Impact of Sleep Deprivation on Mental Health Among Different Age Groups

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Introduction

There are many requirements to keep your body up and running. In most cases, these are easily identifiable, in that they require an external input. However, one of the more misunderstood requirements is sleep, a completely self-contained system, integral to the functioning of the body. Sleep plays an essential role in maintaining good health and well-being throughout one's life. Getting an adequate amount of sleep helps ensure high cognitive function along with physical health benefits. Despite this, for a number of factors, humans often do not receive the required amount of sleep for prime functionality. According to the Centers for Disease Control and Prevention, one in three American adults do not get enough sleep. Just as an appropriate amount of sleep is required for proper functioning, an inadequate amount of sleep, conversely, will lead to negative repercussions on the body and the mind.

Insomnia, only one of the many sleep reducing disorders, is a common issue throughout the world and affects approximately 50-70 million Americans (American Sleep Association), which demonstrates how many people suffer from a lack of sleep. There are two types of sleep deprivation: acute(short-term) and chronic(long-term), with different effects on mental and physical health. Based on research, some common effects on physical health associated with an inadequate amount of sleep include: headaches, eyelid twitching, weight gain, fatigue, and even risk of hypertension, diabetes, heart problems in serious long-term cases of sleep deprivation. Effects on mental health can include: memory impairment, symptoms of depression, inability to concentrate/focus, anxiety, mood disturbances, impaired performance, etc.

Sleep deprivation is prevalent in all age groups and can have adverse effects on the mental well-being of individuals regardless of age. The necessity of sleep is often overlooked and neglected by many people, which is why it is important to bring awareness to and understand

the possible consequences. In this literature review, we investigate the varying effects of sleep deprivation on mental health among different age groups: children, adolescents, adults, and senior citizens.

Effects of Sleep Deprivation on Mental Health in Children

Children are the future and cause many parents a lack of sleep, but we need to take a moment and realize how lack of sleep is affecting our children. Sleep is one of the most discussed topics in children's checkups at the doctors. Newborns are reported to need 14-17 hours of sleep, infants need 12-16 hours of sleep, toddlers need 11-14 hours of sleep, pre-schoolers need 10-13 hours of sleep, and school aged (ages 6-12) need 9-12 hours of sleep. Children who are suffering from mild sleep deprivation are 91% more likely to be overweight, 97% more likely to become depressed, 105% more likely to suffer an injury, 118% more likely to catch a cold, and 190% more likely to fail mathematics. 6 out of 10 middle schoolers do not get enough sleep. Sleep deprivation is affecting our children's mental and physical health.

A research article titled *Common Sleep Disorders in Children* goes more into depth on how common some sleep disorders are in our children and also some possible solutions. Sleep allows our body to reset and restore. It promotes physical and supports mental development. Up to 50% of children will experience a sleep problem and 4% have a formal sleep disorder diagnosis. Identifying a sleep problem early on can prevent negative consequences. Examples of negative consequences can be daytime sleepiness, irritability, behavioral problems, learning difficulties, and poor academic performance. Sleep aligns with the first few years of life and can tell a lot about physical maturation and development. While some sleep behavior is proven to be

genetic, many symptoms can be prevented. For many, distinguishing sleep disruptions from normal age-related changes can be tough and delay treatment.

Sleep disorders come in many forms. The article gives a chart to easily display different sleep disorders in children, how likely they are to occur, and symptoms. Examples of sleep disorders include parasomnia, behavioral insomnia of childhood, delayed sleep phase disorder, restless leg syndrome, and obstructive sleep apnea (OSA). Obstructive sleep apnea is upper airway obstruction that disrupts normal sleep patterns and ventilation. Obstructive sleep apnea usually occurs in 1%-5% between the ages of 2 and 8 but can happen to any age. It can often be associated with obesity, excessive soft tissue in the airway, decreased upper airway lumen size, or failure of pharyngeal dilator muscles. Common symptoms include snoring, unusual sleeping positions, such as mouth open, sleep-related paradoxical breathing, nighttime diaphoresis, morning headaches and excessive daytime sleepiness. It occurs equally amongst males and females, but has shown to be more common in ethnic minorities. This sleepiness is likely to manifest as depressed mood, poor concentration, decreased attention, or behavioral issues. Children with obstructive sleep apnea usually have a normal weight and body mass index but the incidence of obesity-related sleep apnea is steadily increasing. Children with suspected OSA should be referred to a polysomnographer to get treatment.

Parasomnias, also known as sleepwalking, affects up to 50% of children. Children with parents who used to sleepwalk are at higher risk; 1 parent is a 45% risk and 2 parents are a 60% risk. Symptoms include ablation during sleep, difficulty to awaken during an episode, eyes open, confusion, agitation, unusual or dangerous behaviors, or rapid return to sleep. Parasomnia often resolves itself spontaneously by adolescence, but at least 4% will continue to have it. For those who continue to struggle, treatment centers are available to further evaluate the problem. Sleep

terrors affect up to 6.5% of children and affect males and females equally. Symptoms include perceived intense fear, such as screaming, crying, and potentially dangerous activities. While the article does not put possible solutions in the chart along with the sleep disorder, they explain possible solutions to *some* of the sleeping disorders mentioned in the text of the article. Sleep terrors usually occur during the first half of the sleep period, with no memory of the event. Sleep terrors can overlap with other sleep disorders making them sometimes tough to diagnose but not impossible.

The article has a very different layout than most other articles. The introduction paragraph at the top of the article gives a summary of the whole article with some additional information. Throughout the article many body paragraphs are split with some coming on before the chart and some coming on after making it difficult to read. The article uses subheadings making it easier to read and uses statistics to support what they are describing in the article. Only 4% of parasomnias will pierce past adolescence so the best management is parental reassurance and proper safety measures. You can get better at sleep with practice by being consistent with sleep times. Overall treatment to help prevent sleep disorders include good sleep hygiene and a consistent sleep-wake schedule, with nighttime melatonin and/or morning bright light therapy as needed. The article covers some overall methods to help children prevent sleep disorders while also giving solutions to a few sleep disorders in the article. The symptoms listed for each sleep disorder all show physical and mental deterioration.

An article titled "*Assessment of Sleep in Children with Mucopolysaccharidosis Type III",* documented an experiment involving children as participants to document the need for sleep in children. In the article's abstract they discuss, "Sleep disturbances are prevalent in mucopolysaccharidosis Type III (MPS III), yet there is a lack of objective, ecologically valid

evidence detailing sleep quantity, quality or circadian system. Eight children with MPS III and eight age-matched typically developing children wore an actigraph for 7–10 days/nights...Parents completed a sleep questionnaire and a daily sleep diary. Actigraphic data revealed that children with MPS III had significantly longer sleep onset latencies and greater daytime sleep compared to controls, but night-time sleep duration did not differ between groups. In the MPS III group, sleep efficiency declined, and sleep onset latency increased, with age. Questionnaire responses showed that MPS III patients had significantly more sleep difficulties in all domains compared to controls. Melatonin concentrations showed an alteration in the circadian system in MPS III,... Actigraphy was tolerated by children and this monitoring device can be recommended as a measure of treatment success in research and clinical practice" Mahon et al., (2014). Assessment of Sleep in Children with Mucopolysaccharidosis Type III. This article gave us all we needed to know about the experiment, as far as what the experiment is, results, and solutions all in the abstract. While they do list the definition for Mucopolysaccharidosis type III, also known as Sanfilippo syndrome, as an inherited metabolic disorder characterised by an absence/ defect of lysosomal enzymes needed to break down glycosamino- glycans (GAGs), they failed to go more in depth with the definition and discuss it as a progressive disorder that primarily affects the brain and spinal cord (central nervous system). This is important as the article is all about testing sleep in children, which takes place in your mind. The article claims, "Clinicians reported 80–95% of MPS III patients experienced sleep difficulties and daytime behaviours were worse when sleep difficulties were more severe, however some reported that behaviour actually improved when sleep was disturbed" which further proves how not only lack of sleep can affect mental health, but how mental health can affect lack of sleep which can worsen your mental health.

An article titled, *"The Timing of the Circadian Clock and Sleep Differ between Napping and Non-Napping Toddlers"* discusses how early childhood is a time of significant changes in the duration and timing of sleep, and uses experimentation to test differences in circadian phase and sleep between napping and non-napping toddlers. The abstract also covers the experiment in its entirety. The abstract includes information on what the circadian clock is, explains background on information on toddlers napping habits, "Although the sleep-wakefulness pattern of most toddlers includes an afternoon nap, the association between napping and circadian phase in early childhood remains unexplored. This study examined differences in circadian phase and sleep between napping and non-napping toddlers." The abstract covers the experiment and the results itself, "Data were collected on 20 toddlers (34.2±2.0 months; 12 females; 15 nappers). Children followed their habitual napping and non-napping sleep schedules (monitored with actigraphy) for 5 days before an inhome salivary dim light melatonin onset (DLMO) assessment. On average, napping children fell asleep during their nap opportunities on 3.6±1.2 of the 5 days before the DLMO assessment. For these napping children, melatonin onset time was 38 min later ($p = 0.044$; $d = 0.93$), actigraphically estimated bedtime was 43 min later ($p = 0.014$; $d = 1.24$), sleep onset time was 59 min later ($p = 0.006$; $d = 1.46$), and sleep onset latency was 16 min longer ($p = 0.030$; $d = 1.03$) than those not napping. Mid Sleep and wake time did not differ by napping status. No difference was observed in the bedtime, sleep onset, or mid sleep phase relationships with DLMO; however, the wake time phase difference was 47 min smaller for napping toddlers ($p = 0.029$; $d = 1.23$)." As well as a concluding of their findings in the abstract, "Our findings indicate that napping influences individual variability in melatonin onset time in early childhood. The delayed bedtimes of napping toddlers likely permits light exposure later in the evening, thereby delaying the timing of the clock and sleep. Whether the early developmental trajectory of

circadian phase involves an advance associated with the decline in napping is a question necessitating longitudinal data as children transition from a biphasic to monophasic sleep wakefulness pattern."

The articles overall all gave in depth explanation on how lack of sleep does affect mental health in children. The second article delves deeper by adding in not only how mental health can affect lack of sleep which can worsen your mental health. The experimentations given in the articles gave a lot of background information as well as solutions at the end of it all. Children are very impressionable and need to adopt healthy habits from young to prosper.

Effects of Sleep Deprivation on Mental Health in Teens or Adolescents

In this current age of addictive technology and social media, along with society's emphasis on productivity and work, and a number of other factors, adolescents and young adults often do not receive the recommended amount of sleep. According to the American Academy of Sleep Medicine, teenagers, ages 13-18, should regularly receive 8 to 10 hours of sleep per 24 hours, yet the 2006 National Sleep Foundation poll reports that 45% of adolescents, from grades 6-12, get less than 8 hours of sleep per night. Many studies find that sleep deprivation in adolescents may result in negative consequences on their mental health, such as moodiness or aggression, depression, inability to concentrate, poor decision making, memory impairment, etc. (National Adolescent and Young Adult Health Information Center, 2014).

In the article entitled, "Sleep restriction worsens mood and emotion regulation in adolescents" from the 55th volume of *Journal of Child Psychology and Psychiatry*, Baum et al. (2014) investigates mood and emotional regulation in adolescents when restricting the amount of sleep they get on school nights. The introduction referenced the findings of multiple other

studies, and the gaps they hoped to fill with this study. The article then transitions to a detailed procedure of the three-week sleep manipulation protocol, participants consisted of fifty healthy adolescents, 25 male and 25 female, ages 14-17.9, who were not professionally diagnosed with a psychiatric disorder and had no history of neurological illnesses or injuries. For the first baseline week, participants were required to wake up at 8:30 AM but selected their bedtimes and participants who were unable to wake up at 8:30 AM were dropped from the experiment. During the next two weeks, the adolescents were randomly assigned to two conditions: sleep restriction(SR) condition, which consisted of 6.5 hours in bed on week-nights, and healthy sleep duration(HR), which consisted of 10 hours in bed on week-nights. Each participant experienced both conditions. During the weekend, the teenagers were allowed to select their bedtimes but still required to wake up at their prescribed times. Sleep was monitored using an actigraph that was worn on the teens' non-dominant wrist at all times except during contact sports, showers/baths, and swimming. Wake times were monitored using a sleep diary. Mood, emotional regulation, and hyperactivity or impulsivity were assessed each Saturday via self-reports and parent-reports. The results showed that adolescents reported higher levels of anxiety, depression, anger, fatigue, and confusion during the SR condition than the HR condition. The teenagers and parents also reported higher levels of oppositionality/irritability, emotional regulation, and hyperactivity/impulsivity during the SR condition than the HR condition. The article followed with a discussion of the findings, limitations, and a small conclusion making note of how although further research is needed, this study contributed to other findings indicating that chronic sleep deprivation has negative effects and can worsen mood and emotion regulation in adolescents.

This study was not conducted in a lab setting, meaning that it may have been difficult to control for possible extraneous variables, such as the environment, which may have differed for each participant. However, this is also a strength in the sense that it provides ecological validity, which, as mentioned in the introduction, other studies on adolescent sleep deprivation lacked, and thus, the results of this study can be generalized to real-world settings. The study also relied heavily on self-report, which may have introduced bias and inaccuracy in the results. Since mood, emotional regulation, and hyperactivity/impulsivity were assessed every Saturday, the reports of the children and parents were based on memory, which is not as reliable as daily reports. Overall, the results of this study supported previous findings of other studies and demonstrated that there are adverse effects of receiving an inadequate amount of sleep in adolescents. In the future, it would be interesting to conduct a longitudinal study with a larger sample of participants during the school year instead of summer to observe the longer-term effects, as well how it affects teenagers mentally in regards to academics.

In another article entitled, “Awareness of effects of sleep deprivation among college Students” from the 10th volume of *Drug Invention Today*, it begins by introducing sleep as a biological necessity for humans. Compared to the previous article, this one approaches sleep through a general and biological perspective, with less reference to other relevant studies. While the previous study focused on younger adolescents in high school, this study focused on older adolescents in college, “some of the most sleep-deprived people in the nation”(Ranasinghe, Gayathri, Priya, 2018). As opposed to the previous article, it made mention of how in some cases, sleep deprivation can have favorable effects such as increased energy, alertness, and mood. The introduction was relatively short, and then the article begins discussing materials and methods. The study consisted of 100 participants who took a survey that asked questions

regarding the effects of sleep deprivation via a survey planet link. The results were then statistically analyzed. Some of the most common causes of lack of sleep reported by the survey include: the internet(38.4%), stress(21.2%), studying/college assignments(18.2%), and socializing with friends(18.2%). The survey results reported that 61% of participants experienced headaches after being sleep deprived and 62% reported they dozed off during the day after sleep deprivation. This article did not contain a limitations section as opposed to the previous study reviewed.

This concise study served as a general basis for the common factors and effects of sleep deprivation among college students but still needs much more further research. Although the title mentioned the "effects" of sleep deprivation, it appeared that this study did not focus on many of the other effects, but rather, the causes. A weakness of this study was that it was purely a survey, so correlation does not imply causation. Unlike the previous article, which also utilized parent-reports, the results of this study were purely based on self-report, which is not completely reliable. Moreover, the questions in the survey were "After sleep deprivation, you doze during the day?" and "After sleep deprivation do you experience headaches?" Instead, it would have been better to give possible choices of how they were feeling to reduce bias. Furthermore, there was little statistical analysis of the survey results, which reduces the validity of this study. For future studies, the researchers should use a much larger sample to increase validity and ask more questions in the survey to get a better idea of the effects of sleep deprivation in college students.

An article in the 18th volume of *BMC Public Health* entitled, "Chronic sleep deprivation and gender-specific risk of depression in adolescents: a prospective population-based study," explored long-term sleep deprivation and the risk of depression in adolescents. Unlike the previous literature discussed, this study focused on a specific mental health disorder, depression,

and also considered the gender-specific risk of depression. The topic of this study is introduced by first mentioning that adolescents are susceptible to mental health issues. The introduction also makes note of effects of sleep deprivation, “which has been linked to important adverse health consequences such as mood disturbances, poor academic performance, increased food intake and weight gain, and engaging in substance use behaviour”(Conklin, Yao, Richardson, 2018). They then discuss how research on the association between sleep deprivation and depression is established, but there is little research on the direction, longitudinal evidence, as well as gender differences. The researchers hypothesize that there would be a positive association between chronic sleep deprivation and depression levels with differences based on gender. Progressing to the methods section, the population of this study is said to be 3170 students, ages 13-18, from the British Columbia Adolescent Substance Use Survey (BASUS), a cohort study. Depression was measured using the Centre for Epidemiologic Studies Depression Scale (CESD), with higher total scores indicating more symptoms of depression. A CESD score greater than or equal to 24 indicated depression. Sleep was measured based on self-reports of sleep and wake time on weekdays. Sleep deprivation was considered as less than 8 hours of sleep. The reference group was no exposure to sleep deprivation, occasional sleep deprivation meant exposure at one time point, and chronic sleep deprivation meant exposure at two or more time points. The data was statistically analyzed using multivariable linear regression models. Results reported that 53% of the sample was female, averaging 14.8 years, 59% reported good or excellent health, and 23% were depressed. More than 30% of the sample had a high socioeconomic status. 30% of the sample were exposed to sleep deprivation(17% reported occasional sleep deprivation and 13% reported chronic sleep deprivation over 12 months). Further analysis showed that there was a “significant and consistent monotonic increase in the change in CESD scores with cumulative

sleep deprivation in young women, and no association in young men"(Conklin, Yao, Richardson, 2018). Table 2 showed that the mean CESD score at follow-up for female adolescents experiencing chronic sleep deprivation was about five points higher than those not experiencing any sleep deprivation. However, there appeared to be little differences in mean CESD scores across the levels of cumulative sleep deprivation. The article follows with a discussion section and then a strengths and limitations section. It concludes by emphasizing the gender-specific link between cumulative sleep deprivation and increased likelihood of adolescent depression.

This study was quite strong compared to the other two studies analyzed. A strength of this study as opposed to Baum et al. (2014), was that the researchers accounted for confounding variables, such as body mass index (BMI), ethnicity, family income, by self-reports. It also was a longitudinal design, which is better at establishing cause-and-effect relationships. Another strength is its large sample, which was 3071 young people. Much like the other articles reviewed, a shortcoming of this study is its heavy utilization of self-reports, which may be unreliable. Another weakness is that depression was measured using the CESD scale, which is not completely accurate in assessing depression/depressive symptoms. The study also uses data from another cohort study, which may be considered secondary data, and thus, decreasing the reliability.

Overall, the three studies reviewed in this section illustrated that there are adverse effects to a lack of sleep in adolescents. It appears that all of the literature also made note of how schools/academics play a role in why adolescents do not receive enough sleep on a daily basis, reinforcing that changes to sleep policies should be to accommodate healthy sleeping patterns. Peterman, Carper, Kendall (2015) appeared to be the weakest study out of the three reviewed, but the easiest to understand due to its use of basic vocabulary and a simple survey experiment.

All studies made use of self-report, which although it is convenient and easy, may result in bias and less reliability in the results. With the exception of the last study, the studies consisted of a small sample of participants, so in the future, it will be better to use a large sample so it has greater validity and is able to be generalized to the population.

Lack of Sleep in Adults

Adulting brings with it a multitude of responsibilities. From the moment we become college students, we are considered "adults" and a flurry of responsibility rushes on to us unexpectedly and continues on for the rest of adulthood. Often, this causes insomnia and sleep deprivation in many adults. Lack of sleep is a common condition in everyday life, either related to psychosocial demands or related to working shift hours. In healthy individuals, this has shown to cause many adverse effects on an individual's mental health. There is a multitude of research on the effect of the Lack of sleep on mental health including subjects from college students, gender differences and adults carrying on daily responsibilities. This review will serve as an analysis of recent journal articles on the impact that lack of sleep has on individuals with a focus on the impact it has on adults. To gain an accurate perspective of the research being done in this field, articles were chosen from a variety of recent journals focusing on the adverse effects on the lack of sleep in all adults. The diversity of the articles allows for a multi-spectra analysis for the impact of lack of sleep.

Total sleep deprivation (TSD) may induce fatigue, neurocognitive slowing and mood changes, which are partly compensated by stress regulating brain systems, resulting in altered dopamine and cortisol levels in order to stay awake if needed (Klumpers et al., 2015). However, these systems have never been studied together. A research article titled *Neurophysiological*

Effects of Sleep Deprivation in Healthy Adults, a Pilot Study explores how the healthy brain responds to total sleep deprivation (TSD) and how compensatory and regulatory stress mechanisms may interact. It was hypothesized that wakefulness would be associated with an increase in dopamine release and corticotropin releasing hormone (CRH) activation, in the presence of altered emotional functioning.

The research article starts with an introduction by first explaining how from an evolutionary perspective, staying awake has served to guard against outside threats, requiring increased alertness. The article assesses dopamine levels and cortisol levels to explain the effect of lack of sleep on them and then draws conclusions from this data. In the introduction, the article explains that dopamine (DA) release is supposed to increase wakefulness, partly through the D2 receptor. It also talks about CRH releases cortisol from the adrenal cortex via the hypothalamic pituitary adrenal (HPA) axis, a key endocrine response mechanism to a stressful situation (Klumpers et al., 2015). The introduction explains how the surveillance of hormones within the body after total sleep deprivation (TSD) can give an accurate representation of its effects. The article then moves on to a materials and methods section outlining participants and the procedure of the study. The study consisted of twelve healthy adults; 6 females with a mean age of 29.2 years old and 6 males with a mean age of 28.5 years old. It was ensured that none of the participants had a lifetime history of psychiatric disorders, previous use of psychotropic medication known to interfere with the dopaminergic system, 1st degree relatives with psychiatric disorder, somatic disorders, were pregnancy, used sleep medication, and past or current abuse of psychoactive drugs so as to not have an uncontrollable effects which will then skew the data. Saliva samples were collected from participants 7 times a day to measure dopamine and cortisol levels and track the effect of total sleep deprivation (TSD) on the

participants of the study. The article then goes on to explain the detailed methods of data collection and measurements of the dopamine and cortisol levels. Sections titled “Data Analysis”, “Data Processing”, and “Data Acquisition” give an insight into the methods of data collection and tests for significance of that data. The discussions section takes the data into perspective and discusses the implications of their quantitative findings. The research article then makes a transition to the results section where it outlines that after total sleep deprivation (TSD), perceived energy levels, concentration, and speed of thought decreased significantly, whereas mood did not. It then transitions to a brief conclusion section where the researchers say they believe the data may help to understand the therapeutic effects of sleep deprivation in affective disorders.

Articles such as this serve as important and accurate representations of the lack of sleep on the mental health of adults. Their method of data collection was detailed and accurate. Use of technology such as the fMRI to measure cortisol levels and consistent collection of saliva to measure hormone levels in participants suggested a clear and reliable correlation and causation relationship between the data and its physical and mental implications. The article's transparent approach to data collection and a detailed background of techniques used also increase the credibility of the research article. While the article did discuss data collection and data analysis in detail, one shortcoming of the researchers is the lack of regulation of the participants prior to the study. There was no period of acclimation and no regulation of sleep patterns and products such as caffeine that affect alertness before the study was conducted. This could have potentially skewed the data.

An article titled *Insomnia Symptom Severity Modulates The Impact of Sleep Deprivation on Attentional Biases to Emotional Information* is written and conducted in an antagonistic style

to the previous research article. While the research article by Klumpers et al., (2015) focused more on quantitative data, this article focused more on qualitative data and focused on controlling the study more carefully. Vargas, I., Drake, C., & Lopez-Duran, N. (2017) evaluated the effect of experimental sleep deprivation on attentional biases to emotional information among a sample of 40 healthy, young adults which was 20 males and 20 females. The article opens with a lengthy conclusion outlining the prevalence of insomnia in the world citing that approximately one-third of the adult population reports a current history of at least one subtype of insomnia (i.e., difficulty initiating sleep, maintaining sleep, or early morning awakenings (Morin and Jarrin, 2013). They also discussed how prior research supports the link between insomnia and attentional biases for sleep-related stimuli. Vargas, I., Drake, C., & Lopez-Duran, N. (2017) hypothesized that sleep deprivation would be associated with a greater bias for negative information and a reduced bias for positive information, but that these biases would be stronger among participants with greater insomnia symptoms. In the study, participants were excluded if they were pregnant, previously diagnosed with a chronic medical condition (e.g., sleep apnea, cancer, lupus, diabetes), or a psychiatric disorder (including insomnia).

After the lengthy introduction, the article jumps right into methodology where they outlined the participants of the study and their demographics. The article then takes a sharp turn to statistical analysis and procedures. The procedure is detailed and covered all aspects of the study. They explain that during the baseline visit, each participant completed a series of questionnaires about their sleep habits. Following the baseline visit, participants wore an actigraphy device (device for assessing daily sleep/wake patterns) on their wrist for approximately 7 days. In addition, each day participants were asked to complete a brief online sleep diary. Actigraphy and sleep diary data were used to estimate each participant's average

sleep data from the week prior to the overnight laboratory visits. Approximately 1 week after the baseline visit, each participant returned to the lab on two consecutive weekend nights. During the first night, or the adaptation night, participants were instructed to arrive at the lab at approximately 10:00 pm. This adaptation period is something that the previous article lacked. The adaptation period allowed the scientists to delve much deeper into the true effects of insomnia on the mental health of participants. Upon arrival at the lab, participants once again completed questionnaires about their sleep patterns. The adaptation night served to familiarize the participants with sleeping in a novel environment. Participants were given a maximum 8 h sleep opportunity time and were allowed to go home following the adaptation nightThey were then instructed to return to the lab the next day the participants were randomized into either a sleep deprivation condition or control condition. Participants assigned to the sleep deprivation condition underwent a night of total sleep deprivation and were awake for 28 consecutive hours. The research paper then explains the statistical analysis of the data gathered using a table using Means, standard deviations, and p-values for all demographic, sleep, mood, and stress variables for both experimental conditions (sleep deprivation and control) to understand the significance of the data collected.

The article proceeds to talk about results in short paragraphs. The detail results of insomnia on predicting negative and positive bias. Omitting the conclusion section, the article includes a dense and lengthy discussion section instead. In the discussion section, the article again sums up the research that was conducted. It talked about how Vargas, I., Drake, C., & Lopez-Duran, N. (2017) concluded that young adults with low levels of insomnia symptoms are particularly susceptible to the effects of sleep deprivation; such that acute sleep loss can reduce their natural tendencies to attend to positive information in the environment. Their research

suggested that insomnia symptoms did not influence the relationship between sleep deprivation and attentional biases to negative stimuli. They also determined that the impact of sleep deprivation on positive bias scores significantly decreased as insomnia symptom severity decreased.

Sleep deprivation and sleep disorders such as insomnia are extremely prevalent in the lives of many people around the world. The effects of sleep deprivation is apparent and can be measured using many qualitative analysis studies such as the one done by Vargas, I., Drake, C., & Lopez-Duran, N. (2017). Articles such as these serve to better help a more vast population of the world truly understand the effects of sleep deprivation and the qualitative analysis can even help people relate better to their findings. One of the strongest points of this article lies in its rigor of control of the study. The acclimation period of the participants helped to cut out more potential sources of error and helped to strengthen the credibility of the data presented. One shortcoming of the article however, was a lack of clarity and organization within the sections of the article. The paper omits parts of the article such as a proper conclusion and a greater detailed analysis of the results. Instead, it clumps up conclusions into large chunks of texts making it difficult to follow the real conclusions of the data.

Sleep disturbance (SD) has complex associations with depression. A recent meta-analysis of 21 studies found that nondepressed individuals with insomnia have a twofold risk of developing depression compared to those without SD. In the college student population, SD is a common occurrence. In a sample of 583 students, 13% reported clinically significant symptoms of insomnia in a two week period, 27% were at risk for SD, and 60% of college students are poor-quality sleepers (Nyer et al. 2013). An article titled *RELATIONSHIP BETWEEN SLEEP DISTURBANCE AND DEPRESSION, ANXIETY, AND FUNCTIONING IN COLLEGE*

STUDENTS published in 2013 focuses on the link between lack of sleep and mental health disorders such as depression and anxiety.

The article first starts off with a lengthy and detailed introduction where they outline the prevalence of insomnia within college students and their link to depression and anxiety. The researchers hypothesized that students with depressive symptoms with SD would demonstrate a greater burden of comorbid psychiatric symptoms and functional impairment compared to students with depressive symptoms without SD. The article then shifts directly to the methods section where it talks about all the questionnaires that were filled out by participants of the study with bullet points. This made the methods section of the article very clear and much easier to follow along with. The article then proceeds to explain the statistical analysis and discuss the results of the data collected. They used standard deviation and P-values to understand the significance of the data. This transparency increased the credibility of the paper. They found that Students with depressive symptoms and SD, compared to those without SD, endorsed significantly more intense and frequent anxiety and poorer cognitive and physical functioning. Students with depressive symptoms with and without SD did not significantly differ in depressive severity, hopelessness, or quality of life. The article omits a conclusion and instead goes into a lengthy discussion of the implications of their findings. They concluded that college students with depressive symptoms with SD may experience a greater burden of comorbid anxiety symptoms and hyperarousal, and may have impairments in functioning, compared to students with depressive symptoms without SD. The research paper then closes out with a section titled *Conflicts of interest* where they divulge the funding sources and grants the researchers received. This transparency with the audies allows us to trust the finding of this study and trust that the findings were true and untampered with.

Articles such as this are more narrowed down studies on a group of people experiencing a lack of sleep to have more effective results. While lack of sleep related mental distress affects all age groups, it is most prevalent in young adults juggling with school or work. One of the strengths of this research paper is the clear and concise manner of data collection, analysis, and results of the study. It proved links between lack of sleep and anxiety. One of the drawbacks of this paper is the lack of a proper conclusion. It jumps right into the discussions section and doesn't discuss the future implications of this research in a more detailed manner.

Sleep and mental health are closely connected. Sleep deprivation affects your psychological state and mental health. And those with mental health problems are more likely to have insomnia or other sleep disorders. The brain basis of a mutual relationship between sleep and mental health is not yet completely understood. But studies suggest that a good night's sleep helps foster both mental and emotional resilience, while chronic sleep deprivation sets the stage for negative thinking and emotional vulnerability.

New college students face a wide variety of challenges as they come into their higher education careers. It is often difficult for first time college students to manage their own lives and daily schedules. Some challenges they may face may be, adapting to a new environment with less systemic structure, getting more difficult assignments and increased workloads, trying to fit into new social circles, and finding time for self-care outside of school. Another challenge a lot of college students face is adjusting to new sleep schedules and suffering from insomnia. According to the American Academy of Sleep Medicine’s ICSD-3 manual, insomnia is defined as “persistent difficulty with sleep initiation, duration, consolidation or quality”. Most of the aforementioned factors could be contributing to the students’ insomnia.

As stated in an article by Chen and Chen (2019), sleep deprivation has a lot of negative consequences. Sleep is a vital part of muscle growth, tissue repair, mood maintenance, memory, and cognitive function. The first major way sleep deprivation affects college students is by disrupting memory.Chen and Chen (2019) report that “Memory formation is dependent on sleep states. In particular, memory formation is hypothesized to be prompted by slow-wave sleep and consolidated by REM sleep”. As a result, sleep deprived students tend to remember less material which eventually leads to lower grade point averages. Chen and Chen (2019), also state that insomnia reduces daytime alertness and energy, which can make it increasingly difficult to follow daily schedules simply due to fatigue. Studies also show that college students experiencing inadequate sleep may be more likely to skip classes or fall asleep in lectures. All of this chaos that stems from lack of sleep can contribute to lower GPAs.

According to Okano et al. (2019), “Well-controlled sleep deprivation studies have shown that lack of sleep not only increases fatigue and sleepiness but also worsens cognitive performance”. They state that the cognitive performance of someone who has been awake for 17 hours is equal to someone who has a blood alcohol concentration of 0.05%. There is also something called sleep inconsistency which is also known as social jet lag. This is defined by an inconsistent sleep schedule or inconsistencies in sleeping from day to day. An example of this would be people who barely sleep during the work week and then crash and sleep all weekend. College students who suffer from sleep inconsistency perform worse in school as reported by Okano et al. (2019).

Sleep Deprivation in the Elderly

As one gets older, it is a sad fact of life that their body becomes weaker and more frail. And, sadly, very often, the mind starts to go with it. So in those trying times one must do their best to be at their best. This of course entails getting the proper amount of sleep. While the body may no longer be growing, it is still essential to get upwards of six hours of sleep; at least in order to maintain your mental and physical health. But with old age, sleep is not just about upkeep, it's about avoiding extra damage. Because on top of the natural regression, lack of sleep can exacerbate mental deterioration (i.e. memory loss, decrease in fluid intelligence, shortened attention span…). It is therefore important to know how much sleep you actually need, and to adhere to said information.

When looking for articles for the literature review, i wanted to make sure i had a general, but complete, pool of information to choose from. So, after doing loose searches on a few of the databases available to me, I decided to use Academic Search Complete. With it, in order that i not overlook any connected or variant term i used the key words "sleep deprivation or sleep disturbance or reduced sleep or sleep loss or lack of sleep" and "elderly or aged or older or elder or geriatric" and "mental health". I additionally limited the search to only complete text articles published after 2010, for increased accuracy. After filtering through the many results that matched the search criteria, I was left with three articles which contained the desired type of information.

The first article, *Subjective memory complaints in an elderly population with poor sleep quality*, deals with the connection between cognitive ability and sleep quality (i.e. sleep duration and sleep disturbances). The participants of said study were a randomly selected 10% of the elderly (above 60) population in Jukjeon-dong. These people were further vetted for any

comorbidities that could skew the data, such as depression, Parkinson's, or dementia, to name a few. In order to properly assess the quality of their sleep, participants were administered the Pittsburgh sleep quality index (PSQI), and the Epworth sleepiness scale (ESS). Then, for determining the psychological effects, the subjects completed both the subjective memory complaints questionnaire (SMCQ) and the CERAD-KN for objective cognitive function. This left the experiment with only 352 subjects, 143 of which were male, and 209 of which were female. Based on the PSQI, the subjects were subdivided into good sleepers and poor sleepers, depending on if they had a score less than 5 (good) or greater than 5 (poor), respectively. These groups numbered 192 good sleepers, and 160 poor sleepers. It was found that poor sleepers experienced higher amounts of depression than their good sleeper counterparts ($t = -4.350$, $p < 0.001$). Additionally, poor sleepers marked higher in their SMCQ's ($t = -3.725$, $p < 0.001$) than good sleepers. However, in terms of objective cognitive function, there was no statistically significant discrepancy between the two groups. (Kang, et al., 2015).

Another study was conducted by Tingting Sha, Wenwei Cheng, and Yan Yan, about the relation between sleep and long-term/future neurocognitive ability. The study, titled *Prospective association between sleep related factors and the trajectories of cognitive performance in the elderly Chinese population across a 5-year period cohort study*, was formulated on information from CHARLS, the China health and retirement longitudinal study; which, for people in China above the age of 45, surveys the "social, economic, and health circumstances of community-residents" (Zhao, Hu, Smith, Strauss, & Yang, 2012). Among those factors are included: sleep, cognition, and depression. From the CHARLS survey, which was first conducted on 17,708 people, only 15,331 of which completed the three subsequent surveys (spread about two years apart), further isolation of subjects was required. So the conductors of the research

removed any applicant with incomplete data in the relevant areas, then anybody who was under 60 years of age, and anybody with any psychiatric disorders or brain damage. This left the study to be conducted on 3,584 adults between the ages of 60 and 98 years old. The CHARLS tested two cognitive skills, executive function and episodic memory. Executive function was determined by performance on the Telephone interview of cognitive status (TICS) battery, and ability to draw figures from memory, which were altogether graded on a point scale ranging from 0 to 11. Episodic memory was scored between 0 and 10, based off of the average of immediate and delayed recall, when asked to immediately repeat a list of 10 words, and then to do the same thing after four minutes had passed. In terms of sleep data, the CHARLS yielded information comparable to the PSQI. Based off of the information submitted, the subjects were subdivided into four groups: short sleeper (<5 hours)><5 hours), somewhat short sleeper (5-7 hours), normal sleeper (7-9 hours), and long sleeper (>9 hours). To further represent sleep quality, respondents were also questioned about sleep disturbances, and their napping regiment. Splitting again into four groups, how often they had a "restless" night, with the categories being: "rarely or none of the time (<1 day)", "some of the time (1–2 days)", "much or a moderate amount of the time (3–4 days)", and "most or all the time (5–7 days)"><1 day)", "some of the time (1-2 days)", "much or a moderate amount of the time (3-4 days)", and "most or all the time (5-7 days)". And with regards to napping, there are the non-nappers, short nappers (<30 minutes), moderate nappers (30-90 minutes), and long nappers (>90 minutes) (Sha, Cheng, & Yan, 2019). While there was no consequential relationship between sleep duration and executive function in the elderly, sleep disturbances supposedly had a negative correlation with executive function in men n (β = -0.088, 95%CI -0.162, -0.013). And long sleepers, of both male and female, tested worse for episodic memory (β = -0.075, 95%CI -0.174, -0.020 and β = -0.114, 95% CI -0.217, -0.010). Also, of

those who were classified as normal sleepers or short sleepers, they are less likely to be categorized under the cognitive projection of increased cognitive ability compared to initial testing (OR = 0.54, 95%CI 0.36, 0.80 and OR = 0.61, 95%CI 0.40, 0.93). However throughout the study, there are numerous discrepancies between men and women (Sha, Cheng, & Yan, 2019).

A third study was conducted to see how sleep deprivation affects the brain in older adults, titled *The Effects of Sleep Deprivation on Brain Functioning in Older Adults*. In order to ensure internal validity, the participants in this study all had to be: right handed, above the age of 59 (and between 18 and 39 for the younger group), have at least 12 years of education, a consistent sleep schedule of 6-9 hours of sleep per night, have a nonpolarized sleep pattern, and not cognitively impaired (Almklov, Drummond, Orff, & Alhassoon, 2014). Due to the strict nature of these conditions, and other unmentioned factors that made it impossible for a participant to be included, the final number of old people used in this experiment numbered at 28 (6 men and 22 women). Once again, the PSQI and the ESS were used by the participants to quantify and qualify their sleep. The experiment entailed two separate functional MRI (fMRI) testings of the same task; first after a regular night's sleep, and the second after 36 hours of no sleep. No other restraints were put on their daily activities, except for exercise, as that would greatly skew the results. Additionally, participants were protected from extremes of light (i.e. very bright or dark), so that their circadian rhythm would not have any frame of reference off of which to take over. In order to test their response inhibition, and sustained attention, the GO-NOGO test was employed. However, to make it compatible with the fMRI, a slight variation needed to be implemented. The participant was instructed to, as fast as possible, click a button if a GO image appeared on the screen (a large or small square or a large pentagon) and to do nothing if the NOGO image

appeared (a small pentagon). The three factors that were used to grade one's performance on these tests were: hit rate, response time for correct hits, and proportion of false alarms (Almklov, Drummond, Orff, & Alhassoon, 2014). After the sleep deprivation, the results of the GO-NOGO test showed that the old people, relative to the young people, had a lower proportion of false alarms, but also a slower reaction time (Hits RT= 601.7 ± .46, FA= .12 ± .07). However, the main data was that of the fMRI, which showed various areas of activation during the tasks. The results showed that, for older adults when sleep deprived, when concentrating on one task, the brain utilizes resources from other areas in order to compensate for the strain on another area (i.e. lower amounts of activation in areas of the brain that are not essential for the current task at hand). And while this doesn't directly translate to cognitive impairment, it is indicative of extra strain on the brain for simpler tasks (Almklov, Drummond, Orff, & Alhassoon, 2014).

While all of the articles used the PSQI, or something comparable, overall they tested different things. While all of them show that there are negative side effects to improper sleeping habits, the list of variables related to sleep is just too long. For example, while the first two studies were based off of general sleeping habits, the third study was about short term total sleep deprivation, making its data less generalizable. The overall results however are, that in the elderly, sleep deprivation causes increased depression, worse executive function, worse memory, and lowered processing speed. In order to properly validate the results, as well as further understand the repercussions of sleep deprivation, more long term testing is needed.

Conclusion

While research is ongoing to better understand the connections between mental health and sleep, the evidence to date points to a bidirectional relationship. Mental health disorders tend to make it harder to sleep well. At the same time, poor sleep, including insomnia, can be a contributing factor to the initiation and worsening of mental health problems. Both sleep and mental health are complex issues affected by a multitude of factors, but, given their close association, there is strong reason to believe that improving sleep can have a beneficial impact on mental health and can be a component of treating many psychiatric disorders. The second article on how lack of sleep affects children delves deeper by adding in not only how mental health can affect lack of sleep which can worsen your mental health. The experiments done on the children further prove children are very impressionable and need to adopt healthy habits from young to prosper. The research being done on the contribution of a lack of sleep to worsening mental health in adults is diverse and credible. Total sleep deprivation induces fatigue, neurocognitive slowing and mood changes, which are partly compensated by stress regulating brain systems, resulting in altered dopamine and cortisol levels in order to stay awake if needed Klumpers, U. M. H., Veltman, D. J., van Tol, M.-J., Kloet, R. W., Boellaard, R., Lammertsma, A. A., & Hoogendijk, W. J. G. (2015). Additionally, young adults with low levels of insomnia symptoms are particularly susceptible to the effects of sleep deprivation; such that acute sleep loss can reduce their natural tendencies to attend to positive information in the environment Vargas, I., Drake, C., & Lopez-Duran, N. (2017). Finally, college students with depressive symptoms with SD may experience a greater burden of comorbid anxiety symptoms and hyperarousal, and may have impairments in functioning, compared to students with depressive symptoms without SD

Nyer, M., Farabaugh, A., Fehling, K., Soskin, D., Holt, D., Papakostas, G. I., Pedrelli, P., Fava, M., Pisoni, A., Vitolo, O., & Mischoulon, D. (2013).

Oftentimes, adolescents do not receive 8 or more hours of sleep due to academic purposes, sleeping disorders, and other factors. Research in adolescents suggest that there is an association between sleep deprivation and consequences on mental health, with some of them being: poor mood and emotion regulation (Baum et al., 2014), more likely to doze off during the day/inability to concentrate (Ranasinghe, Gayathri, Priya, 2018), a higher risk of depression (Conklin, Yao, Richardson, 2018). Although there were weaknesses in all three studies examined, they provide a good foundation for further research needed to be done on the effects of inadequate sleep. These studies emphasize the significance of sleep and increase awareness to its adverse effects.

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