

5-7-2011

# Prevalence Risk for Engaging in Unhealthy Behaviors in Connecticut Adolescents Experiencing Inadequate Sleep or Low Parental Support

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## Recommended Citation

Jorge, Celeste F., "Prevalence Risk for Engaging in Unhealthy Behaviors in Connecticut Adolescents Experiencing Inadequate Sleep or Low Parental Support" (2011). *Master's Theses*. 77.  
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Prevalence Risk for Engaging in Unhealthy Behaviors  
in Connecticut Adolescents Experiencing Inadequate Sleep or Low Parental Support

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A Thesis Submitted in Partial Fulfillment of the  
Requirements for the Degree of  
Master of Public Health  
at the  
University of Connecticut  
2011

**Approval page**

Master of Public Health Thesis

Prevalence Risk for Engaging in Unhealthy Behaviors  
in Connecticut Adolescents Experiencing Inadequate Sleep or Low Parental Support

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2011

## **Acknowledgements**

I would like to thank my thesis committee for their guidance and encouragement:

Howard Tennen

Joseph Burleson

Diane Aye

Thank you to my colleagues at the Connecticut Department of Public Health,  
especially Diane, for years of motivation.

Most of all, I thank my family, Paul, Lydia and Adam Sobkiewicz for being so supportive and understanding as I balanced my studies and career with motherhood. My heart bursts with love for helping me get through these years.

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## **Introduction**

Sleep is necessary for restorative functions, particularly during adolescence, which is marked by physical and cognitive development and brain maturation (1). Research indicates sleep needs are unchanged from childhood into adolescence, requiring upwards of 9 hours, yet adolescents get considerably less sleep than their younger counterparts (2). Numerous studies have found anywhere between only one-quarter to about half of U.S. teens receiving adequate sleep. The public health implication of chronic inadequate sleep among adolescents is the associations with detrimental health outcomes, both physical and mental well-being (1), risky health behaviors, and school achievement (3). The interactions between biological and psychosocial domains contributing to sleep debt are strongly linked to unhealthy or risky behaviors during adolescence. Studies have been conducted on the relationship between lack of sleep and academic achievement, learning ability, moodiness and depression, suicidal thoughts, substance use or abuse, cognitive ability and even overweight.

The Youth Risk Behavior Survey (YRBS) is a national school-based survey developed by the Centers for Disease Control and Prevention (CDC) to monitor priority health risk behaviors in high-school age youth. In 2007 and 2009, Connecticut YRBS results revealed that one of the strongest associated factors with low prevalence of risky behavior was a sense of strong familial support or involvement (4,5). These findings are supported by research by Brand, et al., (6) and Vignau, et al., (7). Findings from the Connecticut YRBS have also repeatedly shown that Connecticut youth are getting fewer hours of sleep than their U.S. counterparts. The current study explored the associations

between these two domains, inadequate sleep and perceived low parental support, and prevalence risk of several unhealthy behaviors in high-school age adolescents in Connecticut.

## **Background**

### *Sleep Phase Delay*

Only in the past twenty years have sleep researchers investigated the biological changes in sleep patterns in adolescence, which has led to studies examining whether sleep patterns have major health implications for adolescents. While not discounting environmental factors such as school demands and nighttime distractions like television and other electronic media, researchers found the primary influence of sleep habits of adolescents are due to changes in the biological processes that regulate sleep and wakefulness during this developmental period (3,8). Medical research has found that there are chemical changes in the circadian rhythms of teenagers that begins as early as the onset of puberty, and has been termed “sleep phase delay”(1).

Teenagers experiencing a sleep phase delay develop a natural tendency to fall asleep several hours later in the evening (9). Usually, the onset of sleepiness is triggered by the release of melatonin, a hormone involved in regulating the sleep/wake cycle. On average, it seems to peak in adults around 10:00PM; however, melatonin production can be delayed until 1:00AM in adolescents (10). Research shows that the pattern of melatonin secretion makes it difficult for teenagers to fall asleep early in the evening or to wake up early in the morning (11). In some studies, sleep duration decreases as the

adolescent progresses through high school, as pubertal effects tend to increase in sleep disturbance and sleep phase delay (12). Sleep loss among adolescents can also be aggravated by societal factors and demands, for example, balancing the evening schedule with homework, a job, after-school sports and/or social distractions (i.e., non-school-related computer usage), which can spike arousal and worsen the condition.

### *Sleep and Substance Use*

Numerous studies have documented the relationship between inadequate sleep and risk-taking behavior among adolescents, a population already prone to risky behavior (13). Significant associations between substance use (including tobacco, illicit drugs and alcohol) and overall sleep problems have been found in cross-sectional and some longitudinal research (12,14,15,16). Previous research suggests that sleep loss among youth is associated with lower mood control and that inadequate sleep can result in difficulty regulating impulse, emotions and decision making (1,17).

In one of the few longitudinal studies, Wong, et al., (14) found that sleep issues in early adolescence predicted onset of alcohol, cigarette, and marijuana use in later adolescence. Gromov and Gromov (18) conducted a review of numerous sleep studies to summarize the association between sleep and risk behaviors. The domains reviewed included alcohol, tobacco, caffeine, prescription medication abuse, over-the-counter medication abuse, marijuana, cocaine, methamphetamines and inhalants. Their summary and conclusions highlight the importance of recognizing comorbidity of these conditions and behaviors, and using a comprehensive approach to prevent, treat or reduce the likelihood that these adverse health behaviors will occur (18). Research has also shown



that depressed adolescents, especially males, frequently engage in risky behaviors (19) and that depressive symptoms predict both concurrent and subsequent risky health behavior (15).

### *Sleep and Emotional Well-Being*

While some research suggests that depression may lead to short sleep duration, other research shows sleep loss may in turn cause depression, which demonstrates the complex nature of these associations (17,20). In a prospective study, Roberts (21) found adolescents experiencing poor sleep had an increased risk for health problems, received more mental health care, and had more interpersonal problems and difficulties with daily activities. Several studies have examined the association between poor mental health and inadequate sleep (12,22). While these studies have documented the relationship between measured sleep debt and depression, there is also a relationship between *subjective* sleep (perceived sleep quality or sleep satisfaction) and depression and anxiety (23).

Adolescents with sleep disturbances and sleep debt report more depression, anxiety, irritability, fearfulness, anger, tenseness, or emotional instability (7,24,25,26). Johnson and Breslau (15) found a higher rate of irritability, impulsivity, hyperactivity, anxiety, depression, and risk for suicide among children and adolescents with sleep problems.

### *Sleep Data from the YRBS*

The Connecticut YRBS showed that only 21.1% (in 2007) and 25.6% (in 2009) of students report receiving close to what the CDC terms as an adequate night's sleep on a school night, i.e., eight or more hours (4,27). In 2007, the percentage of Connecticut high

school students who reported eight or more hours of sleep on an average school night ranged from 16.8% to 24.0%. There are no significant differences between any of the grades. U.S. high school students were more likely than Connecticut students (31.1% versus 21.1%) to report eight or more hours of sleep on an average school night. When comparing Connecticut students to U.S. by demographic characteristics such as gender, race and grade, Connecticut students were again less likely to report 8 hours of sleep on a school night (4).

In 2009, 25.6% of Connecticut high school students had eight or more hours of sleep on an average school night. Older students were less likely to report eight or more hours of sleep on an average school night, decreasing in grades 9 through 12 from 36.7% to 19.7%. Echoing the 2007 survey findings, compared to Connecticut students, a higher proportion of students in a national sample reported least eight hours of sleep on an average school night (27).

### *Parental Support and Risk Behaviors*

Lack of parental support appears to be associated with sleep problems among adolescents in clinical studies. To understand the link between sleep and parental support among adolescents, researchers such as Dahl and Lewin (1) turned to medical anthropology:

“Social and emotional cues are critical to creating the feelings of safety that promote sleep. This is because for most of human history (and as is true for most social primates today) safety from predators was primarily through a protective social group. Early humans were surrounded by large nocturnal-hunting carnivores without physically safe sleep sites. (Humans cannot sleep in trees or on cliff edges because we lose all muscle tone during REM sleep.) In the human

ancestral environment, a close-knit social group provided protection against predators. The human brain evolved under conditions in which this sense of social belonging and social connectedness formed the underpinning for feelings of safety. Natural tendencies in the modern human brain continue to reflect these links, such that social stresses evoke powerful feelings of threat and sleep disruption, but feelings of love, caring, and social connection create a sense of safety and promote sleep.” (1, p.176)

In the review of literature, Chen, et al., (28) found relationships between adequate sleep amounts and positive health-related behaviors and attitudes, such as life-appreciation, doctor visits, healthy diet, exercising, low frequency of obesity and stress management skills (28). Research by Brand, et al., (6) also shows that perceived positive parenting styles can be a protective factor among sleep deprived adolescents. Growing up in a supportive home and experiencing a stable and secure relationship with one’s parents is important in adolescence (29). Adolescents who viewed their parents as involved were less likely than adolescents with uninvolved parents to report symptoms of depression after stressful life events (30). Some of these associations have been replicated beyond the U.S. (7).

#### *Parental Support in YRBS data*

The 2007 YRBS showed that compared to high school students who reported that their parents never or rarely knew their whereabouts when not at home, students who reported that their parents usually or always knew their whereabouts were less likely to be using alcohol, to have engaged in binge drinking, to be using marijuana or smoking cigarettes (4). High school students who reported feeling loved and supported by their parents were less likely than students who did not feel loved and supported to have recently engaged in binge drinking, to be using marijuana, smoking cigarettes, to have

reported a depressive episode in the past year, or to have seriously considered attempting suicide in the past year (4). In 2009, students who reported that their parents usually knew their whereabouts when they were not at home were less likely to have engaged risky health behaviors such as alcohol use, binge drinking, marijuana use or cigarette smoking compared to students reporting their parents usually did not know their whereabouts when not at home (27).

High school students who reported feeling loved and supported by their family were also less likely than students who did not feel loved and supported to have had a depressive episode in the past year, or to have attempted suicide. They reported better grades and were less likely to use alcohol, binge drink, smoke cigarettes or use marijuana (27).

#### *Using Connecticut YBC data*

In 1990, the Centers for Disease Control and Prevention created the Youth Risk Behavior Surveillance System (YRBSS) to determine the prevalence of health risk behaviors, assess whether those behaviors change over time, and examine the co-occurrence of health risk behaviors. In Connecticut, the YRBS is known as the Youth Behavior Component (YBC) of the Connecticut School Health Survey (CSHS), which is co-administered with the Youth Tobacco Component (nationally known as the Youth Tobacco Survey) in Connecticut public high schools. Connecticut uses YBC data to monitor progress toward achieving national and state health objectives (4).

YBC variables include substance use, alcohol use, cigarette smoking, violence, and sexual behaviors, bullying, depressive episode, suicide, obesity, overweight, activity level, familial and social support, school environment and school performance. States are required to retain a minimum of 58 of the core questions designed by the CDC. The core questions collect information on the behaviors that lead to the major causes of morbidity and mortality in youth, and which lead to chronic disease and illness in adulthood. Including at least 58 core questions allows for comparison of Connecticut data with national data or data from individual states that also use CDC's core questions.

The remaining questions, a total of 99 on each year's YBC, were selected from CDC optional questions, or were developed by the state and added with approval from the CDC. The core and optional questions have been tested by the CDC and in various methodological studies to ensure validity and reliability (27). State added questions are reviewed before approval for the final state survey instrument. The researcher facilitated an interagency workgroup each year, with key program staff in attendance in order to account for data needs across the DPH or other state and community agencies. A youth advisory board was included in the 2009 questionnaire planning process and advocated for an additional question on dating violence. In 2005, this workgroup developed a panel of asset-based questions in order to detect protective factors among youth with lower prevalence in risk behaviors, and these questions have been retained through subsequent survey years.

The CSHS is supported with funding from the CDC and conducted by the Connecticut Department of Public Health. It is co-sponsored with the Connecticut State

Department of Education, and supported by partners from local school districts and local health departments.

### *Research Question*

As a child enters high school, the transition to an earlier school start time and pubertal sleep phase delay can affect total hours of sleep on a typical school night (31). Inadequate sleep has been correlated with poor health behaviors and this is aggravated by the existing vulnerability to engage in risky behaviors during adolescence. In the past 20 years, research continually shows that inadequate sleep can be both a symptom and a cause of risky health behaviors. While parental involvement is a documented protective factor, it is not clear how parental involvement, risky behavior and sleep relate to one another. Because poor health is associated with poor school performance, local and state public school systems are interested in the public health approach to ensure academic success (32). The current study focuses on discovering the associations among risk behavior and inadequate sleep or low parental support during an age of heightened vulnerability to risk behavior.

## **Methods**

### *Study Design and Population*

Data from the 2007 and 2009 Connecticut YBC were analyzed. Because the data are cross-sectional and did not involve time-sensitive topics, the data sets aggregated to improve precision in statistical analysis.

During the spring of 2007 and 2009, the YBC of the CSHS was administered in a sample of Connecticut public high schools. In order to produce a representative sample of high school students, a two-stage cluster design was used. In the first stage, schools were systematically selected using a random start with a probability proportional to enrollment size in grades 9 through 12. In 2007, 59 schools (after eliminating 1 ineligible school) were selected out of 185 and a total of 46 agreed to participate. In 2009, 63 schools were selected out of 177 and 48 participated. In stage two, each school provided a listing of classes representing total eligible<sup>1</sup> school enrollment. Systematic equal probability sampling with a random start was used to select classes in each school. All students within a selected class were eligible to participate in the survey as long as they were able to take the survey without assistance. Survey procedures were designed to protect the privacy of students by allowing for anonymous and voluntary participation (4,27). Once survey responses passed quality control, the data were weighted and received a post-stratification adjustment (27) in order to be considered representative. For both 2007 and 2009, YBC data collected were representative of all regular<sup>2</sup> public high schools students in Connecticut.

### *Data Collection*

In Connecticut, the YBC is supported with funds awarded to the State Department of Education (SDE) by the CDC. Through a Memorandum of Understanding, the

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<sup>1</sup> An eligible student is one that could fully respond to the YBC without assistance. Some classes that were exclusively special education or English language learners were eliminated from the class list.

<sup>2</sup> Regular high school refers to a school that is not considered an institution, or does not exclusively serve a specialized population, i.e., special education, or alternative education for troubled youth.

Connecticut Department of Public Health receives responsibilities for the conduct, design, implementation, collection of data, and analysis of data. The funding received covers operating costs, but personnel costs for the researcher are provided in-kind through state funds, and the personnel costs for the coordinator of the CSHS is covered by multiple federal grants related to adult and youth risk behavior surveillance.

Clearance to administer the survey is obtained at different levels of school administrators, depending on the school district or the school itself. By policy of the SDE, contact with the top level of a public school system (usually a Superintendent) must be made by the head of the agency, the Commissioner. Since the survey is co-sponsored, a joint letter from both agencies is sent to a school district, notifying the Superintendent that a school within that district was selected for the CSHS. Once clearance is obtained by the Superintendent, DPH staff contact the top-level administrator of the selected school (usually a Principal), to obtain clearance to proceed with survey administration. DPH staff work with the school staff to randomly select classrooms based on CDC's protocol. Teachers are then notified that on a certain date and class period, the CSHS will be administered to students in that class. Teachers of selected classrooms can decline to participate in survey administration, as well as a student. Most schools follow policy for passive parental permission (opt-out), however some are required by the local board of education to use active (opt-in) permission.

Teachers are given concise instructions on survey administration to reduce or eliminate bias and protect anonymity and confidentiality. Surveys are designed to be about 40 minutes in length to fit within a typical class period. Once surveys are received



back at DPH, staff calculate completed responses and participation rates. Surveys are shipped to the CDC contractor for scanning and quality control, and if survey participation (school participation \* student participation) is above 60%, the survey data are weighted. A weight is associated with each questionnaire to reflect the likelihood of sampling each student and to reduce bias by compensating for differing patterns of non-response. A post-stratification adjustment factor is calculated based on grade, sex, and race/ethnicity distribution among Connecticut students. In 2007, the Connecticut YBC's overall response rate was 61% and in 2009 it was 64% (4,27). Both the 2007 and 2009 CSHS data are weighted, and considered representative of all regular public high schools students in Connecticut (4).

### *Human Subjects*

Survey procedures were designed by the CDC to protect the privacy of students by allowing for anonymous and voluntary participation. After parental consent requirements were met according to each school policy, student consent is implied by participation in the survey. Identifiers such as school and classroom codes are stripped from the final dataset by the CDC contractor before being received back by the state. Skip patterns are not included in the YBC to further protect students' privacy by increasing likelihood that students will take about the same amount of time to complete the questionnaire. Certain risks may exist to participating students, such as distress from the sensitivity of the question being asked. In Connecticut, students are instructed to stop the survey at any time if certain question topics are too sensitive or upsetting. Instructions before survey administration provide information to call the Connecticut

Infoline at 2-1-1, should a student feel he or she needs to seek support or assistance.

Infoline is a telephone based information, referral and crisis intervention service available to callers within Connecticut, at no toll cost. Students are thanked for their participation, and reminded that survey results will lead to improve school health policy and programs. In both 2007 and 2009, the student keeps the mechanical pencil used to complete the survey, which is also imprinted with “CT Infoline 2-1-1.”

### *Measurement and Analysis*

The Connecticut YBC survey instrument is self-administered on paper, with answers recorded on a scannable sheet. No identifying information is asked. Questions may only be answered by one mutually exclusive response, except for student race for which students are instructed to select all that apply. The YBC survey instruments for 2007 and 2009 may be accessed on the Connecticut DPH website, [www.ct.gov/dph/cshs](http://www.ct.gov/dph/cshs). Variables of interest for this study correlate to a question or questions on the Connecticut YBC instrument. The specific survey questions are listed on Appendix 1. Variables that were not already recoded by the CDC into dichotomous data were recoded for this study. For this study, the risk variables were termed “inadequate sleep” if the student reported getting on average, less than 6 hours of sleep on a school night. The cutoff of 6 hours was selected to make the sub-population more salient versus the CDC variable with a cutoff at 8 hours. The other main variable was termed “low parental support” only if *two* survey questions were answered as follows: 1) parents never or rarely know my whereabouts when not at home, *and* 2) I disagree or strongly disagree that my parents love or support me. These two variables were assessed for associations with 5 risk

behaviors: depressive episode, suicidal thoughts, (which represent the category of emotional well-being), alcohol use, binge drinking, and marijuana use (which represent substance use). More detailed definitions of these variables can be found on Appendix 2. For this study, the term depressive episode is used not as synonymous with depression, but rather as a proxy for a potential future onset of diagnosed depression. Using these cross-sectional data, tests of significance were conducted using SAS-callable SUDAAN (version 10.0) in the SAS, version 9.2 environment (33). SUDAAN was used because the software specializes in providing analysis of survey data which properly accounts for complex survey design features like clustering, weighting, and stratification (34).

In order to test whether a significant relationship existed between two categorical variables, a chi square statistic was calculated in SUDAAN. First, the variable for inadequate sleep was assessed for associations with each of the risk behaviors using a chi square statistic. Prevalence risk was then calculated to quantify the reduced or elevated risk of engaging in the risk behavior in the absence of either adequate sleep or high parental support.

## **Results**

### *Description of the Sample*

The aggregate dataset resulting from the combination of 2007 and 2009 YBC data included 4,464 responses. The details of age, sex, grade level, race and Hispanic ethnicity can be found in Table 1, resulting from using SAS 9.2 survey frequency procedures producing weighted percents.

Table 1. Description of the sample displaying demographic characteristics

<i>Demographic</i>	<i>N</i>	<i>Weighted Percent</i>	<i>SE of %</i>
<b>Age</b>			
14 years or younger	612	13.7	0.51
15 years old	1191	26.7	0.66
16 years old	1169	26.2	0.66
17 years old	986	22.1	0.62
18 years old or older	499	11.2	0.47
<b>Sex</b>			
Female	2232	50.2	0.75
Male	2214	49.8	0.75
<b>Race/Ethnicity</b>			
Black*	506	11.6	0.48
White*	2724	62.2	0.73
Hispanic/Latino	839	19.2	0.59
All other races	178	4.1	0.30
Multiple races	129	2.9	0.26
<b>Grade Level</b>			
9 <sup>th</sup> Grade	1306	29.7	0.69
10 <sup>th</sup> Grade	1283	29.2	0.69
11 <sup>th</sup> Grade	1007	22.9	0.63
12 <sup>th</sup> Grade	800	18.2	0.58

\* Non-Hispanic

### *Findings*

Overall, in the combined dataset, 19.4% (*CI 17.5% – 21.9%*) of high school students reported inadequate sleep (less than 6 hours of sleep in a typical school night), and 22.0% (*CI 20.3% – 23.8%*) reported low parental support. Analysis found that all of the risk behaviors examined had a higher prevalence risk if students were experiencing inadequate sleep, or feeling low parental support, each association with statistically significant levels ( $p < 0.01$ ). Full results from significance testing and calculation of prevalence risk can be found in Table 2. The highest prevalence risk for those

Table 2: Prevalence Risk Estimates for Unhealthy Behaviors Associated With Inadequate Sleep or Low Parental Support

	<i>Depressive Episode</i>	<i>Considered Suicide</i>	<i>Alcohol Use</i>	<i>Binge Drinking</i>	<i>Marijuana Use</i>
<b>Inadequate Sleep</b>					
<i>n</i>	324	223	400	247	223
Prevalence risk	1.91 <sup>1</sup> <i>CI (1.71 – 2.13)</i>	2.45 <sup>1</sup> <i>CI (2.10 – 2.85)</i>	1.25 <sup>1</sup> <i>CI (1.15 – 1.37)</i>	1.35 <sup>1</sup> <i>CI (1.16 – 1.56)</i>	1.39 <sup>1</sup> <i>CI (1.19 – 1.63)</i>
<b>Low Parental Support</b>					
<i>n</i>	408	274	473	306	286
Prevalence risk	2.37 <sup>1</sup> <i>CI (2.05 – 2.74)</i>	3.11 <sup>1</sup> <i>CI (2.64 – 3.65)</i>	1.31 <sup>1</sup> <i>CI (1.18 – 1.45)</i>	1.49 <sup>1</sup> <i>CI (1.29 – 1.74)</i>	1.75 <sup>1</sup> <i>CI (1.49 – 2.07)</i>

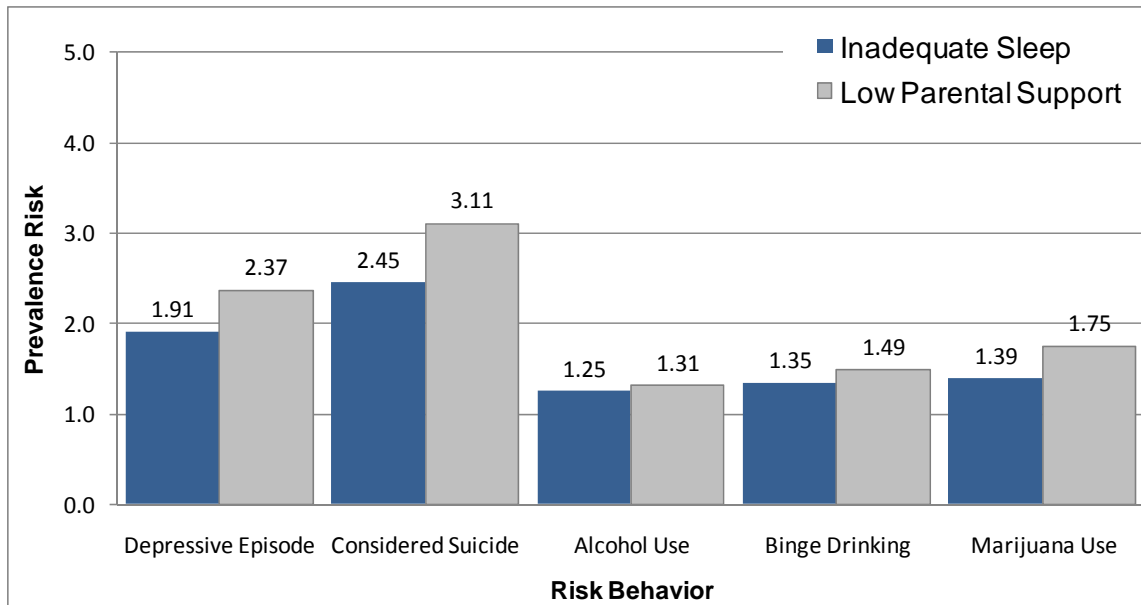
<sup>1</sup> Indicates significant difference (p<0.01)

experiencing inadequate sleep was with having considered suicide. The prevalence of considering suicide for high school students in Connecticut is approximately 2.45 times more likely if the student is experiencing inadequate sleep compared to those getting 6 or more hours of sleep. The highest prevalence risk for students feeling low parental support was also found to be in those considering suicide. The prevalence of considering suicide is approximately 3.11 times more likely if the student is feeling low parental support, compared to those feeling high parental support. In both domains, low parental support or inadequate sleep, the highest prevalence risks were seen in the 2 variables indicative of poor emotional well-being, versus the variables on substance abuse.

## **Discussion**

The key findings to emerge from this study are that both inadequate sleep and low parental support are associated with higher prevalence of adolescents engaging in unhealthy risk behaviors, with statistical significance. Of importance are the findings of prevalence risk for risk category of emotional well-being. The two variables with the highest prevalence risk for each domain are for having a depressive episode and for seriously considering suicide, as displayed in Figure 1. In Connecticut, suicide is one of the leading causes of death in youth ages 15 – 19 years. In 2008, suicide was the second leading cause of death in youth in Connecticut (35) and in previous years, has consistently been one of the top 5 leading causes.

**Figure 1. Prevalence risk and risk behaviors**



Alcohol is the most commonly used substance among youth in Connecticut (27), and binge drinking is a serious risk behavior that can lead to injury, death, and comorbidity with other risky behaviors like early sexually activity, sex without a condom, and drinking and driving (36), which is why this topic was included in this study. Drug use was included in this study because of the associations with violence, delinquency, and likelihood to impair academic achievement (36). Also, in 2009, about 28.9% of high school students in Connecticut had been offered, sold, or given an illegal drug by someone on school property during the past year, which was higher than the national findings (22.7%) (27). Therefore, concerns over access to and availability of drugs led to the inclusion of the variable on marijuana use.

While students have a biological tendency to delay sleep, resulting in less sleep on school days, there are some protective factors that should be considered by parents,

educators, physicians and students themselves. The probability of engaging in risky health behaviors may be lower with efforts to promote more sleep and efforts to be sure a student has a parental-child connectedness to provide a supportive and nurturing home environment. The effects of interventions can be assessed with more sensitive studies to further reveal the complicated relationships among parenting, sleep and risky health outcomes (37,38).

The primary reason why this study focused on the domains of sleep and parental support and associations with risk behavior prevalence resulted from YBC comparisons to national YRBS results, and trend data seen with Connecticut results. In the two YBC survey years that Connecticut included the question on average sleep duration, comparisons were possible with U.S. data since the question was included on the National YRBS questionnaire. In 2007, Connecticut students were less likely to receive at least 8 hours of sleep on a school night (21.1%) than their national counterparts (31.1%), and differences were seen in certain sub-populations (9<sup>th</sup> graders, Black students, and Hispanic students reported less sleep versus US with statistical significance, (4)). In 2009, Connecticut students again were less likely to receive 8 or more hours of sleep on a school night than their national counterparts, 25.6% versus 30.9%. These differences, together with associations in engaging in risk behaviors were a main factor for the analysis conducted in this study.

The reason why parental support was the other domain of focus was due to the repeated pattern of protective effects in risky behavior seen in Connecticut data over the past three survey years (2005, 2007, 2009). There are a series of questions that assess



parental involvement, support and family interaction. In 2007 and 2009, these factors demonstrated the strongest protective effect of risk prevalence (4,27).

### *Limitations*

The YBC in Connecticut is conducted only in public high schools, including magnet and some alternative schools, provided the population is typical of the schools. Private schools and institutionalized youth (prisons, group homes) are excluded. The survey is not reflective of the certain populations such as homeless/transient youth, or those who have dropped out of school. Due to confidentiality, non-English-speaking students were excluded since the survey has not been translated and students cannot be assisted while answering the survey. Special education classes are also exempt from random selection unless the students could take the survey unassisted.

The YBC was not designed for the purpose of constructing the composite measures used in this proposal which leaves unknown validity of the measures. While other states using the YRBS calculate composite variables, surveys can differ from state to state and none exact to these composites exist. Other limitations of the data are that all data are self-reported. However, the survey is anonymous and confidential, and explicit procedure is given to survey administrators in order to increase likelihood of honest responses. The standard high school survey has undergone reliability testing by the CDC to demonstrate that students respond truthfully. Internal reliability checks do remove responses of students that likely falsified answers.

Using cross-sectional data often presents limitations to research. Only associations can be discovered, and not causation. Also, these tests do not control for interactions between variables. Due to the complex nature of the associations between adolescent substance abuse, depression, sleep and parental support, further testing controlling for interactions between variables could better reveal essential information for public health practice.

### **Implications and Conclusions**

Inadequate sleep and perceived low parental support are associated with higher probability for engaging in risky behaviors. Research has shown that adolescents engaging in risky behavior and have poor health outcomes and are more likely to have poor academic success (32). When poor health affects a student's ability to learn, the concern for a student's health reaches into the academic arena, including education departments and staff as stakeholders. The lack of sleep may affect focus at school, which may cause assignments to be a burden at home further delaying sleep, and the student can become trapped in a cycle. Persistent inadequate sleep has been associated with poor health in students' and in poor emotional well-being (32) as seen in the data presented in this study. In ad hoc analyses of the 2007-2009 YBC data set, students with inadequate sleep were found 2.6 (CI 1.93 – 3.51) times more likely to have poor academic grades ( $p < 0.01$ , self-reported mostly Ds and Fs) and those perceiving low parental support were 3.2 (CI 2.2 – 4.5) times more likely to have poor grades ( $p < 0.01$ ).

Involving a parent in the life of their teenager is important, but most important is that parent is involved in a way that the adolescent will perceive the involvement as

supportive and nurturing. A supportive family environment can encourage healthy behaviors, which in turn can improve academic achievement, even when factors such as socio-economic status are taken into account (39). The quality and characteristics of parental involvement offer the kind of support and resources to create motivating and nurturing environments at home, much like translating social support benefit theories to children and relationships with their parents. Perceived parental support can protect against adverse health outcomes by reducing negative emotional and behavioral responses in the presence or absence of stress (40,41). The “family environment” questions from Connecticut’s YBC complement research that parent-child connectedness can be emotional, like having someone to turn to for advice or help, or practical, like eating meals together, or helping with schoolwork. Another consideration is if the student’s parents are not supportive, the ways in which school system could approach this issue perhaps by encouraging means of connectedness with other adults or with his or her school. The Connecticut YBC collects a variable on whether a student has an adult in his or her life besides parents that he or she can turn to when needed. In both 2007 and 2009, over 75% of students reported that there is at least one adult (besides a parent) that they may turn to for help or advice, including school personnel. Broadening the scope from parental support to social support may be another topic to consider in future analyses of YBC data.

During the academic year, adolescents’ week day wake times are determined by their school schedules. On school nights, later bedtimes have been associated with many factors beyond biology, such as homework, extracurricular activities, decreased parental influence on bedtimes, employment, or leisure activities (e.g., internet, television) (42).

If parents are provided with information through the school system or pediatricians to help eliminate certain extraneous contributors of sleep delay, positive potential benefits could be seen. This can include parent-set bed times, elimination of a television or computer in the bedroom, and halting cell phone/telephone usage after a certain time of the evening. Parents should also encourage their adolescents to avoid excessive weekend sleep compensation, which has been shown to have poor health outcomes, including overweight (43).

Research in the education field has raised concern that early high school start times may be leading to chronically sleep-deprived youth (44). Students are self-reporting obtaining significantly less than the recommended amount of sleep for adolescents during the school week. Making up for sleep on the weekends shows little benefit, and in some cases, creating a jet-lag type effect. Delaying start-time for secondary school students has shown to positively influence sleep duration and, therefore, has a positive effect on school performance and health outcomes (45).

A ground-breaking event occurred in the Minneapolis School District with the 1997-98 school year. The district changed the start time of its seven high schools to 8:40 AM and the dismissal time to 3:20 PM. Prior to the change, classes began at 7:15 AM and students were dismissed at 1:45 PM. Kyla Wahlstrom, the primary investigator for this study released her longitudinal data with findings on how several significant health and academic benefits were found by delaying start time for high school. This confirmed that students retained their bed times (contrary to suspicion that students would stay up even later), and increased nightly sleep total by over one hour. Results found less

student-reported depression as well as improved general well-being, improved school performance, less absenteeism or tardiness, and less sleepiness during class (46). Studies like Wahlstrom's have significant policy implications for secondary schools. This however would be the most intense policy change and would potentially create overwhelming logistical burden for public school districts providing transportation for its students.

Adolescent sleep patterns are also gaining attention in the academic arena because of the potential effect on school performance. Natural changes in sleep patterns complicated by early school start times (any time before 8:30am) place students at a disadvantage in terms of arousal and alertness—not only for early morning classes but throughout the day because the adolescent's biological rhythms are out of sync with typical school routines (11). While biological factors are a major contributor to sleep debt in adolescents, certain interventions are not futile, as pointed out by Holm and his colleagues (37). An active role can be taken by parents and educators to promote a healthy level of supportive, nurturing parenting, and to promote tactics to encourage more sleep in order to potentially weaken the relationship with risky health behaviors. Having the health, knowledge and skills to become an active and productive member of society, health and education are key in promoting social mobility (39).

Public health practitioners teamed with school or district health and wellness coordinators could use data like those presented in this study to develop easy-to-understand public health messages for parents, students and even primary care practitioners to address during routine well-visits. Recognizing the link that exists among

sleep, parent-family connectedness and risk behavior is an important first step to initiate more research, which can better direct the development of effective programs to promote health and simultaneously increase likelihood of school achievement. Create multi-disciplinary public health programs or messages to introduce protective factors can make an impact in reducing the potential risk for poor health outcomes in our state's youth and sustain healthy development.

## **Appendices**

## Appendix 1

Questions from the Youth Behavior Component survey instrument used to derive variables for analysis (questions appear in both years 2007, 2009)

*i.* How old are you?

- A. 12 years old or younger
- B. 13 years old
- C. 14 years old
- D. 15 years old
- E. 16 years old
- F. 17 years old
- G. 18 years old or older

*ii.* What is your sex?

- A. Female
- B. Male

*iii.* In what grade are you?

- A. 9th grade
- B. 10th grade
- C. 11th grade
- D. 12th grade
- E. Ungraded or other grade

*iv.* Are you Hispanic or Latino?

- A. Yes
- B. No

*v.* What is your race? (Select one or more responses.)

- A. American Indian or Alaska Native
- B. Asian
- C. Black or African American
- D. Native Hawaiian or Other Pacific Islander
- E. White

*vi.* During the past 12 months, how would you describe your grades in school?

- A. Mostly A's
- B. Mostly B's
- C. Mostly C's
- D. Mostly D's
- E. Mostly F's
- F. None of these grades
- G. Not sure

*vii.* During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing some usual activities?

- A. Yes
- B. No

*viii.* During the past 12 months, did you ever seriously consider attempting suicide?

- A. Yes
- B. No

*ix.* During the past 30 days, on how many days did you have at least one drink of alcohol?

- A. 0 days
- B. 1 or 2 days
- C. 3 to 5 days
- D. 6 to 9 days
- E. 10 to 19 days
- F. 20 to 29 days
- G. All 30 days



*Appendix 1 (cont'd)*

*x.* During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?

- A. 0 days
- B. 1 day
- C. 2 days
- D. 3 to 5 days
- E. 6 to 9 days
- F. 10 to 19 days
- G. 20 or more days

*xi.* During the past 30 days, how many times did you use marijuana?

- A. 0 times
- B. 1 or 2 times
- C. 3 to 9 times
- D. 10 to 19 times
- E. 20 to 39 times
- F. 40 or more times

*xii.* When you are away from home, how often do your parents or other adults in your family know where you are?

- A. Never
- B. Rarely
- C. Sometimes
- D. Most of the time
- E. Always

*xiii.* Do you agree or disagree that your family loves you and gives you help and support when you need it?

- A. Strongly agree
- B. Agree
- C. Not sure
- D. Disagree
- E. Strongly disagree

*xiv.* On an average school night, how many hours of sleep do you get?

- A. 4 or less hours
- B. 5 hours
- C. 6 hours
- D. 7 hours
- E. 8 hours
- F. 9 hours
- G. 10 or more hours

## Appendix 2

### Operational Definitions for Risk Behavior Variables

Inadequate Sleep	On an average school night the number of hours of sleep he/she gets? (Response to Question <i>xiv</i> , <i>Appendix 1</i> recoded into dichotomous variable, 1= Less than 6 hours of sleep, 2= 6 or more hours of sleep)
Low Parental Support	Calculated variable based response to 2 questions: Question <i>xii</i> , <i>Appendix 1</i> When away from home, parents never or rarely know child's whereabouts; and Question <i>xiii</i> , <i>Appendix 1</i> Disagrees or strongly disagrees that family loves, helps, and supports him/her when needed
Depressive Episode	In the past year, has felt so sad or hopeless almost every day for two weeks or more in a row that he/she stopped doing some usual activities (Affirmative response to Question <i>vii</i> , <i>Appendix 1</i> )
Alcohol Use	During the past 30 days, has had at least one drink of alcohol (Affirmative response to <i>Question ix</i> , <i>Appendix 1</i> )
Binge Drinking	During the past 30 days, has had at least one episode of binge drinking (drinking 5 or more drinks in a row within a couple of hours) (Affirmative response to <i>Question x</i> , <i>Appendix 1</i> )
Marijuana Use	During the past 30 days, has had used marijuana at least once (Affirmative response to <i>Question xi</i> , <i>Appendix 1</i> )
Considered Suicide	In the past year, has seriously consider attempting suicide (Affirmative response to <i>Question viii</i> , <i>Appendix 1</i> )

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