Total Sleep Time as Moderator for Serum Glucose Levels in College Students with and without Insomnia

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INTRODUCTION

Epidemiological studies suggest that the average sleep duration of adults has been decreasing across all age ranges.[9,13] Furthermore, 28-29% of adults report an average of less than 6.5 hours of sleep a night.[1] The consequences of sleep curtailment on glucose metabolism are relevant because previous literature has shown that a lack of quality sleep disrupts multiple regulatory systems including metabolic, cardiovascular and immune.[5,2]

Over the last few decades, there has been a trend of increased global serum glucose levels in conjunction with the global prevalence of metabolic syndrome.[3] Furthermore, possessing high serum glucose levels is a major contributor to the development of diabetes mellitus, which is currently the seventh leading cause of death in the US.[3]

Previous literature has established a relationship between sleep curtailment and elevated impairment in glucose metabolism in normal populations[6,9,7,12,4], populations with obstructive sleep apnea[8] and sleep disordered breathing[12] However, this relationship has not been thoroughly examined in regards to the college-aged population with insomnia.

Unlike sleep curtailment, which is generally acute in a laboratory setting, individuals with insomnia complain about inadequate nocturnal sleep whether it is difficulty falling asleep, frequent awakenings, or early awakenings with the inability to go back to sleep for chronic periods of time. If a night of sleep curtailment shows elevated glucose metabolism, then it should be expected that chronic sleep disturbance should also have an effect on glucose metabolism, however there is little in the literature on this subject.

The aim of the current study was twofold in which, glucose levels were predicted to be different between individuals with insomnia and individuals without insomnia. Secondly, the study aimed to examine total sleep time (TST) as a predictor for higher glucose levels in college students with and without insomnia. Lower TST was predicted to be related to higher serum glucose levels in college-aged students with insomnia similar to participants with low TST without insomnia.[6,9,13,7,14,4]

METHODS

Sample and Procedure

Participants were 149 healthy college students; three participants were excluded for missing sleep diary data N = 146 (Insomnia=68, No Insomnia=78). Mean age was 20.24 (SD=2.60); 60% were female. Ethnic categories were 69% non-Hispanic or Latino, 29% Hispanic or Latino, and 2% of unknown ethnicity. Racial categories were 64% white, 11% black or African American, 13% multiracial, 4% Asian, and 8% unknown or not reported. Within the insomnia group, 67.7% had sleep onset insomnia, 24.6% had maintenance insomnia and 20% had terminal insomnia at least 3 nights a week.

Informed participants underwent a semi-structured clinical interview to verify the presence or absence of DSM-5 diagnosable insomnia. Then, they completed 7 days of sleep diaries. At the end of this period, they had blood drawn.

Measures

Total Sleep Time (TST): TST was the mean TST (i.e, time in bed = wake after sleep onset + onsleep onset latency) for 7 days of sleep diaries.

Serum Glucose Levels (mg/dl): A comprehensive metabolic panel (CMP) is used as a broad screening tool to evaluate a range of macromolecule levels circulating in the blood. In the current study, glucose (mg/dl) was examined.

Statistical Analysis

An independent samples t-test was performed to compare serum glucose levels between individuals with and without insomnia. This was followed up by a linear regression within each group to examine the relationship between TST and glucose (mg/dl) (controlling for gender, race, ethnicity and BMI).

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RESULTS

Means and standard deviations for all measures are presented in Table 1. A *t*-test was conducted to examine the differences in glucose (mg/dl) between the Insomnia and No Insomnia groups.

Glucose (mg/dl) was distributed for the non-insomnia group as shown in Figure 1.

Table 1

Means and Standard Deviations of Measures

Measures	Mean	*SD*
IVs		
Sleep Diary TST (Minutes) – Insomnia	394.4	66.86
Sleep Diary TST (Minutes) – No Insomnia	448.91	47.86
DVs		
Glucose (mg/dl) – Insomnia	92.38	9.18
Glucose (mg/dl) – No Insomnia	95.17	13.2

Independent Samples T-Test

As presented in Table 2, the insomnia group had non-significantly higher levels of serum glucose than the non-insomnia group, $t(147) = 1.48$, $p = .14$, $d = .25$.

Table 2

Independent Group T-Test between Serum Glucose (mg/dl) and Insomnia Status

	Individuals with Insomnia		Individuals without Insomnia		
	M	*SD*	*M*	*SD*	*t*
Glucose (mg/dl)	92.38	9.18	95.17	13.2	1.48

p=.14, N=147

Although the difference between the groups was non-significant, the effect size was notable. Therefore, two linear regressions were conducted (one in people with insomnia, one in people without insomnia) to examine the effect of TST on glucose (mg/dl) in each group after controlling for gender, race, ethnicity and BMI.

Individuals with Insomnia

The regression was not significant, $F(1,61) = .01$, $p = .93$. TST was not a significant predictor of glucose (mg/dl) in individuals with insomnia after controlling for BMI and gender. For regression results, see Table 3.

Table 3

Total Sleep Time as Predictor of Glucose in Individuals with Insomnia

Predictor	B	SE(B)	β	*t*	*p*	r_s
TST	-.002	.018	-.012	-.092	.927	-.244
BMI	.243	.210	.144	1.157	.252	.454
Gender	-1.39	2.34	-.075	-.595	.554	-.478

a. Dependent Variable: Glucose (mg/dl)

Individuals without Insomnia

The regression was significant, $F(1,71) = 5.36$, $p = .02$, as shown in Table 4 and Figure 1. TST was a significant predictor of glucose (mg/dl) in individuals without insomnia with higher TST related to lower serum glucose (after controlling for BMI and gender.)

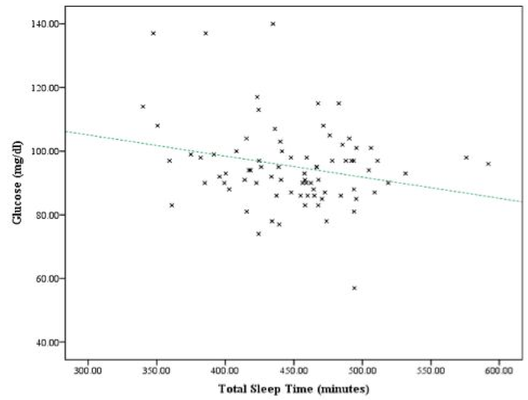
Table 4

Total Sleep Time as Predictor of Glucose in Individuals without Insomnia

Predictor	B	SE(B)	β	*t*	*p*	r_s
TST	-.077	.033	-.278	-2.31	.024	-.678
BMI	.091	.245	.042	.371	.712	.291
Gender	-2.31	3.08	-.087	-.750	.456	-.226

a. Dependent Variable: Glucose (mg/dl)

Figure 1: Unadjusted Regression of Total Sleep Time and Glucose in Individuals Without Insomnia



DISCUSSION

Although individuals with insomnia and individuals without insomnia did not demonstrate different levels of overall serum glucose, there was a difference in the relationship between TST and glucose in each group. In individuals with insomnia, there was no relationship between TST and glucose. However in individuals with no insomnia, longer TST was related to lower levels of glucose. Although these results only allow for preliminary conclusions, this may indicate a behavioral difference in late night food consumption between groups. It's possible that individuals with no insomnia are partaking in late night activities that include food consumption, while individuals with insomnia are spending their night time attempting to fall asleep rather than partaking in such activities.

There are several limitations to this study. First, we did not control for the fluctuation of glucose levels throughout the day. Furthermore, blood was only collected twice over the four week period, and more scheduled blood samples would strengthen the results. Thirdly, the sample size was a limited convenience sample from a North Texas college population and caution should be taken when generalizing results across age ranges as older adults express sharp differences in their metabolism than younger adults.

These results suggest the relationship between total sleep time, insomnia complaints, and glucose levels should be further explored. Future studies should examine glucose across the day in other samples, and examine the relationship of other sleep parameters with metabolic functioning (e.g. variability across nights, sleep efficiency).

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