INDONESIAN JOURNAL OF COMMUNITY SERVICES
Homepage: https://ojs.literacyinstitute.org/index.php/ijcs
ISSN: 2829-7733 (Online)

Volume 4	Issue 2	November (2025)	DOI: 10.47540/ijcs.v4i2.2103	Page: 166 – 174

Vitamin D and Relationship with Cholesterol and Triglycerides

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A R T I C L E I N F O

Keywords: Cholesterol, Triglycerides, Vitamin D.

Received : 28 June 2025
Revised : 12 September 2025
Accepted : 27 November 2025

A B S T R A C T

The study focuses on cholesterol and triglycerides. Vitamin D has a relationship with lipid profile. Material and Methods: involved 2,188 participants, equally divided between males and females, with a wide age distribution. Vitamin D levels were assessed using serum 25-hydroxyvitamin D (25(OH)D) concentration. The findings: The correlation analysis reveals no significant relationships between Vitamin D levels and the variables of age, gender, cholesterol, and triglycerides. All correlation coefficients are near zero, and the p-values exceed the standard significance threshold (0.05), indicating statistical insignificance. Specifically: Age: No meaningful variation in Vitamin D levels with age (P = 0.903). Gender: No substantial difference between males and females (P-value = 0.192). Cholesterol: No significant association with Vitamin D levels (P-value = 0.851). Triglycerides: No meaningful relationship observed (P-value = 0.699). Conclusion: The correlation analysis confirmed no meaningful associations between Vitamin D levels and age, gender, cholesterol, or triglyceride levels. All correlation coefficients were near zero, and p-values exceeded the standard significance threshold (0.05), indicating no statistically significant relationships.

INTRODUCTION

Insufficient vitamin D levels have the potential to lead to a range of chronic conditions, including cardiovascular disease, stroke, and diabetes, as well as being harmful to bone health (Yin et al., 2024). Preventive strategies against Metabolic Syndrome (MetS) involve interventions to maintain optimal vitamin D concentrations (Yin et al., 2024). Several studies have investigated the potential benefits of vitamin D supplementation in PCOS, with a particular focus on its effects on metabolic and hormonal parameters (Wang et al., 2016). The association between vitamin D status and serum lipids can differ between genders (Usman et al., 2024). Based on these considerations, we are keen on exploring how vitamin D can enhance lipid profiles in PCOS (Syafii, 2024). Optimizing the vitamin D level could improve the lipid profiles of healthy Malay adults. There could be a connection between the serum lipid profile and OMGD (Selimoglu et al., 2025). The criteria for exclusion from this study included the following conditions: hereditary adrenal hyperplasia, Cushing's syndrome, a history of autoimmune diseases, diabetes, liver or kidney failure, hyperprolactinemia, hypothyroidism, androgen-secreting tumors, and the use of immunosuppressive medications or vitamin D supplements within the last three months. The criteria for exclusion from this study included the following conditions: hereditary adrenal hyperplasia, Cushing's syndrome, a history of autoimmune diseases, diabetes, liver or kidney failure, hyperprolactinemia, hypothyroidism, androgen-secreting tumors, and the use of immunosuppressive medications or vitamin D supplements within the three months (Moieni et al., 2024).

Moreover, there is a prevalence of VDD in patients with PCOS, and numerous studies have shown that vitamin D status may have an impact on lipid metabolism (Melguizo-Rodríguez et al., 2021). Vitamin D may have a crucial role in metabolic health, as indicated by the TyG index between vitamin D-deficient and non-deficient groups (Lupton et al., 2016). The introduction of additional health measures is crucial to increase awareness among women and health professionals about preventing and controlling cardiovascular risk factors, especially among young individuals (Luo et al., 2021). Blood levels of vitamin D are associated with more favorable LDL, HDL, and cholesterol levels, especially in women. More studies are suggested to investigate this relationship (Li et al., 2024). The association between serum 25(OH)D and serum lipids, as well as the long-term relationship between serum 25(OH)D and TAG over 14 years, may be the reason why low serum 25(OH)D levels are associated with mortality (Lhilali et al., 2024). This negative association may be related to the role of 25(OH)D in insulin resistance (Karimifard et al., 2025). The vitamin D-deficient group of adults with overweight or obesity had impaired lipid profiles, which included higher TG, TC, and LDL levels, and decreased HDL levels (Jorde et al., 2010). In people with ischemic stroke, a rise in vitamin D can lead to an increase in atherogenic lipids (Ji et al., 2025).

To maintain lipid profiles and understand the underlying mechanisms of this relationship, further research is needed to determine the optimal levels of vitamin D intake (Huang et al., 2023). The unfavorable lipid profile discovered in individuals with vitamin D deficiency (Giri et al., 2016). The regional diabetes epidemic and reducing cardiovascular disease risk may be addressed by optimizing vitamin D status through screening and correcting deficiency, which may be a cost-effective approach (Gholamzad et al., 2023). The current research indicated higher levels of triglycerides, total cholesterol, VLDL, and LDL, along with lower HDL, in patients deficient in vitamin D compared to the control group. Therefore, individuals with a vitamin D deficiency ought to be assessed for irregularities in their lipid profiles (Frentusca & Babes, 2024). Over sixty-six percent of employees at IT were found to be lacking in vitamin D. A deficiency in vitamin D was linked to notably elevated levels of LDL, as well as reduced levels of HDL and VLDL. There was no meaningful correlation identified between vitamin D and AIP (Elsheikh et al., 2024). Reduced vitamin D levels should be regarded as an unconventional risk factor for coronary artery disease (CAD) in individuals from Egypt. Low vitamin D levels were found to be associated with coronary atherosclerosis, particularly in patients affected by multivessel conditions (Doddamani & Shetty, 2025). Vitamin D is one of the most significant nutrients in the body; it is soluble in fats (Anantharamakrishnan & Benansia, 2020).

The results indicate that gender could play a role in Vitamin D levels, whereas age does not appear to have a significant effect on deficiency rates. These outcomes emphasize the importance of public health initiatives aimed at improving dietary practices, enhancing sun exposure, and promoting Vitamin D supplementation to reduce deficiency risks, especially in at-risk groups (Alsheekh et al., 2025). The biological roles of vitamin D are being increasingly recognized, leading to scientific research into the health impacts of vitamin D deficiency (Alsheekh et al., 2024).

METHODS

Data Collection

Data collection was 2188, conducted through a structured questionnaire and laboratory assessments. The questionnaire gathered demographic information, including age, gender, and lifestyle factors such as dietary habits and sun exposure. Participants were categorized into specific age groups for analysis, ranging from 10-15 years to over 71 years.

Vitamin D Assessment

Vitamin D levels were quantified through serum 25-hydroxyvitamin D (25(OH)D) concentration, the standard biomarker for assessing Vitamin D status. Blood samples were collected and analyzed in a certified laboratory. Vitamin D levels were classified based on established cut-off values: Normal (≥ 30 ng/mL), Low (20-29 ng/mL), Severely Low (< 20 ng/mL), High (> 50 ng/mL), and Moderately Low (21-29 ng/mL).

Laboratory Procedures

Blood samples were drawn by trained phlebotomists and processed following standard laboratory protocols. The serum was separated and stored at -80°C until analysis. The 25(OH)D levels were determined using a competitive enzyme-linked immunosorbent assay (ELISA) method, known for its sensitivity and specificity in measuring Vitamin D concentrations. Quality control measures were implemented, including standardized reference samples and regular calibration of laboratory equipment.

Data Analysis

Data were analyzed using statistical software (e.g., SPSS, version 27.0). Descriptive statistics were calculated for Demographic variables, including frequencies and percentages for age groups and gender. The distribution of Vitamin D levels was examined across different age categories and genders, with results presented in tabular format.

RESULTS AND DISCUSSION

The table presents the gender distribution of a sample population, showing an equal split between male and female respondents. Both categories have 1,094 individuals, constituting 50.0% of the total sample of 2,188. This balanced representation suggests that the study ensured gender parity, potentially to avoid bias in gender-related analysis. However, the table does not account for non-binary or other gender identities, which may limit inclusivity. If the research topic involves gender differences, this equal representation allows for direct comparisons without the influence of sample size disparities.

Table 1. Frequency and Percentage of gender

Gender	Frequency	Percentage %
Male	1094	50.0
Female	1094	50.0
Total	2188	100.0

The figure illustrates the frequency and percentage distribution of different age groups in the sample population. The data shows a varied age representation, with the highest percentage of individuals falling within the 41-45 (14.7%), 46-50 (13.2%), and 51-55 (13.9%) age groups. This suggests that middle-aged individuals form the majority of the study sample. The lowest percentages are observed in the youngest (1-5 years, 0.37%) and oldest (>86 years, 0.8%) categories, indicating fewer participants in these age brackets. The distribution appears relatively balanced, though it skews towards middle-aged groups, potentially affecting generalizability to younger or older populations. A potential limitation of this figure is that it does not provide absolute frequencies, only percentages, which might make it harder to gauge the actual sample size per category. Additionally, while the data covers a wide range of ages, the grouping of five-year intervals may mask finer demographic trends. If the study aims to analyze age-related trends, further breakdowns or statistical tests may be necessary to ensure meaningful interpretations.

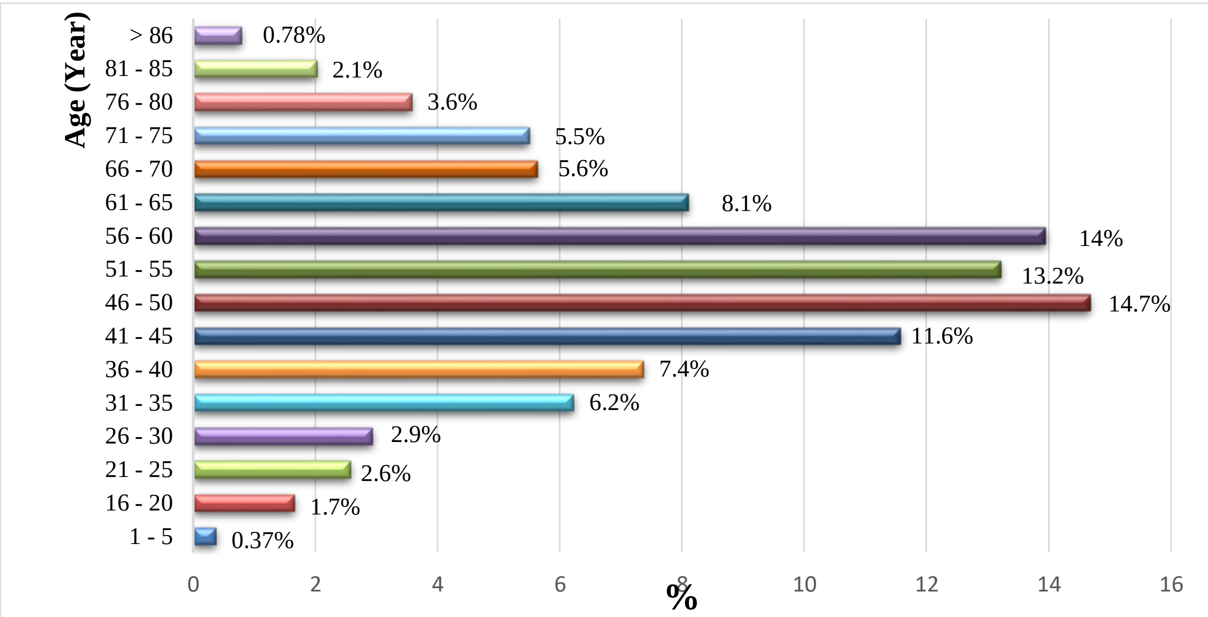

Figure 1. Distribution of Different Age

The table and Figure 2 present a crosstabulation between gender and Vitamin D levels, categorizing participants into four groups: Normal, Very High, Low, and Very Low. The distribution appears similar across genders, with 201 males and 227 females having normal Vitamin D levels and a nearly identical count in the Very High category (3 each). However, a significant proportion of both genders fall into the Low (317 males, 305 females) and Very Low (573 males, 559 females) categories, indicating a concerning prevalence of Vitamin D deficiency in the sample. The total sample size is 2,188, evenly split between males and females. This table suggests that Vitamin D deficiency is a widespread issue across both genders, with little variation between male and female groups. While slightly more females (227 vs. 201) have normal Vitamin D levels, the overall pattern remains consistent. However, without statistical measures (e.g., X2 test), it is unclear whether the differences are significant.

Additionally, the table does not provide mean Vitamin D levels or standard deviations, which could offer deeper insights into severity variations. Further analysis could explore whether other factors, such as age or lifestyle habits, contribute to this trend.

Table 2. The Crosstabs between Gender and Vitamin D

Gender / Vitamin D		Vitamin D				Total
		Normal	V. High	Low	V. Law	
Gender	Male	201	3	317	573	1094
	Female	227	3	305	559	1094
Total		428	6	622	1132	2188

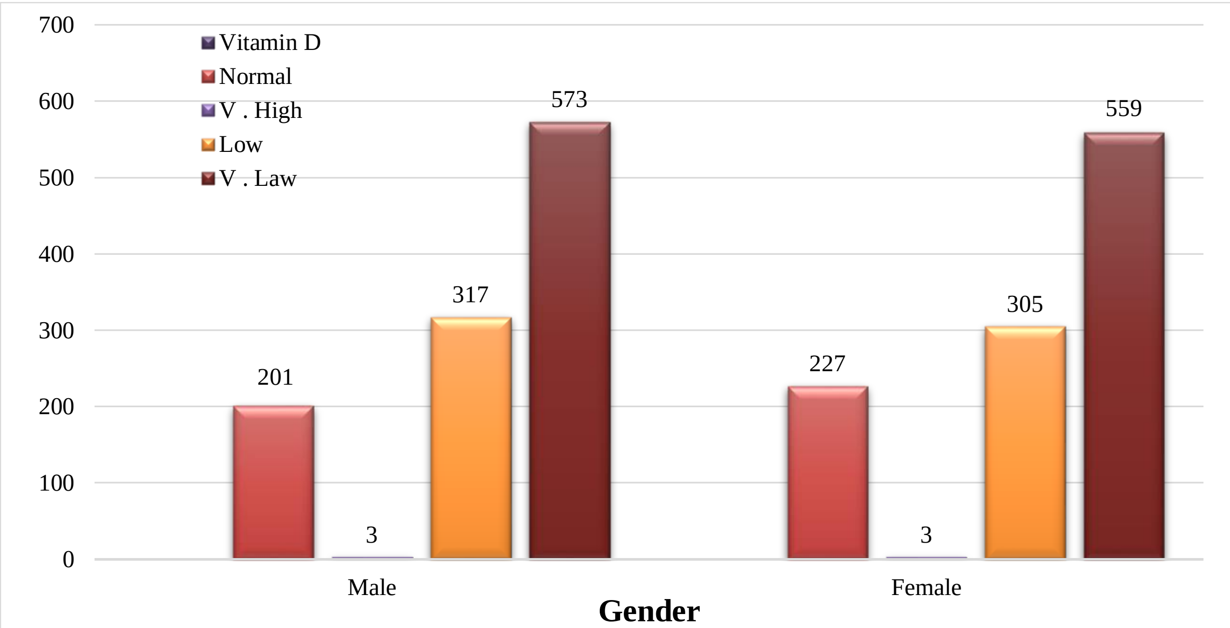

Figure 2. The Crosstabs between Gender and Vitamin D

Table 3 and Figure 3 present a crosstabulation between gender and cholesterol levels, categorizing individuals into Normal, High, and Very High cholesterol groups. The distribution between males and females appears relatively similar, with 867 males and 843 females having normal cholesterol levels. A slightly higher number of females (236) fall into the High cholesterol category compared to males (220), while the Very High category is slightly more common in females (15) than in males (7). Overall, the majority of participants (1,710 out of 2,188) have normal cholesterol levels, while a significant portion (456) falls into the High category, and a small number (22) exhibit Very High levels. While there are slight differences between genders, the variations are not dramatic.

However, statistical significance is not indicated, so it is unclear if these differences are meaningful.

Additionally, the table does not provide cholesterol mean values, standard deviations, or other influencing factors such as diet, age, or lifestyle habits, which could further explain these trends. If the study aims to analyze gender differences in cholesterol levels, a more detailed breakdown or statistical test (such as a chi-square test) would be useful.

Table 3. The Crosstabs between Gender and Cholesterol

Gender / Cholesterol		Normal	High	V . High	Total
Gender	Male	867_a	220_a	7_a	1094
	Female	843_a	236_a	15_a	1094
Total		1710	456	22	2188

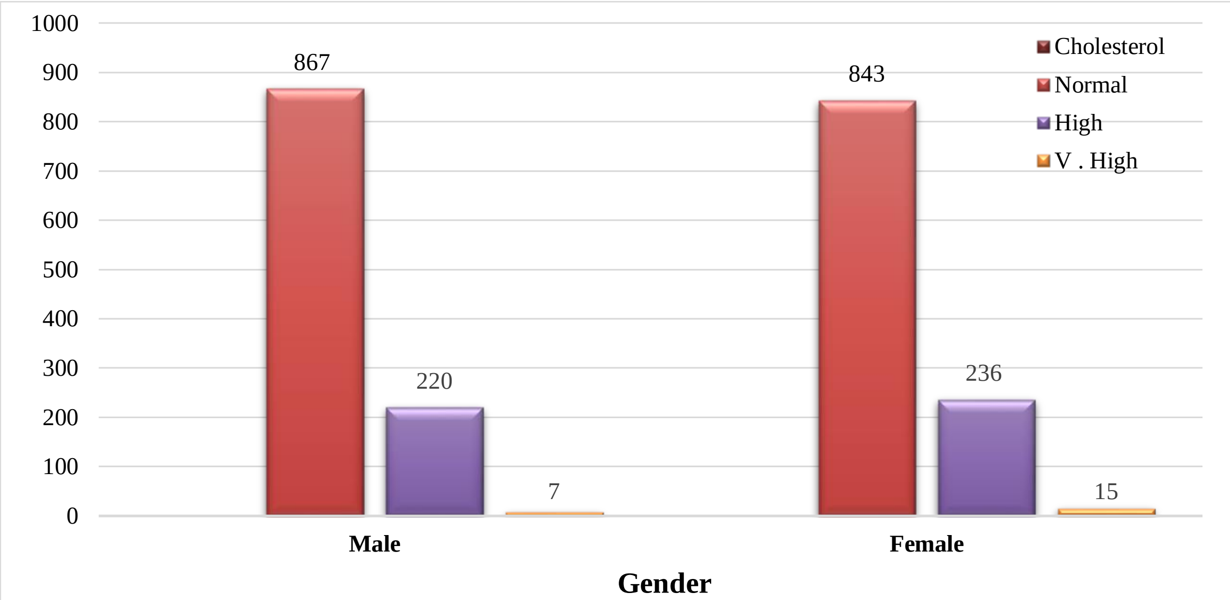

Figure 3. The Crosstabs between Gender and Cholesterol

The table presents a crosstabulation between gender and triglyceride levels, dividing participants into Normal, High, and Very High categories. The distribution is fairly balanced between genders, with 859 males and 867 females having normal triglyceride levels. Slightly more males (155) fall into the High category compared to females (142), while the Very High category shows a minor difference, with 80 males and 85 females. The total sample remains evenly split between genders (1,094 males and 1,094 females), ensuring gender parity in the analysis. The accompanying bar chart visually represents these findings, reinforcing the observation that triglyceride levels do not differ significantly between males and females. The Normal category dominates both groups, while the High and Very High categories constitute a smaller but still notable proportion. However, without statistical significance tests, it remains unclear whether these differences are meaningful. Additionally, factors such as diet, lifestyle, or age are not included, which could provide further insights into triglyceride level variations. If the study aims to analyze triglyceride trends in greater depth, additional statistical measures and covariate analysis would be beneficial.

Table 4. The Crosstabs between Gender and Triglyceride

Gender \ Triglyceride		Normal	High	V. High	Total
Gender	Male	859_a	155_a	80_a	1094
	Female	867_a	142_a	85_a	1094
Total		1726	297	165	2188

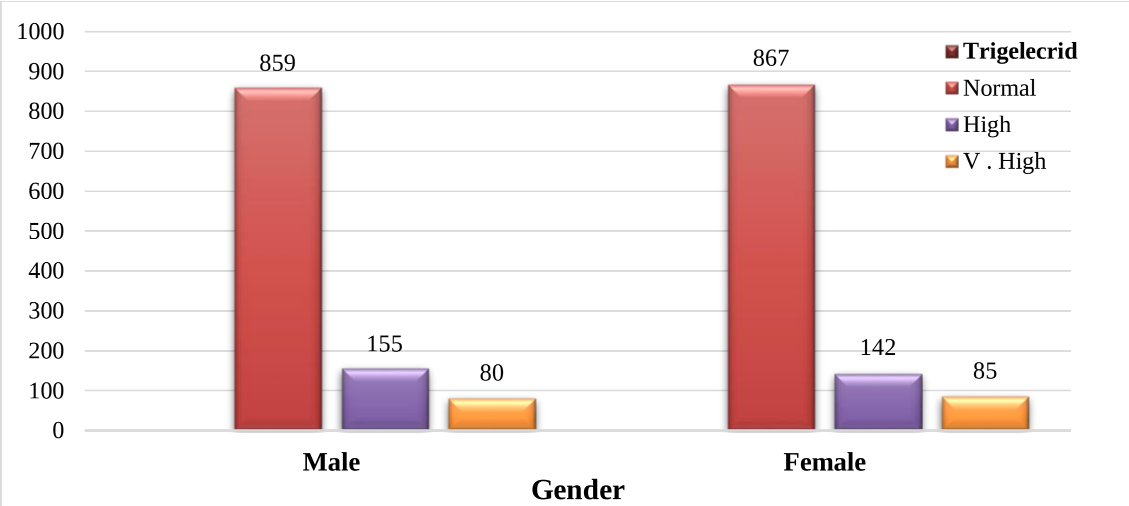

Figure 4. The Crosstabs between Gender and Triglyceride

The table presents the frequency and percentage distribution of Vitamin D, Cholesterol, and Triglyceride levels across different categories. Vitamin D shows a significant deficiency in the population, with 51.7% of participants falling in the Very Low category and 28.4% in the Low category. Only 19.6% have normal levels, and a negligible 0.3% are classified as Very High. This suggests a widespread Vitamin D deficiency, which could have important health implications. For Cholesterol, the majority (78.2%) have normal levels, while 20.8% fall into the High category, and only 1.0% into the Very High category. No cases of Low or Very Low cholesterol are recorded, indicating that high cholesterol is more of a concern than deficiency. Triglyceride levels show a similar trend to cholesterol, with 78.9% in the Normal range. However, 13.6% have High triglycerides, and 7.5% fall into the Very High category. Like cholesterol, there are no recorded cases of Low or Very Low triglyceride levels. The data highlights a major health concern regarding Vitamin D deficiency, which affects a significant portion of the sample.

In contrast, cholesterol and triglyceride levels appear more balanced, with a majority in the Normal range, though a notable percentage falls into the High or Very High categories. This suggests the need for targeted interventions, particularly addressing Vitamin D deficiencies, while also monitoring cholesterol and triglyceride levels to prevent cardiovascular risks. Further analysis could explore whether these patterns vary by gender, age, or other lifestyle factors.

Table 5. Percentage and frequency of Vitamin D, Cholesterol, and Triglyceride

	N (%)				
	Normal	High	V. High	Low	V. Low
Vitamin D	428(19.6)	0(0.0)	6(0.3)	622(28.4)	1132(51.7)
Cholesterol	1710(78.2)	456(20.8)	22(1.0)	0(0.0)	0(0.0)
Triglyceride	1726(78.9)	297(13.6)	165(7.5)	0(0.0)	0(0.0)
Total			2188		

The table presents the correlation analysis between Vitamin D levels and four variables: Age, Gender, Cholesterol, and Triglyceride. The correlation coefficients (RRR) are very close to zero for all variables, indicating no meaningful relationship between Vitamin D and any of the examined factors. The p-values further support this conclusion, as all values are well above the common significance threshold (0.05), meaning that none of these correlations are statistically significant. Age and Vitamin D (R=0.003, P-Value 0.903R = 0.003, P-Value 0.903R=0.003, P-Value 0.903): This suggests that Vitamin D levels do not vary meaningfully with age in this sample. Gender and Vitamin D (R=−0.028, P-Value 0.192, R = -0.028, P-Value 0.192, R=−0.028, P-Value 0.192): The slightly negative but near-zero correlation indicates no substantial difference in Vitamin D levels between males and females. Cholesterol and Vitamin D (R=−0.004, P-Value 0.851, R = -0.004, P-Value 0.851, R=−0.004, P-Value 0.851): This suggests that cholesterol levels do not have a significant association with Vitamin D levels. Triglyceride and Vitamin D (R=0.008, P-Value 0.699, R = 0.008, P-Value 0.699R=0.008, P-Value 0.699): Again, this near-zero correlation suggests no meaningful relationship between triglycerides and Vitamin D.

These findings indicate that Vitamin D levels in this sample are independent of age, gender, cholesterol, and triglyceride levels. This could mean that other factors, such as sun exposure, diet, or genetic predisposition, may play a more significant role in determining Vitamin D levels. Further research could explore lifestyle or environmental influences on Vitamin D levels.

Table 6. The Correlations between Vitamin D and Age, Gender, Cholesterol, Triglyceride

Correlations		Vitamin D
Age	R	0.003
	P-Value	0.903
Gender	R	-0.028-
	P-Value	0.192
Cholesterol	R	-0.004-
	P-Value	0.851
Triglyceride	R	0.008
	P-Value	0.699
	N	2188

The study maintains a balanced gender representation with equal numbers of male and female participants (1,094 each), ensuring unbiased gender comparisons. The age distribution skews toward middle-aged individuals, particularly those between 41 and 55 years old, which may influence generalizability to younger or older populations. Vitamin D levels show a significant deficiency, with over half of the sample (51.7%) classified as having Very Low levels and an additional 28.4% in the Low category. This suggests widespread Vitamin D deficiency across both genders. Cholesterol and triglyceride levels, however, present a more balanced distribution, with the majority of participants having normal levels (78.2% and 78.9%, respectively). While a notable portion falls into the High and Very High categories, no participants were categorized as having Low or Very Low cholesterol or triglyceride levels. The crosstabulations indicate minor gender differences, but statistical significance tests are missing, making it unclear whether these variations are meaningful. Correlation analysis further confirms that Vitamin D levels are not significantly associated with age, gender, cholesterol, or triglyceride levels, suggesting other influencing factors like lifestyle or environmental variables. These findings highlight the need for targeted interventions to address Vitamin D deficiency while monitoring cholesterol and triglyceride levels to mitigate cardiovascular risks. Further statistical analysis could deepen insights into potential contributing factors.

The study's findings align with previous research indicating a high prevalence of Vitamin D deficiency and its effects on lipid metabolism (Karimifard et al., 2025; Luo et al., 2021). There is no significant correlation between Vitamin D and cholesterol or triglycerides, contradicting some earlier studies suggesting a relationship between Vitamin D and lipid profiles (Huang et al., 2023; Jorde et al., 2010). This discrepancy might stem from differences in sample characteristics, environmental factors, or dietary habits. The study's balanced gender representation ensures unbiased comparisons, though the exclusion of non-binary participants limits inclusivity. The findings suggest that factors beyond age and gender, such as lifestyle, sun exposure, and genetic predisposition, may play a more significant role in determining Vitamin D levels. Future research should incorporate additional variables, such as dietary intake and physical activity, to better understand the complex interactions between Vitamin D and metabolic health.

CONCLUSIONS

This study investigated the relationship between Vitamin D levels and lipid profiles, specifically cholesterol and triglycerides, among a diverse sample of 2,188 individuals. Despite a balanced gender representation and a wide age range, the findings revealed a high prevalence of Vitamin D deficiency, with over 80% of participants falling into the "Low" or "Very Low" categories. In contrast, cholesterol and triglyceride levels were largely within normal ranges, with approximately 78% of participants showing normal values for both markers. Crosstabulations showed minor gender differences in lipid profiles, but no statistically significant patterns emerged.

The correlation analysis confirmed no meaningful associations between Vitamin D levels and age, gender, cholesterol, or triglyceride levels. All correlation coefficients were near zero, and p-values exceeded the standard significance threshold (0.05), indicating no statistically significant relationships.

These results suggest that Vitamin D levels are independent of the examined physiological factors and may be more strongly influenced by external variables such as sun exposure, dietary habits, and genetic predisposition. The findings underscore the importance of public health initiatives aimed at addressing Vitamin D deficiency, which remains a widespread concern with potential implications for metabolic and cardiovascular health. Future research should incorporate additional lifestyle and environmental factors to better understand the determinants of Vitamin D status and its broader health impacts.

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