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Mergasor Technical Institute
Department of Nursing

Investigating Vitamin D Deficiency and Its Relationship with Type 2 Diabetes Mellitus

A Study

Submitted to the Council of the Nursing Department- Mergasor Technical Institute as Partial Fulfillment of the Requirements for the Degree of diploma (Nursing)

By

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PhD (Medical Physiology)

Mergasor- Kurdistan

2025

DECLARATION

We declare, that this study entitled **(Investigating Vitamin D Deficiency and Its Relationship with Type 2 Diabetes Mellitus)** is our own original work, and hereby, we certify that unless stated, all work contained within this study is our own independent research, and has not been submitted for the award of any other degree at any institution, except where due acknowledgement is made in the text.

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Name: Asma Rafaat Qader

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Name: Farhad Muhamad Khurshid

SUPERVISOR CERTIFICATE

I certify that this study has been written under my supervision and has been submitted for the award of the degree of diploma in **Nursing.**

Signature

Assist. Prof. Dr. Hazhar Muhammad Balaky

Date: 14/4/2025

APPROVAL OF THE DEPARTMENT

In view of available recommendation, I forward this study for debate by the examining committee.

Signature:

Assist Prof. Dr. Hazhar Muhammad Balaky

Head of the Nursing Department

Date:

EXAMINING COMMITTEE CERTIFICATION

We certify that we have read this study **(Investigating Vitamin D Deficiency and Its Relationship with Type 2 Diabetes Mellitus)** and as an examining committee examined the students (**Asma Rafaat Qader, Tanya Nahro Shekho, Payam Farhan Aziz, Farhad Muhamad Khurshid**) in its content and what related to it. We approve that it meets the standards of a study for the degree of diploma **(Nursing).**

Examining Committee Members:

Signature:

Name: Assist Prof. Dr. Hazhar Muhammad Balaky

Member and Supervisor

Date:

Signature:

Name:

Member

Date:

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Name:

Head

Date:

DEDICATION

We dedicate this study to:

Our dear Family

To all our lovely friends

ACKNOWLEDGEMENTS

First of all, thanks to "**ALLAH**" the Almighty for blessings that we managed to complete our study. We wish to express our appreciation and gratitude to our supervisor **(Assist. Prof. Dr. Hazhar Muhammad Balaky)** for his beneficial guidance, support and patient throughout the duration of this research work. Finally, thanks to all our friends and relatives who supported us, thanks a lot for everything. May Allah reward and blessing all.

ABSTRACT

Background: A major global health concern, vitamin D deficiency is increasingly being connected to chronic illnesses such as Type 2 Diabetes Mellitus (T2DM). This study investigates the connection between vitamin D insufficiency and type 2 diabetes, emphasizing how it affects inflammation, glycemic management, and insulin sensitivity. **Subjects**: Thirty T2DM patients (15 men and 15 women) and thirty age- and gender-matched healthy controls participated in the case-control study. Using an enzyme immunoassay (EIA), serum 25-hydroxyvitamin D (25-OH Vitamin D) levels were determined. **Results:** Serum vitamin D levels were significantly lower ($p < 0.0001$) in T2DM patients than in controls; mean levels in male patients were 7.457 ± 1.116 ng/mL compared to 24.03±1.303 ng/mL in controls, while mean levels in female patients were 6.879±1.078 ng/mL compared to 19.97 ± 1.289 ng/mL in controls. **Conclusions:** With possible sex-based variations, vitamin D insufficiency may affect insulin function and contribute to type 2 diabetes. Although further study is required, routine screening and supplements may improve metabolic results. In high-risk groups, targeted therapies may help lower the risk of T2DM.

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T2DM	Type 2 Diabetes Mellitus
UVB	Ultraviolet B
EIA	Enzyme Immunoassay
25-OH Vitamin D	25-Hydroxyvitamin D
ng/mL	Nanograms per milliliter
SE	Standard Error
GLP-1	Glucagon-like Peptide-1
SGLT2	Sodium-Glucose Cotransporter-2
COVID-19	Coronavirus Disease 2019
β-cells	Beta Cells

CHAPTER ONE

1. INTRODUCTION AND LITERATURE REVIEW

1.1 Background of study

A vital fat-soluble vitamin, vitamin D is essential for immune system function, bone health, and general wellbeing. Although it can also be acquired from diet and supplements, it is mostly produced in the skin by exposure to ultraviolet B (UVB) radiation from sunshine. Its significance extends beyond bone metabolism, as recent studies have shown that it may lower the risk of chronic illnesses like diabetes, cardiovascular disease, and several types of cancer. A 2020 study by Charoenngam and Holick states that vitamin D deficiency is still a global health concern that affects about 1 billion people globally and has an impact on immunological regulation and musculoskeletal health (Charoenngam and Holick, 2020). Additionally, a 2022 study by Amrein et al. (2020) highlighted the crucial function that vitamin D plays in immune defense by highlighting the significance of sufficient vitamin D levels in lowering the severity of respiratory infections, particularly COVID-19 (Amrein et al., 2020). For optimum health, vitamin D levels must be maintained at adequate levels through food, supplementation, or sun exposure.

Because vitamin D deficiency affects insulin secretion and sensitivity, it has been connected to the onset and progression of type 2 diabetic mellitus (T2DM). Skeletal muscle cells and pancreatic beta-cells both have vitamin D receptors, suggesting a direct connection to insulin activity. Reduced insulin production and elevated insulin resistance, two important elements in the pathophysiology of type 2 diabetes, have been linked to low vitamin D levels. Additionally, via influencing

pancreatic islet cell survival and function as well as hepatic glucose and lipid metabolism, vitamin D deficiency may be a contributing factor to diabetes (Pittas et al., 2006).

The purpose of this research is to examine the relationship between vitamin D insufficiency and type 2 diabetic mellitus (T2DM) risk, onset, and progression. It aims to determine the effects of low vitamin D levels on inflammation, glycemic management, and insulin resistance as well as the possible advantages of vitamin D supplementation in enhancing metabolic results. Moreover, this study is aims to shed light on how vitamin D functions in the management and prevention of diabetes.

1.1.1 Vitamin D Metabolism: Synthesis, Activation, and Its Critical Role in Calcium and Phosphate Homeostasis

Vitamin D, a fat-soluble secosteroid, is required for maintaining physiological functioning and can be received by sunshine exposure, dietary sources such as fatty fish and fortified meals, and supplements. By improving intestinal calcium absorption, its active form, calcitriol, contributes significantly to calcium homeostasis, ensuring sufficient serum calcium and phosphate levels for bone mineralization and averting diseases like osteoporosis and rickets. Vitamin D is important for lowering the risk of infections and autoimmune illnesses because, in addition to its traditional role in bone health, it also controls immune function by controlling the expression of genes involved in innate and adaptive immunity (Holick, 2007).

1.1.2 Global Prevalence and Causes of Vitamin D Deficiency in Vulnerable Populations

An estimated one billion people worldwide suffer from vitamin D deficiency, a condition that is more common in certain groups, including the elderly, people with darker skin, people who live in northern latitudes, people who wear concealing clothing, and people who receive little or no sun exposure. Since UVB radiation is necessary for the synthesis of vitamin D in the skin, insufficient exposure to sunshine is the main cause of shortage. Dietary deficiencies, obesity, malabsorption issues, and sunscreen use are other contributing factors. These risk factors highlight the necessity of focused public health initiatives to treat vitamin D insufficiency and the health effects it causes, especially for disadvantaged groups (Holick, 2007).

1.1.3 Type 2 Diabetes Mellitus: Pathophysiology, Risk Factors, Complications, and Management

Hyperglycemia brought on by insulin resistance and decreased insulin production by pancreatic beta cells are hallmarks of type 2 diabetes mellitus (T2DM), a chronic metabolic disease. Beta-cell failure impairs the pancreas's capacity to generate and secrete enough insulin to make up for insulin resistance, which is caused by target tissues like muscle, liver, and fat not responding to insulin as well (Galicia-Garcia et al., 2020).

About 90% of all cases of diabetes worldwide are type 2 diabetes, and its rising prevalence—caused by risk factors like obesity, especially visceral adiposity, sedentary lifestyles, genetic predisposition, aging, and poor dietary habits—makes it a serious public health concern. Serious side effects of the illness include

retinopathy, neuropathy, chronic renal disease, cardiovascular disease, and an elevated risk of infection. In addition to pharmaceutical treatments including metformin, insulin therapy, GLP-1 receptor agonists, and SGLT2 inhibitors, management entails lifestyle changes like diet and exercise. In order to lessen the worldwide burden of type 2 diabetes and its related problems, early diagnosis and thorough management are essential (Chatterjee et al., 2018).

1.1.4 Global Burden of T2DM and Its Complications

An estimated 463 million persons worldwide suffered from type 2 diabetes mellitus (T2DM) in 2019, and by 2045, that figure is expected to rise to 700 million. Because of its severe consequences, which include cardiovascular disease, chronic renal disease, neuropathy, retinopathy, and lower limb amputations, type 2 diabetes is a major source of morbidity and mortality globally. These issues put a heavy financial strain on healthcare systems in addition to lowering quality of life. Urbanization, aging populations, the global increase in obesity, and sedentary lifestyles are some of the factors contributing to the rising prevalence of type 2 diabetes. To stop this expanding epidemic and lessen the consequences it causes, effective public health measures are crucial, such as prevention, early diagnosis, and thorough management (Saeedi et al., 2019).

1.2 Problem statement

With mounting evidence pointing to a possible link between vitamin D insufficiency and the onset and progression of chronic illnesses, such as Type 2 Diabetes Mellitus (T2DM), the condition has become a major global health problem. In addition to its vital function in maintaining calcium homeostasis and bone health, vitamin D also affects insulin production, insulin sensitivity, and systemic inflammation—all of which are important aspects of the pathophysiology of type 2 diabetes.

Numerous research have examined this relationship, but the precise processes relating vitamin D deficiency to type 2 diabetes are still unknown, and results are sometimes contradictory because of differences in study design, population demographics, and vitamin D assessment techniques. The purpose of this study is to determine whether low vitamin D levels increase the risk or severity of type 2 diabetes by examining the prevalence of vitamin D insufficiency and its relationship to the disease. By filling this knowledge vacuum, the study aims to shed light on the possible function of vitamin D supplementation as a therapeutic or preventative approach to the management of type 2 diabetes.

1.3 Specific Objectives

Examine the connection between important indicators of type 2 diabetes and vitamin D levels.

1.4 Significant of study

This study is important because it tackles two key public health issues: the increasing incidence of vitamin D deficiency and the growing worldwide burden of type 2 diabetes mellitus (T2DM). Knowing how vitamin D deficiency and type 2 diabetes are related may help us better understand the disease's underlying causes, which include insulin resistance and compromised pancreatic beta-cell activity. Vitamin D supplementation may be incorporated into prevention and treatment plans for type 2 diabetes if a strong correlation is found, which could lower the chance of the illness developing or improve glycemic control in those who already have it. Additionally, by supporting targeted therapies and frequent vitamin D level screening in at-risk populations, this findings may influence healthcare policies and guidelines. The study's conclusions could ultimately lead to better clinical results, lower medical expenses, and a higher standard of living for people with or at risk for type 2 diabetes.

CHAPTER TWO
2. METHODOLOGY

2.1 Design of Study

This study was carried out between February and April of 2025 using a case-control study. A total of 30 patients (15 men and 15 women) were involved and split into two groups: Group I consisted of 15 male patients and Group II consisted of 15 female patients. Thirty healthy people (15 men and 15 women) who were matched for age and gender were used as controls. The samples were taken at Alla clinical laboratory for medical analysis in Soran city.

2.2 Collection of Blood Specimens

Two millilitres of venous blood was taken from each individual, collected in gold top serum separator tubes (SST) before centrifugation process. The specimens were centrifuged at 3500 rpm for 10 minutes and the resulting serum was separated for subsequent analysis.

2.3 Determination of 25-OH Vitamin D concentration

Serum 25-OH Vitamin D levels were measured using a commercial enzyme immunoassay (EIA) kit (Monobind, Inc.) following the manufacturer’s instructions.

2.4 Statistical Analysis

For statistical analysis, GraphPad Prism (version 9.0) was used. The data is displayed as mean ± SE. The Shapiro-Wilk test was used to determine normality. The unpaired t-test (parametric data) or Mann-Whitney U test (non-parametric data) were used to compare groups; a p-value of less than 0.05 was deemed statistically significant.

CHAPTER THREE

3. RESULTS

3.1 Serum level of vitamin D

The results in this study, shown in Figures 1 and 2 and Table 1, revealed a significant reduction (P<0.0001) in serum vitamin D levels in male T2DM patients (7.457±1.116 ng/mL) compared to healthy controls (24.03±1.303 ng/mL). Similarly, there was a significant decrease (P<0.0001) in serum vitamin D levels in female T2DM patients (6.879±1.078 ng/mL) compared to healthy controls (19.97±1.289 ng/mL)

Table 1. Comparison of serum vitamin D levels among patients and healthy controls

Parameter		Controls (n=15)	Patients (n=15)	P-Value
Male	Vitamin D (ng/ mL)	24.03 ± 1.303	7.457 ± 1.116	P<0.0001
Female	Vitamin D (ng/ mL)	19.97 ± 1.289	6.879 ± 1.078	P<0.0001

The value expressed in Mean±SE

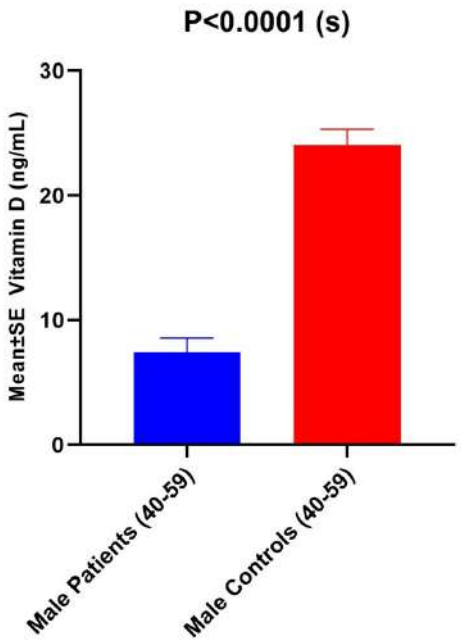

Figure 1: Serum vitamin D levels in male patients compared to control groups.

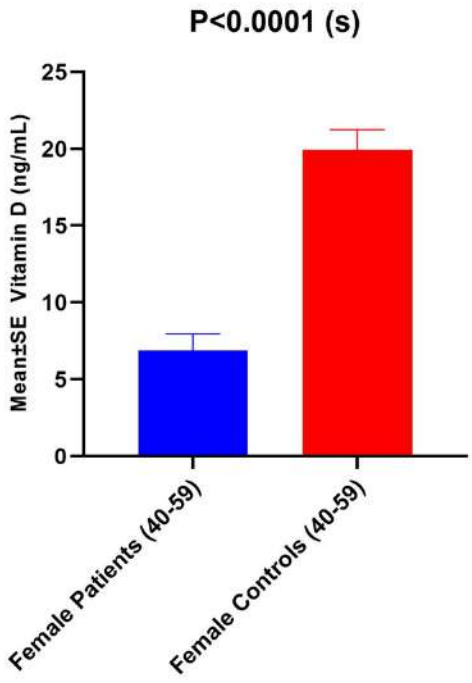

Figure 2: Serum vitamin D levels in female patients compared to control groups.

CHAPTER FOUR

4. DISCUSSION

4.1 Vitamin D Deficiency in Type 2 Diabetes

Type 2 diabetes mellitus (T2DM) has been continuously linked to vitamin D insufficiency, and new research indicates that it may also be a factor in insulin resistance and compromised pancreatic β-cell function (Pittas et al., 2007). There are significant concerns regarding whether the strong association between low vitamin D levels and type 2 diabetes is primary or secondary to other metabolic disorders. According to recent research, vitamin D may affect insulin production, insulin sensitivity, and systemic inflammation, all of which may have an impact on glucose homeostasis (Holick, 2017).

Women continuously exhibit lower vitamin D levels than men in T2DM patients, a sex discrepancy that seems to have multiple causes. This discrepancy may be partially explained by physiological variations, including the involvement of estrogen in the metabolism of vitamin D (Gallagher et al., 2014). Deficit may worsen in postmenopausal women because they exhibit decreased conversion of vitamin D to its active form due to lowering estrogen levels. Furthermore, women often have higher body fat percentages than men, which could lower the bioavailability of fat-soluble vitamin D by sequestering it (Wortsman et al., 2000).

Sex-based variations in vitamin D levels are also influenced by lifestyle and cultural variables. Because of their work habits, wardrobe choices, or sun protection practices, women often experience lower levels of outdoor sun exposure in various cultures (van Schoor & Lips, 2017). In some ethnic and religious groups, whose traditional clothing restricts skin exposure to sunlight, these patterns are

especially noticeable. Women with type 2 diabetes are at risk for vitamin D deficiency due to a combination of biological predispositions and environmental factors.

These discoveries have important clinical consequences. All patients with type 2 diabetes should undergo routine screening for vitamin D deficiency, but female patients who seem to be at the highest risk should receive special care. Although there is ongoing discussion on the ideal serum levels of vitamin D for managing diabetes, data indicates that keeping levels above 20 ng/mL may improve glucose metabolism (Pittas et al., 2007). Sex-specific variations in vitamin D metabolism as well as lifestyle factors that influence dietary intake and sun exposure should be taken into consideration in targeted supplementation regimens.

Future studies should concentrate on clarifying the processes behind the variations in vitamin D metabolism across the sexes and figuring out whether sex-specific supplementation regimens could improve the management of type 2 diabetes. To determine whether treating vitamin D deficiency can enhance glycemic control and lessen diabetic complications, especially in high-risk female populations, extensive intervention trials are required (Holick, 2017). Clinicians should continue to monitor and treat vitamin D levels as part of comprehensive diabetes therapy until such evidence is available.

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Given that both male and female patients had significantly lower levels of vitamin D than healthy people, this study clearly shows a connection between vitamin D insufficiency and type 2 diabetes. The results highlight vitamin D's potential as a modifiable risk factor in the management of diabetes by indicating that it may exacerbate metabolic dysfunction associated with the condition.

5.2 Recommendations

1. All patients with type 2 diabetes should have routine vitamin D screenings, and those who are insufficient should be offered supplements.
2. Diets high in vitamin D and balanced sun exposure should also be encouraged by healthcare professionals.
3. Whether fixing deficiencies improves long-term diabetes outcomes should be investigated further.

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پوختە

کەمی ڤیتامین D کێشەیەکی گەورەی تەندروستی جیهانییە و بەڕێژەیەکی زیاتر بەستراوەتەوە لەگەڵ نەخۆشییە درێژخایەنەکان وەک نەخۆشی شەکرەوەی جۆری دوو .ئەم لێکۆڵینەوەیە لە پەیوەندی نێوان کەمی ڤیتامین D و نەخۆشی شەکرەوەی جۆری دوو دەکۆڵێتەوە، بە تایبەتی کاریگەریەکانی لەسەر هەوکردن، کۆنترۆڵی شەکرە و هەستیاری ئینسولین. ٣٠ نەخۆش ١٥ پیا و ١٥ ئافرەت و ٣٠ کەسی تەندروست (هاوتای تەمەن و ڕەگەز) بەشداربوون لەم لێکۆڵینەوەیە. ئاستی 25-هایدرۆکسی ڤیتامین (25-OH Vitamin D) D لە خوێندا بە هۆی (EIA)دیاریکرا. ئاستی ڤیتامین D لە نەخۆشەکانی T2DM لە هەردوو ڕەگەز بە شێوەیەکی بەرچاو کەمتر بوو بە بەراورد بە کۆنترۆڵەکان. لەوانەیە کەمی ڤیتامین D کاریگەری لەسەر کارکردنی ئینسولین هەبێت و بەشداربێت لە نەخۆشی شەکرەوەی جۆری دوو، لەگەڵ گۆڕانکارییەکانی سەر بنەمای ڕەگەز. هەرچەندە لێکۆڵینەوەی زیاتر پێویستە، بەڵام پشکنینی ئاسایی و تەواوکەرەوەی ڤیتامین D لەوانەیە باشترکردنی ئەنجامە میتابۆلیکییەکان بەدەستبهێنێت. لە گرووپەکانی مەترسی بەرز، چارەسەری ئامانجدار لەوانەیە یارمەتی کەمکردنەوەی مەترسی T2DM بدات.

الخلاصة

نقص فيتامين (د) هو مشكلة صحية عالمية كبرى، ويرتبط بشكل متزايد بالأمراض المزمنة مثل مرض السكري من النوع الثاني. تبحث هذه الدراسة في العلاقة بين نقص فيتامين (د) ومرض السكري من النوع الثاني، مع التركيز على تأثيره على الالتهاب، التحكم في مستويات السكر، وحساسية الإنسولين .شارك في هذه الدراسة 30 مريضًا (15 رجلًا و15 امرأة) و 30 شخصًا سليمًا (مطابقين في العمر والجنس). تم تحديد مستويات 25-هيدروكسي فيتامين (د) (25 OH Vitamin-D)في الدم باستخدام اختبار المناعة الإنزيمية (EIA). أظهرت النتائج أن مستويات فيتامين (د) لدى مرضى السكري من النوع الثاني (T2DM) من كلا الجنسين كانت أقل بشكل ملحوظ مقارنةً بالمجموعة الضابطة. قد يؤثر نقص فيتامين (د) على وظيفة الإنسولين ويساهم في تطور مرض السكري من النوع الثاني، مع وجود اختلافات محتملة بين الجنسين. على الرغم من الحاجة إلى مزيد من البحث، إلا أن الفحص الروتيني ومكملات فيتامين (د) قد يحسنان النتائج الأيضية. في المجموعات عالية الخطورة، يمكن للعلاجات الموجهة أن تساعد في تقليل خطر الإصابة بمرض السكري من النوع الثاني".(T2DM)