Evaluation of the Relationship Between Vitamin D Levels and Glycemic Parameters in Prediabetic Individuals

Prediyabetik Bireylerde D Vitamini Düzeyi ile Glisemik Parametreleri Arasındaki İlişkinin Değerlendirilmesi

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ABSTRACT

Objective: Prediabetic condition is a precursor clinical picture that poses a significant risk for the development of diabetes. Early diagnosis and treatment are crucial for preventing micro and macro complications. Numerous studies have been conducted to explore the relationship between Vitamin D and the development of diabetes, attempting to clarify this connection. We planned this study to examine the relationship between Vitamin D and glycemic parameters in prediabetic individuals and to lay the groundwork for future research in this direction.

Method: Our study included 192 patients aged 24-65 who presented to internal medicine clinics. The study retrospectively examined 93 prediabetic individuals and 99 healthy individuals without any diseases, drug use, Vitamin D supplementation, or any other significant characteristics. The selected patients' demographic data, fasting glucose levels, HbA1C, insulin, HOMA-IR, 25(OH)D vitamin, calcium, and albumin levels were analyzed using chromatography equipment, HPLC method. The Chi-Square test was used to determine the differences in categorical data between groups. The level of statistical significance was set at $p<0.05$.

Results: The mean age was 53.18±12.71 in the prediabetic group and 42.44±14.72 in the control group. No statistically significant difference was observed in gender distribution between the two groups (p=0.9072). When comparing Vitamin D levels between the two groups, it was found to be 14.62±6.87 ng/mL in the prediabetic group and 17.53±11.02 ng/mL in the control group, which was statistically significant (p=0.029).

Conclusion: Our study found a significant difference in Vitamin D levels between prediabetic individuals and healthy individuals with normoglycemic progression. Observational studies suggest a significant relationship between Vitamin D and diabetes mellitus, and similar findings are observed in prediabetic individuals. We believe that Vitamin D supplementation in the prediabetic population could have significant effects on public health and glucose metabolism.

Keyswords: Prediabetes, Vitamin D, Glycemic Parameters.

ÖZET

Amaç: Prediyabetik durum diyabet gelişimi açısından büyük risk oluşturan öncül klinik tablo olup erken tanı ve tedavi ile mikro-makro komplikasyonların önlenmesi açısından önemli yer tutmaktadır. D vitamini ile diyabet gelişimi arasında birçok çalışma yapılmış ve arasındaki ilişki aydınlatılmaya çalışılmıştır. Prediyabetik bireylerde D vitamini ile glisemik parametreleri arasındaki ilişkini irdelenmesi ve bu yönde ileriye dönük çalışmaların ortaya konması adına bu çalışmayı planladık.

Yöntem: Çalışmamıza iç hastalıkları polikliniklerine başvuran 24-65 yaş arası 192 hasta dahil edildi. Çalışmada 93 prediyabetik birey ile herhangi bir hastalığı olmayan ilaç kullanımı olmayan D vitamini desteği almayan ek bir özelliği olmayan 99 sağlıklı birey retrospektif olarak incelendi. Seçilen hastaların demografik verileri, açlık glukoz seviyesi, HbA1C, insülin, HOMA-IR, 25(OH) D vitamini, kalsiyum, albümin düzeyleri kromotografi cihazında, HPLC yöntemi ile çalışılmış olan veriler analiz edildi. Gruplar arasındaki kategorik veri farklılıklarını belirlemek için Ki-Kare testi kullanılmıştır. İstatistiksel anlamlılık düzeyi p<0,05 olarak belirlenmiştir.

Bulgular: Yaş ortalaması prediyabetik grubunda 53,18±12,71 iken kontrol grubunda 42,44±14,72 olarak bulunmuştur. Cinsiyet dağılımlarına bakıldığında ise her iki grup arasında istatistiksel açıdan anlamlı bir fark saptanmamıştır (p=0,9072). Her iki grubun D vitamini düzeyleri karşılaştırıldığında prediyabetik grubunda 14,62±6,87 ng/mL iken kontrol grubunda 17,53±11,02 ng/mL olarak ölçülmüş olup istatistiksel açıdan anlamlı derece farklı olduğu saptanmıştır (p=0,029).

Sonuç: Çalışmamızda prediyabetik bireyler ile normoglisemik seyreden sağlıklı bireylerin D vitamini düzeyleri arasında anlamlı fark olduğu görüldü. Yapılan gözlemsel çalışmalarda D vitamini ile diyabet mellitus arasında anlamlı bir ilişkinin olduğu gibi prediyabetik bireylerde de sonuçların aynı doğrultuda olduğu görülmüştür. D vitamini desteğinin prediyabetik popülasyonunda değerlendirildiğinde toplum sağlığı ile glukoz metabolizması üzerine önemli etkilerin olabileceğini düşünmekteyiz.

Anahtar Kelimeler: Prediyabet, D Vitamini, Glisemik Parametreler.

INTRODUCTION

Diabetes mellitus (DM) represents one of the most significant health challenges in our society. It is a heterogeneous and complex disease characterized by insulin resistance, insufficient secretion, metabolic disturbances causing reduced effectiveness, or complete lack of secretion (1). The complications it causes lead to chronic health problems due to progressive organ and functional losses. It significantly impairs quality of life, being a major cause of morbidity and mortality. Prediabetes, which includes impaired glucose tolerance and impaired fasting glucose, represents elevated glucose levels that are above normal but below the diagnostic threshold for diabetes. Prediabetes is particularly a major risk factor for type 2 DM, with the risk of developing diabetes being approximately six times higher than in individuals with normal glycemic values (2,3). From this perspective, prediabetes has become a precursor to the complications that can occur due to DM. The pathogenesis of prediabetes is similar to type 2 DM and includes factors such as genetic predisposition, environmental factors, defects in insulin secretion, and insulin resistance.

There is evidence suggesting that Vitamin D influences insulin sensitivity and plays a role in glucose regulation (4). Pancreatic beta cells, by expressing the Vitamin D receptor (VDR), affect insulin sensitivity. Pancreatic beta cells lacking VDR exhibit impaired insulin secretion in response to an increased glucose load, contributing to the prediabetic condition. Furthermore, studies indicate that insulin secretion in prediabetic patients could be affected through genomic and non-genomic pathways, although the pathogenesis is not entirely clear (5). Vitamin D enhances insulin receptor expression, thereby increasing insulin sensitivity. Given the current literature, there is a clear correlation between Vitamin D and type 2 DM (6). The significance of Vitamin D levels in prediabetic conditions, which are a significant risk factor for type 2 DM, is evident. Since prediabetes is a persistent condition that may evolve into DM over time, early detection of its causes and combating it with proper treatment before it becomes a chronic health issue is crucial. This study aims to examine the impact of Vitamin D on glycemic parameters in prediabetic individuals.

METHODS

Our study included 192 patients aged 24-65 who visited the internal medicine clinics at Balıkesir Atatürk City Hospital between January 1, 2022, and October 2, 2023. The study retrospectively examined 93 prediabetic individuals who met the following criteria: no diagnosed DM, no current medication use, no intake of Vitamin D or calcium supplements, and oral glucose tolerance test criteria or HbA1C levels between 5.7 and 6.5. Additionally, 99 healthy individuals with no diseases, no medication use, and no Vitamin D supplementation were included. The findings from previously conducted anamneses and physical examinations (age, weight, height, body mass index, etc.) were analyzed. The selected patients' demographic data, fasting glucose levels, HbA1C, insulin, insulin resistance index (HOMA-IR), 25(OH) Vitamin D, calcium, and albumin levels were analyzed using chromatography equipment through the High-Performance Liquid Chromatography (HPLC) method. Patients' 25(OH) Vitamin D levels were categorized as follows: >30 ng/ml as sufficient, 20-29 ng/ml as deficient, 10-19.9 ng/ml as insufficient, and <10 ng/ml as severely insufficient. Data collected during the study were recorded for further analysis.

Statistical Analysis

In this study, the demographic and clinical characteristics of the evaluated cases were examined using descriptive statistical analyses (numbers, percentages, etc.). The data were processed using the SPSS-22 software package. The Chi-Square test was utilized to determine the differences in categorical data between groups. The Shapiro-Wilk and Kolmogorov-Smirnov tests were applied to assess whether the data followed a normal distribution. For comparing measurements of a specific variable between two different groups, the Student's t-test was used for data that followed a normal distribution, while the Mann-Whitney U test was used for data that did not. The level of statistical significance was set at $p < 0.05$. Box-Plot graphs were arranged for biochemical variables that showed significant differences between the patient and control groups.

Ethics Committee Approval

This study received approval from the Ethics Committee of Balıkesir Atatürk City Hospital for Scientific Research (Approval Date: 23/11/2023, Decision No: 2023/11/68).

RESULTS

In our study, various biological and physiological parameters were compared between the prediabetic individuals (n=93) and the healthy control group (n=99). The average age was 53.18±12.71 in the prediabetic group and 42.44±14.72 in the control group, with no statistically significant difference identified between the two groups (p=0.333).

Similarly, no significant differences were observed in terms of average weight and height; the prediabetic group weighed 59.92±6.9 kg, while the control group weighed 60.08±7.01 kg. The average heights were 164.14±7.12 cm and 160.72±6.85 cm, respectively, with no statistically significant differences found (p=0.441 and p=0.922). The body mass index (BMI) was 23.01±1.98 kg/m² in the prediabetic group and 22.5±1.79 kg/m² in the control group, which was not statistically significant (p=0.283). No statistically significant difference was observed in gender distribution between the two groups (p=0.9072) (Table 1).

Regarding glycemic parameters, significant differences were identified between the prediabetic and control groups in fasting glucose, HOMA-IR, HbA1C, albumin, and Vitamin D levels (Table 1). The average fasting glucose in the prediabetic group was 109.75±11.68 mg/dL, compared to 89.68±6.55 mg/dL in the control group, and this difference was statistically highly significant (p<0.001). The HOMA-IR was 6.96±3.67 in the prediabetic group and 1.67±0.47 in the control group, showing a statistically significant difference (p<0.001). HbA1C levels were 6.09±0.25% in the prediabetic group and 5.35±0.21% in the control group, with a statistically significant difference (p<0.001). Albumin levels were 4.39±0.28 g/dL in the prediabetic group and 4.51±0.29 g/dL in the control group, which was statistically significant (p=0.006). When comparing Vitamin D levels, the prediabetic group had 14.62±6.87 ng/mL, whereas the control group had 17.53±11.02 ng/mL, and this difference was statistically significant (p=0.029).

DISCUSSION

Prediabetic individuals are known as a significant public health concern due to their substantial risk of developing DM, which in turn leads to complications, morbidity, and mortality. The pathogenesis of prediabetes involves pancreatic beta-cell dysfunction, resulting in insufficient insulin production and hyperglycemia due to tissue resistance to this hormone (7). While Vitamin D is commonly associated with bone mineralization and diseases such as osteoporosis, its role in common conditions like type 2 DM, prediabetes, depression, and obesity is less understood. The literature provides strong evidence that Vitamin D influences the pathways involved in the pathogenesis of type 2 DM; it is thought to play a critical role in calcium flux in beta cells, cellular viability, and the regulation of insulin secretion (8). According to another hypothesis, the relationship between Vitamin D and glucose metabolism is thought to be linked to the Vitamin D Receptor (VDR) in the pancreas (5). An experimental clinical study in rats has shown that Vitamin D deficiency leads to damage in pancreatic beta cells and insulin deficiency, which can be reversed with Vitamin D supplementation (9). Other studies have also reported that Vitamin D's anti-inflammatory effects positively impact insulin secretion, potentially preventing the development of diabetes. Additionally, numerous studies have associated low Vitamin D levels with decreased insulin sensitivity (10). To date, many studies have documented the relationship between type 2 DM and Vitamin D; our study investigates this connection in prediabetes, a precursor to DM. In this study comparing glycemic parameters and Vitamin D levels, significant differences were found between prediabetic individuals and the healthy group.

We observed that the relationship between glycemic parameters and Vitamin D levels in prediabetic individuals yielded similar results to those studies conducted with DM patients. We found that the fasting glucose levels, HbA1C, and HOMA-IR levels in prediabetic individuals aligned with other studies in the same direction. When comparing Vitamin D levels, those in prediabetic individuals were lower and significantly different statistically compared to the healthy group. In a study by Mitri et al.,

improvements in pancreatic beta-cell functions were demonstrated with Vitamin D and calcium supplementation over 16 weeks. The same study showed that community-wide Vitamin D supplementation reduced the risk of developing type 2 DM by lowering the increase in HbA1c levels (11). Once again, Vitamin D supplementation has proven significant for prediabetic individuals, who are at high risk of developing DM. While the pathogenesis of Vitamin D on glucose metabolism is not yet fully elucidated, its importance is evident. This study demonstrates the potential effect of Vitamin D in prediabetic individuals, similarly to those with DM.

CONCLUSION

Our study observed a significant difference in Vitamin D levels between prediabetic individuals and healthy individuals with normoglycemic progression. Given that prediabetes may progress to DM over time, it is evident that early screening and treatment methods will lead to a decrease in the incidence of DM. Observational studies have shown a significant relationship between Vitamin D and the development of diabetes, and similar results have been observed in prediabetic individuals. We believe that Vitamin D supplementation in the prediabetic population could have significant effects on public health and glucose metabolism.

DESCRIPTIONS

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