Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

Association Between Poor Sleep Quality and Higher Total Cholesterol in South Indian Adults Undergoing Health Check-up: A Cross-Sectional Study

1. Dr Meenakshi Sundaram Andra Suryanarayana, 2. Dr Sudha Ramalingam, 3. Mr Karthik Solayappan C, 4. Dr Merlin Veronika, 5. Mr Baskaran Sreeharin, 6. Ms Shifa Fathima Habeeb Rahuman, 7. Mr Karthik KR, 8. Mr Karthikeyan M

1- Associate Professor, Department of Biochemistry, PSG institute of Medical Sciences and Research, Coimbatore

2- Head of the Department, Department of Community Medicine, PSG institute of Medical Sciences and Research, Coimbatore

3- III B MBBS/ III MBBS part II, PSG institute of Medical Sciences and Research, Coimbatore

4- Associate Professor, PSG Centre for Molecular Medicine and Therapeutics, PSG Institute of Medical Sciences and Research, Coimbatore, Tamil Nadu, India.

5- III A MBBS/ III MBBS part II, PSG Institute of Medical Sciences and Research, Coimbatore

6- III B MBBS/ III MBBS part II, PSG institute of Medical Sciences and Research, Coimbatore

7- III B MBBS/ III MBBS part II, PSG institute of Medical Sciences and Research, Coimbatore

8- III B MBBS/III MBBS part II, PSG institute of Medical Sciences and Research, Coimbatore

(Received: 25 November 2025 Revised: 27 December 2025 Accepted: 11 January 2026)

KEYWORDS

Sleep quality, LDL, HDL, Triglycerides, Cholesterol

ABSTRACT:

Introduction:

The prevalence of diseases associated with metabolic syndrome is on the rise(diabetes, hyperlipidemia, obesity) and poor lifestyle choices such as sleep quality are associated with an increase in the prevalence of those diseases. Our study aimed to evaluate the relationship between the quality of sleep and cholesterol profile of individuals.

Materials and Methods:

PSQI(Pittsburgh Sleep Quality Index) obtained from a questionnaire as well as serum cholesterol levels and personal information such as gender and age.252 patients were given the PSQI questionnaire in which 198 patients were chosen after reviewing the inclusion and exclusion criteria. Logistic regression and multivariate linear regression was done on the data obtained.

Results:

Statistically significant correlation was obtained between poor sleepers and increased serum cholesterol levels when adjusted for age and BMI. In the multivariate linear regression, serum cholesterol increases by approximately 8.3-10.2 mg/dL.

Conclusion:

Although there is a correlation between sleep quality and serum total cholesterol, identifying confounders and adjusting for their effect can further our knowledge and understanding of the biochemical effect on quality of sleep and vice versa.

Introduction:

Our study is aimed to determine whether there is any relationship between serum levels of cholesterol (HDL,

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

LDL, Total)and triglycerides and sleep quality of the patients. Adequate sleep quality and quantity are important for the normal functioning of daily metabolic and hormonal processes as well as regulation of appetite. Chronic sleep debt, which is increasingly common in developed countries, is associated with metabolic and endocrine alterations which cause long term pathological consequences.[1] Sleep plays a vital role in human health and development, with growing evidence suggesting its association with a wide range of physiological processes [2]. Insufficient sleep duration and poor sleep quality have been linked to various adverse health outcomes, including chronic diseases such as obesity, diabetes, and cardiovascular conditions. In this context, the relationship between sleep and lipid (cholesterol and triglycerides) levels is critical to cardiovascular health, turning out to be an area of particular interest and importance[3]. Recognizing the potential implications of this relationship, the present study aimed to examine the association between sleep characteristics, namely sleep duration and quality, and lipid (cholesterol and triglyceride) levels among a sample of adults aged 35 to 75 years.

The Pittsburgh Sleep Quality Index (PSQI) is a widely-used self-report tool specifically designed to assess sleep quality and disturbances in clinical populations over a one-month period. It generates seven component scores, covering key areas of sleep such as subjective quality, latency, duration, efficiency, disturbances, medication use, and daytime dysfunction, each of which has scores ranging from 0-3. The total score, derived from these components, provides a comprehensive global measure of sleep quality. The seven components are then summed to get the global PSQI score which ranges from 0-21. The higher the score, the poorer the sleep quality. A score greater than 5 can be considered as a significant sleep disturbance. Despite the limited number of questionnaires tailored for psychiatric patients, the PSQI remains an effective tool for evaluating sleep-related issues in clinical settings.[4] Lipid transport in the blood occurs via lipoproteins, which are composed of unesterified cholesterol, triglycerides, phospholipids, and proteins. The five major classes of lipoproteins—chylomicrons, VLDL, IDL, LDL, and HDL—each have a specific role in transporting cholesterol and triglycerides to various destinations in the body, ensuring proper lipid distribution and metabolism.[5]

Materials:

We analyzed the HDL and LDL levels by direct method, Serum Cholesterol and Serum Triglyceride levels by enzymatic end point method using Cobas pro machine, in patients who are coming to the hospital for their master health check-up and followed them up with the Pittsburgh Sleep Quality Index questionnaire.

Methodology:

A cross-sectional study was conducted at PSG Institute of Medical Sciences and Research, Coimbatore between 2022 to 2024 following approval from the Institutional Ethical Committee (Ref. No.: PSG/IHEC/2022/Appr/Exp/028). A total of 252 patients visting the master health check-up were given the PSQI questionnaire and informed about thes study. These patients had their blood samples collected during fasting state around between 7:00-8:00am. Patients who were on lipid lowering drug medications, those who were suffering from comorbidities including hypothyroidism, diabetes, hypertension or already clinically diagnosed sleep disorders based on OSA screening were excluded from the study. Out of them, 198 were selected based on the inclusion and exclusion criteria.

This cross-sectional study recruited a representative sample of these 252 adults between the ages of 35 and 75 of the people who visited Master health check-up at PSG hospital, Coimbatore, Tamil Nadu, India. Participants were asked to complete a comprehensive survey that included questions about their sleep habits, including duration and quality, as well as provide blood samples for the assessment of their cholesterol profile. (Basch et al., 2014) The survey collected detailed information on participants' sleep patterns, including the average number of hours slept per night, self-reported sleep quality, and the presence of any sleep-related disturbances or disorders.

The Cobas pro, which was used for determining the cholesterol values, utilizes spectrophotometric and ion-specific electrode measuring systems. The instrument utilizes reusable optically pure plastic reaction cells.[6] Triglycerides are completely hydrolyzed to free glycerol and free fatty acids by the enzyme lipase. The liberated

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

free glycerol content is then determined enzymatically.[7] The documented data was then subjected to statistical analysis and results were interpreted.

Results & Data Analysis:

Table 1

Summary of Demographics and biochemical parameters

Categories		PSQI Global Score Categories		P Value
		Good N = 108	Poor N = 89	
Gender	Male:	88	59	**0.0299**
	Female:	20	30	
Age		50.2 ± 5.72 50 (28,80)	50.22 ± 4.55 50 (40,68)	0.9825
BMI		25.3 ± 1.45 25.3 (22.5, 28.2)	25.0 ± 1.49 24.7 (22.1, 27.8)	0.2335
Cholesterol (serum) (mg/dl)		182.73 ± 31.71 180.5 (113, 259)	192.30 ± 34.29 189 (122, 262)	**0.0452**
Triglycerides (serum) (mg/dl)		127.71 ± 67.65 109 (46, 1468)	134.96 ± 76.31 117.5 (42, 426)	0.4872
HDL Cholesterol (mg/dl)		42.03 ± 8.39 42 (24, 71)	43.73 ± 10.46 42 (25, 72)	0.2184

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

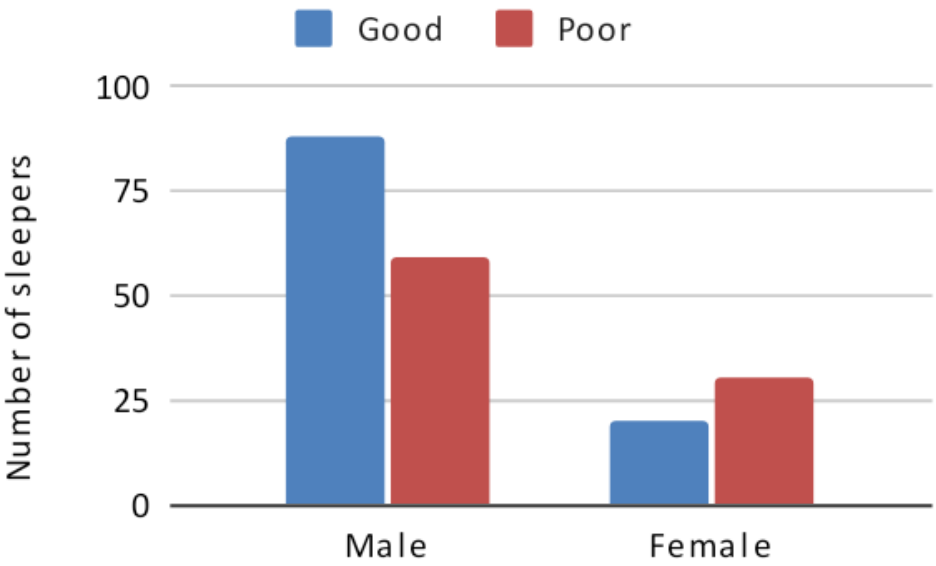

Table 2

Correlation analysis between PSQI scores and biochemical parameters

Categories	Good sleepers		Poor Sleepers	
	R	P Value	R	P Value
Age	0.017	0.864	0.008	0.945
BMI	0.008	0.938	-0.122	0.526
Cholesterol (serum) (mg/dl)	-0.03	0.792	0.044	0.727
Triglycerides (serum) (mg/dl)	0.035	0.722	-0.09	0.547
HDL Cholesterol (mg/dl)	0.094	0.549	0.057	0.704
LDL Cholesterol (mg/dl)	-0.06	0.609	0.078	0.585

Journal of Chemical Health Risks
www.jchr.org
JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

VLDL (mg/dl)	0.06	0.606	-0.078	0.575

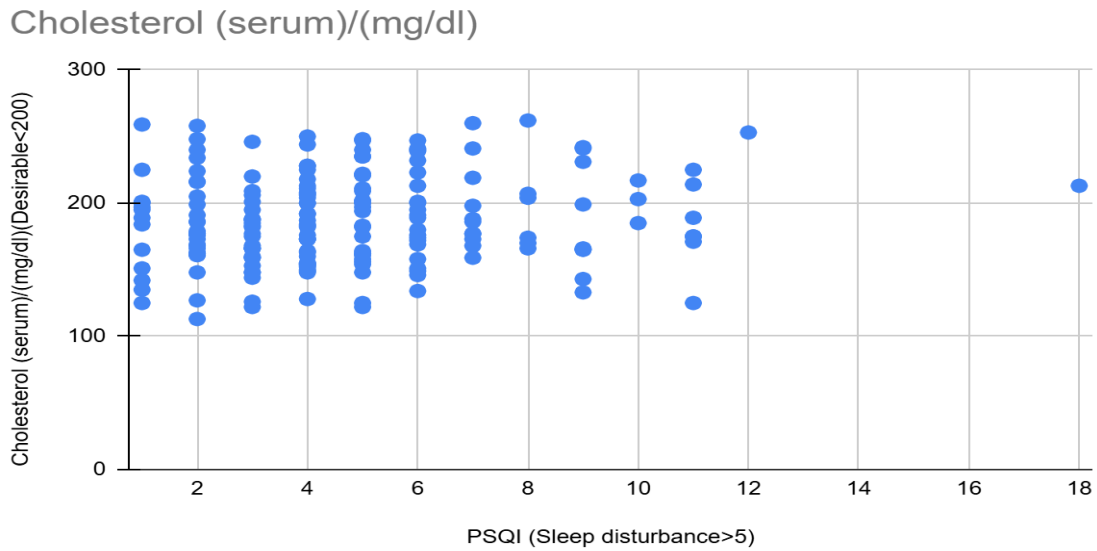

Table 3:

Logistic regression analysis of sleep quality as dependent variable and cholesterol as independent variable, adjusted for confounders

	Beta Coefficient	95% Confidence Interval		P Value
Unadjusted	0.0088	0.0002	0.0177	**0.045**
Adjusted for Age	0.0089	0.0003	0.0178	**0.0445**
Adjusted for BMI	0.0096	0.0009	0.0186	**0.0324**
Adjusted for Gender	0.0077	-0.0009	0.0167	0.0831

Table 4:

Multivariate linear regression with total cholesterol as the dependent variable and Sleep quality as independent variable, adjusted for confounders

	Estimate	95% Confidence Interval		P Value
Unadjusted	9.5718	0.2809	18.862	**0.0432**

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

Adjusted for Age	9.5632	0.2821	18.844	**0.0434**
Adjusted for BMI	10.226	0.9393	19.512	**0.031**
Adjusted for Gender	8.3156	-1.0877	17.7189	0.0827

Methodology:

Numerical continuous variables were represented as mean and standard deviation. Categorical variables were represented as frequencies and percentages. Student t test was used to compare the distribution of continuous variables between groups and Chi-square test was used to compare categorical variables. Polyserial correlation coefficient was calculated to check the association of PSQI global scores and biochemical parameters. Logistic regression was used to calculate the odds ratio. For all tests, P value of less than 0.05 was considered statistically significant . All analysis was carried out in R version 4.5.0.

Results:

The dataset contained 197 samples in total. Those with less than or equal to four PSQI scores were categorized as good sleepers and those with five or above were categorized as poor sleepers. There were 108 good sleepers and 89 poor sleepers.

Table 1 gives the summary of demographics and biochemical parameters. The gender distribution between good and poor sleepers differed significantly (P value = 0.0299). Total cholesterol also differed significantly between good and poor sleepers with a mean ± SD of 182.73 ± 31.71 and 192.3 ± 34.29 respectively (P value = 0.0452). Variables like age, BMI, triglycerides, HDL, LDL and VLDL did not differ significantly between groups (P value > 0.05).

Table 2 provides the polyserial correlation coefficients and P values between biochemical parameters and PSQI sleep scores. Weak positive correlation and weak negative correlation was observed between sleep scores and biochemical parameters but none of them were significant.

Table 3 gives the logistic regression analysis of sleep quality as dependent variable and cholesterol as independent variable, adjusted for confounders. Beta coefficients represent the change in log-odds per 1mg/dL increase in the cholesterol. In all the models(unadjusted, adjusted for age,BMI, gender), the Beta coefficient has a positive value(0.0077-0.0096), indicating that as cholesterol(independent variable) levels increase, the likelihood of the dependent variable(poor sleep quality) also increases. The relationship is also statistically significant in the unadjusted, age-adjusted and BMI-adjusted models. The BMI- adjusted model showed the highest significance($p = 0.0324$) and the highest effect size(Beta = 0.0096), suggesting that when weight is adjusted for, the link between cholesterol and sleep quality becomes even more pronounced. When the model is adjusted for gender, p-value rises to 0.0831, which is higher than the standard threshold of 0.05. This indicates that the relationship is not statistically significant when gender is accounted for. This implies two possibilities: Gender is a strong confounding factor, or that the relationship between cholesterol and sleep quality differs significantly between men and women. Similarly, the Confidence interval does not cross 0 in the first three models (unadjusted, BMI and age), however it crosses zero in the gender-adjusted model(lower bound being -0.0009), confirming that it is not statistically significant .

Table 4 presents a multivariate linear regression analysis where total cholesterol is the dependent variable and sleep quality is the independent variable. This is essentially the inverse of Table 3, analysing how sleep quality predicts cholesterol levels across four models. The estimate refers to the change in total cholesterol for every one-unit change in the sleep quality score. In the BMI- adjusted model, the estimate is the highest at 10.226. This suggests that after adjusting for weight, sleep quality has a substantial predictive relationship

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

with cholesterol levels. Similar to Table 3, the relationship remains statistically significant in the unadjusted($p = 0.0432$), age-adjusted($p = 0.0434$) and BMI-adjusted($p=0.031$). This indicates that since the p-values are consistently below 0.05 across these models, there is a robust association between sleep quality and serum cholesterol. Similarly, adjusting for gender causes the relationship to lose statistical significance($p = 0.0827$). The 95% Confidence Interval includes zero(lower range being -1.0877), hence the fact that the relationship exists independently of gender influence cannot be established definitively.

Table 3, being a logistic regression, looked at the probability of having good vs poor sleep, while Table 4 being a multivariate linear regression treats cholesterol as a continuous numerical value. This suggests that as sleep quality scores worsen, total cholesterol levels significantly rise by approximately 8.3-10.2 mg/dL. Hence looking at the analysis from both the tables, we can say that sleep and cholesterol are significantly related, with controlling for BMI actually making the relationship more significant in both the tables. Conversely, gender is the only variable that when controlled, pushes the results into the statistically not significant category in both the tables.

Discussion:

Poor sleep quality, as previously measured using the PSQI method, can cause derangement of serum cholesterol (HDL, LDL, Triglycerides, Cholesterol) via multiple abnormal physiological functions. These include (but not limited to) reduced HDL cholesterol, Increased LDL cholesterol and triglycerides, inflammation, hormonal imbalance particularly appetite and stress(leptin and cortisol) as well as causing an individual to make poor dietary choices along with reduced physical activity. All of the above derangements can negatively impact serum cholesterol levels.

High serum cholesterol levels can cause atherosclerosis, plaque formation and narrowing of arteries which will cause a reduced blood flow while raising the risk of rupture of clots that can potentially lead to complete occlusion of important arteries such as coronary or cerebral arteries leading to heart attacks and strokes.

Poor sleep quality causes an increase in cholesterol by a decreased expression of NR1D1, a circadian oscillator and transcriptional regulator of CYP7A1, an enzyme that converts cholesterol into bile acids. Decreased conversion causes increased serum cholesterol levels and its accumulation in the liver.[8]

In addition, the available literature shows that sleep restriction/deprivation significantly increases total cholesterol and LDL cholesterol levels. Interventions that can help prolong the sleep duration can help in treating patients who have hypercholesterolemia.[9]

Additionally, we can also consider the converse perspective in which abnormal lipid profile can cause sleep disturbances. One study conducted in rat animal models showed that there is significant sleep disturbances due to increased sympathetic activity after exposure to high cholesterol. This could signify that the inverse correlation of high cholesterol causing sleep apnea and poor sleep quality could also pose a risk to patients.[10] A similar observation has been made in a study conducted in human subjects which tested for hypercholesterolemia and associated sleep disturbances.[11]

Our study has shown significant differences between good and bad sleepers in the table of demographics (Table 1) and logistic regression analysis(Table 3). While these 2 measures show the statistical correlation between sleep quality and cholesterol, clinical correlation has to be better analyzed. Multivariate analysis has also shown a quantifiable increase for cholesterol in patients with decreased sleep quality. One possible confounder can be that obesity(raised BMI, Table 3), poses an increased risk of sleep apnoea, and this could potentially cause disruptions in REM and NREM sleep which could ultimately be the cause of poor sleep quality.[10] Adjustments for BMI and sleep apnea have shown the association between sleep quality and lipid profile to disappear in certain studies.[13] Similarly our study has shown that in the gender adjusted model, the results are not statistically significant . This finding is also echoed in other studies in which they have reported that women might have poorer sleep quality in relation to men.[14]

Studies have also been conducted in which association of sleep quality and serum cholesterol have been measured,

Journal of Chemical Health Risks

www.jchr.org

JCHR (2026) 16(1), 653-661 | ISSN:2251-6727

particularly in those with other metabolic comorbidities such as diabetes mellitus. It has been reported that those with additional comorbidities will have poorer control of serum cholesterol.[15]

Conclusion:

Our study has shown a statistically significant correlation between poor sleep quality and increased total cholesterol. There have been other similar studies in other regions which have similar supporting evidence.[16] This could help us in further research on recognition of poor sleep as a factor in patients who struggle to maintain cholesterol levels under control. Further research can also be done to find out which type of cholesterol is predominantly affected in case of sleep disturbances. However, more analysis as well as multiple confounding factors have to be taken into consideration before drawing significant clinical correlation between poor sleep quality and increased total cholesterol.

References:

1. Hung HC, Yang YC, Ou HY, Wu JS, Lu FH, Chang CJ. The association between self-reported sleep quality and metabolic syndrome. PLoS One. 2013;8(1): e54304. doi: 10.1371/journal. pone.0054304. Epub 2013 Jan 14. PMID: 23342127; PMCID: PMC3544823.
2. St-Onge MP, Mikic A, Pietrolungo CE. Effects of Diet on Sleep Quality. Adv Nutr. 2016 Sep 15;7(5):938-49. doi: 10.3945/an.116.012336. PMID: 27633109; PMCID: PMC5015038.
3. Lao XQ, Liu X, Deng HB, Chan TC, Ho KF, Wang F, Vermeulen R, Tam T, Wong MCS, Tse LA, Chang LY, Yeoh EK. Sleep Quality, Sleep Duration, and the Risk of Coronary Heart Disease: A Prospective Cohort Study With 60,586 Adults. J Clin Sleep Med. 2018 Jan 15;14(1):109-117. doi: 10.5664/jcsm.6894. PMID: 29198294; PMCID: PMC5734879.
4. Buysse DJ, Reynolds CF 3rd, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989 May;28(2):193-213. doi: 10.1016/0165-1781(89)90047-4. PMID: 2748771.
5. Lee Y, Siddiqui WJ. Cholesterol Levels. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www. ncbi. nlm.
6. Supak Smolcic V, Bilic-Zulle L, Fisic E. Validation of methods performance for routine biochemistry analytes at Cobas 6000 analyzer series module c501. Biochem Med (Zagreb). 2011;21(2):182-90. doi: 10.11613/bm.2011.028. PMID: 22135859.
7. MacRae AR. A semi-automated enzymatic assay for free glycerol and triglycerides in serum or plasma. Clin Biochem. 1977 Feb;10(1):16-9. doi: 10.1016/s0009-9120(77)90232-6. PMID: 837520.
8. Xing C, Huang X, Zhang Y, Zhang C, Wang W, Wu L, Ding M, Zhang M, Song L. Sleep Disturbance Induces Increased Cholesterol Level by NR1D1 Mediated CYP7A1 Inhibition. Front Genet. 2020 Dec 23;11:610496. doi: 10.3389/fgene.2020.610496. PMID: 33424933; PMCID: PMC7793681.
9. Gangwisch JE, Malaspina D, Babiss LA, Opler MG, Posner K, Shen S, Turner JB, Zammit GK, Ginsberg HN. Short sleep duration as a risk factor for hypercholesterolemia: analyzes of the National Longitudinal Study of Adolescent Health. Sleep. 2010 Jul;33(7):956-61. doi: 10.1093/sleep/33.7.956. PMID: 20614855; PMCID: PMC2894437.
10. Lin WL, Hsiao YW, Liu SH, Cheng WH, Tsai TY, Chou YH, Yang CCH, Kuo TBJ, Chen SA, Lo LW. Effects of low-density lipoprotein cholesterol on sleep apnea: Insights from a rat model of cardiovascular autonomic dysregulation. Sleep Med. 2024 Mar;115:76-82. doi: 10.1016/j. sleep.2024.02.008. Epub 2024 Feb 2. PMID: 38340526.
11. Sari ADR, Sholihin S, Toga E. Relationship between hypercholesterolemia and sleep quality among older adults. J Pal Nurs Stud [Internet]. 2023 May 30 [cited 2025 Sep. 18];2(2):97-102. Available from: https://jpns-journal. com/index. php/jpns/article/view/7
12. Bikov A, Lazar Z, Horvath P, Tarnoki DL, Tarnoki AD, Fesus L, Horvath M, Meszaros M, Losonczy G, Kunos L. Association Between

Serum Lipid Profile and Obstructive Respiratory Events During REM and Non-REM Sleep. Lung. 2019 Aug;197(4):443-450. doi: 10.1007/s00408-019-00195-7. Epub 2019 Feb 2. PMID: 30712133; PMCID: PMC6647223.

13. Bos MM, Noordam R, van den Berg R, de Mutsert R, Rosendaal FR, Blauw GJ, Rensen PCN, Biermasz NR, van Heemst D. Associations of sleep duration and quality with serum and hepatic lipids: The Netherlands Epidemiology of Obesity Study. J Sleep Res. 2019 Aug;28(4): e12776. doi: 10.1111/jsr.12776. Epub 2018 Oct 15. PMID: 30324729; PMCID: PMC7379241.
14. Fatima Y, Doi SA, Najman JM, Mamun AA. Exploring Gender Difference in Sleep Quality of Young Adults: Findings from a Large Population Study. Clin Med Res. 2016 Dec;14(3-4):138-144. doi: 10.3121/cmr.2016.1338. PMID: 28188139; PMCID: PMC5302457.
15. Barikani A, Javadi M, Rafiei S. Sleep Quality and Blood Lipid Composition Among Patients with Diabetes. Int J Endocrinol Metab. 2019 Jun 2;17(3): e81062. doi: 10.5812/ijem.81062. PMID: 31497039; PMCID: PMC6678070.
16. Pintacom J, Pliannuom S, Buawangpong N, Angkurawaranon C, Pinyopornpanish K. The Association Between Poor Sleep Quality and Lipid Levels Among Dyslipidemia Patients in Thailand: A Prospective Cross-Sectional Study. Healthcare. 2025; 13(6):678.