

# Sleep Off The Fat?

## Objective

Childhood Obesity, particularly in adolescents, is increasingly being recognized as a serious health issue in our society. While there has been focus on diet and exercise, there has been insufficient attention paid to the influence of sleep on obesity. This study will examine the relationship between sleep and body mass index in teenagers.

A Sleep Survey was used to obtain relevant information from students in a Houston suburb, and the data analyzed to test the hypothesis.

The results partially support the hypothesis and identify interesting areas of future investigation.

## Background

Nearly one in three children in the United States are reported to be overweight or obese. The dramatic rise in the prevalence of overweight in US adolescents is a strong predictor of cardiovascular disease and overall mortality in adulthood. Today's kids may be the first generation in American history to live shorter lives than their parents.

Recent studies have shown an association between sleep loss and impaired metabolism and weight gain. Therefore, the interest in understanding the association between sleep and overweight. Body Mass Index (BMI) is a commonly accepted measure of adiposity in adults and for teen adolescents.

Sleep in adolescents differs from that observed among adults and prepubertal children. Adolescents experience a sleep phase shift due to intrinsic biological factors (accompanying puberty) which is exacerbated by extrinsic psychosocial factors (early school starts and academic pressures). This leads to impaired daytime alertness and poor mood, and potentially to weight related problems.

## Hypothesis

The hypothesis being tested is that BMI is negatively correlated with the quantity of sleep for teen adolescents.

## Study Aims

The study was intended to examine the relationship between Sleep Habits and the health and well-being of teen adolescents. Participation was open to all students from 9<sup>th</sup> to 12<sup>th</sup> grade in a high school who were registered for Pre-AP and AP science courses.

Data was to be collected using a validated sleep survey which would provide the basis to test the relationship between sleep duration and weight after accounting for various confounding factors like sex, ethnicity and lifestyle choices. To ensure reliable data, complete anonymity would be maintained during the data collection and analysis.

## Study Design and Procedure

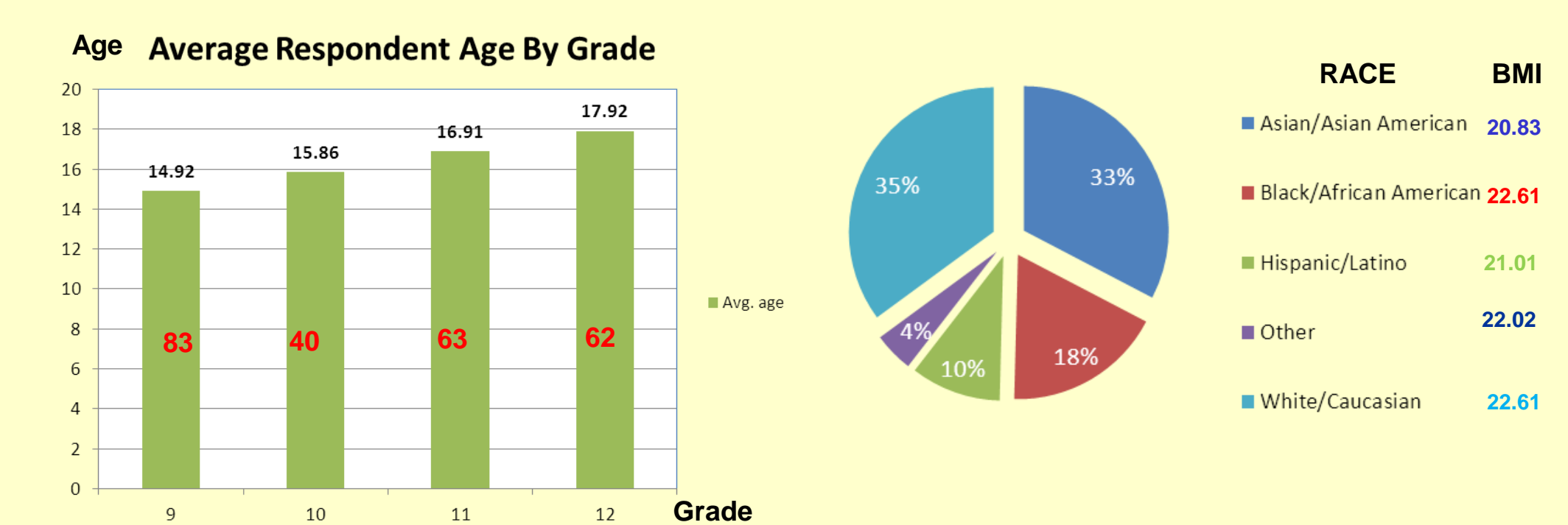
A validated four-page Sleep Habits Survey obtained from researchers at Brown University was administered in December 2010, and January 2011 to the high students. Informed consent forms were provided to over 1000 students taking advanced science courses, and surveys administered only to those who gave consent.

The survey queried the students about their usual sleeping and waking behaviors over the previous 2 weeks. It also elicited information about the sex, ethnicity, height and weight, grades obtained in courses, mood, food choices and typical activities outside school.

The data was entered into an Excel spreadsheet, and formulas embedded to calculate the BMI (weight in kg divided by the square of the height in meters), the sleep duration statistics, and various scales like a Sleepiness (Daytime Alertness) Scale, a Mood Index and Pre-bedtime activities index.

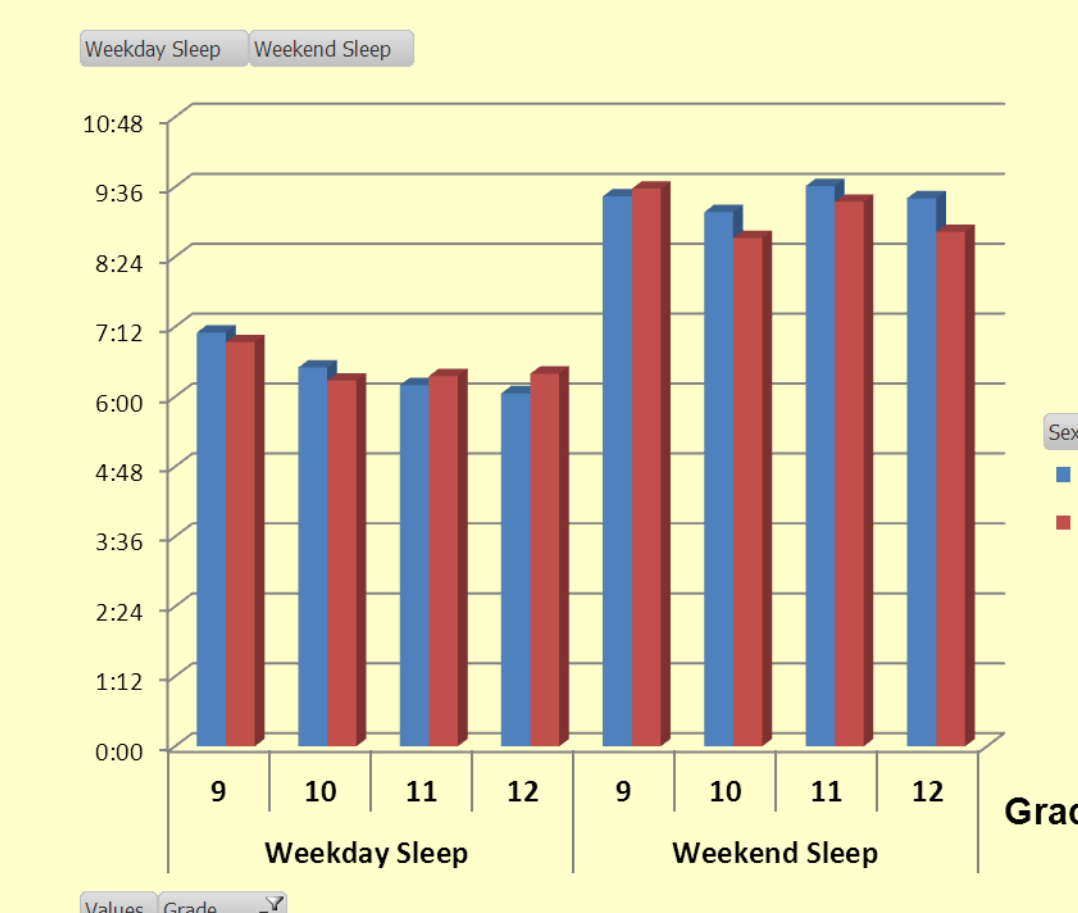
In addition to using Excel, regression analysis were performed using StataSE statistics software. The analyses were separated by sex because of physiological differences in pubertal development with respect to body composition. Regression analyses were performed for the principle outcome variable (BMI) with the set of control variables like School-Night Average Sleep Time, Weekend Bedtime Delay, and Weekend Average Sleep Time. The other covariates included in the analysis were age, race, academic performance, sleep quality, pre-bedtime activity and eating habits.

## Analysis



276 students across all four grades returned the consent forms, and completed the anonymous survey. 28 surveys were rejected for missing vital information. There were 107 valid surveys by males and 141 by females. The most (83) respondents were from 9<sup>th</sup> grade and fewest (40) were from 10<sup>th</sup> grade. The pie chart shows the percent of respondents for each self-identified race. The legend also shows the average BMI for each ethnic group.

The following bar graph shows the average weekday and weekend sleep times by sex.

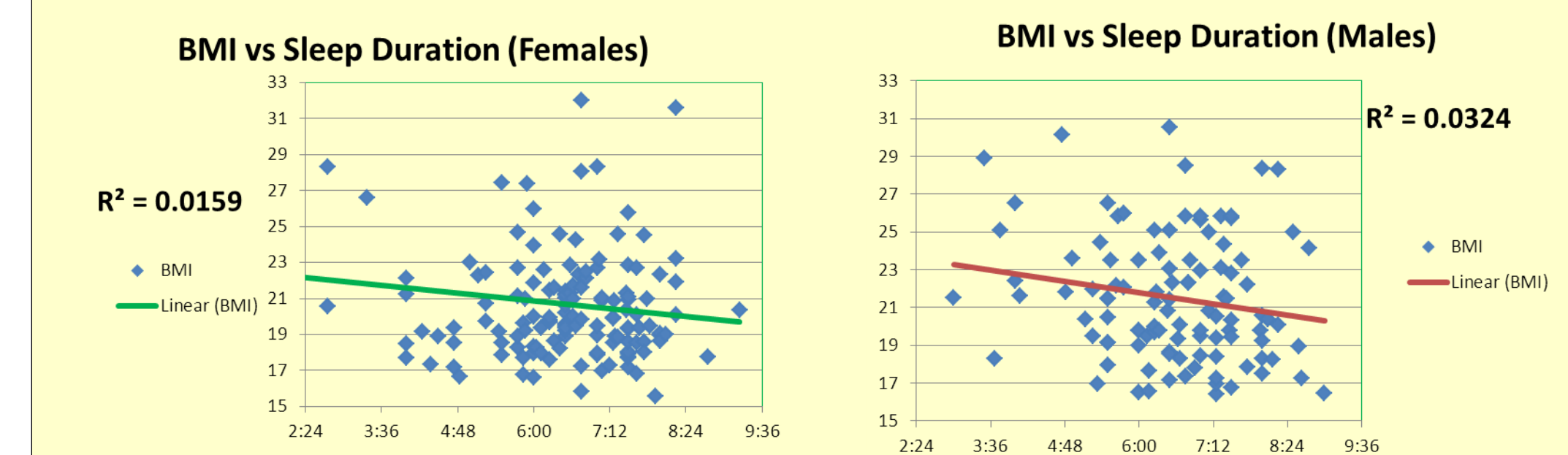


All but one of the respondents reported sleeping less than 9 hours on a weekday and over 90% slept less than 8 hours on average. During the week, males slept an average of 362 minutes while females slept for an average of 358 minutes. On weekends, males had average sleep times of 550 minutes while the females slept 567 minutes on average. The differential between weekend and weekday sleep times was almost 3 hours and indicated that during the workweek the teens are significantly sleep deprived.

For males, mean BMI was 21.50 with a standard deviation of 3.33. For females, mean BMI was 20.72 with a standard deviation of 3.48. Overall median BMI was 20.17. Longer sleep duration was associated with lower BMI values, and with lower risk of being overweight especially for males. In females, blacks were associated with significantly higher BMI relative to whites and Asians.

## Results

Scatterplots of BMI against average weekday sleep duration show considerable spread in the data. There is a weak correlation observed for males.



The sex-related difference in the association between sleep duration and BMI was confirmed by applying a linear regression model with a significance level of 0.05. There was no evident relationship between BMI and weekday sleep hours for females. However, for males, there appears to be a possible relationship between BMI and sleep duration.

Different transformations were tried to find a good fit for the regression model. For males, the regression model for weekday sleep hours appears to have a good fit for the reciprocal of the square root of BMI.

## Future Research

Further studies are needed to better understand how short sleep may affect the development of obesity in teenagers and to understand if there is a biological basis for the sex differences in the BMI association with sleep duration. The cause-effect relationships underlying the association between sleep loss and weight gain needs to be further explored.

## Conclusions & Discussion

This study of 248 teen adolescents, showed a weak inverse correlation between sleep duration and BMI for males. One limitation of the study is that all data is self-reported and therefore observed association may actually be weaker than the real relationship.

The sex-related difference in the association between sleep and BMI has been reported in the past by Knutson in the Journal of Pediatrics. It could well be that the differences in the physiology of puberty in both sexes may play a role. Factors such as sleep can impact metabolism through hormonal effects and thereby influence weight gain differently in the two sexes.