

Ramifications of Sleep Deprivation and Stress on Juvenile Epilepsy

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ABSTRACT

According to recent studies, there is a correlation between stress, sleep deprivation, and elevated levels of epileptic activity among the adult population. An increased presence of either sleep deprivation or stress within epileptic adults typically supports the correlation between stress and sleep deprivation and elevated levels of epileptic activity, showcasing them at an increased risk for experiencing an increase in epileptiform discharges, spike waves occurring in the form of a single discharge that is typically associated with epilepsy and seizures. Researchers have demonstrated that the presence of sleep deprivation and stress is a significant indicator for increased levels of epileptic activity in the adult population, however, they have yet to conclude whether the trend exists within adolescent populations diagnosed with epilepsy, specifically from the ages of 5 to 18. A qualitative study, an interview, and a questionnaire procedure with 47 respondents and 5 interviewees that were adolescents diagnosed with epilepsy and asked questions concerning three themes: (1) The presence of Stress in Juvenile Epilepsy, (2) REM Sleep Duration, (3) Academic and Societal Pressures. The results of the analyses concluded that I found the facilitation of increases in the epileptic activity to correlate with an increased presence of sleep deprivation and stress within adolescents with epilepsy, as it heightens the risk for seizures.

Literature Review

In order to understand the reason behind my decision to explore the relationship between sleep deprivation and stress as facilitators for epileptic activity within adolescents, it is imperative to observe and understand the existing research on the subject. While there is a lack of research that explores sleep deprivation and stress acting as triggers for epileptic activity within juveniles diagnosed with epilepsy, there is however a multitude of studies that suggest sleep deprivation and stress act as triggers for epileptic activity within adults and cats (Cohen et al., 1967; Malow, 2004). Studies like Cohen's observe how rapid eye movement (REM) sleep influences epileptic activity within cats by measuring the number of convulsions the cats' experience. Similar to how REM sleep influences epileptic activity in cats, researchers indicate that humans diagnosed with epilepsy emit a similar reaction when stressed or sleep-deprived (Malow, 2004). However, these studies are extremely limited as they only explore the aspects of how sleep deprivation and stress trigger epileptic activity within adults rather than comparing the data they found for the population of adults to another population of subjects, such as adolescents, to assess if there is any correlation between the influence that sleep deprivation and stress has on epileptic activity within a differing population of subjects in the studies.

Unlike the research provided by Cohen and Malow, there are existing studies that examine how developing a better understanding of sleep deprivation, stress, and epilepsy can allow for enhanced daily life quality for patients suffering from juvenile epilepsy and the development of better treatments. As an example, Xu and his colleagues, well-known sleep medicine scholars, conducted a study in 2018 that explains how circadian rhythms can be used to define the sleep cycle of an individual by altering and defining the sleep architecture and the quality of sleep the individual receives. Xu and his colleagues allude to the variety of sleep architectures present in individuals with epi-

lepsy and their influence on epileptic activity. It has been shown that variations in sleep architecture and schedules can help develop treatment plans tailored to the individual, rather than focusing on the neurological disorder known as epilepsy as a whole. Furthermore, Mekky and her colleagues (2017) further expand upon how sleep architecture varies from person to person, especially those who have epilepsy and those who don't, and how individuals that suffer from epilepsy often take antiepileptic drugs, such as valproate, to combat epileptic activity. In short, both authors emphasize the importance of understanding one's sleep architecture, an individual's circadian rhythm, in controlling epileptic activity and devising a treatment plan that is specific to an individual rather than the disorder itself. Despite their efforts, these authors and their research are limited in the aspect that they observe the role of sleep architecture and circadian rhythms in controlling epileptic activity and provide treatment options while failing to consider how age, amount of sleep, and stress can influence seizure activity.

Therefore, while some studies assert the facilitation of epileptic activity is influenced by sleep deprivation and stress within a demographic of adults with epilepsy, others argue the increase in epileptic activity is controlled by sleep quality and sleep architecture which are two factors that facilitate epileptic activity that vary from age to age. Researchers have not yet examined how sleep deprivation and stress facilitate epileptic activity in varying degrees depending on the subject's age, or how sleep quality and sleep architecture, which is a person's circadian rhythm or natural sleep cycle, may increase epileptiform discharges. Seeing as research has not been aimed to differentiate the influence of sleep deprivation and stress on epileptic activity based on the participant's age, or determined the impacts that one's sleep architecture has on the elicitation of epileptic activity, future research should observe the impacts of sleep architecture on neurological and sleep disorders, such as epilepsy, and how the factors that promote an increase in epileptic activity to varying based on age, in order to bridge the gap in knowledge surrounding this topic. Together, these aspects illustrate a gap in knowledge surrounding the influence of sleep deprivation and stress on epileptic activity, in which this study will attempt to bridge the gap by investigating: To what extent do stress and sleep deprivation facilitate increases in epileptic activity within the brain among juveniles diagnosed with epilepsy?

My research will examine how sleep deprivation and stress levels vary within different age groups and how these levels impact the facilitation of electrical activity within the brain. However, my research will be limited to juveniles who have epilepsy within the Houston area to better understand why juveniles often report an increase in epileptic activity when sleep-deprived or stressed. Additionally, as there has been a lack of studies investigating the influence of sleep deprivation and stress on epilepsy within juveniles, my research will fill a gap found in an existing body of knowledge.

The study will contribute to understanding the relationship between sleep and epilepsy and developing a treatment that is best suited for the patient, rather than the disorder as a whole. The study is designed to examine how aging affects sleep architecture, resulting in sleep deprivation and stress, as well as the effect of this on the elicitation of epileptic activity, and how sleep architecture differs across different ages, including juveniles and adults, in ways that contribute to epileptic activity. Developing a better understanding of the various factors that cause epileptic activity and the relationship between epilepsy and sleep will allow for the development of more effective treatment plans for brain spasms, other than getting a prescription for anti-epileptic drugs, seeing as the basic mechanisms of sleep, circadian rhythms, and epilepsy all go hand in hand.

Methods

This study explores the connection between sleep deprivation and stress among adolescents who have experienced an increase in epileptic activity. The goal of this study is to increase understanding of how sleep deprivation and stress play a role in the elicitation of epileptiform discharges in adolescents with epilepsy in order to devise treatment plans that are specific to the patient's case rather than the neurological disorder as a whole. This is important, as understanding the role of sleep deprivation and stress can contribute to growth in the health of individuals and

increased self-implementation within a community, rather than relying on prescription drugs to control an increase in epileptic activity.

Design

I plan to use an interview-styled questionnaire method in which I ask juveniles from a specified age range that have previously been diagnosed with epilepsy and their guardians to qualitatively understand the role of sleep deprivation and stress on epilepsy and how that role may differ through various ages. It is vital to question the adolescent with epilepsy, guardians of the adolescent, and a wide age range as it will prevent bias within the study and yield a better understanding of how the impact sleep deprivation and stress hold on epilepsy differs between various ages. To further understand how the impact of sleep deprivation and stress on epilepsy differs between ages, I will compare the data obtained in this study regarding adolescents to pre-existing research that evaluates the impact of sleep deprivation and stress within an adult population to better understand how the influence of sleep deprivation and stress differs through different age groups. As seen in research from the literature review, researchers have used questionnaire and survey-based methods to determine the function of sleep deprivation and stress on epileptic activity situated within an adult population, only to find that “stress/anxiety [was] noted most often as a trigger” where the average total sleep time was an average of 72 hours, whereas “daytime sleepiness, fatigue, and insomnia symptoms” were the most common triggers when the average total sleep time was 9 hours (Cobabe et al., 2015, p. 2). Additionally, pre-existing data has not developed an understanding of whether the function of sleep deprivation and stress can depend on the individual’s age as they tended to focus their research on adults, not exploring how function varies across different age groups. Through the usage of a questionnaire that measures qualitative data, access to data that currently does not exist in the body of knowledge is achieved as past research discusses “activation of epileptic seizures” and their catalysts, yet never directly attempts to understand how it may differ across age groups (Tomas et al., 2016, p. 1). The qualitative measures included in the research allow for the analysis of participants' answers regarding whether they noticed an increase in epileptic activity when sleep-deprived or stressed to be compared to that of adults diagnosed with epilepsy to understand better the impact of sleep deprivation and stress across various age groups. Moreover, unexplored data can be analyzed and ideals surrounding epilepsy can be expanded.

Participants of the Study

The subjects of this study will be individuals, specifically adolescents, at varying ages that have been diagnosed with epilepsy, in addition to their guardians or parents. This study will be done in a non-experimental design, with its main focus being to characterize how the influence that sleep deprivation and stress partake on epileptic activity varies across ages. We need a large range of demographics within the participants to accurately present the results on how the influence that sleep deprivation and stress partake on epileptic activity varies across ages.

Instruments

A questionnaire will be administered to both adolescents diagnosed with epilepsy and their guardian in order to obtain qualitative data regarding the influence of sleep deprivation and stress in the increase of epileptic activity and categorize their responses into one that can be qualitatively interpreted. This is necessary to understand reasons why the function of sleep deprivation and stress in epilepsy may differ over age. With this information, it will become possible to understand how to treat the increases in epileptic activity within a specific age group.

Procedure

When conducting my research, various resources will be provided to the participants to ensure the plausibility of amassing validated data that doesn't violate the ethics of any participant. For obtaining qualitative data in my research, a questionnaire was necessary to inquire about the amount of sleep the participants had gotten when experiencing the increase in epileptic activity, as well as to assess the probable triggers responsible for the increase in epileptic activity. Moreover, for the interview portion of my study, a set of ethically board-approved questions were generated and later asked the participants in order to elicit insightful information. Overall, as my research involved the participation of adolescents, signed consent forms for the student participants and legal guardians were issued to ensure the safety of the under-aged participants.

Procedures to conduct my study included initiating the research with supplemental questions to gather baseline data that established the amount of sleep gotten by the participants when they noticed an increase in the elicitation of epileptiform discharges, conducting interviews to gather a more insightful look into the factors that play a role in the elicitation of epileptiform discharges from participants and comparing the answers of adolescents diagnosed with epilepsy to their guardian or parents' answer as to why this increase in epileptic activity occurred and the pre-existing research on the topic on adults.

All in all, efforts within my method to ensure the anonymity of the subject, as well as prioritizing the safety of the participants, were imperative in the process of gathering resourceful data from a sample size that draws attention to the ramifications of sleep deprivation and stress on juvenile epilepsy.

Findings

After the amassing of the 47 survey responses and 5 interviews, the data was then analyzed through Google Spreadsheet and a Google Form. I conducted interviews and questions to juveniles who were previously diagnosed with epilepsy and comprised of all ages, racial groups, and genders. We conducted a heavy analysis of both survey and interview data and identified three major emerging themes: 1) The Presence of Stress in Juveniles, 2) REM Sleep Duration 3) Academic and Societal Pressures.

Presence of Stress in Juvenile Epilepsy

All participants were asked whether stress was present in their lives and the impact it has on evoking seizure activity. In many of the interviews, the subjects were confused as to why they were being asked about their stress levels in a study measuring the causes of epileptic activity, as doctors don't tell their patients to manage their stress levels as a way to combat epilepsy but instead prescribe medication or suggest getting 10 to 12 hours of sleep. Interviewee #1 stated that they "face a decrease in the number of seizures experienced when stress levels were better managed". According to Interviewee #2, they struggled to get their seizure activity under control without taking prescription medications that often made them feel tired, thus they turned to alternative methods and found managing one's stress levels can help mitigate epileptic activity and found it to be an effective solution in some cases. Interviewees 3 through 5 offered similar information, that managing one's stress levels is an alternative to prescription medication in some cases to regulate epileptic activity.

REM Sleep Duration

In this theme, participants' responses in the questionnaire and interview discussed the influence that variances in REM Sleep Duration have on the elicitation of epileptic activity. When participants responded, most understood the connection between sleep and epileptic activity. As opposed to the average ten to twelve hours an adolescent is sup-

posed to sleep, it seems that the majority of the juveniles with epilepsy in the Greater Houston area experience trouble sleeping or oversleep, which are both found to be underlying causes of increases in epileptic activity. Respondent #1 states, “I am always tired, despite me getting a full 10 hours of sleep yesterday. I’ve also noticed, despite me being well rested or sleep-deprived the day before, I still experience some seizures”. Respondent #2 states that “being well rested allowed me to not experience any seizures. However, on the matter of whether sleep deprivation causes an increase in the elicitation of epileptic activity, Respondent #3 states “sleep deprivation didn’t cause any observable seizures” implying while the correlation between sleep deprivation and epileptic activity portray it as the cause of increases in epileptic activity, it rather just put individuals more at risk for experiencing seizures, the same is the case for oversleeping.

Academic and Societal Pressures

When asked to explain any academic and societal pressures they face and the impact they perceive it has on their epileptic activity, participants highlighted the immense pressures coming from friends and family members to perform well in school. Interviewee #4 described the highly competitive nature of schools in the Greater Houston area as “stressful and mentally draining, which they felt had a negative impact on one’s stress levels, causing them to experience more seizure activity in a time filled with high academic and societal pressures.” Due to the impact that societal and academic pressure have on an individual’s stress levels, they result in an increase in the facilitation of epileptic activity.

Analysis

Through the amassing of 47 survey responses and conducting 5 interviews, three major themes emerged from analyzing this data that is the presence of stress in juvenile epilepsy, REM sleep duration, and the presence of academic and societal pressures.

Presence of Stress in Juvenile Epilepsy

Often, stress lends itself to promoting the elicitation of epileptic activity, whether in adolescents or adults, as well as a source of alternative treatments to prevent increases in the facilitation of epileptic activity that may have otherwise been unexplored. The data indicate that the inability to manage stress levels to a certain degree is frequently a common ground seen in stressed juveniles experiencing increases in seizure activity who are unaware of stress acting as a trigger for their seizures, seeing as they are following the doctor’s orders. However, the correlation between increases in seizure activity and stress is not only present when an individual is stressed but can also present itself when the individual is relaxed, as data suggests. As professionals in the field of pediatric sleep medicine stated, stress increases the likelihood of an individual experiencing epileptic activity compared to when they are relaxed. Still, it isn’t the actual trigger of epileptiform discharges.

REM Sleep Duration

While many know the role sleep plays in epilepsy due to it being the centralized method of diagnosis in many places, as patients sleep while EEG is being conducted to measure any abnormal brain activity and provide an accurate diagnosis, they fail to realize the impact that REM sleep possesses on the elicitation of epileptic activity. One of the factors that stayed constant throughout the questionnaire response and interviews was when participants were asked what they believed to be the cause of the increases in epileptic activity that which they are experiencing, many stated they believe sleep deprivation caused these increases to an extent. When asked about the influence that variances in

REM Sleep Duration have on the elicitation of epileptic activity, all interview participants had stated their observations on the days on which they experience increases in seizures and the approximate REM sleep it got the night before. In addition to stating their observations on days in which they experienced increases in epileptic activity, interview participants explained how at times they are well rested, but they still tend to experience increases in epileptic activity. This remains consistent with the existing data present within the body of knowledge, stating that while the correlation between sleep deprivation and epileptic activity portrays it as the cause of increases in epileptic activity, it rather just puts individuals more at risk for experiencing seizures, the same is the case for oversleeping, which may explain why this factor is what many associates with increases in epileptic activity in both the adolescent and adult populations. The frequency by which sleep-deprived juveniles with epilepsy exhibited increases in epileptic activity when compared to the frequency by which oversleeping/well-rested juveniles with epilepsy exhibited increases in epileptic activity, it turned out to be the same as sleep and the elicitation of epileptic activity have a correlational relationship, as both sleep deprivation and oversleeping put juvenile at more for seizures but are not explicit trigger that causes increases in seizure activity. Multiple participants went so far as to say that REM sleep duration had no perceived effects on the elicitation of epileptic activity, by comparing its effects on themselves when they received a high quantity of REM sleep to that of a low quantity of REM sleep. In this sense, changes in REM sleep duration can provoke increases in the elicitation of epileptic activity, but it is not certain if it will provoke a rise in seizure activity.

Due to this strong association between sleep and the object of epilepsy, an evaluation of the effect that varying durations of sleep have on epilepsy, specifically within adolescents, is necessary to maintain or strengthen this relationship. REM sleep is the principal deciding factor within many cases of epilepsy, in this case, REM sleep would be the period of sleep where there is random rapid movement of the eyes, accompanied by low muscle tone throughout the body, and the propensity of the sleeper to dream vividly. There is a large discrepancy between the number of people who get less than 6 hours of sleep and those who get more than 6 hours. Obtaining the effects of receiving various degrees of REM sleep on the epileptic activity of adolescents is the most reliable teller of consistently high answers on all other survey questions, which indicates the implications of sleep deprivation on epileptic activity by showcasing the correlation between REM sleep and epileptic activity. This creates the implication that a drastic change in the duration of one's REM sleep schedule likely results in an increased risk of provoking epileptic activity.

Academic and Societal Pressures

Particularly when participants had higher stress levels that were found to cause increases in epileptic activity at times, the academic and societal pressure surrounding the adolescent within their day-to-day life played a great deal in the extent to which an increase in epileptic activity was triggered, much like those seen when there are changes to REM sleep duration or the presence of stress within an adolescent's life. Participants with immense pressures coming from friends and family members to perform well in school were more likely to experience an increase in the facilitation of epileptic activity, due to the interconnected relationship between academic and societal pressures and an individual's stress levels. Interview participants identified the reasons why they felt immense academic and societal pressure, further triggering an epileptic response, one interviewee described the highly competitive nature of schools in the Greater Houston area as "stressful and mentally draining, which they felt had a negative impact on one's stress levels, causing them to experience more seizure activity in a time filled with high academic and societal pressures." Overall, although academic and societal pressure may not have a direct link in facilitating an increase in epileptic activity, the interconnected relationship between academic and societal pressure and stress allows them to be perceived as a "trigger" that puts adolescents with epilepsy at an increased risk for facing an increase in the facilitation of epileptic activity.

Conclusion

The present study tested whether the presence of sleep deprivation and stress facilitates an increase in epileptic activity among juveniles diagnosed with epilepsy, specifically from the ages of 5 to 18. Adolescents with epilepsy answered a questionnaire and were interviewed to find this information. The results indicate that 100% of the adolescents who experienced an increase in epileptiform discharges held an increased presence of either sleep deprivation or stress during that time period. In opposition to the increases in epileptic activity in the presence of sleep deprivation or stress, some reported increases despite being well-rested and stress-free, proving the correlational relationship between sleep deprivation and stress and the increases in epileptic activity.

Limitations

The conducted research was only partially conclusive for a few reasons. Firstly, the conclusion reached on the correlational relationship between sleep deprivation and stress and the increases in epileptic activity was based primarily on the extent of the information the respondents provided within their questionnaires and how in-depth the 5 interviewees went into their observations. Variances in the depth of the responses from the respondents and interviewees proved to be a limitation, as many participants often summarized their experiences, thus not allowing an in-depth interview into the multitude of causes for the increases in epileptic activity. In-depth responses and interviews from the adolescents would have yielded a more accurate interpretation of the relationship between sleep deprivation and stress and the increases in epileptic activity, and whether sleep deprivation and stress provoke these increases or have a correlational relationship.

Second, some hospitals contacted weren't willing to hand out the questionnaire to participants that fit the criteria, thus posing a limitation as the initial sample size had decreased, which causes the study to produce specified conclusions rather than general ones that could apply to a larger population. In total, about 6 hospitals were contacted and only 3 were willing to pass out the questionnaire. Despite the 3 hospitals that handed out the questionnaire, only 47 adolescents were willing to participate from all 3 hospitals, which was the number of people that answered my questionnaire. Had I increased my sample size and contacted more hospitals, more interviews and questionnaires could have been conducted and analyzed to determine the relationship more accurately between sleep deprivation and stress and the increases in epileptic activity. The other goal of this study was to analyze other factors that influence increases in epileptic activity, which the data collected presented would require a more in-depth and structured approach. Had there been more participants in the study, it would have been possible to deduce the other factors at play.

Another factor was the limit on the interview time. Whilst planning interviews, I often had to work around the interviewee's schedule to obtain the information needed from the interview and aid in my analysis process. However, with the participants being adolescents in school, they had a variety of extracurricular activities making it difficult for them to sit down and talk for an extended period of time, therefore leaving me with a limited amount of interview material to interpret and analyze to better understand the relationship between sleep deprivation and stress and the increases in epileptic activity. This posed a limitation because most interviewed adolescents didn't give specific enough information that offered deeper information or insight to work with.

Further Research

In continuation with evaluating other factors that influence increases in epileptic activity, one observation that didn't get included was the variances in triggers for epileptic activity among various age groups. To explain the large difference in statistics, present among triggers for increases in epileptic activity among a population of adolescents compared to a population of adults with epilepsy, it may seem that the idea that sleep deprivation and stress correlate

with increases in epileptic activity is more common with older adolescents and adults rather in kids in elementary school. A majority of respondents and interviewees who reported sleep deprivation and stress tended to be in middle school or high school, which explains why there were so many participants who experienced an increase in epileptic activity when these factors were not maintained.

Conducting research including a variety of age groups examining the relationship between sleep deprivation and stress on epileptic activity would be a potential next step in evaluating the relationship between sleep deprivation and stress and increases in epileptic activity as it can allow for the development of more age-specific treatments for epilepsy through determining specific trends present in certain age groups rather than generalizing treatment for all individuals with epilepsy.

Applications

The area of epilepsy research continues to grow with every addition of information from researchers. One potential application that this study can lead to is the recognition of more studies that involve an equal number of epileptic individuals in a sample from a wide variety of age groups to better understand epilepsy. Additionally, there could be further research that builds on why sleep deprivation and stress correlate with increases in epileptic activity.

Another significant way in which epilepsy research on adolescents is applicable is with future developments in treatments dedicated toward juvenile epilepsy. From the collected information and the body of knowledge previously presented on the topic, it would seem there are variances in the triggers of epileptic activity among various age groups. With this research, there may be future changes in epilepsy treatment itself to better combat the various epileptic triggers seen throughout different age groups. Additionally, seeing as Epilepsy is a complex neurological disorder, further exploration within the field of sleep medicine and epilepsy will allow various unknown aspects and connections related to epilepsy to be discovered, giving researchers a better understanding of the neurological disorder as a whole. The information found from this research study will hopefully be a useful addition to the existing body of knowledge on epilepsy and its triggers, specifically situated within an adolescent population.

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