, data collection,

and analysis for research motives. The information about the patient group and control group in this study was retrieved from the patients themselves, according to a prepared questionnaire (including their demographic characteristics, age, weight, length, etc.).

Inclusion Criteria: The study included people who met the following criteria:

1. Diabetic patients (T2DM) as patient's groups.
2. Healthy non-diabetic subjects as a control group.
3. Male or female aged between 30-65 years.

Exclusion Criteria: Individuals who met one of the following criteria were excluded from participating in the study:

1. Patients on vitamin K2 supplements therapy.
2. Patients on anticoagulant drug therapy.
3. Use glucocorticoid or orally administered antibiotics for long-term periods.
4. Patients on lipid-lowering drug therapy.

Sample Collection and Preparation: All participants' samples were collected by using a disposable syringe to extract approximately five millilitres of blood from the antecubital vein. The obtained blood was divided into two portions; the first portion, 3 ml, was put in a separation gel tube, which facilitates serum separation by centrifugation at 3000 rpm for 10–15 minutes. The clear serum was pipetted into clear, dry Eppendorf tubes and stored at -20 °C for the subsequent measurement of vitamin K2 (ELISA, Sunlong/China) and lipid profile (Kit supplied by Linear/ Spain). The second part, consisting of 2 mL of blood, was put in a blood collection tube containing ethylene diamine tetra-acetic acid (EDTA) as an anticoagulant for immediate measurement of glycated haemoglobin (HbA1c) using the kit supplied by Roche (Germany). For analysis of measured parameters, Cobas C 111 analyzer (Roche, Germany) and spectrophotometer (Cecil/England) were used.

Statistical Analysis: The data were analyzed using Statistical Package for Social Sciences (SPSS) version 25.0, Microsoft Office 2019, and GraphPad Prism version 9.0. Statistical data, including the mean and standard deviation, were measured to describe the variables. The groups were compared by applying an independent sample t-test (unpaired t-test between two groups), chi-square (for non-continuous data or percentage), and a Mann-Whitney test (to evaluate the difference between the patient group and the control group). The degree of association between continuous variables was calculated by the Pearson correlation coefficient (r), and the results were considered statistically significant when the p-value was less than 0.05.

Results.

The control group included 15 females and 15 males, totalling 30 participants. This accounts for 33.3% of the total sample, while in the T2DM group, there were 30 females and 30 males, totalling 60 participants. This accounts for 66.7% of the total sample. Overall, there were an equal number of females (45) and males (45) in the present study, making a total of 90 participants. There was no difference in sex between the two groups (p=1.00). Additionally, the other descriptive statistics and statistical analysis results for the demographic parameters measured in this study with their p-values for both the control and type 2 diabetic patient groups (Table 1).

These results show that there is no statistically significant difference ($p<0.05$) in the age, weight, and height of type 2 diabetic patients when compared to those of the control group. In the present study, the T2DM group had a mean vitamin K2 level of 185.13 pg/mL (SD = 30.08), while the control group had a mean vitamin K2 level of 303.91 pg/mL (SD = 58.60).

The results of the present study show a highly significant increase ($p < 0.001$) in total cholesterol, TG level, LDL-C, and VLDL-C in T2DM as compared with the control group. Whereas there was a highly significant decrease ($p < 0.001$) in HDL-C in the sera of T2D patients when compared to those of the control group. These results indicate that lipid abnormalities are common in T2D patients in the studied population (Figure1).

A correlational analysis was conducted to explore the relationships between Vitamin K2 and different variables within the T2DM group. However, the strength and significance of the correlations vary across the parameters, indicating complex relationships between these variables in Type 2 DM. Table 2 below provides information on the correlation coefficient (r) and the p-value associated with each correlation. This study showed a weak positive correlation ($r = 0.07$) between vitamin K2 and age, but it was not statistically significant ($p = 0.594$). Also, it showed a positive correlation ($r = 0.29$) between vitamin K2 and BMI, which is statistically significant ($p < 0.05$). However, there are no previous studies to compare these correlations, so further research is needed to interpret these correlations in patients with T2DM.

Table 1. *Clinical Characteristics of the Study Subjects by Group.*

Parameters	Subjects	Mean ± SD	p-value
Age (year)	DM	50.93±8.84	**0.46**
	Control	49.47±9.11	
Weight (Kg)	DM	81.27±11.18	**0.8**
	Control	81.97±12.76	
Height (m)	DM	1.73±0.08	**0.39**
	Control	1.75±0.09	
BMI (Kg/m^2)	DM	27.20±4.25	**0.52**
	Control	26.66±2.30	

Table 2. *Pearson Correlation Results between Vit K2 with Age, BMI, HbA1c and Lipid Profile in the T2DM Group.*

Combination (n*=60)	*r**	p-value
Vitamin K2 and Age	0.07	0.594
Vitamin K2 and BMI	0.29	0.022
Vitamin K2 and HbA1c	-0.25	0.057
Vitamin K2 and Chol	-0.39	0.002
Vitamin K2 and TG	-0.31	0.016
Vitamin K2 and HDL_C	0.17	0.197
Vitamin K2 and LDL_C	-0.39	0.002
Vitamin K2 and VLDL_C	-0.31	0.016
*r: correlation coefficient *n: number		

Discussion.

These results show that there is no statistically significant difference ($p = 0.524$) in the BMI of type 2 diabetic patients when compared to those of the control group. These results

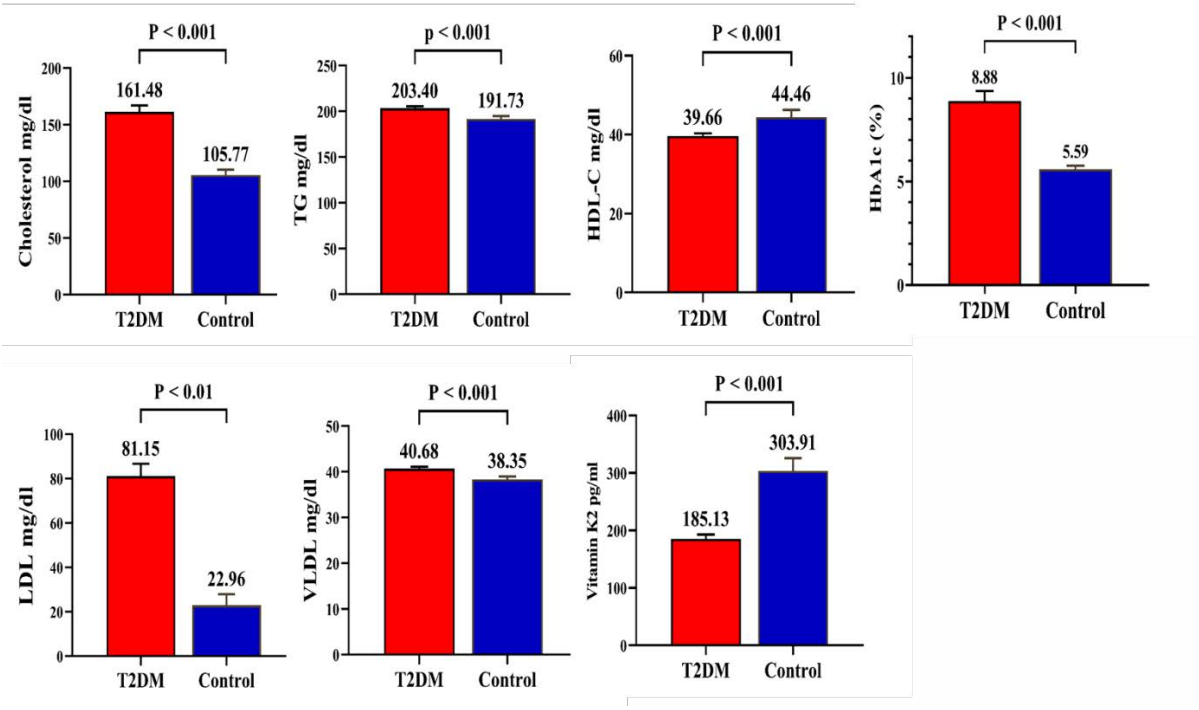

Figure 1. *Evaluation of measured parameters in patients with type 2 diabetes mellitus. Data Expressed as mean±SD.*

indicate that BMI may not be a distinguishing factor between individuals with type 2 diabetes and those without it, and these results agree with Malone et al. [9]. They found in his study that obesity is not the cause of T2DM and that the insulin resistance of T2DM occurs primarily in the muscles of lean individuals predisposed to diabetes before they become obese.

However, the results of the present study disagree with Yaturu et al. [10], who found that elevated BMI and waist circumference (WC) were significantly associated with T2DM because most obese individuals have elevated plasma levels of free fatty acids (FFA), which are known to cause peripheral (muscle) insulin resistance. This disagreement may be due to the small sample size of the control group.

Vitamin K2 (menaquinone, MK) is an essential lipid-soluble vitamin that performs crucial functions in blood coagulation and bone health. It has been gaining attention for its potential role in the prevention of cardiovascular disease, type 2 diabetes, and various health outcomes [11].

These findings indicate that patients with type 2 diabetes in the studied population had highly significant ($p < 0.001$) lower vitamin K2 levels compared to the control group. This implies that the levels of vitamin K2 have a connection with the glycaemic state in type 2 diabetes, and these results agree with Mittal et al. [12] and Helmy et al. [13]. Who found in their studies that serum vitamin K2 levels in T2D patients were significantly reduced when compared to those of the control group, especially when hyperglycemia is uncontrolled.

Although the cause of vitamin K2 deficiency in patients with T2D compared to the control group is unclear, this may be due to those patients mainly receiving multiple drugs that may alter their intestinal normal flora, which has an important role in vitamin K2 production. In addition, some of those patients have a strict low-fat diet, which reduces vitamin K2 absorption because it is a fat-soluble vitamin. Also, some of those patients who reduced their animal diets developed a vitamin K2 deficiency because animal meals are the main source of vitamin K2.

The retrospective studies on the association between diabetes and vitamin K2 levels are limited, and there is a scarcity of studies directly comparing these findings. While the specific relationship and effect between vitamin K2 levels and T2DM remain unclear, many prospective interventional studies have suggested that vitamin K2 supplementation has shown vitamin K's beneficial effect in enhancing insulin sensitivity and glucose tolerance, avoiding insulin resistance, and lowering the risk of developing type 2 diabetes (T2D). This is explained by vitamin K2's effect on osteocalcin (OC) and adiponectin levels and their relationship with glycemic control and insulin sensitivity, in addition to its anti-inflammatory and lipid-lowering effects [14].

These results indicate that lipid abnormalities are common in T2D patients in the studied population. These results are in good agreement with Thapa et al. [15], Feingold et al. [16] and Athyros et al. [17], who found in their studies that hyperlipidemia is the commonest complication of T2DM and predisposes them to premature atherosclerosis and macrovascular complications and that most lipid abnormalities in T2D are elevated serum total cholesterol, triglycerides, LDL-C, and low serum HDL-C.

Insulin resistance in T2DM leads to increased peripheral lipolysis and the release of FAs for energy purposes, and excesses of these FAs are accumulated in the liver and then converted to TGs. Also, increased hepatic VLDL production occurs due to increased substrate availability via FFAs, decreased apolipoprotein B100 degradation, and increased lipogenesis [18].

The higher level of small, dense LDL cholesterol (sdLDL-C) particles is the most frequent type of dyslipidemia linked with insulin resistance. These particles are more susceptible to arterial

entrance and retention, oxidation, have a lower affinity for the LDL receptor and are more likely to cause atherosclerosis [19].

Managing lipid levels is an important aspect of diabetes care to reduce the risk of cardiovascular complications. This may involve lifestyle modifications, such as adopting a healthy diet, engaging in regular physical activity, weight reduction, and other factors that affect lipids, as well as micronutrient supplementation and medication interventions, if necessary, to optimize lipid profiles [20-24].

The present study showed a negative correlation (r = -0.25) between vitamin K2 and HbA1c, but it is not statistically significant ($p<0.057$) and these results agree with Mittal et al. [12], Hussein et al. [23]. Those who reported an inverse association between vitamin K2 and glycated haemoglobin (HbA1c), and this finding implies that the levels of vitamin K2 have a connection with the glycemic state in type 2 diabetes.

Conclusion.

The current study concluded that vitamin K2 levels showed a highly significant decrease in patients with T2DM when compared with those in the control group. This finding supports his potential role in the pathophysiology of T2DM. There was a negative correlation between levels of vitamin K2 and glycated haemoglobin (HbA1c), and this finding implies that his levels have improved glycemic control in type 2 diabetes. There was a negative correlation among levels of vitamin K2 with cholesterol, TG, LDL-C and VLDL-C; and a positive correlation with HDL-C. This finding implies that their levels play an important role in improving the lipid profile in type 2 diabetes. There was a negative correlation between glycated haemoglobin (HbA1c) and cholesterol, TG, LDL-C, and VLDL-C. Thus, HbA1c level is not only a useful biomarker of long-term glycaemic control but also a good marker of dyslipidaemia and identifies patients who are at a greater risk of cardiovascular complications in type 2 diabetics.

REFERENCES

1. Ogurtsova K, Guariguata L, Barengo NC, et al. IDF diabetes Atlas: Global estimates of undiagnosed diabetes in adults for 2021. Diabetes research and clinical practice. 2022;183:109118.
2. Sarhat ER, Mohammed IJ, Mohammed NY, et al. Evaluation of salivary oxidative stress marker (lipid peroxidation), and non-enzymatic antioxidants (vitamin c and vitamin e) in patients with acute myocardial infarction. Tikrit Journal for Dental Sciences. 2019;7.
3. Sarhat ER, Wadi SA, Sedeeq BI, et al. Study of histopathological and biochemical effect of Punica granatum L. extract on streptozotocin-induced diabetes in rabbits. Iraqi Journal of Veterinary Sciences. 2019;33:189-94.
4. Zbaar SA, Sarhat ER, Khalaf SJ. Association of C-Reactive Protein with Risk of Complications of diabetic nephropathy. Egyptian Journal of Chemistry. 2022;65:483-7.
5. Khalaf SJ, Aljader GH, Sarhat ER, et al. Antidiabetic effect of Aqueous Extract of Medicago Sativa with Enhanced Histopathology of Pancreas in Alloxan Induced Diabetic Rats. PJMH S. 2021;15:492-6.
6. Sarhat ER, Rmaid ZJ, Jabir TH. Changes of salivary interleukine17, Apelin, Omentin and Vaspin levels in normal subjects and diabetic patients with chronic periodontitis. Ann Trop Med & Pub Health. 2020;23:S404.
7. Saleh SS, Sarhat ER. Effects of ethanolic Moringa oleifera extract on melatonin, liver, and kidney function tests in alloxan-induced diabetic rats. Indian Journal of Forensic Medicine & Toxicology. 2019;13:1015-9.
8. Manna P, Kalita J. Beneficial role of vitamin K supplementation on insulin sensitivity, glucose metabolism, and the reduced risk of type 2 diabetes: A review. Nutrition. 2016;32:732-9.
9. Malone JI, Hansen BC. Does obesity cause type 2 diabetes mellitus (T2DM)? Or is it the opposite? Pediatric diabetes. 2019;20:5-9.
10. Yaturu S. Obesity and type 2 diabetes. Journal of diabetes mellitus. 2011;1:79-95.
11. Jensen MB, Biltoft-Jensen AP, Jakobsen J. In vitro bioaccessibility of vitamin K (phylloquinone and menaquinones) in food and supplements assessed by INFOGEST 2.0–vit K. Current Research in Food Science. 2022;5:306-12.
12. Mittal M, Garg MK. Vitamin K. A Vitamin that Spans Blood, Bones and Carbs. Indian Journal of Endocrinology and Metabolism. 2022;26:232-3.
13. Helmy MY, Elsaid NH, Gwad MMA. The Association of Vitamin K2 Level with the Glycaemic Status in Type 2 Diabetic Patients: A Case-Control Study. Indian Journal of Endocrinology and Metabolism. 2022;26:87.
14. Li Y, Peng Chen J, Duan L, et al. Effect of vitamin K2 on type 2 diabetes mellitus: A review. Diabetes research and clinical practice. 2018;136:39-51.
15. Thapa SD, KC SR, Gautam S, et al. Dyslipidemia in type 2 diabetes mellitus. Journal of pathology of Nepal. 2017;7:1149-54.
16. Feingold KR, Grunfeld C. Diabetes, and dyslipidemia. Diabetes and Cardiovascular Disease: Springer. 2023:425-72.
17. Athyros VG, Doumas M, Imprialos KP, et al. Diabetes and lipid metabolism. Hormones. 2018;17:61-7.
18. Merkhan M, Mohammad J, Fathi Z, et al. Silent hyperlipidaemia modulated vascular endothelial markers. Pharmacia. 2021;68:479-84.
19. Vekic J, Zeljkovic A, Cicero AF, et al. Atherosclerosis development and progression: the role of atherogenic small, dense LDL. Medicina. 2022;58:299.
20. Mahmood DA, Sarhat ER, Sulaiman YA, et al. Evalution of liver function tests in patients with psoriasis. Revista Latinoamericana de Hipertension. 2022;17.
21. Mahmood DA, Sarhat ER, Sulaiman YA, et al. Relationship between Paraoxonase and Malondialdehyde as a marker of oxidative stress in patients with psoriasis. Revista Latinoamericana de Hipertension. 2022;17.
22. Kovalova Y, Sukhonos N, Brek V, et al. Irisin, interleukin-33 and interleukin-37 in patients with ischemic heart disease and obesity. Medicinski časopis. 2021;55:87-93.
23. Hussein AG, Mohamed RH, Shalaby SM, et al. Vitamin K2 alleviates type 2 diabetes in rats by induction of osteocalcin gene expression. Nutrition. 2018;47:33-8.
24. Schembri B, Falzon ML, Casingena L, et al. Adequacy of clinical surveillance of diabetic patients requiring minor foot amputations. Malta Medical Journal. 2022;34:76-86.