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Original Research Paper

To Determine Vitamin D, Cholesterol, Triglycerides, HDL, LDL, and VLDL Play Roles in Pre- and Post-Menopausal Women with Type 2 Diabetes.

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ABSTRACT:
The two most common long-term health issues that cause cardiovascular disease in women after menopause are glucose homeostasis and abnormal vitamin D levels. An increased risk of type 2 diabetes mellitus (T2DM) may be linked to insufficient vitamin D levels. Vitamin D level in connection to glycemic indices and metabolic parameters was examined in this study of premenopausal and postmenopausal women with type 2 diabetes. Using SPSS software, researchers compared premenopausal and postmenopausal type 2 diabetic women by measuring their fasting blood glucose, lipid profile, and vitamin D levels. Serum levels of HDL-C and vitamin D fell considerably in postmenopausal T2DM women compared to the premenopausal group, while levels of FBG, TC, TAG, LDL-C, increased significantly ($p<0.001$). At $p<0.05$, there was a negative correlation between vitamin D and LDL-C. There was a robust inverse relationship between low vitamin D levels and metabolic or lipid parameters. While low HDL-C levels are associated with menopause, this study revealed no correlation between low HDL-C and low vitamin D levels in postmenopausal type 2 diabetic women. The current analysis delves at the link between vitamin D and cholesterol. Postmenopausal women with type 2 diabetes who also have dyslipidemia are at an increased risk for cardiovascular illnesses, according to this study's results.

Keywords: Type 2 Diabetes Mellitus, Menopause, glucose homeostasis, vitamin-D, Glycemic indices.

INTRODUCTION:

Type 2 Diabetes Mellitus (T2DM), caused by insulin deficiency or insufficiency, is a metabolic disease and prominent lifestyle disorder. Abnormal lipid metabolism is one of the major factors contributing to increased cardiovascular risk in patients with type 2 diabetes [1-4]. In females with type 2 diabetes, there is a combination of insulin resistance and dysfunctional β cells, but they do not need insulin to continue life, although insulin will eventually be needed to control elevated levels of glucose and keep the levels of HbA1c below 7% in almost 90% of patients [5-9]. Almost every year, approximately 1.6 million of the populationlost their lives due to diabetic complications, as stated in the World Health Organization report [10,11].

Women are at a higher risk of diabetes-related complications than men, and vitamin D deficiency is thought to increase the severity of various age-related diseases linked to oxidative stress in women [1]. Therefore, identifying the correlation of Vitamin D with T2DM and lipid profile can be beneficial for controlling poor glycemic index and other age-related diseases [2]. The present study was designed to determine the role of vitamin D, lipid profile, and the antioxidant enzyme superoxide dismutase in type 2 diabetes in females and how all these parameters affect the process of aging in women [3,4]. The dietary pattern of females also helps determine the effects of vegetarian and non-vegetarian diets on hyperglycemia, Vitamin D levels, dyslipidemia, and oxidative stress. This study will be helpful in determining the role of different included parameters in aging and in controlling different risk factors related to Vitamin D deficiency, T2DM, elevated cholesterol levels, and oxidative stress in females [5].The aim of the

present study was to determine Vitamin D, cholesterol, triglycerides, HDL, LDL, and VLDL play roles in pre- and post-menopausal women with type 2 diabetes.

MATERIALS AND METHODS:

The present study commenced after obtaining approval from the institutional ethics committee. The study was conducted at the Department of Biochemistry, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore, India. The comparative study was comprised of two groups: pre-menopausal type 2 diabetic women and another group is of post-menopausal type 2 diabetic women. Total of hundred and with type 2 diabetes were included in this study after obtaining approval from the institutional ethical committee. The study was conducted in a population of 20-42yr women's of pre-menopausal and women aged > 55 years with post-menopausal type 2 diabetes. T2DM was diagnosed according to the American Diabetes Association norms. The T2DM group subjects were diagnosed by consultants of the Medicine Department of Index Medical College, Hospital & Research Centre. Physical examination was performed on all subjects by a qualified doctor using established standard methods. Exclusion criteria were T2DM individuals, less than two years of known T2DM duration, subjects with cancer and thyroid dysfunction, and subjects who were alcoholics and smokers.

5 mL of fasting venous blood were drawn into fluoride and plane vials, after informed written consent from all the study group subjects with a disposable syringe & needle, under all aseptic conditions for the estimation of Vitamin D, lipid profile and blood glucose. Blood samples were allowed to clot for 5-10 min and plasma and serum were separated by centrifugation at 3000 rpm for 20 min. The separated serum was stored in aliquots at -20o C until assayed. For FBS estimation, all samples were run within 2 h after serum separation on a semi-automated analyzer (Chem 7), and serum was stored for estimation of Vitamin D, and lipid profile.

For all collected samples of the study population, serum lipid profile, SOD activity, and fasting blood sugar levels were estimated. All the reagents, calibrators, controls, and samples were brought to room temperature before starting the test run. We measured the serum lipid profile using standard methods on an automated chemistry analyzer.

Statistical Analysis:

The collected data was entered into a Microsoft Excel worksheet and processed using the SPSS version 27. Quantitative data are expressed as the mean ± SD, and Student's t-test was used to determine the difference between the two groups. Qualitative data were expressed as numbers and percentages. The chi-square test was used to determine the association between the two variables. Karl Pearson's coefficient of correlation was used to know the correlation between two variables. A p-value <0.05/ (<0.01) was considered statistically significant (highly significant).

RESULTS:

Table1. Comparison of different parameters in Pre and Post Menopausal T2DM women

Parameters	Pre-menopause (n=206)		Post-menopause (n=206)		P Value
	Mean	SD	Mean	SD	
FBS	193.71	42.14	218.97	51.77	<0.001*
Vitamin- D	34.06	9.91	27.30	10.73	<0.001*
HDL	59.82	14.74	46.20	13.27	<0.001*
LDL	116.21	38.15	145.72	49.09	<0.001*
VLDL	33.21	15.60	43.11	24.73	<0.001*
Total Cholesterol	208.78	44.15	250.40	259.12	0.024**
TAG	163.19	70.00	213.40	112.81	<0.001*

Table 1 shows a comparison of different parameters between the two groups with their mean values. Mean serum FBS level was found to be increased with the value of 218.97±51.77 in post-menopausal women and it is found to be lower with the value of 193.71±42.14 in pre-menopausal women. Mean serum Vitamin D value found to be increased with the value of 34.06± 9.91 in pre-menopausal women which decrease markedly with the value of 27.30±10.73 in post-menopausal group. These variations were highly significant at the 1% level of significance ($P < 0.001$). When we observed the comparison of parametersof lipid profile in both groups, mean serum HDL levels were found to be improved in pre-menopausal women with a value of 59.82±14.74 and was found to be on the lower side with a value of 46.20±13.27 in the postmenopausal group. The mean serum LDL level increased by 145.72±49.09 in post-menopausal women and decreased lower with the value 116.21 ±38.15 in pre-menopausal women. Values of VLDL also increased in the post-menopausal group compared to the pre-menopausal group, as shown in Table 1. These variations were highly significant at the 1% level of significance ($P < 0.001$). Mean serum total cholesterol level was found to be increased with the value of 250.40 ±259.12 in post-menopausal women and it is found to be lesser with the value 208.78 ±44.15 in pre-menopausal women. This value is significant at the 5% level of significance, with a p-value of 0.024. The levels of triglycerides were also significantly increased in the post-menopausal phase compared to the pre-menopausal phase. The antioxidant enzyme superoxide dismutase was found to be decreased in the postmenopausal group with a value of 0.89±0.61, and the status was good in premenopausal women with a value of 5.65±1.48, and these variations were highly significant at the 1% level of significance ($P < 0.001$).

DISCUSSION:

Type 2 Diabetes Mellitus (T2DM) and menopause are associated with vitamin D status. Estrogen decline during menopausal stages promotes hypovitaminosis D. However, the interplay between vitamin D, menopause, lifestyle, and T2DM cannot be overlooked.

Compared to premenopausal women, the lipid profile parameters TC, TAG and LDL-C increased substantially ($P < 0.05$) in postmenopausal women. These results are consistent with those reported by a study[12]. Elevated TAG levels in postmenopausal women may be attributed to various mechanisms, including insulin resistance, excessive production of TAG-rich lipoproteins, and heightened HDL-C clearance, which may be a consequence of reduced estrogen and insulin synthesis. Changes in HDL metabolism can contribute to the onset of atherosclerosis in individuals with hypertriglyceridemia.

Empirical and clinical data have established a negative correlation between low HDL-C levels and elevated susceptibility to cardiovascular disease[13]. HDL particles have been found to facilitate reverse cholesterol transport (RCT) and demonstrate various beneficial activities including antioxidation, inflammation, thrombosis, and vasodilation [14]. Fluctuations in HDL-C concentration and HDL particle composition subsequent to menopause have generated considerable debate. The current study's finding that HDL-C levels decreased ($P < 0.05$) in postmenopausal T2DM women is consistent with the results reported by a study [14].

Furthermore, alterations in lipid profile are associated with an increase in adiposity in the abdominal region throughout the transition to menopause.

Nonetheless, weight gain is a physiological change that occurs during menopause. Most studies have demonstrated that weight gain is exclusively associated with menopausal transition; however, some studies have discovered that the weight gain that occurs during this time appears to be the result of aging rather than the menopausal transition itself [15]. In the present study, we found that the HDL of premenopausal women was lower than those of postmenopausal women were. In addition to weight gain, alterations in body composition and fat distribution are associated with menopause [16]. As postmenopausal age increases, there is a concurrent reduction in lean body mass and an increase in adipose mass, primarily localized in the abdominal region [17]. Increased visceral adipose tissue (VAT) is regarded as a constituent of metabolic syndrome, which is evident in diabetes and is positively correlated with metabolic diseases and cardiovascular risk factors [8].

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diabetes and is positively correlated with metabolic diseases and cardiovascular risk factors [8].

Hypo-vitamin D contributes to the development of numerous chronic diseases, including diabetes [18]. Vitamin D deficiency in menopausal females is predominantly caused by the activation of the VDR (enzyme activating vitamin D and its receptors), which is induced by a reduction in estrogen levels. A negative correlation was observed between vitamin D and both age and HbA1C in postmenopausal women, which may account for the observed effects of menopause in older women.

A statistically significant positive correlation ($p<0.05$) was observed between HDL-C and vitamin D in the premenopausal group, as determined by regression analysis, compared to the postmenopausal group. In premenopausal and postmenopausal T2DM women, decreased vitamin D was negatively correlated with elevated LDL levels respectively.

To enhance the understanding of the correlation between vitamin D and obesity, metabolic parameters, including dyslipidemia were assessed within the study population. The correlation between vitamin D status and dyslipidemia parameters was more significant than that of body weight. This suggests that Tc and low HDL are reliable predictors of CVD risk factors in postmenopausal T2DM patients with an underlying low vitamin D status.

There exist numerous potential mechanisms through which obesity might be associated with a reduction in levels of vitamin D. Adipose tissue sequestration of vitamin D could potentially be a factor in the diminished levels of vitamin D in the bloodstream of obese individuals [19]. An earlier study [20]identified a correlation between lipid profile parameters and T2DM patients, which is consistent with our findings. Vitamin D has the potential to reduce serum TAG in individuals with obesity by increasing the activity of lipoprotein lipase via a regulatory mechanism [21].

Although statistically significant, the correlation between vitamin D and HDL-C levels was positive. In addition to being correlated with the onset of menopause, reduced HDL-C levels may also be influenced by weight gain, insufficient physical activity, metabolic disorders such as diabetes, and weight gain [22].

In a study, vitamin D deficiency has been documented primarily among diabetic males and females, as opposed to non-diabetic individuals [23]. Several clinical trials have examined the effects of vitamin D on postmenopausal women. There have been reported in vitamin D correlations with diabetes from various regions [24]. However, the primary objective of the current study was to examine the correlation between vitamin D levels and glycemic and lipid indices in women with diabetes, specifically in relation to menopausal status. This is an inaugural investigation to examine this correlation in Riyadh, the central region of Saudi Arabia. The current study identified a significant correlation between LDL-C levels and vitamin D deficiency in postmenopausal women. As the investigation of the decrease in HDL levels among postmenopausal women progressed, it was observed that while HDL levels did indeed decrease, the decline was not statistically significant. Indeed, a negative correlation was observed between HDL and BMI, suggesting that HDL levels are influenced not only by vitamin D, but also by the metabolic changes that occur during menopause. However, a significant correlation was observed between vitamin D and LDL levels; therefore, the conclusion regarding LDL levels was confirmed. In conclusion, our data suggest that increased cardiovascular risk factors are significantly associated with reduced Vitamin D levels in postmenopausal women with T2DM. As elevated BMI and LDL-C levels are associated with decreased vitamin D levels, the risk of diabetic vascular complications is exacerbated or increased; therefore, these lipids may serve as prognostic indicators for cardiovascular disease in patients with T2DM.

CONCLUSION:

One of the primary discoveries of this research is the notable fluctuations in vitamin D levels that were identified in type 2 diabetics prior to and following menopause. The significance of vitamin D in preserving general health, encompassing its influence on glucose metabolism and insulin sensitivity, has been firmly established. The observation of decreased vitamin D levels among post-menopausal women who have diabetes implies that it may be especially important to target vitamin D deficiency in this group in order to assist with glycemic control and mitigate the likelihood of diabetes-related complications.

Conflict of interest:

There is no conflict of interest among the present study authors.

REFERENCES:

1. Ishikawa A, Matsushita H, Shimizu S, Morita N, Hanai R, Sugiyama S, Watanabe K, Wakatsuki A. Impact of Menopause and the Menstrual Cycle on Oxidative Stress in Japanese Women. Journal of Clinical Medicine. 2023 Jan 20;12(3):829.

2. Leanza G, Conte C, Cannata F, Isgrò C, Piccoli A, Strollo R, Quattrocchi CC, Papalia R, Denaro V, Maccarrone M, Napoli N. Oxidative Stress in Postmenopausal Women with or without Obesity. Cells. 2023 Apr 12;12(8):1137.
3. Doshi SB, Agarwal A. The role of oxidative stress in menopause. Journal of mid-life health. 2013 Jul;4(3):140.
4. Bade G, Shah S, Nahar P, Vaidya S. Effect of menopause on lipid profile in relation to body mass index. Chronicles of young Scientists. 2014 Jan 1;5(1):20-.
5. Swapnali RK, Kisan R, Murthy DJ. Effect of menopause on lipid profile and apolipoproteins. Al Ameen J Med Sci. 2011;4(3):221-8.
6. Wu B, Fan B, Qu Y, Li C, Chen J, Liu Y, Wang J, Zhang T, Chen Y. Trajectories of Blood Lipids Profile in Midlife Women: Does Menopause Matter?. Journal of the American Heart Association. 2023 Nov 21;12(22):e030388.
7. Rustagi G, Rustagi H, Bawa R. Correlation of Menopause with Lipid Profile: A Study at World College of Medical Sciences and Research, Jhajjar, Haryana. Sch Int J ObstetGynec. 2023;6(12):470-5.
8. Kalavathi L, Dhruvanarayan HR, Zachariah EL. Plasma estradiol and lipid profile in perimenopausal women. Indian Journal of Physiology and Pharmacology. 1991 Oct 1;35(4):260-2.
9. Ayres S, Tang M, Subbiah MR. Estradiol-17β as an antioxidant: some distinct features when compared with common fat-soluble antioxidants. Journal of Laboratory and Clinical Medicine. 1996 Oct 1;128(4):367-75.
10. Markides CS, Roy D, Liehr JG. Concentration dependence of prooxidant and antioxidant properties of catecholestrogens. Archives of Biochemistry and Biophysics. 1998 Dec 1;360(1):105-12.
11. Crawford SL, Johannes CB. The epidemiology of cardiovascular disease in postmenopausal women. The Journal of Clinical Endocrinology & Metabolism. 1999 Jun 1;84(6):1803-12.
12. Meloni A, Cadeddu C, Cugusi L, Donataccio MP, Deidda M, Sciomer S, Gallina S, Vassalle C, Moscucci F, Mercuro G, Maffei S. Gender differences and cardiometabolic risk: the importance of the risk factors. International Journal of Molecular Sciences. 2023 Jan 13;24(2):1588.
13. Hong BV, Agus JK, Tang X, Zheng JJ, Romo EZ, Lei S, Zivkovic AM. Precision Nutrition and Cardiovascular Disease Risk Reduction: The Promise of High-Density Lipoproteins. Current Atherosclerosis Reports. 2023 Oct;25(10):663-77.
14. Allard-Ratick MP, Kindya BR, Khambhati J, Engels MC, Sandesara PB, Rosenson RS, Sperling LS. HDL: Fact, fiction, or function? HDL cholesterol and cardiovascular risk. European journal of preventive cardiology. 2021 Feb 1;28(2):166-73.
15. Vincent J, Inassi J. Comparison of oxidative stress between premenopausal and postmenopausal women. National Journal of

Physiology, Pharmacy and Pharmacology. 2020 Apr 30;10(05).

16. Opoku AA, Abushama M, Konje JC. Obesity and Menopause. Best Practice & Research Clinical Obstetrics &Gynaecology. 2023 May 6:102348.
17. Ajlouni K, Khader Y, Alyousfi M, Al Nsour M, Batieha A, Jaddou H. Metabolic syndrome amongst adults in Jordan: prevalence, trend, and its association with socio-demographic characteristics. Diabetology & Metabolic Syndrome. 2020 Dec;12(1):1-1.
18. Greendale GA, Han W, Finkelstein JS, Burnett-Bowie SA, Huang M, Martin D, Karlamangla AS. Changes in regional fat distribution and anthropometric measures across the menopause transition. The Journal of Clinical Endocrinology & Metabolism. 2021 Sep 1;106(9):2520-34.
19. Suárez-Cuenca JA, De La Peña-Sosa G, De La Vega-Moreno K, Banderas-Lares DZ, Salamanca-García M, Martínez-Hernández JE, Vera-Gómez E, Hernández-Patricio A, Zamora-Alemán CR, Domínguez-Pérez GA, Ruíz-Hernández AS. Enlarged adipocytes from subcutaneous vs. visceral adipose tissue differentially contribute to metabolic dysfunction and atherogenic risk of patients with obesity. Scientific reports. 2021 Jan 19;11(1):1831.
20. Silva LD, de Queiroz NN, de Melo FT, Abrahão Neto JF, Janaú LC, de Souza Neto NJ, de Lemos MN, de Oliveira MC, de Alcântara AL, de Moraes LV, da Silva WM. Improvement in cardiovascular autonomic neuropathy after high-dose vitamin D supplementation in patients with type 1 diabetes. Frontiers in Endocrinology. 2020 Nov 19;11:605681.
21. Mozaffari M, Hajmoradi H, Moravveji A, Asgarian FS, Noory P. The effect of vitamin D therapy on glycemic control and biochemical indices in type 2 diabetic patients: a randomized, clinical trial study. Physiology and Pharmacology. 2021 Jul 10;25(2):125-33.
22. AlAnouti F, Abboud M, Papandreou D, Mahboub N, Haidar S, Rizk R. Effects of vitamin D supplementation on lipid profile in adults with the metabolic syndrome: a systematic review and meta-analysis of randomized controlled trials. Nutrients. 2020 Oct 30;12(11):3352.
23. Rao H, Jalali JA, Johnston TP, Koulen P. Emerging roles of dyslipidemia and hyperglycemia in diabetic retinopathy: molecular mechanisms and clinical perspectives. Frontiers in Endocrinology. 2021 Mar 22;12:620045.
24. Alaidarous TA, Alkahtani NM, Aljuraiban GS, Abulmeaty M. Impact of the glycemic control and duration of type 2 diabetes on Vitamin D level and cardiovascular disease risk. Journal of diabetes research. 2020 Feb 19;2020.