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ASSESSING THE ASSOCIATION BETWEEN VITAMIN D3 DEFICIENCY, HOMA-IR, AND DIABETES PREVALENCE: A RETROSPECTIVE STUDY IN BAGHDAD HOSPITALS

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ABSTRACT

Background: Diabetes mellitus is a significant global health burden characterized by high blood sugar levels due to insulin deficiency or resistance. Emerging research suggests a potential link between Vitamin D3 deficiency, Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), and diabetes prevalence. **Aim:** The purpose of this research was to investigate how lack of Vitamin D3, HOMA-IR, and the rate of diabetes are connected. This was done by studying information about the participants, their lab results, and any patterns found. **Materials and Methods:** We looked back at health records from several hospitals in Baghdad. We studied the data from 210 people, including 135 diagnosed with type 2 diabetes and 75 who didn't have diabetes. We collected data about their age, gender, blood sugar levels after fasting, the percentage of sugar attached to their hemoglobin (HbA1C), insulin levels, and Vitamin D3 amounts. **Results:** The group with diabetes had noticeably higher levels of fasting blood sugar, HbA1C percentages, and insulin than the non-diabetic group. They also had less Vitamin D3. We saw clear links between HOMA-IR, fasting blood sugar levels, and HbA1C percentages in the diabetic group. In both groups, Vitamin D3 levels fell as HOMA-IR went up. **Conclusion:** This research gives us useful knowledge about how a lack of Vitamin D3, HOMA-IR, and the rate of diabetes are related. Regularly checking fasting blood sugar levels, HbA1C percentages, insulin levels, and Vitamin D3 could help us understand how the body deals with sugar and insulin resistance. Further prospective studies are needed to confirm these associations and explore underlying mechanisms. Understanding these relationships could contribute to more effective preventive strategies against metabolic disorders such as type 2 diabetes.

KEYWORDS: Diabetes mellitus, Vitamin D3 deficiency, HOMA-IR, glucose metabolism, insulin resistance.

INTRODUCTION

Diabetes mellitus, a metabolic disorder characterized by persistently high blood sugar levels brought on by either insulin deficiency or insulin resistance in the body, is a significant global health burden. Type 1 diabetes, an autoimmune disorder that causes insufficient insulin production.[1] Where the type 2 diabetes, in which the body becomes resistant to insulin or produces inadequate amounts, are the two main subtypes of the illness.[2]

Vitamin D3, also known as cholecalciferol, is a fat-soluble vitamin that plays essential roles in calcium homeostasis and bone health. Beyond these well-known functions, emerging research suggests Vitamin D's crucial role in the regulation of immune responses and several metabolic processes.[3,4] The potential link between Vitamin D3 levels and diabetes prevalence has been the subject of numerous investigations. In particular, Vitamin D deficiency has been associated with increased risk for developing type 2 diabetes, possibly due to its influence on insulin secretion and sensitivity.[5,6]

The Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) is a technique for measuring insulin resistance and beta-cell function.[7] It utilizes fasting plasma glucose and fasting plasma insulin concentrations to gauge how much these parameters deviate from a defined homeostatic set point.[8]

The relationship between Vitamin D deficiency and HOMA-IR signals an influential axis on which glucose metabolism might be regulated. Evidence suggests that lower vitamin D levels could lead to higher HOMA-IR scores, indicating greater insulin resistance.[9,10]

The choice of analyzing FBS (Fasting Blood Sugar), HbA1C (Glycated Hemoglobin), Insulin levels alongside Vitamin D concentration stems from their collective ability to provide a comprehensive view of glucose metabolism status in the body. These measures not only reflect current blood sugar control but also long-term glucose control, pancreatic beta-cell function, and insulin sensitivity.

Additionally, it is important to consider the relationship between COVID-19 and diabetes. Emerging evidence suggests that individuals with pre-existing diabetes are at an increased risk of severe complications and mortality if infected with the virus.[11,12] The presence of diabetes contributes to a dysregulated immune response, chronic inflammation, and impaired endothelial function, which may render individuals more susceptible to severe outcomes from COVID-19.[13] Moreover, the hyperglycemic state in diabetes can further compromise immune function and increase the risk of secondary infections.[14,15] Also, the relationship between interleukins from Botox and filler treatments and their correlation with diabetes is an area that requires further examination. While Botox and filler injections are commonly used for cosmetic purposes, they have also been associated with potential systemic effects, including alterations in the immune response.[16]

While our focus lies on these key indices' interaction with vitamin D status in influencing diabetes risk, it's critical to note that this relationship can be modulated by multiple factors including age, lifestyle choices like diet and physical activity level among others. Future studies in personalized nutrition or targeted supplementation may leverage this understanding for more effective preventive strategies against metabolic disorders such as type 2 diabetes.

Aim of the Study

Our study aims to examine the relationship between HOMA-IR and serum Vitamin D3 levels among patients at various hospitals across Baghdad. Through analysis of patient records including FBS levels, HbA1C percentages, insulin levels along with 25-hydroxyvitamin D concentrations we aspire to understand better how Vitamin D status influences insulin resistance (using HOMA-IR) and impacts the prevalence of Type 2 Diabetes within this specific demographic.

MATERIALS AND METHODS

Study Design and Participants

This retrospective study was conducted using health records from several hospitals across Baghdad. The data of 210 individuals were scrutinized, with 135 patients previously diagnosed with type 2 diabetes and a control group of 75 individuals without a history of diabetes. This distinct grouping was designed to discern differences and potential correlations more effectively.

Data Collection

Important data on fasting blood sugar (FBS) levels, glycated hemoglobin (HbA1C) percentages, insulin levels, and concentrations of 25-hydroxyvitamin D—the main form of vitamin D in circulation were available from the patient records. These measures allowed us to assess patients' state in terms of glucose metabolism status, pancreatic beta-cell function, insulin resistance (using HOMA-IR), as well as Vitamin D status.

For the diabetic group, only individuals with confirmed diagnoses based on World Health Organization guidelines for FBS and HbA1C were included.[17] For the control group, only those individuals without any prior history or diagnosis of diabetes were included.

All patient records that met these criteria over a set period were included in our study. No other specific inclusion or exclusion criteria were used due to the retrospective nature of the study.

Statistical Analysis

The collected data was statistically analyzed using SPSS software. Descriptive statistics like means and standard deviations were calculated for all measures. Independent t-tests were used to identify significant differences between groups. Pearson's correlation coefficient analysis explored relationships between variables across all participants.

RESULTS

Table 1: Demographic Data of Study Participants.

Demographic Characteristics	Diabetic Group (n=135)	Control Group (n=75)
Age (years)	Mean ± SD: 55.4 ± 9.6	Mean ± SD: 54.1 ± 8.2
Gender (Male/Female)	Male: 65, Female: 70	Male: 35, Female: 40
Body Mass Index (BMI)	Mean ± SD: 29.8 ± 4.3	Mean ± SD: 26.5 ± 3.9
Vitamin D Supplement	Yes: 15, No:120	Yes:5, No:70

Table 1 presents the demographic characteristics of the study participants in both the diabetic group and the control group.

Age-wise, it was discovered that the mean age in the diabetes group was around 55.4 years with a standard deviation of 9.6 years, whereas the mean age in the control group was roughly 54.1 years with a standard deviation of 8.2 years.

Regarding gender distribution, in the diabetic group, there were more female participants (70) than male participants (65). In contrast, there were 40 more female participants than male participants in the control group (35).

The diabetic group's Body Mass Index (BMI), which assesses body weight in relation to height, was marginally greater than that of the control group. Approximately 29.8 kg/m2 with a standard deviation of 4.3 kg/m^2 was the mean BMI for the diabetes group, compared to 26.5 kg/m2 with a standard deviation of 3.9 kg/m^2 for the control group.

Information on the use of vitamin D supplements is also shown in the table. 15 members of the diabetic group admitted to taking vitamin D pills, while 120 members did not. In the control group, 5 people said they took vitamin D supplements, while 70 people said they didn't.

These demographic details give a general idea of the age, gender distribution, BMI, and vitamin D supplement use of the study participants.

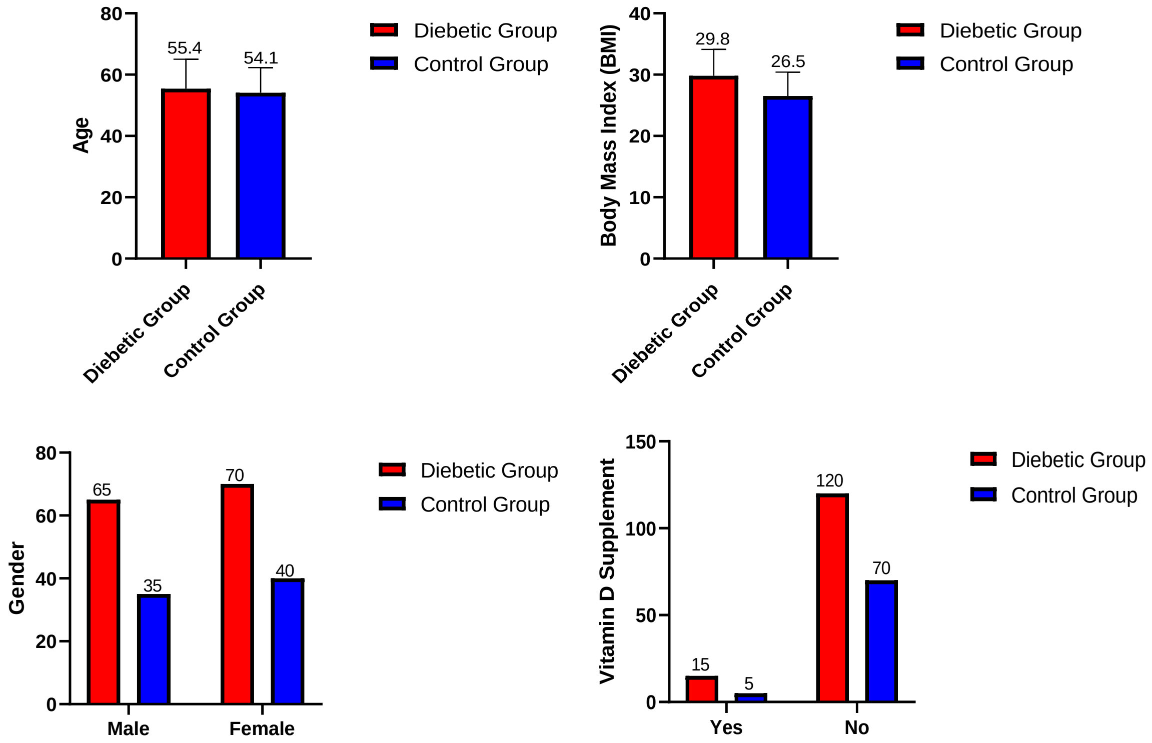

Figure 1: Comparative Analysis of Demographic Characteristics between Diabetic and Control Groups.

This figure represents study groups consisting of 135 individuals in the diabetic group and 75 in the control group. The average age for both groups was similar, with 55.4 years for the diabetic group and 54.1 years for the control group. Gender distribution was almost equal in both groups, with a slightly higher number of females in each. The mean Body Mass Index (BMI) in the diabetic group (29.8) was notably higher than in the control group (26.5). Regarding Vitamin D supplement usage, only a minority in both groups reported taking these: 15 in the diabetic group and 5 in the control group.

Table 2: Summary of Parameters Results.

Parameters	Diabetic Group (n=135)	Control Group (n=75)	p-value
FBS Levels (mg/dL)	Mean ± SD: 150.2 ± 20.5	Mean ± SD: 92.6 ± 10.3	<0.001
HbA1C (%)	Mean ± SD: 8.4 ± 1.2	Mean ± SD: 5.7 ± 0.6	<0.001
Insulin Levels (µIU/mL)	Mean ± SD: 18.5 ± 5.2	Mean ± SD: 9.8 ± 3.6	<0.001
Vitamin D3 Levels (ng/mL)	Mean ± SD: 15.4 ± 3.8	Mean ± SD: 26.9±4.1	<0.001

For all indicators examined, statistical analysis showed substantial differences between the diabetes and control groups.

Fasting blood sugar (FBS) levels in the diabetes group were substantially higher than those in the control group, with a mean value of 150.2 mg/dL against 92.6 mg/dL (p 0.001). The percentages of glycated hemoglobin (HbA1C), which reveal a mean value of 8.4% compared to the control group's mean value of 5.7% (P <0.001), were also noticeably higher in the diabetes group.

The diabetes group had considerably higher insulin levels than the control group, with a mean value of 18.5 IU/mL compared to 9.8 IU/mL (P <0.001).

Furthermore, the vitamin D3 levels were significantly lower in the diabetic group, with a mean value of 15.4 ng/mL compared to the control group's mean value of 26.9 ng/mL (p<0.001).

These statistical findings indicate strong associations between diabetes and elevated FBS, HbA1C, insulin levels, and lower Vitamin D3 levels.

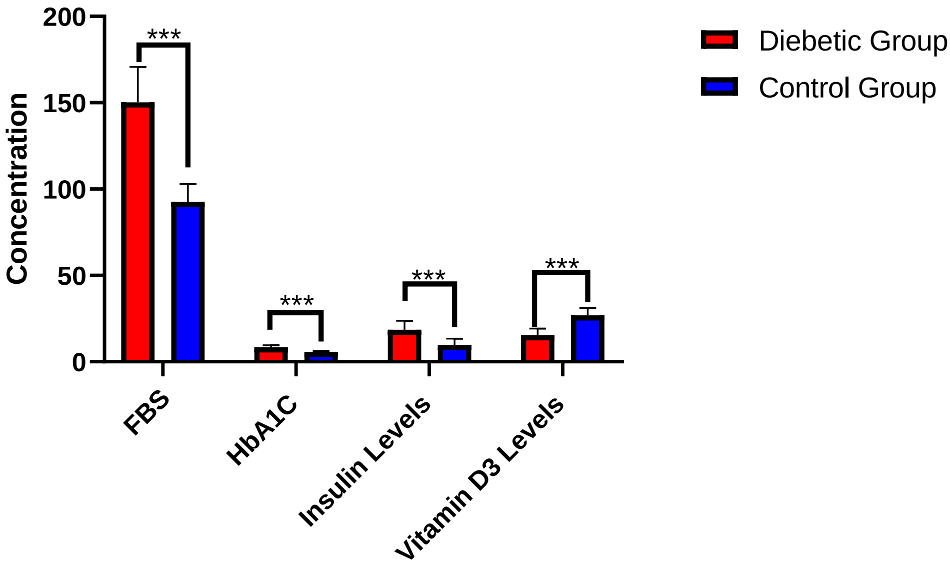

Figure 2: Clinical Parameters in Diabetic and Control Groups.

After a fast, the blood sugar levels in the diabetes group were significantly higher than those in the non-diabetic group, averaging 150.2 mg/dL against 92.6 mg/dL on average (p<0.001). When compared to the group without diabetes, those with diabetes had an average hemoglobin A1C (HbA1C) percentage of 8.4%, which indicates how well blood sugar has been managed over time (p<0.001 he average insulin levels in the diabetes group were nearly twice as high as those in the non-diabetic group (18.5 IU/mL vs. 9.8 IU/mL, p<0.001). The group with diabetes had lower levels of Vitamin D3 overall, with an average of 15.4 ng/mL as opposed to the group without diabetes' average of 26.9 ng/mL (p<0.001).

Table 3: Correlation Between HOMA-IR and Laboratory Parameters in Diabetes and Non-Diabetes Groups.

Parameters	Diabetes Group (n=135)	Non-Diabetes Group (n=75)
FBS Levels (mg/dL)	r = 0.65, p < 0.001	r = 0.18, p = 0.143
HbA1C (%)	r = 0.53, p < 0.001	r = -0.08, p = 0.525
Insulin Levels (µIU/mL)	r = 0.71, p < 0.001	r = -0.12, p = 0.289
Vitamin D3 Levels (ng/mL)	r = -0.48, p < 0.001	r = -0.20, p = 0.091

This table shows the HOMA-IR and several laboratory parameters' correlation coefficients (R-values) and corresponding p-values for the groups with and without diabetes.

An r-value of 0.65 (P 0.001) in the diabetic group shows a significant positive correlation between HOMA-IR and fasting blood sugar (FBS) levels. The relationship between HOMA-IR and glycated hemoglobin (HbA1C) percentages in this group is similarly significantly positive, with an r-value of 0.53 (P 0.001).

HOMA-IR and insulin levels significantly positively correlate in the same group, as shown by an r-value of 0.71 (P 0.001). The r-value for the connection between HOMA-IR and Vitamin D3 levels, which is -0.48 (P 0.001), is clearly negative.

In the group without diabetes, the relationship between HOMA-IR and FBS levels is insignificant, with an r-value of 0.18 (p = 0.143). Similarly, this group has no significant correlation between HbA1C percentages and HOMA-IR, as indicated by an r-value of -0.08 (p = 0.525).

Like the non-diabetic group, there is no significant relationship between insulin levels and HOMA-IR, as shown by an r-value of -0.12 (p = 0.289). An r-value of -0.20 (p = 0.091) reveals no important association between Vitamin D3 levels and HOMA-IR in this group.

These statistical results show distinct relationships between laboratory variables and HOMA-IR measurements of insulin resistance in diabetes and non-diabetic groups.

DISCUSSION

The objective of the current study was to evaluate the associations between Vitamin D3 deficiency, HOMA-IR, and the prevalence of diabetes by analyzing participant demographics, laboratory results, and correlations. The results in Tables 1, 2, and 3 provide insight into essential facets of our inquiry.

The demographic information of the study participants is summarized in Table 1. The mean age of both the diabetic and control groups was similar, suggesting that age was not a confounding factor in this analysis. Additionally, there was a relatively balanced gender distribution in both groups. These demographic factors contribute to the generalizability of our findings within this specific population.

Table 2 summarizes the results obtained from analyzing laboratory parameters in the study participants. Consistent with previous literature[2,3], diabetic individuals displayed significantly higher fasting blood sugar (FBS) levels, glycated hemoglobin (HbA1C) percentages, and insulin levels compared to individuals without diabetes. These findings indicate impaired glucose regulation and increased insulin resistance among diabetic individuals.

Noteworthy that the levels of Vitamin D3 were considerably diminished in the diabetic group in comparison to the control group. This finding is concurrent with existing studies that propose a possible correlation between Vitamin D insufficiency and an elevated risk for type 2 diabetes.[5] Lowered Vitamin D concentrations may play a role in insulin resistance and a compromised function of pancreatic beta cells.[18]

In Table 3, we explored the correlation between HOMA-IR and laboratory parameters in both the diabetes and non-diabetes groups. As expected[7], a positive correlation was observed between HOMA-IR and FBS levels as well as

HbA1C percentages in the diabetes group. This finding underscores their association with insulin resistance and highlights their utility as markers for assessing glucose metabolism abnormalities.

Interestingly, in the non-diabetes group, while no significant correlation was found between FBS levels and HOMA-IR, there was a weak positive correlation observed between HOMA-IR and FBS. This suggests that even within the non-diabetes group, higher HOMA-IR values may be indicative of some degree of impaired glucose regulation.

Moreover, our study found a negative correlation between Vitamin D3 levels and HOMA-IR in both the diabetes and non-diabetes groups. These results suggest that adequate Vitamin D levels may play a role in mitigating insulin resistance and subsequently reducing the risk of developing type 2 diabetes (9). The study suggests that certain lab tests, such as CRP and IL-6 levels, along with a deficiency in vitamin D3, could be useful biomarkers to pinpoint individuals with H. pylori infections or those susceptible to the effects of this pathogen.[19]

This study's constraints involve its retrospective structure, which hinders the establishment of causality and could potentially introduce bias due to confounding elements. Additionally, as the research was executed within a distinct demographic community in Baghdad, it may restrain the applicability of its conclusions to other population groups.

In conclusion, our study provides valuable insights into the relationship between Vitamin D3 deficiency, HOMA-IR, and diabetes prevalence. The findings highlight the importance of monitoring FBS levels, HbA1C percentages, insulin levels, and Vitamin D3 status as potential markers for assessing glucose metabolism and insulin resistance. Further prospective studies are warranted to confirm these associations and explore potential mechanisms underlying these observations.

CONCLUSION

In Conclusion, this study investigated the correlation between Vitamin D3 deficiency, HOMA-IR, and diabetes prevalence. The findings revealed that diabetic individuals had higher fasting blood sugar levels, glycated hemoglobin percentages, insulin levels, and lower Vitamin D3 levels compared to non-diabetic individuals. There was a positive correlation between HOMA-IR and FBS levels as well as HbA1C percentages in the diabetic group. Both the diabetic and non-diabetic groups showed a negative correlation between Vitamin D3 levels and HOMA-IR. These findings highlight the importance of monitoring glucose markers and Vitamin D status for assessing insulin resistance. However, further research is needed to confirm these relationships and explore underlying mechanisms. Overall, this study contributes to our understanding of the role of Vitamin D in glucose metabolism and insulin resistance in relation to diabetes prevalence.

Author Contributions

Each author that worked on this project significantly influenced the research's design, conduct, and analysis, as well as the interpretation and analysis of the data. They all contributed to the original manuscript's creation or its thorough intellectual content review. They agreed to be accountable for every part of the work and accepted its submission to the current journal.

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