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Sleep Duration and the Effects on Cholesterol Levels in College Students.

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Acknowledgments

Abstract

Cardiovascular disease is a rising issue in the United States causing large death rates along with large medical expenses. College students are potentially at risk of CVD due to a lack of knowledge of their health, including cholesterol level. Sleep is an essential biological function which helps with the body's repair, recovery, conservation of energy and maintains cardiovascular regulation. The purpose of this study was to see if there is a correlation between sleep duration and cholesterol levels in college students. Twenty-seven student participants were recruited from the Exercise is Medicine cohort . In-person assessments were conducted at the HPER building under the supervision of the Exercise Science Research Center. If eligible the participants gave consent and then had a finger prick to collet blood which was ran using an ALERE CHOLESTECH LDX® LIPID PROFILE. Sleep was measured by having the participants fill out the Pittsburgh Sleep Quality Index (PSQI), which provide subjective information on participants regarding their sleep. Participants also wore Actigraph GT9 Accelerometers for a week around their wrist which provided objective information about their sleep duration. Results: Student ages ranged from 19-27 and consisted of 13 males and 14 females. Results showed a positive correlation between longer weekend sleep and Low-Density Lipoprotein levels as well as total cholesterol. In unadjusted results, for every extra hour of weekend sleep there was an increase of 14.3 mg/dL of LDL levels (p-.02). When results were adjusted for age, sex and body mass index. for each additional hour of weekend sleep there was an increase of 16.8 mg/dl of LDL levels (p-.02). Adjusted results also show a positive correlation between accelerometer sleep and total cholesterol. Each additional hour of accelerometer sleep there was as an increase of .2 mg/dl of total cholesterol levels (p-.04). These positive correlations are potentially meaningful, as higher cholesterol levels are associated with a higher risk of cardiovascular disease. The observed positive correlation may indicate that longer weekend sleep is associated with an increased risk of cardiovascular disease in college students.

Introduction

Cardiovascular Disease (CVD) is a major risk for people of all age groups and is often not explored until older age. Heart disease is the leading cause of death in the state of Arkansas, which ranks 3rd in the nation for the most deaths due to CVD. In 2014, total hospitalization costs for heart disease in Arkansas were over $116 million *("Stats of the State of Arkansas", 2015).* There are several acknowledged risk factors for cardiovascular disease, and Dyslipidemia unhealthy levels of cholesterol is one of them. Cholesterol is broken down into High-Density lipoproteins (HDL) which is considered good cholesterol because it carries cholesterol to the liver to be removed. Low- Density Lipoproteins (LDL), which is considered bad cholesterol because high amounts can lead to artery blockage *("High Cholesterol",2013).* Nearly 1 in 3 American adults has high cholesterol. Too much cholesterol puts people at risk for heart disease and stroke, which are the two leading causes of death in the United States. High cholesterol has no signs or symptoms so, the only way to know is to get it looked at by a medical professional. Very few college students get their cholesterol checked potentially putting them at risk for cardiovascular disease *(Collins, Dantico, Shearer, N. B. C., & Mossman, K. L. 2004, October).*

Several behaviors contribute to cardiovascular risk including smoking, physical activity, and lack of sleep. Since both smoking and poor physical activity can have negative effects on CVD health (*Criqui, Wallace, Heiss, Mishkel, Schonfeld, & Jones, 1980).* Sleep is an essential biological function which helps with the body's repair, recovery and conservation of energy. Sleep appears to be important for vital functions such as neural development, learning, memory,

emotional regulation, cardiovascular and metabolic function. Good quality and quantity of sleep are essential for good health and overall quality of life ("*Mukherjee, Patel,Kales, Ayas, Strohl, Gozal, & Malhotra,2015*"). Few studies have examined how sleep patterns change when older adolescents enter college, a time of minimal adult supervision and erratic schedules. Twenty-five percent of students reported getting less than 6.5 hours of sleep a night, and only 29.4% of students reported getting 8 or more hours of total sleep time per night *("Aho, Ollila, 2016")*. A study using Pittsburgh Sleep Quality Index (PSQI) showed that women aged 20–29 years have poorer sleep quality compared to nonstudent women in their 20s, college students have later bedtime and rise time and show higher incidence of daytime sleepiness in addition to physical and mental health complaints. 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 CVD risk, of which dyslipidemia is a leading risk factor *("Aho, Ollila, 2016")*.The purpose of this study gathers a better understanding as to how sleep deprivation and cardiovascular risk are related in college students by examining the association of cholesterol, both high-density lipoproteins and low-density lipoproteins with sleep duration.

Methods

Study Design: This study is a cross-sectional sub-study of the larger Exercise is Medicine cohort study.

 Participants: 26 college students from the University of Arkansas were recruited for Exercise is Medicine. Students ages range from 19-27 and are a mix of males and females. Students provided information such sleep duration, diet, family history, and amount of physical activity.

Lipid Profile: A full lipid profile was collected from the participants to include Total

Cholesterol, HDL, LDL Triglycerides, and TC/HDL. Participants were required to fast 8 hours

before the finger prick. Blood was taken up by a capillary tube, place in a blood cassette and

analyzed by ALERE CHOLESTECH LDX® LIPID PROFILE. The results will be compared to

the table below.

Healthy Cholesterol levels	Men	Woman
LDL	<100 mg/dL	<100 mg/dL
HDL	>40 mg/dL	>50 mg/dL
Total Cholesterol	125 to 200 mg/dL	125 to 200 mg/dL
Triglycerides	<150mg/dl	<150mg/dl
TC/HDL	<3.5mg/dl	<3.0mg/dl

Table 1 above is the recommended healthy levels (LDL, HDL, and total cholesterol, triglycerides and TC/HDL) of

cholesterol for men and woman above the age of 20 ("*Cholesterol Levels: What You Need to Know*(pp. 59–

60)",2012)

Sleep: For sleep measurement the Pittsburgh Sleep Quality Index (PSQI) was used, which

helped provide subjective information on participants regarding their sleep. Participants also

wore Actigraph GT9 Accelerometers for a week around their wrist, which will help provide

objective information about their sleep duration.

BMI: Participants were brought into the laboratory for a fitness assessment, during that time

height and weight were collected by a stadiometer and a scale.

Other things known to influence CVD: Smoking deceases the levels of HDL, so non-smokers

will be used for this study. ("*Cholesterol Levels: What You Need to Know*(pp. 59–60)",2012*).*

Students whose parents have had a history of high cholesterol are at risk of developing high

cholesterol. Alcohol showed no effect on cholesterol level. *(Crouse,Grundy,1984).*

Procedure: In-person assessments were conducted at the HPER building under the supervision of the Exercise Science Research Center and Dr. Howie Hickey. Participants were given the opportunity to fill out a questionnaire online to see if they eligible. They then fill out a questionnaire in person to give consent and give more information needed for the study. Participants height and weight were measured to calculate BMI. This information was used to see if they are eligible for the study. If eligible the participants were given informed consent, asked if they are willing to have their blood taken via finger prick, and willing to wear an accelerometer for a week. If consent was given blood was taken by a finger prick using a Lancet and collected on a cholesterol test cassette, the blood was then ran using an Alere Cholestech LDX® lipid profile. After a week the participant returned the accelerometer. Analysis was conducted, and the participant was emailed their results following the research process using a simplified data visualization.

Statistical Analysis. Descriptives of means and standard deviations were calculated. Values were compared between men and women using t-tests. The relationship between sleep and blood lipids was assessed using linear regressions with sleep duration as the independent variable and blood lipids as the dependent variable. Regressions were additionally adjusted for age, sex, and BMI.

Results

Table 2 shows the average analysis of Age, Height, Weight, BMI, LDL, HDL, Total Cholesterol, Triglycerides, TC/HDL, Sleep Duration and Sleep Duration divided between 13 men and 14 women. There is a positive relationship between LDL and Weekend sleep duration (p-.02) as

seen in table 3. The unadjusted association of LDL shows that for every increase of hour sleep on the weekend the LDL level increases by 14.3 mg/dl. The same positive relationship is maintained, as seen in table 4, even after adjusting for factors including age, sex and BMI. In the adjusted table (table 4) for every increased hour of weekend sleep there is an increase of 16.8 mg/dL of LDL levels (p-.02).

Table 2: Sample Descriptives and Means Between Men and Women

	Men	Women	p-value comparing
Age (yrs)	21.2	21.5	0.81
Height (in)	70.1	65.3	<.001
Weight (lbs)	180	147.5	.005
BMI or %fat from DXA (kg/m^2)	25.7	24.2	.320
LDL (mg/dL)	80.6	94.8	.204
HDL (mg/dL)	48.1	71.6	.006
Total Cholesterol (mg/dL)	146.8	187.9	.004
Triglycerides (mg/dL)	92.2	112.4	.40
TC/HDL (mg/dL)	3.6	2.8	.157
Sleep Duration (Weekday) (hrs)	7.2	7.5	.702
Sleep Duration (weekend) (hrs)	7.9	8.7	.037
Sleep (accelerometer) (minutes)	408.19	414.5	.843

Table 3: Associations between sleep and blood lipids unadjusted, n=26

	Weekday Sleep		Weekend Sleep		Total sleep avg		Sleep (accel)	
	Estimate β (SE)	p-value	Estimate β (SE)	p-value	Estimate β (SE)	p-value	Estimate β (SE)	p-value
LDL (mg/dl)	5.3 (4.5)	0.25	**14.3 (5.6)**	**0.02**	10.9 (5.6)	0.06	0.1 (0.1)	0.15
HDL (mg/dl)	4.5 (3.7)	0.23	3.3 (5.3)	0.53	4.4 (4.9)	0.37	0.02 (0.1)	0.72
Total Cholesterol (mg/dl)	9.2 (6.1)	0.15	16.4 (8.0)	0.05	14.4 (7.7)	0.08	0.1 (0.1)	0.19
Triglycerides (mg/dl)	-3.4 (8.1)	0.68	-7.6 (10.9)	0.49	-5.5 (10.4)	0.60	0.01 (0.1)	0.94

	Weekday Sleep		Weekend Sleep		Total sleep avg		Sleep (accel)	
TC/HDL mg/dl	-0.1 (0.2)	0.57	-0.1 (0.3)	0.76	-0.1 (0.3)	0.69	-.003 (.004)	0.44

In table 4, there was also an association between Accelerometer average sleep and Total Cholesterol (p-.04). For each additional hour of sleep there was an increase of Total Cholesterol by .2 mg/dl.

Table 4: Associations between sleep and blood lipids adjusted for age, sex and BMI, n=26

	Weekday Sleep		Weekend Sleep		Total sleep avg		Sleep (accel)	
	Estimate β (SE)	p-value	Estimate β (SE)	p-value	Estimate β (SE)	p-value	Estimate β (SE)	p-value
LDL	5.9 (4.7)	0.23	**16.8 (6.5)**	**0.02**	11.8 (5.9)	0.06	0.2 (0.1)	0.06
HDL	2.9 (3.4)	0.41	-3.2 (5.2)	0.54	0.9 (4.5)	0.84	0.04 (0.06)	0.51
Total Cholesterol	8.5 (5.6)	0.14	11.0 (8.7)	0.22	11.8 (7.3)	0.12	**0.2 (0.1)**	**0.04**
Triglycerides	-1.6 (8.6)	0.85	-13.8 (12.7)	0.29	-5.0 (11.2)	0.66	0.1 (0.2)	0.69
TC/HDL	-.01 (0.2)	0.08	0.3 (0.3)	0.46	0.1 (0.3)	0.69	-.002 (.004)	0.68

Table 5 shows the percent of unhealthy lipids levels for male and female participants. The highest percentage of unhealthy measures was LDL which was 23% and 14%, while triglycerides had the lowest unhealthy measure .07% and 14%.

Table 5: Percent of students with unhealthy levels

	Men	Woman
LDL	3 23%	2 14%
HDL	5 38%	4 28%
Total cholesterol	2 15%	5 35%
Triglycerides	1 .07%	2 14%
TC/HDL	5 38%	5 35%

Unhealthy levels were defined in table 1. % was calculated by taking the number of unhealthy individual and dividing between the 13 males and 14 females.

Discussion

The initial hypothesis suggested that there would be a negative correlation between a lack of sleep and an increase of Cholesterol levels. From the data, however, there is a positive correlation between sleep duration length and an increase of cholesterol level. For each additional hour of sleep there is an increase of LDL levels and total cholesterol levels. These positive correlations are potentially meaningful, as higher cholesterol levels are associated with a higher risk of cardiovascular disease. Thus these positive correlations could potentially indicate that longer weekend sleep may possibly be associated with an increased risk of cardiovascular disease in college students.

Sleep duration and cholesterol association have mixed conclusions when compared to different populations. In a previous study of middle age Japanese men who had moderate to longer sleep duration had a decreased risk of HDL, total cholesterol, and LDL levels ("*Kinuhata, S., Hayashi, T., Sato, K. K., Uehara, S., Oue, K., Endo,Fukuda, K. 2014*"). We found the opposite association in this study, suggesting there may be cultural differences in the effect of sleep duration and cholesterol. A study on middle aged adults using accelerometers and the PSQI found that each hour increase in sleep duration was significantly associated with higher TC (5.2 mg/dL) and LDL (3.4 mg/dL) in the total sample, a 1.1 mg/dL increase in TG among men ("*Petrov, Kim, Lauderdale, Lewis, Reis, Carnethon, Knutson, Glasser 2013*"). Our study found

similar results among college students but with larger increase of LDL and less increase of TC. A study done on young females ages 7-12 showed, each additional hour of sleep was associated with a significantly decreased odds of being diagnosed with high cholesterol in young adulthood. The study concluded that, short sleep durations in adolescent women could be a significant risk factor for high cholesterol (*Gangwisch Malaspina, Babiss, Opler, Posner, Shen, Turner, Zammit, Ginsberg, 2010).* This study focused on college students and no other populations potentially creating different results due to a different sample population. Differences between populations causes a large range of results on the associations between sleep duration and cholesterol potentially showing decreased knowledge about these associations.

This study was done using college students who tend to have erratic schedules. It is possible that the association found in our study can be explained by the lifestyle of college students. Staying up late and alcohol consumption often causes oversleeping the next day, possibilities of post alcohol effects increase the chance of eating fast-food while also having decreased exercise *("Crouse,Grundy,1984").* This lifestyle often seen by college students on the weekends could correlate to the increase cholesterol levels ("*Marrugat, Elosua, Covas, 2003").*

Limitations were that there could have been differences between data collectors and how they measured height and weight. Before assessments started data collectors went through the same training, as well as maintained constant communication during assessments and often overlapped assessments to help create a uniform way to collect data. Blood collected at different times of the day even while fasting could have given different results. If students were not fasted there would be an increase in the cholesterol levels, and it eliminated diet effects on cholesterol. Strengths: the same amount of blood was collected between each participant, blood collection was done before any physical workout. Sleep was also collected from both objective and

subjective sources. Other lifestyle factors were not factored into the study such as diet and physical fitness, those were collected by the larger cohort study to be used in other analysis. Future studies could focus on larger more diverse populations and having more adjusted measures to potentially get more accurate results.

Conclusion

From the data collected there appears to be a positive correlation between too much weekend sleep and an increase of LDL (bad cholesterol) levels. There is also a positive correlation between total cholesterol and accelerometer measured sleep. These correlations could potentially indicate there is an increased risk of cardiovascular disease for college students who tend to sleep more on the weekend. With these results there needs to be an increase of awareness of sleep durations impact on cholesterol levels among students. Campus welcome events as well as campus heath centers can promote and give resources to decrease the risk of cardiovascular diseases amount college students.

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