University of Thi-Qar Journal of Science (UTJsci)
E-ISSN: 2709-0256, P-ISSN: 1991-8690, Vol. 13, No. 1, Jun. 2026

The association among vitamin D and lipids in Pediatric Population with type 1 diabetes

Abrar Dawood Salman *[1a], Doaa Dawood Salman[2b] ,Rahma Dawood Salman[3c] and Noor Thair Tahir[4d]

[1]*College of Education for Pure Sciences, University of Anbar, Ramadi, Iraq.*
[2]*College of Medicine, University of Fallujah, Fallujah, Iraq.*
[3]*Department of fuel and Energy Techniques Engineering, Al-Huda University College, Ramadi, Iraq.*
[4]*National Diabetes Center/Mustansiriyah University, Baghdad, Iraq.*
[b]E-mail: doaa.med@uofallujah.edu.iq.
[c]E-mail: rahma.dawood@uoalhuda.edu.iq. [d]E-mail: dr.noorthair.ndc@uomustansiriyah.edu.iq
[a*]Corresponding author: abrar.dawood@uoanbar.edu.iq.

Received: 25-02-2026, Revised: 29-04-2026, Accepted: 12-05-2026, Published: 01-06-2026

***Abstract*— In pediatric populations with Type 1 Diabetes Mellitus (T1DM), an autoimmune condition brought on by the destruction of pancreatic β-cells and a complete lack of insulin, vitamin D deficiency is a serious problem. The aim of the study is to investigate the prevalence of vitamin D deficiency among Iraqi pediatric patients and healthy individuals (all aged between 4 and 18 years).The study involved 80 pediatric patients with T1DM and 40 individuals healthy, among the biochemical markers examined it Vitamin D levels and lipid functions involved total cholesterol (TC), triglycerides (TG), low-density lipoprotein (LDL) and high-density lipoprotein (HDL) also measure fasting blood glucose (FBS), and glycated hemoglobin (HbA1c).After examining the results, following analysis of the data, it was discovered to rise with a highly significant difference ($p \leq 0.001$) of the TC, LDL, FBS, and HbA1c levels as compared to the healthy group. The results also revealed decreased serum levels of HDL and vitamin D3, with a very significant difference ($p \leq 0.001$). In contrast, levels were high both TG and VLDL with a significant difference ($p < 0.05$). The study found the patients have a relatively high rate of vitamin D deficiency, therefore, early childhood is the optimal time to begin screening and treatment for vitamin D deficiency.**

***Keywords* — Vitamin D Deficiency, Pediatric population , Dyslipidemia, Type 1 Diabetes Mellitus (T1DM).**

I. INTRODUCTION

The chronic autoimmune disease known as type 1 diabetes mellitus (T1DM) is characterized by the selective destruction of the pancreatic beta cells that secrete insulin. Insulin promotes the transport of glucose across the cell membrane then the phosphorylation , which is essential for glucose metabolism and allowing cells to use adenosine triphosphate (ATP) as fuel. Insulin also controls excess glucose by either sending it to adipose tissue or stimulating the liver to store it as glycogen. T1DM, among the most common endocrine conditions worldwide , it mostly affects pediatric population and is caused by an insulin shortage [1-2] healthcare professionals use subcutaneous insulin injections to lower blood glucose levels to treat this disorder. To avoid potentially fatal consequences including diabetic ketoacidosis, diabetic coma, and eventually death [3]. Approximately 1.2 million individuals in the pediatric population worldwide have type 1 diabetes, according to the International Diabetes Federation Diabetes Atlas 2021 [4]. The fat-soluble vitamin D is called calciferol that contributes to bone strength and growth by regulating the equilibrium of phosphorus and calcium[5-6]. Due to the significant Prevalence of vitamin D deficiency among pediatric populations with type 1 diabetes, researchers are paying close attention to studying vitamin D levels in this cohort. Nevertheless, vitamin D deficiency is common among the general population and is not exclusively limited to those with type 1 diabetes [7-8] it is the identification of vitamin D receptors in a number of organs and systems, such as immune cells and pancreatic β cells, has caused researchers to concentrate more on the effects of vitamin D outside of the skeleton [9] 25OHD deficiency is a major health concern, having been linked to autoimmune diseases, cancer, inflammatory diseases, and cardiovascular disease [10-11] low levels of 25OHD can cause an inflammatory state in the pancreatic islets disrupting the equilibrium between insulin sensitivity and secretion this imbalance may contribute to type 2 diabetes (2DM) and insulin resistance [12-13].Additionally, because insulin secretion depends on calcium, vitamin D influences glucose homeostasis both directly through its impact on beta cells and indirectly through calcium regulation [14-15].Studies have proven the existence of a link between vitamin D deficiency and dyslipidaemia, which indicates that the effect of vitamin D extend beyond immune system represented lipid metabolism disorders, lipids are distributed all over the body and play important and effective roles in living organisms due to their involvement in various essential life functions, many

https://doi.org/10.32792/utq/utjsci/v13i1.1576

autoimmune diseases may be directly related to the amount of lipid molecules in the serum [16-17] there is mounting evidence that blood lipid levels alter before to the appearance of type 1 diabetes and even prior to the production of autoimmune antibodies [18-19] pediatric population with type 1 diabetes mellitus [T1DM] frequently has metabolic disorders such as hyperglycaemia and dyslipidaemia, which both raise the risk of cardiovascular disease (CVD) Atherosclerosis may develop earlier in life in T1DM patients, increasing morbidity and death in comparison to the general population [20-21]. The goal of this study was to measure vitamin D and determine the association between it and other metabolic disorders such as dyslipidaemia .in the Iraqi pediatric population with T1DM, As a result of the spread of vitamin D deficiency among this group.

II. Materials and Methods

The pediatric population, aged (4 -18 years) participated in the study and were categorized into two groups: 40 healthy people from the general population and 80 patients from the National Diabetes Center at Al-Mustansiriya University. Data on height and weight were recorded to calculate the Body Mass Index (BMI). 2 mL of venous blood were collected following a 12-hour fast, and they were allowed to clot for 30 minutes at room temperature; subsequently serum was separated using centrifugation for 10 minutes at 3500 rpm. Using enzyme colorimetric assay kits (Biosystems, Spain), serum levels of FBS, HDL-c, TG and TC were measured. Glycated hemoglobin (HbA1c) levels were measured via high-performance liquid chromatography (HPLC) (Bio-Rad, USA), and vitamin D3 levels were measured using a competitive ELISA test kit (Abbott Diagnostics, USA).The levels of LDL-c and VLDL-c were calculated using the Friedewald equation[1] as follows: VLDL-c = TG/5, and LDL-c = TC – HDL-c – (TG/5).

To analyses the results statistically, the program used, SPSS 26 and Origin 2024, the following tests were used to examine the results:

- (T-test): if the difference between any two groups' means has a ($p< 0.05$) was considered significant.
- To assess the strength of the relationship between vitamin D and other variables, Pearson's test was used.

III. Results

The clinical and anthropometric information for the patient group and the healthy group is displayed in Table 1 when comparing the healthy with the patient group, discovered FBS, HbA1c, TC, and LDL levels were high with a highly significant difference ($p \leq 0.001$), but D3 and HDL levels were low with a highly significant difference($p \leq 0.001$), While level of both (TG and VLDL-c) were rise with a significant difference ($p < 0.05$), although Age and BMI showed no significant differences. To determine the status and strength of the correlation among Vitamin D and the other of the parameters, used Pearson's test, where found Weak negative correlation was with each of (Age, w.t, hight, BMI, HbA1c, TG and HDL) while a Found weak positive correlation with each of (FBS, TC, VLDL and LDL) as shown in Table 2 and Fig.1

TABLE 1. [Mean±SD) clinical and anthropometric property of the studied groups

Parameter	Means ±SD		P-value
	Control [N.40]	Patient [N.80]	
Age(year)	13.52±1.67	13.07±3.43	N. S
BMI (kg/m²)	20.7±2.39	20.3±5.58	N. S
FBS [mg/dl)	80±6.80	253.28±82.96	≤.001
HbA1c [%)	5.20±0.46	11.38±10.59	≤0.001
TC [mg/dl)	125±14.38	179 ±34.66	≤0.001
TG [mmol/L)	83.25±6.98	91.90±24.64	<0.05
HDL -c [mg/dl)	55.47±3.32	46.43±9.17	≤.001
LDL-c [mg/dl)	86.17±15.93	114.38±37.09	≤0.001
VLDL-c [mg/dl)	16.6±1.39	18.38±4.92	<0.05
D3 (ng/ml)	33.33 ±5.91	9±1.97	≤ 0.001

TABLE 2. Correlations between vitamin D activity and other variables Patient group

Parameter	Vitamin D		Correlation state
	r	P- value	
Age	-0.056	0.621	Weak negative correlation
BMI	-0.133	0.239	Weak negative correlation
FBS	0.220*	0.049	Weak positive correlation
HbA1c	-0.06	0.59	Weak negative correlation
TC	0.012	0.917	Weak positive correlation
TG	-0.024	0.835	Weak negative correlation
HDL	-0.074	0.512	Weak negative correlation
LDL	0.033	0.774	Weak positive correlation
VLDL	-0.032	0.775	Weak negative correlation

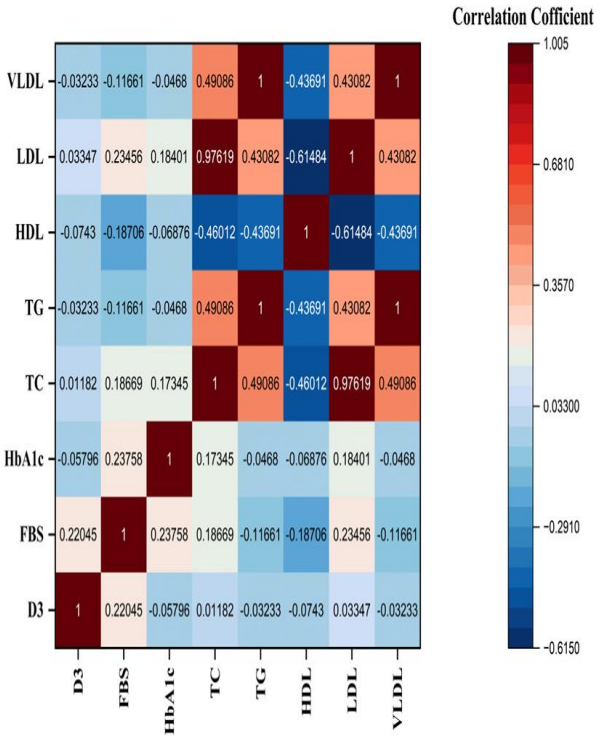

Fig.1: Pearson's correlation coefficient analysis of clinical parameter for patients .

IV. DISCUSSION

Type 1 diabetes is one of the more familiar hormonal disturbances among pediatric population worldwide, negatively impacting their lives, Vitamin D deficiency is one of the most prevalent health common faced by the pediatric population with type 1 diabetes which is consider a modifiable factor that plays a role in preventing T1DM disease complications, Low vitamin D levels were found in pediatric population with type 1 diabetes in our current study, which is consistent with [22-23], research shows a connection among vitamin D lack and type 1 diabetes where vitamin D is transformed in the liver to 25-hydroxyvitamin D, the form measured in the blood and used as a marker for determining vitamin D levels in the body, Type 1 diabetes reduces the liver's ability to convert vitamin D, leads to an increased rate of metabolism of the active form, $1,25(OH)_2D$, lowering the body's concentration [24]. Because vitamin D is important for regulating blood sugar, people with low vitamin D levels are more likely to develop diabetic ketoacidosis (DKA), a complication of type 1 diabetes, or experience more severe episodes, there may be several reasons for this association, Vitamin D is known to play a major role in supporting the immune system, providing protection against viral and bacterial infections, which are common triggers of DKA, the metabolic acidosis associated with DKA also leads to increased urinary calcium excretion in an effort to make up for this loss, the body releases more parathyroid hormone (PTH), which speeds up the turning of 25(OH)D to $1,25[OH)_2D$ its active shape the body's supplies of vitamin D are eventually depleted by this quick conversion, also indicated that ketoacidosis may take down levels of vitamin D-binding protein, which is necessary for the vitamin's transportation in the bloodstream [25]. In addition, depressed vitamin D levels are linked with lack of exposure to sunlight or failure to take vitamin D supplements [26].The pediatric population with diabetes often experience flux in fasting blood sugar and HbA1C levels, and that proper management of their insulin regimen and carbohydrate intake is essential to avoid these fluctuations in blood sugar control and maintain their health [27] multiple factors contribute in these rise levels of hyperglycaemia and HbA1c, mismatches in insulin doses and carbohydrate intake may contribute to hyperglycaemia [28] our study found, consistent with previous studies [29].According to recent studies, there is a link among vitamin D lack and dyslipidaemia, identify by decrease high-density lipoprotein cholesterol (HDL-c), high triglycerides (TG) and high low density lipoprotein (LDL-c) in the pediatric population with type 1 diabetes this is identical to what we have found and consistent with previous [30-31] ,this occurs because the enzyme responsible for metabolizing triglycerides, known as lipoprotein lipase (LPL), is regulated by vitamin D. Vitamin D deficiency leads to the activity of this enzyme decreases and leads to the accumulation of triglycerides in the blood [32], in addition Vitamin D deficiency impairs insulin signalling in fat cells, leading to increased free fatty acid (FFA) release and consequently increased hepatic triglyceride synthesis, ABCA1 helps transport cholesterol and some fats known as phospholipids across the cell membrane to the outside. When vitamin D, which is responsible for regulating this transporter, is deficient, the production of high-density lipoprotein decreases [33]. Furthermore, as a result of vitamin D's role in inhibiting PCSK9, which controls the degradation of LDL receptors, individuals with vitamin D deficiency have 25% higher LDL levels than their peers with sufficient levels [34]. There is proof that hypercholesterolemia is a major factor in the progression of atherosclerosis and that it starts early in life ,total cholesterol (TC) in children should normally be less than 170 mg/dl, serum cholesterol levels between 170-199 mg/dL are borderline, whereas those over 200 mg/dL are regarded as elevated, or hypercholesterolemic. In this study, level of total cholesterol was significantly higher in pediatric population diabetic compared with healthy group, this similar to found in other investigations [35].

V. CONCLUSION

According to the study, the pediatric population with T1DM is often deficient in vitamin D and has elevated (TG, TC, LDL-c, VLDL-c, FBS, and HbA1c), as well as low (HDL-c), these metabolic disorders increase the risk of cardiovascular diseasebecause (CVD) because the enzyme responsible for triglyceride metabolism, known as lipoprotein lipase (LPL), and the ABCA1 transporter are regulated by vitamin D. Therefore, measuring vitamin D levels, lipid profiles, and glycemic indices is important biochemical indicators for assessing health status, and early childhood is the optimal time to begin screening and treatment for vitamin D deficiency.

CONFLICT OF INTEREST

Authors declare that they have no conflict of interest.

REFERENCES

[1] A. Chadt and H. J. P. A.-E. J. o. P. Al-Hasani, "Glucose transporters in adipose tissue, liver, and skeletal muscle in metabolic health and disease," *Pflügers Archiv-European Journal of Physiology*, vol. 472, no. 9, pp. 1273-1298, 2020.

[2] M. R. Alkubaisi, A. S. Lateef, A. D. Salman, N. T. Tahir, and A. R. J. a. Al-Abdaly, "Estimation of Prolactin Level in Iraqi Diabetic Women of Menopause," *Atherosclerosis*, vol. 17, no. 2, pp. 165-171, 2023.

[3] A. Arafat et al., "Glucagon increases circulating fibroblast growth factor 21 independently of endogenous insulin levels: a novel mechanism of glucagon-stimulated lipolysis?," *Diabetologia*, vol. 56, no. 3, pp. 588-597, 2013.

[4] G. Muscogiuri et al., "Mechanisms in endocrinology: vitamin D as a potential contributor in endocrine health and disease," *The European Journal of Endocrinology*, vol. 171, no. 3, pp. R101-R110, 2014.

[5] J. Tuomilehto, G. D. Ogle, N. A. Lund-Blix, and L. C. J. P. e. r. P. Stene, "Update on Worldwide Trends in Occurrence of Childhood Type 1 Diabetes in 2020,"

Pediatric Endocrinology Reviews: PER, vol. 17, no. Suppl 1, pp. 198-209, 2020.

[6] Q. Mansi and A. J. P. J. M. H. S. Aziz, "Comparative study between diabetes mellitus and nondiabetic mellitus toward vitamin D deficiency in children under five year," *Pakistan Journal of Medical and Health Sciences*, vol. 15, pp. 818-22, 2021.

[7] E. Mihoubi et al., "Metabolic imbalance and vitamin D deficiency in type 1 diabetes in the Algerian population," *Endocrine, Metabolic & Immune Disorders - Drug Targets*, vol. 19, no. 8, pp. 1172-1176, 2019.

[8] J. S. Adams, M. J. T. J. o. C. E. Hewison, and Metabolism, "Update in vitamin D," *The Journal of Clinical Endocrinology & Metabolism*, vol. 95, no. 2, pp. 471-478, 2010.

[9] A. Zittermann, S. J. S. Prokop, Vitamin D, and S. Cancer, "The role of vitamin D for cardiovascular disease and overall mortality," *Springer Nature*, pp. 106-119, 2015.

[10] C. S. Zipitis and A. K. J. A. o. d. i. c. Akobeng, "Vitamin D supplementation in early childhood and risk of type 1 diabetes: a systematic review and meta-analysis," *Archives of disease in childhood*, vol. 93, no. 6, pp. 512-517, 2008.

[11] E. J. E. P. Barengolts, "Vitamin D and prebiotics may benefit the intestinal microbacteria and improve glucose homeostasis in prediabetes and type 2 diabetes," *Endocrine Practice*, vol. 19, no. 3, pp. 497-510, 2013.

[12] D. D. Salman, "Covid 19 Infection," *International Journal for Research in Applied Sciences and Biotechnology*, vol. 8, pp. 140-137, 2021.

[13] B. Billaudel, L. Barakat, A. J. D. Faure-Dussert, and metabolism, "Vitamin D3 deficiency and alterations of glucose metabolism in rat endocrine pancreas," *Diabetes & Metabolism*, vol. 24, no. 4, pp. 344-350, 1998.

[14] I. Sergeev and W. J. E. Rhoten, "1, 25-Dihydroxyvitamin D3 evokes oscillations of intracellular calcium in a pancreatic beta-cell line," *Endocrinology,* vol. 136, no. 7, pp. 2852-2861, 1995.

[15] I. Syed et al., "PAHSAs attenuate immune responses and promote β cell survival in autoimmune diabetic mice," *The Journal of Clinical Investigation*, vol. 129, no. 9, pp. 3717-3731, 2019.

[16] W. Sun et al., "Lipid metabolism: immune regulation and therapeutic prospectives in systemic lupus erythematosus," *Frontiers in Immunology*, vol. 13, p. 860586, 2022.

[17] K. Herzog et al., "Alterations in biomarkers related to glycemia, lipid metabolism, and inflammation up to 20 years before diagnosis of type 1 diabetes in adults: findings from the AMORIS cohort," *Diabetes Care*, vol. 45, no. 2, pp. 330-338, 2022.

[18] D. La Torre et al., "Decreased cord-blood phospholipids in young age–at–onset type 1 diabetes," *Diabetes*, vol. 62, no. 11, pp. 3951-3956, 2013.

[19] K. C. Donaghue et al., "Microvascular and macrovascular complications in children and adolescents," *Pediatric Diabetes*, vol. 15, 2014.

[20] A. D. Salman and M. J. J. A. o. t. R. S. f. C. B. Al-Shammaa, "Effect of Osteopontin and Other Biochemical Markers on Iraqi Women with Osteoporosis," *Annals Of The Romanian Society For Cell Biology*, vol. 25, no. 3, pp. 2264-2268, 2021.

[21] A. Vargas-Vázquez et al., "Comparative assessment of LDL-C and VLDL-C estimation in familial combined hyperlipidemia using Sampson's, Martin's and Friedewald's equations," *Lipids in Health and Disease*, vol. 20, no. 1, p. 46, 2021.

[22] S. Savastio et al., "Vitamin D deficiency and glycemic status in children and adolescents with type 1 diabetes mellitus," *Plosone*, vol. 11, no. 9, p. e0162554, 2016.

[23] D. Gülcü Taşkın, H. Onal, A. Ersen, and E. J. C. M. Adal, "Significant vitamin D deficiency in children ID and adolescents with type 1 diabetes mellitus: a cross-sectional study," *Comprehensive Medicine*, vol. 12, no. 3, pp. 217-221, 2020.

[24] L.-P. He, Y.-X. Song, T. Zhu, W. Gu, and C.-W. J. J. o. D. R. Liu, "Progress in the relationship between vitamin D deficiency and the incidence of type 1 diabetes mellitus in children," *Journal of Diabetes Research*, vol. 2022, no. 1, p. 5953562, 2022.

[25] X. Yang, H. Jiang, M. Liao, M. Lin, and J. J. F. i. P. Wu, "Construction of a nomogram for predicting serum vitamin D deficiency in children/adolescents with new-onset type 1 diabetes: a single-center study in China," *Frontiers in Pediatrics*, vol. 13, p. 1554833, 2025.

[26] M. M. Mendes, K. H. Hart, E. L. Williams, J. Mendis, S. A. Lanham-New, and P. B. J. T. J. o. n. Botelho, "Vitamin D supplementation and sunlight exposure on serum vitamin D concentrations in 2 parallel, double-blind, randomized, placebo-controlled trials," *The Journal of Nutrition*, vol. 151, no. 10, pp. 3137-3150, 2021.

[27] C. Tully, L. Aronow, E. Mackey, and R. J. C. d. r. Streisand, "Physical activity in youth with type 1 diabetes: a review," *Current Diabetes Reports*, vol. 16, no. 9, p. 85, 2016.

[28] J. A. Pivovarov, C. E. Taplin, and M. C. J. P. d. Riddell, "Current perspectives on physical activity and exercise

for youth with diabetes," *Pediatric Diabetes*, vol. 16, no. 4, pp. 242-255, 2015.

[29] S. F. Al-Saadi, M. A. Al-Nuaimi, and S. M. J. I. j. o. I. T. Al-Maamouri, "Dyslipidemia among Diabetic Children in Baghdad," *International journal of Information Technology*, vol. 40, pp. 500-511, 2021.

[30] G. D. Zambrana-Calví, E. Palomo-Atance, M. E. Gourdet, A. León-Martín, M. J. Ballester-Herrera, and P. J. E. y. N. Giralt-Muiña, "Lipid changes and their relationship with vitamin D levels in children under 18 years with type 1 diabetes," *Endocrinología y Nutrición*, vol. 63, no. 3, pp. 126-131, 2016.

[31] H. Soliman and A. J. E. P. A. G. Ibrahim, "Prevalence and pattern of dyslipidemia in an Egyptian children and adolescents with type 1 diabetes," *Egyptian Pediatric Association Gazette*, vol. 69, no. 1, p. 21, 2021.

[32] D. Guggisberg et al., "Molecular effects of the consumption of margarine and butter varying in trans fat composition: a parallel human intervention study," *Lipids in Health and Disease*, vol. 21, no. 1, p. 74, 2022.

[33] R. Nufer et al., "International Society for Pediatric and Adolescent Diabetes," *Hormone Research*, vol. 50, pp. 107-140, 1998.

[34] H. Alasbily, S. Abdalrahman, M. Netfa, A. Elemmami, A. J. A. J. o. M. Aldebani, and A. Sciences, "The association between vitamin D status and glycemic control in children and adolescents with type 1 diabetes," *AlQalam Journal of Medical and Applied Sciences*, pp. 470-476, 2024.

[35] A. L. Monteiro et al., "Lipid profile of children and adolescents with type 1 diabetes mellitus," *Soc. Bras. Pediatr*, vol. 170, pp. 170-199, 2020.