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Insufficient Sleep and Depression in Adolescents

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“I, Kristina James, upon my honor as a student, do hereby certify I have neither given nor received any assistance in writing of this paper/assignment, examination from any source whatever.”

“I, Elizabeth Muchiri, upon my honor as a student, do hereby certify I have neither given nor received any assistance in writing of this paper/assignment, examination from any source whatever.”

“I, James Vick, upon my honor as a student, do hereby certify I have neither given nor received any assistance in writing of this paper/assignment, examination from any source whatever.”

### **Introduction**

Overwhelming evidence suggests that sleep plays a crucial role in healthy adolescent development. The national Sleep Foundation along with American Academy of Pediatrics (AAP) recommends adolescents get 8.5 to 10 hours of sleep per night (Hirshkowitz, Whiton, Albert, Alessi, Bruni, DonCarlos, ... Hillard, 2015). Statistics from the National Sleep Foundation poll show that as many as 59% of 6<sup>th</sup> through 8<sup>th</sup> graders and 87% of high school students in the United States get less than the recommended amount of sleep on school nights and that the average amount of school-night sleep obtained by high school seniors is fewer than 7 hours (Melville, 2015). Sleep is a neurochemical process involving sleep promoting and arousal centers in the brain and serves as a significant restorative function that facilitates memory consolidation in humans (Zisapel & Wise, 2007). The need for clarity has been identified between the categories of sleep including insufficient sleep, sufficient sleep and recommended sleep.

The ramifications of insufficient sleep in the adolescent population have been found to be multifaceted. According to the Centers for Disease Control, adolescents not getting sufficient sleep are likely to be overweight due to lack of engagement in daily physical activity, suffer from depressive symptoms, engage in risky behaviors (drinking, smoking tobacco and using illicit drugs), and perform poorly in school (Wheaton, Ferro, & Croft, 2015). According to Healthy People 2020, sleep health objective for adolescents is to ‘Increase the proportion of students in grades 9 through 12 who get sufficient sleep’ with a target outcome of 33.1 % from the current rate of 30 % (United States Department of Health and Human Services [HHS], Healthy People 2020, 2015). Additionally, the relationship between insufficient sleep and the development of depression in adolescents has been examined in many studies.

### **Question**

Depression is a serious and prevalent disease among adolescents (Morelato de Souza & Hidalgo, 2014). Depression is described as a chronic and persistent sadness or loss of enjoyment in pleasurable activities, and it is caused by a complex interplay between physiological, psychological and environmental factors (Mueller, Bridges, & Goddard, 2011). Qualitative and quantitative studies have been designed in an attempt to examine the link between depression and insufficient sleep. The purpose of this literature review is to evaluate the strengths of current evidence in the causal relationship between sleep disturbance and depression in adolescents, and the potential implications this may have in clinical setting for advance practice registered nurse (APRN). Much work has been done in this area, so to bring clarity and increase knowledge this paper will seek to synthesize the latest research and explore the question: “ Are adolescents ages 11-21 with insufficient sleep at increased risk for depression?”.

### **Process of Discovery**

A literature search was conducted using CINAHL, Cochrane, Ebsco Host and PsycInfo electronic databases, covering publications in the last 10 years from 2005-2015. These databases were selected as they were identified as key resources used in healthcare and evidence based practice. MeSH terms used included ‘sleep’, and ‘depression’, and ‘adolescents’. The word ‘and’ was included in our search criteria to ensure all three concepts were included.

An initial search on CINAHL using MeSH terms ‘sleep’, ‘depression’ and ‘adolescents’ yielded 44, 232 results. When narrowed down to English language and in the last 5 years, it yielded 19,221 results. The search was further narrowed down to ‘research articles’ and ‘evidence based practice’ and there were 585 articles generated. Articles that did not have both sleep and depression discussed were excluded, and 20 articles were retrieved based on level of

evidence and peer reviewed selection only. Additional terms that appeared in some of the articles were sleep duration, sleep disturbance, sleep disorder, sleep deprivation, sleep quantity, sleep quality, mood disorders, anxiety, and behavioral disorders.

An initial search on PsychInfo was also conducted using MeSH terms ‘sleep’ and ‘depression’ and ‘adolescents’ and was limited to dissertations in the last five years. There were 15 articles yielded and 2 articles were selected based on applicability to topic. All the selected articles were exported to Zotero and references retrieved. Additionally, reference lists of the selected articles used were scrutinized to include any relevant articles.

There was variability in the adolescent ages from 11-21 years of age used in the various studies. Finally, the search term ‘adolescents’ was used to more appropriately define the selected population based on the stage of physical and psychological human development. In order to limit the search to articles focusing on these specific terms, search fields were limited to ‘adolescent’ as the title, ‘sleep’ and ‘depression’ as the variables.

### **Review of Literature**

#### **Psychological and Environmental Influences**

*Insufficient sleep, depression, anxiety and academic performance.* A systematic, cross sectional review by Shochat, Cohen-Zion, and Tzischinsky (2014) found that inadequate sleep does have significant consequences on various key aspects of adolescent health and functioning, including somatic and psychosocial health, and academic performance. Measures of somatic health included obesity and cardiovascular health, while psychosocial health measured anxiety, depression and academic performance. The subjects were culturally diverse and included culturally diverse adolescent populations bolstering generalizability.

Similarly, Lehto and Uusitalo-Malmivaara (2013) suggested that short sleep duration is related to attention problems and depression. Moreover, they further described that sleep loss is connected to several problems including impairing the capacity to learn, and having a negative effect on academic performance. The cross sectional study conducted by Lehto and Uusitalo-Malmivaara (2013) was comprised of self-reports from n=439 11 years old participants and measured sleep quantity, adverse bedtime behavior, daytime sleepiness, poor attention and symptoms of depression.

***Sleep deprivation and mood.*** The study done by Short and Louca (2015) found additional empirical evidence that the lack of sleep has a negative causal effect on mood in otherwise healthy adolescents. The study involved 12 adolescents aged 14-18 whom were identified as being physiologically and psychologically healthy adolescents. The group was objectively determined to be good sleepers prior to subjecting them to 36 hours sleep deprivation. Researchers interviewed parents and assessed mood and sleepiness both at home and at school. The study included several aspects of mood such as anger, anxiety, depressed mood, confusion, vigor and fatigue. Data was collected through self-reports based on questionnaires, actigraphy, as well as phone and in person interviews. The study of Short and Louca (2015) concluded that sleep plays an important role in mood dysregulation during the crucial time of adolescent development.

***Sleep and social jetlag.*** Morelato de Souza and Hidalgo (2014) suggested that the individual's chronotype (midpoint of sleep) and social jetlag have been associated with depression in different populations, but not well studied in adolescents. Therefore, in their cross-sectional study they examined the relationship between chronotype and social jetlag with depression symptoms in adolescents. They assessed n=351 students aged 12–21 years old using

questionnaire on demographic characteristics, the Munich Chronotype Questionnaire (MCTQ) and the Beck Depression Inventory (BDI). After data analysis, Morelato de Souza and Hidalgo (2014) did not find a strong correlation between age and studied variables, and although the depressed group had shorter sleep duration, this relationship was not statistically significant. However, the authors proposed the importance of reconsidering the weekly routine imposed on young people including extracurricular activities and its relation to sleep and depression (Morelato de Souza & Hidalgo, 2014).

*Sleep and risky behaviors.* The study conducted by Daly, Patterson, McCurdy, Kirk, and Michael (2015) attempted to address the gaps using data from Youth Risk Behavior Survey (YRBS) to study the associations between sleep duration and risk behaviors in lower and upper grade high school students in rural areas. High school students in lower grades (9th and 10th) that reported shorter sleep duration were more likely to have had attributes of mental health, suicidal behavior and substance use (Daly et al., 2015). Even more significant differences were noted in upper grade levels between sleep groups on suicide attempts, alcohol, tobacco and marijuana use. Furthermore, Daly et al. (2015) concluded that short sleep duration is particularly problematic in rural high school students recently transitioning from middle to high school.

*Insufficient sleep, depression and family connectedness.* In a longitudinal study, Mueller, Bridges, and Goddard (2011) investigated the relationship between adolescent depression, levels of sleep and family functioning. The data results indicated that positive perceptions of parent and family relationships helped adolescents avoid depression when they were concurrently experiencing problematic sleep. Also, healthy relationship with mother, father, and family connectedness served as a protective role in the development of depressive symptoms in adolescents with insufficient sleep (Mueller et al., 2011). The combination of

socioeconomic status, age, gender and family interpersonal relationships significantly predicted variance in depressive symptoms in insufficient sleep adolescents, with females indicating higher levels of depressive symptoms than males (Mueller et al, 2011; Short & Louca, 2015).

***Sleep problems and marital harmony vs. disharmony.*** A cross-sectional study by Coulombe, Reid, Boyle and Racine (2010) was done on healthy adolescents aged 12-16 years of age in Ontario, Canada. The study introduced a new variable measuring the family social functioning which was looked at in terms of marital harmony vs. disharmony in order to identify and control for a possible causative variable leading to poor sleep (Coulombe et al., 2010). The study demonstrated a correlation between sleep problems and psychological symptoms. Nightmares, anxiety, depression, aggression, attention problems and withdrawal were self-reported psychological symptoms of sleep problems and tiredness in healthy adolescents (Coulombe et al., 2010).

### **Physiological Influences**

***Sleep duration and circadian rhythm.*** Short, Gradisar, Lack and Wright (2013) developed a study to examine the inter relationships among sleep duration, sleep quality and circadian chronotype and their effect on alertness, depression and academic performance of adolescents aged 13 to 18 years. Circadian chronotype indicated the largest association with adolescent functioning with more evening-typed students reporting worse sleep quality. Adolescents with poor sleep quality and more evening chronotype were more likely to report worse grades and association with depression (Short, Gradisar, Lack et al., 2013). Sleep duration in this study showed no direct effect on adolescent functioning. A strength of Short, Gradisar, Lack et al. (2013) study was the random selection of participants that included students from schools that spanned the socioeconomic spectrum. However, a weakness of this study is lack

of generalizability due to being more theory driven versus data driven and the sample predominantly included urban area high schools.

Similarly, data results in Lehto & Uusitalo-Malmivaara (2013) revealed only a weak correlation between sleep duration during the school week and daytime sleepiness. The authors associated their findings with the low number of participants actually falling under the 7.5 hours of sleep or less category (only 4.6 % of total participants), and suggested that daytime sleepiness in their study be explained by other factors rather than low sleep quantity alone. Other research results revealed that low sleep duration on school week nights was correlated to poor attention ( $r_s = 0.27, P < 0.001$ ), while adverse bedtime behavior predicted depressive symptoms, and daytime sleepiness was a significant predictor for both low attention and depression (Lehto & Uusitalo-Malmivaara, 2013). Therefore, the authors suggested that in addition to sleep length, other aspects of sleep should be investigated in relation to poor attention and depressive symptoms (Lehto & Uusitalo-Malmivaara, 2013).

***Sleep quality and rapid eye movement (REM).*** A quantitative, longitudinal, non-randomized study conducted by Rao, Hammen and Poland (2009) demonstrated a correlation between abnormal biological markers and depression. The variables measured included hypothalamic-pituitary-adrenocortical axis (HPA), electroencephalogram (EEG), electromyography (EMG), and electrooculography (EOG). In fact, researchers found that healthy adolescents with abnormal rapid eye movement (REM) latency and density, elevated cortisol levels in both saliva and urine were associated with an increased risk for depression (Rao, Hammen & Poland, 2009). Therefore, the study not only holds compelling objective findings, but it also reveals a strong association between adolescent with changes in biological and neurological sleep activity and their increased risk for depression.

### **Bidirectional Relationship Between Sleep and Depression**

A meta analysis conducted by Lovato and Gradisar (2014) examined the relationship between sleep disturbance and depression in adolescents (12 – 20 years old). Twenty three studies were utilized and 13 of them explored the association between sleep, depression and sleep disturbance; seven identified the role of sleep disturbance in development of depression; and three looked at the role of adolescent depression in the development of sleep disturbance. The results of these studies provided support for an association between depression and sleep disturbance in adolescents. Adolescents previously diagnosed with depression reported significantly more disturbance with sleep compared to non-clinical adolescents. Overall, depressed adolescents had more wakefulness in bed compared to their non-clinical counterparts (Lovato & Gradisar, 2014). In fact, there was little support found for a predictive role of depressive symptoms in the development of sleep disturbance. A strength of Lovato and Gradisar (2014) meta analysis nature of their research study classifies it as a Level 1 evidence, while a weakness is that many of the reviewed studies differed in their definition of ‘poor sleep’. Also, several confounding variables such as gender, severity of sleep disturbance, depression and other comorbid psychiatric disorders were not controlled.

### **Synthesis**

This literature review identified an overwhelming evidence of physiologic and environmental factors contributing to insufficient sleep and its association with depression in adolescents. Some of these factors include circadian rhythm, stages of sleep, sleep quantity, sleep quality, age, gender, family interconnectedness, marital harmony, schedule obligations, and variability in school start times.

The current understanding of what constitutes normal sleep in adolescents has led to the establishment of recommended guidelines for sleep for the adolescent population. Today 8.5 to 10 hours of sleep is recommended (Hirshkowitz et al., 2015). Consequences of poor sleep has been a subject of further research to identify the association between circadian rhythm, sleep duration, quality sleep and mood in the adolescent population.

It is understood that regulation of primitive sleep-awake cycles is governed by the circadian clock (McCance, & Huether, 2014). The circadian clock is the internal mechanism regulating homeostasis between sleep-awake times. The circadian rhythm is believed to have developed over time as a necessary protective mechanism and the main environmental factor influencing sleep regulation in healthy adolescents (National Institute of Health, 2014).

Sleep can be divided into two very distinct types, non-rapid eye (NREM) and rapid eye movement (REM). NREM sleep proceeds REM sleep and the two types form a complete cycle. Cycles repeat multiple times during the course of a normal night's sleep. Together NREM and REM play a specific role in healthy body function. NREM is the phase of sleep where growth and repair occur and REM sleep has been associated with overall healthy brain function (National Institute of Health, 2014).

Commonly associated factors such as circadian rhythm, sleep quality and sleep duration were identified as being predictive of adolescent depression (Lehto & Uusitalo-Malmivaara, 2013; Rao, Hammen & Poland, 2009; Short, Gradisar, Lack et al. 2013). Circadian rhythm was found to be a cofactor to insufficient sleep and is associated with poor academic performance and depression. Specifically, evening chronotype was linked to increased risk for depression in adolescents. Morelato de Souza and Hidalgo (2014) examined the relationship between chronotype (mid point of sleep), social jet lag (when body's biological clock and actual sleep

schedules don't match up causing a chronic state of sleep deficit) and depressive symptoms among adolescents. The later midpoint of sleep on free days, longer sleep duration on free days and social jet lag were impacted by the individual's chronotype and social schedules (Morelatto de Souza & Hidalgo, 2014).

More social jet lag hours were noted with the older adolescents, they had more advanced social schedules and lacked much parental control on their weekend routines, which resulted in a substantial difference between school and free days (Morelatto de Souza & Hidalgo, 2014). Even more significant differences were noted in upper grade levels between sleep groups on suicide attempts, alcohol, tobacco and marijuana use. Short sleep duration was particularly problematic in high school students recently transitioning from middle to high school (Daly et al., 2015). Additionally, adolescents may have problems with adjusting to an earlier school schedule with high school start times being earlier than middle school start times. The AAP recommends that middle and high school start times aimed at no earlier than 8:30 am to enable students to get adequate sleep, improve their health, academic performance, safety, and quality of life (Wheaton, Ferro, & Croft, 2015). This is the basis of the development of the Healthy People 2020 objective to increase the proportion of students in grades 9 through 12 who get sufficient sleep.

Contrary to the notion that parental involvement becomes less important as adolescents age, research has shown that parental support and closeness can actually protect adolescents from the development of depressive symptoms (Mueller et al., 2011). The impact of family relationships, parental and family connectedness, and marital harmony on adolescents' overall healthy growth and development has been well documented in various studies (Coulombe et al., 2010; Mueller et al., 2011;). Furthermore, research suggests that adolescents who feel safe and

secure in their immediate environments and have strong family attachments have shown to experience better quality of sleep and less depressive symptoms (Mueller et al., 2011).

Furthermore, the literature reveals that promoting adequate sleep in adolescents and encouraging healthy family relationships are key factors that need to be considered in the prevention of depression in adolescents with insufficient sleep.

Adolescents in general are likely to engage in risk taking behaviors and sleep deprivation further exacerbates it (Daly et al., 2015). Studies conducted to determine the effect on mood after 36 hours of sleep deprivation on healthy adolescents revealed that adolescent mood was heavily affected by a night of sleep deprivation with more depressed mood, increased anxiety, confusion, anger, fatigue and less vigor (Short & Louca, 2015). Also, sleep deprivation produced an increased depressed mood in females over males (Mueller et al., 2011; Short & Louca, 2015). Risky behaviors such as use of tobacco, alcohol, illicit drugs, and attempted suicide was more prevalent in upper grade level students that experienced shorter duration of sleep (Daly et al., 2015; Wheaton et al., 2015). Lehto and Uusitalo-Malmivaara (2013) suggested that factors in addition to sleep duration be studied, such as quality of sleep. Short et al. (2013) found that quality of sleep was more strongly associated with depression, than sleep duration alone. Rao, Hammen and Poland (2009) used a quantitative approach to study sleep quality and its association with adolescent depression, revealing that abnormal REM or elevated levels of cortisol were found to be associated with an increased risk for future depression.

Additionally, a decline in psychosocial functioning, mental and emotional health has been associated with increased sleep deprivation in adolescents. This has lead to other health outcomes that include sleep disturbance, anxiety, low self-esteem, and decrease in cognitive function affecting school performance (Shochat et al., 2014). High school students spend on

average of 33 hours per week in class with an additional 4 or 5 hours per week doing homework, which interferes with sleep, a vital necessity for optimal levels of cognitive function (Shochat et al., 2014). All these impact academic performance in adolescents. Daytime sleepiness in the classroom or while doing homework is one of the main byproducts of sleep deprivation noted, and this may predispose them to accidents and subsequent injury. Decreased sleep in adolescents has also been attributed to early school start times, growing academic workload, less parental influence on bedtime, and increased screen time (Shochat et al., 2014).

There is a bidirectional relationship between sleep disorders and depressive symptoms. Several studies have shown a prevalence of sleep disorders such as insomnia, restless sleep, nocturnal fears, nightmares, and daytime sleepiness among children with mood and anxiety disorders (Ramtekkar & Ivanenko, 2015). Mueller et al. (2011) examined the reciprocal relationship between sleep and family environments by further explaining that when one member of the family experiences sleep problems, typically all members of the family are impacted.

### **Proposed Application and Evaluation**

Clinicians and providers should be cognizant of potential consequences of short sleep duration among adolescents. The use of routine screening questionnaires that assess sleep hygiene and duration could be utilized at a preventative screening level and this would be less threatening to adolescents than direct questions on depression and suicide (Daly et al., 2015). In addition, the presentation of adolescents with mental health concerns should prompt the clinician or provider to incorporate sleep hygiene intervention into existing treatment protocols for better outcomes. Daly et al. (2015) concluded that the treatment of co-occurring sleep problems can result in significant improvements in depressive symptoms and substance use. Another vital implication to clinical practice is the need for identifying sleep loss as a risk factor for mood

deficits in healthy adolescents. Clinicians and providers should be aware of the detrimental effect of insufficient sleep on adolescents and the importance to address sleep with adolescents at preventative screenings as well as sick visits.

Clinical providers, educators, parents, and policymakers should acknowledge that chronic sleep deprivation in adolescents is a serious public health issue (Shochat et al., 2014). There is growing evidence suggesting that sleep is vital in supporting cognitive and emotional development during adolescence, and causes and consequences of inadequate sleep in adolescents are often intertwined in many complex ways. Also, the relationship between sleep and depression is well documented and it appears to be reciprocal in nature. A disruption in normal sleep pattern is one of the symptoms of depression and insufficient sleep can also contribute to the development and worsening of depressive symptoms (Cairns, Hui Yap, Pilkington, & Jorm, 2014).

Addressing the complex challenge of inadequate sleep in adolescents requires a multilevel approach that includes clinical and policy-level strategies (Daly et al., 2015). Moreover, midpoints of sleep can be used to evaluate adolescents when addressing health complaints such as a depression. Due to the pre determined social rhythm in adolescents, understanding their chronotype is essential when reinforcing the importance of maintaining a weekly routine. In fact, Owens (2014) suggests providers at local and national levels advocate for educational, administrative, and health policies that promote healthy sleep and reduce the risk for sleep loss in adolescents.

Research suggests that sleep disturbances are a potentially modifiable risk factor for both the prevention of depression and for the maintenance of depression remission (Danielsson et. al, 2013). First, it is important that providers implement regular screenings at clinical settings and

identify adolescents experiencing chronic sleep deprivation. It is imperative that in clinical practice providers educate adolescents and their families on the importance of optimizing adolescents' sleep and the consequent improvement of their well-being, mood and academic performance (Short, Gradisar, Lack et al., 2013). Therefore, the implementation of these specific prevention strategies would aid in reducing long-term health consequences for adolescents at risk for depression. Moreover, these simple cost effective strategies could reduce long-term health care expenditures and relief potential financial burdens.

There has not been enough research done to establish universal criteria defining insufficient sleep. Current studies suggest less than 7 hours as insufficient sleep, above 7 to 8.5 hours as sufficient sleep, and above 8.5 to 10 hours as potentially protective of depression per recommended AAP guidelines. Additional protective variables identified were male gender, increased physical activity, positive family interconnectedness, marital harmony, and delayed school start times as per Healthy People 2020. Finally, future research should be aimed at establishing a universally acceptable definition of insufficient sleep. Additionally, it will be vital to account for factors affecting quality of sleep versus quantity alone. This literature review adds to the knowledge of the provider on the impact of sleep on depression in adolescents, and provides the basis for early prevention and intervention.

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