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Effects of vitamin d supplementation on type 2 diabetes mellitus patients

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ABSTRACT

In Indonesia, around 10.9% of the population has diabetes according to the 2018 basic health research data. It is important for people with diabetes to receive proper treatment to prevent the condition from getting worse. Recently, there have been studies suggesting that taking vitamin D supplements can help improve diabetes. This research aims to explore whether vitamin D supplementation can indeed help control type 2 diabetes mellitus. The approach employed in this investigation entails conducting a comprehensive analysis of existing literature, where relevant articles published in the past 10 years were analyzed based on specific keywords. After finding the appropriate literature, the writing process began. Vitamin D is a substance that acts like a hormone and can increase insulin production in the body. Lot of evidence have shown that taking vitamin D supplements can lower fasting plasma glucose levels, improve insulin resistance, and reduce HbA1c levels when given in high doses over a short period of time. Vitamin D deficiency has also been linked to poor glycemic control in type 2 diabetes mellitus, leading to higher HbA1c levels. Based on the findings from the literature review, it can be concluded that vitamin D supplementation is effective in treating type 2 diabetes mellitus, with a minimum daily dose of 1000 IU. Overall, the evidence suggests that vitamin D supplementation can be a valuable addition to the management of type 2 diabetes mellitus, potentially improving outcomes and overall health in affected individuals. Further research is needed to fully understand the mechanisms behind these benefits and to determine the most effective dosages and treatment protocols.

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INTRODUCTION

Diabetes is a health issue that occurs when the amount of sugar in the blood is higher than normal. Doctors can determine blood sugar levels through tests like HbA1c, fasting blood glucose, and oral glucose tolerance tests. There are various types of diabetes, including type 1, type 2, gestational,

neonatal, and other specific types. Type 2 diabetes commonly affects adults and older individuals who have had elevated blood sugar levels for an extended period or have made poor lifestyle choices (Sapra & Bhandari, 2023; S. A. Soelistijo & et al, 2019).

Diabetes comes in different forms, like type 1, gestational, and neonatal. Type 1 diabetes happens when the immune system attacks insulin-producing cells. Gestational diabetes occurs during pregnancy and usually goes away after giving birth. Neonatal diabetes is rare and happens in infants due to genetic mutations. Managing diabetes involves checking blood sugar levels, eating healthy, exercising, taking medication, and sometimes insulin therapy. It is important to work with healthcare providers to create a personalized treatment plan and make lifestyle changes to stay healthy. Early detection and proper management of diabetes can help lead a fulfilling life.

The increase in diabetes cases worldwide has become a significant concern for public health organizations such as the World Health Organization (WHO). In 2014, the WHO conducted a study that revealed that 8.5% of adults aged 18 and above were living with diabetes. This statistic highlighted the growing prevalence of the disease and the need for effective prevention and management strategies. By 2019, the impact of diabetes had become even more alarming, with the disease causing 1.5 million deaths globally. What was particularly concerning was that almost half of these deaths occurred before individuals reached the age of 70. This highlighted the fact that diabetes was not only affecting older adults but also impacting individuals in their prime years of life.

The number of people living with diabetes continued to rise steadily from 2000 to 2019, with a 3% increase observed during this period (WHO, 2023). This upward trend indicated that the global burden of diabetes was not only persisting but also intensifying. It became evident that urgent action was needed to address the risk factors associated with the disease and to improve access to diabetes prevention and management services. The impact of diabetes was not evenly distributed across countries and income levels. Lower middle-income countries experienced a particularly significant increase in diabetes mortality rates, with a 13% rise observed. This highlighted the need for targeted interventions and support in these regions to address the specific challenges they faced in managing and preventing diabetes.

In Indonesia, the situation was also concerning. According to the Basic Health Research (RISKESDAS), the percentage of diabetes cases in the country increased to 10.9% in 2018 (Riskesdas, 2018). This was a significant jump compared to the data from 2013, indicating a rapid increase in the prevalence of diabetes within a relatively short period. This rise in diabetes cases in Indonesia mirrored the global trend and emphasized the need for comprehensive strategies to tackle the disease at a national level. Overall, the statistics and data presented by the WHO and other research organizations highlighted the urgent need for global and local efforts to address the growing burden of diabetes. It was clear that diabetes was a major public health issue that required a multi-faceted approach, including prevention, early detection, improved access to healthcare, and effective management strategies. By taking action to address the risk factors and provide support to individuals living with diabetes, it was possible to reduce the impact of the disease and improve the overall health and well-being of populations worldwide.

People who have diabetes need to get the right treatment to stop their symptoms from getting worse and to avoid any other problems. Treatment can include teaching patients about diabetes, giving them medicine, or suggesting they take extra vitamins (Sapra & Bhandari, 2023). Recent studies show that taking vitamin D supplements could help improve blood sugar levels in people with Type 2 Diabetes. Essentially, vitamin D supplementation elevates serum Calcifediol or 25(OH)D levels, leading to a reduction in insulin resistance and improved management of blood glucose levels (Lee et al., 2017; Li et al., 2018). Moreover, a research conducted by Hu et al. revealed that participants who were given a brief period of vitamin D supplementation witnessed a reduction in HbA1c levels and an improvement in insulin resistance when compared to individuals in the placebo group (Hu et al., 2019). Even though there has been some debate about

how vitamin D supplements affect glucose metabolism in T2DM patients, this study was done to learn more about how taking vitamin D could help manage T2DM.

The urgency of this research is driven by several important factors related to type 2 diabetes mellitus and the potential benefits of vitamin D supplementation in its management. Type 2 diabetes mellitus is a global health problem with a continuously increasing prevalence and significant impact on individuals' health and quality of life (Anggraeni et al., 2022). With the rising prevalence of diabetes, research on the effects of vitamin D supplementation in type 2 diabetes patients becomes crucial as it can provide new insights into managing this condition. Additionally, evidence suggests that vitamin D supplementation can influence glucose metabolism and insulin resistance, further emphasizing the urgency to explore the potential benefits of vitamin D in controlling type 2 diabetes. Therefore, this research is expected to provide a deeper understanding of the effects of vitamin D supplementation in type 2 diabetes mellitus patients. Consequently, this study can provide a strong scientific basis to support the use of vitamin D as part of an effective diabetes management strategy. Furthermore, this research is expected to contribute to efforts in preventing type 2 diabetes by highlighting the potential of vitamin D in reducing the risk of developing this disease. Thus, this study can assist in designing more holistic and effective prevention strategies to address the burden of type 2 diabetes mellitus globally.

RESEARCH METHOD

Current study used different sources of literature to learn more about how Vitamin D Supplementation affects patients with Type 2 Diabetes Mellitus. In this research, a systematic approach was taken to analyze the sources of reading material. Firstly, the focus was on finding articles related to Diabetes Mellitus, Supplementation, and Vitamin D that were published within the past decade. Moving forward, reputable platforms such as Pubmed, Google scholar, Medline, Ebsco, Hindawi, Science direct, and Cochrane search engines were utilized to search for these sources.. Upon compiling all pertinent literature, we commenced the composition of my manuscript. The gathered literature will be systematically arranged, commencing with the definition, epidemiology, risk factors, mechanism of action of vitamin D on T2DM, and culminating with the evaluation of vitamin D supplementation's efficacy in diminishing the likelihood of developing Type 2 Diabetes Mellitus in patients.

RESULTS AND DISCUSSIONS

Type 2 Diabetes Mellitus

Diabetes is a long-term metabolic condition where blood sugar levels remain high due to issues with insulin production or insulin resistance (Goyal et al., 2023). Diabetes is a serious worldwide issue that can result in death and cause problems that greatly affect quality life. (WHO, 2020). There are two primary forms of diabetes: type 1, commonly referred to as juvenile-onset diabetes, and type 2, also known as adult-onset diabetes. Type 2 diabetes, also called DMT2, accounts for more than 90% of diabetes cases. It occurs when the body develops resistance to insulin and fails to produce an adequate amount of it. (Galicia-Garcia et al., 2020; Genuth et al., 2018). DMT2, also known as Type 2 diabetes, is a condition that we don't fully understand the exact cause of. However, there are several factors that play a role in its development. Things like the way we live our lives, our family history, how old we are, and even our race can all contribute to the occurrence of DMT2. Other risk factors include a history of prediabetes, being overweight, lack of physical activity, and a history of gestational diabetes in women (CDC, 2022). Signs of type 2 diabetes might consist of feeling really thirsty, going to the bathroom a lot, feeling tired, having no energy, wounds that take a long time to heal, tingling in the hands or feet, and having trouble seeing clearly (Goyal et al., 2023). Diagnosis can be confirmed by conducting a blood sugar test, with the diagnostic criteria which set by PERKENI (S. Soelistijo, 2021).

The main goal of managing diabetes mellitus is to enhance the overall well-being of patients by making adjustments to their lifestyle, engaging in physical activities, taking antidiabetic medications, and using insulin when necessary (Goyal et al., 2023; S. Soelistijo, 2021). Until now, there is no medicine that can cure diabetes mellitus, which highlights the significance of taking preventive actions to reduce the impact of this disease on people's health and lives (Ismail et al., 2021; WHO, 2020).

Vitamin D

Vitamin D is a really important type of nutrient that our body needs. It's a special kind of nutrient that dissolves in fat and helps our bones stay healthy. One of the main things it does is help our body absorb calcium, magnesium, and phosphate, which are all really important for our bones (Sizar et al., 2023). Vitamin D is mostly produced in the skin through synthesis. Deficiencies in vitamin D often occur due to inadequate sunlight exposure or reduced skin synthesis (Dominguez et al., 2021). Additionally, vitamin D can be obtained from various animal and plant-based foods. Cholecalciferol, derived from animals, can be found in foods like salmon, tuna, eggs, beef, and chicken. On the other hand, ergocalciferol, derived from plants, is present in mushrooms, broccoli, carrots, almonds, as well as fruits such as apples and bananas (Dominguez et al., 2021; Khan et al., 2022). When sunlight hits our skin, a process called synthesis of vitamin D begins. It starts with previtamin D transforming into provitamin D, also known as 7-dehydrocholesterol (Bikle, 2021; Christakos et al., 2015; Dominguez et al., 2021).

Vitamin D goes through a process in the body called hydroxylation, which leads to the creation of two different compounds: calcitriol (also known as 1,25-dihydroxyvitamin D3) and calcidiol (also known as 25-hydroxyvitamin D3). Among these compounds, calcitriol is considered the active form of vitamin D and it has a relatively short half-life of around 15 hours. On the other hand, calcidiol exhibits a much longer half-life of about 15 days (Bikle, 2021; Christakos et al., 2015). Calcifediol (25(OH)D) changes into 1,25-dihydroxyvitamin D with the help of α-hydroxylase enzymes found in both the kidneys and other parts of the body. After the conversion, this active form of vitamin D plays different important roles in the body (Bikle, 2021; Christakos et al., 2015; Dominguez et al., 2021). Vitamin D not only helps control parathyroid hormone, calcium, and phosphorus levels, but it also plays a role in insulin production, regulates the activation of T and B lymphocytes, and affects heart contractility (Chauhan et al., 2023). Presently, vitamin D analogs are widely employed for the treatment of hypocalcemia, osteoporosis, and as a prophylactic measure against corticosteroid-induced osteoporosis. These analogs can be administered through intravenous, oral, or topical routes (Ohyama & Shinki, 2023).

Vitamin D's ability to help produce insulin is greatly affected by 1,25(OH)2-calcitriol. This compound primarily works to boost the activity of pancreatic β cells by aiding in the entry of calcium ions (Galuşca et al., 2022; Wang et al., 2020). This step plays a vital role in the process of insulin secretion that occurs when blood sugar levels are high. It ultimately leads to the release of insulin from its vesicles (Galuşca et al., 2022; Ubaeed & Marjani, 2023). Moreover, vitamin D also contributes to reducing the production of pro-inflammatory cytokines while enhancing the creation of anti-inflammatory cytokines. These dual functions have implications for type 2 diabetes (DMT2) where insulin resistance is linked to chronic inflammation, mitochondrial dysfunction, and oxidative stress (Galuşca et al., 2022; Wenclewska et al., 2019). Many research studies have found a link between not having enough vitamin D and the risk of developing type 2 diabetes, which backs up the suggested explanations (Karonova et al., 2020; Wang et al., 2020; Wenclewska et al., 2019).

The connection between giving Vitamin D supplements to individuals with Type 2 Diabetes Mellitus

Vitamin D, a hormone-like substance, has been proven to boost the production of insulin in the human body when everything is working as it should, and it also helps maintain a healthy level of glucose in the body (Chunfeng Wu et al., 2023). Farahmand et al. propose that giving

T2DM patients high doses of vitamin D for a short period can help lower fasting plasma glucose and HbA1c levels (Farahmand et al., 2023). In the same way, Hu et al. found that giving vitamin D for a short period of time resulted in lower HbA1c levels and better insulin resistance when compared to those who received a placebo (Hu et al., 2019).

Md Isa et al. (2023) discovered a link between low vitamin D levels and bad blood sugar control in people with type 2 diabetes (DMT2), resulting in higher HbA1c levels. In a similar vein, Li et al. found that taking vitamin D supplements can help lower insulin resistance and boost levels of serum 25(OH)D. They discovered that higher doses of vitamin D given for a short period of time were especially effective in achieving these results (Li et al., 2018).

Wang et al. (2020) propose that having higher levels of 25OHD in the bloodstream can lower the chances of getting DMT2. This is because vitamin D helps improve how sensitive insulin is, which then reduces the risk of diabetes. In line with this idea, Karonova et al. (2020) uncover that taking 40,000 IU of vitamin D per week led to a drop in HbA1c levels for individuals with DMT2.

A recent investigation carried out by Chunhua Wu et al. (Chunhua Wu et al., 2017) has uncovered an intriguing relationship between vitamin D supplements and type 2 diabetes. The research demonstrated that the administration of vitamin D supplements can result in a reduction in HbA1c and fasting plasma glucose levels among individuals with type 2 diabetes. This underscores the significance of maintaining adequate levels of vitamin D to prevent deficiencies and disruptions in glucose homeostasis. In a separate study conducted by Rafiq & Jeppesen, it was discovered that the active form of vitamin D, 1,25-hydroxy, plays a critical role in the development of the metabolic system (Rafiq & Jeppesen, 2021). This encompasses the functionality of beta cells in the pancreas, which are accountable for insulin production. Inadequate levels of vitamin D can influence insulin resistance by impacting the synthesis and release of insulin from beta cells.

Galusca et al. propose an interesting viewpoint indicating that brief vitamin D supplementation can greatly impact HbA1c levels in individuals with DMT2. They suggest that this impact is due to receptor reactions that reduce insulin resistance and insulin production in DMT2 patients. Therefore, vitamin D may be viewed as a valuable supplementary treatment for those with diabetes (Galuşca et al., 2022).

CONCLUSION

Our research has explored the intricate connection between vitamin D supplementation and Type 2 Diabetes Mellitus (T2DM). The high prevalence of T2DM and its impact on global health emphasize the need to investigate additional therapies to improve current management strategies. Our study aimed to overcome existing limitations and provide new insights into the potential benefits of vitamin D in T2DM. The results of our literature review highlight a strong link between vitamin D supplementation and better glycemic control. Studies consistently show that a daily dose of at least 1000 IU can lead to lower fasting plasma glucose levels, improved insulin sensitivity, and reduced HbA1c levels. These findings suggest that vitamin D could be a valuable addition to T2DM management.

The limitations of this study include limited research methods, incomplete data, and limited generalization of results. For future research, it is recommended to expand the sample size, use a more comprehensive research design, collect more complete data, and conduct longitudinal studies. With these steps, further research in this field is expected to provide deeper and more relevant insights into the relationship between vitamin D supplementation and the management of type 2 diabetes mellitus. The varying lengths of interventions also indicate the need for more research to understand the long-term effects of vitamin D supplementation. While our study adds to the existing knowledge, further research is needed to address these complexities and refine clinical recommendations. As we continue to navigate the evolving field of diabetes management, exploring the potential of vitamin D remains a crucial area of investigation.

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