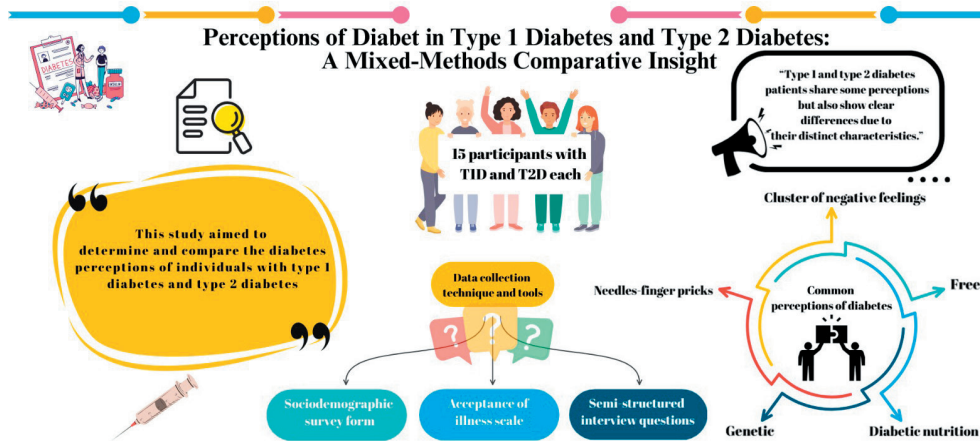


Türkiye Diyabet ve Obezite Dergisi

Turkish Journal of Diabetes and Obesity

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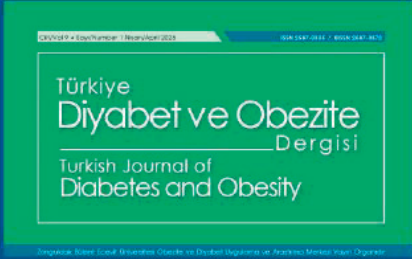




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baytaner@beun.edu.tr, baytaner@yahoo.com, baytaner@hotmail.com

Obezite Bölüm Editörleri / Obesity
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Ender BÜYÜKGÜZEL
Zonguldak Bülent Ecevit Üniversitesi
endericen@hotmail.com



Mustafa GÜMÜŞ
Zonguldak Bülent Ecevit Üniversitesi
mustgumus@gmail.com



Yasin HAZER
Zonguldak Bülent Ecevit Üniversitesi
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Ömercan TOPALOĞLU
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drhomercan@hotmail.com



Meliha Esra BİLİCİ
Zonguldak Bülent Ecevit Üniversitesi
esra.bilici@beun.edu.tr



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Zonguldak Bülent Ecevit Üniversitesi
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Zehra SAFİ ÖZ
Zonguldak Bülent Ecevit Üniversitesi
safizehra@yahoo.com



İnci TURAN
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dr.incituran@gmail.com



Sakin TEKİN
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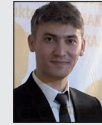
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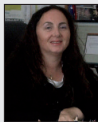
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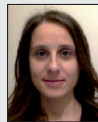
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rında glikojen ve oksidatif stres parametreleri üzerine etkisi. Med J West Black Sea. 2022;6(2):177-185.

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Larsen PR, Kronenberg HM, Melmed S, Polonsky KS. Williams Textbook of Endocrinology, 10th Edition, Philadelphia, Elsevier Science, 2003.

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İlgili bölüm yazar ad(lar)ı, ilgili bölüm adı, editör(ler), kitabın adı, yayım landığı yer, yayınevi, yıl, ilk ve son sayfa numarası.

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Abood S. Quality improvement initiative in nursing homes: the ANA acts in an advisory role. Am J Nurs [Internet yayını]. 2002;102(6) (Erişim Tarihi: 12.08.2002 <http://www.nursing-world.org/AJN/2002/june/Wawatch.htm>).

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Sağlam C. Cerrahi menopoz modeli oluşturulan genç dişi sıçanlarda glp-1 agonistinin depresyon benzeri davranışlara etkisi (Yüksek Lisans Tezi), Zonguldak, Zonguldak Bülent Ecevit Üniversitesi, 2022, 1-106, (ErişimLinki ve Tarihi:)

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¹Zonguldak Bülent Ecevit Üniversitesi, Tıp Fakültesi, Dahili Tıp Bilimler Bölümü, İç Hastalıkları Anabilim Dalı, Endokrinoloji ve Metabolizma Hastalıkları Bilim Dalı
²Zonguldak Bülent Ecevit Üniversitesi, Obezite ve Diyabet Uygulama ve Araştırma Merkezi 67100, Zonguldak, Türkiye

Tel: +90 (372) 291 24 44

E-posta: baytaner@beun.edu.tr
baytaner@yahoo.com
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The aim of the journal is to report and share qualified research studies conducted in relevant fields in Türkiye and abroad by presenting them to the national and international scientific community, and to contribute to scientific to academic and social communication by creating a continuous education platform. In accordance with these aims, the journal publishes original research in the field of obesity and diabetes mellitus, including case reports, review articles, short communications, letters to the editor, biography articles and conference proceedings written in article format. Papers or preliminary studies presented in congresses, symposiums, or online can be published in the journal, provided that this situation is stated. Manuscripts sent to this journal are accepted on the condition that they have not been published anywhere before and have not been sent to another journal for publication.

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Name(s) of the authors of the chapter, title of the book, edition, place of publication, publisher, year.

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Sağlam C. Effect of glp-1 agonist on depression-like behaviors in young female rats created as a surgical menopause model. (Master's Thesis), Zonguldak, Zonguldak Bülent Ecevit University, 2022, 1-106 (Access Link and Date:).

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¹Zonguldak Bülent Ecevit University, Faculty of Medicine, Department of Internal Medical Sciences, Department of Internal Medicine, Branch of Endocrinology and Metabolic Diseases

²Zonguldak Bülent Ecevit University, Obesity and Diabetes Practice and Research Center 67100, Zonguldak, Türkiye

Tel: +90 (372) 291 24 44

E-mail: baytaner@beun.edu.tr
baytaner@yahoo.com
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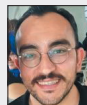


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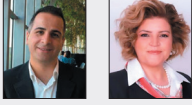
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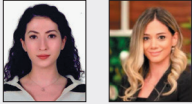
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Editörden

Değerli Okuyucular,

Zonguldak Bülent Ecevit Üniversitesi Obezite ve Diyabet Uygulama ve Araştırma Merkezi tarafından, Türkiye Obezite Araştırma Derneği işbirliği protokolü çerçevesinde Türkiye Diyabet ve Obezite Dergisi'nin 2025 Ağustos (2025 yılı, Cilt 9, Sayı 2) sayısını yayınlamaktayız.

Okuduğunuz dergimiz ve sayımız bilim insanlarının ve sağlık profesyonellerinin özverili çalışmalarının bir yansımasıdır.

Ağustos 2025 sayımız multidisipliner özverili çalışmalarla yer alan makaleler, yalnızca mesleki bilgi birikiminizi artırmakla kalmayacak; aynı zamanda geleceğin obezite ve diabetes mellitus alanında sağlık hizmetlerini şekillendirecek yenilikçi yaklaşımları da keşfetmenize olanak tanıyacaktır.

Bu sayımızda bulacağınız özgün araştırma, olgu sunumu ve derleme yazıları şunlardır;

- Gestasyonel Diyabetli Gebelerde Sağlıklı Yaşam Biçimi Davranışları ve İlişkili Faktörler: Bir Kamu Hastanesi Örneği
- Tip 2 Diyabetli Hastalarda Metformin ve DPP-4 İnhibitörlerinin Elektrolit ve Vitamin B12 Düzeyleri Üzerindeki Etkilerinin Değerlendirilmesi: Retrospektif Bir Çalışma
- Yeni Antihiperglisemik Tedavilerin Tip 2 Diyabetik Hastalarda Sarkopeni Üzerine Etkisi
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- Aile Sağlığı Merkezlerine Başvuran Tip 2 Diyabeti Olan Bireylerde Anksiyete, Depresyon ve İlişkili Psikososyal Faktörler
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Yayın Kurulumuz, Editörler Kurulumuzu da güncelleyerek daha güçlü ve kaliteli bir yayın hayatına doğru ilerledik. Türkiye Diyabet ve Obezite Dergimizin bu sayısında yer alan içerikler, hem bilgi hem de ilham kaynağı olarak sizlere katkı sağlayacaktır.

Dergimizin yayınlanmasında; desteklerini esirgemeyen Rektörümüz Prof. Dr. İsmail Hakkı ÖZÖLÇER'e, Kütüphane ve Dökümantasyon Dairesi Başkanlığına, emeği geçen tüm yazarlara, yazıları titizlikle değerlendiren hakemlere ve editörlere, Danışma Kurulumuza, Dil Redaksiyon Kurulumuza, Alan Editörlerine, Biyoistatistik Kuruluna, Yayın Kurulumuza ve yayınevimize teşekkürlerimizi sunuyoruz.



Doç. Dr. İnci Turan
Sayı Editörü, Ağustos 2025



Prof. Dr. Taner Bayraktaroğlu
Baş Editör, Ağustos 2025

Editorial

Dear Readers,

We are publishing the August 2025 issue (year 2025, Volume 9, Issue 2) of the Turkish Journal of Diabetes and Obesity by the Zonguldak Bülent Ecevit University Obesity and Diabetes Application and Research Center within the framework of the cooperation protocol with the Turkish Obesity Research Association.

The journal and this issue you're reading reflect the dedicated work of scientists and healthcare professionals. Our August 2025 issue, featuring articles from dedicated, multidisciplinary studies, will not only enhance your professional knowledge but also enable you to discover innovative approaches that will shape the future of obesity and diabetes mellitus healthcare.

In this issue, original research, case reports and review articles you will find are as follows:

- Healthy Lifestyle Behaviors and Related Factors in Pregnant Women with Gestational Diabetes: A Public Hospital Model
- Assessment of the Effects of Metformin and DPP-4 Inhibitors on Electrolyte and Vitamin B12 Levels in Patients with Type 2 Diabetes: A Retrospective Study
- The Effect of Novel Antihyperglycemic Treatments on Sarcopenia in Type 2 Diabetic Patients
- The Relationship Between Neuropathic Pain and Quality of Life in Geriatric Type 2 Diabetic Patients
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- The Effects of Taurine on Energy Homeostasis and Health: A Nutritional Perspective
- Late Term Complication After Laparoscopic Sleeve Gastrectomy; Diospirobezoar

By updating our Editorial Board and Editorial Board, we've moved towards a stronger and higher-quality publishing experience. The content in this issue of our Turkish Diabetes and Obesity Journal will serve as both an informative and inspiring reference.

We would like to thank our Rector Prof. Dr. İsmail Hakkı ÖZÖLÇER for his unwavering support in the publication of our journal, to the head of the Library and Documentation Department, all the authors who contributed, the reviewers and editors who meticulously evaluated the articles, our Advisory Board, our Language Editing Board, Field Editors, Biostatistics Board, Publication Board and our publishing house.

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Gestasyonel Diyabetli Gebelerde Sağlıklı Yaşam Biçimi Davranışları ve İlişkili Faktörler: Bir Kamu Hastanesi Örneği

Leman ÇALIŞKAN¹ , Hatice ÇOLAK²  , Berna KARAKOYUN³ 

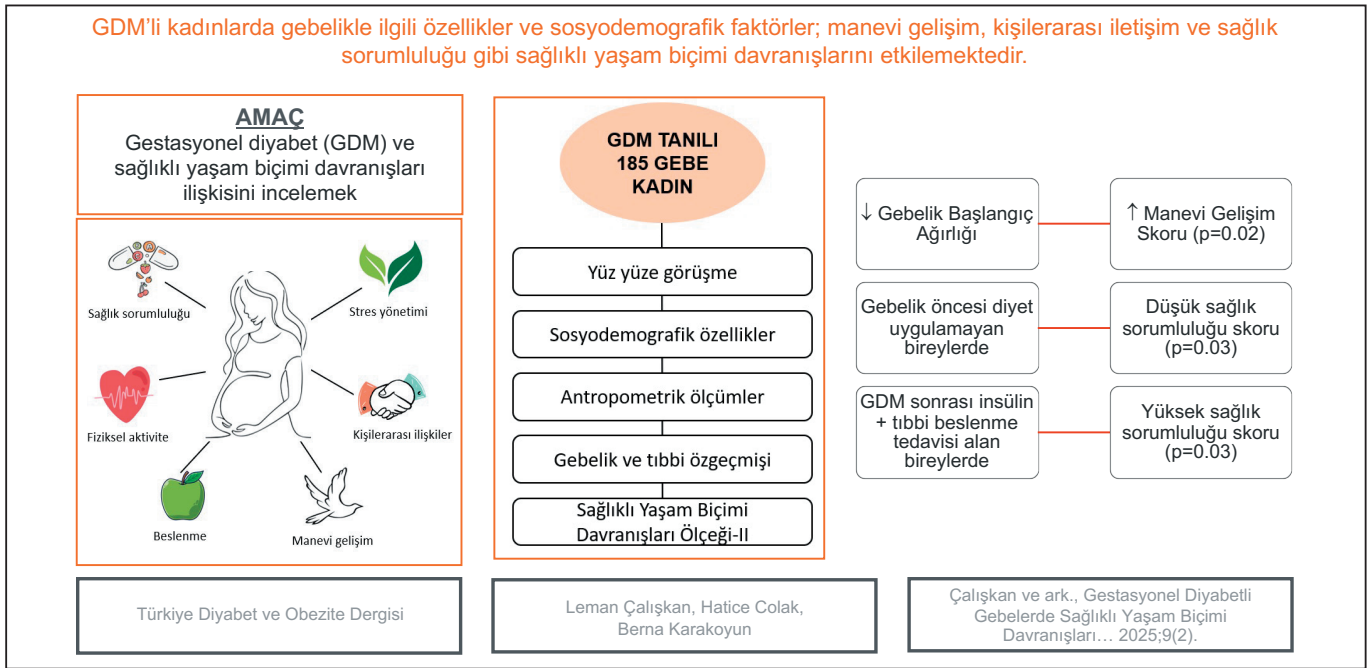
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GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışmada, gestasyonel diyabet (GDM) tanısı olan gebelerde sağlık sorumluluğu, fiziksel aktivite, beslenme, manevi gelişim, kişilerarası ilişkiler ve stres yönetimi konularını içeren sağlıklı yaşam biçimi davranışlarının belirlenmesi amaçlanmaktadır.

Gereç ve Yöntemler: Çalışma, GDM tanılı 185 gebe ile gerçekleştirilmiştir. Katılımcılardan yüz yüze görüşme ile sosyo-demografik özellikleri, antropometrik ölçümleri, gebelik ve tıbbi özgeçmişi ile Sağlıklı Yaşam Biçimi Davranışları (SYBD) Ölçeği-II bilgileri toplanmıştır. İstatistiksel analiz için IBM SPSS v27 programında tek yönlü Anova ve Pearson korelasyon testleri uygulanmıştır.

Bulgular: Bu çalışmada, SYBD ölçeğinin güvenirliği Cronbach's Alpha=0,92 olarak yüksek bulunmuştur. Olguların ortalama yaşı 29,43±6,06 yıl olup; %11,4'ü üniversite mezunudur. Olguların %76,2'si GDM tedavisini için tıbbi beslenme tedavisi uyguladığını bildirmiştir. Olguların SYBD ölçeği-II toplam puanı ortalama 132,10±19,31'dir. Gebelik başlangıç ağırlığı ile manevi gelişim alt boyut

ORCID: Leman Çalışkan / 0009-0008-8342-4912, Hatice Çolak / 0000-0001-5502-8762, Berna Karakoyun / 0000-0003-0929-4239

Yazışma Adresi / Correspondence Address:

Hatice ÇOLAK

Üsküdar Üniversitesi, Sağlık Bilimleri Fakültesi, Beslenme ve Diyetetik Bölümü, İstanbul, Türkiye
Tel: 0 (507) 384 90 05 • E-posta: hatice.colak@uskudar.edu.tr, colakhatices5@gmail.com

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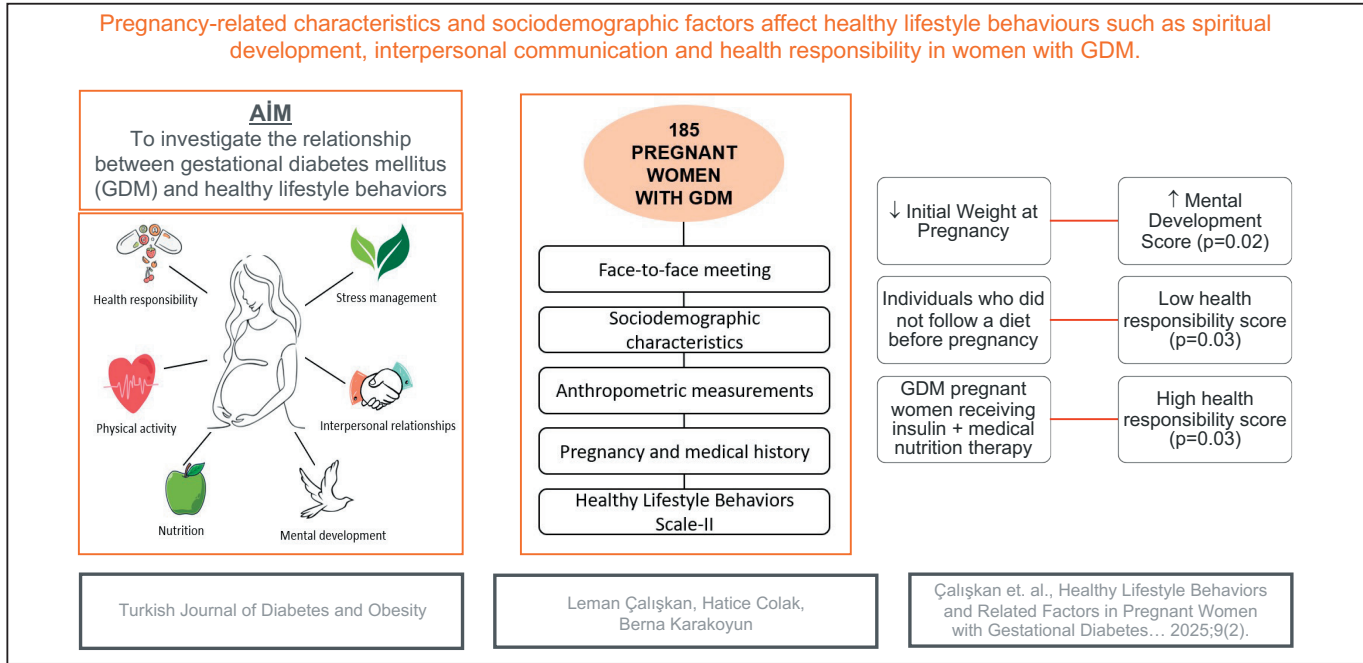
puanının arasında negatif yönlü zayıf korelasyon bulunmuştur ($p=0,02$). Eğitim durumuna, gebelik sayısına ve kan glikoz kontrolü yapma durumuna göre SYBD ölçeği-II toplam ve alt boyut puanları arasında anlamlı bir fark saptanmamıştır ($p>0,05$). Gebelik öncesi diyet uygulamayan olguların sağlık sorumluluğu puanı düşükken ($p=0,03$); GDM tanısı sonrası insülin ve tıbbi beslenme tedavisini birlikte alan olguların sağlık sorumluluğu puanları daha yüksek bulunmuştur ($p=0,03$).

Sonuç: Gestasyonel diyabetli kadınlarda gebelikle ilgili özellikler ve sosyodemografik faktörler; manevi gelişim, kişilerarası iletişim ve sağlık sorumluluğu gibi sağlıklı yaşam biçimi davranışlarını etkilemektedir. Kadınlara gebelik öncesi ve sırasında, sağlıklı yaşam biçimi davranışlarının oluşmasında etkili ve sürdürülebilir müdahalelerin belirlenmesi ve uygulanması, GDM prevalansını azaltabilir.

Anahtar Sözcükler: Gebe, Beslenme, Sağlık, Gestasyonel diyabet, Yaşam biçimi, Obezite

Healthy Lifestyle Behaviors and Related Factors in Pregnant Women with Gestational Diabetes: A Public Hospital Model

GRAPHICAL ABSTRACT



ABSTRACT

Aim: This study aimed to determine healthy lifestyle behaviours including health responsibility, physical activity, nutrition, spiritual development, interpersonal relationships and stress management in pregnant women with gestational diabetes mellitus (GDM).

Material and Methods: The study was conducted with 185 pregnant women who diagnosed with GDM. Socio-demographic characteristics, anthropometric measurements, pregnancy and medical history, and Healthy Lifestyle Behaviours Scale (HLBS)-II information were collected from the participants through face-to-face interviews. For statistical analysis, Anova and Pearson correlation tests were applied in IBM SPSS v27 programme.

Results: In the present study, the reliability of the HLBS scale was found to be high as Cronbach's Alpha=0.92. The mean age of the participants was 29.43 ± 6.06 years and 11.4% were university graduates. 76.2% of the participants reported that they applied medical nutrition therapy for the treatment of GDM. The mean total score of the participants' HLBS-II was 132.10 ± 19.31 . There was weak negative correlation between the initial weight of pregnancy and the spiritual development subscale score ($p=0.02$). No significant difference was found between the total and sub-dimension scores of the HLBS-II according to educational status, number of pregnancies and blood glucose control status ($p>0.05$). Participants who did not follow diet before pregnancy had lower health responsibility scores ($p=0.03$), whereas participants who received insulin and medical nutrition therapy together after GDM diagnosis had higher health responsibility scores ($p=0.03$).

Conclusion: Pregnancy-related characteristics and sociodemographic factors affect healthy lifestyle behaviours such as spiritual development, interpersonal communication and health responsibility in women with GDM. Identifying and implementing effective and sustainable interventions for women before and during pregnancy in the formation of healthy lifestyle behaviours may reduce the prevalence of GDM.

Keywords: Pregnant, Nutrition, Health, Gestational diabetes, Lifestyle, Obesity

GİRİŞ

Gebelik sırasında sık görülen metabolik komplikasyonlardan biri olan gestasyonel diyabet (GDM), gebelikten önce açıkça belirgin olmayan ve gebeliğin 24-28. haftalarında tanısı konulan bir diyabet türüdür (1). Normal gebelik sırasında, pankreasın β -hücreleri gebeliğin artan insülin talebini karşılamak için hiperplazi ve hipertrofiye uğramaktadır. Gestasyonel diyabet sırasında, β hücreleri gebeliğin bu taleplerine karşılık veremez ve insülin duyarlılığı azalır, bunun sonucunda hiperglisemi meydana gelmektedir (2). Gestasyonel diyabetli kadınların doğurduğu bebeklerde makrozomi, neonatal hipoglisemi, hiperbilirubinemi ve neonatal solunum sıkıntısı sendromu gibi erken dönem komplikasyonlarının yanı sıra, çocuklukta obezite ve yetişkinlikte kardiyovasküler hastalıklara yakalanma riski artmaktadır (3). Gestasyonel diyabet öyküsü olan kadınların, gebelik sırasında normoglisemisi olanlara göre, tip 2 diyabet (T2DM) geliştirme riskinin yaklaşık 10 kat daha fazla olduğu görülmüştür (4). Türkiye’de GDM’nin belirgin şekilde yüksek olduğu ve GDM prevalansının ortalama %7,7 (%1,9-27,9) olduğu bildirilmiştir (5).

Sağlıksız yaşam biçimi davranışları, GDM’nin ortaya çıkışını ve ilerleyişini hızlandırmaktadır. Gebelik sürecinde sedanter yaşam ve artmış enerji alımı, gebelerde ağırlık artışına, metabolik bozukluklara ve bozulmuş glikoz dengesine neden olabilmektedir (2). Yaşam biçimi ile ilgili müdahalelerinin glisemik atakları hafiflettiği ve maternal-fetal komplikasyonları azalttığı bildirilmiştir (6). Gebelik öncesinde ve sırasında yapılan düzenli fiziksel aktivite, fetüsün kardiyovasküler adaptasyonuna, annenin sağlıklı ağırlık artışına, GDM’nin önlenmesine ve mental sağlığı iyileştirmeye yardımcı olmaktadır (7). Gestasyonel diyabet tanısı almış gebelerde tıbbi beslenme tedavisinin, glikoz dengesini korumada, insülin duyarlılığını iyileştirmede, gebelik komplikasyonlarını azaltmada ve postpartum maternal metabolik bozukluk riskini azaltmada etkili olduğu gösterilmiştir (8). Aynı zamanda, gebelik öncesi ve sırasındaki sağlıklı beslenme, fetal büyümeyi iyileştirmekte ve fetal makrosomi komplikasyonlarını önlemektedir (2).

Sağlıklı yaşam biçimi, bireyin sağlığını etkileyebilecek tüm davranışlarını kontrol edebilmesi ve sağlık durumunu izleme, koruma ve geliştirme konusunda bilinçli ve aktif bir yak-

laşım sergilemesi olarak tanımlanmaktadır (9). Beslenme, egzersiz, stres yönetimi ve manevi gelişimi kapsayan sağlıklı yaşam biçimi davranışlarının benimsenmesi ve sağlığın desteklenmesi, gebelik komplikasyonları ile GDM önlenmesinde etkili bir strateji olarak değerlendirilebilir (7, 9, 10). Bu çalışma, İstanbul’daki bir hastanede izlenen GDM tanısı almış gebelerin sağlıklı yaşam biçimi davranışlarını değerlendirmeyi ve bu davranışları etkileyebilecek bazı bireysel ve sosyodemografik faktörleri belirlemeyi amaçlamaktadır. Bu çalışmanın sonucu ile GDM’li gebelerin sağlıklı yaşam biçimi davranışlarının düzeyinin ve buna yönelik önlenbilir risk faktörlerinin tespit edilmesi hedeflenmiştir. Aynı zamanda bu çalışma, benzer özelliklere sahip gruplarda farkındalık oluşturmak ve sağlık hizmeti planlamalarına katkı sağlamak açısından önem taşımaktadır.

GEREÇ ve YÖNTEMLER

Kesitsel ve tanımlayıcı türdeki bu araştırma, Mart 2017-Ağustos 2017 tarihleri arasında İstanbul’da bulunan Sağlık Bilimleri Üniversitesi Kanuni Sultan Süleyman Eğitim ve Araştırma Hastanesi’nin Kadın Hastalıkları ve Doğum Kliniğinde gerçekleştirilmiştir. Çalışma için gerekli olan etik kurul onay belgesi çalışmanın yapıldığı hastanenin Sağlık Bilimleri Üniversitesi Kanuni Sultan Süleyman Eğitim ve Araştırma Hastanesi Baştabipliği Klinik Araştırmalar Etik Kurulu’ndan alınmıştır (Konu no: KAEK/2017.2.3). Araştırmanın popülasyonunu İstanbul’da bulunan bir kamu hastanesinin Kadın Hastalıkları ve Doğum Kliniğine başvuran, hekim tarafından GDM tanısı konulmuş hasta grubu oluşturmuştur. Gestasyonel diyabet tanısı, Dünya Sağlık Örgütü kriterlerine göre 75 gram oral glukoz tolerans testi ile belirlenmiştir (11). Güç analizi G*Power 3.1.9.7 programı ile yapılmış olup, etki büyüklüğü 0,5, hata payı 0,05 ve güven aralığı 0,95 olarak alındığında minimum örneklem büyüklüğü 176 kişi olarak belirlenmiştir (12). Araştırma, Kadın Hastalıkları ve Doğum Kliniğinde tedavi ve takibi yapılan ve hekim tarafından GDM tanısı konulan, çalışmaya katılmayı gönüllü olarak kabul eden 185 birey ile gerçekleştirilmiştir.

Çalışmaya katılmayı kabul eden tüm gebelerden, araştırma başlamadan önce bilgilendirilmiş gönüllü onam alınmıştır. Anket uygulamaları, hastane bünyesinde mahremiyetin sağlandığı uygun bir odada, gerekli eğitimleri almış bir araştır-

macı tarafından yüz yüze görüşme yöntemiyle gerçekleştirilmiştir. Katılımcıların sosyodemografik özellikleri, antropometrik ölçümleri, gebelik ve tıbbi özgeçmişi ile Sağlıklı Yaşam Biçimi Davranışları (SYBD) Ölçeği-II sorgulanmıştır. Türkçe geçerlilik ve güvenilirliği yapılan SYBD ölçeğinin bu çalışmada kullanılması için gerekli izinler alınmıştır.

Antropometrik ölçümler

Antropometrik ölçümler için boy uzunluğu ve vücut ağırlığı katılımcıların beyanlarına göre alınmıştır. BKİ, vücut ağırlığının boy uzunluğunun metrekaresine bölünmesiyle hesaplanmış ve “Dünya Sağlık Örgütü’nün (WHO)” BKİ sınıflandırmasına göre sınıflandırılmıştır. WHO’ya göre, BKİ değeri 18,5 kg/m²’nin altında ise zayıf, 18,5-24,99 kg/m² arasında ise normal kilolu, 25,0-29,9 kg/m² arasında ise fazla kilolu, 30 kg/m²’nin üzerinde ise obez olarak kabul edilir (13).

Sağlıklı Yaşam Biçimi Davranışları (SYBD) Ölçeği-II

Sağlıklı yaşam biçimi davranışlarını belirlemek amacıyla ise ‘Sağlıklı Yaşam Biçimi Davranışları (SYBD) Ölçeği-II’ (Health Promotion Lifestyle Profile (HPLP)-II) kullanılmıştır. Walker tarafından geliştirilen SYBD-II ölçeğin, Türkçe geçerlilik ve güvenilirlik çalışmaları Bahar ve ark. tarafından yapılmıştır (14,15). Ölçek, sağlık sorumluluğu, fiziksel aktivite, beslenme alışkanlığı, manevi gelişim, kişilerarası ilişkiler ve stres yönetimi olmak üzere 6 alt boyuttan ve 52 maddeden oluşmaktadır. Ölçek maddeleri, ‘hiçbir zaman’ yanıtına 1; ‘bazen’ yanıtına 2; ‘sık sık’ yanıtına 3; ‘düzenli olarak’ yanıtına 4 puan olmak üzere puanlanmıştır. Ölçekten alınabilecek en düşük puan 52, en yüksek puan ise 208’dir. Ölçeğin 6 alt boyutu bulunmaktadır. Sağlık sorumluluğu, bireyin kendi sağlığı üzerindeki sorumluluk düzeyini göstermektedir. Fiziksel aktivite, egzersizin birey tarafından uygulanma düzeyini ifade etmektedir. Manevi gelişim, bireyin yaşam amaçlarını, bireysel olarak ruhsal gelişim yeteneğini ve memnuniyetini belirlemektedir. Kişilerarası ilişkiler, bireyin yakın çevresi ile iletişimini değerlendirir. Stres yönetimi, bireyin stres kaynaklarını tanıma ve kontrol mekanizmalarını göstermektedir. Her alt boyut ve toplam puan ayrı ayrı değerlendirilmektedir. Ölçekten alınan puanların yükselmesi bireyin belirtilen sağlık davranışlarını yüksek düzeyde uyguladığını göstermektedir. Ölçeğin Cronbach Alpha katsayısı 0,92 olup yüksek güvenilirlik derecesine sahiptir. Benzer olarak, bu çalışmada SYBD ölçeğinin güvenilirliği Cronbach’s Alpha 0,92 olarak yüksek bulunmuştur. Bu değerin 0,6’dan büyük olması, ölçeğin katılımcılar tarafından anlaşılır olduğunu göstermiştir (16).

İstatistiksel Analiz

Kategorik değişkenler için tanımlayıcı istatistikler frekans ve yüzde olarak sunulmuştur. Verilerin normalliğin belirlenmesi için Shapiro-Wilk testi uygulanmıştır. İki bağımsız grup arasında niceliksel sürekli verilerin karşılaştırılmasında t-testi, ikiden fazla bağımsız grup arasında niceliksel sürekli verilerin karşılaştırılmasında tek yönlü Anova testi kullanılmıştır. Anova testi sonrasında farklılıkları belirlemek üzere tamamlayıcı post-hoc analizi olarak Scheffe Testi ile değerlendirme yapılmıştır. Araştırmanın sürekli değişkenleri arasında Pearson korelasyon analizi uygulanmıştır. İstatistik anlamlılık düzeyi p<0,05 olarak kabul edilmiştir. Verilerin istatistiksel analizi “International Business Machines Statistical Package for the Social Sciences (IBM SPSS)” versiyon 27 (IBM Inc., Chicago, IL, USA)” paket programında yapılmıştır.

İstatistik anlamlılık düzeyi p<0,05 olarak kabul edilmiştir. Verilerin istatistiksel analizi “International Business Machines Statistical Package for the Social Sciences (IBM SPSS)” versiyon 27 (IBM Inc., Chicago, IL, USA)” paket programında yapılmıştır.

BULGULAR

Olguların demografik özellikleri Tablo 1’de gösterilmiştir. Olguların ortalama yaşı 29,43±6,06 yıl ve gebelik başlangıç ağırlığı 64,63±10,72 kg’dır. Olguların %51,4’ü gelirinin giderine eşit olduğunu bildirmiştir. Aynı zamanda, olguların %16,8’i lise mezunu iken %11,4’ü üniversite mezunudur.

Olguların %65,4 gebeliğinin ikinci trimesterin son döneminde (25-27. haftalar) yer alırken, %35,6’sı gebeliğinin üçüncü trimesterinde yer almaktadır. Olguların sadece %15,1’inde daha önceki gebeliklerinde GDM tanısı konulmuş ve %14,1’inde kürtaj ve/veya abortus yaşanmıştır. Olguların çoğunluğunda en az bir gebelik öyküsü ve en az bir çocuk bulunmaktadır. Mevcut gebeliğini planlayan olguların %48,6’sını oluştururken, olguların %65,9’u düzenli kontrole gittiğini belirtmiştir (Tablo 2).

Olguların GDM durumuna ilişkin bilgiler Tablo 3’te verilmiştir. Düzenli olarak kan glikozunu ölçen olguların (%31,4’ü) %29,3’ü kan glikoz ölçümünü her gün yapmak-

Tablo 1: Gestasyonel diyabetli olguların temel özellikleri.

Özellikler		Sonuç (n=185)	
Yaş (yıl)*		29,43±6,06	(18,0 – 45,0)
Gebelik Başlangıç Ağırlığı (kg)*		64,63±10,71	(42,0 – 98,0)
Beden Kütle İndeksi (BKİ, kg/m ²)*		28,35±5,13	(18,3 – 42,7)
Eğitim Durumu, n(%)	Okur-yazar değil	21	(11,4)
	Okur-yazar	39	(21,1)
	İlkokul mezunu	31	(16,8)
	Ortaokul mezunu	42	(22,7)
	Lise mezunu	31	(16,8)
	Üniversite mezunu	21	(11,4)
Gelir Durumu, n(%)	Gelirim giderimden az	73	(39,5)
	Gelirim giderime eşit	95	(51,4)
	Gelirim giderimden fazla	17	(9,2)

* Veriler Ortalama ± Standart Sapma (Minimum – Maksimum) olarak gösterilmektedir. **BKİ:** Beden kütle indeksi.

tadır (7 kez/haftada). Olguların %33,5'i hipoglisemi yaşadığını ve bunların %53,2'si haftada 1 kez hipoglisemi yaşadığını belirtmiştir. Gestasyonel diyabet tedavisi için olguların %76,2'si tıbbi beslenme tedavisi uyguladığını bildirmiştir.

Olguların SYBD ölçeği-II toplam puanı ortalama $132,10 \pm 19,31$ olup; alt boyut puanları Tablo 5'te verilmiştir. SYBD ölçeği-II toplam ve alt boyut puanları ile yaş, gebelik başlangıç ağırlığı, BKİ ilişkisi incelendiğinde, yalnızca gebelik başlangıç ağırlığı ile manevi gelişim alt boyut puanı arasında istatistiksel olarak anlamlı, ancak zayıf düzeyde

Tablo 2: Olguların gebeliğine dair bilgiler.

Gebeliğe dair bilgiler *	Gruplar	Sonuç (n=185)
Şu Anki Gebelik Haftası	25	13 (7,0)
	26	44 (23,8)
	27	64 (34,6)
	28	32 (17,3)
	29	17 (9,2)
	30	7 (3,8)
	31	4 (2,2)
	32	2 (1,1)
	33	2 (1,1)
	1	26 (14,1)
Gebelik Sayısı	2	36 (19,5)
	3	33 (17,8)
	4	28 (15,1)
	5 ve üzeri	62 (33,5)
Önceki Gebeliklerde GDM Tanısı	Evet	28 (15,1)
	Hayır	157 (84,9)
Kürtaj ve/veya Abortus Sayısı	Yok	102 (55,1)
	1	57 (30,8)
	2 ve üzeri	26 (14,1)
Doğum Sayısı	Yok	42 (22,7)
	1	46 (24,9)
	2	53 (28,6)
	3 ve üzeri	44 (23,8)
	Çocuk yok	42 (22,7)
Yaşayan Çocuk Sayısı	1	49 (26,5)
	2	52 (28,1)
	3 ve üzeri	42 (22,7)
Şu Anki Gebeliğin Planlı Olma Durumu	Evet	90 (48,6)
	Hayır	95 (51,4)
Düzenli Kontrole Gitme Durumu	Evet	122 (65,9)
	Hayır	63 (34,1)

*Veriler olgu sayısı ve yüzde [n(%)] olarak gösterilmektedir. **GDM:** Gestasyonel Diyabet. **TBT:** Tıbbi Beslenme Tedavisi

bir negatif korelasyon saptanmıştır ($p < 0,05$; $r = -0,18$). Diğer değişkenler arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır (Tablo 4).

Tablo 3: Olguların gestasyonel diyabet durumuna dair bilgiler (n=185).

Gestasyonel diyabet özellikleri*	Gruplar	Sonuç (n=185)
Kan Glikoz Ölçümü	Evet	58 (31,4)
	Hayır	127 (68,6)
	1	18 (31,0)
	2	3 (5,2)
Kan Glikoz Ölçümü Sıklığı (Haftada)	3	5 (8,6)
	4	10 (17,2)
	5	5 (8,6)
	7	17 (29,3)
	1	33 (53,2)
Hipoglisemi Durumu	Evet	62 (33,5)
	Hayır	123 (66,5)
Hipoglisemi Sıklığı (Haftada)	2	19 (30,6)
	3	6 (9,7)
	4	3 (4,8)
	5	1 (1,6)
	İnsülin tedavisi	6 (3,2)
GDM Tedavisi	TBT	141 (76,2)
	İnsülin + TBT	38 (20,5)

*Veriler olgu sayısı ve yüzde [n(%)] olarak gösterilmektedir. **GDM:** Gestasyonel Diyabet.

Tablo 4: Yaş, gebelik başlangıç ağırlığı, beden kütle indeksi ile SYBD ölçeği-II puanları arasındaki ilişki.

SYBD ölçeği-II Alt Boyut	Yaş	Gebelik Başlangıç Ağırlığı	Beden Kütle İndeksi
Sağlık Sorumluluğu	r	0,09	0,08
	p	0,18	0,07
Fiziksel Aktivite	r	0,04	0,05
	p	0,60	0,38
Beslenme	r	0,05	0,04
	p	0,48	0,32
Manevi Gelişim	r	-0,03	-0,18
	p	0,66	0,02*
Kişilerarası İlişkiler	r	0,06	-0,03
	p	0,43	0,50
Stres Yönetimi	r	0,01	-0,04
	p	0,99	0,77
SYBD Toplam	r	0,04	-0,02
	p	0,54	0,60

SYBD: Sağlıklı yaşam biçimi davranışları. * $p < 0,05$

Tablo 5'te bazı demografik özelliklerine göre SYBD ölçeği-II toplam ve alt boyut puanları karşılaştırılmıştır. Eğitim durumuna, gebelik sayısına ve kan glikoz kontrolü yapma durumuna göre SYBD ölçeği-II toplam ve alt boyut puanları arasında istatistiksel olarak anlamlı bir fark saptanmamıştır ($p>0,05$). Geliri giderinden az olan olguların manevi gelişim alt boyut puanlarının daha düşük olduğu görülmüştür ($p<0,001$). Düzenli doktor kontrolüne giden olguların manevi gelişim puanlarının yüksek ve gebelik öncesi diyet uygulamayan olguların sağlık sorumluluğu puanı düşük olduğu bulunmuştur ($p<0,05$). Gestasyonel diyabet tanısı sonrası insülin ve tıbbi beslenme tedavisini birlikte alan olguların sağlık sorumluluğu puanları daha yüksek bulunmuştur ($p=0,03$).

TARTIŞMA

Gestasyonel diyabeti olan gebelerde sağlıklı yaşam biçimi davranışlarını araştıran çalışmamızda; gebelerde sağlık sorumluluğu, fiziksel aktivite, beslenme, manevi gelişim, kişilerarası ilişkiler ve stres yönetimi gibi sağlıklı yaşam biçimi davranışlarının düzeyi vurgulanmaktadır.

Sağlıklı yaşam biçimi davranışlarının değerlendirilmesinde kişinin eğitim ve sosyoekonomik durumu önem arz etmektedir. Çalışmamızda geliri giderden az olan GDM'li gebelerde manevi gelişim puanlarının daha düşük olduğu bulunmuştur. Geniş kapsamlı bir çalışmada, 7511 gebe kadın incelenmiş ve düşük eğitim düzeyine sahip olanlar ile daha düşük sosyoekonomik gruplarda yer alan kadınlarda GDM riskinin arttığı belirlenmiştir (17). Bu çalışmada ise literatür ile benzer olarak, GDM'li olguların eğitim ve ekonomik seviyesi düşük bulunmuştur. Olguların %16,8'i lise ve %11,4'ü üniversite mezunu olduğunu bildirirken %51,4'ü finansal olarak gelirinin giderine eşit olduğunu bildirmiştir. Bu durum, düşük sosyoekonomik alt gruptaki kadınların ve eğitim seviyesi düşük olan kadınların yaşam tarzının hafif kilolu ve obezite oranlarını artırmaya yönelik olması ile açıklanabilir.

Kadınların özyönetimi ve öz yeterliliği, sağlıklı yaşam biçimi davranışlarına uyumu etkileyen faktörlerdendir. Bu çalışmada düzenli doktor kontrolüne giden GDM'li olgularda manevi gelişim puanlarının daha yüksek olduğu bulunmuş ve gebelik başlangıç ağırlığının artması ile manevi gelişim puanlarının azaldığı görülmüştür. Gestasyonel diyabette sağlıklı davranışlara bağlılığı inceleyen bir çalışmada, kadınların algıladıkları öz yeterlilik düzeyleri ile gebelik yaşlarının sağlıklı davranışlara uyumu etkilediği bulunmuştur. Ayrıca, fiziksel sınırlamalar ve zaman kısıtlamaları uyumu engelleyen önemli faktörler arasında yer alırken; GDM ile ilişkili komplikasyonlara yönelik endişeler ve aileden alınan manevi destek, sağlıklı davranışlara uyumu artıran başlıca

motivasyon kaynakları olarak bildirilmiştir (18). Başka bir çalışmada, GDM'li kadınların vücut ağırlıkları ve beslenmeleri üzerinde bir kontrole sahip olmalarının, GDM'nin risk yönetimini kolaylaştırdığı ve tanı sonrası sorumluluklarını daha etkili şekilde yerine getirdiği gösterilmiştir (19). Anne ve bebek üzerinde algılanan GDM riskinin sağlıklı alışkanlıklara uyumu sürdürmede önemli bir rol oynadığı düşünülmektedir (20). Çalışmamızda, olguların %15,1'ine daha önce GDM tanısı konulmuşken, %48,6'sının gebeliğini planladığı belirlenmiştir. GDM yönetiminde gebeleri kısıtlayan ve motive eden potansiyel faktörlerini araştıran bir çalışma, olguların fetal ve maternal komplikasyonları yaşama endişesinin GDM yönetim planına uyum için bildirilen en önemli motivasyon kaynağı olduğu gösterilmiştir. İnsülin enjeksiyonu korkusu olan olguların önerilen diyet planına ve egzersizlere uyum motivasyonunun daha yüksek olduğu bildirilmiştir. Aynı zamanda, olgular, GDM planına uyumun zaman kısıtlamalarının ve ev sorumluluklarının en önemli engeller olduğunu söylerken; iyi sosyal desteğe sahip gebelerin önerilen GDM tedavisi planına uyma olasılığının daha yüksek olduğu ortaya konulmuştur (20). Bununla ilişkili olarak bu çalışmada da tıbbi beslenme tedavisi ve insülin tedavisi uygulayan GDM'li gebelerin kişilerarası iletişim puanının daha yüksek olduğu saptanmıştır. Buna göre, GDM'li gebelerde manevi gelişim ve kişilerarası iletişim gibi sağlıklı yaşam biçimi davranışlarının iyileştirilmesi, anne ve bebek sağlığı üzerine olumlu etkiler gösterebilir.

Sağlık sorumluluğu, sağlıklı yaşam biçimi davranışlarının temel unsurlarından biridir. Bununla birlikte genellikle sağlık sorumluluğu kapsamında sağlıklı beslenme, fiziksel aktivite ve yeterli uyku faktörleri değerlendirilmektedir (21). Çalışmamızda sağlık sorumluluğu puanları gebelik öncesi diyet uygulamayan olgularda düşüken; GDM tanısı sonrası insülin ve tıbbi beslenme tedavisini birlikte alan olgularda daha yüksek bulunmuştur. Çalışmamızdaki olguların %31,4'ü düzenli kan glikozu ölçümü yaparken; %20,5'i insülin ve tıbbi beslenme tedavisi programına uyduğunu bildirmiştir. Bilginer ve ark. tarafından yapılan bir çalışmada, GDM tanısı alan hastaların %27'sinin insülin tedavisine ihtiyaç duyduğu bildirilmiştir. İnsülin tedavisi alan hastalar arasında obezite, morbid obezite ve düşük diyet uyumu oranlarının, yalnızca tıbbi beslenme tedavisi alan hastalara kıyasla anlamlı düzeyde yüksek olduğu bulunmuştur (22). Yapılan bir prospektif kohort çalışmada, gebe kadınların %7,2 (501 gebe)'sine GDM tanısı konulmuştur. Aktif bir fiziksel yaşam, sağlıklı beslenme, yeterli uyku ve ideal ağırlık daha düşük GDM riski ile ilişkilendirilmiş; erken gebelik döneminde sağlıklı yaşam tarzına sahip olan kadınlarda GDM gelişme olasılığının daha düşük olduğu bulunmuştur (21). Başka bir çalışmada ise gebelik döneminde uyku ve gli-

Tablo 5: Olguların demografik özelliklerine göre SYBD ölçeği-II puan ortalamaları (n=185)

SYBD Ölçeği-II Alt Boyutları	n	Sağlık Sorumluluğu (Ort±SS)	Fiziksel Aktivite (Ort±SS)	Beslenme (Ort±SS)	Manevi Gelişim (Ort±SS)	Kişilerarası İlişkiler (Ort±SS)	Stres Yönetimi (Ort±SS)	SYBD Toplam (Ort±SS)
SYBD Ölçeği-II Alt Boyut Puanları		22,632±3,978 Alpha: 0,902	18,368±4,311 Alpha: 0,921	12,903±4,000 Alpha: 0,903	24,584±4,157 Alpha: 0,914	23,632±4,197 Alpha: 0,899	19,984±3,645 Alpha: 0,931	132,103±19,313 Alpha: 0,923
Eğitim Durumu								
Okur-yazar değil	21	23,14±3,64	18,43±4,48	23,91±3,60	24,04±3,91	24,00±3,86	19,71±4,11	133,24±18,46
Okur-yazar	39	23,21±3,65	18,85±3,94	23,51±3,18	24,67±3,37	23,34±3,36	20,85±3,22	134,41±14,97
İlkokul mezunu	31	22,32±4,69	18,03±5,32	22,45±4,68	24,26±4,98	23,13±5,21	19,39±4,14	129,58±25,16
Ortaokul mezunu	42	22,91±3,97	18,09±3,65	23,41±4,12	25,38±4,05	24,21±3,88	20,57±3,51	134,57±17,85
Lise mezunu	31	22,19±3,84	17,67±4,74	22,65±4,33	24,13±4,61	23,65±4,22	19,36±3,50	129,65±19,23
Üniversite mezunu	21	21,63±4,12	19,48±3,91	20,81±3,46	24,52±4,17	23,38±5,08	19,29±3,54	129,09±21,32
F=		0,65	0,60	1,88	0,49	0,33	1,19	0,56
p=		0,66	0,70	0,10	0,79	0,89	0,32	0,73
Gelir Durumu								
Gelirim giderimden az	73	22,59±3,89	18,78±3,99	22,73±3,79	23,30±3,86 ¹	23,43±3,63	19,86±3,54	130,68±18,72
Gelirim giderime eşit	95	22,54±4,13	17,73±4,46	22,88±4,32	25,18±4,18 ²	23,51±4,45	19,89±3,75	131,73±19,93
Gelirim giderimden fazla	17	23,35±3,61	20,18±4,33	23,77±2,99	26,77±3,80 ³	25,24±4,85	21,00±3,57	140,29±17,22
F=		0,31	2,94	0,46	7,25	1,38	0,73	1,76
p=		0,74	0,06	0,63	0,001*	0,25	0,49	0,18
Post-hoc=					2>1, 3>1(p<0,01)			
Gebelik Sayısı								
1	26	21,65±2,68	18,38±3,87	22,23±3,17	23,50±3,64	22,62±3,44	18,61±2,84	127,00±14,71
2	36	23,17±3,05	19,31±4,35	23,13±3,49	25,16±3,09	24,33±3,61	20,83±3,17	135,94±14,88
3	33	21,94±4,05	18,33±4,34	22,72±4,07	25,21±4,68	23,73±4,12	20,36±3,87	132,30±20,97
4	28	23,43±4,36	18,43±4,68	23,39±4,43	25,50±4,40	24,04±4,56	19,79±3,97	134,57±22,55
5 ve üzeri	62	22,74±4,62	17,81±4,32	22,91±4,40	23,95±4,41	23,42±4,67	19,95±3,85	130,79±20,72
F=		1,10	0,686	0,33	1,52	0,74	1,53	0,99
p=		0,36	0,602	0,86	0,20	0,57	0,19	0,41
Düzenli Kontrole Gitme Durumu								
Evet	122	22,75±3,88	18,38±3,94	23,13±3,84	25,12±4,15	24,00±4,09	20,24±3,53	133,62±18,07
Hayır	63	22,39±4,17	18,35±4,98	22,46±4,29	23,54±4,07	22,92±4,33	19,49±3,84	129,16±21,36
t=		0,58	0,04	1,08	2,49	1,67	1,32	1,49
p=		0,56	0,97	0,28	0,01*	0,09	0,18	0,14
Gebelik Öncesi Uygulanan Diyet Durumu								
Evet	20	20,85±4,03	18,60±3,88	23,15±3,80	24,55±3,39	22,00±5,13	20,10±3,24	129,25±16,60
Hayır	165	22,85±3,93	18,34±4,37	22,87±4,03	24,59±4,25	23,83±4,04	19,97±3,70	132,45±19,63
t=		-2,14	0,25	0,29	-0,04	-1,85	0,15	-0,70
p=		0,03*	0,80	0,77	0,97	0,07	0,88	0,49
Kan Glikoz Kontrolü Yapma								
Evet	58	22,22±3,65	18,63±3,53	22,60±3,28	24,05±3,89	23,62±3,62	20,00±2,79	131,16±15,22
Hayır	127	22,82±4,12	18,24±4,63	23,00±4,29	24,83±4,27	23,64±4,45	19,97±3,99	132,54±20,96
t=		-0,94	0,58	0,69	-1,18	-0,03	0,08	-0,45
p=		0,35	0,53	0,45	0,24	0,98	0,93	0,62
GDM Tanısı Sonrası Tedavi								
İnsülin tedavisi	6	24,17±4,17	20,17±3,66	23,50±3,33	25,17±5,60	26,67±3,45	21,50±3,21	141,17±18,08
TBT	141	22,19±3,73	18,29±4,39	22,65±3,72	24,37±4,02	23,19±3,97	19,82±3,40	130,53±18,22
İnsülin + TBT	38	24,00±4,54	18,37±4,13	23,74±4,96	25,29±4,44	24,79±4,78	20,34±4,52	136,53±22,63
F=		3,63	0,54	1,17	0,79	3,91	0,84	2,15
p=		0,03*	0,58	0,31	0,45	0,02*	0,43	0,12
Post-hoc=		3>2 (p<0,05)				1>2, 3>2 (p<0,05)		

GDM: Gestasyonel Diyabet.

koz regülasyonu arasındaki ilişki incelenmiştir. Gebeliğin ilk üç ayında uyku süresinin azalması, daha yüksek glisemiyle ilişkili bulunurken; ikinci trimesterde hem kısa uyku süresinin hem uzun uyku süresinin yüksek glisemiyle ilişkili olduğu görülmüştür (23). Gestasyonel diyabetli kadınlar için sağlıklı beslenme ve fiziksel aktivite hakkında bilgilendirilen öz bakım eğitimleri sağlık sorumluluğu bilincini yükseltmekte ve GDM'nin kontrolü üzerinde etkili olmaktadır (24). Çalışmamızda gebelik ve sosyodemografik özellikler ile beslenme ve fiziksel aktivite alt puanları arasında anlamlı bir fark bulunmamıştır. Ancak literatürde GDM'nin kontrolü sağlıklı davranışlarla bağlantılı görünmektedir. GDM gelişme riski üzerinde diyet kalitesinin etkisini inceleyen, 19 araştırma (108.084 katılımcı) içeren bir meta-analiz çalışmasında; gebelikten önce veya gebelik sırasında kaliteli diyetle yüksek uyumun GDM riskini azalttığı, düşük uyumun ise GDM riskini artırdığı gösterilmiştir (25). NHANES II çalışmasında, 40 yaşından itibaren 13 yıldan uzun süre takip edilen 54062 kadının değerlendirilmesine göre, diyet kalitesini ve fiziksel aktivitesini düzenleyen GDM'li kadınlarda anlamlı iyileşmeler gözlemlendiği sonucuna varılmıştır (26). İngiltere'de gebe kadınlarda yapılan bir çalışmada, toplam hareketsiz süre, GDM tanısından bağımsız olarak, gebelerde açlık ve tokluk glikoz seviyelerindeki artış ile ilişkilendirilmiştir. Hareketsiz süredeki azalma ise GDM'si olan kadınlarda açlık ve tokluk glikoz seviyelerinde düşüş sağlamıştır (27). Başka bir çalışma ise birinci trimester yüksek glukoz homeostazı olan gebelerin GDM için yüksek risk taşıdığını ve GDM'nin bir göstergesi olarak kullanılabilirliğini göstermiştir (28). Buna göre, diyet kalitesini iyileştirmenin, fiziksel aktiviteyi artırmanın, toplam hareketsiz süreyi azaltmanın ve hareketsiz süreyi bölmenin, GDM riski yüksek kadınlarda glikoz seviyelerini yönetmek için bir strateji olabileceğini düşündürmektedir. Ayrıca, yaşam kalitesini artırmaya yönelik yaklaşımlar ve birinci trimesterde biyokimyasal parametrelerin düzenli izlenmesi, gestasyonel diyabet tedavisinde insülin gereksiniminin azaltılması ve tıbbi beslenme tedavisine uyumun artırılması açısından potansiyel katkılar sağlayabilir.

Gestasyonel diyabeti etkileyebilecek sağlıklı yaşam biçimi davranışlarından biri de stres yönetimidir. Gebelik öncesi depresyonun gebe kadınlarda GDM riskini %29 oranında artırabileceği ortaya konulmuştur (29). Çalışmamızda stres yönetimi ile gebelik ve sosyodemografik özellikler arasında bir ilişki bulunmamıştır. Literatürde de gebe GDM'li kadınların gebe olmayan kadınlara ve sağlıklı gebelere kıyasla daha yüksek stres yaşayıp yaşamadıklarına dair çalışmalar tutarlılık göstermemektedir. Ancak bir sistematik derlemede, gebelik sırasında anksiyete veya depresyonun gebe kadınlarda GDM insidansını belli bir ölçüde artırdığı göz-

lenmiştir. Anksiyete ve depresyonu bulunan GDM'li kadınların, yalnızca GDM tanısı olan kadınlara kıyasla; gebelik süresince kan şekeri kontrolü, doğum şekli ve anne-bebek sonuçları açısından daha olumsuz sonuçlarla karşılaşma olasılıklarının daha yüksek olduğu ortaya konulmuştur (30). Başka bir sistematik derleme, daha uzun oturma süresinin, GDM, doğum öncesi ve/veya doğum sonrası depresyon riskini artırdığını bildirmiştir (31). Yamada ve ark. tarafından yapılan bir çalışmada, beslenmeyle ilişkili stres ve sosyal desteğin, GDM'li gebe kadınlarda depresyonun yönetimiyle ilişkili faktörler olduğu bulunmuştur (32). Çağlar ve ark. ise GDM'li kadınların daha fazla sıkıntı ve depresyon belirtileri gösterdiğini ortaya koymuştur (33). Gestasyonel diyabet prevalansındaki artış göz önüne alındığında, GDM'li gebe kadınların stres yönetimi konusunda desteklenmesi ve daha iyi gebelik sonuçları için beslenme planı, fiziksel aktivite, sosyal ve manevi destek, tıbbi bilgilendirme gibi konuları içeren bir psikolojik müdahale programı planlanmalıdır.

Çalışmamız, GDM tanılı gebeler gibi özel bir grubun sağlıklı yaşam biçimi davranışlarını ele alması bakımından literatüre önemli bir katkı sağlamaktadır. Bu özel grup üzerinde çalışmak hem bireysel sağlık davranışlarının iyileştirilmesi hem de toplum sağlığına yönelik politika geliştirme süreçlerine ışık tutabilir. Bununla birlikte, çalışmanın bazı sınırlılıkları bulunmaktadır. Çalışmanın tek merkezde gerçekleştirilmiş olması, farklı coğrafi bölgelerden ve sosyoekonomik gruplardan bireyleri kapsamaması nedeniyle genellenebilirliğini sınırlandırırken; verilerin beyana dayalı toplanması ise sosyal beğenilirlik yanlılığı veya hatırlama hataları gibi etkenlerden etkilenme olasılığını artırabilir. Bu güçlü ve sınırlı yönlerin farkında olunması, çalışmanın bulgularının yorumlanmasını ve gelecekte yapılacak daha geniş kapsamlı araştırmaların planlanmasını kolaylaştırabilir.

Sonuç olarak, bu çalışmada GDM'li kadınlarda gebelikle ilgili özellikler ve sosyodemografik faktörlerin; manevi gelişim, kişilerarası iletişim ve sağlık sorumluluğu gibi sağlıklı yaşam biçimi davranışlarını etkilediği bulunmuştur. Sağlıklı yaşam biçimi davranışlarının oluşmasında etkili ve sürdürülebilir müdahalelerin belirlenmesi ve sağlık harcamalarının azaltılması açısından GDM öyküsü olan kadınlar önemli bir grup hâline gelmektedir. Önerilen GDM yönetim planının içeriğinde sağlıklı beslenme, fiziksel aktivite, stres yönetimi, ilişkili hastalıkla ilgili bilgilendirme ve iyi sosyal desteğin önemi gibi konuları içermesi dikkate alınmalıdır. Bununla birlikte, GDM'li kadınlar için tasarlanmış herhangi bir doğum öncesi sağlık geliştirme müdahalesi planlanmadan önce, sağlıklı davranışlara bağlılığın belirleyicilerini, engellerini ve motivasyonlarını değerlendirmenin önemi dikkate alınmalıdır.

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Assessment of the Effects of Metformin and DPP-4 Inhibitors on Electrolyte and Vitamin B12 Levels in Patients with Type 2 Diabetes: A Retrospective Study

Zeynep Gizem TODURGA SEVEN¹  , Kubra Cigdem PEKKOC UYANIK² ,
Fatma Kubra TOMBULTURK³ , Erhan Rasit AGAY¹ 

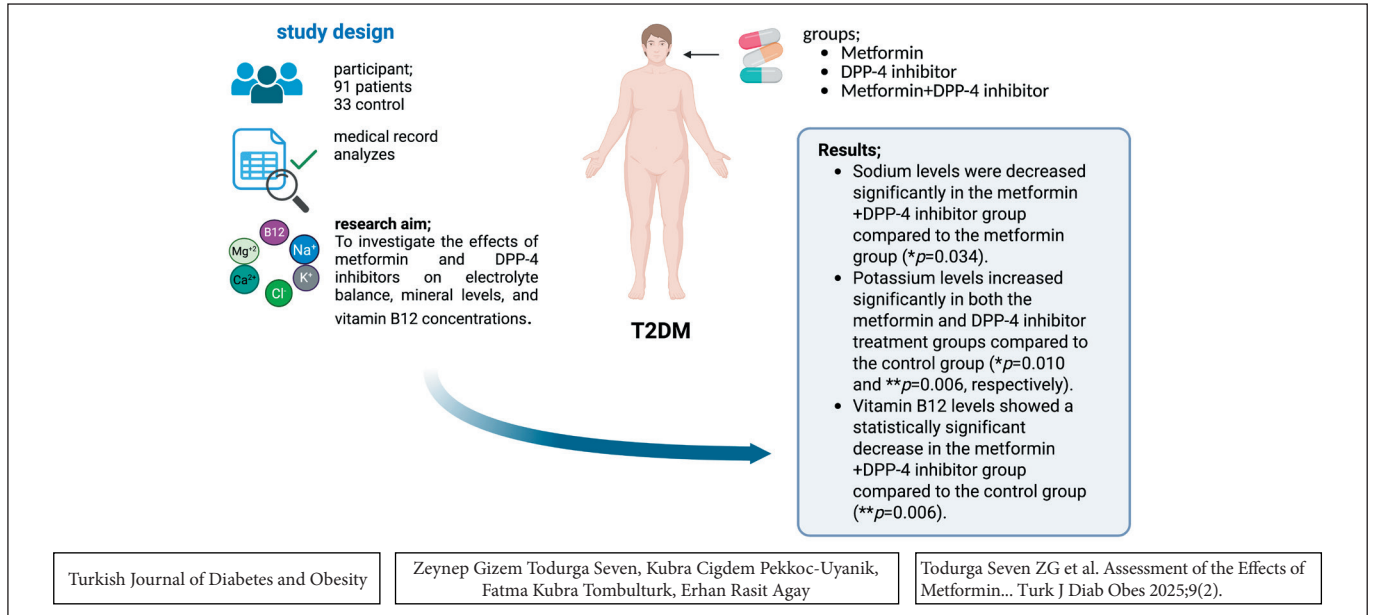
¹Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Department of Medical Pharmacology, İstanbul, Türkiye

²Haliç University, Faculty of Medicine, Department of Medical Biology, İstanbul, Türkiye

³Istinye University, Vocational School of Health Services, Medical Laboratory Techniques, İstanbul, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Aim: Type 2 diabetes mellitus (T2DM) is commonly managed using metformin and DPP-4 inhibitors (vildagliptin, linagliptin) to improve glycemic control. However, their effects on electrolyte, mineral, and vitamin B12 levels remain unclear. The aim of this research was to evaluate the impact of metformin and DPP-4 inhibitors on electrolyte levels, as well as mineral and vitamin B12 levels.

Material and Methods: Electrolyte and mineral levels (including sodium, potassium, calcium, magnesium, and chloride), along with vitamin B12 concentrations, measured through standard laboratory methods in blood samples from T2DM patients receiving metformin and DPP-4 inhibitors, as well as healthy controls, were retrospectively obtained from medical records. The results were analyzed by comparing the control group with the treatment groups and the treatment groups with each other.

ORCID: Zeynep Gizem Todurga-Seven / 0000-0002-2529-0118, Kubra Cigdem Pekkoc-Uyanik / 0000-0002-1056-960X, Fatma Kubra Tombulturk / 0000-0002-4358-2309, Erhan Rasit Agay / 0000-0002-6020-7332

Correspondence Address / Yazışma Adresi:

Zeynep Gizem TODURGA SEVEN

Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Department of Medical Pharmacology, İstanbul, Türkiye,
Phone: +90 (212) 414 30 00 • E-mail: zeynep.seven@iuc.edu.tr,

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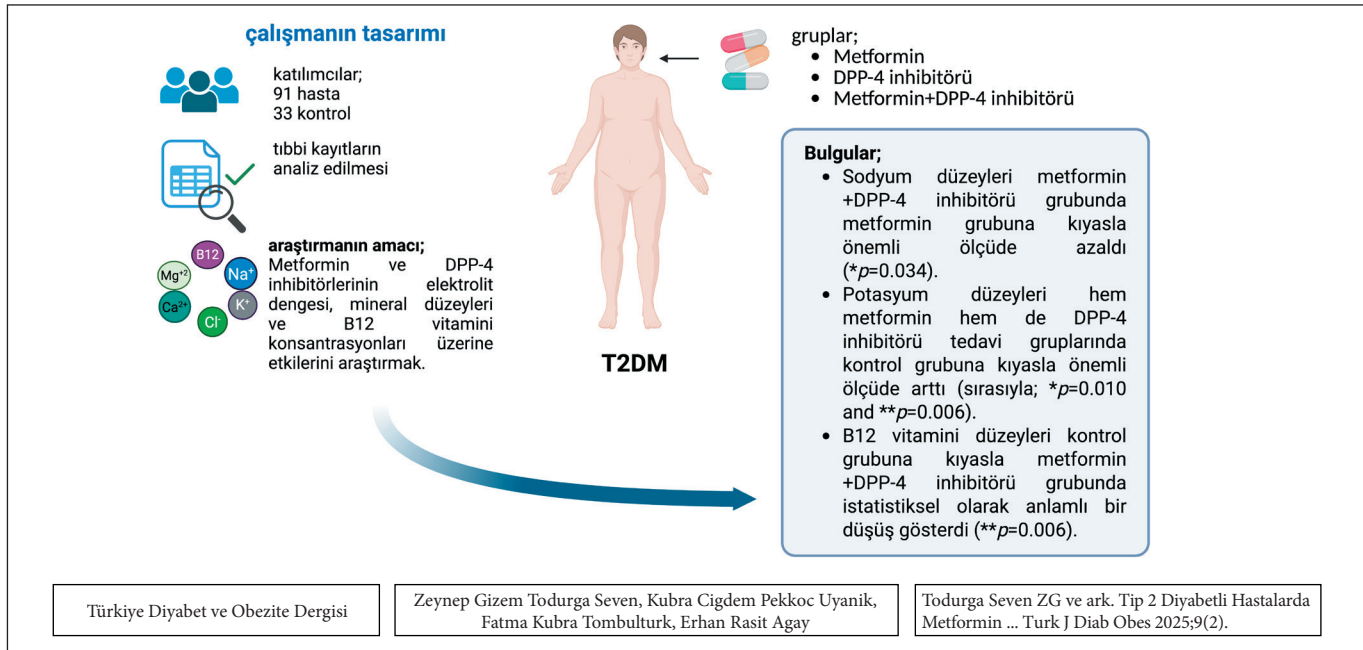
Results: Sodium levels were decreased significantly in the metformin+DPP-4 inhibitor group compared to the metformin group ($p=0.034$). Potassium concentrations were considerably elevated in both the metformin group and the DPP-4 inhibitor group than in the control group ($p=0.010$ and $p=0.006$, respectively). Vitamin B12 concentrations demonstrated a statistically significant reduction in the metformin+DPP-4 inhibitor group relative to the control group ($p=0.006$).

Conclusion: These findings highlight the potential impact of metformin and DPP-4 inhibitors on mineral and electrolyte homeostasis, emphasizing the importance of regular assessment of electrolyte levels and vitamin B12 status in individuals receiving these treatments.

Keywords: T2DM, Metformin, DPP-4 inhibitor, Electrolyte, Vitamin B12

Tip 2 Diyabetli Hastalarda Metformin ve DPP-4 İnhibitörlerinin Elektrolit ve Vitamin B12 Düzeyleri Üzerindeki Etkilerinin Değerlendirilmesi: Retrospektif Bir Çalışma

GRAFİKSEL ÖZET



ÖZ

Amaç: Tip 2 diabetes mellitus (T2DM) tedavisinde sık kullanılan metformin ve DPP-4 inhibitörleri (vildagliptin, linagliptin), glisemik kontrolü sağlamak için yaygın olarak kullanılmaktadır. Ancak, elektrolit, mineral dengesi ve B12 vitamini düzeyleri üzerindeki etkileri tam olarak bilinmemektedir. Bu çalışma, metformin ve DPP-4 inhibitörlerinin elektrolit dengesi, mineral düzeyleri ve B12 vitamini üzerindeki etkilerini incelemeyi amaçlamaktadır.

Gereç ve Yöntemler: Metformin ve DPP-4 inhibitörleri alan T2DM hastalarının ve sağlıklı katılımcıların standart laboratuvar teknikleriyle ölçülen kan örneklerindeki elektrolit/mineral (sodyum, potasyum, kalsiyum, magnezyum ve klorür) ve vitamin B12 seviyeleri geçmiş tıbbi kayıtlardan elde edildi. Sonuçlar, kontrol grubu ile tedavi grupları arasında ve tedavi grupları da kendi aralarında karşılaştırılarak analiz edildi.

Bulgular: Sodyum düzeyleri metformin grubuna kıyasla, metformin+DPP-4 inhibitörü grubunda belirgin şekilde azaldı ($p=0.034$). Potasyum düzeyleri kontrol grubuna kıyasla hem metformin hem de DPP-4 inhibitörü tedavi gruplarında belirgin şekilde arttı (sırasıyla $p=0.010$, $p=0.006$). Vitamin B12 düzeyleri kontrol grubuna kıyasla, metformin+DPP-4 inhibitörü grubunda istatistiksel açıdan önemli bir düşüş gösterdi ($p=0.006$).

Sonuç: Bu bulgular metformin ve DPP-4 inhibitörlerinin mineral ve elektrolit homeostazı üzerindeki potansiyel etkisini vurgulamakta ve bu tedavileri gören hastalarda elektrolit ve vitamin B12 düzeylerinin dikkatli bir şekilde izlenmesi gerektiğini vurgulamaktadır.

Anahtar Sözcükler: T2DM, Metformin, DPP-4 inhibitörü, Elektrolit, Vitamin B12

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as a major global health challenge, driven by rising prevalence of excess body weight, sedentary lifestyles, and unhealthy eating patterns. The prevalence of diabetes has considerably increased in recent years, primarily because of the rising incidence of T2DM. Many people continue to suffer increasingly from this disease, which causes not only health-related difficulties but also economic and sociological challenges, as T2DM is defined by reduced insulin production by the pancreatic β -cells and the inability of insulin-sensitive tissues to properly respond to insulin (1,2). There is a wide range of antidiabetic medications available, which can be used either individually or in combination. There are currently ten classes of pharmacologic agents that can be taken orally to treat T2DM. These consist of sulfonylureas, biguanides, thiazolidinediones, meglitinides, bile acid sequestrants, alpha-glucosidase inhibitors, dopamine receptor agonists, sodium-glucose transporter protein 2 (SGLT2) inhibitors, dipeptidyl peptidase IV (DPP-4) inhibitors and oral glucagon-like peptide 1 (GLP-1) receptor agonists (3, 4). Managing T2DM requires both lifestyle adjustments and medication, with metformin being the first-line therapy due to its proven efficacy, safety profile, and potential benefits in weight management (5). Metformin effects on mineral and electrolyte balance should also be considered. It is a member of the biguanide drug class and functions by reducing glucose production in the liver, increasing insulin sensitivity, and promoting the uptake of glucose in peripheral tissues (6). DPP-4 inhibitors, including vildagliptin and linagliptin, also have a crucial impact in T2DM management; they enhance insulin secretion depending on blood glucose concentrations and inhibit the release of glucagon, thereby contributing to improved glycemic regulation without notable weight gain (7). Additionally, while DPP-4 inhibitors are typically considered safe, some studies have indicated that they may influence electrolyte levels, particularly sodium and potassium (8, 9).

While minerals are important for glucose metabolism and contribute to antidiabetic activity, studies also indicate that diabetes may disrupt the homeostasis of trace elements (4,5,7). Initial disturbances in certain elements may have a significant impact on insulin metabolism. Macro elements primarily include chloride (Cl), calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), potassium (K) and Fe, while some trace elements such as chromium (Cr), copper (Cu), sulfur (S), iodine (I) and Zn activate insulin receptor sites and increase insulin action (10). The role of these trace elements is critical in the onset and advancement of T2DM, and the physiological effects of various macro- and trace el-

ements exhibit variability within the context of this disease (10,11). Metformin, along with Ca, Cu, Cr, Fe, Mg, Mn, K, Se, Zn, and vitamin D, is closely associated with the physiology of pancreatic β -cells. These elements significantly contribute to hormone synthesis, secretion, and signaling, particularly insulin, thereby contributing to the adjunctive enhancement of glycemic control (12-17).

Additionally, chronic use of metformin has been linked to vitamin B12 deficiency in certain individuals (18). This may be due to alterations in the gut microbiota or changes in the absorption of vitamin B12 in the intestines (5). Similarly, reduced serum vitamin B12 concentrations have been reported in patients treated with DPP-4 inhibitors (19). Depending on the population studied, between 5% and 40% of metformin users may experience B12 vitamin deficiency. Findings from the National Health and Nutrition Examination Survey (NHANES) indicates that 5.8% of diabetic patients taking metformin display signs of vitamin B12 insufficiency, compared to only 2.4% in those who are not on the medication (19). Although the literature reveals an association between vitamin B12 levels and administration of metformin and DPP-4 inhibitors, the exact mechanisms by which these medications affect vitamin B12 levels remain unclear, emphasizing the importance of regularly assessing vitamin B12 status in patients with T2DM.

Therefore, the present research aims to evaluate serum Na^+ , K^+ , Ca^{2+} , Cl^- , Mg^{2+} concentrations along with vitamin B12 status in individuals diagnosed with T2DM who are receiving antidiabetic treatments (metformin, DPP-4 inhibitors, or their combination) as well as in a control group.

MATERIALS and METHODS

Study Design and Population

We identified four research groups of 91 patients with T2DM and 33 healthy control who started metformin and DPP-4 inhibitors, and combination of metformin+DPP-4 inhibitors, including available data between 2022 and 2024 (Republic of Turkey Ministry of Health, Sinan Sipahi Family Health Center). In the current retrospective research, we observed the medical records of T2DM patients who attended a family health center for routine follow-up. Inclusion criteria included patients aged between 40 and 75 years who were on a stable regimen of metformin or DPP-4 inhibitor or metformin+ DPP-4 inhibitor combination for at least six months (metformin, 1000 mg; vildagliptin, 50 mg; linagliptin, 5 mg; metformin+vildagliptin, 50 mg/1000 mg). The control group, consisting of healthy people, was selected as people of similar age and gender to the patient groups without any chronic disease, especially diabetes mel-

Table 1: Characteristics of the patients and control subjects.

Characteristics	Control (n=33)	T2DM (n=91)	Total (n)	p value
Gender, n (%)				0,146
Male	15 (45.45)	46 (49.45)	61 (49.19)	
Female	18 (54.55)	45 (50.55)	63 (50.81)	
Age, mean $\pm$ SD, years	55.24 $\pm$ 1.98	58.01 $\pm$ 1.91		0.246
Fasting serum glucose (mg/dL $\pm$ SD)	88.81 $\pm$ 9.20			<0.001
Metformin		121.57 $\pm$ 5.69		
DPP-4 inhibitor		165.26 $\pm$ 12.11		
Metformin+DPP-4 inhibitor		165.82 $\pm$ 10.84		
HbA1c (% $\pm$ SD)	5.93 $\pm$ 0.18			<0.001
Metformin		6.17 $\pm$ 0.11		
DPP-4 inhibitor		7.51 $\pm$ 0.25		
Metformin+DPP-4 inhibitor		7.65 $\pm$ 0.29		

SD: Standard deviation. **Gender:** Chi-square test. Age, fasting serum glucose, and HbA1c; one way ANOVA test.

Participant demographic and clinical profiles in the study, including control and treatment groups, are summarized in the table. Data are presented as mean $\pm$ standard deviation (SD) for continuous variables and percentages for categorical variables. Age and gender distribution are detailed for each group.

Table 2: The study design and sample distribution.

Parameters *	Control (n=33)	T2DM (n=91)	Metformin (n=48)	DPP-4 inhibitor (n=22)	Metformin + DPP-4 inhibitor (n=21)
Na ⁺	32 (97.0)	-	45 (93.8)	18 (81.8)	19 (86.4)
Ca ⁺²	31 (93.9)	-	42 (87.5)	18 (81.8)	17 (77.3)
K ⁺	31 (93.9)	-	44 (91.7)	17 (77.3)	19 (86.4)
Mg ⁺²	29 (87.9)	-	36 (75.0)	16 (72.7)	16 (72.7)
Cl ⁻	26 (78.8)	-	23 (47.9)	10 (45.5)	12 (54.5)
B12	29 (87.9)	-	23 (47.9)	12 (54.5)	10 (45.5)

*Data shown as number and percent (n(%)). T2DM: Type 2 diabetes mellitus

The sample size (n, %) and the number of measurements available for each biochemical parameter across study groups have been outlined. The groups include healthy participants, patients with T2DM, and subgroups of T2DM patients using metformin, DPP-4 inhibitor, or metformin+DPP-4 inhibitor combination therapy.

litus (Table 1). Blood samples were collected during routine clinical visits, and information such as patients' age, gender, and clinical background was retrieved from their electronic medical records.

Electrolyte, Mineral and Vitamin B12 Analysis

Electrolyte and mineral levels (including sodium, potassium, calcium, magnesium, and chloride), along with vitamin B12 concentrations, measured through standard laboratory methods in blood samples from T2DM patients receiving metformin and DPP-4 inhibitors, as well as healthy controls, were retrospectively obtained from medical records. The results were analyzed by comparing the control group with the treatment groups and the treatment groups with each other. Additionally, fasting blood glucose and glycatated hemoglobin (HbA1c) levels were documented for each

participant to provide a comprehensive metabolic profile (Table 2).

Statistical Analysis

Sample size and effect size calculations were completed via G*Power 3.1 software, employing a one-way ANOVA framework with four research groups. With an alpha of 0.05, a power of 0.95, and an effect size of 0.45, the required sample size was calculated as 100. However, 91 participants with T2DM were included in the study. According to Cohen's conventional criteria, large effect sizes were observed for sodium ($f = 0.78$) and chloride ($f = 0.50$), suggesting substantial group differences in these electrolytes. In contrast, potassium ($f = 0.12$), magnesium ($f = 0.05$), vitamin B12 ($f = 0.07$), and calcium ($f = 0.04$) exhibited small effect sizes, indicating more modest variations among the groups.

All statistical analyses were conducted using GraphPad Prism software version 10.5.0. The Shapiro–Wilk test was applied to assess the normality of the data, confirming that all variables followed a normal distribution. Comparisons of serum levels of Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Cl^- , and vitamin B12 across four groups (metformin, DPP-4 inhibitors, combination therapy, and healthy controls) were performed using one-way ANOVA, followed by pairwise comparisons through Tukey's post-hoc test. The outcomes are expressed as mean $\pm$ standard error of the mean (SEM) or standard deviation (SD). A p -value below 0.05 was considered indicative of statistical significance.

RESULTS

Glycemic Parameters

In the control group, fasting serum glucose was 88.81 ± 9.20 mg/dL, and HbA1c was $5.93 \pm 0.18\%$, representing the mean $\pm$ SD values. In the metformin group, fasting serum glucose was 121.57 ± 5.69 mg/dL and HbA1c was $6.17 \pm 0.11\%$. In the DPP-4 inhibitor group, glucose was 165.26 ± 12.11 mg/dL and HbA1c was $7.51 \pm 0.25\%$. In the metformin + DPP-4 inhibitor group, glucose was 165.82 ± 10.84 mg/dL and HbA1c was $7.65 \pm 0.29\%$, representing the mean $\pm$ SD values. (HbA1c, $p < 0.001$; fasting serum glucose, $p < 0.001$). All data are shown in Table 1.

Serum Mineral-Trace Element

Comparisons between groups were made among patients using different antidiabetic drugs, including metformin, DPP-4 inhibitors, and the metformin+DPP-4 inhibitor. Additionally, these diabetic patient groups were compared with the control group. Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Cl^- , and vitamin B12 values between groups are shown in Figure 1.

The Na^+ levels were 140.29 ± 2.42 in the control group, 140.44 ± 2.30 in the metformin group, 139.29 ± 2.71 in the DPP-4 inhibitor group, and 138.47 ± 3.42 in the metformin + DPP-4 inhibitor group, representing the mean $\pm$ SD values. Analysis of serum Na^+ levels showed a significant distinction between the metformin group and the metformin + DPP-4 inhibitor group. Specifically, the metformin group showed higher serum Na^+ concentrations compared to the combination treatment group ($*p = 0.034$, Figure 1A). Serum Na^+ concentrations showed no meaningful differences among the control and other groups ($p > 0.05$).

The K^+ levels were 4.38 ± 0.21 in the control group, 4.66 ± 0.44 in the metformin group, 4.71 ± 0.43 in the DPP-4 inhibitor group, and 4.64 ± 0.26 in the metformin + DPP-4 inhibitor group, representing the mean $\pm$ SD values. K^+ concentrations were considerably elevated in all treatment groups (metformin, DPP-4 inhibitor, and metformin+D-

PP-4 inhibitor groups compared to the control group. However, only the metformin group and the DPP-4 inhibitor group showed significant differences relative to the control group (respectively, $*p = 0.010$, $**p = 0.006$ Figure 1B).

The Ca^{2+} levels were 9.50 ± 0.36 in the control group, 9.40 ± 0.91 in the metformin group, 9.49 ± 0.46 in the DPP-4 inhibitor group, and 9.46 ± 0.38 in the metformin + DPP-4 inhibitor group, representing the mean $\pm$ SD values. No significant differences were observed in serum Ca^{2+} levels between the groups ($p > 0.05$, Figures 1C). The Mg^{2+} levels were 2.03 ± 0.16 in the control group, 1.97 ± 0.21 in the metformin group, 1.87 ± 0.36 in the DPP-4 inhibitor group, and 1.90 ± 0.23 in the metformin + DPP-4 inhibitor group, representing the mean $\pm$ SD values. No significant differences were observed in serum Mg^{2+} levels between the groups ($p > 0.05$, Figures 1D). The Cl^- levels were 103.24 ± 1.89 in the control group, 103.46 ± 2.46 in the metformin group, 103.90 ± 2.64 in the DPP-4 inhibitor group, and 101.67 ± 3.87 in the metformin + DPP-4 inhibitor group, representing the mean $\pm$ SD values. No significant differences were observed in serum Mg^{2+} levels between the groups ($p > 0.05$, Figures 1E).

Serum Vitamin B12 Levels

The comparison of serum vitamin B12 levels between groups is presented in Figure 1. Vitamin B12 levels were significantly lower in the metformin and metformin+DPP-4 inhibitor groups compared to the control group. Vitamin B12 levels were 2.54 ± 0.20 in the control group, 2.44 ± 0.15 in the metformin group, 2.52 ± 0.14 in the DPP-4 inhibitor group, and 2.32 ± 0.20 in the metformin + DPP-4 inhibitor group, representing the mean $\pm$ standard deviation values. A statistically significant decrease was observed in the metformin+DPP-4 inhibitor group compared to the control group ($**p = 0.006$, Figure 1F). However, no statistically significant difference was found between the metformin or DPP-4 inhibitor groups compared to control, and between the metformin+DPP-4 inhibitor groups compared to metformin ($p > 0.05$).

DISCUSSION

The incidence of diabetes mellitus is rising worldwide, and a variety of drug classes are employed in the management of diabetes and its comorbidities (20). Although oral antidiabetic drugs have a safe profile, they have some metabolic and renal effects (21). Consequently, the findings of this research reveal the effects of metformin and DPP-4 inhibitors and their combinations on mineral, electrolyte, and vitamin B12 levels in individuals with T2DM.

T2DM itself is associated with hyponatremia and hypomagnesemia, regardless of antidiabetic drug use (22–24). Evi-

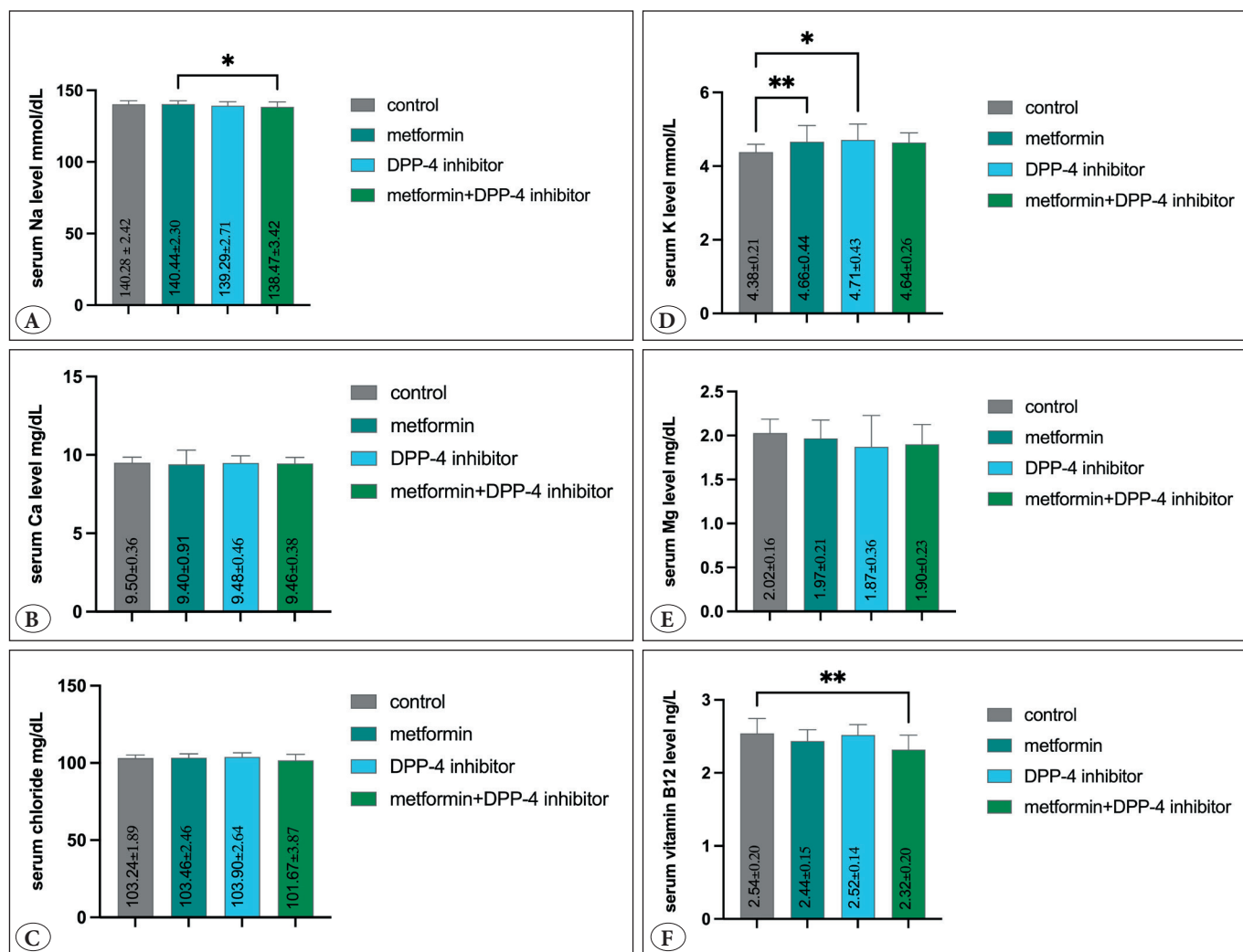


Figure 1: Serum Mineral-trace Element and Vitamin B12 Levels in Control and Treatment Groups. Comparison of serum biochemical parameters among control subjects, metformin users, linagliptin users, and vildagliptin/metformin users.

A) Serum sodium (Na) levels, showing statistically significant differences between (metformin vs metformin+DPP-4 inhibitor) groups, (* $p=0.034$). **B)** Serum calcium (Ca) levels, with no significant differences observed ($p>0.05$). **C)** Serum potassium (K) levels, indicating significant differences between (control vs metformin, control vs DPP-4 inhibitor), (* $p=0.010$, ** $p=0.006$). **D)** Serum magnesium (Mg) levels, with no significant differences observed ($p>0.05$). **E)** Serum chloride (Cl) levels, with no significant differences detected ($p>0.05$). **F)** Serum vitamin B12 levels, highlighting significant differences between (control vs metformin + DPP-4 inhibitor) groups, (** $p=0.006$). Values are shown as mean $\pm$ SEM, with asterisks indicating statistically significant differences (* $p < 0.05$, ** $p < 0.01$).

dence suggests that hypomagnesemia is present in approximately 20% of those with diabetes (24, 25). A case study describing metformin medication leading to clinically significant severe magnesium deficiency (0.33 mmol/L), which resolved after discontinuation of the drug, suggests that gastrointestinal Mg^{+2} loss associated with metformin may lead to the occurrence of hypomagnesemia (26). A study of 940 non-insulin-treated patients in the Fremantle Diabetes Study Phase I found that 19% had hypomagnesemia (<0.70 mmol/L). Individuals on metformin therapy, either alone or combined with a sulfonylurea, had reduced serum Mg^{+2} levels compared to those following a diet-only regimen ($p<0.05$)

(24). A study involving 395 patients with T2DM found that those using metformin had lower plasma Mg^{+2} levels. Among all medications, metformin use showed the strongest correlation with plasma Mg^{+2} concentration, independent of estimated glomerular filtration rate or fasting glucose levels (27). On the other hand, another study involving 208 patients with T2DM found no impact of metformin treatment on serum magnesium levels (28). DPP-4 inhibitors, in addition to metformin, have been associated with reductions in serum M^{+2} . However, the mechanism of action of this condition is not fully known (29). Our findings suggest that metformin alone had no impact on serum Mg^{2+} concentrations.

The osmotic effect of excess glucose in the extracellular space causes water to shift from the intracellular to the extracellular compartment, resulting in a dilution of plasma Na^+ levels (30). This type of hyponatremia is hypertonic and reflects a disturbance in glucose regulation rather than an imbalance of water and Na^+ . However, hypotonic hyponatremia, which indicates a primary disruption of water balance, has been associated with metformin (31). A recent study has shown that metformin increases urinary sodium excretion by decreasing phosphorylation of the thiazide-sensitive Na^+ - Cl^- co-transporter during acute and chronic metformin use (32). Serum Na^+ levels were significantly reduced in the metformin+DPP-4 inhibitor group compared to the metformin-only group ($*p=0.034$, Figure 1A).

In patients with T2DM, the possibility of hyperkalemia is increased by many mechanisms, such as impaired K^+ excretion, impaired renal tubular function, and decreased ability of K^+ to pass into the cell (33). In a study by Fu et al., the use of SGLT-2 inhibitors was correlated with a lower rate of hyperkalemia compared with the use of DPP-4 inhibitors and a slightly reduced risk compared with GLP-1 receptor agonists (34). In this study, an increase in potassium levels across all the treatment groups suggests a possible drug-related shift in potassium homeostasis, which could be relevant for managing T2DM and avoiding complications related to hyperkalemia. Serum K^+ was considerably higher in patients receiving metformin and DPP-4 inhibitors compared to the control group (respectively, $*p=0.01$, $**p=0.006$, Figure 1B). The lack of significant changes in calcium and chloride levels may indicate that these electrolytes are less affected by the treatment regimens used in this study.

Although the exact mechanisms of metformin-induced vitamin B12 deficiency remain unclear, several possible explanations have been suggested. One theory suggests that metformin may impact small intestinal motility, leading to bacterial overgrowth, which in turn interferes with the absorption of the vitamin B12-intrinsic factor complex (18).

A recent study highlighted an important issue regarding the effects of certain diabetes medications on vitamin B12 levels. The research found that a daily dose of sulfonylureas in individuals with T2DM led to a considerable drop in mean blood vitamin B12 levels and an increase in the prevalence of vitamin B12 deficiency. Individuals with vitamin B12 deficiency were found to be older, consumed more sulfonylureas (often in combination with metformin), and had lower HbA1c levels compared to those without vitamin B12 deficiency. A separate study showed that the co-administration of metformin and DPP-4 inhibitors resulted in a severe

reduction in vitamin B12 levels. However, the exact mechanism behind these findings remains unclear, and additional prospective researches are needed to better understand this observation (35). Our results show that serum vitamin B12 levels were significantly reduced in patients using metformin+DPP-4 inhibitors compared to the control group ($**p=0.006$, Figure 1F). As a result, the observed decrease in vitamin B12 levels in the metformin and metformin+DPP-4 inhibitor groups is consistent with previous research highlighting the potential for vitamin B12 depletion in patients treated with metformin over an extended period.

Impaired renal elimination due to diabetic nephropathy may predispose patients to hyperkalemia, as the kidney loses their ability to excrete potassium efficiently (19). Moreover, in patients with poorly controlled diabetes or those on antidiabetic medications, imbalances in sodium, potassium, magnesium, and phosphate are frequently observed, possibly due to mechanisms such as osmotic diuresis, secondary hyperaldosteronism, and insulin resistance (22). Prospective studies incorporating detailed diabetic nephropathy staging, dietary assessment, polypharmacy evaluation, and functional biomarkers (e.g., methylmalonic acid for B12 status) will be crucial for more accurately elucidating the observed biochemical changes and guiding clinical decision-making.

This study adds to the existing body of knowledge by investigating the effects of metformin and DPP-4 inhibitors on electrolyte and mineral balance in patients with T2DM. In particular, the significant effects of concomitant use of metformin and DPP-4 inhibitors on serum sodium and potassium levels have enabled further understanding of the effects of these drugs on electrolyte balance. Furthermore, despite conflicting results in the literature, the effect of metformin monotherapy on serum magnesium levels has not been shown to produce significant changes. In terms of vitamin B12 deficiency, the demonstration that concomitant use of metformin and DPP-4 inhibitors leads to a significant decrease in serum B12 levels supports the need for monitoring of vitamin B12 levels in patients receiving long-term treatment. This finding suggests that the risk of vitamin B12 deficiency may increase, particularly with combination therapy.

In conclusion, our study contributes to the literature on electrolyte balance and vitamin B12 deficiency. It provides insight into the metabolic effects that should be considered during long-term use of these medications. Additional large, prospective investigations are essential to corroborate these findings and deepen comprehension of their mechanisms.

Study Limitations

The major limitation identified in this study is that only patients registered in the Republic of Turkey Ministry of Health Sinan Sipahi Family Health Center were included. The retrospective design of the study resulted in certain limitations regarding the data. Additionally, the relatively small sample size affects the generalizability of the findings and may limit the ability to accurately represent the distribution of interactions between drugs, electrolytes, and vitamins in larger populations.

Conclusion

Metformin and DPP-4 inhibitors influence electrolyte and mineral balance in T2DM patients, with specific reductions in sodium and magnesium levels, as well as a significant decrease in vitamin B12. These findings highlight the importance of regular monitoring of these levels during treatment.

These findings highlight the potential impact of metformin and DPP-4 inhibitors on mineral and electrolyte homeostasis, emphasizing the need for careful monitoring of electrolyte levels and vitamin B12 status in patients undergoing these treatments. Further research is required to investigate the long-term effects of these medications on mineral balance and to assess the clinical significance of these changes, particularly in the context of combined therapy.

This study highlights the need for vigilant monitoring of electrolyte and mineral balance in patients with T2DM, particularly those treated with metformin and DPP-4 inhibitors. While both therapies effectively control blood glucose levels, they can lead to significant shifts in electrolyte levels, including reduced sodium and magnesium and increased potassium. Moreover, long-term metformin therapy may contribute to vitamin B12 deficiency, which necessitates regular assessment and supplementation when appropriate. These findings underscore the importance of individualized treatment plans and routine monitoring to ensure optimal metabolic health in T2DM patients.

Comprehensive studies with larger and prospective cohorts will be instrumental in clarifying the mechanisms and clinical effects of these electrolyte imbalances. This will help refine treatment protocols and improve patient outcomes in the management of T2DM.

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Author Contributions

The study was designed by **Zeynep Gizem Todurga Seven**. Support in providing patient data was given by REA. **Zeynep Gizem Todurga Seven**, **Kubra Cigdem Pekkoc Uyanik**, and **Fatma Kubra Tombulturk** analyzed and interpreted the data. The orig-

inal draft was written and the manuscript was edited by **Zeynep Gizem Todurga Seven** and **Kubra Cigdem Pekkoc Uyanik**. All contributing authors approved the final manuscript.

Conflict of Interest

The authors state that there are no potential conflicts of interest.

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Ethical Approval

This research adhered to the ethical guidelines outlined in the Declaration of Helsinki concerning medical studies involving human subjects. The study protocol was approved by the Ethics Committee of Haliç University (Approval Number: 2024/130). Written informed consent was obtained from all patients and healthy individuals. Written permission was secured from every patient and healthy volunteer before the study.

Peer Review Process

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The Effect of Novel Antihyperglycemic Treatments on Sarcopenia in Type 2 Diabetic Patients

Busra CAN¹ , Zehra KAYA² , Bulent CAN³ 

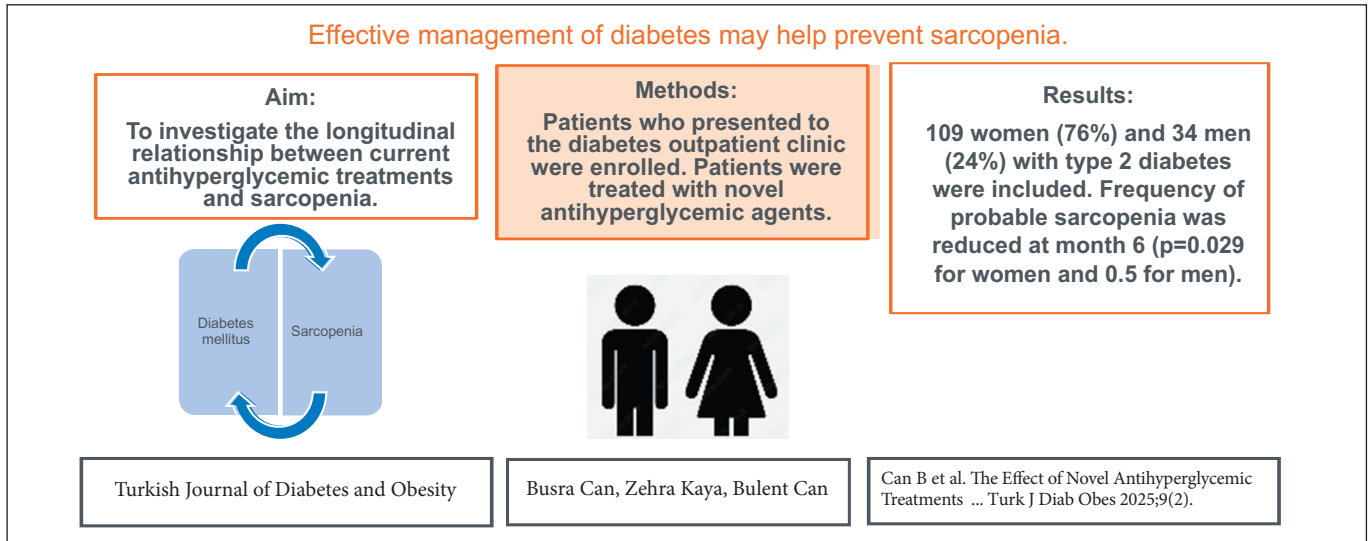
¹Marmara University, Faculty of Medicine, Department of Internal Medicine, Division of Geriatrics, Istanbul, Türkiye

²Istanbul Medeniyet University, Faculty of Medicine, Department of Family Medicine, Istanbul, Türkiye

³Istanbul Medeniyet University, Faculty of Medicine, Department of Internal Medicine, Division of Endocrinology and Metabolism, Istanbul, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Aim: Previous studies indicate a possible association between weight losing interventions and reduced muscle function. There is scarce research on how novel glucose-lowering agents effect sarcopenia parameters. The present study aims to investigate the longitudinal relationship between current antihyperglycemic treatments and sarcopenia.

Material and Methods: Type 2 diabetic patients aged 18 and above were enrolled in this longitudinal observational study. Patient characteristics, list of medications, hours of physical activity per week, laboratory values, anthropometric measurements, handgrip strength and body composition analyzed with bioelectrical impedance analysis were recorded at the initial presentation and at 6 months.

Results: A total of 109 women (76%) and 34 men (24%) with type 2 diabetes mellitus (DM) were included. The mean age of study participants was 53.4±10.4 years, and the mean duration of DM was 10.2±8 years. At 6 months, weight, total fat mass, visceral fat mass, waist circumference, HbA1c, fasting glucose, serum insulin, LDL (low density lipoprotein) and vitamin B12 levels were significantly lower while muscle strength was significantly higher (p=0.012). There was a significant inverse association between age and muscle strength both initially and at 6 months (p=0.001 and 0.001 for women; p=0.005 and 0.001 for men, respectively). Duration of DM was inversely associated with muscle strength only for women (p=0.02 at initial presentation and p=0.001 at month 6). Frequency of probable sarcopenia was reduced at month 6 for both genders (p=0.029 for women and 0.5 for men).

ORCID: Busra Can / 0000-0002-7170-8044, Zehra Kaya / 0009-0003-9761-9060, Bulent Can / 0000-0001-6382-1306

Correspondence Address / Yazışma Adresi:

Busra CAN

Department of Internal Medicine, Division of Geriatrics, Faculty of Medicine, Marmara University, Istanbul, Türkiye
Phone: +90 (216) 625 45 45/9128 • E-mail: alpabusra@hotmail.com

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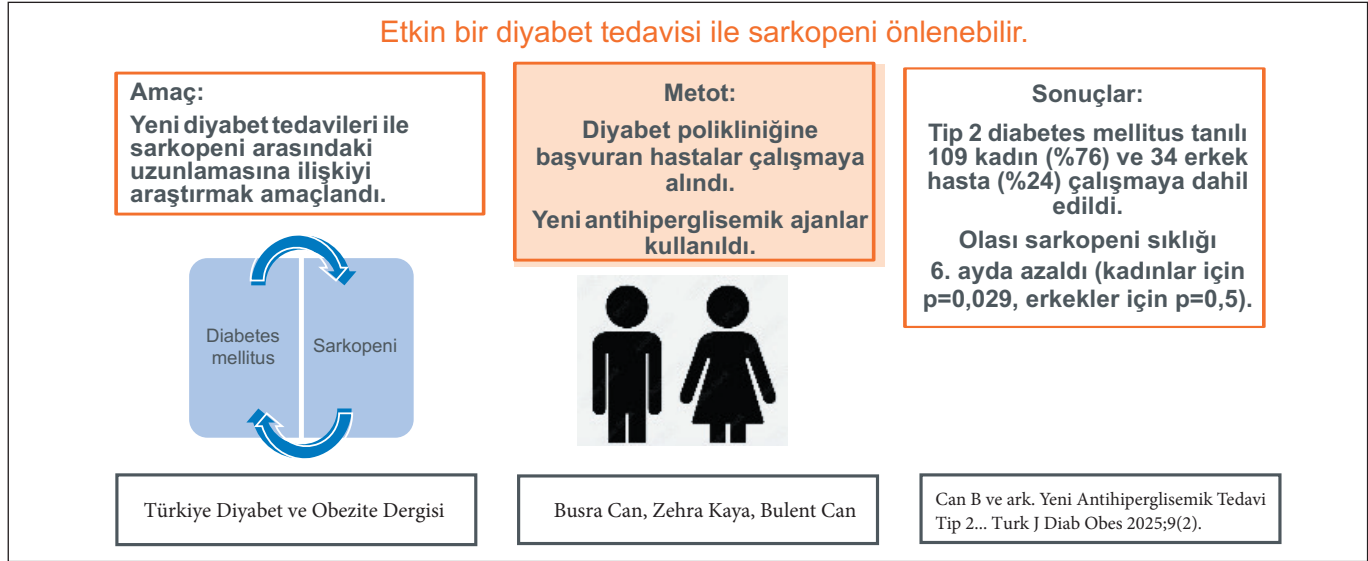
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Conclusion: Glycemic control has a favorable effect on muscle function despite weight loss. Effective management of DM with novel antihyperglycemic agents may help prevent sarcopenia.

Keywords: Antidiabetics, Diabetes mellitus, GLP-1 Receptor agonists, Muscle strength, Sarcopenia, SGLT-2 inhibitors

Yeni Antihiperglisemik Tedavilerin Tip 2 Diyabetik Hastalarda Sarkopeni Üzerine Etkisi

GRAFİKSEL ÖZET



ÖZ

Amaç: Sarkopeni parametrelerinin glisemik kontrol ile ilişkisini inceleyen çok az sayıda araştırma bulunmaktadır. Bu çalışma, yeni diyabet tedavileri ile sarkopeni arasındaki uzunlamasına ilişkiyi araştırmayı amaçlamaktadır.

Gereç ve Yöntemler: Tip 2 diyabetik 18 yaş ve üzeri hastalar bu çalışmaya dahil edildi. Hastaların demografik özellikleri, kullandıkları ilaçlar, haftalık fiziksel aktivite saati, laboratuvar değerleri, antropometrik ölçümleri, el kavrama kuvveti ve biyoelektrik empedans analizi ile analiz edilen vücut kompozisyonu başvuruda ve altıncı ayda kaydedildi.

Bulgular: Tip 2 diabetes mellitus tanılı toplam 109 kadın (%76) ve 34 erkek (%24) dahil edildi. Çalışmaya katılanların ortalama yaşı $53,4 \pm 10,4$ yıl ve ortalama diyabet süresi $10,2 \pm 8$ yıldır. 6. ayda, kilo, toplam yağ kütlesi, visceral yağ kütlesi, bel çevresi, HbA1c, açlık glikozu, serum insülin, LDL (düşük yoğunluklu lipoprotein) ve B12 vitamini düzeyleri azalırken kas gücü anlamlı düzeyde arttı ($p=0,012$). Yaş ve kas gücü arasında hem başlangıçta hem de 6. ayda önemli bir ters ilişki vardı (kadınlar için $p=0,001$ ve $0,001$; erkekler için sırasıyla $p=0,005$ ve $0,001$). Diyabet süresi yalnızca kadınlarda kas gücüyle ters ilişkiliydi (ilk başvuruda $p=0,02$ ve 6. ayda $p=0,001$). Olası sarkopeni sıklığı her iki cinsiyet için de 6. ayda azaldı (kadınlar için $p=0,029$ ve erkekler için $0,5$).

Sonuç: Glisemik kontrolün kas fonksiyonu üzerinde olumlu bir etkisi vardır. Kilo verdirici özelliği olan yeni antidiyabetik tedaviler sarkopeniyi önlemektedir.

Anahtar Sözcükler: Antidiyabetikler, Diabetes mellitus, GLP-1 Reseptör agonistleri, Kas kuvveti, Sarkopeni, SGLT-2 inhibitörleri

INTRODUCTION

The European Working Group on Sarcopenia in Older People (EWGSOP) defines sarcopenia as a syndrome characterized by progressive and generalized loss of skeletal muscle mass and strength (1). Sarcopenia has numerous negative outcomes including impaired functionality, increased risk for falls, fractures, and mortality (1). Sarcopenia may be primary (age related) or secondary, a result of comorbid conditions. Insulin resistance and diabetes mellitus (DM) is an important cause of secondary sarcopenia. Loss of muscle quality due to increased intramuscular fat, dysfunction in the neuromuscular junction and reduced innervation are pathogenetic mechanisms linking DM to sarcopenia (2).

Diabetes mellitus represents a major public health problem worldwide, with an ever-increasing prevalence and incidence (3). Due to the global surge of DM, the burden of secondary sarcopenia is expected to continue rising. Although associated with an increased risk of adverse outcomes and mortality, there are no pharmacological agents approved for the treatment of sarcopenia; current evidence only recommends nutritional support and resistance training (4). It is against this background that glucose-lowering therapies are being investigated for added clinical benefit of improved muscle function (5).

Previous studies on the association between DM and sarcopenia are mostly observational (6-8). A very recent randomized placebo-controlled trial enrolled 72 participants to investigate the efficacy of metformin on physical performance (MET-PREVENT) and showed that metformin was ineffective (9). However, physical performance is the last parameter to change in the sarcopenia algorithm and the study was confined to older adults with prefrailty or frailty. There is scarce research on whether the primary parameters of sarcopenia improve with novel glucose-lowering interventions. The present study aims to investigate the longitudinal relationship between DM treatment and sarcopenia using the revised EWGSOP consensus.

MATERIAL and METHODS

Patients aged 18 and above who presented to the diabetes outpatient clinic of a university hospital between 01.07.2021 and 01.09.2021 were enrolled for this observational longitudinal study. The study was conducted at an obesity center that adheres to international standards and has been accredited by the European Association for the Study of Obesity (EASO). The ethical review board of the university hospital approved the study protocol (approval number: 2021/0314). The study was conducted in accordance with the Declaration of Helsinki.

All patients provided written informed consent to participate. Patients who refused to participate; patients with hepatic/renal impairment, neuromuscular disease, thyroid disease and patients with pacemaker implantation were excluded. DM was defined as a fasting plasma glucose ≥ 126 mg/dl, or a post prandial or random plasma glucose ≥ 200 mg/dl with symptoms of DM, or HbA1c level $\geq 6.5\%$. Urine albumin excretion between 30 and 300 mg/day was defined as moderately increased albuminuria (microalbuminuria).

Height was measured without shoes using a standard stadiometer (m), and weight (kg) was measured using an electronic scale to the nearest 0.1 kg with the patient wearing light clothes. Body mass index (BMI) was calculated as weight (kg)/height squared (m^2). Calf circumference (CC) was measured at the widest part of the calf using a non-stretching tape with the participant in a standing position. CC was evaluated using the national cut-off value (33 cm) (10). Waist circumference was measured using a flexible non-stretching tape at the minimal waist.

Handgrip strength was measured with Jamar® 5030J1 Hydraulic Hand Dynamometer (China). Three measurements were taken in which the individual was seated with the shoulder in adduction, the elbow at 90° flexion and the forearm in the neutral position, and was asked to hold the dynamometer with the dominant hand and squeeze as firmly as possible. Cut-off values defined by the revised EWGSOP consensus were used for handgrip measurements (<16 kg in females, <27 kg in males).

Muscle mass was measured using a bioelectrical impedance analysis (BIA). The BIA used for this study was Tanita® BC-601 Segmental Body Composition Analyzer. The skeletal muscle index (SMMI) was calculated as skeletal muscle mass (kg)/height squared (m^2). Based on the national cut-off values, an SMMI of <7.4 kg/ m^2 for females and <9.2 kg/ m^2 for males was considered significant for sarcopenia (10). A 4-meter walking test was performed for the physical performance evaluation. In the 4-meter walking test, a walking speed of ≤ 0.8 m/s was considered poor physical performance.

Low muscle strength indicated probable sarcopenia, while low muscle strength accompanied by low muscle mass indicated confirmed sarcopenia. Severe sarcopenia was defined as the combination of low muscle strength, low muscle mass and reduced physical performance.

Patient characteristics, list of medications, hours of physical activity per week, laboratory values, anthropometric measurements, handgrip strength and body composition analyzed with BIA were recorded at initial presentation. The

blood samples were collected after a 12-hour fast, also at baseline. All measurements were repeated after 6 months, as weight losing treatments are most effective during the first 6 months after initiation.

Statistical Analysis

Normality of the variables was investigated using visual (histograms and probability plots) and Kolmogorov-Smirnov tests. Numerical variables were given as mean $\pm$ standard deviation (SD) for normally distributed variables and as median (minimum-maximum) for continuous variables. Paired sample t test was used to compare normally distributed variables while Wilcoxon test was used for non-normally distributed variables.

Chi-square test was run to compare categorical variables. McNemar test was used to compare categorical variables before and after follow-up. Inter-variable associations were evaluated using Spearman Rho Correlation Analysis. Groups were compared with independent sample T-test or Mann Whitney U test as appropriate. A *p*-value of less than 0.05 was considered significant. SPSS (SPSS Inc, Chicago, Ill, USA) for Windows 21.0 program was used for the analysis.

RESULTS

Enrolled in the study were 109 women (76%) and 34 men (24%) with type 2 DM. The mean age of study participants was 53.4 ± 10.4 years, and the mean duration of DM was 10.2 ± 8 years. Almost all patients were on metformin. A total of 90 patients (63%) were on Sodium Glucose Cotransporter-2 (SGLT-2) inhibitors and treatment was initiated to another 17 during follow up. Sixty-five patients (46%) were on Glucagon-Like Peptide-1 (GLP-1) receptor agonist therapy. GLP-1 receptor agonists were discontinued in 4 and initiated for 18 patients during follow up. Demographic characteristics are presented in Table 1.

Table 2 shows the change in baseline clinical and laboratory parameters. At 6 months, weight, BMI, total fat mass, visceral fat mass, waist circumference, HbA1c, fasting glucose, serum insulin, LDL (low density lipoprotein) and vitamin B12 levels were significantly lower while muscle strength was significantly higher ($p=0.012$) compared to the baseline measurements. Level of physical activity and gait speed did not show a significant change ($p=0.24$ and 0.99 , respectively). Initially there were 30 patients with moderately increased albuminuria. At 6 months, this number decreased to 23 ($p=0.09$). Intergroup analysis between women and men showed similar results. As shown in Table 2, There was a significant inverse association between age and muscle strength both initially and at 6 months ($p=0.001$ and 0.001 for women; $p=0.005$ and 0.001 for men, respectively). Du-

ration of DM was inversely associated with muscle strength only for women ($p=0.02$ at initial presentation and $p=0.001$ at month 6). The frequency of probable sarcopenia was reduced at month 6 for both genders ($p=0.029$ for females and $p=0.50$ for males).

DISCUSSION

The present study showed that in patients with DM, glucose-lowering intervention for 6 months resulted in reduced weight, fat mass, waist circumference and HbA1c but increased muscle strength for both genders.

Table 1: Characteristics of study participants

Characteristics *	Findings (n=143)	
Gender	Female	109 (76.2)
	Male	34 (23.7)
Smoking	Smoker	21 (14.6)
	Non-smoker	122 (85.3)
Metformin	Using	134 (93.7)
	Discontinued	2 (1.3)
	Initiated	7 (4.8)
SGLT-2 inhibitor	Using	90 (62.9)
	Not using	36 (25.1)
	Initiated	17 (11.8)
GLP-1 agonist	Using	65 (45.4)
	Not using	56 (39.1)
	Discontinued	4 (2.8)
	Initiated	18 (12.6)
DPP-4 inhibitor	Using	29 (20.3)
	Not using	107 (74.8)
	Discontinued	7 (4.8)
Sulfonylurea	Using	3 (2.1)
	Not using	138 (96.5)
	Discontinued	2 (1.4)
Insulin injection	Using	35 (24.5)
	Not using	105 (73.4)
	Discontinued	1 (0.7)
	Initiated	2 (1.4)
Pioglitazone	Using	3 (2.1)
	Not using	138 (96.5)
	Discontinued	1 (0.7)
	Initiated	1 (0.7)
Acarbose	Using	1 (0.7)
	Not using	142 (99.3)

*Data are presented as number and percentages, n(%).

DPP-4: Dipeptidyl peptidase-4, **GLP-1:** Glucagon-like peptide-1, **SGLT-2:** Sodium Glucose Cotransporter-2.

The inverse association between age and muscle strength comes as no surprise, as aging is the primary cause of sarcopenia. However, secondary reasons for sarcopenia may also be evident, as is the case in diabetic individuals. Oxidative stress is considered to have a role in the pathogenesis of both DM and sarcopenia. Insulin resistance, increased advanced glycation end-products, mitochondrial dysfunction and altered lipid metabolism associated with DM may cause increased oxidative stress, which hampers muscle repair (11-14). Hyperglycemia has been shown to have negative effects on the muscle through the Insulin-like Growth Factor-1-Akt-Forkhead box O pathway (15). Microvascular and macrovascular complications of DM limiting the capillarization of the muscle, along with diabetic neuropathy, may also be related to poor muscle health observed in diabetic individuals (12). In addition to hyperglycemia

management, some glucose-lowering treatments also have a direct impact on muscle metabolism. Insulin has anabolic effects on the muscle by stimulating muscle protein synthesis and reducing protein degradation (16). Metformin inhibits the mechanistic target of rapamycin (mTOR), leading to muscle growth (17). Research has even suggested that metformin, GLP-1 receptor agonists, dipeptidyl peptidase 4 (DPP-4) inhibitors and SGLT-2 inhibitors may have a potential role in the treatment of sarcopenia (5, 18, 19).

Although DM and sarcopenia share common pathological pathways, there are contradictory findings in the literature regarding the association between glycemic control and sarcopenia. In line with our study, an inverse association has been observed between higher HbA1c quartiles and lower knee extensor strength (20). In a meta-analysis by Anagnostis et al., diabetic patients were found to have a higher

Table 2: Change in baseline clinical and laboratory parameters

Clinical and laboratory parameters*	Baseline	6-month Follow-up	p
BMI (kg/m ²)	36.6±6.9 (20.2-64.4)	36.4±6.5 (24.2-65.2)	0.001**
Weight (kg)	95.9±18.3 (63.1-165.1)	94.7±17.1 (62.4-158.5)	0.001**
Sarcopenia			
Muscle Mass (kg)	55.7±8.7 (40.4-92)	55.6±8.5 (36.9-90.7)	0.162**
SMM (kg)	23.7±4.8 (16.6-47.9)	23.8±4.6 (17.4-46.8)	0.551***
SMMI (kg/m ²)	9.0±1.3 (6.6-14.1)	9.1±1.3 (6.8-13.8)	0.730***
Fat Mass (kg)	37.1±12.2 (12.7-79.7)	36.1±11 (13-77.5)	0.001**
Visceral Fat Mass (kg)	16.1±5.5 (5.7-41.7)	15.2±5 (5.6-39.5)	0.001***
Muscle Strength (kg)	29.1±9.9 (12-70)	30.1±9.9 (12-72)	0.012**
Waist C. (cm)	109.4±11.8 (80-137)	106.9±11.9 (78-144)	0.001***
Calf C. (cm)	40.2±4.4 (30-53)	40.4±4.5 (31-57)	0.268**
Plasma Markers			
HbA1c (%)	7.3±1.8 (4.8-14.7)	7.0±1.3 (5.1-13.1)	0.001**
Fasting Glucose (mg/dl)	141.5±50 (74-335)	122.6±30.2 (69-254)	0.001**
Insulin (mIU/l)	14.5±12.4 (2.2-93.4)	12.4±13 (2-128)	0.001**
C-peptide (mg/l)	3±1.3 (0.4-8.9)	2.9±1.5 (0.18-9.9)	0.052**
LDL (mg/dl)	101.5±36.1 (34-213)	93.2±32.4 (14-170)	0.001**
Triglyceride (mg/dl)	166.7±87.1 (38-615)	169±91.6 (36-764)	0.385**
Creatinine (mg/dl)	0.7±0.2 (0.4-1.8)	0.7±0.2 (0.4-1.6)	0.699**
TSH (mIU/l)	3.2±12.3 (0.01-148)	2.2±2.2 (0.01-23.1)	0.118**
Free T4 (ng/dl)	1.3±0.2 (0.3-3)	1.2±0.2 (0.7-2.8)	0.593**
Albumin (g/l)	45.8±2.8 (35.9-54.2)	45.4±2.6 (39.3-53.6)	0.118***
Hemoglobin (g/dl)	13.5±1.7 (6.3-18)	13.4±1.5 (10.6-17.8)	0.121***
Vitamin B12 (ng/l)	385.5±213 (100-1996)	341.9±131.7 (100-1893)	0.001**
Ferritin (mg/l)	79.5±94.3 (10-301)	47.4±58 (7-213)	0.349***

*Data are shown as mean±SD (minimum - maximum). **Wilcoxon test ***Paired sample t test **Paired sample t test ***Wilcoxon test.

BMI: Body Mass Index, **C:** Circumference, **FT4:** free thyroxine, **HbA1c:** Hemoglobin A1c, **LDL:** Low Density Lipoprotein, **TSH:** Thyroid Stimulating Hormone, **SMM:** Skeletal Muscle Mass, **SMMI:** Skeletal Muscle Mass Index.

risk of sarcopenia compared with non-diabetic peers (7). Muscle strength and performance of diabetic patients were lower, with no significant difference in muscle mass. Contrary to these results, Volpato et al. have shown that diabetic patients have lower muscle mass compared to non-diabetic controls (8). Similarly, Sugimoto et al. have reported an association between DM and low muscle mass in non-obese individuals (21). It is worth noting that all of the aforementioned studies had a cross-sectional design.

In a multi-center observational longitudinal study (the MUSCLES-DM) investigating the effect of DM treatment on sarcopenia in 588 Japanese patients with type 2 DM (22), a $\geq 1\%$ decrease in HbA1c has been found to improve gait speed, but not hand grip strength. Contrary to our findings, the MUSCLES-DM study has failed to demonstrate a favorable effect of glycemic control on probable sarcopenia. Study participants had a mean baseline BMI of 24.7 kg/m² as opposed to 36.6 kg/m² in our study. Moreover, participants of the MUSCLES-DM study were weight neutral at the end of the follow-up period, whereas our patients experienced weight loss. It is possible that reduced fat mass underlies the relationship between DM management and improved sarcopenia demonstrated in our study.

The cumulative negative effect of DM on the muscle may be more pronounced over time. However, we failed to show a relationship between the duration of DM and muscle strength in men. The fact that men had higher baseline muscle strength to begin with may have attenuated the contribution of DM chronicity. Another reason may be that women constituted the majority of the study population.

The present study differed from previous studies in the literature with its accessibility of new treatment options for DM. Namely, about three fourths of the participants were on a SGLT-2 inhibitor and more than one half was on a GLP-1 receptor agonist. Weight reducing antidiabetics were actively adopted, as obese patients constituted the majority of the study population. Loss of lean mass may compromise the metabolic benefits of weight loss and place some patients at a high risk for adverse outcomes associated with sarcopenia (23). This risk becomes more worrisome with advancing age. In light of the findings that weight loss in older adults may lead to significant loss of lean mass and therefore aggravate the development of sarcopenia (24), the European Society for Clinical Nutrition and Metabolism (ESPEN) guideline for older adults advised caution about weight reducing interventions even for obese individuals (25). The aforementioned study recruited adults over the age of 70. However, we recruited relatively younger individuals (mean age: 53 $\pm$ 10 years) and showed that weight loss has a beneficial effect on muscle function.

Of note, almost all patients were on metformin, which could explain the observed vitamin B12 deficiency.

The present study contributes to the existing literature (6-8, 26) by providing follow-up information to assess the effectiveness of glycemic control interventions. In addition to presenting real world data regarding novel glucose-lowering agents, it has valuable clinical implications for sarcopenia treatment. Our findings demonstrate the beneficial effect of novel antihyperglycemic drugs on muscle function, representing a promising therapeutic approach against sarcopenia. Another strength of the study is that the most current and widely accepted EWGSOP criteria for sarcopenia have been used, as opposed to previous studies on the association of sarcopenia and DM that have used either the muscle mass or muscle strength as a proxy of sarcopenia.

This study has several limitations. First, since the study was not designed as a randomized control trial, study findings should be interpreted with caution. Second, HbA1c levels provide a crude estimation of blood glucose profile and do not provide information regarding hypoglycemic episodes; an established risk factor for sarcopenia. However this limitation was mostly overcome, since our clinic avoids hypoglycemic agents whenever possible (Only 1 patient continued to use sulfonylurea and patients on insulin therapy received basal insulin). Lack of nutritional assessment is another shortcoming of the study. We do not have information regarding the patients' energy and protein intake during the follow-up period. Nevertheless, all patients have been evaluated by the same clinical dietitian. Therefore, all patients received age and disease appropriate dietary advice. Finally, a separate analysis has not been performed for sarcopenic obesity, as it would lead to reduced statistical power.

In conclusion, glycemic control with novel antihyperglycemic treatments plays a valuable role in the prevention of sarcopenia. Still, larger prospective studies with long-term follow-up are warranted to substantiate the study findings. Understanding the change in skeletal muscle may pave the path for developing appropriate interventions that are urgently needed in the field of sarcopenia.

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Authorship Contributions

Conception and Design: **Busra Can, Zehra Kaya, Bulent Can**, Materials, Data Collection or Processing: **Zehra Kaya, Bulent Can**, Analysis or Interpretation: **Busra Can, Zehra Kaya, Bulent Can**, Literature Search: **Busra Can, Zehra Kaya**, Writing: **Busra Can, Zehra Kaya, Bulent Can**, Critical Review: **Busra Can, Zehra Kaya, Bulent Can**, Supervision: **Busra Can**.

Conflict of Interest

No conflict of interest was declared by the authors.

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Ethical Approval

Istanbul Medeniyet University Ethical Review Board approved the study protocol (approval number: 2021/0314).

The datasets analyzed during the current study are available from the corresponding author upon reasonable request.

All participants provided informed consent in the format required by the ethical review board.

Peer Review Process

Extremely and externally peer-reviewed.

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The Relationship Between Neuropathic Pain and Quality of Life in Geriatric Type 2 Diabetic Patients

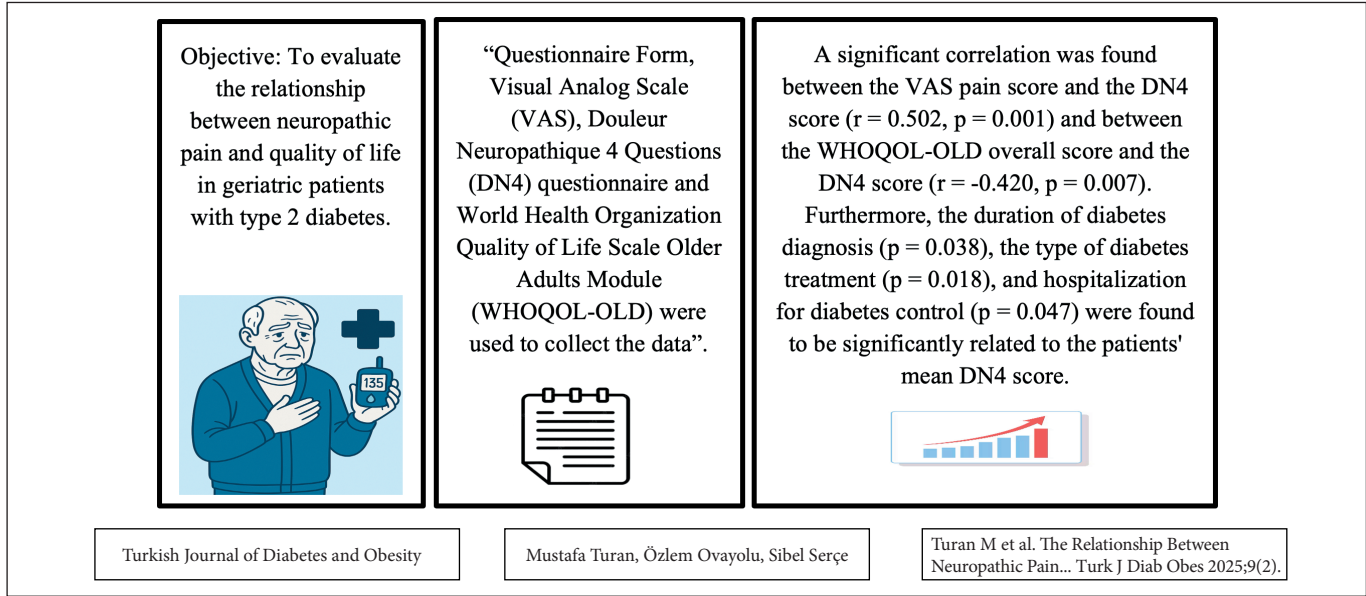
Mustafa TURAN¹ , Özlem OVAYOLU² , Sibel SERÇE²  

¹Kilis 7 Aralık University Vocational School of Health Services, Gaziantep, Türkiye

²Gaziantep University, Faculty of Health Sciences, Department of Nursing, Gaziantep, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Aim: This descriptive study was conducted to evaluate the relationship between neuropathic pain and quality of life in geriatric patients with type 2 diabetes.

Material and Methods: The data of the study were collected using “Questionnaire Form, Visual Analogue Scale (VAS), Douleur Neuropathique 4 Questions (DN4) questionnaire, and the World Health Organization Quality of Life Instrument Older Adults Module (WHOQOL-OLD). In the DN4 questionnaire, the limit value for neuropathic pain was determined to be 4/10 and above. The scores obtained from the WHOQOL-OLD scale ranged between 24 and 120”.

Results: This study, which included patients aged 65-79, found that the majority of the patients were male, 65-69 years old, and illiterate. The majority of the geriatric patients had type 2 diabetes for more than 10 years, were using oral antidiabetic medications along with insulin for their diabetes treatment, and had chronic cardiovascular disease in addition to their diabetes. The patients' mean overall pain score according to the VAS was 6.27 ± 1.48 , the mean neuropathic pain score according to the DN4 was 8.15 ± 1.14 , and the mean overall quality of life score according to the WHOQOL-OLD was 68.67 ± 6.61 .

ORCID: Mustafa Turan / 0000-0001-7894-179X, Özlem Owayolu / 0000-0002-7335-4032, Sibel Serçe / 0000-0003-3490-5193

Correspondence Address / Yazışma Adresi:

Sibel SERÇE

Gaziantep University, Faculty of Health Sciences, Department of Nursing, Gaziantep, Türkiye
Phone: +90 (534) 267 32 61 • E-mail: s_serce80@hotmail.com

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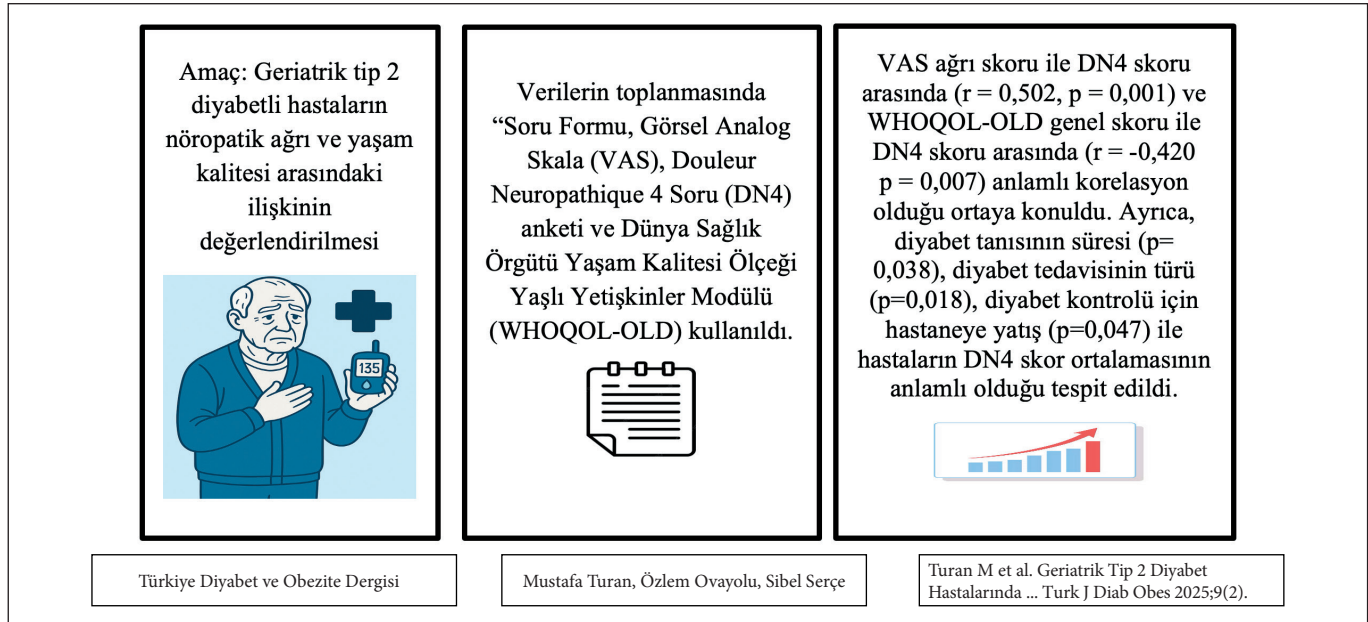
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Conclusion: The study results revealed a significant correlation between the VAS pain score and the DN4 score ($r=0.502$, $p=0.001$), and between the WHOQOL-OLD overall score and the DN4 score ($r=-0.420$, $p=0.007$). Furthermore, the duration of diabetes diagnosis ($p=0.038$), the type of diabetes treatment ($p=0.018$), and hospitalization for diabetes control ($p=0.047$) were found to be significantly related to the patients' mean DN4 score.

Keywords: Type 2 diabetes, Geriatrics, Neuropathic pain, Nursing

Geratrik Tip 2 Diyabet Hastalarında Nöropatik Ağrı ve Yaşam Kalitesi Arasındaki İlişki

GRAFİKSEL ÖZET



ÖZ

Amaç: Çalışma, geriatrik tip 2 diyabetli hastalarda nöropatik ağrı ile yaşam kalitesi arasındaki ilişkiyi değerlendirmek amacıyla tanımlayıcı olarak gerçekleştirildi.

Gereç ve Yöntemler: Çalışmanın verileri “Soru Formu, Görsel Analog Skala (VAS), Douleur Neuropathique 4 Soru (DN4) anketi ve Dünya Sağlık Örgütü Yaşam Kalitesi Ölçeği Yaşlı Yetişkinler Modülü (WHOQOL-OLD) kullanılarak toplandı. DN4 anketinde nöropatik ağrı için sınır değeri 4/10 ve üzeri olarak belirlendi. WHOQOL-OLD ölçeğinden elde edilen puanlar 24 ile 120 arasında değişti.”

Bulgular: 65-79 yaş aralığındaki hastaların dahil edildiği bu çalışmada hastaların çoğunluğu erkek, 65-69 yaş aralığında ve okuma yazma bilmiyorlardı. Geriatrik hastaların çoğunluğunun 10 yıldan uzun süredir tip 2 diyabet hastası olduğu, diyabet tedavisinde insülin ile birlikte oral antidiyabetik ilaç kullandığı ve diyabete ek olarak kronik kardiyovasküler hastalığının da bulunduğu tespit edildi. Hastaların VAS’a göre genel ağrı skor ortalaması $6,27 \pm 1,48$ iken, DN4’e göre nöropatik ağrı skor ortalaması $8,15 \pm 1,14$ ve WHOQOL-OLD’a göre genel yaşam kalitesi skor ortalaması $68,67 \pm 6,61$ olarak bulundu.

Sonuç: Çalışmanın sonuçlarına göre, VAS ağrı skoru ile DN4 skoru arasında ($r = 0,502$, $p = 0,001$) ve WHOQOL-OLD genel skoru ile DN4 skoru arasında ($r = -0,420$, $p = 0,007$) anlamlı korelasyon olduğu ortaya konuldu. Ayrıca, diyabet tanısının süresi ($p=0,038$), diyabet tedavisinin türü ($p=0,018$), diyabet kontrolü için hastaneye yatış ($p=0,047$) ile hastaların DN4 skor ortalamasının anlamlı olduğu bulundu.

Anahtar Sözcükler: Tip 2 diyabet, Geriatri, Hemşirelik, Nöropatik ağrı

INTRODUCTION

According to the “World Health Organization (WHO), persons aged 65 years and older are classified as “elderly.” The demographic shift towards an expanding older population has resulted in a parallel escalation of age-associated health challenges” (1). Physiological changes affecting the cardiovascular, gastrointestinal, urinary, and endocrine systems accompany the aging process, while the cumulative effect of long-term exposures contributes to a greater occurrence of chronic conditions, notably diabetes mellitus and hypertension (2). Diabetes, in particular, is a progressive and multifactorial metabolic disorder whose prevalence is shaped by hereditary predispositions, environmental influences, behavioral tendencies, and socio-cultural dynamics (3,4). “WHO’s *Global Report on Diabetes* (2016) highlights a dramatic rise in the global burden of the disease: adult cases increased from 108 million (4.7%) in 1980 to 422 million (8.5%) by 2014, reflecting an approximate twofold growth. In 2012 alone, diabetes was responsible for an estimated 1.5 million deaths, ranking it as the eighth leading cause of mortality worldwide” (5).

The likelihood of developing diabetes, as well as its prevalence, grows substantially with advancing age. Individuals aged 65 years and above account for close to 40% of all diagnosed cases, while approximately 20% of this cohort live with impaired glucose tolerance. Alarming, about 10% of older adults are believed to have diabetes that remains undiagnosed (6). In modern public health, preventive strategies are viewed as equally critical as the clinical management of complications once the disease is established (7). Numerous organizations, including WHO and the International Diabetes Federation (IDF), have mobilized resources to curb the onset of diabetes, limit associated complications, enhance healthcare accessibility, improve quality of life, and reduce avoidable mortality. Their collaborative initiative, *Diabetes Action Now*, seeks to raise global awareness, foster preventive practices, and ensure optimal diabetes control, especially within low- and middle-income nations. A key component of this program is the prevention and management of diabetic neuropathy, one of the most common and burdensome chronic sequelae of diabetes (8).

Diabetic neuropathy—frequently termed *Diabetic Peripheral Neuropathy* (DPN)—emerges from prolonged hyperglycemia-induced damage to the peripheral nervous system. Clinical manifestations range from sensory deficits in the extremities to burning or tingling sensations, numbness, muscle weakness, and persistent pain (8,9). In older adults, inadequate glycemic control often precipitates neuropathic pain (10), which stands as a leading cause for hospital visits in this demographic (11). This type of pain not only disrupts

sleep patterns but also limits mobility, impairs daily functioning, and erodes independence, culminating in a marked decline in life quality (12). Empirical evidence demonstrates that elderly individuals with a prolonged history of diabetes face a heightened risk of DPN, a condition closely linked to diminished functional capacity and poorer quality of life (13). Additionally, diabetes-related complications—such as mobility impairments, chronic pain, depressive symptoms, and cognitive deterioration—further exacerbate the loss of autonomy in this population (14).

Although diabetic neuropathic pain is recognized as one of the most prevalent neuropathic disorders in the geriatric population and is known to severely compromise quality of life, a review of the existing literature indicates a notable scarcity of research in Turkey on this subject. Addressing this gap, the present study aims to examine diabetic neuropathic pain among older adults in a holistic manner, promote greater awareness, and contribute to strategies that enhance the overall well-being of this vulnerable group.

MATERIAL and METHODS

Design, Sample, and Inclusion Criteria

This research was carried out between September 2018 and September 2019 in the Internal Medicine and Endocrinology Clinics of a state hospital. The study population consisted of individuals aged 65 years and older who visited the relevant outpatient clinics, were admitted to the hospital, and had a confirmed diagnosis of type 2 diabetes during the study period. For sample size calculation, assuming a moderate correlation coefficient [$r = 0.5$] between neuropathic pain and quality of life scores, the minimum required sample was determined to be 29 participants ($\alpha = 0.05$, $1-\beta = 0.80$). However, to strengthen the reliability of the findings, the study was completed with 40 participants. Eligible participants were those aged 65 or above, diagnosed with type 2 diabetes and neuropathy confirmed by electromyography (EMG), with a minimum general pain score of 2 on the “Visual Analogue Scale (VAS), a score of at least 4 on the Douleur Neuropathique 4 Questions (DN4), and a score of 24 or above on the Standardized Mini Mental Test (SMMT) or its illiterate version (SMMT-I)”. Only individuals without any physical or psychological conditions that could hinder communication and who provided informed consent were included. Those who did not meet the inclusion criteria or declined participation were excluded.

Data Collection Tools

Data were obtained using a questionnaire on demographic and disease-related information, along with the “VAS for general pain, SMMT and SMMT-I, DN4, and the World

Health Organization Quality of Life – Old Module (WHO-QOL-OLD)”. Permissions to use the scales were secured from their respective authors prior to data collection.

Questionnaire

Developed after a literature review (15,16), this form included questions about socio-demographic characteristics and clinical details of the participants.

Visual Analogue Scale (VAS)

The “VAS consists of a 10 cm line, marked from “no pain = 0” to “worst pain = 10,” where patients indicate the point corresponding to their current pain level”. Higher scores represent greater pain intensity. In this study, the VAS was used to measure general body pain other than neuropathic pain (17).

Standardized Mini Mental Test (SMMT) and Illiterate Version (SMMT-I)

The SMMT, first introduced in 1975, is widely used for cognitive screening. It consists of 19 questions in five domains—orientation, registration, attention-calculation, recall, and language—scored out of 30. In Turkey, its validity and reliability were confirmed by Güngen et al. in 2002 (cut-off score: 23/24; sensitivity: 0.91; specificity: 0.95). For illiterate individuals the “SMMT-I, which mirrors the original content is adapted for those unable to read or write. Its Turkish adaptation was validated. in 2016. Scores of 24–30 indicate normal cognition, 18–23 suggest mild dementia, and ≤ 17 indicate severe dementia (18,19). In this study, the average SMMT score for literate participants ($n=18$) was 26.9 ± 1.5 , and for illiterate participants ($n=22$) using SMMT-I it was 25.7 ± 1.1 . Only those with scores in the normal range were included.

Douleur Neuropathique 4 Questions (DN4)

Developed by the French Neuropathic Pain Group, the DN4 assesses neuropathic pain through four sections. The first two rely on patient interviews about pain characteristics and sensory changes (paresthesia/dysesthesia). The last two involve clinical assessment of sensory deficits and pain response to light touch. Each “yes” response scores one point, “for a maximum of 10. A score of ≥ 4 indicates neuropathic pain” (20). The Turkish version has a Cronbach’s alpha of 0.97.

WHOQOL-OLD

This 24-item quality of life instrument contains “six subscales—sensory abilities, autonomy, past/present/future activities, social participation, death and dying, and intimacy—rated on a 5-point Likert scale”. Each subscale addresses specific aspects affecting elderly well-being, such as sensory limitations, independence, life achievements, communi-

ty involvement, social relationships, and attitudes towards death. The Turkish adaptation by Eser et al. (2004) reported Cronbach’s alpha coefficients ranging from 0.68 to 0.88 for subscales, and 0.85 for the total score (21).

Electromyography Protocol

Participants meeting cognitive criteria (SMMT or SMMT-I score ≥ 24) and reporting VAS ≥ 2 with DN4 ≥ 4 underwent EMG evaluation. Only those with EMG-confirmed neuropathy were enrolled after providing written consent.

Study Procedure

Following ethics committee approval and institutional permission, physicians and nurses in the clinics were informed about the study objectives and procedures. Eligible patients were approached, informed about the study, and invited to participate. Data collection was conducted face-to-face, with each session lasting approximately 45–60 minutes.

Ethical Considerations

Ethics committee approval (Decision no: 2018/72) was obtained from the Gaziantep University Clinical Research Ethics Committee, and institutional permission was granted by the Provincial Health Directorate. Written and verbal consent was obtained from all participants or their legal representatives. Permissions for the use of the DN4 and SMMT were also secured from the authors of the Turkish adaptation studies.

Statistical Analysis

Data were analyzed using SPSS version 20. “Normality was assessed with the Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive statistics (frequency, percentage) summarized demographic variables. For group comparisons, the Mann-Whitney U test was used for two groups, and the Kruskal-Wallis test for three or more groups. Post-hoc pairwise comparisons were Bonferroni-adjusted. Spearman’s correlation coefficient was used to examine associations between scale scores.” A p-value < 0.05 was considered statistically significant.

RESULTS

Examination of the Results Related to Some Sociodemographic Characteristics of the Patients

The study sample comprised individuals predominantly aged 65–69 years, accounting for 50% of the participants. Males represented 52.5% of the sample, and 82.5% were married. More than half of the participants (55%) were illiterate, while 62.5% reported a moderate income level. All respondents had health insurance coverage. Half of the participants rated their overall health as “moderate,” and

a substantial majority (92.5%) resided with their spouse or children (Table 1).

Examination of the Pain-Related Findings of the Patients Other than the Diabetes and Neuropathy

It was determined that 52.5% of the patients were diagnosed with diabetes for more than 10 year, 50% used insulin together with the oral anti-diabetic (OAD) drug in the diabetes treatment, 27.5% received insulin treatment for 4-6 years, 52.5% were never hospitalized due diabetes, 47.5% went for

a diabetes control only when they felt unwell, the partner of 42.5% were diabetes patients, and 60% had a chronic disease of the cardiovascular system (hypertension, chronic heart failure etc.) together with diabetes.

It was determined that the patients experienced pain other than neuropathic pain and 67.5% had muscle and joint pain other than neuropathic pain (Table 2).

Examination of the Findings of the Patients Concerning Pain other than Neuropathic Pain, Neuropathic Pain, and Quality of Life Mean Scores

It was found that the minimum - maximum general pain score (other than neuropathic pain) of the patients they obtained based on VAS varied between 3 and 9 and their general pain mean scores was 6.27 ± 1.48 . It was determined that the lowest and highest DN4 neuropathic pain score of the patients were 6 and 10, The mean DN4 score was found to be 8.15 ± 1.14 , respectively. The mean quality of life score was found to be 68.67 ± 6.61 . 12.98 ± 1.48 for "Sensory abilities" subscale, 11.55 ± 2.30 for "Autonomy" subscale, 10.57 ± 1.84 for "Past, present, and future activities", 9.97 ± 2.21 for "Social Participation", 12.08 ± 3.32 for "Dying and death", and 11.53 ± 2.29 for "Intimacy" subscale (Table 3).

Examination of the Correlation between Some Sociodemographic and Diabetes Characteristics of the Patients and their Pain and Quality of Life Mean Scores

Based on VAS assessments, general (non-neuropathic) pain scores were higher among patients who were male, aged 75–79 years, university graduates, married, reported their health as "very poor," and lived with their partner and children. Higher non-neuropathic pain scores were also observed in those diagnosed with diabetes for more than 10 years, performing exercise for diabetes management, not using insulin, hospitalized for 7–9 days due to diabetes, attending hospital visits once every six months for diabetes control, having a spouse with diabetes, and having a respiratory-related chronic comorbidity in addition to diabetes. However, no statistically significant associations were found between diabetes-related characteristics and VAS mean scores.

For neuropathic pain (DN4), higher mean scores were observed in patients who were male, aged 75–79 years, primary school graduates, single, reported "very poor" health, and lived with their partner or children. Neuropathic pain scores were also higher in those diagnosed with diabetes for more than 10 years, performing exercise for diabetes management, using insulin, hospitalized for more than 10 days due to diabetes, seeking hospital care for diabetes control only when unwell, having a spouse with diabetes, and having a respiratory-related chronic comorbidity. A statistically sig-

Table 1: Distribution of Some Sociodemographic Characteristics of The Patients

Variables*	Findings (n=40)
	n (%)
Gender	
Female	21 (52.5)
Male	19 (47.5)
Age (years)	
65-69	20 (50.0)
70-74	11 (27.5)
75-79	9 (22.5)
Education status	
Illiterate	22 (55)
Primary	15 (37.5)
Secondary	2 (5)
University	1 (2.5)
Marital status	
Married	33 (82.5)
Single	7 (17.5)
Economical situation	
Bad	9 (22.5)
Moderate	25 (62.5)
Good	6 (15)
Health assurance	
Available	40 (100)
Health assessment	
Very bad	3 (7.5)
Bad	15 (37.5)
Moderate	20 (50)
Good	2 (5)
People they live with	
Single	3 (7.5)
Partner or children	37 (92.5)
Total	40 (100)

*Data shown as number and percent.

Table 2: Distribution of the Characteristics of the Patients Related to Diabetes and the Pain Other than Neuropathic Pain.

Variables*	Findings (n=40)	Variables*	Findings (n=40)
Duration of diabetes (years)		Presence of another chronic disease	
4-6	6 (15)	No	3 (7.5)
7-9	13 (32.5)	Cardiovascular system diseases	24 (60)
10 ↑	21 (52.5)	Respiratory system diseases	2 (5)
Diabetes treatment method		Urinary system diseases	11 (27.5)
Exercise	1 (2.5)	The presence of another pain	
OAD usage	4 (10)	Yes	40 (100)
İnsülin usage	12 (30)	Another pain location	
OAD + İnsülin usage	20 (50)	Muscle and joint pain in the feet	27 (67.5)
All	3 (7.5)	Pain in the hands	12 (30)
Duration of insulin usage (years)		Other	1 (2.5)
Does not use	5 (12.5)	Duration of another pain (months)	
1-3	5 (12.5)	0-1	3 (7.5)
4-6	11 (27.5)	2-6	7 (17.5)
7-9	10 (25)	7-11	8 (20)
10 ↑	9 (22.5)	12 ↑	22 (55)
Hospitalization time due to diabetes (days)		Analgesic use status for another pain	
0 (no previous hospitalization)	21 (52.5)	Yes	22 (55)
4-6	10 (25)	No	18 (45)
7-9	3 (7.5)	The number of analgesics used daily (pieces) for another pain	
10 ↑	6 (15)	Does not usage	18 (45)
Application to the hospital for diabetes control		1	10 (25)
When ill	19 (47.5)	2	10 (25)
Once in a month	4 (10)	3	2 (5)
Bimonthly	3 (7.5)	Factors that increase another pain	
Quarterly	7 (17.5)	Hot	13 (32.5)
Once in a six month	6 (15)	Cold	12 (30)
once a year	1 (2.5)	Movement - exercise	15 (37.5)
Presence of diabetes patient in the family		Factors that decrease another pain	
No	7 (17.5)	No factor	6 (15)
Mother	2 (5)	Hot	2 (5)
Father	3 (7.5)	Cold	4 (10)
Sibling	1 (2.5)	Usage of drug	14 (35)
Wife	17 (42.5)	Massage	4 (10)
Childrens	10 (25)	Movement - exercise	10 (25)
		Total	40 (100)

*Data shown as number and percent.

nificant relationship was found between DN4 mean scores and duration of diabetes, type of diabetes treatment, and frequency of hospital visits for diabetes control ($p < 0.05$).

Regarding quality of life, higher WHOQOL-OLD mean scores were observed in female patients, those aged 65–69

years, university graduates, married individuals, those reporting “good” health, and those living with their partner or children. No statistically significant associations were identified between sociodemographic characteristics and VAS, DN4, or WHOQOL-OLD scores. Higher quality of

Table 3: Distribution of the Pain other than Neuropathic Pain, Neuropathic Pain and Quality of Life Mean scores of the Patients

Scales*		Findings (n=40)	
WHOQOL-OLD Subscales Score	VAS	6.22±1.48	6 (3 - 9)
	DN4	8.15±1.14	8 (6-10)
	Sensory Abilities	12.98±1.48	13 (10-15)
	Autonomy	11.55±2.30	12 (8-16)
	Past, Present and Future Activities	10.57±1.848	11 (8-16)
	Social Participation	9.97±2.217	9 (7-16)
	Death and Dying	12.08±3.324	12 (4-16)
	Intimacy	11.53±2.29	12 (8-16)
	WHOQOL-OLD		
	Quality of Life	68.67±6.61	69 (55-85)
(Overall Score)			

*Data shown as “mean±SS, median (minimum-maximum)” “**VAS:** Visual Analogue Scale; **DN4:** Douleur Neuropathique 4 Questions; **WHOQOL-OLD:** World Health Organization Quality of Life Instrument Older Adults Module”

life scores were also seen among patients diagnosed for 4–6 years, receiving multiple diabetes treatments (“all”), using insulin, not hospitalized due to diabetes, attending monthly diabetes control visits, having a mother with diabetes, and having no additional chronic diseases. A statistically significant association was found between duration of insulin use and WHOQOL-OLD mean scores ($p < 0.05$) (Table 4).

Examining the Correlation between Pain and Quality of Life Mean score

A statistically significant, positive, and moderate correlation was found between patients’ DN4 and VAS mean scores ($p = 0.001$; $r = 0.502$). The “sensory abilities” subscale of WHOQOL-OLD showed no significant correlation with either VAS ($p = 0.348$; $r = 0.152$) or DN4 ($p = 0.892$; $r = -0.022$) scores. For the “autonomy” subscale, there was a significant, negative, and low-level correlation with VAS ($p = 0.031$; $r = -0.342$) and a significant, negative, and moderate correlation with DN4 ($p = 0.001$; $r = -0.535$). The “past, present, and future activities” subscale did not significantly correlate with VAS ($p = 0.227$; $r = -0.195$), but showed a significant,

Table 4: Comparison of Some Sociodemographic and Diabetes-Specific Characteristics of the Patients and their Quality of Life Mean scores.

Variables*	VAS	p	DN4	p	WHOQOL-OLD	p
Gender						
Female (n=21)	6.62±1.68	0.099	8.33±1.23	0.347	67.19±6.84	0.226
Male (n=19)	5.89±1.15		7.94±1.02		70.31±6.11	
Age groups						
65-69 years (n=20)	6.00±1.45	0.249	8.20±0.95	0.335	71.10±6.34	0.117
70-74 years (n=11)	6.18±1.66		7.72±1.27		65.63±5.57	
75-79 years (n=9)	7.00±1.22		8.55±1.33		67.00±6.96	
Education status						
Illiterate (n=22)	6.36±1.43	0.539	8.18±1.18	0.854	68.04±5.97	0.096
Primary (n=15)	6.00±1.64		8.20±1.20		67.93±7.21	
Secondary (n=2)	6.50±0.70		7.50±0.70		76.50±2.12	
University (n=1)	8.00±0.00		8.00±0.00		78.00±0.00	
Marital status						
Married (n=33)	6.45±1.48	0.102	8.12±1.13	0.626	68.96±6.83	0.363
Single (n=7)	5.43±1.27		8.28±1.25		67.28±5.76	
Health assessment						
Very bad (n=3)	7.33±1.52	0.515	8.66±1.52	0.349	67.33±9.45	0.754
Bad (n=15)	6.27±1.38		8.00±1.13		68.00±5.87	
Moderate (n=20)	6.05±1.57		8.30±1.12		69.00±7.21	
Good (n=2)	7.00±1.41		7.00±0.00		72.50±3.53	
People they live with						
Single (n=3)	5.33±1.52	0.249	7.66±1.52	0.578	63.33±5.50	0.142
Partner or children (n=37)	6.35±1.47		8.18±1.12		69.08±6.59	

Table 4 continue

Diabetes diagnosis time						
4-6 (years) (n=6)	6.17±1.47	0.059	8.00±1.41	0.038	70.66±6.91	0.748
7-9 (years) (n=13)	5.62±1.04		7.53±0.87		68.53±7.41	
10 ↑ (years) (n=21)	6.71±1.61		8.57±1.07		68.19±6.24	
Diabetes treatment method						
Exercise (n=1)	8.00±0.00	0.383	9.00±0.00	0.018	66.00±0.00	0.295
OAD usage (n=4)	6.00±1.82		7.50±1.29		67.00±5.47	
Insulin usage (n=12)	6.67±1.07		8.91±0.79		66.50±6.51	
OAD + Insulin usage (n=20)	6.20±1.57		7.95±1.14		69.65±6.99	
All (n=3)	5.00±1.73		7.00±0.00		74.00±4.58	
Insulin usage status						
Yes (n=35)	6.26±1.46	0.812	8.20±1.13	0.605	68.94±6.85	0.473
No (n=5)	6.40±1.81		7.80±1.30		66.80±4.76	
Insulin usage time (years)						
Does not use (n=5)	6.40±1.81	0.131	7.80±1.30	0.179	66.80±4.76	0.022
1-3 (n=5)	6.20±1.30		7.60±0.54		78.40±3.91	
4-6 (n=11)	5.55±0.82		7.72±1.10		67.09±5.87	
7-9 (n=10)	6.30±1.56		8.70±1.15		69.30±4.71	
10 ↑ (n=9)	7.11±1.76		8.55±1.13		65.55±7.09	
Hospitalization due to diabetes (days)						
No (n=21)	6.24±1.33	0.608	7.95±1.07	0.138	70.47±6.12	0.415
4-6 (n=10)	5.90±1.59		7.90±0.73		66.80±6.81	
7-9 (n=3)	7.00±2.64		8.33±2.08		62.33±7.76	
10 ↑ (n=6)	6.67±1.36		9.16±1.16		68.66±6.25	
Application to the hospital for diabetes control						
When ill (n=19)	6.68±1.25	0.185	8.68±1.05	0.047	67.26±6.84	0.479
Once in a month (n=4)	6.00±2.16		7.75±0.50		72.00±4.24	
Bimonthly (n=3)	5.33±1.15		7.00±1.00		71.66±3.05	
Quarterly (n=7)	5.57±1.27		7.71±0.95		70.71±7.97	
Once in a six month (n=6)	6.83±1.72		8.16±1.16		66.66±6.97	
Once a year (n=1)	4.00±0.00		6.00±0.00		71.00±0.00	
Presence of diabetes patient in the family						
No (n=7)	6.43±1.27	0.501	8.14±0.89	0.814	72.14±9.65	0.232
Mother (n=2)	6.00±8.28		8.00±0.00		74.50±4.94	
Father (n=3)	6.00±2.00		7.66±1.15		72.00±4.35	
Sibling (n=1)	3.00±0.00		7.00±0.00		69.00±0.00	
Wife (n=17)	6.65±1.45		8.35±1.36		67.29±5.27	
Childrens (n=10)	6.00±1.15		8.10±1.10		66.40±6.43	
Presence of another chronic disease						
No (n=3)	6.67±1.15	0.235	7.00±0.00	0.135	74.00±4.58	0.077
Cardiovascular system diseases (n=24)	5.92±1.50		8.12±1.11		69.91±5.98	
Respiratory system diseases (n=2)	7.50±0.70		9.00±0.00		62.50±4.94	
Urinary system diseases (n=11)	6.73±1.48		8.36±1.28		65.63±7.20	

*Data shown as mean±standart deviation; **VAS:** Visual Analogue Scale; **DN4:** Douleur Neuropathique 4 Questions; **WHOQOL-OLD:** World Health Organization Quality of Life Instrument Older Adults Module

negative, and moderate correlation with DN4 ($p = 0.006$; $r = -0.424$). The “social participation” subscale had significant, negative correlations with both VAS (low-level; $p = 0.031$; $r = -0.341$) and DN4 (moderate; $p = 0.003$; $r = -0.454$). No significant association was found between the “death and dying” subscale and VAS ($p = 0.252$; $r = 0.186$) or DN4 ($p = 0.052$; $r = 0.309$) scores. For the “intimacy” subscale, significant, negative, and low-level correlations were observed with both VAS ($p = 0.048$; $r = -0.314$) and DN4 ($p = 0.023$; $r = -0.359$). Finally, the WHOQOL-OLD overall mean score showed no significant correlation with VAS ($p = 0.006$; $r = -0.293$), but had a significant, negative, and moderate correlation with DN4 ($p = 0.007$; $r = -0.420$) (Table 5).

Analysis of the Findings of the Multiple Linear Regression Analysis to Determine the Effect of the Neuropathic Pain Scale and VAS Pain Score on Quality of Life

DN4, VAS pain score on quality of life. The regression model for determining the effect of the VAS pain score on quality of life was found to be statistically insignificant ($p > 0.05$), while the regression model for determining the effect of the DN4 on quality of life was found to be statistically sig-

nificant ($p < 0.05$). Examination of this regression model revealed that a one-unit increase in the Neuropathic Pain Scale (DN4) resulted in a 2.428 decrease in quality of life. The explanatory coefficient was calculated as ($R^2 = 0.176$), and in the established model, DN4 explained 17.6% of the variance in quality of life.

DISCUSSION

With the growing elderly population, the number of patients diagnosed with diabetes—a major contributor to global mortality—continues to rise. Inadequate diabetes treatment and control can negatively impact individuals' quality of life and lead to numerous complications (15). Among these, the prevalence of diabetic peripheral neuropathy increases with advancing age and longer disease duration (22). In a study by Karataş and Ozkan involving diabetic individuals, both disease duration and advanced age were identified as significant factors in the development of polyneuropathy (23). Chronic pain caused by diabetic peripheral neuropathy, often localized in the feet, is frequently reported in elderly patients and is associated with symptoms such as burning, tingling, and numbness, which impair comfort and ultimately reduce quality of life (15).

In this study, most geriatric patients with diabetes were male, married, of moderate economic status, had social insurance, and lived with their spouse or children. Similar demographic trends have been reported in other studies on diabetes (15,16). Furthermore, the present findings showed that most patients had been diagnosed with diabetes for more than 10 years, had family members with diabetes, had coexisting cardiovascular diseases, used insulin for treatment, and regularly visited hospitals for diabetes control. Comparable patterns have been noted in other studies, which also reported long disease duration, familial diabetes history, comorbid cardiovascular conditions (e.g., hypertension), insulin use, and periodic hospital visits for diabetes management (24).

Chronic diseases such as diabetes frequently cause persistent pain in the elderly (25). In the current study, geriatric patients reported moderate general body pain in addition to neuropathic pain, and all used analgesics for relief. Tanık et al., in their study on pain, depression, and sleep disorders among diabetic and non-diabetic patients with carpal

Table 5: Distribution of the Correlation between VAS, DN4 and WHOQOL-OLD Mean scores of the Patients.

Scales*		VAS r/p	DN4 r/p
WHOQOL-OLD Subscales Score	DN4	0.502/0.001	-
	Sensory Abilities	0.152/0.348	-0.022/0.892
	Autonomy	-0.342/0.031	-0.535/<0.001
	Past, Present and Future Activities	-0.195/0.227	-0.424/0.006
	Social Participation	-0.341/0.031	-0.454/0.003
	Death and Dying	0.186/0.252	0.309/0.052
	Intimacy	-0.314/0.048	-0.359/0.023
	WHOQOL-OLD Quality of Life (Overall Scores)	-0.293/0.006	-0.420/0.007

*r: Spearman Correlation Coefficient, VAS: Visual Analogue Scale; DN4: Douleur Neuropathique 4 Questions; WHOQOL-OLD: World Health Organization Quality of Life Instrument Older Adults Module

Table 6: Findings of Multiple Linear Regression Analysis to Determine the Effect of Neuropathic Pain Scale and VAS Pain Score on Quality of Life.

Independent Variables*	β j	S(bj)	t	p	95% GA	F	p	R ²
Constant	88.460	-	12.627	<0.001	74.278 - 102.642	8.130	0.007	0.176
DN4	-2.428	-0.420	-2.851	0.007	-4.151 - -0.704			
VAS				0.554				

tunnel syndrome, found high VAS pain scores (7.9 ± 1.1) among diabetic patients (26). Similarly, Aguiar et al., in their evaluation of neuropathic pain in diabetic patients, reported a high prevalence of pain (27). The present study also revealed a statistically significant, positive, and moderate correlation between DN4 and VAS scores, indicating that the severity of neuropathic pain is directly related to overall pain intensity. This finding highlights the importance of healthcare professionals addressing both neuropathic and general pain in diabetes care to optimize pain management.

Existing literature consistently reports that neuropathic pain is common in patients with diabetic neuropathy and negatively affects quality of life (28). For instance, Ji-Yan Cong et al. found that microvascular complications significantly reduced quality of life in individuals with Type 2 DM (29). Similarly, Onsüz and Can observed reduced quality of life in patients with peripheral neuropathy (30). In the current study, the mean DN4 score was 8.15 ± 1.14 , indicating high neuropathic pain levels—comparable to the findings of Tanık et al. (7.7 ± 1.6) (26). Neuropathic pain constitutes a major proportion of peripheral neuropathies regardless of etiology and is a well-recognized contributor to diminished quality of life (31).

The mean overall WHOQOL-OLD score in this study was 68.67 ± 6.61 , indicating a moderate quality of life. Similar outcomes have been reported by Paiva et al., who emphasized the negative impact of pain on quality of life in elderly diabetic patients (15), and by Akgül Gündoğdu et al., who found moderate quality of life scores among elderly individuals (32). Systematic reviews, such as that by Girach et al., confirm that painful peripheral neuropathy significantly impairs quality of life (31). Other studies—including those by Iqbal et al. (33) and Dermanovic Dobrota et al. (34) further support the link between neuropathic pain and reduced quality of life.

Additional factors influencing quality of life in elderly individuals with diabetes have also been identified. Nguyen et al. reported that duration of diagnosis, comorbidities, and treatment type adversely affect quality of life (35). Uçgun et al. found that elderly patients with Type 2 DM had lower physical activity and quality of life compared to those with hypertension (36). Sousa et al. demonstrated that patients' diabetes-related knowledge and attitudes significantly influence quality of life (37). Arslan and Ozdelikara concluded that higher self-efficacy correlates with better quality of life (38), while Küçük et al. found that being female, older, and previously diagnosed with Type 2 DM negatively affected healthy living behaviors and self-efficacy (39). Lima et al. identified a negative correlation between diagnosis duration and quality of life (40).

In the present study, a significant negative correlation was observed between WHOQOL-OLD "Autonomy" scores and DN4/VAS values, suggesting that increased pain reduces independence and decision-making capacity. Additionally, the significant negative correlation between overall WHOQOL-OLD and DN4 scores confirms that neuropathic pain adversely impacts quality of life. Reducing neuropathic pain severity could therefore lead to substantial improvements in well-being.

Given these findings, diabetes nurses have a critical role in managing pain related to diabetes and diabetic neuropathy, which requires a multidisciplinary approach. Regular assessment of elderly diabetic patients for neuropathy and pain, timely referrals, educational interventions, and holistic care strategies should be prioritized to optimize patient outcomes.

The findings demonstrated significant associations between the duration since diabetes diagnosis, type of treatment, and frequency of hospital visits for diabetes management with the DN4 neuropathic pain mean score. The length of insulin use was also significantly related to the overall WHOQOL-OLD mean score. Furthermore, DN4 neuropathic pain scores showed a moderate, positive correlation with VAS general pain scores, and a moderate, negative correlation with WHOQOL-OLD mean scores. These results highlight the importance of regular assessment of neuropathic pain and quality of life in older adults with diabetes, prioritizing effective pain management, monitoring its impact on life quality, and implementing targeted interventions to enhance well-being in this population.

The most important limitation of this study is that there was only one EMG device in the related hospital and the data collection period and time to reach the adequate number of patients prolonged as the EMG device broke down frequently.

Although the sample size was calculated using power analysis, the low number of samples in the subgroup analyses is another limitation of the study.

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Author Contributions

The authors contributed equally to all stages of the manuscript process. The authors have read and approved the final version of the article.

Conflict of Interest

Authors must declare that they have no conflict of interest and that this research was not prepared as a product of artificial intelligence.

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Peer Review Process

Extremely and externally peer-reviewed.

Ethical Approval

Ethics committee approval (Decision no: 2018/72) was obtained from the Gaziantep University Clinical Research Ethics Committee, and institutional permission was granted by the Provincial Health Directorate. Written and verbal consent was obtained from all participants or their legal representatives. Permissions for the use of the DN4 and SMMT were also secured from the authors of the Turkish adaptation studies

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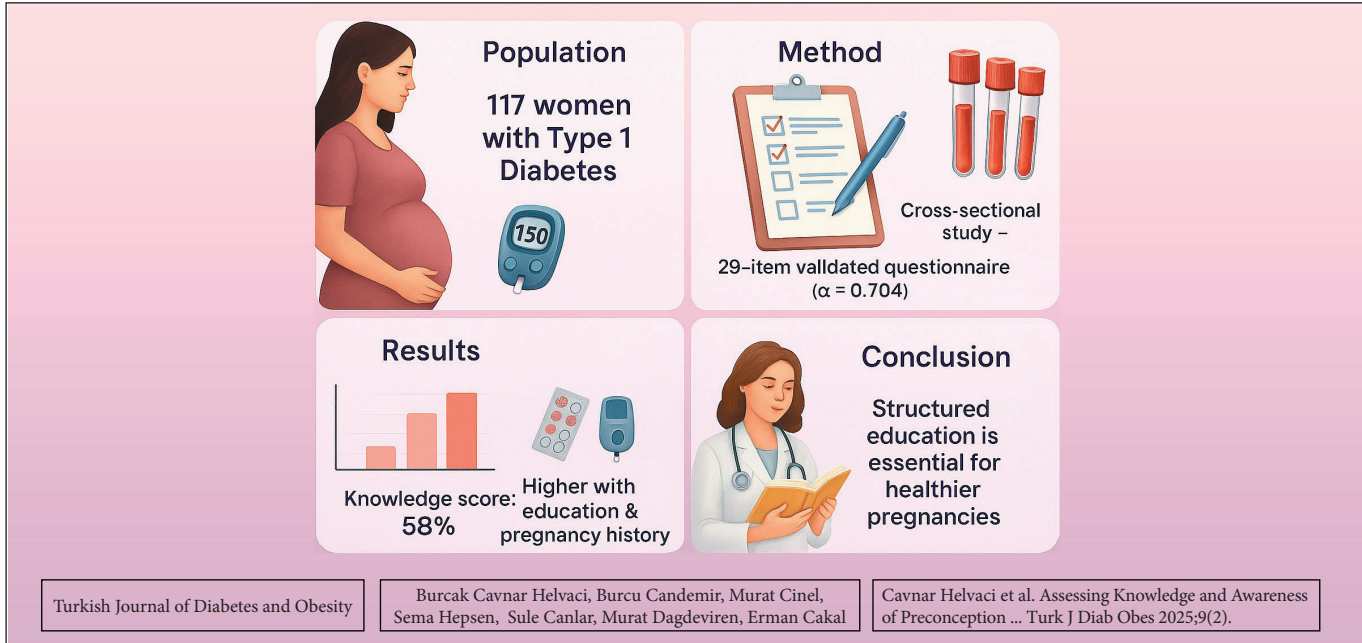
Assessing Knowledge and Awareness of Preconception Care Among Women with Type 1 Diabetes Mellitus: Implications for Optimizing Maternal and Fetal Health Outcomes

Burcak CAVNAR HELVACI ✉, Burcu CANDEMİR , Murat CİNEL , Sema HEPSEN , Sule CANLAR ,
Murat DAGDEVİREN , Erman CAKAL 

Ankara Etlik City Hospital, Department of Endocrinology and Metabolism, Ankara, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Aim: Diabetes mellitus raises risks for the mother, fetus, and infant. Preconception care plays a vital role in reducing the likelihood of miscarriage, congenital anomalies, and perinatal mortality. A higher level of knowledge before pregnancy is associated with better glycemic control and reduced diabetes-related risks. This study aimed to assess the pre-pregnancy knowledge of women of reproductive age with type 1 diabetes mellitus (T1DM) and to inform strategies for improved pregnancy planning and care in this high-risk group.

Material and Methods: This cross-sectional, single-center study included women with T1DM aged 18–45 years attending an endocrinology outpatient clinic. Participants completed a structured questionnaire designed to evaluate their knowledge of preconception care.

ORCID: Burcak Cavnar Helvacı / 0000-0002-8356-4463, Burcu Candemir / 0000-0003-1800-6235, Murat Cinel / 0000-0001-9241-7900, Sema Hepsen / 0000-0002-8375-7409, Sule Canlar / 0000-0001-7695-9611, Murat Dagdeviren / 0000-0003-4715-2557, Erman Cakal / 0000-0003-4455-7276

Correspondence Address / Yazışma Adresi:

Burcak CAVNAR HELVACI

Ankara Etlik City Hospital, Department of Endocrinology, Ankara, Türkiye
Phone: +90 (537) 381 78 50 • E-mail: burcakcavnar@gmail.com

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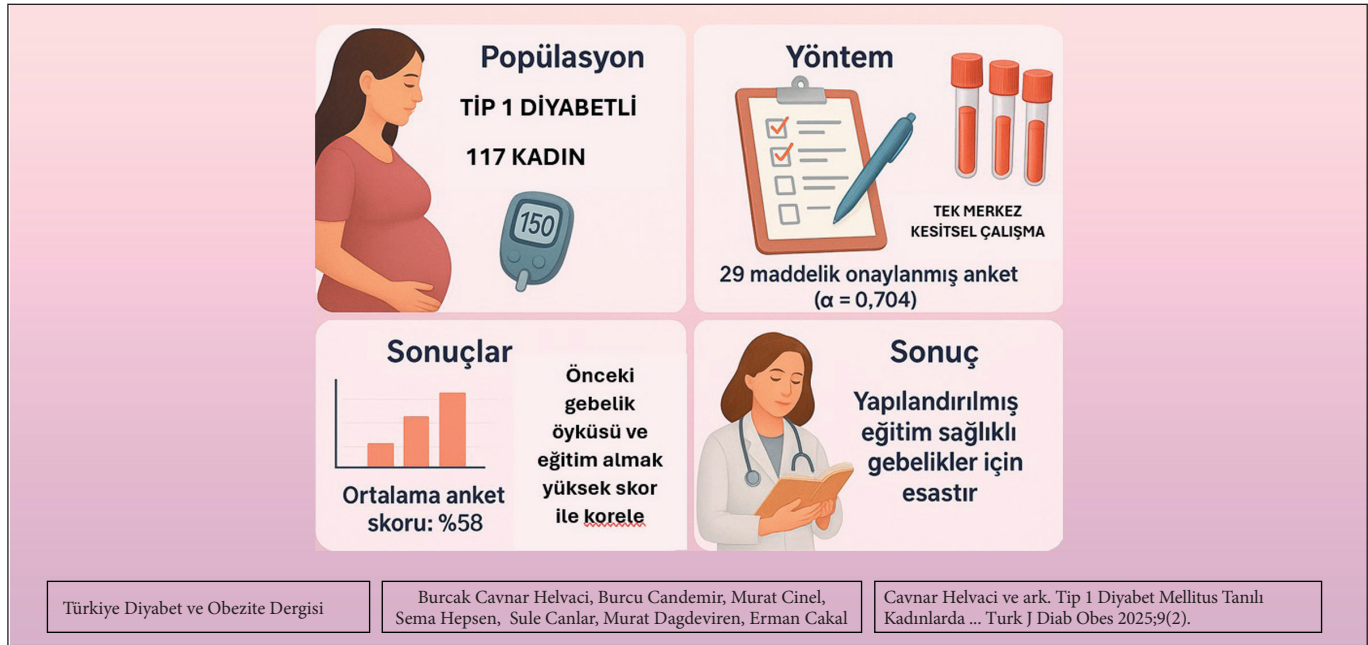
Results: A total of 117 women with T1DM participated in the study. The mean knowledge score was 58.6%. Participants who had received preconception care education scored significantly higher than those who had not (69.98% vs. 47.13%, $p < 0.001$). Similarly, women with previous pregnancy experience had higher scores compared to those without (65.19% vs. 50.19%, $p < 0.001$). Positive correlations were observed between knowledge scores and age ($r = 0.29$, $p < 0.001$), diabetes duration ($r = 0.28$, $p < 0.001$), marital status ($r = 0.46$, $p < 0.001$), pregnancy history ($r = 0.37$, $p < 0.001$), and prior education on the topic ($r = 0.57$, $p < 0.001$). No significant correlation was found between education level and knowledge scores ($p = 0.71$).

Conclusion: This study revealed a moderate average knowledge level regarding preconception care among women with T1DM. Prior pregnancy experience and receiving preconception care education were significantly associated with higher knowledge scores, while general educational attainment showed no correlation. These findings emphasize the importance of targeted, diabetes-specific educational interventions rather than relying solely on general education. Integrating structured preconception counseling into routine diabetes care may help bridge knowledge gaps and improve pregnancy outcomes in this high-risk population.

Keywords: Preconception care, Awareness rate, Knowledge, Type 1 diabetes mellitus, Pregnancy

Tip 1 Diyabet Mellitus Tanılı Kadınlarda Gebelik Öncesi Bakım Bilgi ve Farkındalık Düzeyinin Değerlendirilmesi: Anne ve Fetüs Sağlık Sonuçlarını İyileştirmeye Yönelik Çıkarımlar

GRAFİKSEL ÖZET



ÖZ

Amaç: Diyabetes mellitus, anne, fetüs ve yenidoğan için riskleri artırmaktadır. Gebelik öncesi bakım, düşük, konjenital anomaliler ve perinatal mortalite olasılığını azaltmada kritik bir rol oynamaktadır. Gebelikten önce edinilen daha yüksek bilgi düzeyi, daha iyi glisemik kontrol ve diyabetle ilişkili risklerin azalması ile ilişkilidir. Bu çalışma, tip 1 diabetes mellitus tanılı, üreme çağındaki kadınların gebelik öncesi bilgi düzeyini değerlendirmeyi ve bu yüksek riskli grupta gebelik planlaması ve bakımının iyileştirilmesine yönelik stratejilere katkı sağlamayı amaçlamaktadır.

Gereç ve Yöntemler: Kesitsel ve tek merkezli olarak yürütülen bu çalışmaya, 18–45 yaş aralığında olup bir endokrinoloji polikliniğine başvuran T1DM tanılı kadınlar dahil edilmiştir. Katılımcılar, gebelik öncesi bakıma ilişkin bilgi düzeylerini değerlendirmeye yönelik yapılandırılmış bir anket doldurmuştur.

Bulgular: Çalışmaya toplam 117 T1DM tanılı kadın katılmıştır. Ortalama bilgi puanı 58,6 olarak bulunmuştur. Gebelik öncesi bakım eğitimi almış katılımcılar, almayanlara kıyasla anlamlı düzeyde daha yüksek puan almıştır (69,98'e karşı 47,13; $p < 0,001$). Benzer şekilde, daha önce gebelik yaşamış kadınların puanları, gebelik yaşamamış olanlara göre daha yüksektir (65,19'a karşı 50,19; $p < 0,001$). Bilgi

puanları ile yaş ($r = 0,29$; $p < 0,001$), diyabet süresi ($r = 0,28$; $p < 0,001$), medeni durum ($r = 0,46$; $p < 0,001$), gebelik öyküsü ($r = 0,37$; $p < 0,001$) ve konuya ilişkin daha önce eğitim alma ($r = 0,57$; $p < 0,001$) arasında pozitif korelasyon saptanmıştır. Genel eğitim düzeyi ile bilgi puanı arasında ise anlamlı bir ilişki bulunmamıştır ($p = 0,71$).

Sonuç: Bu çalışma, T1DM tanılı kadınlar arasında gebelik öncesi bakıma ilişkin bilgi düzeyinin orta düzeyde olduğunu ortaya koymuştur. Önceki gebelik deneyimi ve gebelik öncesi bakım eğitimi alma, bilgi düzeyinin artmasıyla anlamlı şekilde ilişkilidir; ancak genel eğitim seviyesi bu düzey üzerinde etkili değildir. Bulgular, genel eğitim yerine diyabete özgü hedeflenmiş eğitim müdahalelerinin önemini vurgulamaktadır. Yapılandırılmış gebelik öncesi danışmanlığın rutin diyabet bakımına entegre edilmesi, bilgi eksikliklerinin giderilmesine ve bu yüksek riskli grupta gebelik sonuçlarının iyileştirilmesine katkı sağlayabilir.

Anahtar Sözcükler: Gebelik öncesi bakım, Farkındalık oranı, Bilgi düzeyi, Tip 1 diabetes mellitus, Gebelik

INTRODUCTION

The coexistence of pregnancy and diabetes mellitus (DM) creates a bidirectional adverse impact. While the majority of DM cases during pregnancy are attributed to gestational diabetes mellitus (GDM), the prevalence of pregestational diabetic (PGDM) pregnancies among women with type 1 DM is steadily increasing due to advancements in life expectancy and quality of life. Data from the 2021 Diabetes Atlas published by the International Diabetes Federation (IDF) reveal that 16.7% of the 126.4 million women aged 20–49 who gave birth had DM, with 80.3% having GDM, 9.1% other forms of DM diagnosed during pregnancy, and 10.6% PGDM (1). Although PGDM accounts for a smaller proportion of DM in pregnancy, it is associated with a range of maternal and fetal challenges despite the potential for healthy outcomes. Hyperglycemia during conception and pregnancy significantly increases maternal and fetal morbidity and mortality risks. The complications of DM in pregnancy encompass miscarriage, congenital malformations, preeclampsia, stillbirth, large-for-gestational-age neonates, neonatal hypoglycemia, jaundice, and respiratory distress syndrome (2).

Observational studies have highlighted the proportional relationship between elevated glycated haemoglobin (HbA1C) levels during the first 10 weeks of gestation and the risk of diabetic embryopathy, including microcephaly, renal anomalies, congenital heart defects, and caudal regression (3-5). Given that organogenesis occurs primarily between the 5th and 8th weeks of gestation, achieving HbA1C levels $< 6.5\%$ (< 48 mmol/mol) reduces the risks of preeclampsia and preterm birth. A large meta-analysis further demonstrated that lower HbA1C levels correlate with reduced risks of congenital malformations, preterm delivery, perinatal mortality, small-for-gestational-age neonates, and neonatal intensive care unit admissions (6). Preconception care, including pregnancy planning, is associated with decreased risks of adverse outcomes, underscoring its importance (7,8). Results from the DIEP Study concluded that women who received early prenatal care had a significantly lower rate of congenital malformations (4.9%) compared to

those who initiated prenatal care more than 21 days after conception (9.0%) (9). In a meta-analysis conducted by Ray JG and colleagues, which evaluated nine published studies on preconception care in women with DM, the pooled rate of major congenital anomalies was reported to be lower in those who received preconception care education prior to conception (2.1%) compared to those who did not (6.5%) (RR: 0.36; 95% CI: 0.22–0.59) (10). Although clinical guidelines emphasize the need for preconception counseling for all women with DM starting in adolescence, the rates of such counseling remain suboptimal (11-13).

Recognizing the problem is the initial step toward resolution. Therefore, this study aims to evaluate the level of knowledge and awareness regarding preconception care and pregnancy among women with type 1 DM to enhance pregnancy management and optimize outcomes.

MATERIALS and METHODS

Objectives

The specific objectives of this cross-sectional study are:

1. To evaluate the level of knowledge about preconception care among women with type 1 DM
2. To identify factors that may be associated with preconception care knowledge levels.

The study described is a single-centered, cross-sectional study conducted at the Endocrinology and Metabolism Department of Etlik City Hospital in Ankara, Turkey. The study protocol received approval from the local ethical committee on September 11, 2024, under the reference number AESH-BADEK-2024-751.

Inclusion and Exclusion Criteria for Participants

The study included patients with type 1 DM, 18 years old or older.

Exclusion criteria

1. Unwilling to participate
2. Pregnancy at the time of interview
3. Type 2 DM

Patients who met the study criteria and agreed to participate were given details about the study and signed a free informed consent form.

Data Collection and Evaluation of Scores

This study used a questionnaire that included 29 questions split into 2 sections. The first section covered demographic information, such as patients age, age at DM diagnosis, duration of DM, education level, marital status, employment status, use of insulin pumps, presence of comorbidities and the use of additional medications, diet and exercise compliance, history of previous pregnancies and miscarriages, history of delivering macrosomic infants, whether they had experienced maternal or fetal complications in previous

pregnancies as defined by the American Diabetes Association Professional Practice Committee (11), whether they had received preconception care education, and if so, from whom. The second section included 14 questions on DM management before and during pregnancy for women with type 1 DM planning pregnancy. Questions were open, or binary (i.e., yes or no), or with multiple choices. The items in the existing scales related to the subject in the current literature were reviewed by the expert researchers and revised based on both clinical guidelines and insights gained from patient interviews (2,14,15). Then, to assess the reliability of the survey conducted to evaluate knowledge and awareness regarding preconception care among women with Type 1 DM, a Cronbach's alpha reliability analysis was performed, yielding a reliability coefficient of $\alpha = 0.704$. Therefore, the survey used in our study has been considered a reliable measurement tool, as a Cronbach's alpha value of 0.70 or higher is generally regarded as sufficient to establish the reliability of a measurement instrument (16). Furthermore, the Cronbach's alpha analysis revealed a positive correlation among the items within the scale. The Turkish and English versions of the survey are included as Supplementary Table 1 and 2. Additionally, it was noted whether this was their first visit to our hospital.

Blood samples were collected in the morning after 12 hours of overnight fasting. All the tests were strictly controlled according to the uniform laboratory standards. Laboratory tests included alanine aminotransferase (ALT), fasting blood glucose (FPG), HbA1c, thyroid stimulating hormone (TSH),

Table 1: Characteristics of the cohort.

Characteristics	Findings (n=117)
Age, (year $\pm$ SD)	30.67 $\pm$ 9.09
Mean age at diabetes diagnosis, (year $\pm$ SD)	15.52 $\pm$ 5.93
Educational background; n (%)	
Primary school	11 (9.4)
Middle school	18 (15.4)
High school	33 (28.2)
University	55 (47.0)
Employment status; n (%)	
Not working	64 (54.7)
Students	16 (13.7)
Employed	37 (31.6)
Comorbidity; n (%)	
Hypothyroidism	22 (17.9)
Hyperlipidemia	4 (3.5)
Graves Disease	4 (3.5)
Celiac Disease	2 (1.7)
Systemic lupus erythematosus	2 (1.7)
Hypertension	1 (0.9)
Depression	1 (0.9)
Polycystic ovary syndrome	1 (0.9)
Pregnancy History; n (%)	
Maternal complication	23 (36.5)
Fetal complication	12 (19)
Macrosomia	15 (23.8)
Education regarding pregnancy; n (%)	
Endocrinologist and a diabetes nurse	34 (57.9)
Internal medicine doctor	12 (21.1)
Family doctor	7 (12.3)
Obstetrician	4 (7)
FPG level (mg/dL $\pm$ SD)	170 $\pm$ 70.82
HbA1C level % ($\pm$ SD)	8.5 $\pm$ 1.71
Creatinine level (mg/dL $\pm$ SD)	0.66 $\pm$ 0.12
Mean ALT level (IU/L $\pm$ SD) (<35 IU/L)	13.3 $\pm$ 7.0
Mean TSH level (mIU/mL $\pm$ SD) (0.4 - 4 mIU/mL)	2.14 $\pm$ 1.10

Table 2: Survey Answers.

Question No*	Findings (n=117)		
	True	False	Not sure
1	29 (24.8)	30 (25.6)	58 (49.6)
2	54 (46.2)	12 (10.3)	51 (43.6)
3	55 (47)	22 (18.8)	40 (34.2)
4	43 (36.8)	17 (14.5)	57 (48.7)
5	112 (95.7)	0(0.0)	5 (4.3)
6	81 (69.2)	16 (13.7)	20 (17.1)
7	58 (49.6)	33 (28.2)	26 (22.2)
8	39 (33.3)	40 (34.2)	38 (32.5)
9	101 (86.3)	3 (2.6)	13 (11.1)
10	93 (79.5)	7 (6.0)	17 (14.5)
11	84 (71.8)	12 (10.3)	21 (17.9)
12	88 (75.2)	9 (7.7)	20 (17.1)
13	70 (59.8)	6 (5.1)	41 (35)
14	52 (44.4)	14 (12)	51 (43.6)

*Data are shown as number and percentage, n(%).

creatinine, and estimated glomerular filtration rate (GFR) according to CKD-EPI. Additionally, patients were assessed for diabetic microvascular complications (nephropathy, retinopathy, neuropathy), and the results were documented.

Statistical Analysis

Statistical analysis was conducted using SPSS version 20.0 for Windows (IBM Corp., Armonk, NY, USA).

Descriptive Statistics: Quantitative variables were tested for normality using the Shapiro-Wilk test. Normally distributed continuous variables are expressed as mean $\pm$ standard deviation (SD), while non-normally distributed variables are presented as median (interquartile range [IQR]). Categorical data are expressed as frequencies and percentages. Group Comparisons: For normally distributed continuous variables, independent samples t- test was used for two-group comparisons. For non-normally distributed data, Mann-Whitney U test was employed. Categorical variables were compared using chi-square (χ^2) test or Fisher's exact test when appropriate.

Correlation Analysis: Pearson correlation coefficient (r) was used for normally distributed continuous variables, while Spearman's rank correlation coefficient (rho) was used for non- parametric data and ordinal variables. Correlation strength was interpreted as weak (r or rho 0.20-0.39), moderate (0.40-0.59), high (0.60-0.79), or very high (≥ 0.80).

Sample Size Calculation: Based on pilot data (n=20) with mean score of 55 ± 15 , assuming medium effect size (Cohen's $d=0.5$), $\alpha=0.05$, and power=80%, minimum sample size was calculated as 34 participants. Our final sample size exceeded this minimum by more than threefold. All statistical tests were two-tailed, and significance was set at $p<0.05$. P-values <0.001 are reported as $p<0.001$.

RESULTS

The study included 122 patients from June 2022 to June 2024. Five patients who did not provide informed consent were excluded, and a total of 117 patients were analyzed. A total of 117 patients were included in the study. The mean age of the patients was 30.67 ± 9.09 [SD], ranging from 18 to 56 years. The mean age at DM diagnosis of the patients was 15.52 ± 5.93 [SD]. The participants' educational background was as follows: 9.4% had completed primary school, 15.4% had completed middle school, 28.2% had completed high school, 43.6% had attended university, and 3.4% had pursued postgraduate studies. The 59.8% of participants were married. The participants' employment status was as follows: 54.7% were not working, 13.7% were students, and 31.6% were employed (Table 1). The majority of participants (82.1%) were visiting our clinic for the first time.

19.7% of the patients had a history of previous miscarriage. Among the 63 patients with a history of pregnancy, 23.8% had a history of delivering a macrosomic baby. The mean number of pregnancies among the participants was 1.28 ± 1.51 [SD]. Additionally, 36.5% of these 63 patients experienced maternal complications, and 19% experienced fetal complications during pregnancy. 46.2% of the patients reported having received education about birth control, while 48.7% stated they had received education regarding pregnancy. Among the 57 participants who reported having received education on pregnancy and DM, 57.9% had received their education from an endocrinologist and a diabetes nurse, 21.1% from an internal medicine doctor, 12.3% from a family doctor, and 7% from an obstetrician.

Only 12.8% of the patients were using insulin pumps. A total of 37 patients (21.6%) had comorbid conditions, and of these, 27 patients (23.1%) were using additional medications. 40.2% of the patients adhered to a diabetic diet, while 25.6% followed an exercise regimen. Additionally, eight patients (6.8%) had diabetic microvascular complications (Table 1).

The mean FPG level was 170 ± 70.82 [SD] mg/dL. The mean HbA1c value of patients was $8.5\% \pm 1.71$. The mean creatinine levels were 0.66 ± 0.12 [SD] mg/dL. The mean eGFR was 115.52 ± 14.55 [SD] 60 ml/min/1.73m². The mean ALT levels were 13.3 ± 7.0 [SD] IU/L. The mean TSH level was 2.14 ± 1.10 [SD] mIU/mL.

The distribution of correct responses across the survey questions was as follows: 24.8% of participants answered question 1 correctly, 46.2% answered question 2 correctly, 47% answered question 3 correctly, 36.8% answered question 4 correctly, 95.7% answered question 5 correctly, 69.2% answered question 6 correctly, 49.6% answered question 7 correctly, 33.3% answered question 8 correctly, 86.3% answered question 9 correctly, 79.5% answered question 10 correctly, 71.8% answered question 11 correctly, 75.2% answered question 12 correctly, 59.8% answered question 13 correctly, and 44.4% answered question 14 correctly. The overall mean score of the patients was 58.26% (Table 2).

Table 3 presents a comparison of mean survey scores among different participant groups. A statistically significant difference was observed between women who had received preconception care training and those who had not (71% (35-100) vs. 42% (0-85), $p<0.001$), indicating higher levels of knowledge and awareness among trained individuals. Similarly, participants with a history of previous pregnancies demonstrated significantly higher scores compared to those without such a history (64% (14-100) vs. 50% (0-85), $p<0.001$). No statistically significant differences were found

Table 3: Comparison of Median Survey Scores Across Different Groups.

Groups	Medians of survey scores	p-value
Received preconception care training		
Yes	71	<0.001
No	42	
Previous pregnancy history		
Yes	64	<0.001
No	50	
History of fetal complications		
Yes	64	0.590
No	64	
History of maternal complications		
Yes	69	0.210
No	64	

Note: Statistically significant differences were observed between groups in preconception care training and pregnancy history ($p<0.05$).

in survey scores between those with and without a history of fetal complications ($p=0.59$), or maternal complications ($p=0.21$) in previous pregnancies.

Correlation analysis revealed a positive correlation between knowledge scores and factors such as the patient's age ($p<0.001$, $r=0.29$), duration of DM ($p<0.001$, $r=0.28$), marital status ($p<0.001$, $\rho=-0.48$), pregnancy history ($p<0.001$, $\rho=0.37$), and previous education ($p<0.001$, $\rho=0.57$). However, no correlation was found between the patient's educational level and their knowledge scores ($p=0.71$). No correlation was found between FPG and HbA1c levels and the knowledge scores ($p=0.25$, $p=0.06$).

DISCUSSION

Our study is the first to assess the preconception care knowledge level in Turkish patients with type 1 DM in the available literature. Preconceptional care provides significant benefits for improving both maternal and fetal health in women with DM. Despite this well-documented benefit, participation rates in preconceptional care remain below 50%, as evidenced by existing studies in the literature, which highlight geographical differences (17,18). This low participation rate suggests that despite the high benefits, adequate attention has not been given to implementing preconceptional care. Although preconceptional care is a global health issue, the lack of substantial changes in scientific publications since the first study in 1998 indicates that insufficient measures have been taken. Our study similarly found that 48.7% of patients with type 1 DM had received prior education about preconceptional care (19,20). Furthermore, nearly all participants in the study have been followed in

specialized units for diabetes care, and the low percentage of patients who received education on preconception care may indicate a significant gap in this area. Identifying gaps in clinician- and patient-centered approaches to improving maternal and fetal health within this patient group could contribute to developing more effective health policies.

The first two questions of the second section of our survey addressed contraception. Only 24.8% of participants answered the first question correctly, while 46.2% answered the second question correctly. This is particularly significant given that studies have shown that women with DM aged 18 to 45 receive less counseling and fewer prescriptions for contraception compared to their non-diabetic counterparts (47.8% vs. 62.0%) (21). Moreover, the study by Schwarz et al. demonstrated that many women with DM believe they have very few safe contraceptive options, further underscoring the need for improved education and guidance in this area (22). For individuals with DM, pregnancy planning is critical to achieving optimal glycemic control, which is essential for preventing congenital malformations and minimizing pregnancy-related complications. One of the significant barriers to this process is unplanned pregnancy. Therefore, all individuals with DM who are of reproductive potential should be regularly informed about effective contraceptive methods and should have access to the same range of contraceptive options as those without DM. However, the potential metabolic effects of hormonal methods may require a careful risk-benefit assessment based on an individual's diabetic profile. A significant number of young women with poorly controlled DM or additional cardiovascular risk factors may have influenced clinicians to avoid prescribing hormonal contraception. Paradoxically, these women are among those most at risk for unplanned pregnancy. In their study, Shawe et al. demonstrated that hormonal contraception is a safe and effective option for women with uncomplicated DM (23). The importance of effective contraceptive management is further emphasized by the American Diabetes Association, which recommends that: 'Family planning should be discussed, and effective contraception (with consideration of long-acting, reversible contraception) should be prescribed and used until a woman's treatment regimen, and HbA1c are optimized for pregnancy' (11). Educating patients about the more significant risks associated with unplanned pregnancy in DM, in comparison to the risks of available contraceptive methods, may increase awareness and support more informed reproductive health decisions. Prescribing 400 mg of folic acid before conception is recommended (24). The percentage of participants who correctly answered this question was 36.8%.

The proportion of participants who correctly identified the pre-pregnancy target for fasting plasma glucose was 69.2%. In comparison, 49.6% correctly identified the target for two-hour postprandial plasma glucose, and 33.3% correctly identified the target HbA1c levels. It is recommended to optimize glycemia prior to conception with an HbA1C level of <6.5% (<48 mmol/mol), fasting plasma glucose is 80–110 mg/dL, and postprandial plasma glucose is <155 mg/dL, as this is associated with the lowest risk of congenital anomalies, given that organogenesis primarily occurs between 5 and 8 weeks of gestation (11). Achieving this target is also linked to a reduced risk of preeclampsia and preterm birth. It was observed that fewer than half of the participants correctly identified the preconceptional glucose targets. In order to achieve these targets, individuals must be first made aware of them. By identifying gaps in participants' knowledge, our study further highlights the importance of preconception care education.

During pregnancy, treatment is adjusted based on fasting and postprandial glucose targets. For individuals with type 1 DM, multiple daily insulin doses should be administered. In cases where multiple daily insulin injections are insufficient, transitioning to insulin pump therapy (CSII) may be considered for pregnant individuals with type 1 DM. Current insulin formulations have been shown not to cross the placenta. Insulins classified as category B for pregnancy include basal insulins such as detemir or NPH and bolus insulins like short-acting crystalline (regular) insulin or rapid-acting analog insulins (lispro, aspart). Although glulisine, glargine, and degludec insulins have not shown adverse maternal or fetal effects, insufficient randomized controlled trials recommend their use during pregnancy. Glargine, degludec, and glulisine insulins are classified as category C for pregnancy. The percentage of participants who correctly answered the question regarding insulin use during pregnancy was 47% in our study. Individuals with DM of reproductive age need to have accurate knowledge about the types of insulin that can be safely used during pregnancy, as this plays a critical role in pregnancy planning and in ensuring the timely initiation of regular antenatal care once pregnancy occurs.

Over 70% of participants correctly answered questions regarding the association between hyperglycemia during pregnancy and fetal and maternal complications. However, only 59.8% of participants were aware that women with DM have an increased risk of having macrosomic infants, and 44.4% correctly identified that hyperglycemia increases the risk of miscarriage. Previous studies have reported that postprandial hyperglycemia is a good predictor of macrosomia (25).

In our study, participants' average score of correct answers to the survey questions was 58.6%. Therefore, one of the most effective changes that could be made is ensuring that all women with DM begin receiving education about pregnancy complications starting from adolescence. Sereika et al. demonstrated that women who received information about preconception care during adolescence were more likely to use effective birth control and seek guidance from a health-care provider when planning a pregnancy (26). Planning pregnancy also allows more time to improve health, preserve fertility, have a healthy mother, and have healthy birth outcomes (27). It is also crucial to plan these educational interventions in a multidisciplinary manner. The health-care professionals patients have access to vary, and in our study, we found that physicians from different specialties had educated participants who reported receiving prior education on this topic. Therefore, it would be valuable to include healthcare providers from various specialties in the educational planning for this issue.

Another objective of our study was to identify factors influencing knowledge levels. The duration of DM was positively correlated with knowledge level. Similarly, a study conducted in France found that women diagnosed with DM before age 15 exhibited higher interest levels than others (14). This may be related to the fact that individuals with a longer duration of DM likely had more education opportunities. Similarly, our study also found positive correlations between knowledge levels and factors such as age, prior education on preconception care, and previous pregnancy history. The increased exposure to relevant education and experience with age could explain this. However, our study did not find a correlation between educational and knowledge levels. Even among those with higher education, a lack of training on the subject was associated with insufficient knowledge. This further underscores the importance of planning educational interventions on this topic from a health policy perspective.

Limitations of our study include the exclusion of women with type 2 DM and the lack of an evaluation of clinicians' approaches to the issue. Being a single-center study limits the generalizability of our findings. A broader, multicenter approach would help capture a more diverse population, which may lead to more representative results. However, a significant strength of our study is that it is the first to be conducted among Turkish women with type 1 DM, and it is expected to significantly contribute to shaping future health policies. Also, our study directly addresses an important issue in maternal and fetal health by assessing the knowledge levels of women with T1DM, helping to identify gaps in preconception care education, and supporting the

development of tailored interventions to improve pregnancy outcomes.

In conclusion, our study revealed that women with type 1 DM have moderate knowledge of preconception care, with significant gaps in areas such as contraceptive use, glycemic targets, and insulin safety during pregnancy. Participants with prior education, longer DM duration, or previous pregnancies showed higher knowledge levels. These findings emphasize the importance of integrating structured preconception education into routine DM care to support healthier pregnancy outcomes. The foundation of planning involves making decisions about what will be done in the future based on known information from both the past and the present.

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None.

Authors' contributions

All authors contributed to the study conception and design. Material preparation, and analysis were performed by **Burcak Cavnar Helvacı**. Data collection was performed by **Burcak Cavnar Helvacı**, **Burcu Candemir**, **Murat Cinel**, and **Sule Canlar**. The first draft of the manuscript was written by **Burcak Cavnar Helvacı** and all authors commented on previous versions of the manuscript. The study was supervised by **Sema Hepsen**, **Murat Dagdeviren**, **Ermann Cakal**. All authors read and approved the final manuscript.

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Conflict of Interest

The authors declare that they have no conflict of interest. In addition, the authors have no financial relationship with the companies that manufactured the materials used in this study.

Ethical Approval

All procedures performed in studies involving human participants were by the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study protocol received approval from the local ethical committee on September 11, 2024, under the reference number AESH-BADEK-2024-751. Informed consent was obtained from all participants included in the study.

Peer Review Process

Externally and extremely peer-reviewed.

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Supplementary Table 1 Survey (English version)

Question 1	"Diabetic women have more limited contraceptive options compared to women without diabetes."	True False Not sure
Question 2	"Women with diabetes cannot use oral contraceptives for family planning."	True False Not sure
Question 3	"All insulins are suitable for use during pregnancy."	True False Not sure
Question 4	"Women with diabetes planning a pregnancy should take the same amount of folic acid as women without diabetes."	True False Not sure
Question 5	"Women with diabetes should receive education from a healthcare professional regarding pregnancy planning and the pregnancy process."	True False Not sure
Question 6	"What should the preconception fasting plasma glucose target be?"	
Question 7	"What should the preconception postprandial plasma glucose target be?"	
Question 8	"What should the preconception HbA1c level % target be?"	
Question 9	"Women with diabetes can have a healthy baby."	True False Not sure
Question 10	"Preconception blood glucose levels can affect fetal health."	True False Not sure
Question 11	"Blood glucose levels during pregnancy can affect the mother's health."	True False Not sure
Question 12	"Blood glucose levels during pregnancy can affect the fetal health."	True False Not sure
Question 13	"Women with diabetes have a higher risk of delivering babies weighing over 4000 grams compared to women without diabetes, and this condition may complicate labor."	True False Not sure
Question 14	"Women with uncontrolled diabetes have a higher risk of miscarriage compared to women without diabetes."	True False Not sure

Ek Tablo 2 – Anket (Türkçe versiyonu)

Soru 1	"Diyabetli kadınlar, diyabeti olmayan kadınlara kıyasla daha sınırlı doğum kontrol yöntemlerine sahiptir."	Doğru Yanlış Bilmiyorum
Soru 2	"Diyabetli kadınlar, aile planlaması için doğum kontrol hapı kullanamazlar."	Doğru Yanlış Bilmiyorum
Soru 3	"Tüm insülinler, gebelik sırasında kullanım için uygundur."	Doğru Yanlış Bilmiyorum
Soru 4	"Diyabetli kadınlar gebelik planlarken, diyabeti olmayan kadınlarla aynı miktarda folik asit almalıdır."	Doğru Yanlış Bilmiyorum
Soru 5	"Diyabetli kadınlar, gebelik planlaması ve gebelik süreci hakkında bir sağlık profesyoneliinden eğitim almalıdır."	Doğru Yanlış Bilmiyorum
Soru 6	"Gebelik öncesi açlık plazma glukoz hedefi ne olmalıdır?"	
Soru 7	"Gebelik öncesi tokluk 2.saat plazma glukoz hedefi ne olmalıdır?"	
Soru 8	"Gebelik öncesi HbA1c % hedefi ne olmalıdır?"	
Soru 9	"Diyabetli kadınlar sağlıklı bir bebek sahibi olabilirler."	Doğru Yanlış Bilmiyorum
Soru 10	"Gebelik öncesi kan glukoz seviyeleri, fetal sağlığı etkileyebilir."	Doğru Yanlış Bilmiyorum
Soru 11	"Gebelik öncesi kan glukoz seviyeleri, annenin sağlığını etkileyebilir."	Doğru Yanlış Bilmiyorum
Soru 12	"Gebelik sırasında kan şekeri seviyeleri, fetüsün sağlığını etkileyebilir."	Doğru Yanlış Bilmiyorum
Soru 13	"Diyabetli kadınların, diyabeti olmayan kadınlara kıyasla 4000 gramdan fazla ağırlığa sahip bebek doğurma riski daha yüksektir ve bu durum doğumu zorlaştırabilir."	Doğru Yanlış Bilmiyorum
Soru 14	"Kontrolsüz diyabeti olan kadınların, diyabeti olmayan kadınlara kıyasla düşük yapma riski daha yüksektir."	Doğru Yanlış Bilmiyorum

Perceptions of Diabet in Type 1 Diabetes and Type 2 Diabetes: A Mixed-Methods Comparative Insight

Tuğba BİLGEHAN¹  , Bahar VARDAR İNKAYA¹ , Ayşenur ALTUNSOY² , Mehmet AYTEMUR³ 

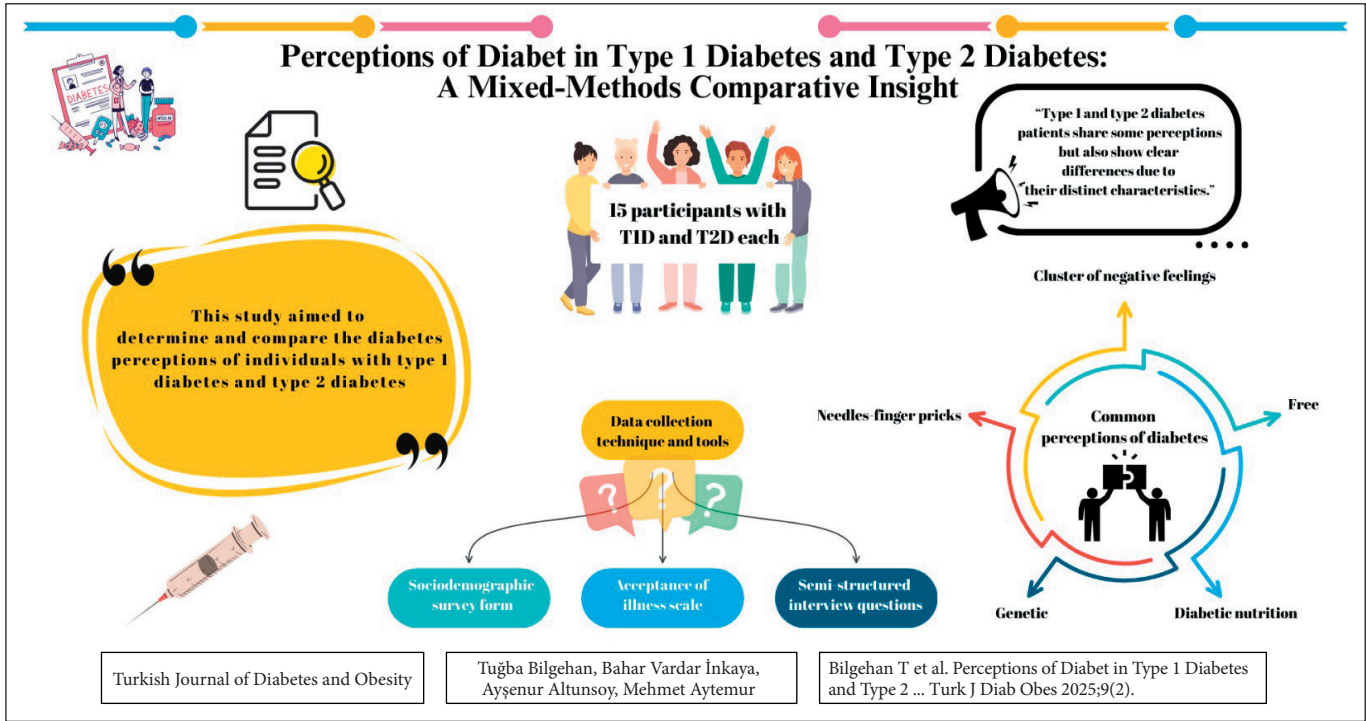
¹Ankara Yıldırım Beyazıt University, Health Science Faculty, Nursing Department, Ankara, Türkiye

²Ankara Yıldırım Beyazıt University, Institute of Health Sciences, Department of Internal Medicine Nursing, Ankara, Türkiye

³Erciyes University, Institute of Health Sciences, Department of Internal Medicine Nursing, Kayseri, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Aim: Type 1 diabetes and type 2 diabetes exhibit significant differences in terms of treatment methods, and management processes. This mixed-method study explored and compared the diabet perceptions of individuals with type 1 diabetes and type 2 diabetes.

Material and Methods: This study employed a convergent parallel mixed method design, integrating both quantitative and qualitative approaches. The research included a total of 30 people, 15 with diagnosis of type 1 diabetes and 15 with diagnosis of type 2 diabetes, meeting the inclusion criteria. Data were collected from April to December 2023 using sociodemographic surveys, the Acceptance of Illness Scale, and semi-structured interviews. The quantitative data were analyzed using SPSS 27.0, while the qualitative data were analyzed using the Nvivo 12.

Results: The mean illness acceptance score for the participants was 22.50 ± 5.63 . Qualitative analysis revealed seven themes regarding diabetes perceptions, including the cause of diabetes, management priorities, facilitators, challenges, pre- and post-diabetes experiences,

ORCID: Tuğba Bilgehan / 0000-0002-3326-776X, Bahar Vardar İnkaya / 0000-0002-9151-6795, Ayşenur Altunsoy / 0000-0002-4212-6643, Mehmet Aytemur / 0000-0002-8381-5023

Correspondence Address / Yazışma Adresi:

Tuğba BİLGEHAN

Ankara Yıldırım Beyazıt University, Health Science Faculty, Nursing Department, Ankara, Türkiye
Phone: +90 (554) 468 65 52 • E-mail: tgb.bilgehan@gmail.com

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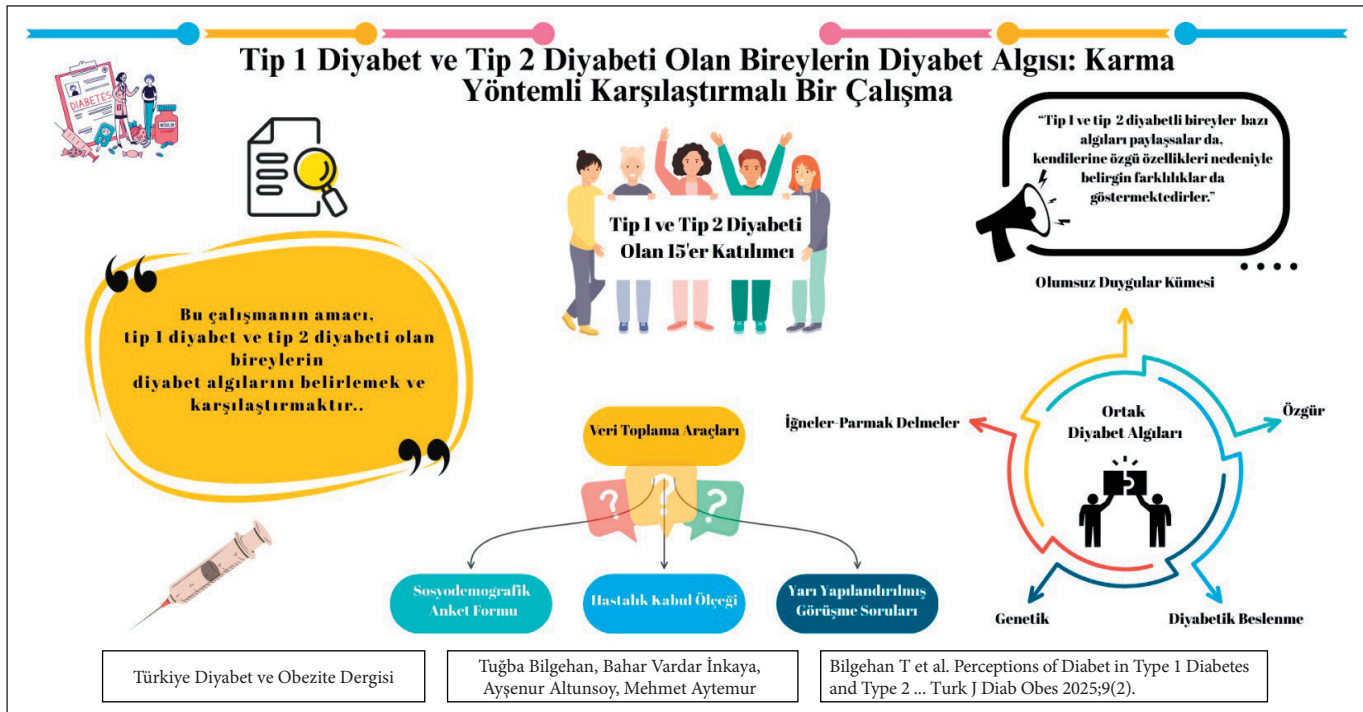
and emotional aspects. Participants with type 1 diabetes often linked their condition to stress and uncertain, whereas type 2 diabetes participants more frequently cited lifestyle habits and fate as contributing factors. Furthermore, both groups emphasized the importance of nutrition, medication adherence, and physical activity in managing diabetes, with type 1 diabetes participants additionally focusing on self-awareness and balance.

Conclusion: The findings highlight differences in diabetes perceptions between individuals with type 1 diabetes and type 2 diabetes, indicating the need for tailored approaches to diabetes management and education.

Keywords: Acceptance process, Perception, Type 1 diabetes mellitus, Type 2 diabetes mellitus, Qualitative research

Tip 1 Diyabet ve Tip 2 Diyabeti Olan Bireylerin Diyabet Algısı: Karma Yöntemli Karşılaştırmalı Bir Çalışma

GRAFİKSEL ÖZET



INTRODUCTION

Diabetes mellitus (DM) is an endocrine and metabolic disease occurring due to inadequate secretion of insulin due to destruction of beta cells in the pancreas, absence or impaired action of insulin in the body, progressing with capillary membrane changes and accelerated atherosclerosis, characterized by hyperglycemia, requiring chronic and continuous care due to disrupted metabolism of fat, protein and carbohydrate digestion, where microvascular and macrovascular complications may develop. The two most frequently-encountered types of diabetes are type 1 diabetes and type 2 diabetes. Type 1 diabetes is generally diagnosed in the childhood period and is defined as an insulin-dependent diabetes. Type 2 diabetes is defined as disease at advanced age characterized by elevated blood sugar due to inability of the pancreas to secrete sufficient amounts of insulin or inability of the body to use secreted insulin to a sufficient degree (1,2).

As in the rest of the world, diabetes has become an important public health problem in Türkiye with increasing prevalence every day. According to data from the International Diabetes Federation (IDF), in 2019 there were 463 million individuals with diabetes in the world, while this number is expected to rise by 51% and reach 700 million individuals by 2045 (3). It is predicted that mean 8.3 per 100 people globally are diabetic individuals. According to IDF 2019 diabetic atlas data, 6.6 million diabetic individuals live in Türkiye; however, this number is expected to reach 10 million by 2045. Additionally, the IDF predicted that Türkiye would be one of the top 10 countries where most diabetics live globally in 2045 (3,4).

If diabetes management is not effectively provided, it may become a situation with negative impact on all areas of life and quality of life of an individual. It is a chronic disease with high levels of mortality and morbidity due to the chronic complications related to diabetes (e.g., retinopathy, nephropathy, neuropathy). Perceptions related to diabetes of diabetic individuals are known to have a significant correlation with treatment requirements and other diabetes management practices. Supporting this view, a recent study from Türkiye reported that individuals with diabetes who perceived higher complication risks exhibited stronger self-management skills, underscoring the strong relationship between illness perceptions and disease management (5,6). As a result, in recent years, as with several diseases, the concept of disease perception among individuals with diabetes has begun to gain importance (5).

Disease perception is the meaning given to disease in line with the cognitive reflections of the person's current status,

in other words the person's own beliefs, closely affecting the whole life and treatment process of the individual (7,8). When people learn that they are sick, they develop a variety of beliefs in line with their personal experiences, culture, values and knowledge to give meaning to the situation (9). These beliefs comprise key points in the person's behavior during disease management and changes to the disease perception and ideas of the individual are reflected in the treatment process (9). The disease perception forming in individuals appears to be a driving force in decision-making about the disease and the beginning of the process (10). The perceptions or cognitive processes forming in individuals directly affect the individual's emotional response to the disease, ways of coping, adherence to treatment and quality of life (7,9).

Disease perceptions of individuals with type 1 diabetes and type 2 diabetes may be different. Type 1 diabetes and type 2 diabetes involve a variety of differences in terms of age of diagnosis, treatment and management processes. Individuals with type 1 diabetes use lifelong insulin treatment as a treatment method; however, individuals with type 2 diabetes can use a variety of treatment types led by oral anti-diabetics. Though both are types of the same disease, there appear to be differences in terms of management processes and difficulties encountered during these processes (1,2,10).

Disease perceptions of individuals with chronic disease like diabetes affect quality of life and self-care (11,12). Detection of how individuals perceive disease plays an important role in disease management. Diabetes is a chronic situation with psychosocial dimensions affecting emotional, social, economic and mental status of the individual, in addition to its physical effects. In addition to the physical effects of diabetes, there are psychosocial dimensions and it is a chronic situation that affects the individual's emotional, social and spiritual status through these dimensions. In this context, evaluating the disease perception of individuals with diabetes from several perspectives gains additional importance (13-15).

Most research about this topic appears to have used quantitative techniques (10,16). In the literature, there is no research encountered investigating diabetes perception with qualitative techniques in addition to measurement of disease perception forming in diabetic individuals with quantitative methods. In addition to quantitative research, there is a need for more information to understand how diabetic individuals perceive diabetes and how they symbolize their perceptions. Within this framework, this research is thought to fill a gap in the literature by comparing the two diabetes types using quantitative and qualitative methods together in relation to perceptions of diabetic individuals

about their disease. This study aimed to determine and compare the diabetes perceptions of individuals with type 1 and type 2 diabetes.

MATERIAL AND METHOD

Research Type

This study employed a convergent parallel mixed method design, integrating both quantitative and qualitative approaches. In this design, multiple forms of data are collected concurrently and examined from different perspectives to provide a more comprehensive understanding of the research questions (17,18). The convergent parallel design allows for the simultaneous collection, separate analysis, and subsequent integration of quantitative and qualitative findings, thereby offering a deeper and more nuanced understanding of illness perceptions among individuals with type 1 and type 2 diabetes. By combining these complementary approaches, the study strengthens the validity of the results and provides a more robust basis for addressing the research objectives.

Research questions:

- What are the illness acceptance levels of individuals with type 1 diabetes and type 2 diabetes?
- What are the opinions of type 1 diabetes and type 2 diabetic individuals about diabetes perceptions?
- Are there differences between the diabetes perceptions of individuals with type 1 diabetes and type 2 diabetes?

Research Population and Sample

The population of the study consisted of individuals diagnosed with type 1 diabetes and type 2 diabetes who applied to the internal medicine outpatient clinics of Ankara Mamak State Hospital and Duatepe State Hospital. The purposeful sampling method was applied when determining the sample for the research (19). The research included individuals aged 18-64 years, without communication or hearing disability, with no psychiatric problems, with diagnosis of type 1 diabetes or type 2 diabetes for at least one year, without development of any advanced chronic complications and who accepted voluntary participation in the research. Reaching data saturation in qualitative research is an important criterion to complete the data collection process and it is accepted that there is no need to collect data after data saturation (20,21). In line with this, the research was ended when data saturation was reached. The research included a total of 30 people, 15 with diagnosis of type 1 diabetes and 15 with diagnosis of type 2 diabetes, voluntarily accepting participation and meeting the inclusion criteria.

Ethical Aspect of the Research

To be able to perform the research, ethics committee permission was obtained from Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee Chair (research code: 2022-1152, ethics committee decision date and number: 10.11.2022-16) and necessary written permissions were obtained from the institutions where the research was performed. This research process was completed in accordance with the Helsinki Declaration. Participants provided written consent after being given information about what the research was, purpose, importance, method and data collection forms. They were informed that the surveys would not include any information related to their personal information and that these surveys would not be shared with anyone other than the researchers. After collecting research data, it was stored in locked cupboards and encrypted computers where no one other than the researchers could access it. Recordings and transcripts were stored in a password-protected device. The study is reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) 32-item checklist (22).

Data Collection Technique and Tools

Collection of data used a sociodemographic survey form, acceptance of illness scale and semi-structured interview questions.

Sociodemographic survey form: This form was developed after literature screening by the researchers and included a total of 13 questions about age, gender, marital status, educational status, employment status, type of diabetes and years of diabetes diagnosis (10,23).

Acceptance of Illness Scale: This was developed by Felton et al. in 1984 with the aim of determining disease acceptance levels of individuals (24). Turkish validity and reliability studies for diabetic individuals were performed by Besen et al. The scale has 5-point Likert type rating and comprises eight items. Increased scores obtained from the scale show increased level of acceptance of illness. The Cronbach alpha coefficient for the scale was 0.79 (25). In this research, the Cronbach alpha coefficient for the scale was 0.82.

Semi-structured Interview Questions: These comprised a total of 14 open-ended questions to learn the diabetes perceptions of individuals. Questions were created by the researchers after literature screening (10,16, 26) (Table 1).

Data Collection Process

Collection of data occurred from April 2023 to December 2023. Qualitative and quantitative data were collected simultaneously with the face-to-face interview method.

Table 1: Semi-structured interview questions.

1. What do think is the reason you have diabetes?
2. What did you feel when you first learned about your diabetes diagnosis?
3. If you could express your diabetes using 3 words, what would they be?
4. For you, what is the most important thing related to diabetes?
5. Please explain the effects of diabetes on your daily life.
6. Considering your diabetes in general, how do you feel? Which emotions?
7. What was the first symptom of diabetes in your body and how did this affect you?
8. What do you feel about your diabetes?
9. Please explain what type of health care is required for your diabetes?
10. Please explain what situations facilitate or assist you in managing your diabetes.
11. Please explain the situations most difficult for you for diabetes management and tough situations about hard management diabetes.
12. What was your individual life like before diabetes?
13. What was your individual life like after diabetes?
14. What 3 things would you like to change about your diabetes?

After the research received ethics committee and institutional permission, individuals accepting participation and meeting the research criteria were explained the purpose and content of the research and that they could leave the research at any point by the interviewing researcher. After this information was given, those who signed the volunteer consent form were accepted into the research.

For collection of quantitative data, the researcher asked a total of 13 questions about sociodemographic data to individuals participating in the research. Then the individuals completed the Acceptance of Illness Scale. This section lasted about 10-15 minutes.

Interviews were held face-to-face asking the semi-structured questions and every interview was recorded with a voice recording device with permission of the participant.

Statistical Analyses

Data were analyzed from the inductive perspective. The inductive analysis approach involves separating data into categories by coding, revealing the relationships between the categories and obtaining an integrated picture from the categories and sub-categories based on this. The basic point of data analysis in the research comprised categoric coding that contains data (27). These data were analyzed and re-

ported using the NVivo 12 program. To increase reliability of the research, analysis was performed by the first and third authors. Then the second and fourth authors confirmed the suitability of the thematic structure. In situations without agreement, the researchers met again and again until consensus was reached. To increase validity and credibility of the research, some statements by individuals participating in the research are directly cited. Analysis of qualitative data obtained from interviews used the 7-stage analysis method developed by Colaizzi for phenomenological research (28). The qualitative data were analyzed following the seven-step descriptive phenomenological approach of Colaizzi: transcription and repeated reading of the data with reflective memos kept by the researchers; systematic extraction of significant statements; formulation and coding of meanings from these statements; grouping of codes into sub-themes and overarching themes; comprehensive description of all themes; derivation of the fundamental structure of the phenomenon; and verification with participants (member checking) (28). After the initial coding, the transcripts were returned to participants for feedback to confirm the accuracy and resonance of the interpretations. Throughout the analytic process, an audit trail was maintained, inter-coder consensus was achieved, and trustworthiness criteria (credibility, dependability, confirmability, and transferability) (29). The analytic process flowchart is presented in Figure 1, and an example coding table developed according to themes is shown in Table 2.

Analysis of quantitative data in the research was performed using the SPSS 27.0 program. For descriptive statistics, n, %, mean and standard deviation values are given. The Mann Whitney U test and Kruskal Wallis H test were used. Statistical significance level was accepted as $p < 0.05$.

RESULTS

Quantitative Findings of the Research

Most of the sample were women (70%), with 46.7% aged from 25-44 years, and 53.3% married. Of participants, 56.7% were university graduates, 63.3% were not employed, 26.7% had received diabetes education, 63.3% received social support and 73.3% did not have any chronic disease other than diabetes. When diabetes management and acceptance scores are examined, 76.7% of participants had diabetes acceptance scores from 6-10, while 90% of participants had diabetes management scores of 6-10 points. In the research, there was a statistically significant correlation identified between the mean acceptance of illness scale scores of diabetic individuals with the scores individuals had for acceptance of diabetes ($p < 0.05$). There were no significant correlations identified between other sociodemographic and di-

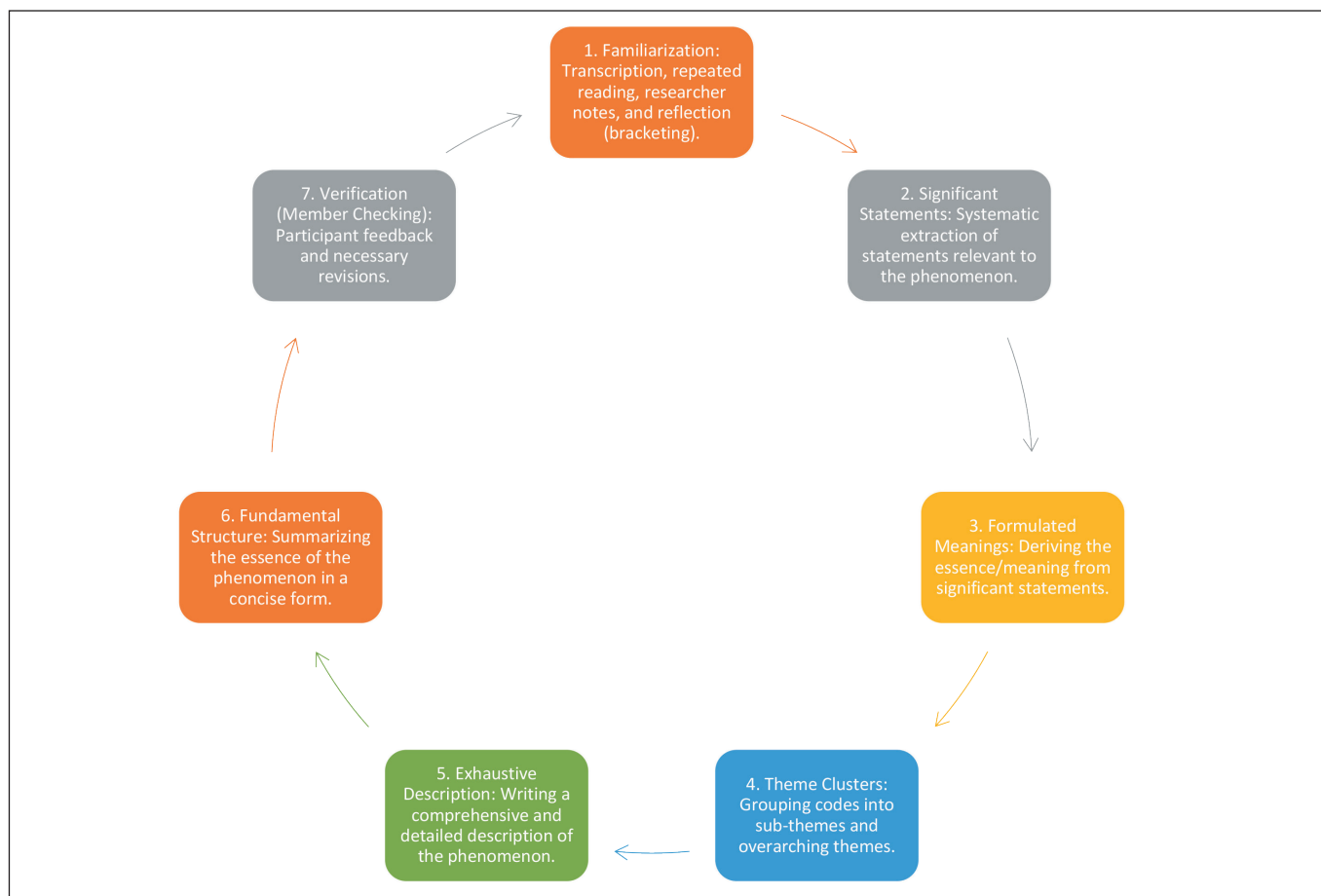


Figure 1: Colaizzi's seven-step phenomenological analysis process: The figure illustrates the sequential stages applied in the qualitative analysis, including data familiarization, extraction of significant statements, formulation of meanings, clustering into themes, development of comprehensive descriptions, derivation of the fundamental structure, and final verification through participant feedback (member checking).

Table 2: Colaizzi coding table.

Significant Statement	Formulated Meaning	Theme	Sub-theme
"...The hardest is pricking my fingers, it hurts so much when pricking, so I don't want to even check my sugar..."	Finger pricking causes pain and loss of motivation, and negatively affects glycemic control.	Difficulties in Diabetes Management	Needles-finger pricks
"...Fully genetic factors, it's in my family, I was expecting I would have it..."	Family history leads to interpretation of diabetes as genetic in cause.	Perceived Cause of Diabetes	Genetic
Surprise, sadness, fear... I really thought the world had fallen on my head... I	Shock, sadness, and fear all create a feeling that society and life are being turned upside down.	Emotional Responses	Cluster of negative feelings
"...Regular eating and nutritional content are very difficult for me... I consume a lot of packaged foods but normally there should be none of them..."	Changing unhealthy eating habits is challenging for the participant.	Difficulties in Diabetes Management	Diabetic nutrition
"...I was free, I lived by doing what I wanted. I ate without being fussy. I was irregular..."	Pre-diabetes is perceived as an unrestricted and free life.	The Period Before Diabetes	Free

abetes-related features of diabetic individuals with mean acceptance of illness scale scores ($p>0.05$; Table 3). In our research, the mean acceptance of illness scale score for diabetic individuals was identified as 22.50 ± 5.63 .

Qualitative Findings of the Research

This study explored the perceptions of diabetes among individuals with type 1 diabetes and type 2 diabetes through

Table 3: Sociodemographic and patient characteristics of individuals with diabetes.

Characteristic*	Findings (n=39)		Acceptance of Illness Scale	
Gender				
Woman	21	(70.0)	22.0	U=71.000
Man	9	(30.0)	19.0	p=0.304
Age				
18-24	7	(23.3)	19.0	KW=0.988
25-44	14	(46.7)	19.5	p=0.610
45+	9	(30.0)	23.0	
Marital status				
Single	14	(46.7)	20.0	U=113.500
Married	16	(53.3)	21.5	p=0.951
Educational level				
Primary education	2	(13.3)	19.5	KW=1.400
High school	9	(30.0)	23.0	p=0.706
University	17	(56.7)	19.0	
Employment status				
Employed	11	(36.7)	20.0	U=116.500
Unemployed	19	(63.3)	20.0	p=0.611
Duration of diagnosis				
1-6	18	(60.0)	21.0	KW=2.303
7-11	3	(10.0)	26.0	p=0.316
12+	9	(30.0)	19.0	
Type of diabetes				
Type 1	15	(50.0)	20.0	U=122.000
Type 2	15	(50.0)	20.0	p=0.713
Admission after diagnosis				
Yes	18	(60.0)	21.0	U=107.500
No	12	(40.0)	19.5	p=0.983
Received diabetes education				
Yes	8	(26.7)	19.5	U=101.000
No	22	(73.3)	21.5	p=0.565
Social support				
Yes	19	(63.3)	20.0	U=139.000
No	11	(36.7)	24.0	p=0.145
Chronic disease (apart from DM))				
Yes	8	(26.7)	19.0	U=116.500
No	22	(73.3)	22.5	p=0.185
Diabetes management score				
0-5	3	(10.0)	19.0	U=57.000
6-10	27	(90.0)	22.0	p=0.283
Diabetes acceptance score				
0-5	7	(23.3)	18.0	U=122.500
6-10	23	(76.7)	23.0	p=0.037

*Data are presented as number and percentages, n(%). **KW:** Kruskal Wallis Test **U:** Mann Whitney U Test **p:** Test significance value

a comparative and interpretative approach. While participants from both groups shared some common emotional and behavioral experiences, significant differences were identified in their understanding of the cause of diabetes, management strategies, perceived difficulties, and emotional responses (Figure 2). The themes are presented narrative-

ly below, with selected participant quotes to illustrate the diversity and depth of these experiences. In addition, both the quantitative and qualitative findings were integrated to provide a comprehensive understanding of illness acceptance and perceptions, as summarized in Table 4.

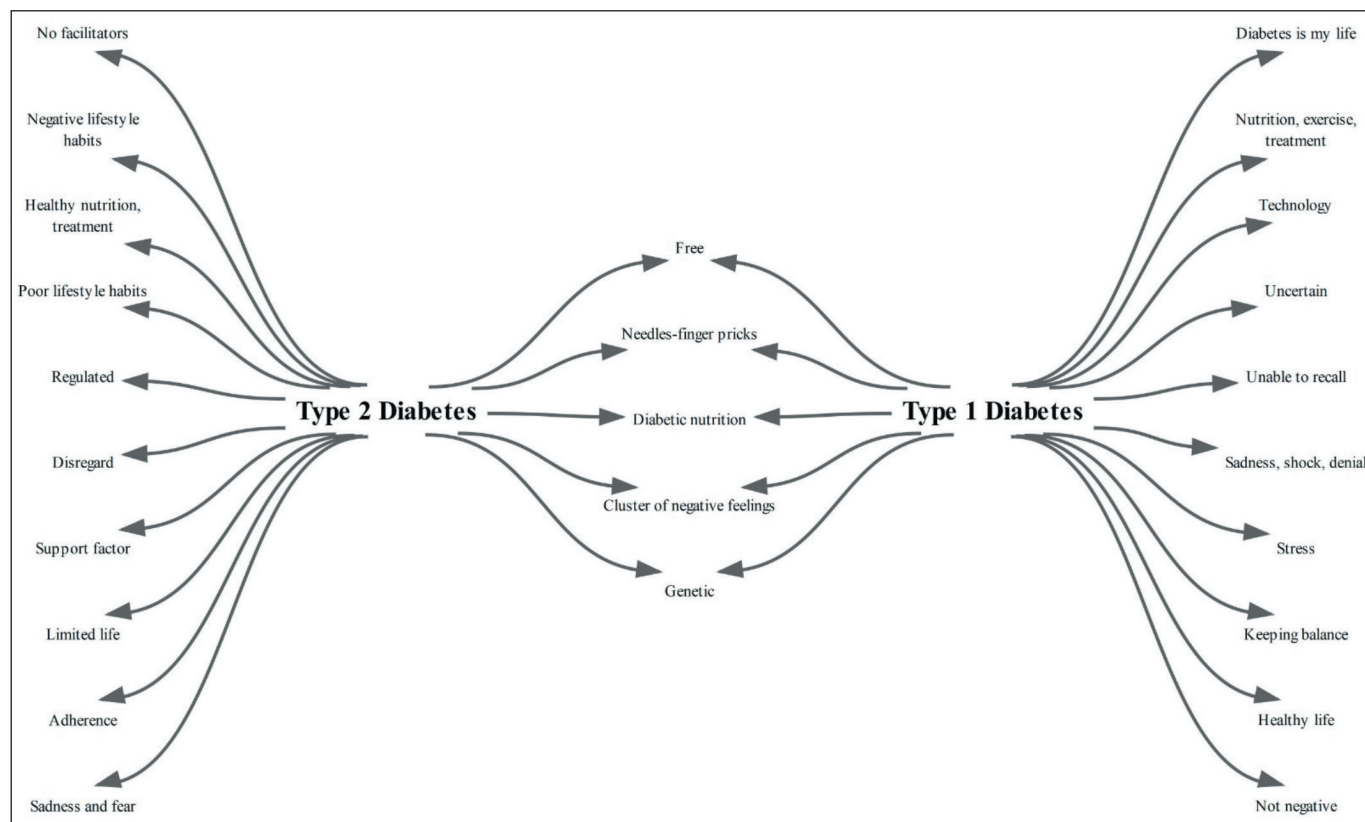


Figure 2: Common and divergent themes reflecting diabetes perceptions among individuals with type 1 diabetes and type 2 diabetes: The figure 1 presents both the shared perceptions (e.g., diabetic nutrition, genetic factors, negative feelings) and the distinct themes specific to each group, illustrating how diabetes perceptions differ between type 1 and type 2 diabetes.

Table 4: Integration of quantitative and qualitative findings on diabetes perceptions.

Quantitative Findings	Qualitative Findings	Integrated Interpretation
Illness Acceptance Scale mean score = 22.50 ± 5.63	Many participants described difficulties in adapting emotionally, especially at diagnosis.	Both data indicate partial acceptance and ongoing struggles.
No statistically significant difference between male and female participants on the Illness Acceptance Scale ($p > 0.05$).	Both male and female participants expressed similar challenges in emotional adjustment and coping with lifestyle changes.	Quantitative and qualitative findings both indicate no major gender-based differences.
No statistically significant difference in illness acceptance scores between T1D and T2D participants	T1DM participants: More emphasis on lifelong insulin use, early age diagnosis, identity challenges. T2DM participants: Greater focus on lifestyle change, diet, and medication adherence.	Quantitative results show no difference, but qualitative findings reveal distinct perception patterns between T1DM and T2DM.
Participants who rated their diabetes acceptance between 6–10 had significantly higher illness acceptance scores compared to those rating between 1–5.	Participants with higher self-ratings described more effective coping strategies, better emotional adjustment, and greater integration of diabetes into daily life. In contrast, those with lower ratings expressed denial, uncertainty, and greater psychological distress.	Quantitative results align with qualitative findings, as higher acceptance ratings corresponded with more positive illness perceptions and coping experiences.

Perceived Cause of Diabetes (Theme 1)

Individuals with type 1 diabetes often expressed “uncertainty” regarding the cause of their condition. Many could not recall the time before diagnosis or questioned why they had developed diabetes despite living a seemingly balanced life.

One participant reflected,

“...Actually, I asked myself this question a lot. It’s not in my genetics... however, believe me the cause is a giant question mark to me...” (P5).

In contrast, those with type 2 diabetes were more likely to attribute their diagnosis to “negative lifestyle habits”. Fast food consumption, physical inactivity, and poor dietary patterns were frequently cited. For instance, a participant stated,

“...I think my being diabetic is fully due to mistaken nutrition. I used to consume too much fast food and I enjoyed it. As a result, I was faced with diabetes...” (P16).

Only participants with type 1 diabetes identified stress as a trigger for their condition. Some recalled emotionally intense events shortly before the onset of symptoms, suggesting a perceived link between psychological trauma and disease manifestation. One adolescent participant described,

“...I had started middle school, the principal called us, he was very insulting, this situation upset me so, so much. I got stressed and then symptoms started...” (P13). Stress was seen not only as a trigger, but also as a complicating factor in disease control.

Among individuals with type 2 diabetes, some explained their diagnosis through the lens of fate or divine will. This belief helped participants distance themselves from self-blame and facilitated acceptance. One participant expressed this clearly:

“...Thinking about it, if only it hadn’t happened, I say, but what can be done—divine will. If it came from Allah, there’s nothing to be done. Fate, I say...” (P24). While not universal, this interpretation served as a source of comfort for several participants.

Genetic factors were acknowledged by participants in both type 1 diabetes and type 2 groups. Those with a family history of diabetes frequently accepted the diagnosis as something expected or inevitable.

“...Fully genetic factors, it’s in my family, I was expecting I would have it...” (P4) stated a participant with type 1 diabetes, while a participant with type 2 diabetes noted,

“...Genetic tendency had an effect. Genetically it’s present in my family. When I didn’t pay attention, unfortunately it happened to me...” (P19). Genetic explanations often helped individuals rationalize the diagnosis and reduce self-blame.

Foundations of Diabetes Management (Theme 2)

Participants from both type 1 diabetes and type 2 diabetes groups consistently identified healthy nutrition, medical treatment, and medication adherence as the most essential components of diabetes management. While this shared theme formed a common ground across both groups, some distinctions emerged. Participants with type 1 diabetes of-

ten expanded this understanding to include more reflective concepts such as maintaining balance and knowing oneself, reflecting a deeper personal integration of the disease into their daily lives. In contrast, participants with type 2 diabetes more frequently emphasized medication adherence and weight control as key strategies, often grounded in practical outcomes and behavioral adjustments.

Both groups underscored the importance of healthy nutrition, regular physical activity, and medical treatment as the fundamental pillars of diabetes management. Type 1 diabetes participants emphasized insulin use and precise blood glucose monitoring. One participant shared,

“...Paying attention to healthy nutrition, exercising and of course insulin is a condition. Then I adapt to diabetes in a way” (P2). Similarly, another participant stated,

“...Insulin use is the most important factor for my diabetes. Blood sugar control and checking insulin doses are important...” (P6).

Participants with type 2 diabetes also highlighted medication adherence and healthy eating as essential, particularly when reflecting on past lapses.

“...The most important factor is being able to eat healthily, I think. In fact, it happened because I didn’t pay attention in time...” (P23), said one participant. Another added,

“...Yes, for me, the most important thing is taking sufficient medications on time...” (P16). These perspectives reflect a shared understanding that structured routines and compliance with medical guidance are central to controlling diabetes.

Unique to the type 1 diabetes group was the theme of keeping balance, reflecting a deeper emotional and behavioral awareness of the self-management journey. Participants used metaphorical language to describe their efforts to live in harmony with their condition.

“...I like the expression like a rainbow after rain. If I do the things I should do, I see the rainbow. If I don’t, I must put up with the rain. There should be balance...” (P3) said one participant, demonstrating a poetic yet practical view of responsibility and consequence. This perspective indicates a broader life philosophy integrated into disease management.

Also unique to type 1 diabetes participants was the idea that knowing oneself is essential to managing diabetes. Some viewed self-awareness as the starting point for long-term success. *“...Firstly, you need to know yourself. Like a puzzle, the rest will come...”* (P12) shared one participant, highlighting a reflective approach that emphasized inner understanding as a foundation for external behavior change.

In contrast, type 2 diabetes participants highlighted the need for adherence and adjustment—often presented as a struggle but also as a necessity. One participant expressed, “...It’s important to adjust. Diabetes is actually a very problematic illness... I’m aware of this, but humankind can’t understand some things until the last minute. I won’t be like that, Inshallah...” (P21). This statement reflects a tension between awareness and action, suggesting that knowledge alone is not always sufficient for behavioral change.

Lastly, some participants with type 2 diabetes emphasized weight control as their top priority. This view was often rooted in the belief that losing weight would directly improve glucose levels.

“...For me, I think the important thing is my weight. If I lose weight, my sugar will drop and I’ll be a little more comfortable...” (P25) noted one participant. This belief often shaped participants’ goals and strategies, and was expressed as both a motivator and a challenge.

Facilitators in Diabetes Management (Theme 3)

When asked about what makes it easier to live with and manage diabetes, participants shared diverse experiences. While individuals with type 1 diabetes mostly identified internal strengths, use of technology, and quality education as key facilitators, participants with type 2 diabetes often described external social support—or in some cases, the complete absence of any facilitative factors. This contrast highlights the role of both structural resources and individual context in diabetes management.

Participants with type 1 diabetes frequently identified diabetes-related technology as a major facilitator in daily disease management. Devices such as insulin pumps and continuous glucose monitoring systems were viewed as tools that simplified their routines and enhanced their control.

“...Pump and sensor use make my life easier; diabetes technology really means everything...” (P2) shared one participant. This sentiment reflected not only convenience, but also an emotional sense of relief and safety that came with real-time monitoring and automated insulin delivery.

Some type 1 diabetes participants also pointed to personal characteristics—such as being organized, active, or disciplined—as internal resources that helped them cope with the demands of diabetes. One participant stated,

“...I was a mobile and disciplined person. This situation assisted in my adapting to diabetes and about organizing my lifestyle in this way. As I was an active person, I really love exercising...” (P7). Such qualities were often framed as pre-existing strengths that transferred into diabetes self-management and created a sense of empowerment.

The value of educational support was another theme voiced by type 1 diabetes participants. Those who received high-quality, personalized training from healthcare professionals described it as a turning point in their disease journey.

“...I think what facilitates for me is that I received very good diabetes education. My doctor and the nurses did not just give rote training; they explained things they had seen benefit from when they applied them...” (P1). These narratives emphasize the importance of applied, experience-based education in creating understanding and confidence in disease management.

Among type 2 participants, family support emerged as a significant external facilitator. Spouses, children, and other relatives were described as active figures in monitoring and motivating the participant’s diabetes care.

“...My family, my spouse and my children facilitate for me. They warn me to check my sugar, don’t eat too much, they say. They manage me; for this reason, I’m better...” (P25). These participants often relied on reminders and emotional support to sustain daily care routines, highlighting the relational nature of diabetes management in this group.

In stark contrast, a large number of type 2 participants reported having no facilitators at all. This sense of isolation or lack of support sometimes contributed to a negative or disengaged approach toward managing the condition. One participant stated bluntly,

“...There are no facilitating situations for me. What could there be? Nothing, never...” (P27). These responses reflected a feeling of helplessness or disengagement, suggesting the absence of both internal motivation and external support structures.

Among individuals with type 2 diabetes, support from family members emerged as a meaningful facilitator. Relatives were often described as active partners in managing the disease.

“...My family, my spouse and my children facilitate for me... they warn me to check my sugar, don’t eat too much, they say. They manage me...” (P25). Another participant added,

“...Thanks to my children, they facilitate things. When I forget something, they warn me...” (P28). These narratives reflect the interpersonal nature of diabetes care in this group, where family plays a guiding and motivating role.

Difficulties in Diabetes Management (Theme 4)

Participants described a variety of challenges related to living with and managing diabetes. These ranged from physical discomfort and dietary restrictions to psychological

burdens and lack of support. Although both type 1 diabetes and type 2 diabetes groups shared certain difficulties—particularly in relation to finger pricks and diabetic nutrition—other challenges were more specific to each group.

For both type 1 diabetes and type 2 diabetes participants, the act of pricking fingers for blood glucose monitoring was described as one of the most burdensome aspects of diabetes management. This physical discomfort was often linked to emotional avoidance. One participant with type 1 diabetes explained,

“...Every aspect is difficult for me. Measuring sugar, even injecting insulin, I don’t like it at all. I’ve never liked needles my whole life...” (P1). Similarly, a type 2 participant shared,

“...The hardest is pricking my fingers, it hurts so much when pricking, so I don’t want to even check my sugar...” (P25). The routine nature of finger pricks, despite being medically necessary, emerged as a demotivating factor across both groups.

Another commonly expressed challenge across both groups was diabetic nutrition. For some, the difficulty stemmed from early restrictive messaging at the time of diagnosis, which led to confusion or resistance.

“...At first when I received the diagnosis, they said you’ll never eat any chocolate or sweets... they didn’t mention carbohydrate counts. This situation felt very difficult...” (P6). For others, especially in the type 2 group, the issue was linked to behavioral change.

“...Regular eating and nutritional content are very difficult for me... I consume a lot of packaged foods but normally there should be none of them...” (P19). These statements reflect a struggle to adopt and sustain dietary habits aligned with diabetes care, often due to ingrained patterns or lack of willpower.

Among participants with type 1 diabetes, psychological distress was frequently reported as a hidden but profound difficulty. Emotions were not only centered around self-care, but also around relationships. One participant noted,

“...For me, the most difficult thing is the psychological dimensions. I should not upset my loved ones. If they are upset, I will also be very upset, and my diabetes will enter a very bad state...” (P1). This illustrates the emotional balancing act that individuals with type 1 diabetes often feel responsible for—managing not just their own wellbeing, but also the emotional impact on their surroundings.

In contrast, individuals with type 2 diabetes more commonly cited a lack of social or emotional support as a significant barrier to effective self-management. The absence of exter-

nal encouragement seemed to diminish their motivation to engage in regular care behaviors. One participant shared,

“...There is no one to motivate me to encourage management. I talk with friends and they have mothers, fathers, partners... they support them... but here, I have none of them...” (P16).

The absence of even basic encouragement appeared to leave some participants feeling isolated, unmotivated, and unable to sustain self-care practices on their own.

The Period Before Diabetes (Theme 5)

Participants were asked to reflect on the period before their diabetes diagnosis. Their narratives revealed contrasting themes of freedom, unawareness, and unhealthy behaviors. While individuals with type 1 diabetes often described this period as a vague or distant childhood memory, those with type 2 diabetes recounted specific lifestyle habits that they now believed contributed to the onset of the disease.

Participants from both groups described life before diabetes as a time of freedom—a period characterized by few restrictions and carefree living. This sense of autonomy often carried nostalgic undertones. One participant with type 1 diabetes reflected,

“...I was a child, I was like everyone is as a child. I was free. I was out on the street from morning to night, we ate and drank everything, there were no obligations—until diabetes...” (P15). Similarly, a participant with type 2 diabetes shared,

“...I was free, I lived by doing what I wanted. I ate without being fussy. I was irregular...” (P27). In both groups, the transition to a life with diabetes was experienced as a stark contrast to this earlier period of spontaneity and indulgence.

A unique subtheme in the type 1 diabetes group was the difficulty in recalling life before diagnosis, particularly among those diagnosed at a young age. For these individuals, diabetes had always been part of their lived experience.

“...I can’t really recall my previous life, believe me I was very small...” (P1) shared one participant. The absence of a clear “before” created a sense of continuity rather than rupture in some participants’ life stories.

In contrast, participants with type 2 diabetes often looked back on their pre-diagnosis lifestyle with critical awareness. Sedentary behavior, high sugar intake, and unhealthy eating patterns were commonly cited. One participant admitted,

“...The truth is I had a sedentary life. I got on great with deserts. I drank coffee and tea with lots of sugar. I consumed fast food outside, and when I came home, even before getting home, I would make plans about what I would eat at home...” (P21). These accounts suggest a retrospective understand-

ing of the role that lifestyle may have played in the development of diabetes, often accompanied by feelings of regret or accountability.

Period After Diabetes (Theme 6)

Participants' reflections on life after diabetes diagnosis revealed profound changes in lifestyle, routines, and identity. While both groups acknowledged the transformative nature of diabetes, the experience varied in tone. Type 1 diabetes participants often described a sense of integration—where diabetes became part of their identity—whereas individuals with type 2 diabetes more frequently emphasized external structure and limitation.

For many individuals with type 1 diabetes, the post-diagnosis period was characterized by a deep integration of diabetes into their identity and daily existence. The condition was no longer viewed as separate but rather as a defining element of life itself. One participant expressed, "...Time passes with measurements and blood sugar regulation. Diabetes is my life. It plans my life a little, but I don't miss my irregular child-like state" (P3). Another added,

"...I have become bound to diabetes... now that's my life..." (P1). These accounts reflected a level of acceptance and co-existence, where diabetes shaped routines, behaviors, and long-term self-concept.

In contrast, participants with type 2 diabetes often highlighted the theme of regulation as a major post-diagnosis change. For them, diabetes introduced structure—particularly in diet, sleep, and lifestyle—that was previously absent.

"...The most important change in my life is the transition to regular and healthy nutrition. I completely changed my eating-drinking pattern. I even began to pay attention to hours of sleep. I became regulated..." (P22). This transformation was viewed positively by some, signaling increased health awareness and discipline.

Some participants with type 1 diabetes described the shift toward a healthier lifestyle not only as an individual adaptation but also as a family-wide transition.

"...Now with my family we eat our food by counting carbohydrates... it's been a healthy change for us..." (P6). This collective effort reflected how the management of a chronic condition can extend beyond the individual and become a shared lifestyle within the household.

On the other hand, some individuals with type 2 diabetes expressed that life after diagnosis felt limited or confined. The sense of being trapped in a rigid structure—emotionally and behaviorally—was prominent. One participant noted,

"...I feel I'm inside a stuck loop within boundaries. I don't

want to go outside, what if something happens..." (P18). Another shared,

"...I can't control my diabetes. I struggle with my inner voice. I fight. If I live like I don't have diabetes, the voice inside gives warnings like don't eat that, don't do this..." These expressions revealed a psychological tension between the desire for freedom and the constraints imposed by diabetes management.

Emotional Responses (Theme 7)

Participants' emotional responses to their diabetes diagnosis varied widely, ranging from shock and fear to acceptance and even indifference. These emotions were not only shaped by the moment of diagnosis but also by how individuals internalized the disease over time. While participants with type 1 diabetes often recounted initial feelings of denial followed by eventual adjustment, those with type 2 diabetes displayed more polarized responses—ranging from deep fear to complete emotional disengagement.

For many participants with type 1 diabetes, the moment of diagnosis was marked by shock, sadness, or denial. Particularly for those diagnosed in adolescence, the experience was overwhelming and difficult to process.

"...We were in shock as a family. I entered an emotional void. I thought life is over for me. The feeling that after this nothing will be the same was dominant..." (P5). Another participant shared,

"...I didn't accept it for a certain duration, I denied it. It felt like a mini game to me..." (P4). These responses highlight the disorientation and resistance that can accompany an unexpected, life-altering diagnosis.

In contrast to initial distress, some participants with type 1 diabetes later developed a positive or accepting emotional stance toward their condition. For some, diabetes became a source of self-awareness or personal growth.

"...I've adjusted to living with diabetes, just like a friend. I enjoy taking more care of myself..." (P2). Another participant reflected,

"...No matter how much difficulty I experienced, I like my diabetes, but it caused me to know life better..." (P1). These statements reflect a transformation in perspective, where diabetes was no longer viewed as purely negative but rather as a companion that demanded discipline and mindfulness.

Participants from both type 1 diabetes and type 2 diabetes groups described a complex mix of emotions—ranging from fear and grief to shame and helplessness. One participant likened the experience to an unwelcome but familiar visitor:

"...It's like a friend arrived, one I always knew was coming but who I never wanted to arrive. I broke down when I was diagnosed... I was hurt, I was scared..." (P26). Another said, *"...Surprise, sadness, fear... I really thought the world had fallen on my head... I always hid, I was very ashamed of my diabetes..."* (P13). These accounts reflect the layered emotional toll of living with a chronic condition, often intensified by societal perceptions and self-judgment.

Interestingly, some participants with type 2 diabetes expressed a form of emotional disengagement or disregard. This detachment was often a coping mechanism rather than an indication of wellness.

"...I don't give it much importance as I feel good. I live like it doesn't exist..." (P19). Another added,

"...I don't think about it much, but there's no sadness or whatever..." (P16). These statements may reflect emotional numbing or denial, possibly as a way to minimize the psychological burden of the disease.

At the other end of the spectrum, several individuals with type 2 diabetes reported persistent sadness and fear, especially when confronted with the lifelong nature of the illness.

"...I was only sad" (P18), one participant admitted. Another shared,

"...At first, like everyone, I was scared... I realized that diabetes is not a temporary illness like flu, I realized I had to live with it and I began to try to manage it, but I'm still scared..." (P24). These ongoing emotional responses underscore the need for psychological support in chronic disease management, especially when adaptation does not come easily.

DISCUSSION

This research comes to the forefront as the first research to use quantitative and qualitative methods together for diabetes perceptions of individuals with type 1 diabetes and type 2 diabetes. In our research, the mean disease acceptance scores for diabetic individuals were 22.50 ± 5.63 . When other research in the literature is investigated, research by Bertolin et al. identified mean scores as 24.6, while research by Şireci et al. identified mean scores as 27.82 ± 5.70 (30,31). The mean scores obtained in our research appear to be lower than the mean scores in national and international research. The low disease acceptance level of diabetic individuals included in the research compared to other research may be due to differences in the population where the research was performed and cultural features.

Qualitative Findings

Of individuals with type 1 diabetes participating in the research, 6 stated they experienced uncertainty about the

cause of diabetes and that they did not know the cause of diabetes. Other responses included 5 people who stated factors linked to stress may be effective while 4 people said it may be genetic inheritance. Opinions about the cause of diabetes among type 2 diabetics participating in the study included 9 people who stated it may be due to the presence of negative eating habits in their lives, and excess consumption of packaged food and food without nutritional value. Additionally, 3 people proposed genetic inheritance may be effective, while 3 people stated fate without connection to a specific cause was effective. When the literature is investigated, occurrence of type 1 diabetes is stated to be an autoimmune disorder where the reserve of beta cells is lost (32). At the same time, there are studies stating that genetic factors and environmental factors contribute to the development of type 1 diabetes (33,34). In addition to the effect of genetic factors in the pathogenesis of type 2 diabetes, environmental and lifestyle effects are reported. Negative lifestyle is thought to increase the prevalence of type 2 diabetes, especially (35). A study by Yorulmaz et al. stated that diabetes had more impact on physical, social and psychological functions compared to individuals with type 2 diabetes (9). Additionally, another study observed that individuals with type 2 diabetes connected the cause of diabetes more to fate and chance and in this way had different disease perceptions compared to individuals with type 1 diabetes (26). In line with these elements, responses given in our study are similar to the literature. Individuals receiving diagnosis of any chronic disorder may make a variety of assumptions and have beliefs about their current situation. As a result of processes involving different assumptions and beliefs, a variety of problems may be experienced about treatment and self-care in disease management. Disease acceptance and assimilation in the presence of chronic disorders positively impacts the disease management process (10). Similar situations are experienced in diabetes, where disease management is important and in line with this, it appears that individuals participating in our study displayed differences in diabetes perceptions.

When individuals participating in the study were asked about the most important points for diabetes management, diabetic individuals commonly stated nutrition, exercise and treatment ($f=8$ for type 1, $f=9$ for type 2) may be effective for diabetes management. Individuals with type 1 diabetes also proposed that keeping balance ($f=5$) and knowing yourself ($f=2$) were important. For individuals with type 2 diabetes, there were opinions that factors like compliance ($f=4$) and weight control ($f=2$) may be effective for management of type 2 diabetes. This situation shows that there are differences in the elements of diabetes management according to differences in diabetes types during management

of type 1 diabetes and type 2 diabetes. Self-management related to treatment and care of individuals with diabetes may display differences according to attitudes, behavior and beliefs related to diabetes. Basic elements in diabetes management target sustaining current well-being, preventing complications that may occur, and managing and minimizing symptoms (36). In practices to ensure diabetes management, it is important to perform specific implementations for each individual for diabetes self-management to obtain the best outcomes by preserving the basic targets and to progress in cooperation with the individual (37). In our study, there were differences observed for diabetes management perceived linked to the diagnoses of diabetic individuals and personal traits.

When diabetic individuals participating in the study were questioned about factors facilitating diabetes management, individuals with type 1 diabetes stated technology use ($f=7$), benefiting from individual traits ($f=4$) and education received ($f=4$). The majority of individuals with type 2 diabetes stated there were no facilitating factors ($f=10$), while some stated the support factor helped ($f=5$). When the literature is investigated, situations like adequate levels of self-management skills, participation and trust in individual treatment and care of the person, presence of social support through adequate support and encouragement from those around them and ensuring positive communication with health team members were stated to facilitate diabetes management (38). At the same time, there are opinions that glucose measurement through finger pricks, in addition to digital technology use (sensors, insulin infusion pumps, etc.) and adoption of models with supportive and therapeutic effect have beneficial features in reaching the targeted metabolic levels (39). As seen in our findings and in the literature, there are common factors facilitating type 1 diabetes and type 2 diabetes management, in addition to important independent facilitators. Within this framework, it is necessary to pay attention to facilitating factors according to the type of diabetes, when ensuring diabetes management.

When diabetic individuals participating in the study were questioned about difficulties experienced with diabetes management, most type 1 diabetes and type 2 diabetic individuals stated needle-finger pricks ($f=7$, $f=6$, respectively) was the most difficult situation for management. When the literature is investigated, it appears that there are obstacles experienced during diabetes management and difficulties linked to these obstacles cause diabetes self-management to be disrupted. Diabetes self-management is affected by factors like the person's material and spiritual status, knowledge levels about diabetes, health literacy level and current

lifestyle (38). At the same time, the literature includes several data about diabetic individuals avoiding performing insulin injections and fear experienced when measuring fingertip blood sugar. In a study of diabetic individuals, more than half of diabetics with insulin treatment stated they disrupted insulin treatment due to fear of performing injections (40). In another study, individuals with type 1 diabetes stated they avoided injecting themselves (41). These difficulties experienced with needles and finger prick procedures may negatively affect self-management of diabetic individuals. As a result, this shows the need to develop innovative approaches to make procedures like needles and finger pricks less stressful and to offer solutions better responding to individual needs.

When diabetic individuals participating in the study were asked about the periods before and after diabetes, individuals with type 1 diabetes mostly stated they felt free in the period before ($f=9$), while most stated that their lives were diabetes for the period after. For individuals with type 2 diabetes, they felt free in the period before, like individuals with type 1 diabetes, but differently, they stated they achieved a regular life after diabetes ($f=10$). It is known that diabetes encompasses several complex situations. The reason for both type 1 diabetes and type 2 diabetic individuals answering freedom is thought to be the lack of generally healthy lifestyle habits before diabetes ($f=10$), as a result they described this as being free ($f=5$). In the present study, the complication feared most by type 1 diabetics was hypoglycemia. In studies, the frequency of hypoglycemia is variable, while hypoglycemia was experienced with 14.5% frequency. This situation is thought to be lead to type 1 diabetic individuals performing frequent monitoring and adopting a regular life (42). In our study, similar to these findings, individuals with type 1 diabetes responded that diabetes was part of their lives after diagnosis.

When individuals with diabetes were questioned about what feelings dominated about diabetes, individuals with type 1 diabetes stated they experienced sadness and shock ($f=6$), while most individuals with type 2 diabetes stated they mainly experienced a cluster of negative feelings ($f=5$). Contrary to this, there were type 1 diabetics who stated they did not feel any negative elements ($f=5$). A study investigating factors obstructing diabetes control in 2018 by Üren and Yılmaz determined that the majority of diabetic individuals experienced difficulties linked to negative attitude (43). Other studies included in the literature observed that individuals with type 2 diabetes described negative attitude like fear, anxiety and hopelessness toward diabetes and management (44,45). This is important in terms of the impact on management of the mood toward diabetes of di-

abetic individuals. Emotional factors like stress, irritation and sadness affect the ability of individuals with diabetes to control eating frequency, balanced nutrition, physical activity and self-management concepts (46).

This study has several limitations. First, it was conducted in a single-center setting, which may limit the generalizability of the findings to broader populations. Second, the sample size, although sufficient for thematic saturation and quantitative analysis, was relatively small. Third, self-reported data may be subject to recall or social desirability bias. Finally, participants' prior experiences with diabetes education and healthcare services may have influenced their perceptions, which was not controlled for in the analysis.

In this study, the disease acceptance and diabetes perceptions of individuals with type 1 diabetes and type 2 diabetes were considered, in an attempt to present data about diabetes perception from a certain perspective. Our study is unique due to its comparison of diabetes perceptions between the two most frequently observed diabetes types and use of mixed methods.

As a result of the data obtained, it was identified that individuals with type 1 diabetes and type 2 diabetes have common descriptions of diabetes perceptions, in addition to clear differences. These differences are thought to be due to the basic characteristic features of type 1 diabetes and type 2 diabetes. These findings emphasize the need for a more specialized approach to the topics of diabetes management and patient education. Offering personalized health services according to diabetes type, especially, is thought to assist diabetic individuals with more effective management of their diabetes. This study provides an important contribution in terms of understanding different perceptions between type 1 diabetes and type 2 diabetes and valuable information for health policies and clinical practice in the future.

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Author Contributions Statements

Idea/concept: **Tuğba Bilgehan**, Design: **Tuğba Bilgehan**, **Bahar Vardar İnkaya**, Auditing: **Tuğba Bilgehan**, **Bahar Vardar İnkaya**, Data collection and/or processing: **Ayşenur Altunsoy**, **Mehmet Aytemur**, Analytical interpretation: **Tuğba Bilgehan**, **Ayşenur Altunsoy**, Literature review: **Tuğba Bilgehan**, **Ayşenur Altunsoy**, **Mehmet Aytemur**, Article writing: **Tuğba Bilgehan**, **Ayşenur Altunsoy**, **Mehmet Aytemur**, Critical review: **Tuğba Bilgehan**.

Conflict of Interest

The authors report no conflict of interest related to this study.

Authorship Statement

Collectively declare that we are the sole authors of this work and that all sources used have been appropriately acknowledged. The authors declare that this study was not generated by artificial intelligence and represents original scholarly work.

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None.

Ethical Approval

When collecting data about participants in this study, the relevant ethical principles of informed consent, volunteerism and preservation of privacy were met. This research was permitted by Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee (research code: 2022-1152, ethics committee decision date and number: 10.11.2022-16).

Peer Review Process

Extremely peer-reviewed.

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Tip 2 Diyabet Hastalarında İlaç Uyumu ve Etkileyen Faktörler

Ferhat BOLUKÇU , Şebnem YÜCEL 

Selçuk Üniversitesi, Sağlık Bilimleri Fakültesi, Sağlık Yönetimi Anabilim Dalı, Konya, Türkiye

Bu makaleye yapılacak atıf: Bolukçu F ve Yücel Ş. Tip 2 diyabet hastalarında ilaç uyumu ve etkileyen faktörler. Turk J Diab Obes 2025;9(2): 164-178.

GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışma klinik ve sosyo-demografik özellikler ile ilaç uyumu arasındaki ilişkiyi incelemeyi amaçlamaktadır.

Gereç ve Yöntemler: Kesitsel tipteki bu nicel çalışmamıza, Ankara 29 Mayıs Devlet Hastanesi dahiliye polikliniklerine 20 Kasım 2023–20 Şubat 2024 tarihleri arasında Tip 2 diyabet kontrol muayenesi için başvuran 431 hasta katılmıştır. Dolayısıyla bu çalışmanın verileri, Ankara 29 Mayıs Devlet Hastanesi dahiliye polikliniklerine ilgili zaman diliminde muayene olmak için başvuran tip 2 diyabetli katılımcılarından elde edilen veriler ile sınırlıdır. Araştırmada veri analizlerinde tanımlayıcı istatistikler (frekans, yüzde, ortalama, standart sapma) ve farklılık testleri (varyans analizi ve t-testi) kullanılmıştır. Farklılık testleri kapsamında sosyo-demografik değişkenler ve klinik duruma ilişkin yaşam tarzı alışkanlıkları ile ilaç uyum düzeyi arasındaki anlamlı farklılıklar analiz edilmiştir. Anlamlı fark tespit edildiğinde farkların hangi gruplar arasında olduğunu tespit etmek için Post-Hoc testi kullanılmıştır. Veri analizi için SPSS 26 sürümü kullanılmıştır.

Bulgular: Diyetisyene yönlendirilen hastaların ilaç uyum raporu ölçeği ortalamaları ($23,9 \pm 1,74$) yönlendirilmeyenlere göre daha fazladır ($t = 3,07$, $p = 0,002$). Önerilen diyetle dikkat edenlerin ilaç uyum raporu ölçeği ortalamaları ($24 \pm 1,60$) dikkat etmeyenlere göre

ORCID: Ferhat Bolukçu / 0000-0002-4062-6193, Şebnem Yücel / 0000-0003-2135-242X

Yazışma Adresi / Correspondence Address:

Ferhat BOLUKÇU

Selçuk Üniversitesi, Sağlık Bilimleri Fakültesi, Sağlık Yönetimi Anabilim Dalı, Konya, Türkiye
E-posta: 203172002003@selcuk.edu.tr bolucufherhat@gmail.com

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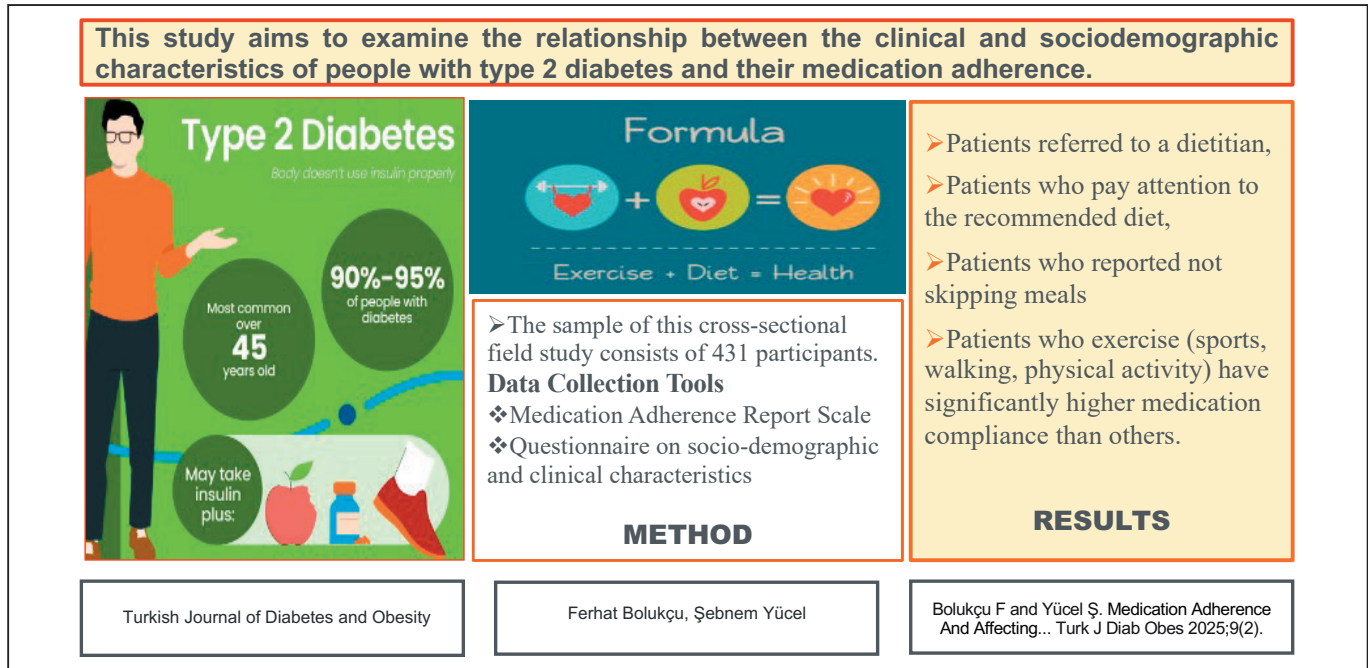
daha fazladır ($t= 3,31, p= 0,001$). Öğün atlamadığını belirten hastaların ilaç uyum raporu ölçeği ortalamaları ($24\pm1,69$) atlayanlara göre daha fazladır ve bu fark istatistiksel olarak anlamlıdır ($t= -2,28, p = 0,023$). Egzersiz yapan bireylerin ilaç uyumu anlamlı şekilde ($F= 4,96, p=0,002$) daha yüksektir.

Sonuç: İlaç uyumu açısından egzersiz ve diyet gibi sağlıklı yaşam tarzı alışkanlıklarının kazandırılması önemli bir gereklilik olarak düşünülmektedir.

Anahtar Sözcükler: Sağlıklı yaşam tarzı, Tip 2 diyabet, İlaç uyumu

Medication Adherence and Affecting Factors in Type 2 Diabetes Patients

GRAPHICAL ABSTRACT



ABSTRACT

Aim: This study aims to examine the relationship between clinical and socio-demographic characteristics and medication adherence.

Material and Methods: In this cross-sectional field study, 431 patients who applied to the internal medicine outpatient clinics of Ankara 29 Mayıs State Hospital between November 20, 2023 and February 2024 for Type 2 diabetes control examination participated. Therefore, the data of this study are limited to the data obtained from participants with type 2 diabetes who applied to the internal medicine outpatient clinics of Ankara 29 Mayıs State Hospital for examination in the relevant time period. Descriptive statistics (frequency, percentage, mean, standard deviation) and difference tests (analysis of variance and t-test) were used in the data analysis of the study. Within the scope of difference tests, significant differences between socio-demographic variables and lifestyle habits related to clinical status and medication adherence levels were analyzed. When a significant difference was detected, a post-hoc test was used to determine which groups the differences were between. SPSS version 26 was used for data analysis.

Results: The mean scores of the medication adherence scale of patients referred to a dietitian (23.9 ± 1.74) were higher than those of patients who were not referred ($t= 3.07, p= 0.002$). The mean score on the medication adherence scale (24 ± 1.60) of those who followed the recommended diet was higher than those who did not ($t= 3.31, p= 0.001$). The average score on the medication adherence scale for patients who reported not skipping meals (24 ± 1.69) was higher than for those who did skip meals, and this difference was statistically significant ($t= -2.28, p= 0.023$). Medication compliance of individuals who exercise is significantly higher ($F= 4.96, p=0.002$).

Conclusion: From the point of view of drug compliance, it is considered an important requirement to acquire healthy lifestyle habits such as exercise and diet.

Keywords: Healthy lifestyle, Type 2 diabetes, Medication adherence

GİRİŞ

Diyabet hastalığı dünyanın en yaygın, en maliyetli ve en ölümcül kronik rahatsızlıklarından biri olarak değerlendirilmektedir (1). Uluslararası Diyabet Federasyonu (International Diabetes Federation (IDF)) 2019 yılı verilerine göre, dünyada 463 milyon yetişkin (20-79 yaş arası) diyabetle yaşamaktadır (2), yani başka bir deyişle dünyada her 100 yetişkinden 10'nunun diyabetli olduğu sonucunu doğurmaktadır. Bu sayının 2030 yılında 522 milyona ulaşılacağı (3) ve 2045'te ise 700,2 milyona ulaşılacağı öngörülmektedir (2). Türkiye ise Avrupa ülkeleri arasında diyabet prevalansının en yüksek olduğu ülke konumundadır (4).

Dünya çapında toplam diyabet vakalarının %90'ını (5) hatta bazı kaynaklara göre %96'sını (6) Tip 2 diyabet oluşturmaktadır. Aynı zamanda diyabet hastalığına atfedilen engelliliğe ayarlanmış yaşam yıllarının %95'ini Tip 2 diyabet temsil etmektedir. Tip 2 diyabet, bireyler üzerinde fiziksel ve psikolojik sonuçları olan birçok ölümcül komplikasyona sebep olmaktadır (7). Fakat Tip 2 diyabet hastalığı erken aşamada teşhis ve tedavi edildiğinde büyük oranda iyileşme görülebilir ve kontrol altına alınabilir (6). Buna rağmen Tip 2 diyabetin önlenip kontrol altına alınması ile ilgili olarak hasta ve hizmet sağlayıcıdan kaynaklı hâlen devam eden problemler vardır.

Erişkin başlangıçlı diyabet olarak adlandırılan Tip 2 diyabet, insülin direncine sahip ve genellikle göreceli insülin salgılama düzensizliğine sahip bireyleri içermektedir (8). Tip 2 diyabet, kandaki glikoz seviyelerinin yükselmesiyle karakterize edilen ve zamanla diğer organlara ciddi hasar veren metabolik bir hastalıktır (9). Bu bakımdan Tip 2 diyabet global ölçekte önemli bir morbidite, sakatlık ve mortalite nedeni olup (10) kötü beslenme seçimleri, yetersiz fiziksel aktivite (egzersiz) sonucu ortaya çıkan bir hastalık türüdür (1, 11).

Tip 2 diyabet kandaki glikoz düzeyini önerilen aralıkta tutmak için ilaçlarla dikkatli yönetim gerektiren bir tür kronik hastalıktır (12, 13). Ama Tip 2 diyabetlilerin %45'inde kandaki glikoz seviyesi optimal sınırlar içerisinde değildir (14). Bu bakımdan kandaki glikoz düzeyinin nasıl kontrol altında tutulacağını öğrenmek önemli bir gerekliliktir (15). Bu noktada farmakolojik tedaviye uyum önem kazanmaktadır.

İlaç uyumu, bir kişinin davranışının ilacı en uygun (sağlık profesyonelinin belirlediği gibi) şekilde almaya ne ölçüde uyduğunu ifade etmektedir (16). Bu değer optimal sınırların dışında olmasının en temel nedenlerinden biri zayıf ilaç uyumudur (14). İlaç uyumunun zayıf olmasının pek çok sebebi vardır. DSÖ'ye göre bu sebepler arasında hasta, sağlık çalışanları ve sistemden kaynaklı unsurlar, tanı-tedavi ile ilişkili etmenler ve sosyo-demografik unsurlar sayılabilir (17-19). İlaç uyumunu etkileyen sosyo-demografik etmen-

ler arasında özellikle cinsiyet, kişisel özellikler ve kültürel değerler bulunmaktadır. Zayıf ilaç uyumu sonucunda morbidite ve mortalite sayıları, ayaktan tedavi, hastaneye yatış ve acil servis başvuruları artmaktadır (14, 20). Bu bağlamda, Tip 2 diyabet hastalığının kontrolünün optimize edilmesi ve ilerlemesinin sınırlandırılması hususunda hatırı sayılır düzeyde önem teşkil eden ilaç tedavisine uyumun teşvik edilmesi ve ilaç uyumunu etkileyen bireysel ve demografik nedenlerin farkına varılması amacıyla bu çalışma gerçekleştirildi. Dolayısıyla bu çalışma Tip 2 diyabet hastalarının sosyo-demografik değişkenler ve tip 2 diyabete özgü bazı klinik özellikler ile ilaç uyumu arasındaki ilişkiyi incelemeyi amaçlamaktadır.

GEREÇ ve YÖNTEMLER

Evren ve Örneklem

Araştırmanın evrenini, Ankara 29 Mayıs Devlet Hastanesi'ne 20 Kasım 2023 - 20 Şubat 2024 tarihleri arasında kontrol tedavisi için ayaktan başvuran Tip 2 diyabet hastaları oluşturmaktadır. Bilinci açık olan, kendi rızası ile araştırmaya katılmayı isteyen hastalar araştırma kapsamına alındı. Ancak zihinsel ve kendini ifade etme sorunu olanlar, 18 yaşından küçük olanlar, anket sırasında hayati önem taşıyan komplikasyonlar geçirenler ve acil tıbbi tedavi odalarına alınan hastalar araştırma kapsamına alınmadı. Dolayısıyla bu çalışmanın verileri, Ankara 29 Mayıs Devlet Hastanesi dahiliye polikliniklerine ilgili zaman diliminde başvuran tip 2 diyabetli katılımcıları ile sınırlıdır. Bu çalışmada, araştırma kriterlerini taşıyan 431 Tip 2 diyabet hastası; ulaşılan örneklem sayısıdır. Bu çalışmada örneklem büyüklüğünü belirleme noktasında öncül güç analizi yapılmıştır. İstatistiksel anlamlılık düzeyi için 0,05, test gücü için $(1 - \beta)$ %80 ve etki büyüklüğü için literatürde orta düzey bir farkı temsil eden Cohen's $d = 0,30$ esas alınmıştır (21, 22). Güç analizi için G*Power sürümü 3.1.9.7 versiyonu kullanılarak yapıldı. Bu durumda yapılan güç analizi sonucunda, her bir grup için minimum 89 kişi olmak üzere toplamda 177 kişilik bir örneklem yeterli olduğu belirlenmiştir. Ancak çalışmada ulaşılan örneklem sayısı 431 kişi olduğundan çalışmada ulaşılan örneklem büyüklüğü hedeflenen güç düzeyini sağlamakta hem de küçük etki büyüklüklerini saptayabilecek düzeydedir.

Veri Toplama Yöntemi ve Araçları

Çalışmanın verileri, en az altı ay önce Tip 2 diyabet tanısı konulan ve tedavisine Ankara 29 Mayıs Devlet Hastanesinde devam etmekte olan 18 yaş üstü yetişkin bireylerden toplanmıştır. Bu kapsamda, Ankara 29 Mayıs Devlet Hastanesi dahiliye polikliniği bekleme salonlarında muayene sırasını bekleyen ve muayene olan Tip 2 diyabetli hastalarla yüz yüze görüşme sağlanarak, onamları alındıktan sonra anket

uygulandı. Veri toplama araçları, demografik özellikler, klinik özelliklere ilişkin sağlık bilgi formu ve anket formundan oluşmaktadır. Anket formu İlaç Uyum Raporu Ölçeği sorularından oluşmaktadır. Dolayısıyla araştırma verileri kolayda örnekleme yöntemi ile toplanmıştır.

Demografik Değişkenler ve Tip 2 Diyabete Özgü Klinik Özellikler Formu

Demografik değişkenler ve klinik özellikler formunda, katılımcıların yaş, cinsiyet, diyetisyene yönlendirilme, diyet uyumu, diyabet eğitimi alma durumu, ailede diyabet öyküsü, ana öğün sıklığı, öğün atlama durumu, hipoglisemik atak geçirme durumu ve diğer kronik hastalık durumu, medeni durum, eğitim durumu, çalışma durumu haftalık egzersiz yapma durumu, ne zamandan beri Tip 2 diyabet tanısının konulduğu, Tip 2 diyabet tanısı konulduktan sonra vücut ağırlığında değişim, ne zamandan beri Tip 2 diyabet tedavisi aldığı, kan şekeri ölçüm sıklığı, Tip 2 diyabet kontrol tedavisi için doktora gitme sıklığı, alkol ve sigara kullanımı gibi demografik ve klinik özelliklere ilişkin sorular yer almaktadır.

İlaç Uyum Raporu Ölçeği

Horne ve Hankins tarafından ilaç uyumunu değerlendirmek için geliştirilen bu jenerik ölçek, hastalık türüne göre özelleştirilebilmektedir (23). İlaç Uyum Raporu Ölçeği (The Medication Adherence Report Scale - MARS-5); tansiyon, diyabet, romatoid artrit, astım, kolesterol yüksekliği gibi pek çok hastalığa yönelik uyarlamalara literatüründe yer vermektedir (24). İlaç Uyum Raporu Ölçeği'nin (İÜRÖ) Türkçe geçerlilik ve güvenilirlik çalışması, Sen ve ark. tarafından yapılmıştır (25). Ölçekte ters ifadeli soru bulunmamaktadır. Beş ifadeden oluşan Likert tipinde olan bu ölçek, tek boyutludur. Ölçekte "5" skoru "asla", "4" skoru "nadiren", "3" skoru "bazen", "2" "sık sık" ve "1" "her zaman" şeklinde derecelenmiştir. Ölçekten minimum 5 puan, maksimum 25 puan alınmaktadır. Orijinal çalışmada, ölçeğin Cronbach alfa değeri 0,85 olarak bulunmuştur (23). Ölçeğin Türkçe geçerlik ve güvenilirlik çalışmasını yürüten yazarlardan gerekli izinler alınmıştır.

İstatistiksel Analiz

Bu araştırma, kesitsel bir nicel çalışma olarak tasarlanmıştır. Araştırma, diyabet yönetimi ve ilaç uyumu konularında daha derinlemesine bilgi edinmeyi hedeflemiştir.

Araştırmada veri analizlerinde tanımlayıcı istatistikler (frekans, yüzde, ortalama, standart sapma) ve farklılık testleri (ANOVA-varyans analizi ve t-testi) kullanılmıştır. Farklılık testleri kapsamında farklı sosyo-demografik değişkenler ve klinik duruma ilişkin yaşam tarzı alışkanlıkları ile ilaç uyum düzeyi arasındaki anlamlı farklılıklar analiz edilmiştir.

Ayrıca ANOVA testlerinde anlamlı fark tespit edildiğinde farkların hangi gruplar arasında olduğunu tespit etmek için Post-Hoc testi kullanılmıştır. İstatistiksel anlamlılık için $p < 0,05$ değeri kabul edilmiştir. Ayrıca, değişkenlerin normal dağılımına bakmak amacıyla skewness ve kurtosis değerleri de hesaplanmıştır. Bu çalışmada veriler, SPSS 26 sürümü ile analiz edilmiştir.

BULGULAR

Hastaların 257'si (%59,6) 60 yaş ve üzeri, 174'ü (%40,4) 60 yaş altındadır. Hastaların 298'inin (%69,1) kadın, 133'ü (%30,9) erkektir. Medeni durum açısından bakıldığında hastaların büyük bir çoğunluğunun evli olduğu (%78,2; 337 kişi), 34'ününün (%7,9) bekâr, 60'ının (%13,9) boşanmış, dul, eşinden ayrı yaşadığı tespit edilmiştir (Tablo 1). Bkİ açısından değerlendirildiğinde obez kategorisinde 165 kişi (%38,3), kilolu kategorisinde 152 kişi (%35,3), normal kiloda 59 kişi (%13,7) ve zayıf kategorisinde ise 55 kişi (%12,8) olduğu tespit edilmiştir. Öğrenim düzeyi açısından değerlendirildiğinde hastaların 198'i (%45,9) ilköğretim ve ortaokul, 126'sı (%29,2) lise, 60'ı (%13,9) lisans veya lisansüstü, 47'si (%10,9) okuryazar olmadığı görülmektedir. Katılımcıların büyük bir çoğunluğu %50,1'i (206 kişi) çalışmamakta,

Tablo 1: Katılımcı profiline ilişkin bulgular.

Değişkenler*	Sonuç (n=431)
Yaş grubu	60 yaş altı
	174 (40,4)
60 yaş ve üzeri	257 (59,6)
Cinsiyet	Kadın
	298 (69,1)
Erkek	133 (30,9)
Beden Kütle İndeksi (Bkİ)	Zayıf
	55 (12,8)
	Normal
	59 (13,7)
Kilolu	152 (35,3)
	Obez
	165 (38,3)
	Evli
Medeni Durum	337 (78,2)
	Bekar
	34 (7,9)
	Boşanmış
Öğrenim Durumu	60 (13,9)
	Okuryazar değil
	47 (10,9)
	Lise mezunu
	126 (29,2)
	İlk-orta okul
	198 (45,9)
Lisans veya lisansüstü	60 (13,9)
	Çalışıyor
	68 (15,8)
	Çalışmıyor
Emekli	216 (50,1)
	147 (34,1)

*Veriler sayı ve yüzde olarak [n(%)] gösterilmektedir. Bkİ hastaların kilogram cinsinden ağırlıklarının metre cinsinden boylarının karesine bölünmesiyle hesaplanmaktadır. Bkİ göre vücut kompozisyonunun sınıflandırılması (26): *0-18,4 kg: Zayıf **18,5-24,5 kg: Normal Kilolu ***25-29,5 kg: Fazla Kilolu **** 30 kg ve üzeri: Obeziteli sınıfta yer almaktadır.

%34,1'i (147 kişi) emekli ve %15,8'i (68 kişi) çalışmaktadır. Kısacası katılımcıların demografik özellikleri genel bir çerçevede özetlendiğinde, emekli ve bilhassa çalışmayan katılımcıların fazla olduğu, yaşlı nüfusun ve özellikle obezite oranının yüksek olduğu bir profil ortaya çıkmaktadır (Tablo 1).

Tip 2 diyabet tanısı ne zaman konulduğuna ilişkin sorulan soruya katılımcıların 33'ü (%7,7) 6 ay ile 1 yıl arasında, 32'si (%7,4) 1 ile 2 yıl arasında, 76'sı (%17,6) 2 ile 5 yıl arasında, 93'ü (%21,6) 5 ile 10 yıl arasında, 197'si (%45,7) 10 yıl ve üzerinde bir sürede tanı aldıklarını ifade etmiş bulunmaktadır (Tablo 2). Dolayısıyla katılımcıların önemli bir kısmı diyabet tanısını uzun süre önce almış (10 yıl ve üzeri) bulunmaktadır. Bu, katılımcıların uzun süreli diyabet deneyimi olduğunu göstermektedir. Diyabet tanısı konulduktan sonra vücut ağırlığında değişim sorusuna hastaların 149'u

(%34,6) vücut ağırlığının arttığını, 110'u (%25,5) vücut ağırlığının azaldığını, 172'si (%39,9) ise vücut ağırlığında bir değişim olmadığını ifade etmektedir. Hastaların 350'si (%81,2) diyetisyene yönlendirilme sorusuna evet cevabını verirken 81'i (%18,8) ise hayır cevabını vermiştir. Hastaların 262'si (%60,8) verilen diyetle dikkat ettiğini, 169'u ise (%39,2) verilen diyetle dikkat etmediğini ifade etmektedir. Hastaların 35'i (%8,1) 6 ay ile 1 yıl arasında Tip 2 diyabet tedavisi gördüğünü, 33'ü (%7,7) 1 ile 2 yıl arasında, 78'i (%18,1) 2 ile 5 yıl arasında, 84'ü (%19,5) 5 ile 10 yıl arasında ve 201'i (%46,6) 10 yıl ve üzerinde Tip 2 diyabet tedavisi gördüğünü belirtmektedir. Hastaların 220'si (%51) diyabet eğitimi almış iken 211'i (%49) diyabet eğitimi almadığını beyan etmektedir.

Ailede diyabet öyküsünün varlığına ilişkin soruya hastaların 348'i (%80,7) evet demişken 83'ü (%19,3) hayır cevabı

Tablo 2: Diyabet, diyet, egzersiz ve bazı alışkanlıklara ilişkin bulgular.

Değişkenler*	Sonuç (n=431)
Tanının konulduğu zaman aralığı	6 Ay - 1 Yıl 33 (7,7)
	1 Yıl - 2 Yıl 32 (7,4)
	2 Yıl - 5 Yıl 76 (17,6)
	5 Yıl - 10 Yıl 93 (21,6)
	10 Yıl Ve Üzeri 197 (45,7)
Tip 2 diyabet tanısı sonrası vücut ağırlığında değişim durumu	Arttı 149 (34,6)
	Azaldı 110 (25,5)
	Değişme Olmadı 172 (39,9)
Diyetisyene yönlendirilme durumu	Evet 350 (81,2)
	Hayır 81 (18,8)
Verilen diyetle dikkat etme durumu	Evet 262 (60,8)
	Hayır 169 (39,2)
Tip 2 diyabet tedavisi görme süresi	6 Ay - 1 Yıl 35 (8,1)
	1 Yıl - 2 Yıl 33 (7,7)
	2 Yıl - 5 Yıl 78 (18,1)
	5 Yıl - 10 Yıl 84 (19,5)
	10 Yıl ve Üzeri 201 (46,6)
Diyabet eğitimi alma durumu	Evet 220 (51,0)
	Hayır 211 (49,0)
Ailede diyabet öyküsü durumu	Evet 348 (80,7)
	Hayır 83 (19,3)
Haftalık egzersiz yapma durumu	Her gün düzenli egzersiz yapanlar 87 (20,2)
	Haftada en az üç gün egzersiz yapanlar 51 (11,8)
	Haftada bir veya iki gün egzersiz yapanlar 143 (33,2)
	Haftalık egzersiz yapmayanlar 150 (34,8)

Değişkenler*	Sonuç (n=431)
Kan şekeri ölçüm sıklığı	Her gün 86 (20,0)
	Ara sıra 232 (53,8)
	Neredeyse hiç (çok az) 113 (26,2)
Diyabet Kontrolü için doktora gitme sıklığı	Ayda bir 36 (8,4)
	3 ayda bir 149 (34,6)
	6 ayda bir 121 (28,1)
	Yılda bir 74 (17,2)
Ana öğün tüketim sıklığı	Düzenli kontrole gitmiyor 51 (11,8)
	İki defa 189 (43,9)
Ara öğün tüketim sıklığı	Üç defa 242 (56,1)
	Yok (tüketmiyor) 40 (9,3)
Öğün atlama	1 ara öğün 219 (50,8)
	2 ara öğün 172 (39,9)
	Evet 245 (56,8)
Alkol kullanma durumu	Hayır 186 (43,2)
	Nadiren 35 (8,1)
	Kullanmayı bırakanlar 32 (7,4)
Sigara kullanma durumu	Hiç kullanmayanlar 364 (84,5)
	Düzenli kullananlar 62 (14,4)
	Nadiren 57 (13,2)
Hipoglisemik atak geçirme durumu	Kullanmayı bırakanlar 71 (16,5)
	Hiç kullanmayanlar 241 (55,9)
	Evet 41 (9,5)
Diğer kronik hastalık durumu	Hayır 390 (90,5)
	Evet 372 (86,3)
	Hayır 59 (13,7)

*Veriler sayı ve yüzde olarak [n(%)] gösterilmektedir.

nı vermiş bulunmaktadır. Haftalık egzersiz yapma ile ilgili soruya hastaların 87'si (%20,2) her gün düzenli egzersiz yaptığını, 51'i (%11,8) haftada en az üç gün egzersiz yaptığını, 143'ü (%33,2) haftada bir veya iki gün egzersiz yaptığını ve 150'sinin ise (%34,8) haftalık egzersiz yapmadığını belirtmiştir. Katılımcı hastaların 86'sı (%20) kan şekeri ölçüm sıklığı sorusuna her gün cevabını vermişken 232'si (%53,8) ara sıra, 113'ü (%26,2) neredeyse hiç (çok az) cevabını verdiği görülmektedir. Hastaların diyabet kontrolü için doktora gitme sıklıkları sorulduğunda ise 36'sı (%8,4) ayda bir kez, 149'u (%34,6) üç ayda bir, 121'i (%28,1) altı ayda bir, 74'ü (%17,2) yılda bir kez doktora gitmekte iken 51'i (%11,8) düzenli olarak doktora gitmediğini dile getirmiştir. Hastaların 189'u (43,9) günde iki defa ana öğün tükettiğini, 242'si (%56,1) günde üç defa ana öğün tükettiğini ifade etmektedir. Ara öğün tüketim sıklığına bakıldığında; hastaların 40'ı (%9,3) ara öğün tüketmediğini, 219'u (%50,8) bir ara öğün tükettiğini, 172'si (%39,9) iki ara öğün tükettiğini belirtmiştir. Hastaların 245'i (%56,8) öğün atladığını, 186'sı (%43,2) ise öğün atlamadığını belirtmiştir. Hastaların 35'i (%8,1) nadiren alkol kullandığını, 32'si (%7,4) kullanmayı bıraktığını, 364'ü (%84,5) hiç kullanmadığını belirtmiştir (Tablo 2).

Sigara kullanma durumu sorulduğunda ise 62'si (%14,4) düzenli sigara içtiğini, 57'si (%13,2) nadiren sigara içtiğini, 71'i (%16,5) kullanmayı bıraktığını ve 241'inin ise (%55,9) sigara kullanmadığını ifade etmektedir. Hastaların 41'i (%9,5) hipoglisemik atak geçirdiğini 390'nın ise (%90,5) atak geçirmediğini beyan etmektedir. Katılımcı hastaların 372'sinin (%86,3) kronik hastalığı bulunmakta iken 59'unun (%13,7) kronik hastalığı bulunmamaktadır (Tablo 2).

Tip 2 diyabet hastalarının %77,5'i insüline bağımlı değil iken %96,5'i oral antidiyabetik ilaçlarla tedavi olmaktadır. Dolayısıyla katılımcıların neredeyse tamamı ilaçla tedavi olmaktadır. Hastaların %19'u (82 hasta) hem oral antidiyabetik tablet hem de insülin kullanmaktadır. Hastaların %42,9'una tedavi olarak egzersiz önerilmiştir (Tablo 3). Tip 2 diyabetli bireylerde mikrovasküler komplikasyonların (nefropati, nöropati, retinopati) dağılımı ve eşlik eden kronik hastalıkların dağılımı Tablo 4'de sunulmaktadır.

Tablo 4 incelendiğinde, mikrovasküler komplikasyonlara sahip vakaların yüzdesi % 100'ü geçtiği için bazı hastaların birden fazla komplikasyona sahip olduğu söylenebilir. Katılımcıların %86,3'ünde nefropati (böbrek yetersizliği, böbrek fonksiyonlarında bozulma) komplikasyonu gelişmemiştir. Nöropati komplikasyonu katılımcılarda neredeyse yarı yarıya (%47,8) görülmektedir. Buna karşın diyabetik retinopati, en yaygın görülen komplikasyon olarak tespit edilmiştir. Katılımcıların %51'inde diyabetik retinopati komplikasyonu gelişmiştir.

Araştırmaya katılan Tip 2 diyabet hastalarında görülen ek hastalıklara (komorbidite) ilişkin bilgiler incelendiğinde toplamda %100'ü aşan "katılımcı yüzdesi" her bireyin birden fazla hastalık yaşadığı sonucunu doğurmaktadır. Tip 2 diyabetle en sık görülen hastalıkların başında hipertansiyon gelmektedir. Bu araştırmada da katılımcıların %60,3'ünde hipertansiyon hastalığı mevcuttur. Katılımcıların yarıdan fazlasının (%51,5) kolesterol yüksekliği şikayeti var olup bu durum kardiyovasküler risk artışı açısından önemlidir. Katılımcıların %29'unda kalp damar hastalıkları mevcuttur. Kronik böbrek hastalığı katılımcıların %2,1'inde görülmektedir. Bu durum ya hastaların erken evrede tedavi edilmelerinden kaynaklı olabilir ya da tanı konulmamasından kaynaklıdır. Katılımcıların %5,8'inde nörolojik hastalıklar görülmektedir. Solunum sistemiyle ilgili hastalıklar (KOA ve astım) yaklaşık her 4 katılımcıdan birinde (%28,8) mevcuttur. Katılımcıların %3'ünde kanser hastalığı tanısı vardır. Katılımcıların %11,4'ünde psikiyatrik bir hastalık vardır. Psikiyatrik bir tanıya sahip olma bilhassa Tip 2 diyabetlilerin yaşam kalitesi ve tedavi uyumu açısından önemlidir. Son olarak araştırmamızda katılımcıların %29,2'si tiroid hastalıkları olduğunu bildirmiştir (Tablo 4).

Tablo 3: Hastaların insülin, oral antidiyabetik ilaç, egzersiz ve diyet tedavi durumlarına ilişkin dağılımı.

Tedavi Şekli	Sonuç (n=431)	
İnsülin kullananlar	97	(22,5)
Hap (tablet) kullananlar	416	(96,5)
Egzersiz yapanlar	185	(42,9)
Diyet tedavisi uygulayanlar	168	(39,0)

Tablo 4: Tip 2 diyabetli bireylerde mikrovasküler komplikasyonların dağılımı ve eşlik eden kronik hastalıkların görülme sıklığı.

Mikrovasküler komplikasyonlar*	Sonuç (n=431)	
Nefropati	59	(13,7)
Nöropati	206	(47,8)
Diyabetik retinopati	220	(51,0)
Eşlik eden kronik hastalıkların görülme sıklığı		
Hipertansiyon hastalığı	260	(60,3)
Kolesterol yüksekliği şikayeti	222	(51,5)
Kalp damar Hastalıkları	125	(29,0)
Kronik böbrek hastalıkları	9	(2,1)
Kronik nörolojik hastalıklar	25	(5,8)
Astım-KOA Hastalıkları	124	(28,8)
Kanser Hastalıkları	13	(3,0)
Psikiyatrik Hastalıklar	49	(11,4)
Tiroid Hastalığı	126	(29,2)

*Veriler sayı ve yüzde olarak [n(%)] gösterilmektedir.

Normallik ve Güvenilirlik Bulguları

İURÖ ait güvenilirlik ve normallik bulguları Tablo 5’de sunulmaktadır.

Tablo 5 incelendiğinde, ölçek minimum 5 maksimum 25 aralığında puanlanmaktadır. Katılımcıların ölçeğe verdiği yanıtların ortalaması oldukça yüksektir (ortalama 23,7). İURÖ ölçeğine ait normallik bulguları incelendiğinde, çarpıklık ve basıklık değerleri doğrultusunda ölçeğin normal

Tablo 5: İURÖ ilişkin normallik ve güvenilirlik bulguları.

Parametreler	İURÖ
N	431
Mean	23,7
Standard deviation	2,11
Minimum	5,00
Maximum	25,0
Skewness	-3,32
Std. error skewness	0,11
Kurtosis	18,3
Std. error kurtosis	0,23
Cronbach’s α	0,77

varsayımları sağlamadığı görülmektedir. Bir ölçeğin normal dağılım sağlaması için çarpıklık (skewness) ve basıklık (kurtosis) değerlerinin literatürde kabul edilebilir değer olan -1,5 ile +1,5 arasında yer alması gerekmektedir (26,27). Dolayısıyla İURÖ ölçeğinde çarpıklık ve basıklık değerleri incelendiğinde verilerin normal dağılıma uymadığını göstermektedir. Bu bakımdan gruplar arası farklara bakılırken İURÖ için normallik gerektirmeyen testler kullanılmıştır. Öte yandan çarpıklık ve basıklık değerleri ile karşılaştırıldığında standart hata değerlerine ilişkin fark istatistiksel olarak anlamlıdır. İlaç Uyum Raporu Ölçeğinin Cronbach’s alfa (α) katsayısı 0,77 olarak elde edilmiştir. Buna karşın ölçeğin geliştirildiği orijinal çalışmada Cronbach’s alfa değeri 0,85 olarak elde edilmiştir (23). Literatürde $\alpha > 0,70$ olması genellikle yeterli görülmektedir (28). Dolayısıyla ölçeğin güvenilir olduğu söylenebilir.

Tip 2 Diyabet Hastalarının Bazı Demografik ve Klinik Özelliklerine İlişkin İlaç Uyum Raporu Ölçeği Puanlarının Karşılaştırılması

Tablo 6’da Tip 2 diyabet hastalarının demografik ve klinik özelliklerine göre ilaç uyum raporu ölçeği puanlarının farklılık gösterip göstermediğine ilişkin yapılan bağımsız örneklem T-testi sonuçları incelendiğinde, yaşa göre ilaç uyum

Tablo 6: Katılımcıların sosyo-demografik ve klinik özelliklerine göre İURÖ’ye ilişkin T Testi bulguları.

Değişkenler		Sonuç (n=431)	T değeri	p
Yaş	60 yaş altı (n=174)	23,7 $\pm$ 2,12	-0,48	0,630
	60 yaş ve üzeri (n=257)	23,8 $\pm$ 2,10		
Cinsiyet	Kadın (n=298)	23,8 $\pm$ 1,93	0,596	0,552
	Erkek (n=133)	23,6 $\pm$ 2,46		
Diyetisyene Yönlendirilme Durumu	Evet (n=350)	23,9 $\pm$ 1,74	3,07	0,002
	Hayır (n=81)	23,1 $\pm$ 3,19		
Verilen Diyetle Dikkat Etme Durumu	Evet (n=262)	24,0 $\pm$ 1,60	3,31	0,001
	Hayır (n=169)	23,3 $\pm$ 2,66		
Diyabet Eğitimi Alma Durumu	Evet (n=220)	23,9 $\pm$ 1,64	1,78	0,076
	Hayır (n=211)	23,5 $\pm$ 2,49		
Ailede Diyabet Öyküsü Olma Durumu	Evet (n=348)	23,6 $\pm$ 2,21	-1,90	0,058
	Hayır (n=83)	24,1 $\pm$ 1,52		
Günlük Ana Öğün Sıklığı	2 defa (n=189)	23,7 $\pm$ 2,37	-0,555	0,579
	3 defa (n=242)	23,8 $\pm$ 1,88		
Öğün Atlama Durumu	Evet (n=245)	23,5 $\pm$ 2,36	-2,28	0,023
	Hayır (n=186)	24,0 $\pm$ 1,69		
Hipoglisemik Atak Geçirme Durumu	Evet (n=41)	23,3 $\pm$ 2,13	-1,19	0,234
	Hayır (n=390)	23,8 $\pm$ 2,10		
Diğer Kronik Hastalığının Olup Olmaması Durumu	Evet (n=372)	23,7 $\pm$ 2,11	-0,055	0,956
	Hayır (n=59)	23,7 $\pm$ 2,13		

Veriler Ortalama $\pm$ SS, T $\pm$ SD olarak verilmektedir.

raporu ölçeğinden elde edilen puanlar istatistiksel yönden farklılaşmamaktadır ($p>0,05$). Dolayısıyla tip 2 diyabet hastalarının yaşları ile ilaç uyum raporu ölçeğinden alınan puanlar arasında istatistiksel yönden anlamlı bir ilişki söz konusu değildir. Benzer şekilde cinsiyete göre ilaç uyum raporu ölçeğinden elde edilen puanlar istatistiksel yönden farklılaşmamaktadır ($p>0,05$). Dolayısıyla cinsiyet ile ilaç uyum raporu ölçeğinden alınan puanlar arasında anlamlı bir ilişki söz konusu değildir.

İlaç uyum raporu ölçeğinden elde edilen puanlar diyetisyene yönlendirilme durumuna göre istatistiksel yönden farklılaşmaktadır ($p<0,05$). Zira diyetisyene yönlendirilenlerin ilaç uyum raporu ölçeği ortalamaları ($23,9\pm1,74$) yönlendirilmeyenlere göre daha fazladır ve söz konusu olan bu fark istatistiksel yönden anlamlıdır ($t = 3,07, p = 0,002$). Aynı şekilde verilen diyetle dikkat etme değişkenine göre ilaç uyum raporu ölçeğinden elde edilen puanlar istatistiksel yönden farklılaşmaktadır ($p<0,05$). Diyetle dikkat edenlerin ilaç uyum raporu ölçeği ortalamaları ($24\pm1,60$) diyetine dikkat etmeyenlere göre daha fazladır ve söz konusu olan bu fark istatistiksel yönden anlamlıdır ($t = 3,31, p = 0,001$). Aynı şekilde öğün atlama durumu değişkenine göre ilaç uyum raporu ölçeğinden elde edilen puanlar istatistiksel yönden farklılaşmaktadır ($p<0,05$). Öğün atlamadığını belirten hastaların ilaç uyum raporu ölçeği ortalamaları ($24\pm1,69$) öğün atlayanlara göre daha fazladır ve söz konusu olan bu fark istatistiksel yönden anlamlıdır ($t = -2,28, p = 0,023$). Sonuç olarak diyetisyene yönlendirilenler, diyetine dikkat edenler ve öğün atlamayanlar, daha yüksek ilaç uyumu puanına sahiptir. Öte yandan diyabet eğitimi alma, ailede diyabet öyküsü olma, ana öğün sıklığı, hipo glisemik atak geçirme ve diğer kronik hastalık durumu gibi değişkenler açısından anlamlı bir farklılık ($p>0,05$) saptanmamıştır (Tablo 6).

Araştırmada elde edilen bu bulgular ışığında, tip 2 diyabet hastalarının ilaç uyumu üzerinde özellikle beslenme eğitimi ve diyet davranışlarının etkili olduğu söylenebilir. Nitekim diyetisyene yönlendirilme, verilen diyetle dikkat etme ve öğün atlama durumu ile ilgili unsurlar tip 2 diyabet hastalarının ilaç uyumunu anlamlı şekilde yordamaktadır. Dolayısıyla tip 2 diyabet tedavisinde diyetisyene yönlendirme ve diyet uyumunu artırmaya yönelik danışmanlık hizmetlerinin desteklenmesinin, tedavi başarısını pozitif yönde etkileyebileceği düşünülmektedir. Buna karşın yaş, cinsiyet diyabet eğitimi alma, ailede diyabet öyküsü olma, ana öğün sıklığı, hipo glisemik atak geçirme ve diğer kronik hastalık durumu gibi değişkenler tip 2 diyabet hastalarının ilaç uyumu üzerinde belirleyici olmadığı sonucuna ulaşılmıştır (Tablo 6). Demografik ve klinik özellikleri göre İÜRO ara-

cına ilişkin Anova Testi bulguları Tablo 7’de sunulmaktadır.

Tablo 7 tek yönlü ANOVA testinin sonuçlarını kapsamaktadır. Bu test ile ilaç uyum raporuna ilişkin demografik ve sağlık değişkenleri arasında (gruplar arasında) anlamlı farklar olup olmadığı ortaya koyulmaktadır. Tabloda haftalık egzersiz (yürüyüş, spor, fiziksel aktivite) yapma durumuna ilişkin ilaç uyum raporu ortalamaları sırasıyla incelendiğinde egzersiz yapmayanların ilaç uyumu ortalaması 23,2; her gün egzersiz yapmayanların ilaç uyumu ortalaması 23,7 ve haftada en az üç gün egzersiz yapanların ilaç uyumu ortalaması 24,2 en yüksektir. Dolayısıyla egzersiz yapan bireylerin ilaç uyumu anlamlı şekilde ($F = 4,96, p = 0,002$) daha yüksektir (Tablo 7).

Aynı şekilde Tip 2 diyabet tanısı konulduktan sonra vücut ağırlığında değişime ilişkin gruplar arasındaki fark istatistiksel olarak sınırda anlamlılık ($p \approx 0,05$) göstermektedir. Tanı konulduktan sonra kilo alımı artan hastaların ilaç uyumu ortalaması 23,5 iken kilosu azalanların ilaç uyumu ortalaması 24’tür. Dolayısıyla Tip 2 diyabet tanısı konulduktan sonra kilo kaybı olan hastaların ilaç uyumu daha yüksektir. Ancak bu fark tam anlamlıya ($p = 0,053$) istatistiksel olarak anlamlı değildir (Tablo 7).

ANOVA testi sonuçlarına göre, ara öğün sayısı, BKİ skoru, medeni durumu, eğitim durumu, çalışma durumu, Tip 2 diyabet tanısının ne kadar süre önce konulduğu, ne zamandan beri Tip 2 diyabet tedavisi alındığı, kan şekeri ölçüm sıklığı, Tip 2 diyabet kontrol tedavisi için doktora gitme sıklığı, alkol ve sigara kullanma durumuna göre ilaç uyum raporu ölçeğinden elde edilen puanlar istatistiksel olarak farklılaşmamaktadır ($p> 0,05$). ANOVA analizinde anlamlı fark çıkan (haftalık egzersiz durumu) değişkenin gruplar arasındaki farkının detayını gösteren Post Hoc testi sonuçları Tablo 8’de sunulmaktadır.

Bu test, hangi gruplar arasında fark olduğunu belirginleştirmektedir. Post Hoc analizlerine göre hiç egzersiz yapmayanlar, haftada 1-2 gün ve en az 3 gün egzersiz yapanlara göre anlamlı bir şekilde daha düşük ilaç uyum puanına sahiptir. Dolayısıyla her gün egzersiz yapanlarla diğer gruplar arasında istatistiksel olarak fark yoktur, ama ilaç uyumu ortalamaları yine de daha yüksektir. Netice olarak ANOVA ve Post Hoc analizleri sonucunda, haftalık egzersiz yapma sıklığı ile ilaç uyum düzeyi arasında anlamlı bir ilişki bulunmuştur ($p = 0,002$). Bilhassa haftada en az 1-2 gün egzersiz yapan hastalar, hiç egzersiz yapmayan bireylere kıyasla anlamlı düzeyde daha yüksek ilaç uyumu puanına sahiptir ($p < 0,01$). Ancak her gün egzersiz yapan bireylerle diğer gruplar arasında anlamlı bir fark gözlenmemiştir (Tablo 8).

Tablo 7: Demografik ve klinik değişkenlere göre İÜRÖ'ye ait ANOVA Testi bulguları

Demografik ve klinik değişkenler*		n	Sonuç (n=431)	F	p
Ara Öğün Sayısı	Ara öğün yok	40	23,6± 2,10	0,073	0,929
	Bir	219	23,7± 2,22		
	İki	172	23,7± 1,97		
BKİ Skoru	Zayıf	55	24,1± 1,30	2,02	0,112
	Normal	59	23,8± 1,98		
	Kilolu	152	23,6± 2,34		
	Obez	165	23,6± 2,14		
Medeni Durumu	Evli	337	23,8± 1,75	1,57	0,216
	Bekar	34	22,9± 3,14		
	Boşanmış, dul	60	23,6± 2,99		
Öğrenim Durumu	Okur yazar değil	47	23,7± 2,38	0,423	0,736
	İlk-orta okul	198	23,7± 2,2		
	Lise Mezunu	126	23,9± 1,66		
	Lisans veya Lisansüstü	60	23,6± 2,38		
Çalışma Durumu	Çalışıyor	68	23,8± 1,96	0,351	0,704
	Çalışmıyor	216	23,6± 1,96		
	Emekli	147	23,8± 2,38		
Ne zamandan beri Tip 2 diyabet tanısının konulduğu	6 ay -1 yıl	33	23,2± 3,04	0,609	0,657
	1 yıl - 2 yıl	32	23,9± 1,44		
	2 yıl - 5 yıl	76	23,9± 1,59		
	5 yıl - 10 yıl	93	23,8± 2,67		
	10 yıl ve üzeri	197	23,7± 1,87		
Tip 2 diyabet tanısı konulduktan sonra vücut ağırlığında değişim	Arttı	149	23,5± 2,06	2,96	0,053
	Azaldı	110	24,0± 1,35		
	Değişme olmadı	172	23,7± 2,49		
Ne zamandan beri Tip 2 diyabet tedavisi aldığı	6 ay -1 yıl	35	23,2± 2,97	0,585	0,674
	1 yıl - 2 yıl	33	24,0± 1,42		
	2 yıl - 5 yıl	78	23,6± 2,64		
	5 yıl - 10 yıl	84	23,9± 1,93		
	10 yıl ve üzeri	201	23,7± 1,85		
Haftalık Egzersiz Yapma Durumu	Her gün düzenli egzersiz yapanlar	87	23,7± 1,86	4,96	0,002
	En az üç gün egzersiz yapanlar	51	24,2± 1,18		
	Bir veya iki gün egzersiz yapanlar	143	24,1± 1,24		
	Haftalık egzersiz yapmayanlar	150	23,2± 2,90		
Kan Şekeri Ölçüm Sıklığı	Her gün	86	23,9± 1,52	2,11	0,124
	Ara sıra	232	23,9± 1,71		
	Neredeyse hiç	113	23,3± 2,99		
Tip 2 Diyabet Kontrol Tedavisi için Doktora Gitme Sıklığı	Ayda bir	36	23,1± 2,79	2,10	0,085
	3 Ayda bir	149	24,0± 1,52		
	6 ayda bir	121	23,9± 1,52		
	Yılda bir	74	23,6± 2,10		
	Düzenli gitmeyenler	51	22,9± 3,56		
Alkol Kullanma Durumu	Nadiren	35	23,7± 1,81	1,09	0,343
	Bıaktım	32	23,1± 2,63		
	Hiç kullanmayalar	364	23,8± 2,08		
Sigara Kullanma Durumu	Düzenli kullananlar	62	23,1± 2,34	1,09	0,353
	Nadiren kullananlar	57	24,0± 1,70		
	Kullanmayı bırakanlar	71	23,9± 1,52		
	Hiç kullanmayanlar	241	23,6± 2,27		

*Veriler ortalama±standart sapma olarak verilmiştir.

Tablo 8. Haftalık egzersiz yapma durumuna göre İÜRO'ye ilişkin POST HOC bulguları

Değişkenler	Her gün düzenli egzersiz yapanlar	Haftada en az üç gün egzersiz yapanlar	Haftada bir veya iki gün egzersiz yapanlar	Haftalık egzersiz yapmayanlar
Her gün düzenli egzersiz yapanlar	Ortalama fark —	-0,429	-0,3368	0,560
Haftada en az 3 gün egzersiz yapanlar	Ortalama fark —	—	0,0926	0,990*
Haftada bir veya iki gün egzersiz yapanlar	Ortalama fark —	—	—	0,897 **
Haftalık egzersiz yapmayanlar	Ortalama fark —	—	—	—

TARTIŞMA

Bu araştırma, Tip 2 diyabet hastalarının ilaç uyumu ile sosyo-demografik değişkenler ve Tip 2 diyabete ait klinik özellikler arasındaki ilişkiyi inceleyen bir araştırmadır. Araştırma, Tip 2 diyabetlilerin ilaç uyumu hakkında derinlemesine bilgi sağlamayı amaçlayan bir araştırmadır. Dolayısıyla bu araştırma, Tip 2 diyabet hastalarının ilaç uyumuna doğrudan etkisi olan potansiyel faktörleri belirlemektedir.

Çalışmamızda cinsiyet özelinde yapılan bir değerlendirmede, kadın hastaların ilaç uyum düzeylerinin erkeklere göre daha yüksek olduğu görülmüştür. Ancak Tip 2 diyabetli popülasyonda yürütülen başka bir çalışmada ise kadın hastaların erkek hastalara kıyasla tedaviye uyum düzeylerinin daha düşük olduğu görülmüştür (29). Çalışmamızın sonuçları ile tutarlı olarak yetişkin kronik hastalar üzerinde yapılan başka bir çalışmada ise cinsiyet, eğitim ve medeni durum değişkenlerinin ilaç uyumu üzerinde anlamlı bir etkisi söz konusu olmamıştır (30). Aynı şekilde Nepal'de yürütülen bir çalışmanın sonuçlarına göre yaş, mesleki durum, ilaç alım süresi ve diyabet ilaç alım türleri ile ilaç uyumu arasında bir ilişki görülmemiştir (31). Çalışmamızın sonuçlarıyla tutarlı olarak İtalya'da, Etiyopya'da ve Endonezya'daki çalışmalarda eğitim durumu ile ilaç uyumu arasında bir ilişki bulunmamıştır (29,30,32). Aynı şekilde Lee ve ark., Sweileh ve ark., Chew ve ark., Aloudah ve ark. Tip 2 diyabetli katılımcılar ile yapmış oldukları çalışmalarda eğitim durumu ile ilaç uyumu arasında istatistiksel olarak gruplar arasında bir farklılık saptanmamıştır (33-36). Buna karşın Nepal'deki çalışmada eğitim düzeyi ve diyabet eğitimi alma durumunun (diyabet danışmanlığına katılım durumu) Tip 2 diyabet hastalarının ilaç uyumunu pozitif yönde etkilediği sonucuna ulaşılmıştır (31). Sah ve ark. tarafından Nepal'de yapılan başka bir çalışmada, ise yaş grubu, eğitim durumu ve çalışma durumu ile ilaç uyumsuzluğu arasındaki ilişki istatistiksel olarak anlamlı iken ailede diyabet öyküsü olma durumu, alkol tüketimi ve sigara kullanma alışkanlığı ile ilaç uyumsuzluğu arasındaki ilişkinin anlamlı olmadığı saptanmıştır

(37). Sweileh ve ark., Chew ve ark., Aloudah ve ark. Tip 2 diyabetli hastalarla yapmış oldukları çalışmalarda medeni durum ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki saptamamaları çalışmamızın sonucuyla örtüşmektedir. Aynı zamanda Sweileh ve ark. Chew ve ark., Aloudah ve ark. ve Ekici'nin çalışmalarında yaş ile ilaç uyumu arasında bir ilişki bulunmamıştır (34-36,38). Buna karşın Lee ve ark.nın yaptıkları çalışmada yaş ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki olduğu ve gruplar arasında olan farkın anlamlı olduğu sonucuna ulaşılmıştır (33).

Tip 2 diyabet tanısı yeni konulan bir popülasyon örneğinde, diyabet tanısı konulmadan önce ve tanı konulduktan sonra ilk 6 yıl içinde kilo değişimlerinin gözlemlendiği bir çalışmada, 559 hasta (%64,8) diyabet tanısı konulduktan sonraki 6 yıl içinde kilo verme eğiliminde iken 304 hasta (%35,2) ise kilo almıştır (39). Tersine çalışmamızda ise Tip 2 diyabet tanısı konulduktan sonra 149 hastanın (%34,6) kilosu artarken, 110 hastanın (%25,5) kilosu azaldı ve 172 hastanın (%39,9) ise kilosunda değişim olmamıştır. Amerika Birleşik Devletlerinde yapılan bir çalışmada ise yalnızca insülin ve insülin ile birlikte oral antidiyabetik ilaç kullanan erkeklerde kilo alımı olmuştur. Ayrıca bahsi geçen çalışmada önceki 10 yıl içinde sigarayı bırakmış olan erkekler arasında kilo alımı en fazlasıydı (40).

Hipoglisemi diyabet hastalığının en önemli komplikasyonları arasında yer almaktadır. Hipoglisemi, çoklu organ hasarı ve bilhassa beyin hasarını önlemek açısından derhal tanınması ve tedavi edilmesi gereken bir tablodur. Hipoglisemiye bağlı gelişen kısa ve uzun vadeli komplikasyonlar arasında bilişsel işlev değişikliği, nöbet ve koma durumu, nörolojik hasar, böbrek yetmezliği, kardiyovasküler hasar ve ölümler yer almaktadır (41, 42). Dolayısıyla hipogliseminin tanınması, buna bağlı oluşacak komplikasyonların önlenmesi açısından, kan şekeri ölçümü ve doktor takibi gerekli görülmektedir (42). Tip 2 diyabetlilerde yoğun diyabet tedavisi ve uzun süre boyunca sürdürülen insülin tedavisi ile hipoglisemi ilişkili bulunmuştur (43). Buna kar-

şın çalışmamızda hipoglisemik atak geçirme ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır.

Kronik hastalıkları olan hastalar açısından ilaç uyumu kilit bir rol üstlenmektedir (44). Kronik hastalığı olan hastaların takriben %50'si ilaçlarını reçete edildiği gibi kullanmamaktadır (17). Gana'da diyabet ve hipertansiyon hastaları ile yapılan bir çalışmada, ilaç uyumsuzluğunun temel nedeni, ilaçların bu şikâyetleri yönetmede etkisiz olduğu algısından kaynaklı olduğu sonucuna dayandırılmıştır (45). Çalışmamızda Tip 2 diyabet dışında diğer bir kronik hastalığının olması durumu ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki saptanmamıştır.

Tip 2 diyabet hastalarının kendi kendilerine kan şekeri ölçümü yapmaları ve hangi sıklıkta ölçüm yapmaları gerektiği uzun süredir tartışa gelen bir konudur (46, 47). Ancak insülin ve antidiyabetik ilaç kullanan Tip 2 diyabet hastaları açısından kan şekeri ölçümünün bizzat hasta tarafından günlük olarak ölçülmesi önerilmektedir (48). Zira kan şekeri düzeyinin daha sık kendi kendine izlenmesi, diyabet türü ve tedavisine bakılmaksızın gerek klinik olarak gerekse istatistiksel olarak daha iyi glisemik kontrol ile ilişkili bulunmuştur (49). Aynı şekilde Türkiye'de (Tip 2 diyabetli popülasyonda) yürütülen bir çalışmada, kan şekeri ölçüm sıklığı artıkcâ metabolik kontrolün iyileştiği tespit edilmiştir (50). Buna karşın çalışmamızda, kan şekeri ölçüm sıklığı ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır. Tip 2 diyabetlilerde insüline tedavisine uyum ile uzun dönem metabolik kontrol arasında anlamlı bir ilişki bulunmuştur (51). Ancak çalışmamızda Tip 2 diyabet tedavisi kontrolünün yapıldığı süre dilimi ile ilaç uyumu arasında bir ilişki bulunmamıştır. Aynı zamanda Tip 2 diyabet kontrol tedavisi için doktora gitme sıklığı ile ilaç uyumu arasında bir ilişki çalışmamızda bulunmamıştır. Çalışmamızda düzenli olarak doktor kontrolüne gitmeyenlerin oranı %11,8 (51 hasta), doktor kontrolüne yılda bir gidenlerin oranı %17,2 (74 hasta), 6 ayda bir gidenlerin oranı %28,1 (121 hasta), 3 ayda bir gidenlerin oranı %34,6 (149 hasta) ve ayda bir doktor kontrolüne gidenlerin oranı ise %8,4 (36 hasta) olarak bulunmuştur. Türkiye'de yapılan iki çalışmada da Tip 2 diyabet hastalarının düzenli doktor kontrolüne gitme oranları sırasıyla %54,8 ile %55 olarak bulunmuştur (50, 52).

Son zamanlarda, batı toplumlarının genel popülasyonunda bir obezite salgını meydana geleceğine dair büyük bir endişe var olmuştur (53). Bu obezite salgınının bir sonucu olarak artan BKİ'nin tip 2 diyabetin gelişmesine yol açacağından endişe edilmektedir (40). Ekici'nin çalışmasında, düzensiz diyet alışkanlığı ilaç uyumu için risk faktörü olarak tespit

edilmiştir. Aynı çalışmada normal kilolu olan katılımcıların tedaviye uyum düzeyleri en düşük görülmüştür (38). Oysa çalışmamızda kilolu ve obez olanların tedaviye uyum düzeylerinin daha düşük olduğu gözlenmiştir. Nitekim çalışmamızda BKİ yönünden zayıf olan katılımcıların diğer gruplara göre ilaç uyum düzeylerinin daha yüksek olduğu sonucuna varılmıştır.

Ekici'nin çalışmasında (38), diyabet tanısının konulduğu süre ile ilaç uyumu arasında bir ilişkinin saptanmayışı çalışmamızın sonucu ile örtüşmektedir. Aynı şekilde ve Lee ve arkadaşlarının ve Aloudah ve ark.nın çalışmalarında (33, 36), Tip 2 diyabet tanısının konulduğu süre ile ilaç uyumu arasında istatistiksel yönden anlamlı ilişki saptanmamıştır. Buna karşın Arulmozhi ve ark.nın Tip 2 diyabetli hastalarla yapmış oldukları çalışmada (54), Tip 2 diyabet tanısı 1 yıl ve 1 yıldan daha çok önce konulan hastaların 1 yıldan daha az olanlara göre ilaç uyum seviyelerinin anlamlı bir şekilde daha yüksek olduğu saptanmıştır. Tersine Fadare ve ark. çalışmasında ise diyabet tanısının konulduğu süre 1 yıldan fazla olanlarının ilaç uyum düzeylerinin daha kötü olduğu görülmüştür (55).

Bilindiği üzere Tip 2 diyabet genellikle sağlıklı bir diyet ve yeterli fiziksel aktivite gibi yaşam tarzı alışkanlıkları ile yönetilebilmektedir (56). Dünya genelinde kronik diyabet vakalarının yaklaşık %90'nı temsil eden Tip 2 diyabet hastalığı, en çok fiziksel hareketsizlik, beslenme ve diyet ile ilişkili olduğu için önlenabilir bir hastalık olarak değerlendirilmektedir (7, 57, 58). Öyle ki bozulmuş glikoz toleransı olan 577 kişilik bir rastgele klinik çalışmasının sonuçlarına göre günlük 30 dakika yürüyüş yapanlarda diyabet gelişme riskinin %46 düzeyinde azaldığı görülmüştür (59). Çalışmamızın sonuçlarına göre ilaç uyumu bakımından egzersiz çok önem taşımaktadır. Çalışmamızda egzersiz yapan Tip 2 diyabetlilerin ilaç uyumu anlamlı şekilde ($F=4,96$, $P=0,002$) daha yüksektir. Ayrıca egzersiz yapmayanlar, haftada 1-2 gün ve en az 3 gün egzersiz yapanlara göre anlamlı bir şekilde daha düşük ilaç uyum puanına sahiptir. Ekici'nin (2021) çalışmasında diyabet kontrol sıklığının az olması ve egzersiz alışkanlığının yetersiz olması ilaç uyumu bakımından risk faktörü olarak tespit edilmiştir (38). Nitekim Ekici Tip 2 diyabet tanısı alan hastalar üzerinde yaptığı çalışmada egzersiz ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki olduğunu ve düzenli egzersiz yapanların yapmayanlara göre ilaç uyumlarının daha iyi seviyede olduğunu saptamıştır (38). Benzer şekilde Wong ve ark.nın yapmış oldukları çalışmada, (örneklemnin Tip 2 diyabetlilerden oluştuğu) hastaların egzersiz alışkanlıkları orta ve iyi düzeyde olup düzenli egzersiz alışkanlığı olan hastaların ilaç uyumlarının daha yüksek olduğu tespit edilmiştir (60).

Literatürde de bahsedildiği üzere diyetisyen, diyabet tedavisinin önemli bir üyesi konumundadır. Öyle ki Tip 2 diyabet hastalarının tedavi ve bakımı hususunda (ilaç kullanımının optimal kılınmasında) bir uzman diyetisyenin sağlık ekibinin bir parçası olarak önemli bir rol üstlendiği söylenebilir (61). Ancak diyabet tedavisi sürecinde diyetisyen hizmetlerine erişim ile ilgili yaşanan aksaklıkların en temel sebeplerinden biri, ilk tanıyı koyan doktorun hastayı diyetisyene yönlendirmemesi olarak karşımıza çıkmaktadır (50). Zira diyetisyen hizmeti için diyetisyene yönlendirilen hastaların %90'nının diyetisyen ile görüştüğü bildirilmektedir (62). Nitekim çalışmamızda da, 350 hastanın tedavi sürecinde diyetisyene yönlendirilip diyetisyen hizmeti aldığı 81 hastanın ise yönlendirilmediği ve diyetisyen desteği almadığı tespit edilmiştir. Literatürde bir üniversite hastanesinde Tip 2 diyabet tanısı konulan hastaların %37.2'sinin (ilk tanı koyan doktor tarafından) diyetisyene yönlendirilmediği ancak tanı konulan hastaların önemli bir kısmının (%90,3) tedavi süreci içinde en az bir kez diyetisyen hizmeti aldığı saptanmıştır.

Diyet, Tip 2 diyabetin önlenmesi ve başarı ile yönetilmesinde önemli bir koşulu barındırmaktadır. Diyet eğitimi ve danışmanlığı, gerek prediabetin diyabete dönüşmesinin engellenmesi gerekse ilaç kullanımının azaltılması bakımından son derece gerekli ve önemlidir (63). Dolayısıyla Tip 2 diyabette diyetin (beslenme tedavisi) amacı, ileri yaşlarda ortaya çıkacak majör ve mikro komplikasyonları önlemek, yeterli ve dengeli beslenme kültürünü kazandırmak, BKİ yönünden sağlıklı bir vücut ağırlığına kavuşturmak, yaşam kalitesini yükseltmek ve yaşam süresini uzatmaktır (64-66). Fakat bireylerin yeme alışkanlıklarını ve kültürlerini değiştirmek karmaşık ve zor bir süreçtir (67, 68). Ancak diyet ile kilo vermek önemli bir fark yaratır (63). Zira Tip 2 diyabetin etkin bir şekilde yönetilmesinde paha biçilemez derece katkı sağlayan optimal kilo yönetimi için düzenli diyetisyen takipleri gereklidir. Diyetisyen liderliğinde tip 2 diyabetlilere yapılan 19 haftalık yaşam tarzı müdahalesi ile kilo kaybı, iyileştirilmiş glisemik kontrol ve bu müdahale sonucunda kullanılan ilaçların azaltılması arasında istatistiksel olarak anlamlı bir ilişki saptanmıştır (67). Ekici ile Küçük ve Yapar'ın Tip 2 diyabet popülasyonu üzerinde yapmış oldukları çalışmalarında (38, 69), diyet ile ilaç uyumu arasındaki ilişkinin istatistiksel olarak anlamlı olduğu ve diyet uyumu düzenli olan hastaların ilaç uyumlarının daha iyi düzeyde olduğu tespit edilmiştir. Nitekim çalışmamızda da diyetisyenin belirlediği diyete uyma durumu ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki olduğu saptanmıştır. Buna karşın diyet ile ilaç uyumu arasındaki ilişkinin Wong ve arkadaşlarının (2015) tarafından incelendiği çalışmada, gruplar arasında ilaç uyum düzeyine ilişkin farkın istatistiksel olarak anlamlı olmadığı saptanmamıştır (60).

Çalışmamızda tip 2 diyabet hastalığı açısından egzersiz, tedavinin önemli bir parçası olmasına rağmen, katılımcıların yarısından fazlası bu alışkanlığa sahip olmadığı görülmüştür. Bu durum, yaşam tarzı değişikliklerinin yeterince hastalar tarafından benimsenmediğini göstermektedir. Aynı şekilde katılımcıların %60'na tedavi olarak diyet önerilmemiştir. Ancak Tip 2 diyabet şikâyeti bakımından diyet tedavisinin önemli bir basamağını teşkil etmektedir. Sonuç olarak tedavi türü olarak insülin kullanımı görece daha azdır. Bu durum hastaların erken evrede diyabet tanısı almaları ve tedavilerine başlamalarının bir sonucu olabilir.

Çalışmamızın sonuçlarına göre egzersiz yapma durumu, diyetisyene yönlendirilme durumu, verilen diyete dikkat etme ve öğün atlama durumu ile ilaç uyumu arasında istatistiksel olarak anlamlı bir ilişki olduğu saptanmıştır. Sonuç olarak egzersiz ve diyet hem Tip 2 diyabetin etkin yönetimi hem de prediabetin diyabete dönüşmesinin önlenmesi açısından gereklidir (56, 63-67). Dolayısıyla Tip 2 diyabet rahatsızlığı nedeniyle komplikasyon gelişme riskini azaltmak açısından egzersiz ve diyet gibi sağlıklı yaşam tarzı alışkanlıklarının kazandırılması önemli bir gereklilik olarak düşünülmektedir.

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Çalışmada herhangi bir çıkar çatışması yoktur. "Tip 2 diyabet hastalarının aktivasyon düzeylerinin ve hekim ile ilişkilerinin ilaç uyumlarına etkisinde sağlığa bağlılıklarının aracı rolü" başlıklı tezin bir bölümünden elde edilmiştir.

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Anxiety, Depression, and Associated Psychosocial Factors in Individuals with Type 2 Diabetes Attending Family Health Centers

Çiğdem SAMANCI TEKİN  , Yasemin UĞURLU , Aysun GÜZEL 

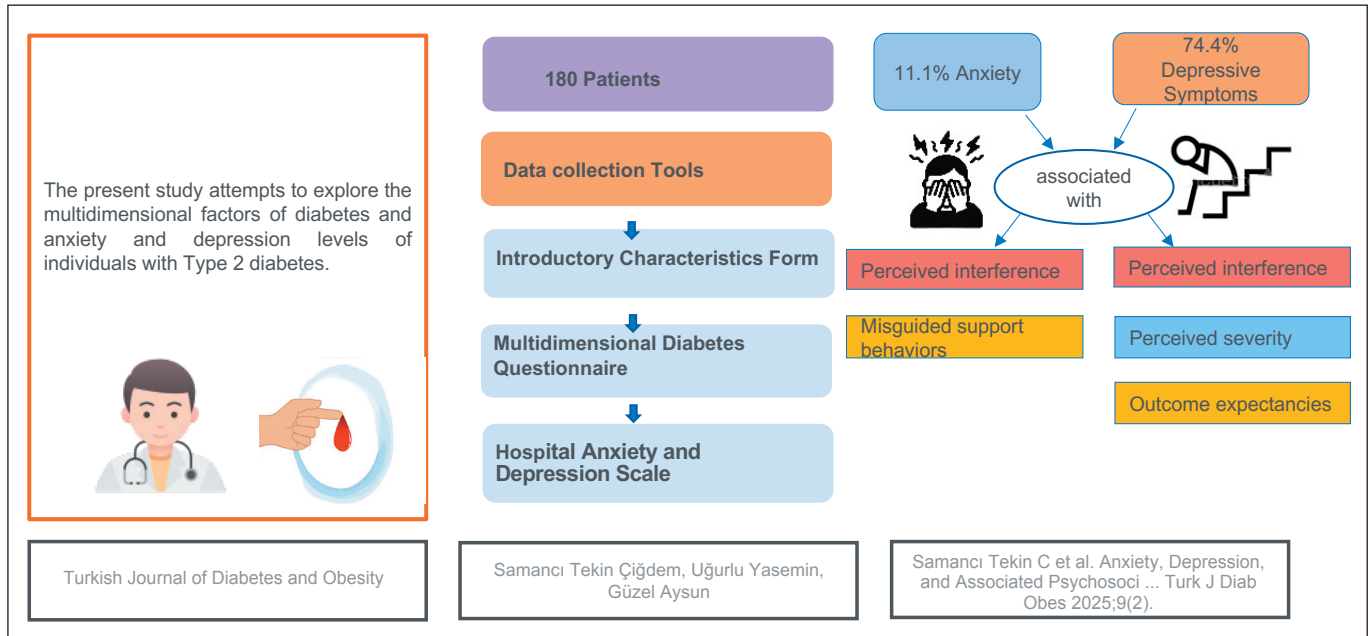
¹Niğde Ömer Halisdemir University, Faculty of Medicine, Internal Medical Sciences, Department of Public Health, Niğde, Türkiye

²Niğde Zubeyde Hanım Faculty of Health Science, Department of Principles of Nursing, Niğde, Türkiye

³Burdur Mehmet Akif Ersoy University, Faculty of Health Sciences, Emergency and Disaster Management, Burdur, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Aim: The present study aims to explore the multidimensional factors of diabetes, as well as the anxiety and depression levels, in individuals with Type 2 diabetes attending family health center.

Material and Methods: This cross-sectional study included 180 patients with Type 2 diabetes registered in three randomly selected family health centers. We collected data using the Multidimensional Diabetes Questionnaire (MDQ) and the Hospital Anxiety and Depression Scale (HADS) between June and November, 2023. The data were then subjected to the Mann-Whitney U test, the Kruskal-Wallis test, and multiple linear regression analysis.

Results: The disease duration was 1-5 years for 63.3% of participants, and 75.6% reported self-monitoring their blood glucose levels. While 11.1% of participants exhibited symptoms of anxiety, 74.4% had depressive symptoms. Our analysis showed the factors associated

ORCID: Çiğdem Samancı Tekin / 0000-0003-0895-1911, Yasemin Uğurlu / 0000-0002-0478-9091, Aysun Güzel / 0000 0002 7071 3511

Correspondence Address / Yazışma Adresi:

Çiğdem SAMANCI TEKİN

Niğde Ömer Halisdemir University, Faculty of Medicine, Internal Medical Sciences, Department of Public Health, Niğde, Türkiye E-mail: cigdemstekin@hotmail.com

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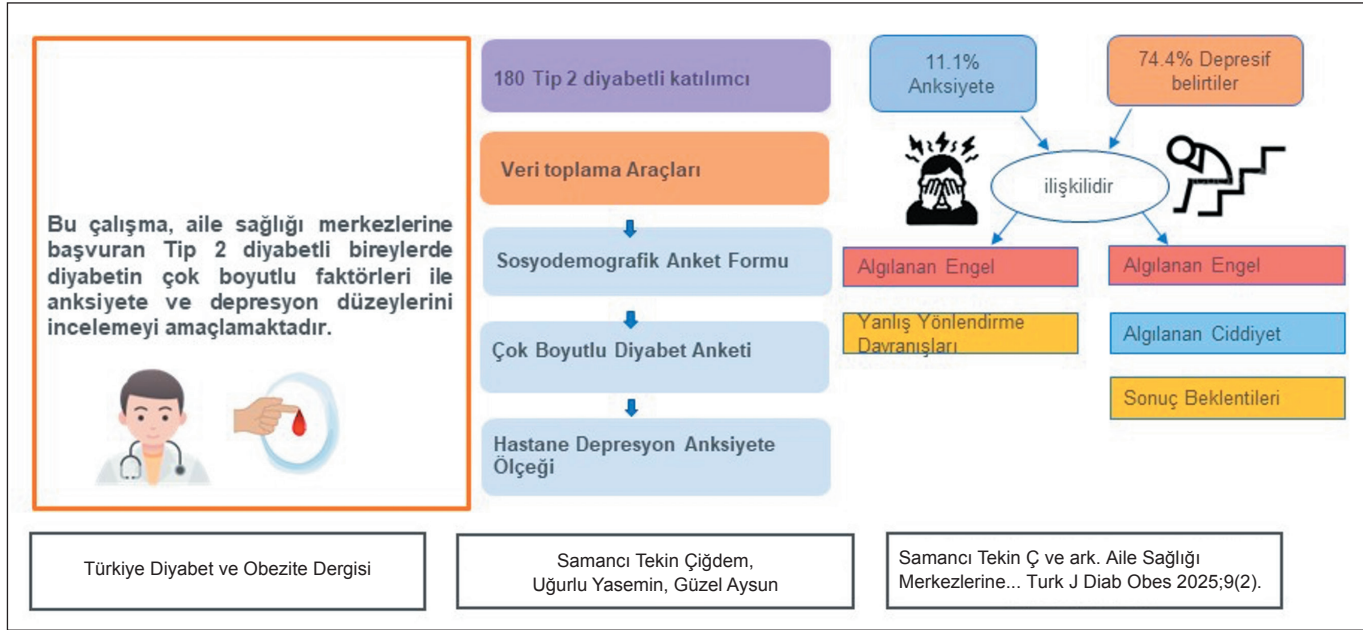
with anxiety symptoms to be perceived interference and misguided support behaviors. Moreover, perceived interference, perceived severity, and outcome expectancies significantly contributed to the manifestation of depressive symptoms ($p<0.05$).

Conclusion: To attain more effective diabetes management, it seems key to reinforcing family health centers and securing comprehensive diabetes-specific services and training in family health centers. Moreover, the multifaceted factors and psychological aspects of diabetes should be considered in the planning of diabetes-oriented services.

Keywords: Diabetes Mellitus, Type 2, Anxiety, Depression, Adult

Aile Sağlığı Merkezlerine Başvuran Tip 2 Diyabeti Olan Bireylerde Anksiyete, Depresyon ve İlişkili Psikososyal Faktörler

GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışma, aile sağlığı merkezlerine başvuran Tip 2 diyabetli bireylerde diyabetin çok boyutlu faktörlerini ve anksiyete ile depresyon düzeylerini incelemeyi amaçlamaktadır.

Gereç ve Yöntemler: Kesitsel tipteki bu araştırmaya, rastgele seçilen üç aile sağlığı merkezine kayıtlı 180 Tip 2 diyabet hastası dâhil edilmiştir. Veriler, Haziran-Kasım 2023 tarihleri arasında Çok Boyutlu Diyabet Ölçeği (MDQ) ve Hastane Anksiyete ve Depresyon Ölçeği (HADS) kullanılarak toplanmıştır. Elde edilen veriler Mann-Whitney U testi, Kruskal-Wallis testi ve çoklu doğrusal regresyon analizi ile değerlendirilmiştir.

Bulgular: Katılımcıların %63,3'ünde hastalık süresi 1-5 yıl arasında olup %75,6'sı kan şekeri düzeylerini kendi kendine izlediğini belirtmiştir. Katılımcıların %11,1'inde anksiyete semptomları, %74,4'ünde ise depresif semptomlar saptanmıştır. Analizler sonucunda, anksiyete semptomları ile ilişkili faktörlerin algılanan engel ve yanlış yönlendirme davranışları olduğu bulunmuştur. Ayrıca, algılanan engel, algılanan hastalık ciddiyeti ve sonuç beklentilerinin depresif semptomların ortaya çıkmasına anlamlı düzeyde katkıda bulunduğu belirlenmiştir ($p<0,05$).

Sonuç: Daha etkili diyabet yönetimi sağlanabilmesi için aile sağlığı merkezlerinin güçlendirilmesi ve bu merkezlerde kapsamlı diyabete özgü hizmetler ile eğitimlerin güvence altına alınması gereklidir. Ayrıca, diyabete yönelik hizmetlerin planlanmasında hastalığın çok boyutlu faktörleri ve psikolojik yönleri dikkate alınmalıdır.

Anahtar Sözcükler: Diabetes mellitus, Tip 2, Anksiyete, Depresyon, Erişkin

INTRODUCTION

Diabetes mellitus is a chronic disease caused by insufficient insulin production or ineffective insulin use, which leads to hyperglycemia and, as a result, causes damage to the nerves, blood vessels, and organs. It is estimated that about 422 million individuals globally, predominantly residing in low- and middle-income countries, are affected by diabetes, which accounts for 1.5 million deaths annually (1). In Türkiye, diabetes is a major public health concern with the highest prevalence in Europe and a rapidly increasing trend (2,3). Type 2 diabetes mellitus (T2DM), the most common form, has risen markedly across all income groups over the past three decades (1). Type 2 diabetes mellitus (T2DM) is heterogeneous, differing in age of onset, obesity, insulin resistance, and risk of complications (4,5). It also affects biological and psychosocial aspects throughout life (6,7), making the assessment and monitoring of psychosocial status in diabetic patients essential (6-8). Diabetes necessitates lifelong self-management and continuous medical care to prevent acute complications and reduce chronic health risks (9). Its management includes multifaceted self-care and lifestyle modifications such as dietary adjustments, physical activity, foot care, medication use, insulin administration, and SMBG (10,11). One should also possess sufficient knowledge, skills, and positive attitudes concerning diabetes to achieve effective diabetes control (12,13). In addition, psychological, cognitive, and social factors facilitate behavioral change in diabetic patients in the treatment process (14-16). Thus, it seems key to delineating the impacts of social-cognitive factors on the achievement of behavioral changes in diabetic patients (17). In these patients, it is postulated that perceived interference, disease severity, support, self-efficacy, and outcome expectancies are associated with self-care behaviors and functional adequacy in achieving diabetes control (14,15,17).

It was previously demonstrated that self-care behaviors are essential for efficient self-management of diabetes and higher quality of life; yet, diabetic patients often exhibit insufficient self-care behaviors that are affected by a multitude of social-cognitive factors (18,19). In consideration of the social learning theory, which underscores the interplay between individual and environmental factors in shaping behavior, Talbot et al. identify several psychosocial variables associated with T2DM self-care behaviors including perceived self-efficacy, perceived interference of diabetes in activities of daily living, perceived diabetes severity, and perceived social support from family and friends (14).

One in eight people, or 970 million individuals, worldwide suffer from a mental disorder, most commonly anxiety and depression (20,21). The COVID-19 pandemic in 2020 significantly increased these disorders, with reports showing 26% and 28% rises in anxiety and depression within a year

(21). In Turkey, the 'Mental Health Profile' reported mental illness in 17.2% of the population, mainly anxiety and depression (22). A pandemic-specific study further showed prevalence rates of anxiety and depression symptoms at 25.7% and 30.9%, respectively (23).

As with physical complications, diabetic patients may also experience various psychological problems, most commonly anxiety and depression (19,24-27). A meta-analysis found that depression prevalence is 1.76 times higher in T2DM patients than in healthy individuals (28). While some studies suggest diabetes may contribute to depression and anxiety (29,30), others indicate these conditions are risk factors for T2DM (30,31). Psychological, social, and biological factors precipitate the onset of depression, often co-occurring with chronic illnesses such as diabetes (32,33). Evidence links depressive disorders in T2DM with poor HbA1c control, reduced medication adherence, increased complications, and higher mortality (34,35). Conversely, higher diabetes-related self-efficacy (36) and stronger family support (37) are associated with better glucose control and self-management, whereas lower self-efficacy relates to greater depressive symptoms, poor glycemic control, and reduced self-care (38). Ultimately, patient-centered care that is respectful and responsive to preferences and barriers remains a primary goal in diabetes management (39).

Diabetes is a common condition that imposes a considerable burden on patients and healthcare systems, prompting organizations and guidelines to design screening programs for both patients and the general population (40). These programs aim to prevent symptom onset, ensure earlier diagnosis, reduce organ damage, and address risk factors contributing to hyperglycemia (40). However, despite numerous guidelines (19,41,42), high-quality care is not always achieved; risk factor control (43) and international disparities in meeting clinical targets remain problematic (44-47). While diabetes care is increasingly delivered in primary care near patients' homes and guidelines emphasize psychosocial assessment in follow-up (47), depression screening is inadequate, with nearly 70% of chronic disease patients not screened within the recommended timeframe (48). Similarly, anxiety screening in diabetic patients is suboptimal in many countries (49,50).

Turkey adopts a community-based primary healthcare system (family medicine) offering basic and low-cost services. In 2021, the Ministry of Health introduced the Disease Management Platform to support screening and follow-up of chronic diseases in family health centers based on evidence-based guidelines. However, its use is optional, and effectiveness is limited by physician- and patient-related factors such as workload or reluctance to participate. These centers also manage multiple chronic conditions, making it difficult to focus on diabetes risks, and only physical health

indicators are recorded without mental health assessment (51). Thus, for efficient diabetes management in primary healthcare, attention should be given to factors supporting patients' self-management, including social and familial support, motivation, education, and access to medications/food (52). Ultimately, this study aims to determine the prevalence of anxiety and depression symptoms accompanying diabetes, identify the psychosocial factors that may influence these conditions, and explore the potential relations between these variables to inform and improve diabetes care practices in primary care.

MATERIAL and METHODS

This study employs a cross-sectional design, and the study population consisted of T2DM patients registered in family health centers in the Niğde province. We selected the sample from a pool of voluntary diabetic patients aged 18 years and older who applied to three randomly selected family health centers out of 11 centers located in Niğde. To select the three family health centers required for the sample, we noted 11 centers on slips of paper and randomly drew three of them. To be included in the study, patients had to have been diagnosed with T2DM for at least one year, not have a diagnosed psychiatric condition, and be literate. Participants were initially asked about any psychiatric disorders, and for those who reported not having such conditions, their medical records were checked at the relevant family health centers to confirm the absence of a prior diagnosis. We excluded individuals who were diagnosed with T2DM less than a year ago, had a diagnosed psychiatric disorder, were illiterate, or were unwilling to participate.

Given the national diabetes rate (12.1%) and the current population of Niğde (362,861), the sample size was calculated as 164 people with a 95% confidence interval (CI) using the OpenEpi 3.01 program (53). We initially administered the data collection tools to 20 diabetic patients and finalized them in a pilot study; yet, the data from these participants were not considered in the main analyses.

Upon necessary permissions from the family health center administrations, we initially identified the days and hours of dense patient visits with the help of physicians and other staff in the centers. We then collected the data face-to-face from 180 patients in the selected centers in June-November 2023. The data set was free of any instances of missing data, and there were no instances of participants dropping out of the study during the data collection phase.

Data Collection Tools

We collected the data through a questionnaire booklet covering an introductory characteristics form, the Multidimensional Diabetes Questionnaire (MDQ), and the Hospital Anxiety and Depression Scale (HADS).

Introductory Characteristics Form: The form comprises 17 questions designed to elicit participants' sociodemographic and diabetes-related characteristics.

Multidimensional Diabetes Questionnaire: The MDQ was developed by Talbot et al. (14) and was adapted into Turkish by Coşansu and Erdogan (54). The 41-item original version is comprised of six subscales within three components. The sub-scales are designed to assess various aspects of participants' perceptions of social-cognitive factors of diabetes, including perceived interference, condition severity, support, misguided support behaviors, self-efficacy, and outcome expectancies. The scale does not yield a total score; rather, each sub-scale can be deployed separately. The Cronbach's alpha reliability coefficients calculated for the MDQ were .90 for perceived interference, .91 for perceived support, .77 for perceived severity, .58 for misguided support behaviors, .82 for self-efficacy, and .86 for outcome expectancies (54). We calculated the internal consistency coefficients (Cronbach's alpha) to be .90 for perceived interference, .90 for perceived support, .85 for perceived severity, .92 for misguided support behaviors, .83 for perceived self-efficacy, and .96 for outcome expectancies and the results are similar.

Hospital Anxiety and Depression Scale: The four-point Likert-type HADS was initially designed by Zigmond and Snaith (55) to assess the likelihood of anxiety and depression and quantify the extent and severity of these conditions in patients. The scale comprises a total of 14 items, with odd numbers measuring anxiety and even numbers measuring depression. In the Turkish context, Aydemir (56) established the validity and reliability of the HADS in screening depression and anxiety symptoms in individuals with physical disorders. The scale consists of the anxiety (HAD-A) and depression (HAD-D) subscales. In the adaptation study, the optimal cut-off scores were found to be 10 for the anxiety subscale and 7 for the depression subscale, suggesting that individuals scoring above these thresholds are considered to be at risk for the mentioned disorders. The lowest and highest possible scores for both subscales are 0 and 21, respectively.

Statistic Analysis

We analyzed the data using the IBM SPSS 29.0 program (IBM Corp., Armonk, New York, USA). Descriptive statistics are presented as number (n), percentage (%), mean $\pm$ standard deviation ($M \pm SD$), median (Mdn), minimum (min), maximum (max), and interquartile range (IQR). The normality of the data distribution was checked using the Shapiro-Wilk test. While using the Mann-Whitney U test pairwise comparisons of the participants' scores, we performed the Kruskal-Wallis test with Dunn-Bonferroni correction for multiple-group comparisons. We calculated Spearman's rank-order correlation coefficients to explore

the relationships between participants' scores. Moreover, we sought the impacts of social-cognitive factors of diabetes (MDQ) on anxiety and depression (HADS) through multiple linear regression analysis. In the regression model, we also considered confounding variables and employed backward elimination to achieve the final model. A p-value < 0.05 was accepted as statistically significant.

RESULTS

Participants' mean age was 52.2 ± 11.3 years. More than half of them (61.7%) were females, and 86.7% were married. While 52.2% were primary school graduates, 60.0% were not employed. About a quarter of them (25.6%) identified themselves as experiencing financial difficulties and struggling to make ends meet. About half of them (49.4%) lived with their spouses, and 72.2% were city dwellers. The majority (70%) had a disease other than diabetes, and 29.4% used medication other than those for diabetes. The disease duration was 1-5 years for 63.3% of participants. Oral antidiabetic medication was the most commonly utilized treatment modality (36.7%), and retinopathy represented the most prevalent complication of their condition (10.0%). The prevalence of a family history of diabetes was 46.7%, with first-degree relatives exhibiting the highest incidence (65.5%). Self monitoring of blood glucose (SMBG) was a prevalent practice, with 75.6% of participants engaging in this self-management strategy (Table 1).

Table 1: Participants' Introductory Characteristics

Characteristics	Findings (n=180)	
Age, (years$\pm$SD) (min-max)	52.2 $\pm$ 11.3 (30-83)	
Gender, n (%)		
Female	111	(61.7)
Male	69	(38.3)
Marital status, n (%)		
Married	156	(86.7)
Single	24	(13.3)
Health insurance, n (%)		
Yes	163	(90.6)
Education, n (%)		
Literate	11	(6.1)
Primary school	94	(52.2)
Middle school	46	(25.6)
High school and above	29	(16.1)
Employment, n (%)		
Retired	55	(30.6)
No	108	(60.0)
Yes	17	(9.4)
Financial status, n (%)		
Needy/economically disadvantaged	46	(25.6)
Middle-high income	134	(74.4)
Cohabitants, n (%)		
Alone	19	(10.6)
Spouse	89	(49.4)
Spouse and children	57	(31.7)
Other (relatives, friends, etc.)	15	(8.3)
Place of residence, n (%)		
City center	130	(72.2)
District	19	(10.6)
Town	15	(8.3)
Village	16	(8.9)

gling to make ends meet. About half of them (49.4%) lived with their spouses, and 72.2% were city dwellers. The majority (70%) had a disease other than diabetes, and 29.4% used medication other than those for diabetes. The disease duration was 1-5 years for 63.3% of participants. Oral antidiabetic medication was the most commonly utilized treatment modality (36.7%), and retinopathy represented the most prevalent complication of their condition (10.0%). The prevalence of a family history of diabetes was 46.7%, with first-degree relatives exhibiting the highest incidence (65.5%). Self monitoring of blood glucose (SMBG) was a prevalent practice, with 75.6% of participants engaging in this self-management strategy (Table 1).

Characteristics	Findings (n=180)	
Comorbidities, n (%)		
Yes	54	(30.0)
Medication other than for diabetes, n (%)		
Yes	53	(29.4)
Disease duration, n (%)		
1-5 years	115	(63.9)
6 years and over	65	(36.1)
Diabetes treatment modality, n (%)		
Dietary regimen	44	(24.4)
Oral diabetes medication	66	(36.7)
Insulin	52	(28.9)
Insulin and oral diabetes medication	18	(10.0)
Diabetes complications, n (%)		
No	151	(83.9)
Yes	29	(16.1)
Retinopathy	18	(10.0)
Neuropathy	4	(2.2)
Nephropathy	7	(3.9)
Diabetic family members, n (%)		
No	96	(53.3)
Yes	84	(46.7)
Degree of relationship with diabetic family members, n (%)		
First-degree relative(s)	55	(65.5)
Second-degree relative(s)	20	(23.8)
Spouse	9	(10.7)
SMBG, n (%)		
Yes	136	(75.6)
No	44	(24.4)
If yes, the frequency per week M (min-max)	3	(1-21)
Total	180	(100)

n: Number of patients, %: Column percentage, **SMBG**: Self Monitoring of Blood Glucose

Participants' HADS scores uncovered that while 11.1% exhibited anxiety symptoms (≥ 11 points), 74.4% demonstrated depressive symptoms (≥ 8 points). Perceived severity scores of females were significantly higher than those of males. Patients with health insurance had significantly lower misguided support behaviors and higher outcome expectancies scores than those without health insurance. Misguided support behaviors scores were also significantly lower among literate patients, while middle school graduates had significantly higher outcome expectancies scores. Perceived support scores of retirees were found to be significantly higher than those of unemployed participants. Patients living with their spouses and children had significantly lower perceived anxiety and perceived interference scores and higher outcome expectancies scores than those living alone and with their spouses. Patients living with their spouses had significantly higher misguided support behaviors scores than those living with their spouses and

children. Individuals with comorbidities and those utilizing medications other than those for diabetes obtained significantly lower anxiety, depression, perceived interference, perceived support, and misguided support behaviors and higher outcome expectancies scores compared to those without. Those diagnosed with diabetes for a period of six years or longer had significantly lower anxiety, depression, and misguided support behaviors and higher perceived self-efficacy and outcome expectancies scores compared to patients diagnosed for a period of one to five years. Participants with another diabetic person in their family had significantly lower anxiety, depression, perceived interference, perceived support, and misguided support behaviors and higher self-efficacy and outcome expectancies scores. Finally, patients with SMBG had significantly higher anxiety, depression, perceived interference, and misguided support behaviors and lower outcome expectancies scores than patients without (Table 2).

Table 2: Participants' HADS and MDQ Scores by Their Sociodemographics

Sociodemographic characteristics	HADS				MDQ			
	Anxiety (HAD-A)	Depression (HAD-D)	Perceived Interference	Perceived Severity	Perceived Support	Misguided support behaviors	Perceived Self-efficacy	Outcome Expectancies
Gender								
Female	8.0 (3.0)	10.0 (5.0)	2.8 (1.9)	3.3 (1.7)	3.0 (1.5)	1.0 (2.8)	43.3 (26.0)	61.7 (57.7)
Male	7.0 (3.5)	10.0 (5.0)	2.8 (1.1)	3.0 (1.7)	3.0 (0.7)	2.8 (3.0)	40.0 (20.0)	48.3 (52.5)
Test statistic ^{&}	0.969	0.124	0.452	2.311	1.735	1.882	1.035	1.294
p	0.333	0.901	0.651	0.021	0.083	0.060	0.301	0.196
Health insurance								
No	7.0 (3.0)	10.0 (2.5)	2.9 (0.9)	3.3 (0.8)	3.0 (1.0)	3.0 (1.8)	37.1 (17.1)	40.0 (20.0)
Yes	8.0 (3.0)	10.0 (5.0)	2.8 (1.8)	3.3 (1.7)	3.0 (0.8)	1.8 (3.0)	42.9 (26.0)	60.0 (57.7)
Test statistic ^{&}	0.162	1.261	1.826	0.465	0.171	2.769	1.669	2.539
p	0.871	0.207	0.068	0.642	0.864	0.006	0.095	0.011
Education								
Literate	7.0 (5.0)ab	8.0 (5.0)	2.3 (3.4)	3.0 (3.7)	1.9 (1.5)	0.0 (0.0) ^a	67.1 (41.4)	78.3 (40.0) ^a
Primary school	6.5 (4.0)a	10.0 (5.0)	2.7 (1.6)	3.3 (1.7)	3.0 (1.1)	0.9 (3.0) ^b	40.7 (22.0)	58.3 (57.8) ^{ab}
Middle school	9.0 (3.0)b	11.0 (3.0)	2.9 (0.8)	3.3 (1.0)	3.1 (0.5)	2.8 (1.8) ^b	40.0 (20.7)	41.7 (41.7) ^b
High school and above	7.0 (4.0)ab	10.0 (6.0)	2.8 (1.9)	3.7 (1.8)	3.0 (0.7)	2.3 (3.0) ^b	48.6 (37.0)	65.0 (59.2) ^{ab}
Test statistic [‡]	8.966	4.492	2.776	3.639	5.285	18.711	4.969	7.978
p	0.030	0.213	0.428	0.303	0.152	<0.001	0.174	0.046
Employment								
Retired	7.0 (5.0)	11.0 (5.0)	2.9 (1.2)	3.3 (1.3)	3.2 (1.1) ^a	2.5 (3.0)	41.4 (20.0)	46.7 (53.7)
No	8.0 (4.0)	10.0 (4.8)	2.8 (2.1)	3.3 (1.7)	3.0 (1.2) ^b	1.5 (2.9)	42.1 (27.2)	59.2 (58.3)
Yes	7.0 (3.5)	10.0 (4.0)	2.7 (1.7)	3.7 (2.0)	3.1 (0.8) ^{ab}	2.5 (3.0)	50.0 (23.7)	58.3 (47.2)
Test statistic [‡]	5.594	0.637	0.507	1.346	6.320	1.787	0.342	0.748
p	0.061	0.727	0.776	0.510	0.042	0.409	0.843	0.688
Cohabitants								
Alone	8.0 (4.0)a	10.0 (3.0)	3.0(0.4) ^a	3.0 (1.0)	-	-	40.0 (10.0)	38.3 (10.0) ^a
Spouse	8.0 (4.0)a	11.0 (5.0)	2.9(0.8) ^a	3.3 (1.3)	3.0 (0.6)	2.5(2.5) ^a	40.0(18.6)	45.0 (54.2) ^a
Spouse and children	7.0 (2.5)b	10.0 (7.0)	2.0(2.2) ^b	3.7 (2.2)	2.9 (2.0)	0.0 (1.9) ^b	48.6 (34.3)	84.0 (44.8) ^b
Other	7.5 (4.0)ab	10.0 (5.0)	2.1(2.1) ^{ab}	4.0 (3.0)	2.9 (3.4)	0.0 (2.5) ^b	60.0 (40.0)	80.0 (41.7) ^b
Test statistic [‡]	12.253	1.515	11.505	4.885	1.108	36.075	5.976	20.853
p	0.007	0.679	0.009	0.180	0.775	0.001	0.113	0.001

Table 2 continue

Comorbidities								
No	8.0 (4.0)	11.0 (3.0)	2.9 (0.8)	3.3 (1.0)	3.1 (0.6)	2.8 (2.3)	41.4 (17.1)	44.2 (48.8)
Yes	6.0 (5.0)	7.0 (6.3)	1.8 (2.9)	3.5 (3.8)	2.7 (2.0)	0.0 (1.0)	51.5 (43.6)	90.0 (45.0)
Test statistic ^{&}	2.954	4.623	3.845	0.331	3.352	6.219	0.475	3.980
p	0.003	<0.001	<0.001	0.741	<0.001	<0.001	0.635	<0.001
Medication other than for diabetes								
No	8.0 (4.0)	11.0 (3.0)	2.9 (0.8)	3.3 (1.0)	3.1 (0.7)	2.8 (2.3)	41.4 (17.1)	45.0 (48.3)
Yes	6.0 (5.0)	7.0 (6.0)	1.9 (2.9)	3.3 (3.8)	2.8 (1.9)	0.0 (1.0)	51.4 (45.9)	91.7 (45.0)
Test statistic ^{&}	2.535	5.020	3.484	0.197	2.771	6.112	0.520	4.286
p	0.011	<0.001	<0.001	0.844	0.006	<0.001	0.603	<0.001
Disease duration								
1-5 years	8.0 (4.0)	11.0 (3.0)	2.9 (1.2)	3.3 (1.3)	3.0 (0.5)	2.8 (2.5)	40.0 (17.1)	41.7 (51.7)
6 years and over	7.0 (3.5)	9.0 (5.0)	2.4 (1.9)	3.7 (2.7)	3.1 (2.4)	0.0 (2.0)	54.3 (37.1)	85.0 (45.8)
Test statistic ^{&}	2.523	2.601	1.338	1.352	0.923	4.920	3.134	4.520
p	0.012	0.009	0.181	0.176	0.356	<0.001	0.002	<0.001
Diabetic family members								
No	8.0 (2.0)	10.5 (3.0)	3.0 (0.7)	3.3 (1.0)	3.0 (0.7)	2.8 (2.3)	40.0 (17.1)	43.3 (44.2)
Yes	6.0 (5.0)	9.0 (8.0)	2.3 (2.6)	3.3 (2.7)	2.9 (1.6)	0.3 (2.7)	47.9 (35.7)	82.5 (59.6)
Test statistic ^{&}	3.200	2.563	4.345	0.770	2.372	4.506	2.296	3.971
p	0.001	0.010	<0.001	0.442	0.018	<0.001	0.022	<0.001
SMBG								
Yes	6.0 (5.0)	7.5 (8.0)	2.0 (2.8)	3.2 (3.0)	2.9 (2.2)	0.0 (1.7)	50.7 (45.5)	95.5 (44.2)
No	8.0 (3.0)	10.5 (3.0)	2.9 (1.1)	3.3 (1.3)	3.0 (0.7)	2.5 (3.0)	40.0 (19.6)	45.8 (50.0)
Test statistic ^{&}	2.317	3.787	2.566	0.301	1.879	3.758	1.124	4.097
p	0.020	<0.001	0.010	0.763	0.060	<0.001	0.261	<0.001

Data are presented as median (IQR). [&]: Mann-Whitney U test, [‡]: Kruskal-Wallis H test, ^{ab} indicates group differences in each row. Groups with the same superscripts yield no significant differences.

We found a significant moderate positive correlation between participants' anxiety and misguided support behaviors scores ($r=0.419$, $p<0.001$). It is also the case between their depression scores and perceived interference ($r=0.405$, $p < 0.001$) and misguided support behaviors scores ($r = 0.443$, $p < 0.001$).

We sought the impacts of participants' perceived social-cognitive factors of diabetes (MDQ subscale scores) on their anxiety (HADS-A scores) through multiple linear regression analysis. In the univariate analyses, variables with a p-value < 0.20 in comparisons involving anxiety or the Multidimensional Diabetes Questionnaire subscales were considered as confounding factors (57). We considered confounding variables (gender, age, health insurance, education, employment, cohabitants, comorbidities, medication other than for diabetes, disease duration, family history of diabetes, SMBG) in the regression model and concluded the final model using backward elimination. Our findings showed that a one-point increase in participants' perceived interference scores led to a 0.602-point increase

in their anxiety scores, while a one-point increase in their misguided support behaviors scores was associated with a 0.378-point increase in their anxiety scores. The variables in the model explained 25.2% of anxiety among participants (Table 3).

The relationships between the mentioned factors and depression were also explored using the multiple linear regression analysis. We also considered confounding variables (gender, age, health insurance, education, employment, cohabitants, comorbidities, medication other than for diabetes, disease duration, family history of diabetes, SMBG) in the analysis and obtained the final model through backward elimination. The results demonstrated that a one-point increase in participants' perceived interference and perceived severity scores led to an increase of 0.644 points and 0.612 points in their depression scores, respectively. Yet, a one-point increase in their outcome expectancies scores was linked with a 0.040-point decrease in their depression scores. The variables in the model explained 37.5% of depression among participants (Table 4).

Table 3: Regression Analysis of the Relationships Between Social-Cognitive Factors of Diabetes and Anxiety

	Regression Coefficients*					
	β	se	$z\beta$	t	p	95.0% Confidence Interval for β
						Lower Bound Upper Bound
Model						
Constant	3.542	1.779		1.991	0.048	0.029 7.054
Perceived Interference	0.602	0.171	0.285	3.514	<0.001	0.264 0.940
Misguided Support Behaviors	0.378	0.172	0.206	2.195	0.030	0.038 0.718

Variables entered in step 1: outcome expectancies, perceived interference, perceived self-efficacy, misguided support behaviors
 Confounding factors: gender, age, health insurance, education, employment, cohabitants, comorbidities, medication other than for diabetes, disease duration, family history of diabetes, SMBG
 Elimination method: Backward
 Model Statistics
 Model Summary: F=4.343; p<0.001; R²=0.327; Adj R²=0.252, Power=0.999
 Collinearity Statistics: Tolerance=0.155-0.831; Variance inflation factor= 1.204-6.471
 Normality for standardized residuals: Shapiro-Wilk test statistic: 0.944; p=0.725

Table 4: Regression Analysis of the Relationships Between Social-Cognitive Factors of Diabetes and Depression

	Regression Coefficients*					
	β	se	$z\beta$	t	p	95.0% Confidence Interval for β
						Lower Bound Upper Bound
Model						
Constant	7.339	2.484		2.955	0.004	2.434 12.244
Perceived Interference	0.644	0.215	0.24	3.003	0.003	0.221 1.068
Perceived Severity	0.612	0.177	0.258	3.459	<0.001	0.262 0.961
Outcome Expectancies	-0.040	0.011	-0.309	-3.571	<0.001	-0.062 -0.018

Variables entered in Step 1: outcome expectancies, perceived interference, perceived self-efficacy, misguided support behaviors
 Confounding factors: gender, age, health insurance, education, employment, cohabitants, comorbidities, medication other than for diabetes, disease duration, family history of diabetes, SMBG
 Elimination method: Backward
 Model Statistics
 Model Summary: F=6.648; p<0.001; R²=0.441; Adj R²=0.375, Power=0.999
 Collinearity Statistics: Tolerance=0.151-0.831; Variance inflation factor= 1.204-6.829
 Normality for standardized residuals: Shapiro-Wilk test statistic: 0.989; p=0.195

DISCUSSION

This study focuses on two key objectives in the primary healthcare setting: 1) to identify the prevalence of anxiety and depression symptoms, which are not typically included in routine diabetes screening programs and 2) to examine the psychosocial factors that not only contribute to the presence of anxiety and depression—often seen as comorbidities in diabetes—but also adversely affect diabetes management and increase the risk of complications. Over half of our participants were in the early stages of diabetes, with a diagnosis of less than five years. While three-quarters of them exhibited depressive symptoms, one in ten had anxiety symptoms, which aligns with the findings of previous research (25,58). The incidence of diabetes complications was less than one in five patients. Similarly, the observation-

al DISCOVER study identified a global prevalence of 18.8% for microvascular complications and 12.7% for macrovascular complications among diabetic patients (59).

The Health Belief Model (HBM) states that perceived susceptibility and severity determine perceived threat, which predicts self-management behaviors (60). Consistent with prior studies, females reported greater perceived severity (61). Among diabetic patients, higher socioeconomic status (SES) was linked to more favorable outcome expectancies and self-efficacy, whereas lower SES was associated with negative expectancies (62). In this study, health insurance was related to enhanced outcome expectancies and reduced misguided support, while retirees reported higher perceived support than unemployed participants. Educational attainment also influenced perceptions; literate participants

showed lower misguided support behaviors, possibly due to greater understanding of such behaviors.

Family members and close acquaintances of individuals with diabetes play a critical role in disease management, as the condition affects not only the patient but also their family (63). Family support has been shown to enhance self-care and treatment adherence, reduce morbidity, and improve quality of life (64-66). In this study, participants living with their families exhibited lower anxiety, perceived interference, and misguided support behaviors, along with higher outcome expectancies. Interestingly, contrary to previous reports linking comorbidities to poorer quality of life (65,67), our findings indicated that patients with comorbidities, a family history of diabetes, multiple medication use, and cohabitation with diabetic family members reported lower anxiety, depression, perceived interference, and misguided support behaviors. This may reflect a greater acceptance of the disease due to recognition of genetic predisposition and prior adaptation through observing diabetic relatives' management practices. Supporting this, 75% of Saudi patients perceived diabetes as hereditary (68), and adolescents with a family history of T2DM were found to emphasize non-modifiable over modifiable risk factors (69). However, comorbidities and the use of non-diabetes medications were associated with lower perceived social support, while longer disease duration and living with diabetic relatives correlated with higher self-efficacy and outcome expectancies, consistent with literature suggesting that prolonged disease experience fosters greater understanding and fewer negative emotional representations (70,71).

Self monitoring of blood glucose (SMBG) is a pivotal strategy for diabetes management (72). In this study, three-quarters of patients practiced SMBG weekly; however, they were more prone to anxiety and depression, greater perceived interference and misguided support, and poorer outcome expectancies. Systematic reviews confirmed both benefits of SMBG and its link to higher anxiety and depression. Notably, the DiGEM and ESMON trials (73,74) showed a negative effect on anxiety and/or depression, likely due to its invasive nature evoking undesirable experiences. SMBG may also reduce quality of life (75), though qualitative studies reported that limited daily SMBG led some patients to feel well (76).

Social-cognitive factors of diabetes assessed with the subscales of the MDQ explained 25.2% of participants' anxiety scores (perceived interference) and 37.5% of their depression scores (perceived interference, perceived severity, and outcome expectancies). In the fields of social sciences and psychology, considering the challenges of studying human behavior, even values between 0.10 and 0.30 are often regarded as acceptable (77,78).

Perceived interference refers to one's estimation of the difficulty of various social, economic, and personal challenges to a specific behavioral goal. It is therefore key to identifying these barriers to minimize the adverse impacts on adherence to self-management programs (79). Perceived interference was also a significant factor contributing to the anxiety and depressive symptoms of our patients. The perception of the disease as an interference with life may have increased patients' anxiety and depression symptoms. Similarly, a study with diabetic patients reported depression to be positively associated with perceived barriers, perceived severity of diabetes, and misguided support behaviors from family members but negatively linked to self-efficacy (80). In another qualitative study, diabetic participants reported being challenged to adapt to every domain of life while suffering from diabetes (81). It was also demonstrated that diabetic patients perceive a multitude of interferences in physical activities, dietary restrictions, pharmacological treatment, and adherence to self-care activities (82,83). In this study, misguided support behaviors—a type of negative social support—contributed to participants' anxiety. Previous research also found anxiety symptoms to be positively related to misguided support behaviors from family members, which is consistent with our findings (80). Despite a non-significant relationship between perceived support and anxiety/depression, misguided support behaviors were significantly associated with anxiety, suggesting that reducing negative social support rather than increasing positive support may better enhance the psychosocial status of diabetic patients.

The perceived severity of a disease—whether controllable, understandable, treatable, cyclical, or severe—is a risk factor for depression (84,85). Outcome expectancy, another social-cognitive factor, reflects one's perception of self-care behaviors on metabolic control and complication prevention; high outcome expectancy reduces depression risk, whereas low expectancy increases it (14,86). Outcome expectancy, intention, and self-efficacy are critical in early behavioral modification for diabetes adaptation (86). Prior research shows higher outcome expectancies reinforce self-management behaviors such as diet and exercise (14,86), while depressive symptoms impair self-management and treatment adherence, further hindering outcome expectancies (87). This study is not free of a few limitations. The cross-sectional design of the study prevents the deduction of causal relationships between the variables. In addition, we did not measure patients' HbA1c values but rather relied on their statements when delving into the relationships between anxiety, depression, and social-cognitive factors. Finally, our findings are limited to the data from patients applying to family health centers and may be representative only of this particular patient population.

In a nutshell, the present study examined the sociodemographic characteristics, anxiety and depression levels, and psychosocial factors of diabetes among T2DM patients followed up in three family health centers. The findings revealed that the sociodemographic characteristics of these patients were associated with multidimensional factors of diabetes. Overall, the findings from both the original scale development study and the present study indicate that the MDQ is a reliable instrument for assessing psychosocial factors in individuals with type 2 diabetes. It is well known that T2DM patients often have a desire to discuss their coping strategies with their care providers; therefore, primary care centers where patients conveniently consult their physicians may be an optimal setting for their follow-up. It is essential to enhance the efficacy of diabetes screening and follow-up programs in primary healthcare and ensure the integration of psychosocial assessments into these processes. To achieve this, further in-depth research is recommended to explore the barriers to the routine implementation of screening programs and support the integration of psychosocial components into diabetes management in primary healthcare. Moreover, family physicians and primary care staff should be well informed about the multidimensional factors of diabetes, including its psychological aspects, to effectively manage patients with T2DM. It is also essential to offer psychological counseling services tailored to the specific needs of individuals with diabetes in family health centers. Finally, relevant educational interventions for diabetic patients and their families help improve their social-cognitive perceptions of diabetes to encourage their adherence to treatment and reduce the risk of developing anxiety and depression.

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Authors Contributions

Çiğdem Samancı Tekin and **Yasemin Uğurlu** conceptualized the study. **Çiğdem Samancı Tekin** and **Yasemin Uğurlu**, interpreted the data, being supervised by **Aysun Güzel**. **Çiğdem Samancı Tekin** wrote the first draft, which was reviewed and edited by all authors.

Conflict of Interest

The authors declare no competing interests.

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Ethical Approval

The Research Ethics Committee of Nigde Omer Halisdemir University granted ethical approval to our study (No: 2020/06-11 dated 01/07/2020). We obtained informed consent from all par-

ticipants and strictly followed the ethical principles predicated in the Declaration of Helsinki in each research phase. Consent for publication :Not applicable. Availability of data and materials:The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Peer Review Process

Extremely and externally peer-reviewed.

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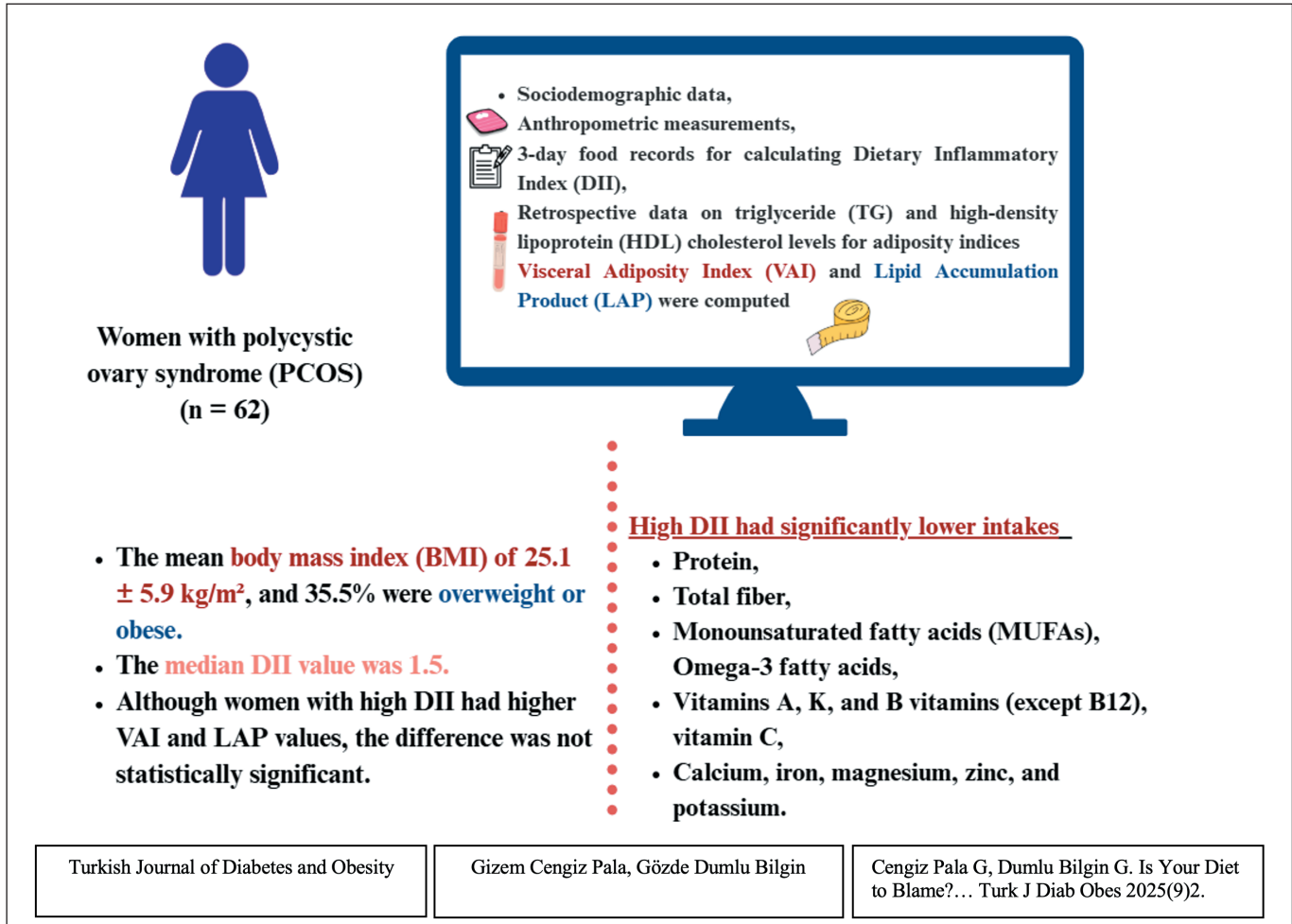
Is Your Diet to Blame? Unveiling the Role of Dietary Inflammatory Index in Lipid Accumulation Product Index and Visceral Adiposity Index in Polycystic Ovary Syndrome

Gizem CENGİZ PALA , Gözde DURLU BİLGİN  

Yeditepe University, Faculty of Health Sciences, Department of Nutrition and Dietetics, İstanbul, Türkiye

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GRAPHICAL ABSTRACT



ORCID: Gizem Cengiz Pala / 0000-0001-6651-2314, Gözde Dumlu Bilgin / 0000-0001-6385-0190

Correspondence Address / Yazışma Adresi:

Gözde DURLU BİLGİN

Yeditepe University, Faculty of Health Sciences, Department of Nutrition and Dietetics, İstanbul, Türkiye
E-mail: gozde.dumlu@yeditepe.edu.tr

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ABSTRACT

Aim: The present study sought to examine how the Dietary Inflammatory Index (DII) is related to different adiposity indices in women diagnosed with polycystic ovary syndrome (PCOS).

Material and Methods: The study enrolled sixty-two women aged 18 - 44 years who applied to a PCOS outpatient clinic in Istanbul. Sociodemographic data, anthropometric measurements, 3-day food records for calculating DII, and retrospective data on high-density lipoprotein (HDL) cholesterol levels and triglyceride (TG) for adiposity indices were collected. Visceral Adiposity Index (VAI) and Lipid Accumulation Product (LAP) were computed based on the obtained anthropometric data and specified blood parameters. Since the data were divided into low and high DII groups, the Mann-Whitney U test was employed based on the statistical distribution to evaluate group differences between continuous variables.

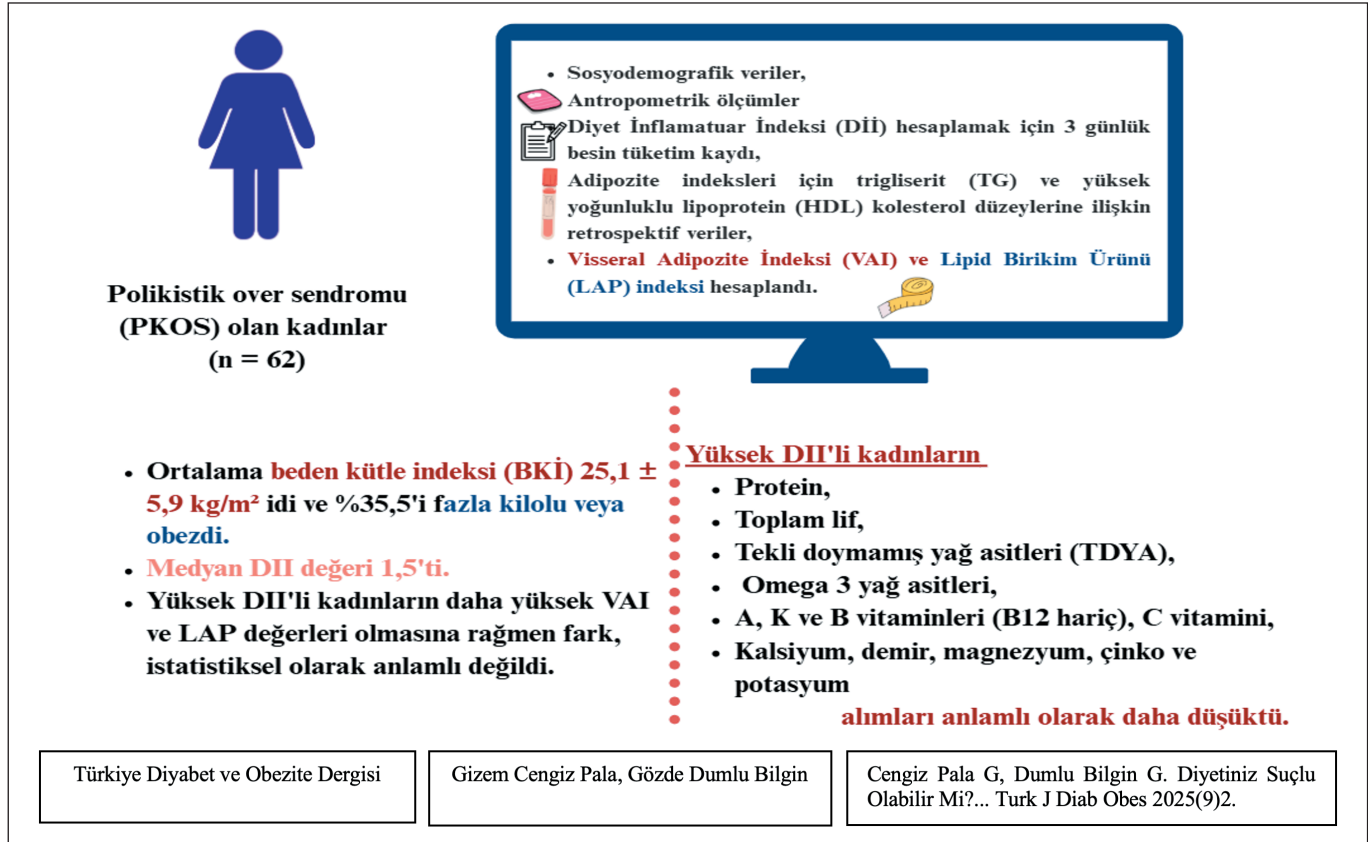
Results: The mean age of women was 26.3 ± 6.1 years, with a body mass index (BMI) of 25.1 ± 5.9 kg/m², and 35.5% were overweight or obese. The median DII value was 1.5. Although women with high DII had higher VAI and LAP values, the difference was not statistically significant. Additionally, women with high DII had significantly reduced dietary intakes of protein, total fiber, omega-3 fatty acids, monounsaturated fatty acids (MUFAs), vitamins A, K, and B vitamins (except B12), vitamin C, iron, calcium, zinc, potassium, and magnesium.

Conclusion: These findings suggest that diet-induced inflammation may contribute to metabolic disturbances in PCOS, emphasizing the importance of anti-inflammatory dietary approaches in managing the condition.

Keywords: Polycystic ovary syndrome, Dietary inflammatory index, Visceral adiposity index, Lipid accumulation product, Adiposity indices, Diet

Diyetiniz Suçlu Olabilir Mi? Polikistik Over Sendromunda Diyet İnflamatuar İndeksinin, Lipid Birikim Ürünü İndeksi ve Visseral Adipozite İndeksi Üzerindeki Rolünün İncelenmesi

GRAFİKSEL ÖZET



ÖZ

Amaç: Bu çalışma, polikistik over sendromu (PKOS) olan kadınlarda Diyet İnflamatuar İndeksi'nin (Dİİ) çeşitli adipozite indeksleriyle ilişkisini incelemeyi amaçlamıştır.

Gereç ve Yöntemler: Çalışmaya, İstanbul'da bir PKOS polikliniğine başvuran 18 - 44 yaş arası altmışiki kadın dahil edildi. Sosyodemografik veriler, antropometrik ölçümler, Dİİ'yi hesaplamak için 3 günlük besin tüketim kaydı ve adipozite indeksleri için yüksek yoğunluklu lipoprotein (HDL) kolesterol ve trigliserit (TG) düzeylerine ilişkin retrospektif veriler toplandı. Visseral Adipozite İndeksi (VAI) ve Lipid Birikim Ürünü (LAP) indeksi, elde edilen antropometrik verilere ve belirtilen kan parametrelerine dayanarak hesaplandı. Veriler, düşük ve yüksek Dİİ gruplarına ayrıldığından, sürekli değişkenler arasındaki grup farklarını değerlendirmek amacıyla, verilerin dağılımına bağlı olarak Mann-Whitney U testi uygulanmıştır.

Bulgular: Kadınların ortalama yaşı $26,3 \pm 6,1$ yıl, beden kütle indeksi (BKİ) $25,1 \pm 5,9$ kg/m² idi ve %35,5'i fazla kilolu veya obezdi. Medyan Dİİ değeri 1,5'ti. Yüksek Dİİ'li kadınların daha yüksek VAI ve LAP değerleri olmasına rağmen fark, istatistiksel olarak anlamlı değildi. Bunun yanı sıra, yüksek Dİİ'li kadınların protein, toplam lif, omega-3 yağ asitleri, tekli doymamış yağ asitleri (TDYA), A, K ve B vitaminleri (B12 hariç), C vitamini, demir, kalsiyum, çinko, potasyum ve magnezyum alımları anlamlı olarak daha düşüktü.

Sonuç: Bu bulgular, diyet kaynaklı inflamasyonun PKOS'ta metabolik bozukluklara katkıda bulunabileceğini düşündürmekte ve hastalığın yönetiminde anti-inflamatuar diyet yaklaşımlarının önemini vurgulamaktadır.

Anahtar Sözcükler: Polikistik over sendromu, Diyet inflammatuar indeksi, Visseral adipozite indeksi, Lipid birikim ürünü indeksi, Adipozite indeksleri, Diyet

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a multifaceted female endocrine and metabolic disorder characterized by the presence of two of the following three features: oligomenorrhea, hyperandrogenism, and polycystic ovary appearance on ultrasound (1). PCOS affects approximately 10% of women of childbearing age (2) and is metabolically interrelated with several diseases, including insulin resistance, dyslipidemia, hypertension, cardiovascular diseases (CVD), psychiatric disorders, gynecological cancers, being overweight and obesity, type 2 diabetes, and increased infertility (1,3–5).

Approximately 38–88% of women with PCOS worldwide are affected by overweight or obesity (6), and this excess weight contributes to the hyperandrogenism commonly seen in PCOS through various mechanisms, including elevated secretion of androgens from the ovaries, higher levels of adipokines, and increased insulin resistance (7). The body mass index (BMI) is the most frequently employed metric for the assessment of obesity. Nevertheless, its primary function is the evaluation of generalized obesity, and it lacks the capacity to provide insight into the distribution of body fat (8). Therefore, its utility is limited in distinguishing between adipose tissue and lean mass, or in determining the distribution or functional role of distinct fat depots (9). In this regard, two novel indices have been proposed-the lipid accumulation product (LAP) index (10) and the visceral adiposity index (VAI) (11)-which are mathematical models derived from anthropometric parameters and lipid profiles, offering a more nuanced approach to assessing obesity and its associated risks. In clinical practice, these indices are highly sensitive markers in showing visceral adiposity, in-

flammation, insulin resistance, and cardiometabolic risk (4,7,12). In previous studies, it has been demonstrated that these scores were increased in PCOS patients (12–14). Furthermore, PCOS has been linked to chronic low-grade inflammation, which is theorized to play a critical role in the development of long-term cardiovascular risks, and dietary components also have substantial effects on inflammation (15).

It has been demonstrated that particular dietary constituents can trigger chronic inflammation through the process of oxidative damage. The Western-type diet, characterized by a high consumption of red meat, high-fat dairy products, and refined grains, has been associated with elevated levels of inflammatory markers such as C-reactive protein (CRP), interleukin-6 (IL-6), and fibrinogen (16). Conversely, the Mediterranean diet, marked by a diet abundant in whole grains, fruits, green vegetables, and fish, and with limited consumption of red meat and butter, moderate alcohol intake, and olive oil, has been linked to reduced inflammation levels (17).

The Dietary Inflammatory Index (DII), conceptualized and developed by Shivappa et al., is a quantitative scale that is scored according to the intake of frequently consumed dietary components that are related to critical inflammatory blood markers (18). A number of studies have demonstrated a correlation between elevated DII scores and an augmentation in certain cardiometabolic risk indices (19,20). In a cross-sectional study conducted on individuals with type 2 diabetes, it was observed that high DII scores were associated with elevated triglyceride levels, LAP, and anthropometric measurements (21). Moreover, numerous stud-

ies have investigated the inflammatory potential of diet in PCOS patients, revealing that higher DII scores are linked to increased odds of PCOS diagnosis (22,23). Despite the existence of studies that have examined various adiposity indices within this group (9,12,24,25), addressing the relationship between the DII and adiposity indices, including LAP and VAI, in this population remains to be elucidated.

Therefore, the primary objective of this study was to clarify the interaction between the DII and certain adiposity-related measures in women diagnosed with PCOS. Since LAP and VAI are accepted as reliable proxy indicators of metabolic dysfunction and heart disease risk among PCOS patient, investigating their relationship with dietary inflammation may provide deeper insights into the underlying mechanisms linking nutrition, inflammation, and fat distribution in this population. By filling this gap, the study aims to enhance the available literature and promote the creation of more targeted dietary approaches to manage metabolic complications in women with PCOS.

MATERIALS and METHODS

Study Design and Participants

This single-center, cross-sectional study was conducted at the PCOS and Hirsutism Clinic of a University Hospital in Istanbul between April and August 2022 with women aged 18 years and older who were newly diagnosed with PCOS based on the Rotterdam criteria (26). Prior to the initiation of the study, ethical approval was obtained from the Non-Interventional Research Ethics Committee of the Faculty of Health Sciences at Yeditepe University (Approval Date and Number: 08.04.2022/16). Using *G*Power* (v3.1.9.7), an a priori power analysis was carried out based on a presumed moderate effect size (with Cohen's *d* value of 0.76), a significance threshold of 0.05, and 90% power. Findings from the analysis indicated that a total of 60 participants would be required. Our study included 62 participants, which is close to this estimate and therefore considered sufficiently powered to detect medium effect sizes.

Participants were not eligible for the study if they were pregnant or lactating, under 18 years old, or had conditions, including cancer, congenital adrenal hyperplasia, Cushing's syndrome, hyperprolactinemia, or any conditions that could affect inflammatory status (e.g., infections, rheumatological diseases, inflammatory bowel diseases). Additionally, those on non-steroidal anti-inflammatory drugs, statins, or antihypertensive therapy, individuals with severe psychiatric disorders or using psychiatric medications, as well as those with endocrine, kidney, or liver diseases, or diseases requiring specific dietary interventions (such as type 1 diabetes or celiac disease) were also excluded.

Anthropometric Measurements

Participants' body weight, height, waist, and hip circumference were taken and evaluated following the World Health Organization (WHO) guideline (27). All measurements in the study were performed and recorded by a dietitian and were repeated twice. The body compositions of women were assessed using a Tanita body analyzer (*Model RD-953, Tanita Corporation, Tokyo, Japan*), which operates based on the Bioelectrical Impedance Analysis (BIA) method. A rigid tape measure was employed to obtain the required measurements, ensuring that they were perpendicular to the body's long axis and parallel to the ground. Women's height was recorded while they were barefoot, in an upright position, and the Frankfort plane (above the auricle and the lower border of the orbital-eye socket aligned and level with the ground), with the feet side by side using a stadiometer accurate to 0.1 cm (*Seca, Germany*).

The body mass index (BMI) was determined by applying the following formula: weight (kg)/height (m²), based on the obtained weight and height data. According to the standards established by WHO, categorization of BMI values was conducted into the following classes: underweight (BMI < 18.5 kg/m²), normal (18.5-24.99 kg/m²), overweight (25.0-29.99 kg/m²), and obese (BMI ≥ 30.0 kg/m²) (27). The waist-to-hip ratio (WHR) and the waist-to-height ratio (WHtR) were obtained through the measurement of waist circumference (WC), hip circumference (HC), and height.

Biochemical Parameters

The high-density lipoprotein (HDL) cholesterol and triglyceride (TG) levels were retrospectively retrieved from patient records, based on routine measurements performed at the Clinical Biochemistry Laboratory of the University Hospital using standardized automated enzymatic assays performed by experienced laboratory personnel.

Dietary Assessment and Calculation of Dietary Inflammatory Index (DII)

The Dietary Inflammatory Index (*DII*) is a literature-derived dietary scoring approach designed to determine the contribution of diet to an individual's inflammatory status; a high DII score indicates a diet's pro-inflammatory properties, while a low DII score indicates a diet's anti-inflammatory properties (18). According to this index, 45 nutrients (composed of whole foods, macro and micro nutrients, and other biologically active substances) affect six inflammation markers, interleukins (IL) such as IL1β, IL-4, IL-6, IL-10, TNF-α, and CRP (28). In this study, the DII was computed based on 29 components obtained from 3-day dietary records. The intake levels of participants were assessed for en-

ergy, protein, carbohydrates, fiber, fat, saturated fatty acids (SFAs), cholesterol, monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), omega-3 and omega-6 fatty acids, as well as vitamins A, D, E, K, vitamin C, riboflavin, thiamine, niacin, vitamin B6, folic acid, vitamin B12, and minerals including calcium, iron, zinc, magnesium, selenium, sodium, and potassium. Other components of the original DII score (such as anthocyanidins, eugenol, flavones, flavonols, flavan-3-ols, flavanones, isoflavones, and saffron) were excluded from the analysis because data on their daily intake were missing in this dataset.

A three-day food record was obtained to identify the participants' nutritional status and calculate the DII scores. Women were instructed to keep a record of the foods and drinks they consumed for three continuous days, including two weekdays and one weekend day. The instructions on how to fill in the food consumption registration form were explained to the individuals with examples. "Food and Nutrition Photo Catalogue" (29) has been employed to identify the amount of food eaten by individuals at home in a portion, and "Standard Food Recipes" to determine the amount of nutrients in a portion of food consumed outside the home (30).

The food record analysis was conducted using the Computer Assisted Nutrition Program, Nutrition Information System (BeBis 8.2), a software developed specifically for Türkiye. BeBis is based primarily on the German Food Code and Nutrient Data Base (Bundeslebensmittelschlüssel), and it also includes Turkish foods that have been adapted and validated for use in Turkish populations. The software has been used in multiple studies in Türkiye and has shown acceptable validity and reliability for assessing dietary intake.

The z-score values for women's daily nutrient intake were calculated using the formula: "([individual daily average consumption - standard global daily mean intake] / standard deviation)". These z-scores were then converted into percentile scores. DII, which reflects the inflammatory potential of the person's daily dietary intake, was determined by summing the scores obtained by multiplying the percentile value for each nutrient with the corresponding "specific overall inflammatory effect score" for that nutrient.

Visceral Adiposity Index (VAI)

The VAI is established as an empirically based mathematical equation, differentiated by gender, derived from basic anthropometric [BMI (kg/m²) and WC (cm)] and metabolic indices [TG (mmol/L) and HDL cholesterol (mmol/L)], that is predictive of adipose tissue distribution and function (11).

The VAI for women is calculated using the following equation:

$$\text{VAI} = \left(\frac{\text{WC}}{36.58 + (1.89 \times \text{BMI})} \right) \times \left(\frac{\text{TG}}{0.81} \right) \times \left(\frac{1.52}{\text{HDL}} \right),$$

Lipid Accumulation Product (LAP) index

The LAP index, first introduced by Kahn et al., is derived from a composite of WC (cm) and fasting TG levels (mmol/L) (10). The TG concentration in mmol/L, which is utilized in the equation, was derived by multiplying their value in mg/dL by 0.0113.

The LAP index for women is calculated using the following equation:

$$(\text{WC [cm]} - 58) \times (\text{TG [mmol/L]})$$

Statistical Analysis

The statistical analyses were conducted using SPSS software (Windows version 23). The characteristics of the samples were presented as mean $\pm$ standard deviation (SD) and range (minimum-maximum) for continuous variables and as percentages (%) and numbers (n) for qualitative variables. Assessment of normality for continuous variables was conducted using the Shapiro-Wilk test, which indicated a deviation from normal distribution. Hence, non-parametric methods (Mann-Whitney U test) were employed for comparisons between two groups. To provide a more comprehensive representation of data distribution, descriptive statistics were supplemented with medians and interquartile ranges (IQR). The determination of the confidence interval was based on the 95% level of significance in all analyses, and the results were deemed statistically significant at $p < 0.05$.

RESULTS

General Characteristics of the Participants

A total of 62 adult women diagnosed with PCOS were analyzed in this study, with a mean age of 26.3 ± 6.1 years. Of these, 87.1% were single, 90.3% were university graduates or higher, and most were nulliparous (93.5%), and non-smokers (82.3%). More than half (58.1%) of the women in the study were noted to have one or more diagnosed diseases. The average sleep length of women was 7 hours, and the average age at which PCOS was diagnosed was 21.4 years. When individuals were listed based on their diagnosed disease, thyroid disease ranked first with 35.7%, followed

by gastrointestinal disease with 23.8%, and migraine with 21.4%. The majority of participants (85.5%) indicated that PCOS had a notable impact on their quality of life, with the typical menstrual cycle duration falling between 21 and 40 days. The most commonly reported symptoms among women with PCOS were hairing (74.2%), acne (72.6%), and fatigue (72.6) (Table 1).

Anthropometric Measures and Adiposity Indices of the Participants

When the anthropometric characteristics of women with PCOS were examined, it was revealed that the mean BMI was 25.1 ± 5.9 kg/m² and 35.5% were overweight or obese. In addition, the average WC, WHR, WHtR, and fat mass of women are determined to be 76.2 cm, 0.76, 0.47, and 30.76% respectively. The mean values of the VAI and LAP in women were 1.19 ± 1.13 and 22.9 ± 33.3 , respectively (Table 2). Median values are also presented in this table; accordingly, the median VAI was 0.79 (IQR 0.55 - 1.16) and the median LAP was 10.1 (IQR 5.5 - 24.4). Moreover, adiposity indices showed statistically significant positive correlations with key anthropometric measures, including BMI, waist circumference (WC), waist-to-hip ratio (WHR), and waist-to-height ratio (WHtR) (Table 3).

Dietary Inflammatory Index (DII)

In our study, the mean DII value for women with PCOS was 1.37 ± 1.50 , with a median value of 1.5 [0.18 - 2.44]. Accordingly, the DII scores were stratified into two categories: low and high, based on their position relative to the median value. All parameters were consequently evaluated following this classification (Table 4). While median VAI and LAP index values were higher in women with high DII, no statistically significant difference was observed.

On the other hand, women in the high DII group had significantly lower median (IQR) values for age [24.0 (22.0 - 26.0) vs. 27.0 (24.0 - 30.0)], protein intake [48.9 (41.5 - 62.9) vs. 63.6 (52.9 - 72.1) g/day], total fiber [12.0 (9.1 - 14.2) vs. 19.5 (15.1 - 20.9) g/day], MUFAs [27.0 (22.0 - 30.3) vs. 31.5 (26.9 - 36.5) g/day], omega-3 fatty acids [1.1 (0.9 - 1.4) vs. 1.8 (1.4 - 2.7) g/day], vitamin A [709.2 (503.1 - 895.5) vs. 1603.7 (1366.0 - 1946.3) µg RE/day], vitamin K [53.9 (31.9 - 74.1) vs. 131.4 (94.7 - 179.2) µg/day], vitamin C [53.5 (32.0 - 72.3) vs. 114.4 (89.2 - 138.6) mg/day], calcium [494.0 (418.4 - 619.0) vs. 607.7 (469.5 - 764.5) mg/day], iron [7.1 (5.9 - 8.2) vs. 10.2 (8.9 - 12.0) mg/day], magnesium [170.0 (149.4 - 206.7) vs. 245.7 (222.0 - 315.2) mg/day], zinc [7.5 (6.5 - 9.3) vs. 9.4 (7.6 - 10.6) mg/day], and potassium [1510.9 (1334.5 - 1776.6) vs. 2412.9 (2097.1 - 2686.9) mg/day] (Table 4).

Table 1: General characteristics of women

Variables	Findings (n = 62)
Age (years ± SD) (min-max)	26.3 ± 6.1 (18 - 44)
Marital status, n (%)	
Single	54 (87.1)
Married	8 (12.9)
Education level, n (%)	
Primary/Middle School	1 (1.6)
High School	5 (8.1)
Undergraduate/Graduate	56 (90.3)
Parity, n (%)	
Nulliparous	58 (93.5)
Primiparous or multiparous	4 (6.5)
Presence of disease, n (%)	
Yes	36 (58.1)
No	26 (41.9)
Diagnosed diseases*, n (%)	
Thyroid diseases	15 (35.7)
Gastrointestinal diseases	10 (23.8)
Migraine	9 (21.4)
Allergy	3 (7.1)
Asthma	2 (4.8)
Skin diseases	2 (4.8)
Depression	1 (2.4)
Smoking status, n (%)	
Non-smoker	51 (82.3)
Current smoker	6 (9.7)
Ex-smoker	5 (8.0)
Sleep duration (hours)	7.1 ± 1.5 (3 - 12)
Age at diagnosis of PCOS	21.4 ± 4.9 (12 - 33)
Symptoms related to PCOS*	
Hairing	46 (74.2)
Menstrual irregularity	37 (59.7)
Obesity	26 (41.9)
Acne	45 (72.6)
Hair loss	36 (58.1)
Fatigue	45 (72.6)
Depression	19 (30.6)
Insulin resistance	23 (37.1)
Does PCOS affect their quality of life?	
Yes	53 (85.5)
No	9 (14.5)
Menstrual cycle	
<21 day	2 (3.2)
21-40 days	48 (77.4)
> 40 days	12 (19.4)

Variables are shown as means ± standard deviations (SD) and range. Categorical variables are expressed as frequency (%)

*Participants ticked more than one option. **PCOS:** Polycystic ovary syndrome, **SD:** Standard deviation

Table 2: Anthropometric measures, Dietary Inflammatory Index (*DII*), and adiposity indices of participants

Variables*	Findings (n = 62)		
	Mean $\pm$ SD	Median [IQR]	min.-max
Weight (kg)	65.3 $\pm$ 15.7	60.5 [54.6 - 70.9]	38.9 - 115.3
BMI (kg/m ²)	25.1 $\pm$ 5.9	23.0 [21.6 - 27.8]	17.1 - 41.9
BMI classification, n (%)			
Underweight	3 (4.8)	-	-
Normal	37 (59.7)	-	-
Overweight and Obese	22 (35.5)	-	-
WC (cm)	76.2 $\pm$ 13.8	73.5 [67.0 - 81.5]	53 - 115
HC (cm)	99.26 $\pm$ 11.34	97.5 [92.0 - 102.3]	81 - 136
WHR	0.76 $\pm$ 0.07	0.75 [0.71 - 0.80]	0.65 - 0.94
WHtR	0.47 $\pm$ 0.09		0.35 - 0.73
Fat mass (%)	30.76 $\pm$ 7.33		16.20 - 48.10
DII	1.37 $\pm$ 1.50	1.50 [0.18 - 2.44]	-1.93 - 4.64
VAI	1.19 $\pm$ 1.13	0.79 [0.55 - 1.16]	0.39 - 6.79
LAP	22.9 $\pm$ 33.3	10.1 [5.5 - 24.4]	-4.18 - 151.99
TG (mg/dL)	87.8 $\pm$ 57.2	68.5 [51.8 - 107.8]	35 - 349
HDL cholesterol (mg/dL)	62.9 $\pm$ 13.6	62.5 [55.8 - 70.0]	35 - 106

*Data are shown as "Mean $\pm$ SD, Median [IQR], minimum-maximum".

BMI: Body mass Index; (Underweight <18.5 kg/m²; Normal: 18.5-24.99 kg/m²; Overweight: BMI 25.0-29.99 kg/m²; Obesity: BMI $\geq$ 30 kg/m²)

Data are shown as mean $\pm$ standard deviation, median [interquartile range, IQR], and minimum-maximum. Categorical variables are expressed as frequency (%).

DII: Dietary inflammatory index, **HC:** Hip circumference, **HDL:** High density lipoprotein, **LAP:** Lipid accumulation product, **TG:** Triglyceride, **VAI:** Visceral adiposity index, **WC:** Waist circumference, **WHtR:** Waist-to-height ratio, **WHR:** Waist-to-hip ratio

Table 3: Correlation analysis of Dietary Inflammatory Index (*DII*), adiposity indices, and anthropometric measures

		1	2	3	4	5	6	7	8
1. DII	r_s	1							
	p	-							
2. VAI	r_s	0.059	1						
	p	0.651	-						
3. LAP	r_s	0.125	0.878	1					
	p	0.334	<0.001**	-					
4. BMI (kg/m²)	r_s	0.152	0.486	0.755	1				
	p	0.237	<0.001**	<0.001**	-				
5. WC (cm)	r_s	0.125	0.581	0.816	0.926	1			
	p	0.334	<0.001**	<0.001**	<0.001**	-			
6. HC (cm)	r_s	0.172	0.468	0.760	0.913	0.883	1		
	p	0.180	<0.001**	<0.001**	<0.001**	<0.001**	-		
7. WHR	r_s	0.007	0.517	0.596	0.623	0.804	0.437	1	
	p	0.955	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	-	
8. WHtR	r_s	0.150	0.549	0.778	0.943	0.974	0.841	0.805	1
	p	0.245	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	-

BMI: Body mass index, **DII:** Dietary inflammatory index, **HC:** Hip circumference, **LAP:** Lipid accumulation product, r_s , Spearman's rank correlation coefficient, **VAI:** Visceral adiposity index, **WC:** Waist circumference, **WHtR:** Waist-to-height ratio, **WHR:** Waist-to-hip ratio

** $p < 0.01$

Table 4: Distribution of dietary intakes and adiposity indices based on the categories of DII

Variables	Median-splitted DII		<i>p</i> -value
	Low < 1.5 (n = 31)	High ≥1.5 (n = 31)	
Age (years)	27.0 [24.0 - 30.0]	24.0 [22.0 - 26.0]	0.048*
BMI (kg/m ²)	22.6 [21.1 - 26.8]	23.4 [21.6 - 28.5]	0.468
WC (cm)	72.0 [66.0 - 81.0]	74.0 [68.0 - 85.0]	0.464
HC (cm)	97.0 [92.0 - 102.0]	99.0 [92.0 - 106.0]	0.607
WHR	0.74 [0.71 - 0.80]	0.76 [0.70 - 0.80]	0.882
WHtR	0.43 [0.40 - 0.49]	0.44 [0.41 - 0.52]	0.310
VAI	0.71 [0.54 - 1.15]	0.89 [0.62 - 1.18]	0.495
LAP	10.1 [5.1 - 17.9]	10.2 [5.5 - 31.2]	0.593
Energy intake (kcal/d)	1523.4 [1311.0 - 1863.6]	1505.8 [1326.9 - 1650.4]	0.314
Protein (g/d)	63.6 [52.9 - 72.1]	48.9 [41.5 - 62.9]	0.006*
Carbohydrate (g/d)	142.4 [108.1 - 184.6]	149.3 [100.4 - 180.3]	0.916
Total fiber (g/d)	19.5 [15.1 - 20.9]	12.0 [9.1 - 14.2]	<0.001**
Total fat intake (g/d)	80.8 [72.2 - 97.1]	72.0 [65.1 - 86.6]	0.074
Cholesterol (mg/d)	360.1 [254.9 - 440.9]	285.6 [191.7 - 398.3]	0.113
SFAs (g/d)	26.5 [21.9 - 34.2]	27.2 [21.2 - 35.8]	0.961
MUFAs (g/d)	31.5 [26.9 - 36.5]	27.0 [22.0 - 30.3]	0.003**
PUFAs (g/d)	14.2 [12.1 - 18.4]	13.2 [10.2 - 18.0]	0.269
Omega-3 fatty acid (g/d)	1.8 [1.4 - 2.7]	1.1 [0.9 - 1.4]	<0.001**
Omega-6 fatty acid (g/d)	12.1 [10.2 - 14.7]	11.7 [8.7 - 16.3]	0.324
Vitamin A (µg RAE/d)	1603.7 [1366.0 - 1946.3]	709.2 [503.1 - 895.5]	<0.001**
Vitamin D (µg/d)	4.0 [2.1 - 21.9]	3.2 [1.9 - 4.2]	0.069
Vitamin E (mg/d)	13.7 [10.9 - 18.1]	10.9 [7.8 - 17.7]	0.085
Vitamin K (µg/d)	131.4 [94.7 - 179.2]	53.9 [31.9 - 74.1]	<0.001**
Thiamine (mg/d)	0.8 [0.8 - 1.1]	0.6 [0.5 - 0.7]	<0.001**
Riboflavin (mg/d)	1.3 [1.0 - 1.8]	1.0 [0.8 - 1.2]	0.001**
Niacin (mg NE/d)	13.1 [10.2 - 18.8]	9.7 [7.1 - 10.8]	<0.001**
Folic acid (µg/d)	281.9 [230.4 - 355.0]	181.7 [160.8 - 202.8]	<0.001**
Vitamin B6 (mg/d)	1.3 [1.0 - 1.7]	0.8 [0.6 - 0.9]	<0.001**
Vitamin B12 (µg/d)	4.1 [2.7 - 7.1]	3.5 [2.9 - 4.8]	0.435
Vitamin C (mg/d)	114.4 [89.2 - 138.6]	53.5 [32.0 - 72.3]	<0.001**
Calcium (mg/d)	607.7 [469.5 - 764.5]	494.0 [418.4 - 619.0]	0.038*
Iron (mg/d)	10.2 [8.9 - 12.0]	7.1 [5.9 - 8.2]	<0.001**
Magnesium (mg/d)	254.7 [222.0 - 315.2]	170.0 [149.4 - 206.7]	<0.001**
Zinc (mg/d)	9.4 [7.6 - 10.6]	7.5 [6.5 - 9.3]	0.019*
Selenium (µg/d)	12.1 [6.9 - 20.0]	9.4 [3.8 - 18.7]	0.243
Sodium (mg/d)	2163.0 [1891.0 - 2957.9]	2113.2 [1687.6 - 2543.9]	0.161
Potassium (mg/d)	2412.9 [2097.1 - 2686.9]	1510.9 [1334.5 - 1776.6]	<0.001**

p-values were computed by the Mann-Whitney U Test for continuous variables; **p* < 0.05 ***p* < 0.01

Data are presented as median [interquartile range, IQR].

DII: Dietary inflammatory index, **HC:** Hip circumference, **HDL:** High density lipoprotein, **LAP:** Lipid accumulation product, **MUFAs:** Mono unsaturated fatty acids, **NE:** Niacin equivalent, **PUFAs:** Polyunsaturated fatty acids, **RAE:** Retinol Activity Equivalents, **SFAs:** Saturated fatty acids, **TG:** Triglyceride, **VAI:** Visceral adiposity index, **WC:** Waist circumference, **WHtR:** Waist-to-height ratio, **WHR:** Waist-to-hip ratio

DISCUSSION

Based on existing literature, this study appears to be the first to elucidate the relationship between diverse adiposity indices and DII in women with PCOS. In this study, VAI and LAP index, known as surrogate markers of adiposity, were employed in women with PCOS. Elevated levels of visceral adiposity are hallmarks of PCOS and trigger a surge in cardiovascular mortality via several mechanisms, including underlying chronic low-grade inflammation, metabolism of sex steroids and cortisol locally in visceral fat, and a release of adipokine secretions, that directly affect the ovary (7,12,13). Several studies involving women with PCOS have demonstrated increased levels of VAI and LAP index compared with the control group (24,31). Although the present study lacked a control group, we observed notably lower mean and median values for both VAI and LAP in the PCOS sample compared to established thresholds in the literature. For instance, in India, women with PCOS exhibited higher values for both VAI and LAP, with reported averages of 9.17 and 63.49, respectively (4). Similarly, a study in Türkiye involving a comparable sample found that women with PCOS had mean values of 3.58 for VAI and 25.10 for LAP (31). Another study conducted in Türkiye with a similar study population reported mean values of 2.22 for VAI and 37.7 for LAP in women with PCOS (32). Notably, an Indian study identified $VAI \geq 2.76$ and $LAP \geq 48.06$ as optimal thresholds for predicting metabolic syndrome, demonstrating strong diagnostic performance (33). Wilgen et al. reported that a $LAP \geq 34.5$ is considered an additional risk factor for cardiovascular disease in patients with PCOS (14). The lower values observed in our sample may reflect differences in demographic characteristics, such as age and BMI, as well as ethnic variations in adiposity distribution. Additionally, the substantial standard deviation observed in the LAP index suggests significant heterogeneity within our sample, indicating that while the mean values are low, some individuals may still be at increased metabolic risk. These findings emphasize the need to account for individual differences when evaluating metabolic risk in patients with PCOS. While VAI and LAP are valuable tools for identifying individuals at risk, their interpretation should be contextualized within the individual's overall clinical profile.

It is well-documented that the occurrence of overweight or obesity in women affected by PCOS can reach up to 61% (31); however, the majority of participants in our study had a normal BMI. Although the mean BMI of the study population was within the normal range, VAI and LAP were included due to their ability to reflect visceral adiposity and metabolic risk more precisely than BMI, particularly in populations such as women with PCOS who may have

hidden metabolic risk factors despite normal weight. Supportively, a recent study suggested that LAP and VAI may have significant potential for the early detection of insulin resistance and cardiometabolic risk, and could also be valuable in assessing hyperandrogenism, even in lean women with PCOS (12). A study by Mario et al. explored the predictive capacity of various adiposity indices for identifying subclinical metabolic disruptions and cardiometabolic risk in patients with PCOS, classified as classic or ovulatory, and in healthy controls. Their findings indicated that the LAP, with a cut-off value of ≥ 34 , and the VAI, with a cut-off value of ≥ 1.32 , emerged as the most effective markers for PCOS of the classic and ovulatory types, respectively (34). Therefore, the critical role of heightened adiposity indices in the screening of cardiometabolic risk within these demographic groups should not be overlooked.

Emerging evidence indicates a pivotal role for pro-inflammatory and inflammatory mediators in the pathophysiology of PCOS, which appears to be distinctly associated with obesity and other factors (15,35). A substantial array of studies highlights the potent influence of diet on the escalation of inflammatory factors (17,20,35). Dietary constituents, including fruits and vegetables, dietary fiber, omega-3 fatty acids, vitamin C, and vitamin E, have been shown to decrease inflammatory activity in the human body. Conversely, certain components of the diet, such as SFAs, high glycemic index foods, and a high omega-6/omega-3 ratio of PUFAs, contribute to inflammation (22). Whilst the inflammatory potential measured using DII in our study was higher than studies conducted with similar samples in the literature (22,23,36), the study by Azarbayjani et al. reported a notably higher inflammatory potential than we observed (37). A case-control study has demonstrated that a diet with a high DII score was associated with a 1.75-fold increased risk of PCOS (22). Furthermore, in a population-based prospective study, high DII scores were characterized by an increased risk of CVD (38). Based on all this evidence, we hypothesized that adiposity indices, which are effective markers to assess metabolic disorders contributing to CVD, would be high in patients with a high DII.

Although the results are consistent with this assumption, the non-significance of the findings may be explained by the limited number of samples and different phenotypes of PCOS patients included in the studies.

We revealed that increased DII is related to a lower intake of some macro- and micronutrients such as protein, fiber, MUFAs, omega-3 fatty acids, vitamin A and K, vitamin C, B vitamins except B12, and minerals such as calcium, iron, magnesium, zinc, and potassium. The observation that an-

ti-inflammatory components, especially omega-3 fatty acids, vitamin A, and vitamin C, are observed at lower levels in patients with a pro-inflammatory diet (high DII) is consistent with the existing literature (39). Diet has been acknowledged as one of the modifiable lifestyle factors with a significant influence on oxidative stress, and incorrect eating patterns and lack of physical activity can trigger and aggravate the symptoms of PCOS (40). Research in this area frequently emphasizes that women with PCOS tend to have suboptimal intake of essential micronutrients, including vitamins A, C, and K, as well as critical minerals such as magnesium, zinc, calcium, and potassium (41). These nutrient deficiencies may be exacerbated by the consumption of pro-inflammatory foods, contributing to a higher DII. A diet with high inflammatory potential can hinder proper nutrient absorption and disrupt metabolic processes, worsening the nutrient gaps commonly observed in women with PCOS (42). These phenomena point to a potential role for inflammation in shaping both nutrient intake and overall health outcomes in this population.

A strength of this study is its pioneering approach to investigating adiposity indices and dietary inflammatory potential. However, limitations of this study involve the small study population, the lack of a control group, and the inability to establish causal relationships, which hinder the generalizability of the results. Due to the cross-sectional nature of the study, it is not possible to determine whether diet influences adiposity or vice versa. Increased visceral adiposity may also contribute to altered dietary intake patterns or nutrient metabolism, suggesting a potential bidirectional relationship that warrants further investigation in longitudinal studies. In particular, the limited sample size—especially when participants are divided into subgroups—may have reduced the statistical power of the analyses. This might partially account for the absence of statistically significant results in certain comparisons. A post hoc power analysis or future studies with larger samples would help clarify these relationships more reliably. Furthermore, the findings of this study are based on data collected from patients at a single center and therefore reflect characteristics specific to this particular population. As such, the results may not be generalizable to other populations or settings. This limitation should be taken into account when interpreting the findings, and future multi-center studies with more diverse populations are recommended to enhance generalizability. Moreover, given that the DII was estimated through a 3-day dietary record, which may not fully capture habitual intake, future studies should consider combining dietary records with food frequency questionnaires (FFQs) to enhance the assessment of long-term dietary inflammatory potential.

In the context of our study, both VAI and LAP values among women with PCOS were found to be lower compared to previously reported values in the literature. While no statistically significant correlation was identified between DII values and adiposity indices, it is noteworthy that this may potentially confer long-term risks for these individuals. The study emphasizes the critical importance of promoting a dietary pattern that is conducive to reducing inflammation, which is a pivotal factor in the management and progression of the disease.

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Author Contributions

The study was conceptualized and designed by **Gizem Cengiz Pala** and **Gözde Dumlu Bilgin**. Data collection was carried out by **Gizem Cengiz Pala**, while data analysis and interpretation of the findings were performed by **Gözde Dumlu Bilgin**, in collaboration with **Gizem Cengiz Pala**. Both authors contributed to drafting and revising the manuscript.

All authors have critically reviewed and approved the final version of the manuscript and take full responsibility for all aspects of the study.

Conflict of Interest

The authors have declared no conflicts of interest. This study was not generated by or with the assistance of artificial intelligence tools. It is the original work of the author(s).

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Ethical Approval

This study was performed in accordance with the guidelines outlined in the Declaration of Helsinki, and all procedures were approved by the Yeditepe University Faculty of Health Science Non-Interventional Research Ethics Committee with date and number 08.04.2022/16.

Peer Review Process

Extremely and externally peer-reviewed.

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Investigation of Psychiatric Comorbidity in Children and Adolescents with Obesity: A Single-Center Study

Öznur ADIGÜZEL AKMAN¹ , Hakan KAYIŞ¹ , Esra BİLİCİ² , Ceyda BIYIKLI¹ , Hacer ARIKAN³ ,
Elif MUMCU¹ , Ezgi ÖZKAN³ 

¹Zonguldak Bülent Ecevit University Hospital, Child and Adolescent Psychiatry Clinic, Zonguldak, Türkiye

²Zonguldak Bülent Ecevit University Hospital, Pediatric Endocrinology Clinic, Zonguldak, Türkiye

³Zonguldak Bülent Ecevit University Hospital, Mental Health and Psychiatry Clinic, Zonguldak, Türkiye

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GRAPHICAL ABSTRACT

The high prevalence of psychiatric comorbidities in obese children and adolescents highlights the importance of early diagnosis and integrated treatment approaches.

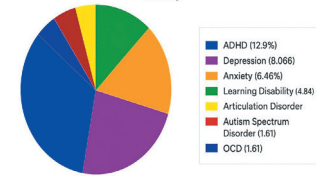
1. Introduction and Aim

- Obesity is a chronic health problem characterized by excessive accumulation of fat in the body.
- Today, childhood obesity has become an increasingly common public health problem worldwide.
- This study aimed to investigate the prevalence and distribution of psychiatric comorbidities in obese children and adolescents, as well as to determine the potential risk factors associated with the severity of obesity and the development of psychiatric disorders.

2. Methods

- The study included 87 cases.
- 28 obese children,
- 32 as severely obese children
- 27 healthy controls
- Sociodemographic data form,
- K-SADS-PL,
- Children's Depression Inventory (CDI),
- Pediatric Quality of Life Inventory (PedsQL)

Distribution of Psychiatric Comorbidities in Children with Obesity



BMI ↑ Depression
 $r=0.387, p<0.001$

Family History
Comorbidity
 $p<0.01$

Quality of Life in
Obesity
 $p<0.001$

Turkish Journal of Diabetes and Obesity

Öznur Adigüzel Akman, Hakan Kayış, Esra Bilici,
Ceyda Biyıklı, Hacer Arıkan, Elif Mumcu, Ezgi Özkan

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Comorbidity in Children ... Turk J Diab Obes 2025;9(2).

ABSTRACT

Aim: This study aimed to investigate the frequency and distribution of psychiatric comorbidities in children and adolescents with obesity, as well as to identify potential risk factors between disease severity and the development of psychiatric disorders in obese children.

Material and Methods: The study included 87 cases. Of these, 60 cases diagnosed with obesity were referred to the Child Psychiatry Outpatient Clinic between 2024 and 2025 through the Pediatric Endocrinology Clinic of Zonguldak Bülent Ecevit University Faculty of Medicine; 28 were classified as obese and 32 as severely obese. In addition, 27 healthy children served as the control group. Sociodemographic data form, K-SADS-PL, Children's Depression Inventory (CDI), and Pediatric Quality of Life Inventory (PedsQL) were applied to the cases. Group differences were analyzed using an independent samples t-test and one-way ANOVA, with post-hoc Tukey tests conducted when significant differences were observed. The relationships between the variables were examined with the Spearman correlation coefficient.

ORCID: Öznur Adigüzel Akman / 0000-0001-8196-6664, Hakan Kayış / 0000-0001-6800-9587, Esra Bilici / 0000-0002-9262-7200, Ceyda Biyıklı / 0009-0009-2011-3006, Hacer Arıkan / 0009-0000-8478-2713, Elif Mumcu / 0009-0003-1200-2513, Ezgi Özkan / 0009-0001-0653-9643

Correspondence Address / Yazışma Adresi:

Öznur ADIGÜZEL AKMAN

Zonguldak Bülent Ecevit University Hospital, Child and Adolescent Psychiatry Clinic, Zonguldak, Türkiye
Phone: +90 (537) 824 87 28 • E-mail: oznuradiguzel58@gmail.com

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Results: Psychiatric comorbidities were found in 37% of children and adolescent cases with obesity. The diagnoses that appeared most frequently were ADHD (12.1%), depression (8.1%), and anxiety disorders (6.5%). A significant positive relationship was observed between BMI and depressive symptom severity (Spearman's $\rho = 0.387$, $p < 0.001$). Quality of life scores were significantly lower in the children with obesity compared to controls. A family history of psychiatric illness was significantly associated with higher comorbidity rates ($p < 0.001$).

Conclusion: The elevated occurrence in children and adolescents with obesity highlights the importance of early diagnosis and integrated treatment approaches. Addressing co-occurring psychiatric disorders can improve treatment outcomes and enhance quality of life.

Keywords: Obesity, Children, Adolescents, Psychiatric comorbidity

Obeziteli Çocuk ve Ergenlerde Psikiyatrik Komorbiditenin Araştırılması: Tek Merkezli Bir Çalışma

GRAFİKSEL ÖZET

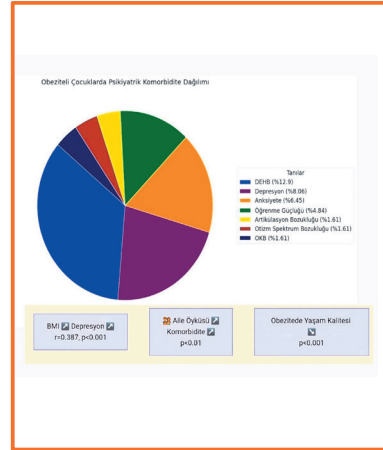
Obeziteli çocuk ve ergenlerde psikiyatrik komorbiditelerin yüksek prevalansı, erken tanı ve bütüncül tedavi yaklaşımlarının önemini vurgulamaktadır.

1. Giriş ve Amaç

- Obezite, vücutta aşırı yağ birikimiyle karakterize kronik bir sağlık sorunudur.
- Günümüzde çocukluk çağı obezitesi, dünya çapında giderek yaygınlaşan bir halk sağlığı sorunu haline gelmiştir.
- Bu çalışmanın amacı, obez çocuk ve adolesanlarda psikiyatrik komorbiditelerin prevalansını ve dağılımını araştırmak, ayrıca obezite şiddeti ve psikiyatrik bozuklukların gelişimi ile ilişkili potansiyel risk faktörlerini belirlemektir.

2. Yöntem

- Çalışmaya 87 olgu dahil edildi.
- 28 obeziteli çocuk,
- 32 şiddetli obez çocuk olarak
- 27 sağlıklı kontrol
- Sosyodemografik veri formu,
- K-SADS-PL,
- Çocuklarda Depresyon Envanteri (ÇDE),
- Pediatric Yaşam Kalitesi Envanteri (PedsQL)



Türkiye Diyabet ve Obezite Dergisi

Öznur Adıgüzel Akman, Hakan Kayış, Esra Bilici, Ceyda Bıyıklı, Hacer Arıkan, Elif Mumcu, Ezgi Özkan

Adıgüzel Akman Ö ve ark. Obeziteli Çocuk ve Ergenlerde Psikiyatrik Komorbiditenin ... Turk J Diab Obes 2025;9(2).

ÖZ

Amaç: Bu çalışmada, obeziteli çocuk ve ergenlerde psikiyatrik komorbidite sıklığı ve dağılımının araştırılması, aynı zamanda obeziteli çocuklarda hastalık şiddeti ile psikiyatrik hastalık gelişimi arasında olası risk faktörlerinin açığa kavuşturulması amaçlanmıştır.

Gereç ve Yöntemler: Çalışmaya toplam 87 katılımcı dahil edildi. Bunlardan 60 olgu, Zonguldak Bülent Ecevit Üniversitesi Tıp Fakültesi Pediatrik Endokrinoloji Kliniği aracılığıyla 2024–2025 yılları arasında Çocuk Psikiyatrisi Polikliniğine yönlendirilen obezite tanılı hastalardı; 28'i obez, 32'si ise aşırı obez olarak sınıflandırıldı. Ayrıca, 27 sağlıklı çocuk kontrol grubu olarak yer aldı. Katılımcılara sosyodemografik veri formu, K-SADS-PL, Çocuklarda Depresyon Envanteri (ÇDE) ve Pediatric Yaşam Kalitesi Envanteri (PedsQL) uygulandı. Gruplar arası farklar iki grup için t-testi ve tek yönlü varyans (ANOVA) analizi ile, anlamlı farklılık saptanan durumlarda post-hoc Tukey testi ile değerlendirildi. Değişkenler arası ilişkiler ise Spearman korelasyon katsayısı ile incelendi.

Bulgular: Obeziteli çocuk ve ergenlerin %37'sinde psikiyatrik komorbiditeler saptanmıştır. En sık görülen tanılar dikkat eksikliği ve hiperaktivite bozukluğu (%12,1), depresyon (%8,1) ve anksiyete bozuklukları (%6,5) olmuştur. Vücut kütle indeksi ile depresif belirti şiddeti arasında pozitif yönde anlamlı bir korelasyon belirlenmiştir (Spearman's $\rho = 0,387$, $p < 0,001$). Obeziteli grubun yaşam kalitesi puanları, kontrol grubuna kıyasla anlamlı düzeyde daha düşük bulunmuştur. Psikiyatrik hastalık öyküsü bulunan bireylerde komorbidite oranları anlamlı şekilde daha yüksek bulunmuştur ($p < 0,001$).

Sonuç: Obeziteli çocuk ve ergenlerde psikiyatrik komorbidite oranlarının yüksek olması, erken tanı ve bütüncül tedavi yaklaşımlarının önemini bir kez daha ortaya koymaktadır. Obezite tedavisinde, eşlik eden psikiyatrik bozuklukların tespiti ve uygun müdahalelerin planlanması, tedavi etkinliğini artırarak bu çocukların yaşam kalitesinin yükselmesine katkı sağlayabilir.

Anahtar Sözcükler: Obezite, Çocuk, Ergen, Psikiyatrik komorbidite

INTRODUCTION

Obesity is a chronic metabolic disorder defined by the excessive accumulation of fat in the body at a level that poses a risk to health (1). Currently, childhood obesity represents a major and growing global public health issue (2). During childhood, obesity is usually evaluated through age- and sex-specific BMI percentiles, which are then expressed as standard deviation scores (SDS) according to reference growth charts (2). In children under 2 years of age, obesity is defined as a weight-for-length above the 97.7th percentile or exceeding 120% of the ideal weight. For those older than 2 years, BMI values between the 85th and 95th percentiles indicate overweight, whereas ≥ 95 th percentile defines obesity (3). Studies from the early COVID-19 pandemic reported a 2% rise in childhood obesity prevalence (4). Similarly, a Turkish study showed that between 1990–1995 and 2011–2015, the rate of obesity increased from 0.6% to 7.3%, reflecting more than an eleven-fold rise (5). Multiple anthropometric indices such as BMI-SDS, waist circumference, waist-to-height ratio, TMI, BRI, and AVI are utilized to predict overweight/obesity risk in children (5). According to the reference growth curves developed for children and adolescents, individuals with a BMI SDS between +1 and +2 are considered overweight; those between +2 and +3 SDS are considered obese; and those with a BMI SDS of +3 or higher are classified as severely (morbidly) obese (6). In Turkey, nationally developed reference curves are widely used for diagnosis and follow-up in children and adolescents (6).

The primary causes of obesity include unhealthy eating habits, physical inactivity, and genetic factors (7). In addition, in some studies, it has been reported that the increasing frequency of Type-2 diabetes among children (8), female gender in addition, has also been linked with a higher risk of obesity (9).

Studies have shown that obesity rates in children, adolescents, and adults have tripled since 1975. According to the World Health Organization (WHO), over 340 million individuals aged 5 to 19 years were classified as obese in 2020 (10).

Childhood obesity impacts both physical and psychological health. Psychiatric comorbidities associated with obesity may significantly affect emotional, cognitive, and social functioning, leading to reduced quality of life (2). Previous research has demonstrated associations between obesity and depression, anxiety, low self-esteem, behavioral issues, substance use, and eating disorders (1,11). Additionally, obesity in children has been linked to reduced psychomotor activity, lower mood, and heightened stress responses (12).

Meta-analyses report a depression prevalence of about 10% in obese children, with more than 1.3 times higher risk compared to normal-weight peers. Low self-esteem and social isolation further contribute to vulnerability for depression (13). Furthermore, how obesity negatively affects quality of life, including low self-esteem and social isolation, may elevate the risk of depression in this population (13,14).

Anxiety disorders are also commonly observed psychiatric conditions in children diagnosed with obesity. Body image issues and social exclusion related to obesity may increase anxiety levels in affected individuals (15). Moreover, studies highlight the link between obesity and Attention-Deficit/Hyperactivity Disorder (ADHD), suggesting that certain features of ADHD, such as impulsive behavior and poor dietary habits, may contribute to weight gain in children (16).

The existing literature reveals a high prevalence of psychiatric comorbidity among obese children (17). Thus, evaluating co-occurring psychiatric symptoms in the clinical assessment of obese children is essential. This present study aims to investigate the frequency and distribution of psychiatric comorbidity among obese children and adolescents with obesity and to explore potential risk factors and underlying mechanisms. The findings are intended to contribute to early diagnosis and intervention efforts and to support the development of an integrative treatment approach.

MATERIALS and METHODS

The study comprised 60 patients attending the Pediatric Endocrinology Outpatient Clinic at Zonguldak Bülent Ecevit University Faculty of Medicine during 2024–2025. Among them, 28 were classified as obese and 32 as severely obese. All were referred to the child psychiatry outpatient clinic for screening. The control group comprised 27 healthy children.

Using G*Power 3.1.9.7, an a priori power analysis indicated a minimum sample size of 53 cases per group ($N \approx 159$) would be required to detect a medium effect (Cohen's $f = 0.25$) with $\alpha = 0.05$ and power = 0.80. With the actual sample (27 controls, 28 obese, 32 severely obese), the study had sufficient sensitivity to detect medium-to-large effects (Cohen's $f \geq 0.34$).

The study protocol was approved by the Zonguldak Bülent Ecevit University Faculty of Medicine Ethics Committee on Clinical Research (Approval no: 2024/18). All procedures were carried out in accordance with the Declaration of Helsinki and national ethical standards.

Control Group Inclusion Criteria:

1. Children whose BMI is below the 85th percentile for age and sex (Non-obese children)
2. No history of chronic physical illness.

3. 3. Agreeing to participate voluntarily in the study and obtaining family consent.

Control Group Exclusion Criteria:

1. Having a diagnosis of obesity or severe obesity (BMI $\geq$ 95% percentile).
2. History of chronic medical diseases such as diabetes, cardiovascular disease, and endocrine disorders.
3. Any medical condition that requires regular medication.
4. Failure to give consent by the family or child for participation in the study.

All cases completed the sociodemographic data form, the Children's Depression Inventory (CDI), K-SADS-PL, and the Pediatric Quality of Life Inventory (PedsQL).

Data Collection Tools

Sociodemographic Data Form:

The semi-structured tool developed by the researchers to gather demographic, medical, and family psychiatric information.

K-SADS-PL (Schedule for Affective Disorders and Schizophrenia for School-Age Children – Present and Lifetime Version):

Updated in 2016 by Kaufman et al. based on DSM-5 criteria, the Turkish adapted form of this semi-structured interview was conducted by researchers. Following translation and back-translation processes, along with pilot testing involving children and parents, the final Turkish version was established (K-SADS-PL-DSM-5-T, November 5, 2016) (14). The first section gathers general information; the second includes over 200 symptom-related questions; and the third confirms DSM-5 diagnoses through evaluation and observation. DSM-5-based semi-structured interview, updated in 2016, with Turkish validity and reliability established by Ünal et al (18).

Children's Depression Inventory (CDI):

The Children's Depression Inventory (CDI), developed by Kovacs in 1980, is widely used to evaluate depression in children aged 6 to 17. The scale includes 27 items, each rated from 0 to 2 according to severity, yielding total scores between 0 and 54, with a cut-off value of 19. The Turkish adaptation and validation of the CDI were carried out in 1991, and the scale demonstrated good internal consistency, with a Cronbach's alpha of 0.86 (19). In this study, Cronbach's alpha coefficient of CDI was found to be 0.83. Necessary permission has been obtained from the relevant researchers regarding.

Pediatric Quality of Life Inventory (PedsQL):

Developed in 1999 by Varni et al., the scale assesses health-related quality of life among children between 2 and 18 years of age (21). The PedsQL is a reliable and internally consistent instrument. It contains versions for child self-reporting and parent proxy-reporting, tailored to different age ranges. The scale consists of 23 statements covering physical (8), school functioning (5), social (5), and emotional (5). Items are scored from 0 to 100, where higher scores correspond to a more favorable perception of quality of life. The Turkish validation studies were conducted in 2005 (20). In order to evaluate the reliability of PedsQL, internal consistency analysis was performed, and the scale demonstrated excellent reliability, with a Cronbach's alpha coefficient of 0.93 (21). Cronbach's alpha coefficient in this study was calculated as 0.84. Necessary permission has been obtained from the relevant researchers regarding the use of the scales.

Statistical Analysis

Statistical analyses were performed using SPSS v 22. Descriptive statistics were summarized as mean $\pm$ standard deviation for continuous variables and percentages for categorical variables. Normality was tested with the Shapiro–Wilk test. Group comparisons were conducted with chi-square for categorical data, and one-way ANOVA or Kruskal–Wallis for continuous variables, followed by Tukey's HSD or Dunn's test where appropriate. Effect sizes were reported as partial η^2 . Correlations were assessed with Pearson or Spearman coefficients. A p-value <0.05 was considered statistically significant.

RESULTS

Among the 87 cases, 52 (59.8%) were female and 35 (40.2%) were male. Sociodemographic characteristics are provided in Table 1.

Among the 60 obesity group (obese + severely obese) included in the study, 37% (n = 23) were diagnosed with at least one psychiatric disorder. The observed psychiatric conditions included Attention-Deficit/Hyperactivity Disorder (ADHD) (12.1%), depression (8.1%), anxiety disorders (6.5%), learning disability (4.8%), articulation disorder (1.6%), obsessive-compulsive disorder (OCD) (1.6%), and high-functioning autism (1.6%). Additionally, 6% of the cases were diagnosed with more than one psychiatric disorder. The frequencies of psychiatric diagnoses are summarized in Table 2.

The rate of psychiatric symptoms among obese individuals with a positive family history of psychiatric disorders were 70%, which was significantly higher than that of those without a family history (p <0.001).

Table 1. Descriptive and Demographic Characteristics of Cases

Characteristics	Findings (n=87)	
Gender n(%)	Male	35 (40.2)
	Female	52 (59.8)
Group n(%)	Obese	28 (32.2)
	Morbidly Obese	32 (36.8)
	Control	27 (31.0)
Family Type n(%)	Nuclear	66 (75.9)
	Extended	14 (16.1)
	Separated	7 (8.1)
Age (years±SD)*	11.78 ± 3.08	12 (5 – 17)
Height (cm±SD)*	152.0 ± 14.6	155 (114 – 178)
Weight (kg±SD)*	67.2 ± 26.4	67 (20 – 130)

*Data are shown as n (%), mean ±Standart deviation (SD) with median (minimum – maximum) values.

Table 2. Distribution of Psychiatric Diagnoses Among Cases

Diagnosis	Findings	%
No Diagnosis	39	(62.9)
ADHD	8	(12.9)
Depression	5	(8.06)
Anxiety	4	(6.45)
Learning Disorder	3	(4.84)
Articulation Disorder	1	(1.61)
ASD	1	(1.61)
OCD	1	(1.61)

*Data are shown as n (%), **ADHD**: Attention-Deficit/Hyperactivity Disorder, **OCD**: Obsessive Compulsive Disorder, **ASD**: Autism Spectrum Disorder.

Table 3. Comparison of Scale Among Obese, Severe Obese, and Control Groups Using One-Way ANOVA

	Source	df	SS	MS	F	ηp^2	p
CDI	Between Groups	2	1105.25	552.62	9.03	0.177 ^a	< 0.001 ^b
	Within Groups	84	5141.38	61.21			
	Total	86	6246.62				
(PedsQL) (child)	Between Groups	2	7012.52	3506.26	20.42	0.327 ^a	< 0.001 ^b
	Within Groups	84	14426.34	171.74			
	Total	86	21438.86				
PedsQL (parent)	Between Groups	2	6158.48	3079.24	16.1	0.277 ^a	< 0.001 ^b
	Within Groups	84	16063.75	191.24			
	Total	86	22222.23				

^aEffect size; ^bOne- way ANOVA; CDI: Children's Depression Inventory; PedsQL: Pediatric Quality of Life Inventory (PedsQL)

When analyzed by gender, 38.1% of boys and 34.1% of girls were diagnosed with a psychiatric disorder. Nevertheless, the difference was no statistically significant association between gender and psychiatric diagnosis ($p = 0.758$).

Depression scores were significantly higher in the obese group compared to controls ($p < 0.001$), whereas no significant difference was found between obese and severely obese subgroups ($p = 0.22$).

A significant positive correlation was observed between BMI and depressive symptom severity (Spearman $\rho = 0.387$, $p < 0.001$).

Quality of life scores were significantly lower in obese children than in controls ($p < 0.001$). Subscale analyses revealed no significant differences, except for interpersonal functioning ($p = 0.107$).

Comparisons of CDI, PedsQL-Child, and PedsQL-Parent scores across groups showed significant differences (CDI: $F(2.84)=9.03$, $p < 0.001$; PedsQL-Child: $F(2.84)=20.42$, $p < 0.001$; PedsQL-Parent: $F(2.84)=16.10$, $p < 0.001$). Post-hoc analyses demonstrated that the obesity groups scored significantly worse than controls ($p < 0.001$), while no significant differences were detected between obese and severely obese subgroups ($p > 0.05$) (Table 3).

Moreover, a negative correlation was found between BMI and overall PedsQL scores (Spearman's $\rho = -0.55$, $p < 0.001$).

DISCUSSION

This study aimed to investigate psychiatric comorbidities among obese children and adolescents, highlighting the types and distribution of common co-occurring psychiatric

disorders in this population. Our findings indicate that psychiatric disorders are more prevalent in obese individuals, aligning with much of the existing literature and supporting a relationship between obesity and psychiatric conditions.

Meta-analytic studies have demonstrated that obesity is more prevalent among individuals with ADHD and vice versa (16,22). These findings suggest that deficits in impulse control may contribute to unhealthy eating behaviors and weight gain. Moreover, dysfunctions in the dopaminergic system may be implicated in both ADHD and obesity (16).

In one study, after ADHD, the most frequently observed psychiatric disorders in overweight/obese individuals were specific phobias and social anxiety disorder, both of which were significantly more common than in normal-weight individuals (23). Consistently, our study found ADHD (12.1%) to be the most common diagnosis, followed by depression (8.1%) and anxiety disorders (6.5%).

Another study reported that among overweight and obese children, increased body dissatisfaction was associated with elevated anxiety levels and reduced quality of life, especially when parental psychological distress was present (15). Although some studies report no significant differences in perceived life quality between children with obesity and those without obesity (24), our results revealed a marked reduction in perceived life quality in obese children as well as their parents.

Obesity may lead to a negative body image in children. Experiences such as peer bullying, exclusion, and ridicule can increase feelings of shame and worthlessness, potentially resulting in depressive symptoms. Previous research supports this idea (2). In another study, only chronic obesity was found to be significantly linked to psychiatric disorders. While conduct disorders were common in both boys and girls, depressive disorders were more frequently seen in obese boys (25). However, our study found no significant gender differences in the frequency or types of psychiatric diagnoses. A study comparing obese individuals to the general population reported that lifetime prevalence rates of depression (42.6%), anxiety (40.4%), substance use (36.2%), somatoform disorders (14.9%), and eating disorders (17.0%) were significantly higher in the obese group (26). Additionally, neurodevelopmental deficits and cognitive impairments were reported to occur more often among children with obesity (27), although some studies found no differences in autism spectrum disorder (ASD) prevalence (28). In our study, high-functioning autism was diagnosed in only one case, with no significant link to obesity. An extensive study from the United States involving children aged 10 to 17 found that obese children showed higher levels of

both internalizing and externalizing problems compared to their normal-weight peers. ADHD, learning disabilities, depression, developmental delays, and conduct disorder were also more common in this group (29). Similarly, another study involving obese individuals across childhood, adolescence, and adulthood reported prevalence rates of ADHD (42.5%), anxiety disorders (31.3%), depression (24.3%), and eating disorders (12.9%). Male sex, morbid obesity, and older age were significantly associated with psychiatric comorbidity (30). Although our study did not find gender differences in psychiatric diagnoses, this may be due to the limited sample size and cross-sectional design. A study examining the link between childhood BMI and psychiatric disorders in adulthood found that higher BMI during childhood was significantly correlated with an elevated risk of developing schizophrenia later in life (31). Similarly, our study found a positive correlation between BMI and the severity of depressive symptoms. Depression may lead to behaviors such as emotional eating, particularly the consumption of high-calorie comfort foods, which can result in increased BMI and perpetuate a vicious cycle. Moreover, adolescents and young adults with high BMI may experience depressive symptoms due to body image disturbances, low self-esteem, and unfavorable social comparisons. Collectively, these results underscore that obesity is not solely a physical health issue but a chronic disorder often accompanied by significant psychiatric comorbidity. An important aspect of this study is that obesity and psychiatric symptoms were assessed together in children and adolescents within a specific region. Considering regional characteristics and sociocultural factors, these findings provide unique insights into the existing literature.

This study has several limitations. Firstly, its cross-sectional design does not allow for causal conclusions. Secondly, the short follow-up period restricts the evaluation of long-term psychiatric outcomes. Additionally, the relatively small sample size and the single-center setting limit the generalizability of the results. Investigations carried out in several centers are necessary to support these findings and increase their generalizability. Additionally, psychiatric diagnoses were primarily based on clinical interviews and self-report scales, which may introduce bias. In future studies, it is recommended to reach a larger sample size and to use longitudinal designs to better explain the link between psychiatric disorders and obesity. Furthermore, exploring the association between obesity-related biomarkers and psychiatric conditions in children and adolescents may offer new insights.

The considerable frequency of psychiatric comorbidities among children and adolescents with obesity highlights the importance of early diagnosis and the implementation

of comprehensive treatment strategies. Identifying and addressing co-occurring psychiatric conditions in the context of obesity treatment can enhance treatment efficacy and promote better overall well-being among those affected.

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Author Contributions

Study Design, Methodology, Data Collection: **Öznur Adıgüzel Akman, Hakan Kayış, Esra Bilici**, Technical support: **Ceyda Bıyıklı, Elif Mumcu, Hacer Arıkan, Ezgi Özkan**, Analysis or Interpretation, Manuscript Draft, Critical Review of Content: **Öznur Adıgüzel Akman**.

Conflict of Interest

The authors state that they have no conflicts of interest to disclose.

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Ethical Approval

The research protocol received approval from the Ethics Committee on Clinical Research at Zonguldak Bülent Ecevit University Faculty of Medicine with approval number [2024/18].

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The Effects of Taurine on Energy Homeostasis and Health: A Nutritional Perspective

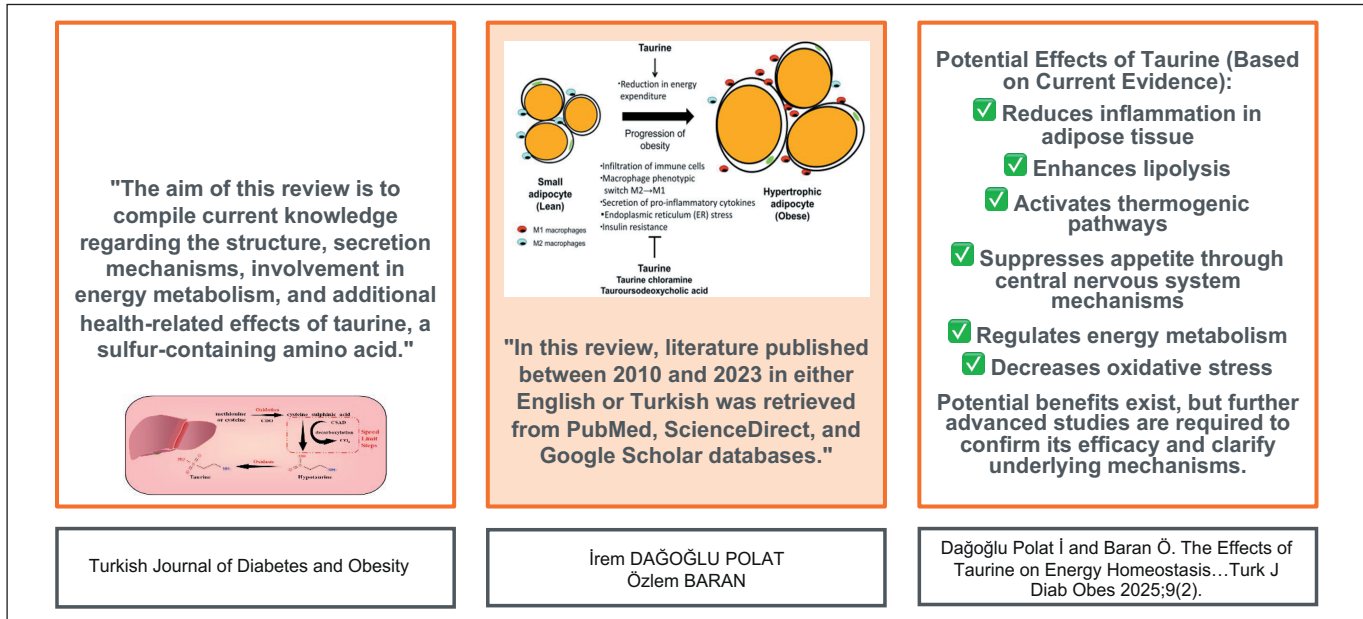
İrem DAĞOĞLU POLAT¹ , Özlem BARAN² 

¹Firat University Faculty of Medicine Hospital, Department of Nutrition and Dietetics, Elazığ, Türkiye

²Lokman Hekim University, Faculty of Health Sciences, Department of Nutrition and Dietetics, Ankara, Türkiye

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GRAPHICAL ABSTRACT



ABSTRACT

Taurine is a sulfur-containing β -amino acid that structurally differs from standard amino acids. It is found in high concentrations across various tissues of the human body and plays a role in numerous physiological processes, including antioxidant defense, energy regulation, and modulation of the central nervous system. Globally increasing obesity is accompanied by serious health problems such as metabolic syndrome, insulin resistance, dyslipidemia, and hyperglycemia. While traditional approaches have regarded adipose tissue as a passive structure solely involved in lipid storage, it is now recognized as an active endocrine organ. In this context, the biologically active molecules secreted by adipocytes and their roles in metabolic processes are critically important in the pathogenesis of obesity. The primary aim of this review article is to systematically evaluate the functional effects of taurine in adipose tissue and the mechanisms by which it counteracts obesity. Taurine possesses a structure that distinguishes it from typical amino acids and is present in high concentrations in the body, contributing to various biological functions such as reducing oxidative stress, suppressing inflammation, and regulating energy metabolism. Studies in animal models have demonstrated that taurine supplementation reduces inflammation in adipose tissue, increases lipolysis, activates thermogenic pathways, and suppresses appetite via central nervous system mechanisms,

ORCID: İrem Dağoğlu Polat / 0000-0003-4110-4446, Özlem Baran / 0000-0003-3868-4850

Correspondence Address / Yazışma Adresi:

İrem DAĞOĞLU POLAT

Department of Nutrition and Dietetics, Firat University of Medicine Hospital, Elazığ, Türkiye

Phone: +90 (533) 573 37 94 • E-mail: dytiremdagoglu@gmail.com

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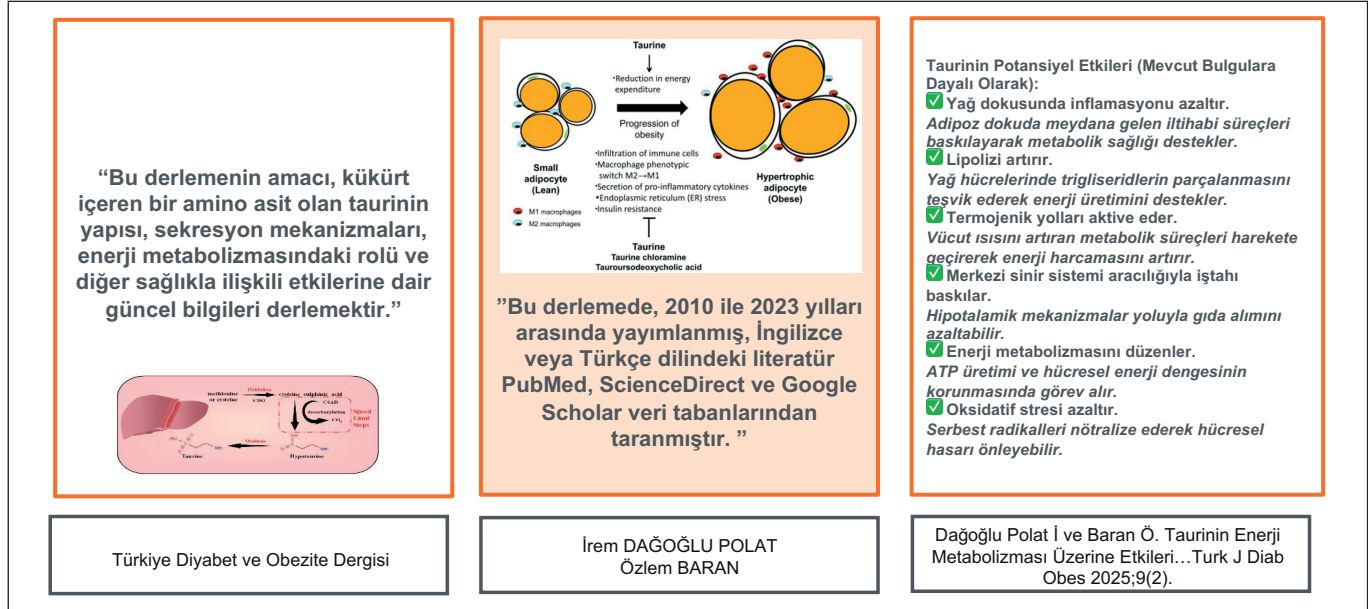
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thereby preventing the development of obesity. Moreover, findings of low plasma taurine levels in individuals living with obesity and diabetes suggest that taurine deficiency may disrupt metabolic balance. Although animal and epidemiological studies indicate that taurine is promising for alleviating metabolic disorders, further advanced research is necessary to fully elucidate its mechanisms and confirm its efficacy in humans.

Keywords: Adipose Tissue, Obesity, Taurine

Taurinin Enerji Homeostazi ve Sağlık Üzerindeki Etkileri: Beslenme Perspektifi

GRAFİKSEL ÖZET



ÖZ

Taurin, standart amino asitlerden yapısal olarak farklılık gösteren, sülfür içeren bir β -amino asittir. İnsan vücudunun çeşitli dokularında yüksek konsantrasyonlarda bulunur ve antioksidan savunma, enerji regülasyonu ve merkezi sinir sisteminin düzenlenmesi gibi çok sayıda fizyolojik süreçte rol alır. Küresel olarak artan obeziteye metabolik sendrom, insülin direnci, dislipidemi ve hiperglisemi gibi ciddi sağlık sorunları eşlik etmektedir. Geleneksel yaklaşımlar yağ dokusunu sadece lipid depolamada rol alan pasif bir yapı olarak görürken, artık aktif bir endokrin organ olarak kabul edilmektedir. Bu bağlamda, adipositler tarafından salgılanan biyolojik olarak aktif moleküller ve bunların metabolik süreçlerdeki rolleri obezitenin patogenezinde kritik öneme sahiptir. Bu derleme makalesinin temel amacı, taurinin adipoz dokudaki fonksiyonel etkilerini ve obeziteye karşı koyma mekanizmalarını sistematik olarak değerlendirmektir. Taurin, onu tipik amino asitlerden ayıran bir yapıya sahiptir ve vücutta yüksek konsantrasyonlarda bulunur, oksidatif stresi azaltmak, inflamasyonu bastırmak ve enerji metabolizmasını düzenlemek gibi çeşitli biyolojik işlevlere katkıda bulunur. Hayvan modellerinde yapılan çalışmalar, taurin takviyesinin yağ dokusundaki enflamasyonu azalttığını, lipolizi artırdığını, termojenik yolları aktive ettiğini ve merkezi sinir sistemi mekanizmaları yoluyla iştahı baskıladığını ve böylece obezite gelişimini önlediğini göstermiştir. Ayrıca, obezite ve diyabetle yaşayan bireylerde düşük plazma taurin düzeylerinin saptanması, taurin eksikliğinin metabolik dengeyi bozabileceğine işaret etmektedir. Her ne kadar hayvan ve epidemiyolojik çalışmalar taurinin metabolik bozuklukları hafifletmek için umut verici olduğunu gösterse de, mekanizmalarını tam olarak aydınlatmak ve insanlardaki etkinliğini doğrulamak için daha ileri araştırmalara ihtiyaç vardır.

Anahtar Sözcükler: Obezite, Taurin, Yağ dokusu

INTRODUCTION

Taurine, a sulfur-containing β -amino acid structurally distinct from standard amino acids, accumulates in high concentrations in various human tissues and contributes to key physiological processes such as antioxidant defense, energy regulation, and modulation of the central nervous system (1).

Researchers have directly linked the rapid global increase in obesity to metabolic syndrome, which encompasses metabolic disorders such as dyslipidemia, insulin resistance, and hyperglycemia. The expansion of adipose tissue reflects a persistent positive energy balance resulting from a sedentary lifestyle shaped by genetic predisposition and environmental factors. In earlier models, scientists regarded adipose tissue as a passive lipid reservoir. However, current scientific paradigms recognize it as a metabolically active endocrine organ that synthesizes a wide range of bioactive molecules (2).

These biologically active molecules released from adipose tissue are termed adipocytokines, which include leptin, adiponectin, and resistin. Leptin, predominantly secreted by white adipose tissue, plays a central role in the regulation of energy balance by acting on the hypothalamus to inhibit appetite and increase energy expenditure. In the context of obesity, circulating leptin levels are paradoxically elevated; however, this is often accompanied by leptin resistance, a condition in which target tissues fail to respond adequately to leptin's anorexigenic effects, thereby contributing to persistent hyperphagia and weight gain. Adiponectin, in contrast, exhibits anti-inflammatory, anti-atherogenic, and insulin-sensitizing properties. It enhances fatty acid oxidation, improves glucose uptake in skeletal muscle, and suppresses hepatic gluconeogenesis. Notably, adiponectin levels are inversely correlated with adiposity and are significantly reduced in individuals with obesity and type 2 diabetes. Resistin, originally identified as an adipocyte-derived hormone linked to insulin resistance, is now known to be primarily produced by macrophages in humans. It promotes the expression of pro-inflammatory cytokines such as TNF- α and IL-6 and is implicated in the development of insulin resistance, systemic inflammation, and endothelial dysfunction. Collectively, these adipocytokines serve as key mediators linking adipose tissue dysfunction to metabolic and inflammatory pathways involved in obesity-related complications (3-5).

These molecules play key roles in insulin sensitivity, nutrient metabolism, inflammatory responses, and stress regulation. In obesity, macrophages infiltrate adipose tissue and trigger chronic low-grade inflammation through in-

creased production of proinflammatory cytokines such as tumor necrosis factor- α (TNF- α), interleukin-6 (IL-6), and monocyte chemoattractant protein-1 (MCP-1). This chronic inflammatory state significantly contributes to the development of insulin resistance and obesity-related complications (6).

As outlined in the previous section, certain bioactive compounds that adipose tissue secretes play a pivotal role in the development of chronic inflammation and obesity-related complications. In this context, recent studies have identified taurine as a promising regulatory molecule with therapeutic potential for managing metabolic disorders. Among all free amino acids in mammals, taurine exhibits the highest intracellular concentrations, typically ranging from 20 to 50 mM—markedly higher than the micromolar levels seen for most other amino acids. Taurine plays a central role in maintaining cellular homeostasis, as the body synthesizes it from cysteine and also obtains it through dietary sources. Beyond its classical function in bile acid conjugation, recent research has emphasized taurine's diverse physiological and pharmacological effects. These include anti-obesity properties, enhanced insulin sensitivity, suppression of macrophage infiltration into adipose tissue, regulation of endoplasmic reticulum stress, antioxidant and anti-inflammatory effects, and neuromodulatory actions (7,8).

This study aims to investigate the functional roles of taurine in adipose tissue, with a particular emphasis on its involvement in the development of obesity and the regulation of energy homeostasis in both human and animal models.

TAURINE

Taurine derives its name from the Latin word *taurus*, meaning bull, and is etymologically linked to the Ancient Greek term ταῦρος (*taúros*). It was first isolated in 1827 by German scientists Leopold Gmelin and Friedrich Tiedemann from the bile of *Bos taurus* (ox bile), a discovery that not only contributed to the understanding of bile constituents but also gave the compound its name. Taurine is a β -amino sulfonic acid found in high concentrations in the brain, retina, heart, skeletal muscle, and leukocytes, where it plays essential roles in various physiological processes (9).

Taurine is predominantly concentrated in oxidative tissues that are rich in mitochondria, such as cardiac and skeletal muscle, whereas its levels are comparatively lower in glycolytic tissues. The distribution of taurine varies markedly across human tissues, reflecting its involvement in tissue-specific metabolic functions. Chemically, taurine ($C_2H_7NO_3S$) is classified as a β -amino acid with a molecular weight of 125.15 g/mol. Its molecular structure consists of

an amino group (NH_2) and a sulfonic acid group (SO_3H) attached to the β -carbon, notably lacking a carboxyl group. This unique structural configuration enables taurine to remain unbound as a free amino acid within cells, thereby allowing significant functional versatility, particularly in cellular signaling, osmoregulation, and mitochondrial homeostasis (9,10).

Taurine's isoelectric point is approximately pH 5.12. Its strong acidic nature allows it to remain highly soluble in water across physiological pH ranges. Although taurine is structurally similar to amino acids, it lacks a carboxyl group and possesses a beta-amino configuration, features that prevent its incorporation into protein synthesis (11).

Dietary Sources and Biosynthesis of Taurine

Taurine is present in numerous food sources, and daily intake ranges from approximately 40 to 400 mg depending on dietary habits. Rich dietary sources include fish, milk, eggs, and meat. Consequently, individuals adhering to vegetarian diets typically have lower taurine intake. The primary dietary sources of taurine and the corresponding concentrations found in each food item are detailed in Figure 1 (9,12, 13).

Taurine is chiefly produced in the liver and kidneys, yet it is also distributed across various tissues, including the brain, retina, heart, placenta, leukocytes, and skeletal muscles. Its biosynthesis originates from the metabolic processing of cysteine and methionine. In the principal pathway, cysteine undergoes oxidation via cysteine dioxygenase (CDO), yielding cysteine sulfinic acid. This compound is subsequently decarboxylated by cysteine sulfinic acid decarboxylase (CSAD) to generate hypotaurine, which is further oxidized to taurine through the action of hypotaurine dehydrogenase. An alternative trans-sulfuration route converts homocysteine into cystathionine, followed by sequential enzymatic reactions involving cystathionine γ -lyase (CGL), CDO, and CSAD, ultimately leading to taurine formation (Figure 2) (13,14).

Toxicological Effects of Taurine

Taurine, a naturally occurring amino acid, shows minimal adverse effects in the body. Toxicity studies have reported that taurine is neither genotoxic, carcinogenic, nor teratogenic (15). Some studies have defined tolerable upper intake levels based on the no-observed-adverse-effect level (NOAEL). For instance, intravenous administration of 1000–2000 mg/kg/day for 13 weeks to increased water con-

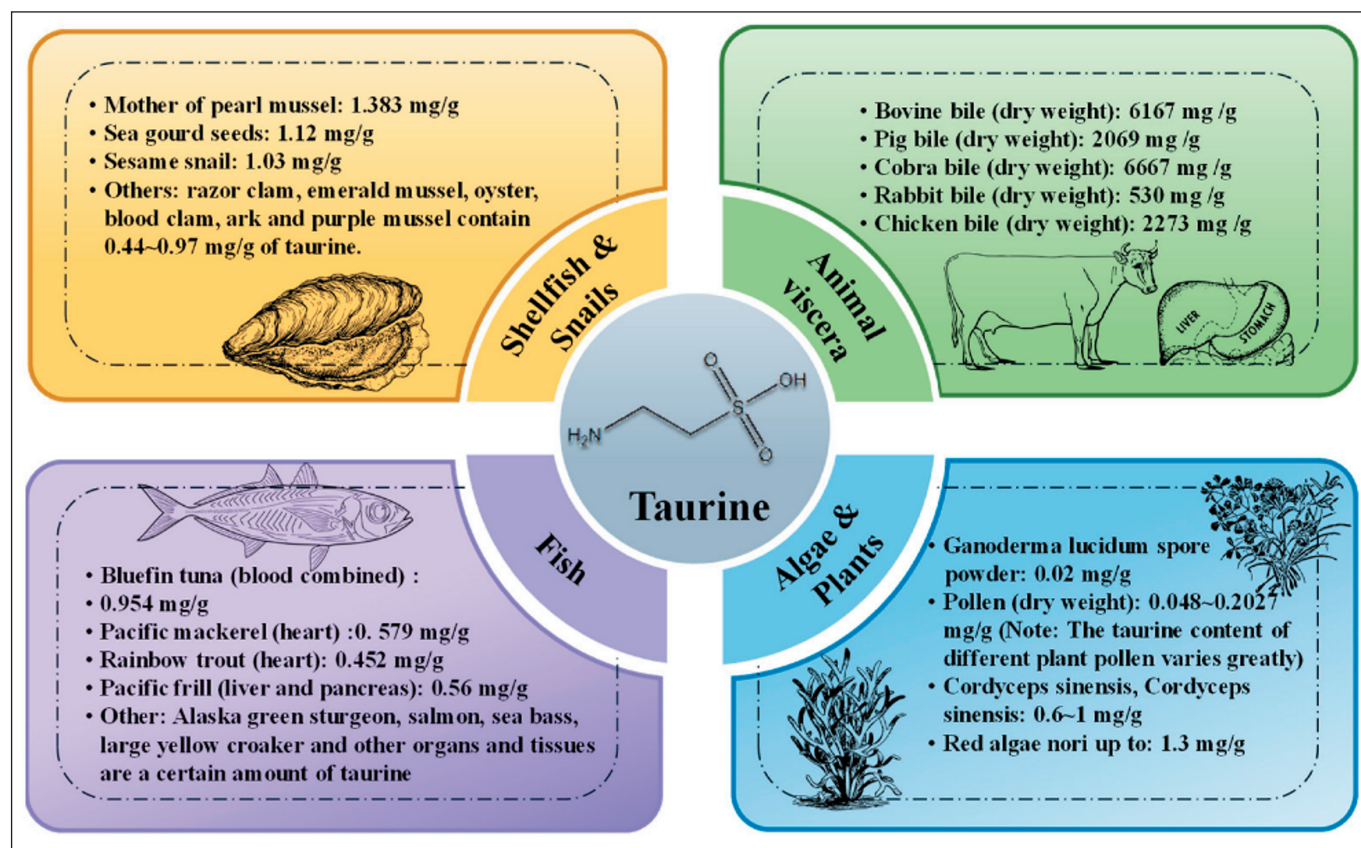


Figure 1: Main dietary sources of taurine and the proportion of taurine in each food.

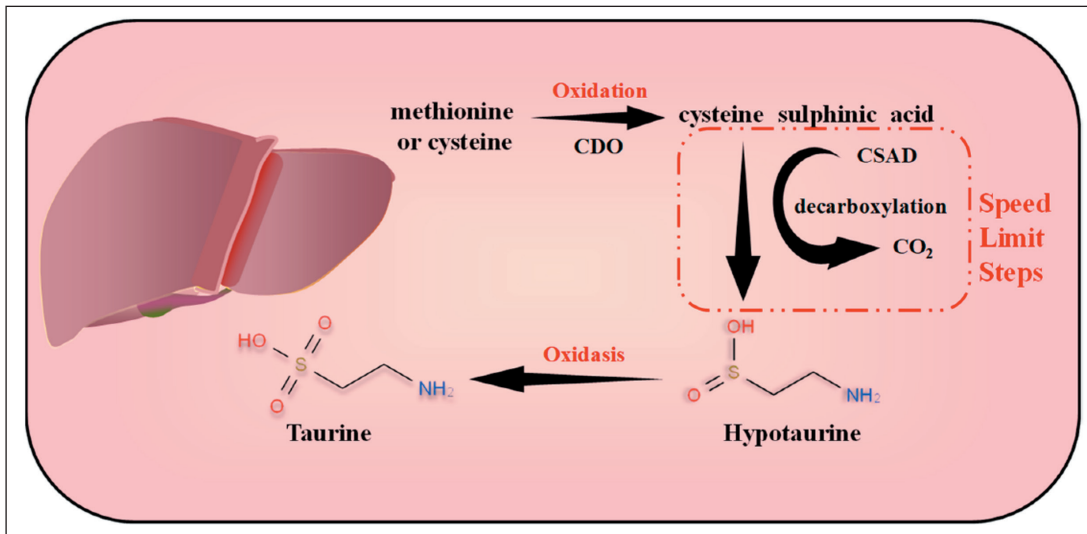


Figure 2: Taurine synthesis pathway in the liver.

sumption and hemosiderin deposition in rat lungs. Almo-haimeed et al. reported a NOAEL of 500 mg/kg/day, whereas observed hepatic lipid infiltration in guinea pigs at 462 mg/kg/day over two weeks (16). A risk assessment concluded that a maximum dose of 3 g/day posed no toxicological concern in clinical studies. According to the VKM Report 2015:22, titled Risk Assessment of “Other Substances” Taurine, a NOAEL of 1000 mg/kg/day was identified for taurine based on subchronic toxicity studies in animals. (17).

A study investigated the effects of taurine on the brain tissue energy status and lipid peroxidation in a guinea pig model of endotoxemia. Endotoxemia significantly reduced the ATP/ADP ratio and taurine levels in the brain, while increasing malondialdehyde (MDA) levels, a marker of lipid peroxidation. However, taurine administration did not exhibit the anticipated antioxidant and neuroprotective effects; on the contrary, it may have contributed to neuronal damage at the administered dose. These findings suggest that taurine, when used at certain doses, may exert toxic rather than neuroprotective effects (18).

In another experimental trial, the administration of a high taurine dose (6 g) was assessed for its influence on performance-related variables, namely time to exhaustion (TTE), maximal oxygen uptake (VO₂max), maximal heart rate (HRmax), and perceived exertion (RPE), during treadmill exercise of progressively increasing intensity. The study included 10 well-trained male endurance athletes and employed a double-blind, randomized, crossover design. Participants were given a sugar-free lemonade mixed with either taurine or placebo approximately 90 minutes before the exercise trial. The treadmill protocol began at a speed of 6 km/h, with both speed and incline increasing over time.

The results indicated that taurine had no significant effect on TTE or HRmax, although a non-significant 2% increase in VO₂max was observed. These findings suggest that high-dose taurine supplementation does not confer a notable benefit to endurance performance (19).

Biological Functions of Taurine

Taurine's distinct physicochemical characteristics enable it to act as a modulator in a variety of essential biological processes, including protection against oxidative stress, regulation of protein phosphorylation and calcium homeostasis, antioxidant defense, membrane stabilization, bile acid conjugation, lipid metabolism, and glucose control. Notably, taurine exerts pleiotropic effects across multiple organ systems, including the cardiovascular system, skeletal muscle, retina, liver, kidneys, and central nervous system (20,21).

Taurine exerts its cellular antioxidant effects primarily through scavenging peroxy radicals, nitric oxide, and superoxide anions—though it is ineffective against hydrogen peroxide. This free radical scavenging activity increases with concentration and reaches its peak efficacy at approximately 60 mM (22).

A recent study comparatively investigated the antiproliferative, antimigratory, and antioxidant effects of the compounds capsaicin, β-carotene, melatonin, and taurine on healthy cells (L929 fibroblasts) and breast cancer cells (MCF-7). Cell viability, migration, and oxidant/antioxidant levels were assessed following treatment with various concentrations of these compounds. The results demonstrated that all compounds significantly reduced the migratory capacity of MCF-7 cells, particularly after 48 hours of exposure. Furthermore, β-carotene emerged as the most effective

tive compound in terms of antioxidant activity, although it also exhibited pro-oxidant properties at high concentrations. These findings suggest that the aforementioned compounds may hold potential as anticancer agents for breast cancer treatment (23).

Taurine has been shown to play a significant cytoprotective role in reproductive physiology. Experimental studies on rabbit spermatozoa have demonstrated that taurine exerts a strong antioxidant effect, particularly against highly reactive species such as hypochlorite (HOCl) molecules and hydroxyl (OH) radicals. It also provides moderate protection against hydrogen peroxide (H₂O₂) and superoxide (O₂⁻) radicals. These findings suggest that taurine may contribute to the preservation of sperm function and viability by mitigating oxidative stress in the male reproductive system (24).

In skeletal muscle physiology, taurine serves multiple essential functions related to contractile and regenerative capacity. It plays a key role in calcium ion-dependent excitation-contraction coupling, regulates cellular volume, and enhances myogenesis. These effects become especially critical in aging or disease states, where a decline in endogenous taurine levels is commonly observed. Under such conditions, taurine supplementation has been shown to support muscle repair and maintain functional integrity (25).

The role of taurine in skeletal muscle function has been widely explored in scientific research. According to De Luca et al., taurine contributes to the modulation of muscle cell excitability and contractile activity by stabilizing cellular membranes, maintaining osmotic balance, and regulating intracellular calcium homeostasis. Additionally, taurine has been implicated in influencing metabolic pathways and gene expression within muscle tissue, thereby promoting adaptive and cytoprotective responses. Notably, in pathological conditions such as disuse-induced muscle atrophy and various myopathies, disturbances in intramuscular taurine concentrations have been observed. Preclinical evidence indicates that taurine supplementation may help restore muscle performance by enhancing contractile function and sustaining electrical excitability through its effects on ion channel regulation. These findings suggest that taurine holds therapeutic promise for managing muscle-related disorders (26).

In an experimental study, the effects of taurine on inflammatory muscle injury were investigated using a myositis model induced by acetic acid in Wistar albino rats. The animals were divided into three groups: control, myositis, and myositis + taurine (500 mg/kg/day), and taurine treatment was administered for 15 days. Histopathological and immunohistochemical analyses revealed significant im-

provements in parameters such as degeneration, necrosis, inflammation, and structural disorganization of muscle tissue, particularly in the taurine-treated group ($p < 0.01$). Moreover, a significant reduction was observed in the levels of caspase-3, a marker of apoptosis. These findings suggest that taurine, through its anti-inflammatory and anti-apoptotic properties, may serve as a potential therapeutic agent in mitigating myositis-induced muscle damage (27).

In the cardiovascular system, taurine modulates apolipoprotein B100 levels and enhances myocardial contractility, which may reduce the severity of atherosclerosis and coronary heart disease. A recent meta-analysis suggests taurine may exert antihypertensive effects in humans (28).

An experimental study assessing taurine's protective role against oxidative stress, inflammation, and endothelial dysfunction in the cardiac tissue of diabetic rats reported several favorable outcomes. In the diabetic state, upregulation of the proinflammatory transcription factor NF- κ B was accompanied by diminished expression of pivotal antioxidant and endothelial regulatory molecules, including nuclear factor erythroid 2-related factor 2 (Nrf2), heme oxygenase-1 (HO-1), endothelial nitric oxide synthase (eNOS), and sirtuin-1 (SIRT-1). Taurine supplementation partially reinstated the expression of these molecular targets, highlighting its regulatory influence on redox-sensitive signaling mechanisms. Additionally, cardiac oxidative injury associated with diabetes—indicated by elevated malondialdehyde (MDA) concentrations and reduced activities of antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx)—was markedly alleviated following taurine administration. Taken together, these results indicate that taurine mitigates oxidative injury, downregulates inflammatory mediators, and enhances endothelial function in the heart, supporting its therapeutic potential for preventing and managing cardiovascular complications linked to diabetes (29).

Taurine is integral to kidney homeostasis, serving as an efficient osmolyte while influencing fundamental cellular mechanisms such as apoptosis and regulation of the cell cycle. Its presence contributes to fluid-electrolyte balance and cytoprotection under physiological and pathological conditions. Additionally, taurine is essential for normal retinal development and calcium signaling, highlighting its broad physiological relevance across multiple organ systems (20). A recent experimental study further elucidated taurine's renoprotective effects in the setting of cold ischemia, a major challenge in kidney transplantation. In this model, kidneys harvested from rats were stored for 72 hours at 4 °C in University of Wisconsin (UW) solution with taurine supplementation. The findings indicated that taurine ad-

ministration led to a significant decline in malondialdehyde (MDA) concentrations, reflecting reduced lipid peroxidation and mitigation of oxidative damage. Concurrently, the activities of key antioxidant enzymes—superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx)—were substantially enhanced. Histopathological assessment further demonstrated that taurine treatment lessened morphological alterations, including tubular necrosis and glomerular lesions. Collectively, these outcomes imply that taurine confers protection to renal tissue by counteracting oxidative stress and preserving both its architecture and functional capacity. Within the framework of advanced transplantation techniques and extended organ preservation, taurine supplementation could represent a viable approach to minimizing post-transplant complications and enhancing graft survival (30).

Though it cannot scavenge hydrogen peroxide or hydroxyl radicals directly, taurine prevents reactive oxygen species generation, protects mitochondria from superoxide overload, and enhances electron transport chain activity. It also reduces endoplasmic reticulum (ER) stress and supports protein folding (31-33).

Taurine and Adipose Tissue: Mechanistic Insights into Anti-Obesity Effects

Recent research has highlighted taurine's pivotal influence on adipose tissue physiology, especially in the context of obesity and related metabolic impairments. Within adipose depots, taurine mitigates obesity-associated changes by regulating adipogenesis, lipolysis, adipokine release, inflammatory signaling, and oxidative stress (7,34). Additionally, taurine participates in the modulation of ligand-activated transcription factors that govern lipid handling, energy utilization, and redox equilibrium. Of particular importance, taurine influences the function of peroxisome proliferator-activated receptor gamma (PPAR γ), a nuclear receptor that plays a critical role in adipocyte maturation and the storage of lipids. Through downregulation of PPAR γ , taurine suppresses adipogenesis and promotes a metabolically favorable adipocyte phenotype. In addition, taurine-induced activation of nuclear factor erythroid 2-related factor 2 (NRF2) enhances antioxidant defense mechanisms, while its interaction with bile acid receptors such as farnesoid X receptor (FXR) and Takeda G-protein-coupled receptor 5 (TGR5) may further influence energy metabolism, thermogenesis, and inflammatory signaling pathways (35,36).

Evidence indicates that taurine suppresses the differentiation of adipocytes by downregulating peroxisome proliferator-activated receptor gamma (PPAR γ) and CCAAT/enhancer-binding proteins (C/EBPs), leading to decreased

lipid deposition in preadipocytes. In a study by Kim et al., taurine treatment markedly inhibited adipogenesis in white adipose tissue (WAT) while leaving thermogenic brown adipose tissue (BAT) unaffected, underscoring its tissue-specific modulatory actions (37,38).

In models of high-fat diet-induced obesity, taurine supplementation ameliorated systemic inflammation by reducing the expression of TNF- α , IL-6, and MCP-1 in adipose tissue (33). This anti-inflammatory action is partly attributed to taurine chloramine, an endogenous metabolite known to inhibit nuclear factor kappa B (NF- κ B) signaling and suppress proinflammatory gene transcription (39). Furthermore, taurine-treated adipocytes exhibit enhanced expression of adiponectin, an insulin-sensitizing and anti-inflammatory adipokine often reduced in obesity (34).

Neonatal exposure to monosodium glutamate (MSG) in rodents impairs the regulation of appetite and energy balance, promoting the onset of obesity, glucose intolerance, and insulin resistance. The potential anti-obesity actions of taurine have been examined using this experimental model. In Wistar rats with MSG-induced obesity, dietary taurine supplementation (2.5% in drinking water for 70 days) led to reduced fat deposition in retroperitoneal and periepididymal adipose depots, alongside lowered lipid concentrations in both plasma and hepatic tissues. These results indicate that taurine may confer favorable metabolic effects by influencing lipid storage mechanisms and enhancing lipid profiles in obesity models (40).

Epidemiological Research Has Increasingly Highlighted Taurine's Potential Anti-Obesity And Cardiometabolic Regulatory Properties

Adipose tissue is now understood to function not solely as a passive reservoir for energy storage but as an active endocrine organ with diverse regulatory roles. While the liver and kidneys are classically regarded as the primary sites of taurine production, experimental evidence has revealed that epididymal and perirenal white adipose depots exhibit markedly elevated expression of cysteine dioxygenase (CDO) and cysteine sulfinic acid decarboxylase (CSAD)—the two key enzymes involved in taurine biosynthesis. This observation indicates that white adipose tissue may play a meaningful role in maintaining systemic taurine balance. In obesity, however, the expression of these enzymes is markedly diminished, occurring in parallel with a reduction in circulating taurine concentrations. In vitro studies using 3T3-L1 preadipocytes have shown that CDO and CSAD protein levels increase markedly during differentiation into mature adipocytes, whereas hypertrophic adipocytes associated with obesity exhibit a diminished capacity for taurine

synthesis. This decline in taurine production mirrors the reduced adiponectin levels frequently observed in obesity, supporting the hypothesis that taurine may function as a novel adipokine. Thus, reduced taurine production within adipose tissue may constitute an important mechanistic contributor to the development of obesity and its related metabolic derangements. Figure 3 provides a schematic overview illustrating taurine's regulatory influence on adipose tissue dysfunction and the inflammatory processes linked to obesity (41,43)

Figure 3 presents a mechanistic overview of taurine's role in modulating adipose tissue function along the continuum from metabolic health to obesity. In metabolically healthy, lean individuals, small adipocytes demonstrate active taurine biosynthesis, which supports systemic energy balance and sustains an anti-inflammatory milieu dominated by M2 macrophages. As obesity develops, adipocytes enlarge (hypertrophy), accompanied by reductions in both energy expenditure and taurine production. This pathological shift fosters increased immune cell infiltration—particularly of pro-inflammatory M1 macrophages—alongside a transition from the M2 to the M1 macrophage phenotype. Consequently, local inflammation intensifies, with elevated secretion of cytokines such as TNF- α and IL-6, activation of endoplasmic reticulum (ER) stress pathways, and the

emergence of insulin resistance. Taurine and its bioactive derivatives—taurine chloramine and tauroursodeoxycholic acid (TUDCA)—act to mitigate these adverse changes by promoting M2 macrophage polarization, inhibiting pro-inflammatory signaling cascades, and reducing ER stress, thereby restoring adipose tissue functionality and improving overall metabolic health (41).

In the context of obesity, mitochondrial dysfunction in white adipose tissue contributes to impaired fatty acid oxidation and reactive oxygen species (ROS) accumulation. Taurine mitigates these adverse effects by stabilizing mitochondrial membranes, enhancing electron transport chain efficiency, and reducing superoxide generation. Surai et al. showed that taurine at physiological concentrations scavenges ROS including nitric oxide and superoxide anions, thus preserving redox balance (21,32).

Importantly, the CARDIAC (Coronary Artery Disease in Asian Communities) Study—conducted across 61 population groups in 25 countries—assessed 24-hour urinary taurine excretion as an indicator of dietary taurine intake. Findings demonstrated a strong inverse correlation between urinary taurine concentrations and mortality from coronary heart disease, supporting the notion that taurine may exert a protective influence on cardiovascular health outcomes (44).

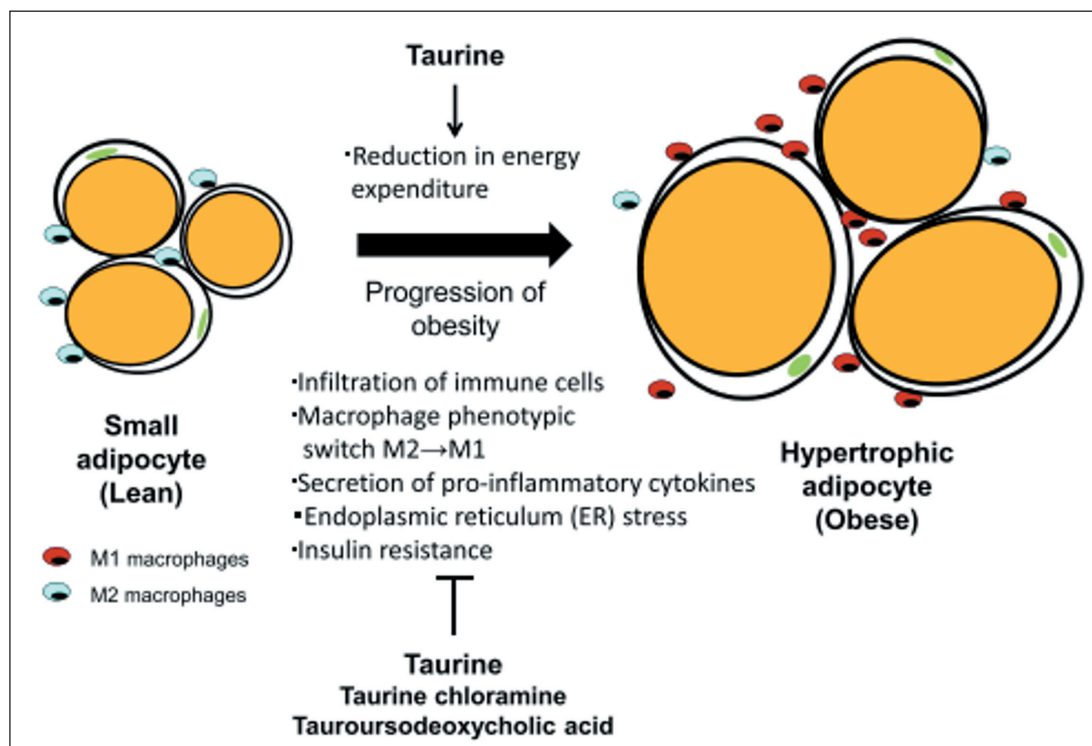


Figure 3: Taurine and its derivatives attenuate adipose tissue inflammation, macrophage polarization, and metabolic dysfunction during obesity progression.

In addition to cardiovascular outcomes, higher urinary taurine excretion was also associated with lower body mass index (BMI), systolic and diastolic blood pressure, and plasma total cholesterol levels, suggesting a protective effect on metabolic health (45).

Moreover, individuals with higher fish consumption—known to be a primary dietary source of taurine—exhibit greater systemic taurine levels compared to those following predominantly meat-based or vegetarian diets. These findings point to the dietary origin and inter-individual variability in taurine status, which may modulate the compound's metabolic efficacy. In this context, the therapeutic potential of taurine in humans is likely to be influenced by factors such as dosage, duration of supplementation, baseline taurine status, and genetic or lifestyle-related metabolic risk factors (46).

Taurine has been shown to improve insulin signaling in adipose tissue by increasing the phosphorylation of Akt and reducing endoplasmic reticulum (ER) stress-related markers such as CHOP and GRP78. These effects collectively contribute to enhanced glucose uptake and improved insulin responsiveness, particularly under metabolic stress conditions (47).

Moreover, taurine alleviates endoplasmic reticulum (ER) stress, a key contributor to insulin resistance and metabolic inflammation in obesity. ER stress triggers the unfolded protein response (UPR), leading to upregulation of stress markers such as GRP78, CHOP, and XBP1 (48). Taurine suppresses these markers by modulating redox homeostasis and preventing calcium dyshomeostasis between the ER and mitochondria (49). Taurine supplementation significantly reduced ER stress markers and improved hepatic insulin signaling in models of nonalcoholic fatty liver disease, suggesting systemic benefits beyond adipose tissue (50).

Mitochondrial biogenesis and oxidative metabolism in adipose tissue are further influenced by taurine via upregulation of peroxisome proliferator-activated receptor gamma coactivator 1- α (PGC-1 α) (51).

Taurine has been increasingly recognized for maintaining mitochondrial integrity and regulating energy expenditure, particularly within metabolically active tissues such as adipose tissue. Taurine enhances mitochondrial biogenesis and promotes oxidative phosphorylation by modulating transcriptional regulators such as PGC-1 α , nuclear respiratory factors (NRFs), and mitochondrial transcription factor A (TFAM) (52).

Regulation of Appetite and Energy Balance: The Role of Taurine, Central Nervous System, and Bile Acid Signaling

Specifically, taurine has been reported to modulate the hypothalamic arcuate nucleus—a central hub for controlling energy intake—by enhancing the responsiveness of anorexigenic signaling pathways and concurrently downregulating orexigenic mediators, including neuropeptide Y (NPY) and agouti-related peptide (AgRP). This dual action ultimately contributes to a decrease in food consumption (53).

Taurine plays a role in bile acid signaling pathways by modulating bile acid metabolism and receptor activation. Bile acids function not only in digestion but also act as endocrine regulators via G-protein-coupled receptors (e.g., TGR5) and nuclear receptors such as farnesoid X receptor (FXR) (54). Taurine-conjugated bile acids (e.g., taurocholic acid) have high affinity for TGR5, which is expressed in the CNS, adipose tissue, and intestinal epithelium. Activation of TGR5 enhances energy expenditure, mitochondrial function, and secretion of glucagon-like peptide-1 (GLP-1), contributing to improved metabolic homeostasis (7,55).

Choudhuri and Klaassen reported that specific bile acid-sensitive G-protein coupled receptors respond more strongly to taurine-conjugated bile acids than to glycine-conjugated forms (56). This receptor activity promotes brown adipose tissue thermogenesis, increases mitochondrial uncoupling protein 1 (UCP1) expression, and facilitates glucose disposal, making taurine a potential modulator of bile acid-mediated metabolic effects (57).

These neurometabolic mechanisms collectively suggest that taurine may serve as a central and peripheral integrator of signals involved in energy intake and expenditure, positioning it as a candidate for novel interventions targeting neuroendocrine pathways in obesity management (53).

CONCLUSION

Taurine is a multifaceted amino sulfonic acid that exhibits a wide range of physiological functions relevant to metabolic health, particularly in the context of obesity and energy regulation. This review highlights taurine's significant influence on adipose tissue remodeling, anti-inflammatory and antioxidant defense, mitochondrial and endoplasmic reticulum homeostasis, insulin sensitivity, and central appetite regulation.

Both experimental and clinical data support taurine's potential to ameliorate obesity-related metabolic disorders.

Its ability to modulate adipocyte differentiation, suppress macrophage-driven inflammation, enhance mitochondrial function, and improve insulin signaling positions it as a promising agent in the nutritional and pharmacological management of metabolic syndrome. Notably, taurine's interaction with bile acid receptors such as TGR5 and its effects on gut-brain axis signaling pathways further expand its relevance in energy homeostasis.

Despite compelling evidence from animal and cellular studies, human trials examining taurine's effects on adiposity and metabolic risk remain limited. The variability in dietary taurine intake across populations, particularly in vegetarians and individuals with chronic diseases, necessitates further evaluation of optimal intake levels and supplementation protocols. Moreover, the precise molecular mechanisms through which taurine regulates transcription factors, adipokines, and nutrient sensors in adipose and neural tissues warrant deeper investigation.

In future research, randomized controlled trials with well-characterized cohorts are essential to confirm taurine's efficacy and safety in treating obesity and its comorbidities. Advances in omics technologies may also provide new insights into taurine's personalized applications in metabolic health. Ultimately, taurine's diverse biological effects and low toxicity profile make it a compelling candidate for integrative strategies targeting metabolic homeostasis.

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None.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization: İrem Dağoğlu Polat, Literature review: İrem Dağoğlu Polat, Özlem Baran, Writing – original draft: İrem Dağoğlu Polat, Özlem Baran.

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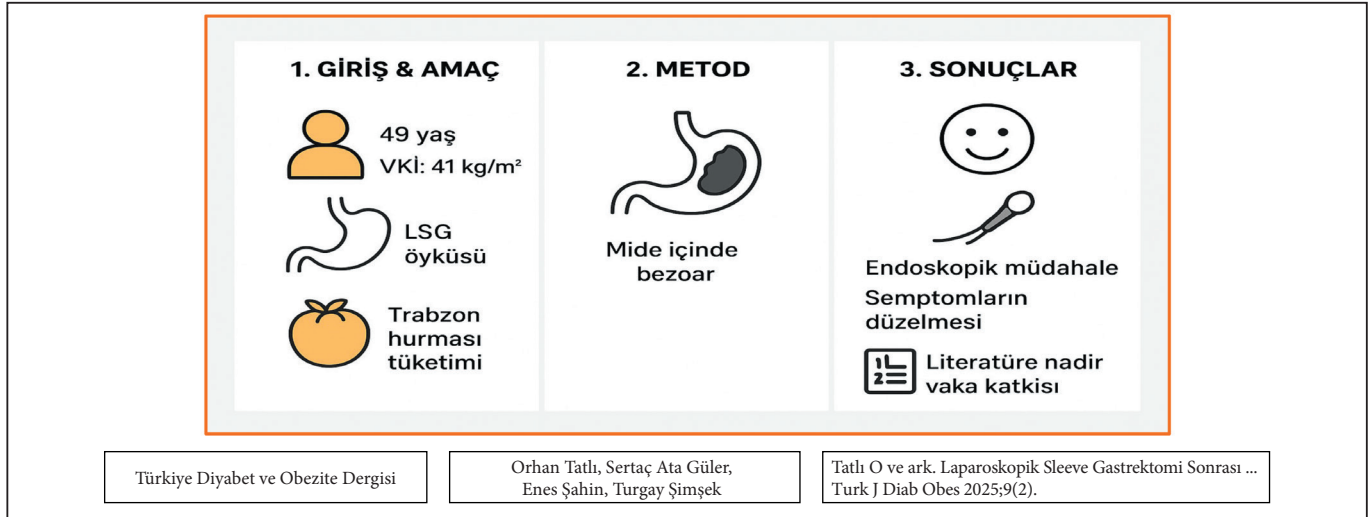
Laparoskopik Sleeve Gastrektomi Sonrası Gelişen Geç Dönem Komplikasyonu; Diospirobezoar

Orhan TATLI , Sertaç Ata GÜLER , Enes ŞAHİN , Turgay ŞİMŞEK 

Kocaeli Üniversitesi Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, Kocaeli, Türkiye
Kocaeli Üniversitesi Tıp Fakültesi Araştırma ve Uygulama Hastanesi, Anabilim Dalı, Kocaeli, Türkiye

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GRAFİKSEL ÖZET



ÖZ

Gastrointestinal sistemdeki obstrüksiyonların önemli bir kısmına bezoarlar neden olmaktadır. Diospyros (Hurma bitkisi) sindirimi zor yapısı nedeniyle fitobezoarların en sık rastlananlarından. Günümüzde popülaritesi çok yüksek olan bariatrik cerrahi yöntemlerinden sonra da bezoar gelişebilir. Seçilen tekniğe göre oluşturulan yeni anatomik yapı darlık gelişimi ve buna bağlı bezoar oluşumunu arttırabilmektedir. Bizim hastamızda VKİ 41 kg/m² idi ve yapılan değerlendirmeler sonucunda LSG uygun görüldü. Operasyon sonrası yeterli kilo vermesine rağmen operasyondan 1,5 yıl sonra aniden başlayan bulantı, kusma, oral alımda azalma ve kilo kaybı gelişti. Ayrıntılı anamnez ve sonrasında yapılan endoskopik tetkikler ile sebebin Diospirobezoar olduğu görüldü. Bezoar endoskopik yöntem ile parçalanarak çıkarıldı. İşlem sonrası yapılan kontrollerde hastanın şikayetlerinin gerilediği görüldü. Operasyon sonrası geç dönemde görülen bu durum başlangıçta stapler hattında darlığı, brid ileus vb. akla getirirse de bu olasılık geç dönemde de akılda tutulmalıdır. Kimyasal çözdürücüler, endoskopik yöntemler ve cerrahi tedavi seçeneklerinden bazılarıdır.

Anahtar Sözcükler: Bezoar, Sleeve gastrektomi, Obezite

ORCID: Orhan Tatlı / 0009-0004-4180-9487, Sertaç Ata Güler / 0000-0003-1616-9436, Enes Şahin / 0000-0003-3777-8468, Turgay Şimşek / 0000-0002-5733-6301

Yazışma Adresi / Correspondence Address:

Orhan TATLI

Kocaeli Üniversitesi Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, Kocaeli, Türkiye
E-posta: drorhantatli@gmail.com

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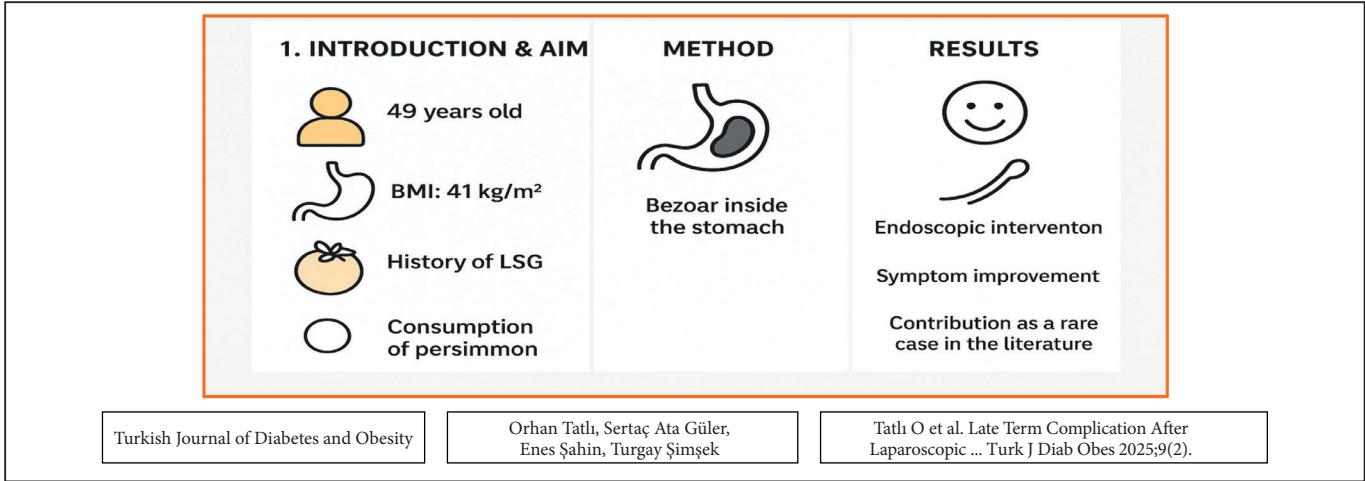
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Late Term Complication After Laparoscopic Sleeve Gastrectomy; Diospiro bezoar

GRAPHICAL ABSTRACT



ABSTRACT

A significant portion of obstructions in the gastrointestinal tract are caused by bezoars. Diospyros (date palm) is one of the most common phytobezoars due to its difficult-to-digest structure. Bezoars can also develop after bariatric surgery, which is very popular today. The new anatomical structure created by the chosen technique can increase the risk of stricture development and subsequent bezoar formation. Our patient's BMI was 41 kg/m², and following evaluation, LSG was deemed appropriate. He lost sufficient weight after the operation. However, 1.5 years after the operation, he suddenly developed nausea, vomiting, decreased oral intake, and weight loss. A detailed history and subsequent endoscopic examinations confirmed the cause as a diospyros bezoar. The bezoar was fragmented and removed endoscopically. Post-procedure follow-ups revealed that the patient's symptoms had resolved. Although this late-stage postoperative condition initially suggests staple line stenosis, bridg ileus, etc., this possibility should also be kept in mind in the later period. Chemical disintegrants, endoscopic methods, and surgery are some of the treatment options.

Keywords: Sleeve gastrectomy, Bariatric surgery, Bezoar

GİRİŞ

Bezoar gelişimi, gastrointestinal sistemi etkileyen nadir durumlardan biridir. Sindirilemeyen gıda vb. maddelerin sıkışması ve sertleşmesi ile oluşur. Bu kütleler gastrointestinal sisteme bilinçli veya kazayla alınabilir. Bezoarları oluşturan maddelere göre dört gruba ayırabiliriz. Bunlar; fitobezoarlar, trikobezoarlar, farmakobezoarlar ve laktobezoarlardır. Yaygın olan besin kabukları, çekirdekler, kuru üzüm ve hurma nedenli gelişen fitobezoarlardır (1). Selüloz, tanen ve lignin içerdiklerinden bu besinlerin sindirimi zordur (2). Ayrıca yutulan saç ve vücut kılları nedenli trikobezoarlar da sık görülür. Çok nadiren plastik maddeler, metaller, diş parçaları, parazitler de sebep olabilir.

Kısacası sindirimi güç olan her şey bezoar oluşumuna sebep olabilir. Ayrıca sindirim sisteminde oluştuğu yerlere göre de ayrı gruplar halinde incelenebilir. Yaygın olanı mide bezoarlarıdır ve çoğunlukla ülser, kanama ve obstrüksiyona neden olmaktadır. Fitobezoar sebeplerinden özellikle hur-

ma (*Diospyros kaki*) ülkemizde ve tüm dünyada ayrıca sık raporlanmaktadır (2, 3).

Geçirilmiş mide cerrahileri de bezoar oluşumunu artırabilir. Günümüzde obezite tedavisinde en sık kullanılan bariyatrik cerrahi yöntemlerinden olan Laparoskopik Roux-en-Y gastrik bypass (LRYGB) ve laparoskopik sleeve gastrektomi (LSG) sonrasında da bezoar oluşumu raporlanmıştır. Gastrointestinal sistemde yapısal olarak değişime neden olmaları, mide motilitesinde azalmaya sebep olabilmeleri, pilor disfonksiyonuna sebep olabilmeleri ve istenmeyen bir durum olsa da gastrik stenoz yapabilmeleri nedeniyle bu yöntemler sonrasında bezoar gelişebilmektedir. Literatürde daha çok LRYGB sonrasında bildirilse de LSG sonrasında da özellikle incisura darlığına bağlı gelişen bezoar vakaları raporlanmıştır (3).

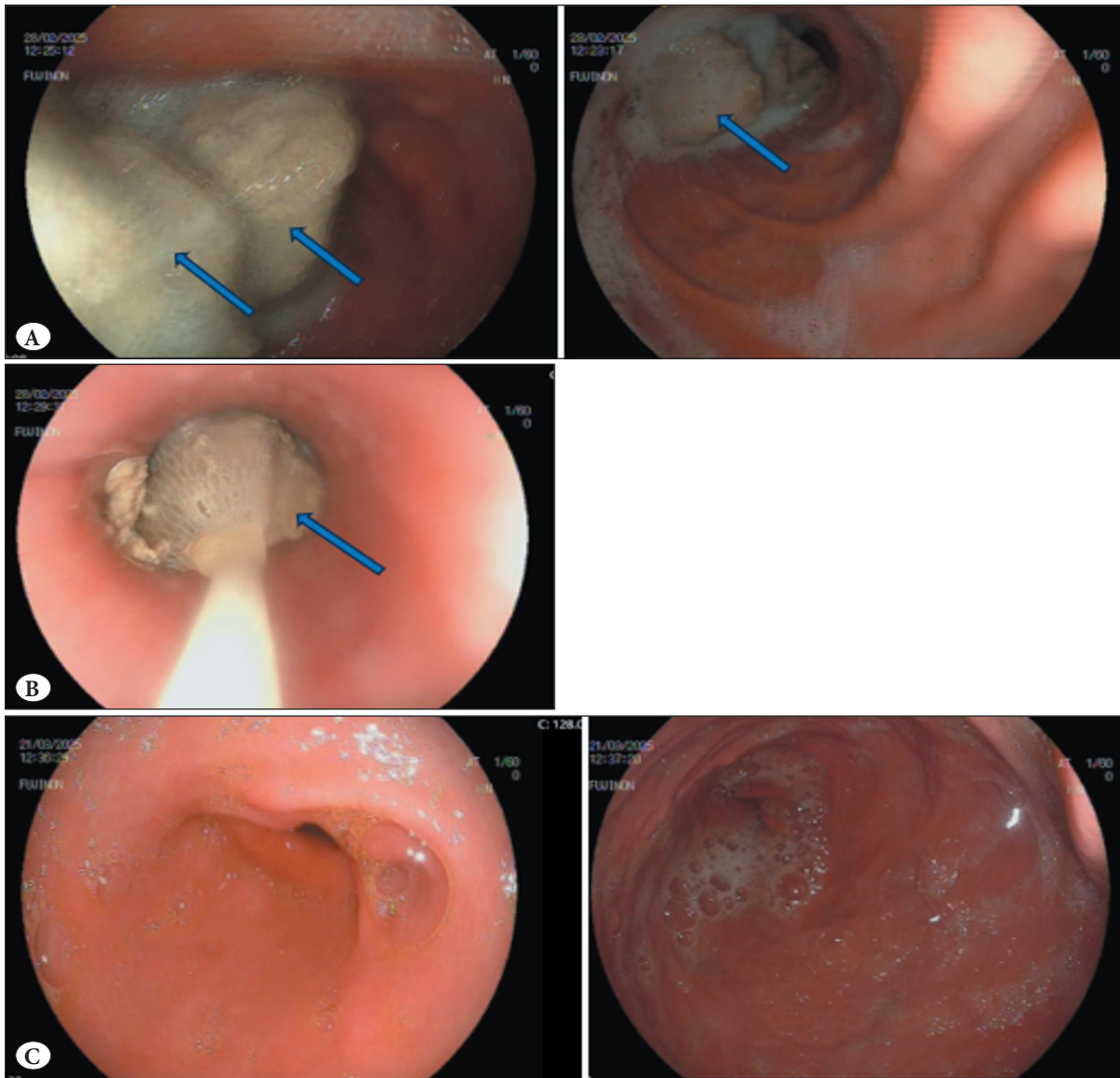
Burada LSG'den 1,5 yıl sonra gelişen bir diospiro bezoarlı olgu sunulacaktır. Obezite cerrahisi sonrası geç dönemde de komplikasyonlar olabileceğine dikkat çekilmek istenmiştir.

OLGU SUNUMU

Kırkdokuz yaş erkek hasta kilo verememe şikâyetiyle Ağustos 2023 tarihinde genel cerrahi polikliniğine başvurdu. Hastamızın bilinen ek hastalığı veya geçirilmiş cerrahisi yoktu. Hasta profesyonel diyet ve medikal desteğe rağmen kilo veremediğini ifade etmekteydi. Hastanın VKİ (vücut kütle indeksi) 41 kg/m² olarak hesaplandı. Yapılan tetkikler ve multidisipliner konsey değerlendirmeleri sonucunda hastaya LSG (Laparoskopik Sleeve Gastrektomi) kararı alındı ve aynı ay içerisinde operasyon yapıldı. LSG işlemi 36-F buji üzerinde birkaç adet endostapler ile gerçekleştirildi. Postoperatif dönemde komplikasyonsuz normal bir iyileşme dönemi sonrasında beslenme önerileri ile taburcu edildi.

Hasta ameliyattan sonraki dönem içerisinde 51 kg verdi ve VKİ 26 kg/m² oldu. Ameliyattan 1,5 yıl sonra bulantı, safarasız kusma, oral alamama ve yediklerinin ağzına gelmesi şikâyetleri başladı. Tekrar hızlı kilo kaybı oldu ve 12 kg verdi.

Bu semptomlar ile hastaya stapler hattı darlığı şüphesi ile pasaj probleminin sebebinin aydınlatmak amaçlı gastroduodenoskopi yapılmasına karar verildi. Yapılan gastroskopiye prepilorik alana oturmuş büyüğü yaklaşık 4x3 cm çaplı çok sayıda fitobezoar ve katı gıda artıkları saptandı. Tekrar yapılan ayrıntılı sorgulamasında hastanın şikâyetlerinin başladığı dönemde bol miktar hurma tükettiği öğrenildi.



Şekil: A) Ok işareti ile gösterilen alanlarda hastanın yapılan ilk gastroskopisinde saptanan fitobezoarlar görülmektedir. Bezoarlar nedenli proksimalde, köpüksü sıvı birikmiş ve distale geçiş zorlaşmıştır. B) Ok ile işaretli alanda mide içerisindeki pasajı engelleyen bezoarların parçalandıktan sonra basket kataer ile tutularak çıkarılması gösterilmiştir. C) Daha önce bezoar nedenli endoskopik işlem yapılan hastanın kontrol gastroduodenoskopisinde, mide içerisinde katı gıda artığı olmadığı görülmüş ve pasajın artık açık olduğu saptanmıştır. (Fotoğraflar hastanın ve kurumun izni ile PACS sisteminden alınarak paylaşılmıştır.)

Endoskopik olarak bezoarlar parçalandı ve parçalar basket yardımıyla çıkarıldı. Yapılan işlem sonrasında hasta diyet önerileri ile taburcu edildi ve iki hafta sonra kontrole çağırıldı. Kontrolde hastanın şikâyetlerinin tekrar olmadığı görüldü ve kontrol gastroduodenoskopide bezoar izlenmedi, pilor rahatlıkla geçilebildi.

TARTIŞMA

Tüm dünyada bariatrik cerrahi sayısı her geçen gün artmaktadır. Bu artan vaka sayısı ve popülerite beraberinde bariatrik cerrahların ve ekibin tecrübesini artırmıştır. Bu sayede yeni teknikler ve yeni öneriler de tanımlanmaktadır. Tüm bunlar beraberinde istenmeyen erken ve geç sonuçları getirmektedir. Bu nedenle bariatrik cerrahlar ve ekibin diğer üyeleri işlemlerin olası erken ve geç komplikasyonları hakkında bilgilendirilmelidir. Genelde tüm dünyada klinisyenler erken dönemde gelişen, ciddi morbidite ve mortaliteye sebep olan erken komplikasyonlar hakkında yeterli bilgi ve dikkate sahip olsa da geç dönem komplikasyonları gözden kaçabilmektedir.

Bu geç dönem komplikasyonlarından bir tanesi de Fitobezoarlardır. Literatürde bu vakaların daha çok LRYGB'den sonra geliştiği bildirilmiştir. Ancak LSG'den sonra da bildirilen vakalar mevcuttur. Bu cerrahilerde tekniğe bağlı bezoar gelişimini artıran durumlar olsa bile esas risk faktörleri mide rezeksiyonu yapılıyor olması ve buna bağlı mide hareketlerinin azalmasıdır. LRYGB işleminde ek olarak bir anastomoz yapılması ise darlık riskini görece artırmaktadır. LSG'de anastomoz yoktur ancak geniş bir rezeksiyon yapılması, uzun stapler hattı olması ve özellikle de İncisura Angularis darlığı ihtimalinin olması bezoar riskini artıran sebeplerdir (5-6).

Bezoarların tedavi şekilleri bezoarın yerine, türüne ve hastanın o anki klinik durumuna göre değişmektedir. Bu nedenle standart bir tedavi tarif etmek güçtür. Örneğin ince bağırsak bezoarları genelde obstrüksiyona yol açar ve genelde cerrahi ihtiyacı gelişir.

Gastrik fitobezoar için şu anda birden çok tedavi yöntemi tariflenmiştir. Bunlar arasında bezoarın gazlı içecekler ile çözdürülmesi, papain, selüloz, endoskopik parçalama ve çıkarma, laparoskopik /açık cerrahi olarak sayılabilir (4-8). Hurma nedenli gelişen fitobezoarlar genelde sert ve sindirimi zor olur ve kimyasal olarak çözdürülmesi güçtür. Bu nedenle daha çok endoskopik işlem ya da cerrahi yapılır.

Yukarıda da belirtildiği gibi bezoarların tedavisinde seçim hastanın o anki durumuna göre yapılmalıdır. Başlangıçta gazlı içecekler, papain, selüloz gibi kimyasal çözdürücülerini denemek kullanım kolaylığı, noninvaziv olması ve maliyetinin düşük olması nedenli daha doğrudur (8,10). Ancak

özellikle bizim vakamızda olduğu gibi hurma nedenli gelişen bezoarlarda kimyasal çözdürücüler faydalı olmayabilir. Bu durumlarda endoskopik olarak bezoarın parçalanması ve mümkünse çıkarılması daha doğrudur (9). İnvaziv bir işlem olması, tecrübeli personel ihtiyacı, görece maliyetli olması, anestezi gerekebilmesi, mide hacminin azalmış olmasına bağlı endoskopik manevralarda zorlanma ihtimali bu yöntemin olumsuzluklarıdır. Bizim işlemimizde mide içerisindeki tüm bezoarların parçalanması ve çıkarılması mümkün olmuştur. Ancak her zaman bu mümkün olmayabilir ve cerrahi ihtiyacı gelişebilir.

Fitobezoarlar, bariatrik cerrahilerden sonra erken veya geç dönemde ortaya çıkabilir. Hekimler özellikle LSG yaparken İncisura Angularis darlığı gelişmemesi için buji kullanımı ve torsiyonu engelleyici omental süturasyon yapmayı tercih ederler. Tekrarlayan fitobezoarlarla gelen hastalarda çoğunlukla İncisura Angularis darlığını veya anastomoz darlığı akla gelse de bunun nedeni nadiren darlık olmaksızın hurma tüketimi nedenli gelişen Diopirobezoar olabileceği akılda tutulmalıdır. Hastaya operasyon sonrası diyet önerileri yapılırken bu akılda tutulmalıdır. Hastada anamnez alınması esnasında muhakkak hurma tüketimi sorgulanmalı ve bu durumlarda kimyasal çözdürücülerin etkisiz olma ihtimali yüksek olduğu için hızlıca endoskopik işlem ile çıkarılması denenmelidir. Bu olgu sunumu bariatrik cerrahinin geç dönem komplikasyonlarından biri olan Diopirobezoar'a hatırlatma yapılmıştır. Nadir görülen bu durumun tedavisinde daha az invaziv olan endoskopik yöntemlerin başarı sağlayabileceğine değinilmiştir.

Teşekkür

Olgu sunumu için onam veren hastamıza teşekkür ederiz.

Yazar katkıları

Fikir: **Orhan Tatlı, Sertaç Ata Güler**, Tasarım: **Orhan Tatlı, Sertaç Ata Güler, Enes Şahin, Turgay Şimşek**, Veri Toplama veya İşleme: **Orhan Tatlı**, Analiz/yorum: **Orhan Tatlı, Sertaç Ata Güler, Enes Şahin, Turgay Şimşek**, Literatür taraması: **Orhan Tatlı, Sertaç Ata Güler**, Yazı yazar: **Orhan Tatlı, Sertaç Ata Güler, Enes Şahin, Turgay Şimşek**, Eleştirel İnceleme: **Orhan Tatlı, Sertaç Ata Güler, Enes Şahin, Turgay Şimşek**.

Çıkar Çatışması

Yazarlar herhangi bir çıkar çatışması beyan etmemiştir. Bu olgu sunumu herhangi bir tez çalışmasından üretilmemiştir.

Finansal Destek

Bu olgu sunumu hazırlanırken yazarlar herhangi bir kurumdan, kuruluştan ya da şahıstan destek almamıştır.

Etik Kurul Oluru

Olgu sunumu olduğundan etik kurul oluru gerekmemiştir. Çalışma hasta ve hasta yakınından yazılı aydınlatılmış onam alınarak yapılmıştır. Olgu sunumuna katılım gönüllülük esasına dayalı olup tüm süreç boyunca Helsinki Deklarasyonuna uygun hareket edilmiştir.

Hakemlik Süreci

Kör hakemlik süreci değerlendirme yapılmıştır.

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13 ULUSAL OBEZİTE ve EŞLİK EDEN HASTALIKLAR KONGRESİ 25-28 Eylül 2025 MARRIOTT OTEL KAPADOKYA



13 ULUSAL OBEZİTE ve EŞLİK EDEN HASTALIKLAR KONGRESİ 25-28 Eylül 2025 MARRIOTT OTEL KAPADOKYA

25 EYLÜL 2025 PERŞEMBE

13:00-15:15	Obezitenin psikolojik zemini, davranış terapisi ve iletişim teknikleri Kurs açılışı ve kursiyerler ile tanışma Kurs Moderatörleri: Başak YÜCEL, Şeniz ÜNAL, Ezgi DEVECİ, Dilara KARŞIDAĞ ALTIKARDEŞ Obezite ve yeme bozukluklarında keşifen alanlar Başak YÜCEL Obeziteli birey ile Subjektif Anamnez Şeniz ÜNAL Obezite ve Damgalama (Stigma) Ezgi DEVECİ Obezite Tedavisinde Dilara KARŞIDAĞ ALTIKARDEŞ Sağlık Çalışanının Özbakımı	SALON A
13:00-15:15	Egzersiz reçetelendirmesi kursu Egzersiz fizyolojisi/fizyoterapi ilkeleri Kurs açılışı ve kursiyerler ile tanışma Kurs Moderatörleri: Gökhan METİN, Şensu DİNÇER Egzersiz sistemlerinin fizyolojik uyum ve cevapları Gökhan METİN Egzersiz reçetesi hazırlanırken kullanılan değerlendirme yöntemleri Şensu DİNÇER Nasıl ve hangi model egzersiz, FITT prensibi Şensu DİNÇER	SALON B
15:15-15:30	Kahve arası	

15:30-16:15	Atölye Çalışması Oturma Başkanı: Mustafa Kemal BAŞARALI Obezitesi olan birey ile görüşme: Başak YÜCEL Yapılması & Yapılmaması Gerekenler	SALON A
15:30-16:15	Atölye Çalışması Oturma Başkanı: Volkan Demirhan YUMUK Obezitesi olan bireyin takibinde spor hekimi yaklaşımı Gökhan METİN	SALON B
15:30-16:15	Atölye Çalışması Oturma Başkanı: M. Temel YILMAZ İşlenmiş gıdalar ve kilo yönetimi: Mehmet PALA Bilimsel kanıtlar, etiket okuma ve uygulamalı yaklaşımlar	SALON C
16:30-17:15	Açılış Töreni M. Temel YILMAZ 13. Ulusal Obezite ve Eşlik Eden Hastalıklar Kongresi Başkanı Volkan Demirhan YUMUK Türkiye Obezite Araştırma Derneği Başkanı Mustafa Kemal BAŞARALI Sağlıklı Beslenme ve Hareketli Hayat Dairesi Başkanı Türkiye'de obeziteyle mücadele: Mustafa Kemal BAŞARALI Güncel politikalar ve uygulama stratejileri	
17:15-18:15	Ustalara saygı oturumu Ahmet ÇORAKÇI, Mine YURTTAGÜL	
20:00-22:00	Akşam atölyesi: "Rolümüz ağır bizim" İletişim ve toplumsal farkındalık çalışması Deniz SEZGİN	

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13 ULUSAL OBEZİTE ve EŞLİK EDEN HASTALIKLAR KONGRESİ 25-28 Eylül 2025 MARRIOTT OTEL KAPADOKYA



13 ULUSAL OBEZİTE ve EŞLİK EDEN HASTALIKLAR KONGRESİ 25-28 Eylül 2025 MARRIOTT OTEL KAPADOKYA

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08:30-09:45	PANEL Genetik ve epigenetik perspektif ile obezite Oturma Başkanları: Fahri BAYRAM, Mustafa Kemal BALCI 08:30-08:50 Monogenik obezite Tayfun ÖZÇELİK 08:50-09:10 Sendromik obezite Doğa TÜRKKAHRAMAN 09:10-09:30 Obezite epigenetiği ve endokrin bozucular Seher TANRIKULU 09:30-09:45 Tartışma	
09:45-10:30	KONFERANS Oturma Başkanları: Hasan İLKÖVA, Dilek YAZICI Beslenme, obezite ve tümör mikroçevresinde immün sistem bağlantıları Ömer YILMAZ	
10:30-10:45	Kahve arası	
10:45-11:30	UYDU SEMPOZYUMU Kilo tedavisinde tek molekül ile çok fayda: Kilo kontrolü ve metabolik sağlıkta iyileşme Moderatör: Fahri BAYRAM, Dilek YAZICI Konuşmacılar: Sinem KIYICI, Özlem ÇELİK	
11:30-12:45	PANEL Obezite ve beslenme Oturma Başkanları: Yüksel ALTUNTAŞ, Emine AKAL YILDIZ İkili kalıtım kuramı ve mikrobiyota Emine AKAL YILDIZ Nutrigenetik: Zehra BÜYÜKTUNCER Kişisel beslenme biliminin uygulanması Hülya GÖKMEN ÖZEL Çocukluk çağı obezitesinde beslenme tedavisi Mehmet PALA Yeni nesil fonksiyonel gıdalar Tartışma	
12:45-13:45	Öğle yemeği	

13:45-15:00	PANEL Obezite yönetiminde kronik hastalıklara yaklaşım Oturma Başkanları: İlhan SATMAN, Ayşe KUBAT ÜZÜM Diabetes Mellitus Mine ADAŞ Kardiyovasküler hastalıklar ve kalp yetersizliği İbrahim ŞAHİN Kronik böbrek hastalığı Mehmet KANBAY Tartışma	
15:00-15:45	KONFERANS Oturma Başkanları: Mehmet ÖZBEK, Meral MERT Pediyatrik ve adolesan dönem obezitesinde etiyopatogenez ve komorbiditeler Abdullah BEREKET	
15:45-16:00	Kahve arası	
16:00-16:45	POSTER BİLDİRİLER Oturma Başkanı: Taner BAYRAKTAROĞLU	
16:45-18:00	PANEL Pediyatrik ve adolesan dönemde obezite Oturma Başkanları: Ayşehan AKINCI, İlknur ARSLANOĞLU Metabolik Sendrom: Melikşah KESKİN Tanı, risk faktörleri ve erken müdahale stratejileri Pediyatrik organ yağlanması: Saygın ABALI Karaciğer, kalp ve diğer organlarda erken yağlanmanın klinik etkileri Pediyatrik obezitede farmakoterapi: İlknur ARSLANOĞLU Endikasyonlar ve gelecek perspektifler Tartışma	
18:00-18:15	Kahve arası	
18:15-19:15	SÖZLÜ BİLDİRİLER Oturma Başkanları: Sinem KIYICI, Murat YILMAZ	
20:00-21:00	Akşam atölyesi: Oturma Başkanı: Gülhan SAMUR Beslenme modellerinde güncel uygulamalar Aslı AKYOL MUTLU	

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13 ULUSAL OBEZİTE ve EŞLİK EDEN HASTALIKLAR KONGRESİ

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08:30-09:45

PANEL

Obezite yönetiminde İnkretin bazı tedavi yaklaşımları ve klinik sonuçları

Oturum Başkanları: **Taner BAYRAKTAROĞLU, Dilek GOGAS YAVUZ**

08:30-08:45

Kısa Etkili GLP-1 reseptör agonistleri

Ramazan SARI

08:45-09:00

Haftalık GLP-1 reseptör agonistleri

Tevfik DEMİR

09:00-09:15

Dual GLP-1/GIP reseptör agonistleri

Ayşe KUBAT ÜZÜM

09:15-09:30

GLP-1 reseptör agonistlerinde gelecek Perspektifler ve yeni moleküller

Alev ALTINOVA

09:30-09:45

Tartışma

09:45-10:30

KONFERANS

Oturum Başkanları: **M. Temel YILMAZ, Kubilay KARŞIDAĞ**

Obezite ve komplikasyonlarının tedavisinde immunometabolik yaklaşımlar: Ufukta neler var?

Mehmet Furkan BURAK

10:30-10:45

Kahve arası

10:45-11:30

UYDU SEMPOZYUMU

Mounjaro ile vücut ağırlığı kontrolünde dual etkili yaklaşım

Oturum Başkanı: **Ramazan SARI**

Konuşmacılar: **Mine ADAŞ, Özgür DEMİR**

11:30-12:45

PANEL

Obezitede kilo geri alım mekanizmaları ve önleme stratejileri: Multidisipliner perspektifler

Oturum Başkanları: **Canan ERSOY, Gökhan METİN**

11:30-11:45

Endokrinoloji perspektifi

Ömercan TOPALOĞLU

11:45-12:00

Psikiyatri perspektifi

Hayriye ELBİ

12:00-12:15

Psikoloji perspektifi

Şeniz ÜNAL

12:15-12:30

Beslenme perspektifi

Emel ÖZER

12:30-12:45

Fizyoterapi perspektifi

Demet TEKİN

12:45-13:45

Öğle yemeği



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13 ULUSAL OBEZİTE ve EŞLİK EDEN HASTALIKLAR KONGRESİ

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18:15-19:15

SÖZLÜ BİLDİRİLER

Oturum Başkanları: **Okan Sefa BAKINER, Ömercan TOPALOĞLU**

20:00-21:00

Akşam Atölyesi:

Oturum Başkanı: **İbrahim ŞAHİN**

Yeni nesil teknolojiler ile obezite tedavisi

Ferhat ÇETİN

08:30-09:45

PANEL

Bariatrik cerrahi sonrası komplikasyonlar:

Erken ve uzun dönem yönetim stratejileri

Oturum Başkanları: **Taner BAYRAKTAROĞLU, Sinem KIYICI**

08:30-08:45

Medikal komplikasyonlar

Fulya ÇALIKOĞLU BARBAROS

08:45-09:00

Beslenme yönetimi

Zekiye Nihal ERDEM

09:00-09:15

Egzersiz ve fizyoterapi

Sıla POLAT

09:15-09:30

Cerrahi komplikasyonlar

Halit Eren TAŞKIN

09:30-09:45

Tartışma

09:45-10:30

KONFERANS

Oturum Başkanları: **Gülşah YENİDÜNYA YALIN, Özgür DEMİR**

Polikistik over sendromunda inkretin bazı tedaviler /GLP-1 reseptör agonistlerinin kullanımı

Bülent Okan YILDIZ

10:30-10:45

Kahve arası

10:45-11:15

PANEL

Obezite tedavisinde hangisi daha etkili?

Düşük karbonhidratlı diyetler mi, düşük yağlı diyetler mi?

Oturum Başkanları: **Erman ÇAKAL, Ceren İŞERİ**

10:45-11:00

Düşük karbonhidratlı diyetler etkilidir

Elif ŞAHİNER

11:00-11:15

Düşük yağlı diyetler etkilidir

Cemile İDİZ

11:15-12:30

PANEL

Obezite merkezinin organizasyonu ve sağlık politikalarının geliştirilmesine yönelik stratejiler

Oturum Başkanları: **Volkan YUMUK, M. Temel YILMAZ**

11:15-11:30

Obezite merkezlerinin organizasyonu, kayıt ("Registry") ve multidisipliner uzlaşı prensipleri

Alper SÖNMEZ

11:30-11:45

Medikal tedavi kriterleri

Meral MERT

11:45-12:00

Cerrahi tedavi kriterleri

Tanık Zafer NURSAL

12:00-12:15

Güncel obezite tedavisinde beslenme uzmanının rolü

Ceren İŞERİ

12:15-12:30

Tartışma

12:30-12:45

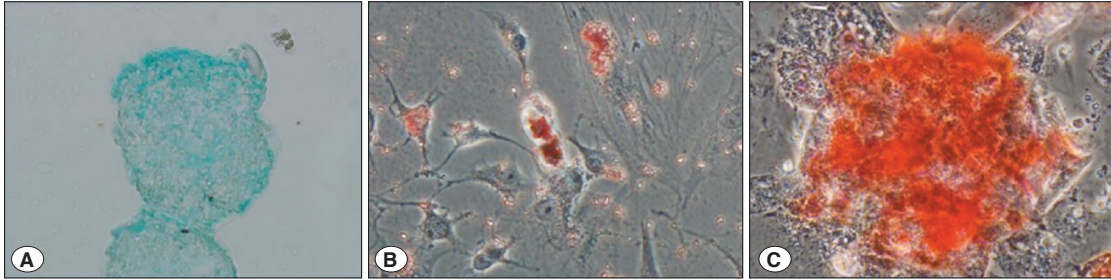
KAPANIŞ



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Batı Karadeniz Tıp Dergisi



Cells maintained in a chondrogenesis differentiation medium for 14 days were positively stained with Alcian Blue (x400) (A). Cells maintained in adipogenesis differentiation medium for 15 days contained lipid droplets positively stained with Oil Red O (x400) (B). Cells maintained in osteogenesis differentiation medium for 21 days were positively stained with Alizarin Red S. (x400) (C). As a result, it was determined that the cells showed adipogenic, chondrogenic and osteogenic changes.

- Dopamin Sekrete Eden Baş ve Boyun Paragangliomaları: Literatür İncelemesi ve Olgu Sunumu
- Katarakt Cerrahisi Öncesi Göz İçi Lens Gücü Hesaplamasında Ultrasonik Biyometri: Postoperatif Refraktif Sonuçlar
- Approach to Lingual Frenulum in Children at a Baby-Friendly University Hospital
- The Effect of Halp Score on the Development of Pharyngocutaneous Fistula After Laryngectomy
- Isolation and Characterization of Mesenchymal Stem Cells Derived from Human Amniotic Membrane by Explant Technique
- Evaluation of DNA Damage Detection in Reproductive and Menopausal Cervical Smears and Blood Samples
- Effects of Lipid Profiles and Vitamin D Levels on the Degree of Fatty Liver in Children with Non-Alcoholic Fatty Liver Disease
- Surgical Treatment Protocols and Risk of Malignancy in Perianal Fistulas: A Single-Center Retrospective Study
- "TIRONOD Decision-Support System" in the Clinical Management of Thyroid Nodules
- Relationship Between Emotional Eating and Stress Levels in Pregnant Women and Affecting Factors
- The Association between GHRL and LEP Gene Polymorphisms and ADHD: Evidence from a Pediatric Cohort
- Incidence, Risk Factors, and Clinical Outcomes of BCG-Related Complications
- Evaluation of Thyroid Functions After Radiotherapy in Primary Head and Neck Malignancies without Surgery
- Investigation of Nomophobia, Anxiety, and Depression Levels and Their Relationships in Children Diagnosed with Attention Deficit Hyperactivity Disorder
- Multisystemic Evaluation in Pediatric Spinal Muscular Atrophy: Linking Biochemical Markers to Functional Outcomes and Family Quality of Life
- Impact of Inflammatory Bowel Disease on Pulmonary Hemodynamics and Right Ventricular Function: The Role of Pulmonary Pulse Transit Time in Assessing Pulmonary Stiffness and Right Ventricular Function
- Bilateral Internal Carotid Artery Stenosis: Risk Factors and Prognosis
- Betulinic Acid Induces Apoptosis and G2/M Cell Cycle Arrest in SH-SY5Y Neuroblastoma Cells via EAG1 Suppression
- Semi-Sitting Position in Posterior Fossa and Pineal Region Surgery: Single-Center Experience
- Evaluation of C-Reactive Protein Levels as Prognostic Indicators in Subarachnoid Hemorrhage Patients
- Adherence to Home Exercise Programs: The Impact of Demographic and Clinical Factors



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Özgün Araştırmalar / Original Researchs

Gestasyonel Diyabetli Gebelerde Sağlıklı Yaşam Biçimi Davranışları ve İlişkili Faktörler: Bir Kamu Hastanesi Örneği
Healthy Lifestyle Behaviors and Related Factors in Pregnant Women with Gestational Diabetes: A Public Hospital Model
Leman ÇALIŞKAN, Hatice ÇOLAK, Berna KARAKOYUN

Assessment of the Effects of Metformin and DPP-4 Inhibitors on Electrolyte and Vitamin B12 Levels in Patients with Type 2 Diabetes: A Retrospective Study
Tip 2 Diyabetli Hastalarda Metformin ve DPP-4 İnhibitörlerinin Elektrolit ve Vitamin B12 Düzeyleri Üzerindeki Etkilerinin Değerlendirilmesi: Retrospektif Bir Çalışma
Zeynep Gizem TODURGA SEVEN, Kubra Cigdem PEKKOC UYANIK, Fatma Kubra TOMBULTURK, Erhan Rasit AGAY

The Effect of Novel Antihyperglycemic Treatments on Sarcopenia in Type 2 Diabetic Patients
Yeni Antihiperglisemik Tedavilerin Tip 2 Diyabetik Hastalarda Sarkopeni Üzerine Etkisi
Busra CAN, Zehra KAYA, Bulent CAN

The Relationship Between Neuropathic Pain and Quality of Life in Geriatric Type 2 Diabetic Patients
Geriatrik Tip 2 Diyabet Hastalarında Nöropatik Ağrı ve Yaşam Kalitesi Arasındaki İlişki
Mustafa TURAN, Özlem OVAYOLU, Sibel SERÇE

Assessing Knowledge and Awareness of Preconception Care Among Women with Type 1 Diabetes Mellitus: Implications for Optimizing Maternal and Fetal Health Outcomes
Tip 1 Diyabet Mellitus Tamlı Kadınlarda Gebelik Öncesi Bakım Bilgi ve Farkındalık Düzeyinin Değerlendirilmesi: Anne ve Fetüs Sağlık Sonuçlarını İyileştirmeye Yönelik Çıkarımlar
Burcak CAVNAR HELVACI, Burcu CANDEMİR, Murat CİNEL, Sema HEPSEN, Sule CANLAR, Murat DAGDEVİREN, Erman CAKAL

Perceptions of Diabet in Type 1 Diabetes and Type 2 Diabetes: A Mixed-Methods Comparative Insight
Tip 1 Diyabet ve Tip 2 Diyabeti Olan Bireylerin Diyabet Algısı: Karma Yöntemli Karşılaştırmalı Bir Çalışma
Tuğba BİLGEHAN, Bahar VARDAR İNKAYA, Ayşenur ALTUNSOY, Mehmet AYTEMUR

Tip 2 Diyabet Hastalarında İlaç Uyumu ve Etkileyen Faktörler
Medication Adherence and Affecting Factors in Type 2 Diabetes Patients
Ferhat BOLUKÇU, Şebnem YÜCEL

Anxiety, Depression, and Associated Psychosocial Factors in Individuals with Type 2 Diabetes Attending Family Health Centers
Aile Sağlığı Merkezlerine Başvuran Tip 2 Diyabeti Olan Bireylerde Anksiyete, Depresyon ve İlişkili Psikososyal Faktörler
Çiğdem SAMANCI TEKİN, Yasemin UĞURLU, Aysun GÜZEL

Is Your Diet to Blame? Unveiling the Role of Dietary Inflammatory Index in Lipid Accumulation Product Index and Visceral Adiposity Index in Polycystic Ovary Syndrome
Diyetiniz Suçlu Olabilir Mi? Polikistik Over Sendromunda Diyet İnflamatuar İndeksinin, Lipid Birikim Ürünü İndeksi ve Visseral Adipozite İndeksi Üzerindeki Rolünün İncelenmesi
Gizem CENGİZ PALA, Gözde DURLU BİLGİN

Investigation of Psychiatric Comorbidity in Children and Adolescents with Obesity: A Single-Center Study
Obeziteli Çocuk ve Ergenlerde Psikiyatrik Komorbiditenin Araştırılması: Tek Merkezli Bir Çalışma
Öznur ADIGÜZEL AKMAN, Hakan KAYIŞ, Esra BİLİCİ, Ceyda BİYİKLİ, Hacer ARIKAN, Elif MUMCU, Ezgi ÖZKAN

Derleme / Review

The Effects of Taurine on Energy Homeostasis and Health: A Nutritional Perspective
Taurinin Enerji Homeostazi ve Sağlık Üzerindeki Etkileri: Beslenme Perspektifi
İrem DAĞOĞLU POLAT, Özlem BARAN

Olgu Sunumu / Case Report

Laparoskopik Sleeve Gastrektomi Sonrası Gelişen Geç Dönem Komplikasyonu; Diospirobezoar
Late Term Complication After Laparoscopic Sleeve Gastrectomy; Diospirobezoar
Orhan TATLI, Sertaç Ata GÜLER, Enes ŞAHİN, Turgay ŞİMŞEK