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Original Article

Effect of sleep duration during and after examination on serum lipid profile among basic medical sciences students of ABU Zaria.

Nafisat M. Gonto,[1] Abubakar M. Bello,[2] Dibali E. Musa.[1]

[1]Department of Anatomy and Physiology, Plateau State College of Nursing Sciences, Vom, Plateau State, Nigeria.
[2]Department of Human Physiology, University of Maiduguri, Borno State, Nigeria.

Correspondence to: Nafisat M. Gonto, Department of Anatomy and Physiology, Plateau State College of Nursing Sciences, Vom, Plateau State, Nigeria. Email: nafisamuhammad221@gmail.com.
Phone: +234-8130218338. ORCID: https://orcid.org/0009-0001-5720-9265

Abstract

Background: Adequate sleep is essential for general healthy functions. Contemporary research has shown that insufficient sleep contributes to numerous health conditions, including obesity, type 2 diabetes, and hyperlipidaemia. **Aim:** To determine the effect of sleep variation during and after examination on serum lipid profile**. Methodology:** Subjects were interviewed with a standardised questionnaire. A duration of 16weeks was used for the study. The cross-sectional relationship between sleep duration and serum lipid profile was analysed. **Results**: Sleep duration was decreased during examination to about 1-3 hours (21%) and increased to about 7-10 hours (63.8%) after examination. There was a significant ($P < 0.05$) increase in total cholesterol and triglyceride levels after examination, with values of 141.5 ± 1.35 and 151.2 ± 3.71 compared to the values during examination, with values of 91.6 ± 0.68 and 101.0 ± 1.34, respectively. High-density lipoprotein (HDL) levels were lower during the examination, with a value of 33.3 ± 0.53, compared with 42.9 ± 0.53 after the examination, although the difference was not statistically significant. But there was a statistically significant increase in low-density lipoprotein (LDL) levels during examinations (67.6 ± 0.79) compared to after examination with a value of 47.1± 0.60. **Conclusion**: The study suggests that sleep deprivation is associated with an abnormal serum lipid profile.

Keywords: *Cross-sectional relationship, Diabetes, High-density lipoprotein, Sleep deprivation, Total cholesterol, Triglyceride.*

Introduction

Adequate sleep is essential for maintaining overall health and proper physiological functioning. [1] Sleep is an active state of unconsciousness produced by our body where the brain is relatively in a state of rest and is primarily reactive to internal stimulus.[2] Contemporary research has shown that insufficient sleep contributes to numerous health conditions, including obesity, type 2 diabetes, hypertension, and cardiovascular disease.[3] Sleep is recognised as a vital physiological necessity, and chronic sleep deprivation has been linked to oxidative stress and systemic inflammation, resulting in multi-organ injury.[4] Furthermore, sleep serves a critical restorative role, supporting both psychological and physical well-being.[1] Inadequate sleep is associated with increased stress, mood disturbances, and a heightened risk of depression.[5] There is also growing evidence that sleep deprivation impairs vascular and endothelial

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function, thereby increasing long-term cardiovascular risks.[6]

Sleep deprivation impacts lipid metabolism through several physiological mechanisms. It disrupts the balance of appetite-regulating hormones, such as leptin and ghrelin, leading to increased caloric intake and altered lipid synthesis.[7]Disorders of lipoprotein metabolism are collectively referred to as "dyslipidaemias". It is generally characterised by increased plasma levels of cholesterol, triglycerides (TG) or both, variably accompanied by reduced levels of high-density lipoprotein (HDL) cholesterol.[8] Currently, dyslipidaemias cause 4.3 million deaths per year worldwide and 39 million disability-adjusted life years lost.[9] Therefore, the National Cholesterol Education Program (NCEP) developed guidelines for the detection, evaluation, and treatment of high blood cholesterol in adults.[9]

An examination is defined as a formal written, spoken or practical test, especially at school or college, to see how much you know about a subject or what you can do. [10] During examination, most students decrease their sleep duration from the normal 8 hours of sleep to less than four hours of sleep, which puts them at risk of dyslipidaemia. [11]

College students have later bedtimes and rise times and show a higher incidence of daytime sleepiness in addition to physical and mental health complaints.[11] Most college student sleep studies have focused on sleep patterns, fatigue, and academic performance, but only a few have examined sleep in college students and its association with dyslipidaemia as a leading risk factor for cardiovascular disease.[12] Thus, this study aims to point out the effect of sleep deprivation among individuals during and after examinations on serum lipid profile.

Materials and Methods

Study area

The School of Medicine, Faculty of Basic Medical Sciences, Ahmadu Bello University, Zaria, Kaduna State, Nigeria, was purposely selected by the researchers because of the demanding nature of medical education and its erratic schedule of activities.

Subject enrolment

A cross-sectional study was conducted among forty-seven men and women volunteers aged between 18 to 26 years using a convenience sampling method. Written informed consent was obtained from the participants after obtaining ethical approval from the Health Research Ethics Committee of Ahmadu Bello University, Zaria, with reference number ABUTH/HREC/TRG/36. Men and women of the age group 18–30 years who were willing to participate in the study, nonsmokers and non-alcoholics, were included in the study. Students with a history of hypertension, diabetes and chronic respiratory disease were excluded from the study.

Materials

Hand gloves, 5 ml syringes, cotton wool, methylated spirit, ethylenediaminetetraacetate (EDTA) bottles, colorimetric assay kits, and a tourniquet.

Collection of blood samples

Venous blood was collected from the cubital fossa using a 5 ml syringe attached to a needle. The blood was collected into plain capped bottles containing ethylenediaminetetraacetate (EDTA). The study duration was 16 weeks. The samples were used for the estimation of the serum lipid profile.

Sleep Habits Questionnaire

The Pittsburgh Sleep Quality Index (PSQI) is used as a subjective measure of sleep quality. Sleep patterns of the study participants were evaluated using a standardised questionnaire—The Pittsburgh Sleep Quality Index (PSQI). [13] A doctor who supervised the work in the faculty evaluated the content validity of the questionnaire.

Estimation of Serum Lipid Profile

This was determined spectrophotometrically, using enzymatic colometric assay kits (Randox, Northern Ireland) as follows.

Determination of Serum Total Cholesterol

The serum level of total cholesterol was quantified after enzymatic hydrolysis and oxidation of the sample as described by the method of Stein (1987).[14] Briefly, 1000µl of the reagent was added to each of the samples and the standard. This was incubated for 10 minutes at 20-25°C after mixing, and the absorbance of the sample (A_{sample}) and standard ($A_{standard}$) was measured against the reagent blank within 30 minutes at 546 nm. The value of total cholesterol present in the serum was expressed in mg/dl. Total cholesterol concentration = A sample /A standard x 196.86 mg/dL.

Determination of Serum Triglyceride

The serum triglyceride level was determined after enzymatic hydrolysis of the sample with lipases as described by Tietze (1990).[14] Briefly, 1000µl of the reagent was added to each sample and standard. This was incubated for 10 minutes at 20-25 ^{0}C after mixing, and the absorbance of the sample (A_{sample}) and standard ($A_{standard}$) was measured against the reagent blank within 30 minutes at 546 nm. The value of triglyceride present in the serum was expressed in mg/dl. Triglyceride concentration = A sample/A

standard x 194.0 mg/dL.

Determination of Serum High-Density Lipoprotein Cholesterol

The serum level of HDL-C was measured using the method of Wacnic and Albers (1978).[14] Low-density lipoproteins (LDL and VLDL) and chylomicron fractions in the sample were precipitated quantitatively by the addition of phosphotungstic acid in the presence of magnesium ions. The mixture was allowed to stand for 10 minutes at 20-25°C and centrifuged for 10 minutes at 4000 g. The supernatant represented the HDL-C fraction. The cholesterol concentration in the HDL fraction, which remained in the supernatant, will be determined. The values of HDL-C were expressed in mg/dL.

Determination of Serum Low-Density Lipoprotein Cholesterol

The serum level of LDL-C was measured according to the protocol of Friedewald *et al*. (1972)[14] using the equation below: LDL-C = TC - (TGL/5 + HDL-C). The value was expressed in mg/dL.

Statistical Analysis

Data were statistically analysed using Paired t test to compare mean levels of plasma lipid profile in subjects during (experimental group) and after (control group) examination, and values were expressed as the mean ± standard error of the mean. P values less than 0.05 were considered statistically significant. The statistical analysis was done using the software IBM SPSS version 27 and Excel 2013 for Windows with an adjustable power of 80.

Results

Table 1 shows that the majority of the study participants were between the ages of 18-20 years (44.7%), single (97.9%), mostly men (55.3%) and stayed in the hostel (76.6%). About 12 (25.5%) of the students slept for 1-3 hours during the examination, while 0 (0%) slept within this range after the examination. 33 (70.2%) of the students slept for 4-6 hours during the examination, while 7 (14.9%) slept within this range after the examination. For the sleep duration of 7-10 hours and 11-14 hours, only 2.1% of students slept within this range during exams, while 30 (63.8%) and 10 (21.3%) slept after exams for 7-10 and 11-14 hours, respectively, as shown in Table 2.

Table 1: CHARACTERISTICS OF PARTICIPANTS

Characteristics	Frequency (%)
Age group	
18 to 20 (years)	21 (44.7 %)
21 to 23 (years)	20(42.6 %)
24 to 26 (years)	6 (12.6 %)
Sex	
MALE	26 (55.3 %)
FEMALE	21 (44.7 %)
Place of residence	
Hostel	36 (76.6 %)
Off Campus	11 (23.4 %)
Marital Status	
Single	46 (97.9 %)
Married	1 (2.1 %)
Existing Disease Condition	
Yes	0 (0.0 %)
None	47 (100 %)
Current Medication to Shorten Sleep Duration Due to Examination	
None	47 (100 %)

Table 2: DURATION OF SLEEP DURING AND AFTER EXAMINATION

Duration of sleep (Hours)	During Exams (%)	After Exams (%)
1-3	12 (25.5)	0 (0.0)
4-6	33 (70.2)	7 (14.9)
7-10	1 (2.1)	30 (63.8)
11-14	1 (2.1)	10 (21.3)

On the association between sleep and serum lipid profile, there was a significant ($P < 0.05$) increase in total cholesterol and triglyceride levels after examination, with values of 141.5 ± 1.35 and 151.2 ± 3.71 compared to the values during examination, with values of 91.6 ± 0.68 and 101.0 ± 1.34, respectively. High-density lipoprotein (HDL) levels were lower during the examination, with a value of 33.3 ± 0.53, compared with 42.9 ± 0.53 after the examination, although the difference was not statistically significant. But there was a statistically significant increase in low-density lipoprotein (LDL) levels during examination (67.6 ± 0.79) compared to after examination, with a value of 47.1± 0.60, as depicted in Table 3.

Table 3: ASSOCIATION BETWEEN SLEEP AND SERUM LIPID PROFILE

PARAMETERS	DURING EXAM	AFTER EXAM
Cholesterol (mg/dL)	91.6 ± 0.68	141.5 ± 1.35*
Triglycerides (mg/dL)	101.0 ± 1.34	151.2 ± 3.71*
HDL (mg/dL)	33.3 ± 0.53	42.9 ± 0.53
LDL (mg/dL)	67.6 ± 0.79	47.1 ± 0.60*

*Significant at $P < 0.05$

Discussion

Our sleep-wake cycle is associated with serum lipid and lipoprotein levels.[15] Recently, the effect of decreased sleep duration on dyslipidaemia and metabolic syndrome has become more popular as it affects cardiovascular health.[16] High levels of triglycerides and low High Density Lipoprotein are considered risk factors for coronary heart disease, diabetes, and metabolic syndrome.[3] The findings of our study show the presence of altered serum lipid profile parameters among students during examination due to sleep deprivation, compared to after examination.

This is similar to a cross-sectional study among undergraduate students that found that higher perceived stress was associated with elevated total cholesterol and triglyceride levels, suggesting that stress may disrupt normal lipid homeostasis in young adults.[17] This is thought to occur via activation of the hypothalamic-pituitary-adrenal (HPA) axis and subsequent cortisol secretion, which can influence lipid synthesis and mobilisation. [17] The elevation in triglyceride levels after examination is also in line with a study on acute academic stress and its associated behavioural changes, such as altered sleep patterns, irregular eating and reduced physical activity, all of which can affect serum lipid profile.[18] This supports the relevance of stress in lipid regulation among university students.

HDL-cholesterol levels increased after the examination period, though the value was not statistically significant; it may be a reflection of stress recovery and potential lifestyle normalisation.[19] Improved sleep, reduced anxiety, and better dietary choices once examinations conclude could contribute to favourable changes in HDL levels, a pattern similar to a study in Lebanon.[19] Also, low levels of HDL can also be a result of impaired lipid metabolism and impaired glucose tolerance as seen in people with short durations of sleep.[20]

A study on healthy volunteers showed that the serum levels of LDL cholesterol and triglyceride in people with low sleep quality were significantly higher than participants with good sleep quality.[20] This is in line with our study, as LDL levels significantly decreased after examination. Though, another study shows a contrast with our findings with chronic stress models where prolonged stress promotes atherogenic profiles.[21]The difference may be because post-exam relief leads to metabolic recovery that includes LDL levels being lowered.

Conclusion

The study suggests that sleep deprivation is associated with an abnormal serum lipid profile. It also highlights the importance of sleep quality in the prevention of dyslipidaemia, diabetes and cardiovascular risk among medical students.

Recommendations

1. Additional studies that consider sleep duration over multiple semesters can be conducted to ascertain an association over a longer period.
2. Further studies on different medical schools can be evaluated by researchers to show trends in the effect of sleep duration among students.
3. To elucidate the causal pathways between sleep disturbances and lipid metabolism, we propose that the study be conducted with a larger sample size.

Conflict of interests

The authors declare no conflicts of interest.

Author contributions

NMG conceptualised the work and drafted the manuscript, NMG and AMB administered the questionnaire, studied the design, and performed data analysis, and DME managed the literature search. All authors revised the draft and approved the final draft of the manuscript before final submission.

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