



The Relationship Between Diabetes, Vitamin B12 and D3 Deficiency, and Optic Nerve Impairment

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Abstract

The objectives of this study were to evaluate the association among diabetes mellitus, B12 and D3 serum levels and their influence on optic nerve status especially in patients with diabetic retinopathy. With this purpose in mind, different vitamin levels were measured by specific laboratory methods with the latests statistical analysis to determine the statistical significance between diabetic patients and non-diabetic subjects. The study results indicated a significant deficiency of vitamin D3 and B12 levels in diabetic patients. This suggests that symptoms of the neurologic and visual defective phenotypes, such as optic nerve impairment and retinopathy can be acquired and linked to this deficiency. Vitamin D3 helps in neuroprotection at the same time its role is to regulate immunity while vitamin B12 involves the optimal functioning of nerve and development of red blood cells. From the result of this study, it seems that follow up and control of nutritional status in patients with diabetes mellitus specially vitamins D3 and B12 may create a good outcome to prevent severe vision complications which their final treatment could influence in total or partial one part of life. This increases the importance of merging The Clinical Examination with laboratory analysis for a cose Combined Clinical-Picture. This research is a scientific contribution to increasing awareness of the importance of nutrition in the treatment of diabetes and diabetic complications. Thus, it calls for more research to establish the role of vitamin supplementation in the holistic treatment protocols for diabetic patients who can suffer from nerve and sight diseases.

Keywords : Diabetes Mellitus ,Vitamin D3 Deficiency ,Vitamin B12 Deficiency Optic Nerve Impairment , Diabetic Retinopathy.

العلاقة بين داء السكري ونقص فيتامين B12 و D3 وضعف العصب البصري

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الملخص:

تهدف هذه الدراسة إلى استكشاف العلاقة بين داء السكري ومستويات فيتاميني B12 وD3، وكيف يمكن أن يؤثر هذا الارتباط على صحة العصب البصري، خصوصاً لدى المرضى المصابين باعتلال الشبكية السكري. ركز البحث على تقييم الفروقات في مستويات هذه الفيتامينات بين مرضى السكري والأشخاص الأصحاء، باستخدام تقنيات مخبرية دقيقة وتحليل إحصائي موثوق. أظهرت نتائج الدراسة وجود نقص معنوي في مستويات فيتامين D3 و B12 لدى مرضى السكري، مما يشير إلى وجود ارتباط محتمل بين هذه النواقص وظهور أعراض عصبية وبصرية، من بينها ضعف العصب البصري واعتلال الشبكية. ويُعرف عن فيتامين D3 دوره الأساسي في الحماية العصبية وتنظيم الاستجابة المناعية، في حين أن فيتامين B12 ضروري لصحة الأعصاب وتكوين خلايا الدم الحمراء. تشير هذه النتائج إلى أن مراقبة وتحسين الوضع الغذائي لمرضى السكري، وبشكل خاص فيما يتعلق بفيتاميني D3 وB12، قد يُسهم في الوقاية من المضاعفات البصرية الخطيرة التي قد تؤثر على جودة حياة المرضى. كما تسلط الدراسة الضوء على أهمية الدمج بين الفحص السريري والتحليل المخبرية لتكوين صورة شاملة ودقيقة عن حالة المريض. وتُعد هذه الدراسة إسهاماً علمياً في تأكيد دور التغذية في إدارة داء السكري ومضاعفاته، كما تشير إلى الحاجة لإجراء دراسات إضافية تستقصي إمكانية دمج مكملات الفيتامينات ضمن الخطط العلاجية الشاملة لمرضى السكري، خاصةً المعرضين لمضاعفات عصبية وبصرية.

الكلمات المفتاحية: داء السكري، نقص فيتامين D3 ، نقص فيتامين B12 ، ضعف العصب البصري، اعتلال الشبكية السكري.

1.Introduction

The eye is one of the five human senses and is widely regarded as the most vital, as living without vision is considered extremely difficult. The process of vision is highly complex, with a large portion of the brain dedicated to visual processing compared to all other senses combined. The human visual system operates through a series of steps: light enters through the pupil and is focused on the retina at the back of the eye, which converts the light signals into electrical impulses. These impulses are transmitted via the optic nerve to the brain, where the images are processed (Pineles *et al.*, , 2020)

The optic nerve is one of the primary cranial nerves in the nervous system, known as the second cranial nerve (Meola , 2023). Its main function is to transmit visual signals from the retina to the brain, where visual perception occurs. The optic nerve contains over one million nerve fibers and passes through the optic chiasm, where some fibers cross to ensure integrated vision. Any damage to this nerve can lead to visual impairment or even total vision loss. Common conditions affecting the optic nerve include optic neuritis, glaucoma, and ischemic optic neuropathy. Diagnosis involves tools such as fundoscopy, magnetic resonance imaging (MRI), and optical coherence tomography (OCT). Maintaining eye health through proper



nutrition, regular check-ups, and avoiding increased intraocular pressure can prevent many optic nerve-related conditions (He et al , 2023)

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels due to defects in insulin production or function. There are two main types of diabetes: Type 1, in which the immune system attacks insulin-producing cells in the pancreas, and Type 2, which is caused by insulin resistance or insufficient insulin production. Symptoms include excessive thirst, frequent urination, unexplained weight loss, and chronic fatigue. Poorly managed diabetes can result in serious complications such as cardiovascular disease, neuropathy, kidney failure, and eye disease. Treatment depends on the type of diabetes and includes lifestyle changes, physical activity, medications, or insulin injections. Prevention involves a balanced diet, regular exercise, and continuous monitoring of blood glucose levels (Rachel et al.,, 2023) .

Vitamin D3 (cholecalciferol) is a form of vitamin D essential for bone health, aiding in the absorption of calcium and phosphorus from food. It is naturally synthesized in the skin upon exposure to sunlight and is also found in foods like fatty fish, egg yolks, and fortified dairy products. A deficiency in vitamin D3 may lead to osteoporosis, muscle weakness, and an increased risk of autoimmune diseases. Symptoms of deficiency include fatigue, bone pain, and depression. Recommended daily intake varies with age, but supplementation may be advised in some cases. Regular sun exposure and consumption of vitamin D-rich foods are crucial for maintaining adequate levels in the body (Gallagher& Rosen., 2023).

Vitamin B12, or cobalamin, is a vital nutrient involved in red blood cell formation, nerve health, and cognitive function. It is predominantly found in animal products such as meat, fish, eggs, and dairy, making vegetarians particularly susceptible to deficiency. B12 deficiency may result in anemia, fatigue, weakness, numbness in the limbs, and difficulties with concentration and memory. Its absorption is complex and requires a stomach-produced protein called intrinsic factor. Diagnosis involves blood testing, and treatment may include dietary supplements or B12 injections in severe cases. Maintaining sufficient levels of this vitamin is essential for brain and nervous system health and for preventing related disorders (Halczuk et al , 2023).

3. Materials and Methods

1.3 Study Samples

This study was conducted at specialized medical clinics in the city of Kirkuk. The study samples were divided as follows:



Patient Group: Included 60 individuals diagnosed with strabismus.

Control Group: Included 30 healthy individuals.

2.4 Blood Sample Collection

Blood samples were collected from patients, with 5 mL drawn from the vein. The blood was placed into vacuum glass tubes containing gel and clot activator, without anticoagulant. The samples were left at room temperature for 30 minutes to allow coagulation, then centrifuged at 3000 rpm for 15 minutes to separate the serum. Some laboratory tests were performed immediately after sample preparation.

3.3 Measurement of Vitamin B12 Levels

Vitamin B12 levels were measured using ready-to-use reagent kits manufactured by Roche Diagnostics with the Cobas analyzer. The Cobas system applies electrochemiluminescence immunoassay (ECLIA) technology, based on the interaction between specific antibodies and vitamin B12 in the blood.

4.3 Determination of Serum Vitamin D Levels

The purpose of this test is to quantitatively determine the level of 25-hydroxyvitamin D in serum. This assay is used as an aid in assessing vitamin D adequacy. The electrochemiluminescence binding assay was designed for use with the Cobas and Elecsys immunoassay analyzers (Lewis and Elder, 2008).

5.3 Statistical Analysis

The results obtained in this study were analyzed using the SPSS statistical software. The T-test was employed to compare the means of the patient and control groups at a significance level of ($P \leq 0.05$). The values of the variables were expressed as mean $\pm$ standard deviation (SD).

4. Results and Discussion

4.1 Serum Vitamin D3 Levels

The results of this study showed that vitamin D3 serum levels significantly decreased in those with diabetic retinopathy and optic nerve functionality compared to the healthy control group. Results The mean serum levels of vitamin D3 in cases & controlled groups were 15.78 ± 7.80 mg/ml and 51.84 ± 5.65 mg/ml, respectively which with respect to this criteria statistically highly significant different was observed between two conditions ($P < 0.0001$). This difference is



associated by a very highly significant ($P \leq 0.05$) relationship showing a definite correlation between the deficiency of vitamin D3 and appearance of diabetic neuropathy and retinopathy.

Group	Vitamin D3 (Mean $\pm$ SD)	Significance Level
Patients	15.78 $\pm$ 7.80 B	$P \leq 0.05$
Healthy	51.84 $\pm$ 5.65 A	$P \leq 0.05$

The observed data suggests that monitoring the levels of vitamin D3 may be indication for early detection in diabetic patients, as well as preventive strategies for the disease. Treatment of vitamin D3 might be helpful in decreasing the likelihoods of diabetic retinopathy in subjects at risk, and would significant improve visual function if they were developed with diabetic retinopathy (Satman et al., 2023).

4.2Serum Vitamin B12 Levels

Similarly, a significant decrease ($P < 0.05$) was found in the serum concentration of vitamin B12 measured in patients with diabetic retinopathy and optic nerve involvement when compared to control subjects Table (2): The Mean Level of B12 Vitamin in Patients Group for Our Work Were 460.35 pg/ml $\pm$ 130.23, Also In Control Group Were 721.53 pg/ml $\pm$ 126.69

Group	Vitamin B12 (Mean $\pm$ SD)	Significance Level
Patients	460.35 $\pm$ 130.23 B	$P \leq 0.05$
Healthy	721.53 $\pm$ 126.69 A	$P \leq 0.05$

Table (1) and Table (2) show that vitamin D3 and B12 levels have basically statistical difference in healthy to diabetic patients with higher values found in health instead of diabetes, respectively. These findings indicate a potential beneficial effect of these vitamins on neurological and visual outcomes among diabetics.

Recently, the vitamin many researchers are looking at is B12, and they are questioning if common medications (like metformin) used for type 2 diabetes may be causing B12 levels to drop. An investigation carried out in Jordan revealed that diabetes patients who were using metformin had an increased incidence of



peripheral neuropathy, possibly secondary to vitamin B12 deficiency (Sun et al., 2023).

In addition, a British study reported that currently available routine methods of either screening for or treating vitamin B12 deficiency appear to be effective prevention strategies in the diabetic population to forestall neuropathy. Results from the study suggested that 64% of patients had never been tested for B12 and 9.6% were already deficient in this vitamin Tan et al., 2023; Wang et al., 2018) .

In another study done in Al-Khums, Libya — 1 out of every 5 type 2 diabetics who were using metformin was vitamin B12 deficient. However, this deficiency was unrelated to HbA1c levels, suggesting that it might be more related to the dose and time of use of metformin rather than glycemic control (Wang et al., 2019.)

5.Conclusions

1. Conclusion: The serum level of vitamin D3 showed significant decrease in patients with diabetic retinopathy and optic neuritis as compared to healthy control.
2. A substantial vitamin B12 levels decrease was observed in the same group of patients as well.
3. It is assumed that the deficit of these vitamins D3 and B12 could be involved in the development of diabetic optic neuropathy.
- 4.The findings of the study underscore that it is essential to evaluate these vitamin levels as part of integrated health services for diabetic patients

6.References

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