SLEEP, SIBLING-CONNECTEDNESS, AND FRIEND SOCIAL SUPPORT – IMPLICATIONS FOR ADOLESCENT DEPRESSION

By

Evan Arnold Withrow

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ABSTRACT

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Objective: Assess the number of depressive symptoms exhibited in adolescents with regards to the average length of sleep obtained while accounting for potential risk factors, including relationships with friends and sibling-family connectedness.

Design: Secondary cross-sectional analysis of the Addhealth Study data.

Measurements: Regression analyses were run for the overall study population, as well as three sleep subgroups, by regressing the depressive symptom scale scores on sleep category (in the primary analysis), and potential related covariates. Sleep subgroups included less than optimal sleep (less than seven hours), optimal sleep (seven to 10 hours), and more than optimal sleep (more than 10 hours).

Results: Results showed that obtaining less than optimal sleep, when compared to optimal sleep, was significantly related to higher depressive symptom scale scores. Gender, sibling closeness scores and number of close friends were all significantly related to depressive symptom scale scores in the general population and optimal sleep subgroup.

Conclusions: Results support that amount of sleep, sibling closeness and number of friends are factors related to the expression of depressive symptoms in adolescents.

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INTRODUCTION

Background

The Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-V) defines major depressive disorder as "five (or more) of the following symptoms have been present during the same 2-week period and represent a change from previous functioning; at least one of the symptoms is either (1) loss of mood or (2) loss of interest or pleasure." Other symptoms include depressed mood, markedly diminished interest or pleasure at all, significant weight loss, insomnia or hypersomnia, psychomotor agitation, fatigue or loss of energy, feeling of worthlessness, diminished ability to think or concentrate, and recurrent thoughts of death¹. According to the National Survey on Drug Use and Health, 11.4% of adolescents between the ages of 12 and 17 had one or more major depressive episodes in the last year at the time of the survey². Major depressive episodes were defined in the study using the definition from the DSM-IV. The prevalence of major depressive episodes in youths age 12 to 17 rose from 8.2% in 2011, to 9.1% in 2012, 10.7% in 2013 and 11.4% in 2014². The continual increase in incidence of major depressive episodes in adolescents is alarming and must be examined³.

The rate of deaths in adolescents ages 15 to 24 due to suicide is 11.1%, while 8% of high school students attempted suicide in 2015^{3,4}. Comorbidity of mental disorders has been linked to an increase in risk for suicide as well⁵. In a recent prospective cohort study, it was found that the rate of suicide was 30.7% among veterans that were diagnosed with depression⁶. A study conducted by Henriksson et al. estimates this percentage of individuals who committed suicide in the general

population with depression to be as high as 59%⁷. With the general upward trend of depression incidence, it is possible that these numbers have increased. Not only are the rapidly increasing incidence rates concerning, but stark changes in suicide rates could be possible in the near future as well.

Previous studies have linked multiple risk factors for adolescents and their risk for depression. It has been found that adolescents that use drugs, including alcohol and tobacco, are at a higher risk of depression. In adolescents, the incidence of depression is roughly even for males and females, but in adolescence, approximately twice as many females will suffer from depression as compared to males⁸. Poor family home environment, including abuse, poor family communication, family conflict, and lack of social support, has been linked to an increased risk for depression in adolescence⁸. Traumatic life events, such as loss of parents or friends, have also been linked to an increased risk for adolescent depression⁹. Bullying has been linked to increased depression in adolescence as well as increased suicidality¹⁰. Adolescents suffering from depression typically have less than optimal relationships with friends, as well as fewer friends¹¹. The risk of depression in adolescent individuals is also greater for individuals that spend less time working on schoolwork and have lower grade point averages¹¹. Further examination of this relationship suggests that poor academic performance is potentially a result of adolescent depression¹². Dissatisfaction with one's body image has also been linked to increased rates of major depressive disorder (MDD) in adolescent individuals¹³. Sleep deprivation was found to be present in 72.7% of adolescents suffering from MDD¹⁴.

A previous study conducted by Mueller et al. looked at sleep and parent-family connectedness, or the degree of closeness in the relationship between parent and child in adolescents suffering from adolescent depression¹⁵. Mueller used the data from the National Longitudinal Study of Adolescent Health (Add Health Study) and grouped individuals as either insufficient sleep (one to six hours per night) or typical (seven to 10 hours per night). It was found that there was a significant negative relationship between levels of depression and parent connectedness. When looking at males with insufficient sleep, there was a significant negative relationship between depression and a positive relationship with their father. The same was true for females and their mothers. Results show that a higher degree of parent connectedness can potentially help to avoid depression in adolescents that are obtaining inadequate nightly sleep¹⁵. Further research showed that reduced quality and quantity of sleep was related to a higher risk for depression in adolescents¹⁶. The Mueller et al. study looked at parent-family connectedness, but did not account for friends or siblings. This study was conducted to look at these variables that were not previously addressed, specifically sibling connectedness and friend closeness.

Parent-family connectedness is one piece of the adolescent depression puzzle. Another factor that must be looked at is friend connectedness and sibling connectedness. If there are similar findings with the relationship between adolescent depression, sibling connectedness, friends, and average amount of sleep per night, potential advances can be made to help treat or avoid adolescent depression. Adolescent depression has high rates of comorbidity with other diseases as well as recurrence rates^{17,18}. Treatment protocols are still not uniform and more research is

being done in the field of adolescent depression¹⁹. The results from this study will potentially help to offer another tactic to help avoid an increased risk for adolescent depression.

<u>Objective</u>

The primary objective of this study was to identify how average length of sleep was related to the number of depressive symptoms among adolescents in the general U.S. population of adolescents.

Specific Aim 1) Assess the potential relationship between average length of sleep and number of depressive symptoms exhibited while accounting for important risk factors for adolescent such as relationships with friends and peers, as well as sibling-family connectedness.

I hypothesized that there will be fewer depressive symptoms exhibited in individuals with optimal average length of sleep (seven to 10 hours per night), as well as in individuals with stronger relationships with friends and peers, as well as siblings. This hypothesis will be accepted if there are significantly lower depressive symptom scores in the optimal sleep group as compared to the less than optimal sleep group, as well as significant findings with relation to sibling connectedness and depressive symptom scores, and friend closeness and depressive symptom scores.

Specific Aim 2) Assess the risk factors for depression in adolescents averaging less than optimal length of sleep (less than seven hours per night) and the correlation to the number of depressive symptoms exhibited.

I hypothesized that there will be fewer depressive symptoms exhibited in individuals with stronger sibling-family and friend connectedness among adolescent

individuals obtaining the recommended length of sleep. This hypothesis will be accepted if results from linear regression analysis show a significant relationship between sibling closeness and depressive symptom scale scores, and friend closeness and depressive symptom scale scores in the lack of sleep group.

Specific Aim 3) Assess the risk factors for depression in adolescents averaging an optimal length of sleep (seven to 10 hours per night) and the correlation to the number of depressive symptoms exhibited.

I hypothesized that there will be fewer depressive symptoms exhibited in individuals with stronger sibling-family and peer connectedness among adolescent individuals obtaining the recommended length of sleep. This hypothesis will be accepted if results from linear regression analysis show a significant relationship between sibling closeness and depressive symptom scale scores, and friend closeness and depressive symptom scale scores in the optimal sleep group.

Specific Aim 4) Assess the risk factors for depression in adolescents averaging greater than optimal length of sleep (greater than 10 hours per night) and the correlation to the number of depressive symptoms exhibited. This hypothesis will be accepted if results from linear regression analysis show a significant relationship between sibling closeness and depressive symptom scale scores, and friend closeness and depressive symptom scale scores in the more than optimal sleep group.

I hypothesized that there will be fewer depressive symptoms exhibited in individuals with stronger sibling-family connectedness and peer and friend connectedness among adolescent individuals obtaining the recommended length of sleep.

METHODS

Study Design

This study used secondary cross-sectional data and was an analysis of the Add Health Study. Wave I of the Add Health Study was used in this analysis, as this was the largest wave of sampling with the most complete question set. Data collection occurred between September of 1994 and December of 1995. This was a nationwide sampling. The public use data set was used in this analysis. The dataset and sleep categories are the same as the previous study that was conducted by Mueller et al.¹⁵

Population

The study population consisted of 6,504 adolescents in grades seven through 12 in the United States during the 1994-1995 school year from the public-use Add Health data set. Use of the public-use data set did result in a few limitations. The sample size was smaller at 6,504 individuals instead of over 100,000 individuals. A smaller sample size corresponds to larger confidence intervals and larger standard errors in analysis. The final study group consisted of 6,469 individuals after one individual was dropped for not listing a gender, one individual was dropped for declining to take the sibling portion of the questionnaire, two participants were dropped for declining to release their age, seven participants were dropped for declining to answer the length of sleep of an average night. Analysis was only conducted on individuals with siblings and in the study group the final analytic population was reduced to 1,201 participants (Figure 1).

The first wave of sampling was split into two different stages. The first stage of sampling was a school sample that was a stratified, random sample of all high schools

in the United States. A total of 80 high schools were selected that properly represented the United States by region, size, type, ethnicity and how urban or rural the schools were. All eligible schools included an 11th grade and had more than 30 students actively attending the school. These 80 schools that were selected referred "feeder schools" to researchers. "Feeder schools" were middle schools that included a 7th grade and had at least five graduates matriculate to their high school. The in-school questionnaire was given to over 90,000 students and lasted one class period ranging from 45 to 60 minutes, depending on the school.

Stage two of sampling of the first wave was an in-home sample that was conducted, and a core sample was used along with some oversampling for select categories. Oversampling was used to look at 1,038 black adolescents from welleducated families, 334 Chinese adolescents, 450 Cuban adolescents and 437 Puerto Rican adolescent individuals. All students from 16 of the schools were selected to partake in the in-home interview questionnaire. The in-home interview was conducted in person by the researchers between the months of April 1995 and December 1995.

Definition of Key Variables

Dqtotal was the variable that measured where individuals were on a depressive symptom scale. The scale used the information from the questions from the AddHealth survey that closely resembled the Center for Epidemiologic Studies Depression Scale (CESD) depression questionnaire. The variable dqtotal was a continuous variable that had a minimum value of 0, meaning there were no depressive symptoms, to 57, meaning there were obvious depressive symptoms displayed on every question of the

questionnaire. Overall, this variable measured the number and severity of depressive symptoms exhibited in each person.

Age was a continuous variable that ranged form 12 to 22 depending on where the individual was in their schooling.

Gender was a binary variable that showed either a "0" for male or a "1" for female.

Race was self-identified and was "White," "African American," "American Indian," "Asian" or "Other."

Sleepcat was the variable that divided the study population into the three different sleep categories based on average number of hours slept per night. The first sleep category was the insomnia group, or lack of sleep group, with less than seven hours of sleep on average per night. The second group was the optimal sleep group that ranged from seven to 10 hours of sleep per night. A third group was the hypersomnia group, or with individuals who slept, on average, ten hours or more per night.

Hangout was a categorical variable that measured the average number of reported times that study participants spent "hanging out" with friends over the course of a week. The variable was then broken into hangout levels. A hangout value of "0" indicated the response of "none at all" when asked how many times the participant hung out with friends over the course of the week. The value of hangout as a "1" was "1 or 2 times," hangout value of "2" corresponded to an answer of "3 to 4 times," and the final choice of "3" was corresponded to "5 or more times" in a week.

Numfriends was a variable that counted the number of friends listed when the respondents were asked to identify up to five male friends and five female friends. The range of numfriends was 0 to 10, meaning that no friends could have been listed as well as up to five male friends and five female friends.

Friendanswer was a continuous variable that kept track of the answers of how close individuals were with their friends. For each friend that was listed, questions were asked about how close the individual was with their friend. Answers to each question were weighted to determine how close the study participant was with the friends that were listed. The individual could have friend answer value of 0 to 50. A value of 0 would indicate that no friends were listed and they were not close with any peers, while a value of 50 would indicate that 10 total friends were listed and they had a very close relationship with all of these friends.

Sibscore was a continuous variable as well. Participants were asked to list up to five siblings and then questions were asked about how close the participants were with the listed siblings. For the analysis of sibling closeness, four different questions were used for each sibling that could have an answer of 0 to 3 for each question. A total score could range from -15 to 45. A score of -15 would indicate a very poor relationship with all five siblings listed and a score of 45 would indicate a strong relationship with all five siblings listed. If there were no siblings listed, a score of 0 was given.

Statistical Analysis

Analysis of the data set was conducted using the program Stata. Data was cleaned before analysis was conducted. The data set started with 6,504 individuals, which allowed for individuals with incomplete answers to be removed while maintaining

power. The final number of participants used for study analysis was 1,201. This drop in the number of participants used in analysis was due to individuals not having siblings. If an individual was an only child, their values for sibling closeness were considered missing, and thus not able to be used in regression analysis. The Add Health Study was of complex survey design, and so proper complex survey commands in Stata were used. The cluster variable associated with the study was school and the researchers provided sample weights.

To address each of the study aims, linear regression was used to look at how the potential risk factors correlated to changes in the depressive symptom scale scores. Linear regression analysis was used as individual variables can be analyzed to see potential relationships with an outcome variable. A base model was constructed to evaluate the number of depressive symptoms exhibited in all of the adolescents in the study against the other variables. A linear regression was set up with the depressive symptom score against sleep category, number of friends listed on the survey, the answers to the friends section of the survey, the sibling relationship score, gender, age, number of friends hung out with in a week, and race. After this regression was run, a Lowess plot was run between depressive symptom score and number of friends, depressive symptom score and friend answers given, depressive syptom score and sibling score, and depressive symptom score and age. After looking at each of these plots individually, it was determined that number of friends, friend answers given, and sibling scores were potentially quadratic equations and the squared values of the originals were added into the model. Number of friends was also potentially cubic and was added into the new model.

When the new model was run, the cubic term for number of friends was nonsignificant and was dropped. The squared term of sibling score was also dropped, as it was non-significant. This final model was used for the overall analysis, as well as all three of the subpopulations. Due to the survey being of complex survey design, special Stata commands were used for the subgroup analysis. The "svyset" and "svy subpop" commands allowed for subgroup analysis to be conducted while accounting for the total number of individuals in the survey. Using these commands allowed for better standard error approximations for each subgroup. Analysis was performed on the lack of sleep group (less than seven hours of sleep), the optimal sleep group (seven to 10 hours of sleep), and the more than optimal sleep group (more than 10 hours of sleep) to look at potential factors affecting depression in sleep-deprived adolescents using the same linear regression model as the overall analysis.

RESULTS

Demographics

The age for participants ranged from 12 years of age to 22 years of age. Mean age of participants was 16.4 years of age (Table A1). Among all participants, 75.5% of participants self-identified as white, 12.4% as African American, 4.6% as Hispanic, 4.7% as Asian, 2.5% as American Indian, and 0.3% as "Other" (Table 1). Males accounted for 49.0% of the overall study population (Table 1).

Frequencies

A total of 185 individuals were in the lack of sleep group, which is 14.9% of the total sample population. There were 989 individuals that were in the optimal sleep category and made up 83.0% of the sample population. The group that slept longer than optimal contained 27 individuals, or 2.1% of the total population. Frequency breakdowns of each variable can be found in Table 1. The mean values for depressive symptom scores, age, number of friends listed, answers to questions regarding friend closeness, sibling closeness scores, and hangout scores were given for each of the sleep categories and compared (Table 1). The lack of sleep group had the highest average depressive symptom scores as well as the highest age. Individuals in the lack of sleep group had significantly higher depressive symptom scale scores than individuals in the optimal sleep group (P<0.001). The more than optimal sleep group was not significantly different from either the less than optimal sleep group (P=0.708) or the less than optimal sleep group (P=0.052). The number of friends listed was similar in all three categories except for the more than optimal sleep group. As individuals slept more, it appeared that the number of "hangouts" per week decreased.

Overall Linear Regression Analysis

When the final model of the linear regression analysis was run, there were multiple significant values that were found. The final model included sleep category, number of friends listed, the squared value of number of friends, answers to the friend guestions, the squared value of the answers to the friend questions, sibling closeness scores, gender, age, number of hang outs in a week, and race. The R-squared value was 0.106, indicating that it is predicted that 10.6% of the risk factors associated with depressive symptom scale scores were looked at in the variables listed. The difference between the lack of sleep group and the excessive sleep group with regards to depressive symptom scale scores was found to be significant (P=<0.001). Sibling closeness scores were found to be significant with relation to the depressive symptoms scale as well (P<0.001). The coefficient for the optimal sleep group was -2.82. This value corresponds to a predicted 2.82 unit decrease in depressive symptom scores for the lack of sleep group compared to the optimal sleep group, holding all else constant. The value for the lack of sleep group compared to excessive sleep group, holding all else constant, was -3.42 but was not significant at the 5% level, although it was very close (P=0.052) (Table 2).

Individuals with more friends had significantly lower depressive symptom scores as well (P=0.003). A coefficient of -0.89 was obtained from the linear regression for the relationship between number of friends listed and depressive symptom score. The number of friends squared was significant as well with a coefficient of 0.018 (P=0.010). A graph of number of friends squared with number of friends and depressive symptom scale scores, holding all else constant, showed a quadratic function that had a slope

that was a steep negative slope at the lowest possible number of friend values, at or near zero friends, and then the slope leveled out as more friends were listed.

A significant increase in depressive symptom scores was found for increasing values of the variable measuring closeness to friends (P=0.036). There was a positive coefficient of 0.24 for the variable measuring responses to questions on closeness to friends. Number of friends squared was also significant with a coefficient of 0.036 (P=0.048). The graph of number of friends squared and number of friends against depressive symptom scale scores, holding all else constant, showed an inverse u-shape that had a positive slope when friend closeness values were low and a negative slope when friend closeness values were low and a negative slope when friend closeness values were low and a negative slope when friend closeness values were low and a negative slope when friend closeness values were low and a negative slope when friend closeness values were low and a negative slope when friend closeness values were high. Hanging out with friends, no matter how many, was not significantly related to depressive symptom scale scores (Table 2).

The coefficient for gender in relation to depressive symptom scale scores was 2.88, which means that, holding all other variables constant, females had depressive symptom scores 2.88 units higher than males. Females were also significantly more likely to have higher depressive symptom scores than males (P<0.001). Age was not significantly related to depressive symptom scale scores. Sibling closeness was found to be significant with a coefficient of -0.27 (P<0.001). A one unit increase in sibling closeness scores, holding all else constant, would predict a 0.27 unit decrease in depressive symptom scale scores (Table 2).

Individuals who self identified as white had significantly lower depressive symptom scores than those who identified as "African American," "American Indian" or "Other" (P<0.011). There was no significant difference between individuals who self identified as white and those who identified as "Hispanic" (P=0.166) or "Asian"

(P=0.053). Compared to an individual that self-identified as "White," an individual that self-identified as "African American" had a coefficient of 2.19, individuals that self-identified as "American Indian" had a coefficient of 3.85, and those that self-identified as "Other" had a coefficient of -3.75. These coefficients mean that, holding all other variables constant, compared to self-identifying as "White", there is a 2.19 unit increase, a 3.85 unit increase, and 3.75 unit decrease respectively in depressive symptom scores. Further sleep category analysis was conducted by running a second linear regression analysis on each of the sleep subgroups (Table 2).

<u>Sleep Category Linear Regression Analysis</u>

When the less than optimal sleep group was analyzed by itself, significant variables related to number of depressive symptoms exhibited changed. Number of friends listed (p=0.382) and friend closeness (p=0.061) were not longer significant as well. Sibling closeness was not significant at the 5%-level but was significant at the 10%-level (P=0.083). Hanging out with friends was also no longer significant at the 5% level regardless of the number of times per week the individual hung out with friends. The only two self-identified races that was significantly different from self-identifying as "White" was the "Hispanic" group and the "Other" group, both with lower depressive symptom scale scores. All other self-identified races were not significantly different from self-identifying as "Hispanic" and depressive symptom scores was - 4.54 and the coefficient for self-identifying as "Hispanic" would predict a 4.54 unit decrease in depressive symptom scores and identifying as "Other" would predict a 10.7 unit

decrease in depressive symptom scale scores, as compared to identifying as "White". It is also worth noting that sample size for this subgroup was small with 185 total individuals (Table 2).

The optimal sleep group showed many of the same trends as the general population. Number of friends was significantly related to the number of depressive symptoms exhibited (P=0.024). Gender (P<0.001), sibling closeness scores (P=0.002), and identifying as any race other than "White" (P<0.033) were all significantly related to the number of depressive symptoms exhibited. Hanging out with friends in any amount was not significantly different than not hanging out with friends. Age (P=0.908), number of friends listed squared (P=0.064), friend closeness (P=0.061), and friend closeness squared (P=0.069) were all found to be non-significant at the 5%-level (Table 2).

When the more than optimal sleep group was analyzed by itself, all factors except self-identifying as "African American" or "Asian" were found to not be significant. It is important to note that there were only 27 individuals in the excess sleep group and therefore was quite small. This small sample size corresponded to large confidence intervals. Identifying as "African American" was found significantly correlated with depressive symptom scores in the more than optimal sleep group (p=0.011). Identifying as "Asian" was significantly correlated with depressive symptom scores in the more than optimal sleep group (p=0.011). Identifying as "African American" had a coefficient of 6.97, while self-identifying as "Asian" group had a coefficient of 6.36. Compared to self-identifying as "White", holding all other variables constant, self-identifying as "African American" would predict a 6.97 unit increase in the

depressive symptom scores while identifying as "Asian" would predict a 6.36 unit increase in depressive symptom scores (Table 2).

DISCUSSION

Overall Study Population

There are multiple risk factors that have been related to adolescent depression that are exhibited in the data from this study. Results showed that there was a significant decrease in depressive symptom scores when an individual, on average, received the recommended seven to 10 hours of sleep per night, as compared to individuals receiving less than seven hours of sleep. These findings corroborate with previous findings from other studies that suggest that lack of sleep is related to adolescent depression^{20,17}. These findings help to show that sleep is an important aspect of the complicated disease that is adolescent depression.

The number of friends that an individual listed as close friends was also significantly related to the depressive symptom scale scores for the individual. Findings corroborate with previous studies showing that there is an inverse correlation between number of friends and risk of depression¹⁸. The quadratic relationship of the squared term for number of friends is important to note. This relationship shows that there is a greater benefit going from no friends to one friend than nine friends to 10, with regards to depressive symptom scale scores. A relationship such as this suggests that it is beneficial at all times to have more friends, but it is most beneficial for an individual to make new friends when an individual has few friends.

The variable measuring the responses to the questions about closeness to friends was also significantly related to depressive symptom scale scores, as was the squared value of friend closeness. When looking at the squared value, an inverse parabola shape was shown. This corresponds to increasing values of depressive

symptom scale scores for the lowest values of friend closeness, and decreasing values of depressive symptom scale scores for the highest values of friend closeness. The interpretation of this is that as friend closeness increases from zero, the likelihood of depressive symptoms increases slightly, but for those near the middle of the spectrum and moving toward the highest values of friend closeness, the likelihood of depressive symptoms actually decreases. Hanging out with friends in any capacity was not significantly different with regards to depressive symptom scale scores than not hanging out with friends at all. Age was also not significantly related to depressive symptom scale scores.

Sibling closeness scores were significantly related to depressive symptom scale scores in the general adolescent population. As the bond between siblings increased, lower depressive symptom scores were expected. This research, as well as future research into interventions to increase sibling closeness, could help to lower the number of depressive symptoms adolescents are exhibiting.

Gender was related to depressive symptom scale scores in the general study population. These findings regarding higher depressive symptom scores in adolescent females agree with previous findings from other studies. Previous research has shown higher depression rates were found in adolescent females as compared to their male counterparts^{8,18,20,21}. The findings from this study suggest that females exhibit more depressive symptoms than males, which corroborates with this previous research.

Race was also a significant factor in relation to depressive symptom scores. When compared to the self-identified "White" population, identifying as "African American," "American Indian" or "Other". Identifying as "African American" or "American

Indian" were both related to increases in depressive symptom scale scores. Identifying as "Other" correlated to decreases in depressive symptom scale scores. Previous research on race and depression shows increased rates for "Asian" and "Hispanic" groups as well as minorities in general^{21,22}. This research, paired with previous research, helps to show the importance of external factors such as race. Although race is not a modifiable characteristic, it is still worth noting the differences in adolescent depression rates.

Adolescents with Lack of Sleep

There were multiple potential risk factors that were significant for the overall sample population that were no longer significant when looking at the lack of sleep subgroup. One of the limitations of this study was the subgroup sample size as the lack of sleep subgroup only contained 185 individuals. Confidence intervals were quite large with the small subgroup population. Due to the small sample size, few factors were significantly correlated to depressive symptom scale scores.

Gender was one of the few factors that was significantly related to depressive symptom scale scores. Similarly to the overall study population, females were more likely to experience more depressive symptoms than males. Identifying as either "Hispanic" or "Other" was related to lower depressive symptom scale scores in this subgroup. Multiple coefficients, which were close to the 5% significance cutoff value, are worth noting. Sibling closeness and number of friends squared were both close to the 5% significance cutoff value and future research with larger sample sizes could prove to be beneficial in looking at these potential relationships.

Adolescents with Optimal Sleep

Some of the same relationships that were found in the overall population were found in the optimal sleep subgroup as well. Number of friends, sibling closeness and gender were all significantly related to depressive symptom scale scores. These relationships have very similar implications as those listed in the overall population. Gender is worth noting, however it is not modifiable. Looking for interventions that improve the number of friends an adolescent has, as well as interventions that can help to make siblings closer to each other, could prove to be beneficial with regards to decreasing the number of depressive symptoms adolescents exhibit. It is worth noting that number of friends squared, friend closeness and friend closeness squared are all close to being deemed significant. When plotted, the curves for both number of friends squared and for friend closeness squared are similar in shape to the overall study population. It is reasonable to predict that future studies will find similar trends if a larger sample size is used.

Adolescents with More than Optimal Sleep

The only significant relationship in the excess sleep individuals with depressive symptom scores were identifying as "African American" and identifying as "Asian". It is important to note that there were only 27 participants in the more than optimal sleep group, and therefore the sample size was not ideal. A larger sample size would be needed to further examine if adolescents obtaining more than optimal sleep per night show similar patterns relating to sleep and depression.

CONCLUSION

The results from this study corroborate with previous research in many different aspects. Results showed a significant relationship between the number of depressive symptoms exhibited in adolescents with both gender and race which is consistent with previous research^{8,11,21,23}. Findings from this study suggest that sibling closeness is important in adolescents with regards to the number of depressive symptoms being exhibited. Increased friend social support, by increased number of close friends being related to a decreased number of depressive symptoms exhibited, is consistent with research conducted by Lewinshone et al.¹⁸ This is the first study that has looked at sibling interaction in a lack of sleep group. Sibling closeness was significant in the overall study population, as well as the optimal sleep group. With larger sample sizes in the less than optimal sleep group and more than optimal sleep group, the relationships examined in these subgroups can be further studied. These findings are potentially beneficial in helping to slow the current trend of increasing adolescent depression rates.

Further research would be beneficial in looking at other aspects of friend closeness as well as sibling closeness, such as amount of physical time spent together and type of time spent together. Having a properly powered sample for the sleep subgroups would be an opportunity for further research in preventing and treating adolescent depression, as both insomnia and hypersomnia are symptoms of depression. Future research could include parent interaction as a covariate. There is potential for benefit if the relationship between time spent with friends and number of activities with friends is further looked at with relation to presence of depressive symptoms.

APPENDIX

Table	1:	Data	Dictionary
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Variable	Definition	Levels
Age	Age of study subject at date of survey administration	Continuous
Dqtotal	Depression scale score	Continuous
Sleephours	Average number of hours slept per night	Continuous
Sleepcat	Sleep category	Categorical
	1 = <7 hours of sleep per night	_
	2 = 7-10 hours of sleep per night	
	3 = 10 + hours of sleep per night	
Numfriends	Number of friends listed on the survey	Continuous
Numfriendsq	The squared value of Numfriends	Continuous
Friendanswer	Total of all values of questions regarding closeness of friends	Continuous
Friendanswersq	The squared value of Friendanswer	Continuous
Sibcount	Number of siblings listed	Continuous
Gender	The gender of the study participant	Categorical
Sibscore	Total of all values of questions regarding sibling closeness	Continuous
Sibscoresq	The squared value of Sibscore	Continuous
Hangout	Number of times the study participant "hung out" with friends within the last 7 days of taking the survey	Categorical
	0 = Did not "hang out" with friends	_
	1 = 1-2 "hangouts"	_
	2 = 3-4 "hangouts"	_
Dage	3 = 5 + ``nangouts''	Catagorigal
Race	particpant	Categorical
Race1	Numerical value associated to each race listed	Categorical
	0 = "White"	_
	1 = "Hispanic"	-
	2 = "African American"	-
	3 = "American Indian"	_
		-
	5 = "Other"	

Table 2: Descriptive Statistics

Descriptive Statistics				
	Overall	Sleep Category		
	Overall	1	2	3
n	1,201	185	989	27
% of Population	100	14.9	83.0	2.1
Average Length of Sleep	7.8	5.6	8.1	11.6
Depressive Symptom Score	11.2	14.0	10.8	10.9
Age	16.4	17.2	16.2	15.6
Number of Friends Listed	2.9	3.0	3.0	2.3
Friend Closeness Score	7.9	8.6	7.8	5.9
Number of Hangouts Per Week				
0	9.2	8.7	9.1	17.0
1-2	22.1	17.5	22.8	28.4
3-4	26.7	31.7	26.0	17.8
5+	42.0	42.1	42.2	36.8
Sibling Closeness Score	4.7	4.8	4.7	5.8
Race (%)				
White	75.5	63.7	78.0	61.0
Hispanic	4.6	7.5	4.0	5.0
African American	12.4	19.1	10.9	25.9
American Indian	2.5	3.8	2.3	3.2
Asian	4.7	5.7	4.5	4.8
Other	0.3	0.2	0.4	-
Gender - % Male	49.0	47.0	48.7	74.9

*Significant at 5% level

Table 3: Regression Analysis

	Sleep Category Regression Coefficients			
	Overall	1	2	3
Age	-0.03	-0.29	0.02	0.64
Number of Friends Listed	-0.89*	-1.09	-0.75*	-4.26
Num. Friends Sq.	0.018*	0.087	0.014	0.14
Friend Closeness Score	0.24*	0.27	0.22	-0.04
Friend Closeness Sq.	0.036*	-0.007	-0.006	0.02
Number of Hangouts Per Week (Compared to No Hangouts)				
1-2	-1.93	-4.22	-2.03	4.04
3-4	-1.84	-2.75	-1.92	2.29
5+	-0.90	-1.31	-1.11	0.05
Sibling Closeness Score	-0.27*	-0.36	-0.23*	-0.78
Gender (Female Compared to Male)	2.88*	2.97*	2.85*	4.35
Race (Compared to White)				
Hispanic	2.06*	-4.54*	4.15*	-0.514
African American	2.19*	1.33	2.04*	6.97*
American Indian	3.85*	4.29	3.88*	4.91
Asian	2.10	0.64	2.15*	6.36*
Other	-3.75*	-10.70*	-3.38*	-

*Significant at 5% level

Figure 1: Study Sample Flow Chart



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