Sports, Exercise, and Health Sciences
Extended Essay

The Impact of Supplemental Melatonin on the Sleep Cycle

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Introduction

How does the human brain interact with medications during a stage of rest? One common topic concerning sleep is that of dreaming. Often, the term "dream" describes a goal that is difficult to attain. Since the word dream is polysemous, it can undermine the aspect of the word in a sleep context. In regards to slumber, a dream occurs within the mind during sleep as numerous things such as thoughts and images pass through to create a storyline ("Dream"). Many different factors contribute to dreams, including supplemental medicine and the number of hours slept (Roland).

As sleep plays a vital role in keeping individuals healthy, it should be a priority to know what role medications play in slumber. All medications including sleep medicine (as well as in general) have to be approved by the U.S. Food and Drug Association ("Unapproved Drugs"). The implication of using sleep medicine to induce specific types of dreams is a particularly underfunded and understudied topic in the field of medicine. Supplements, especially melatonin may affect not only the type of dream but also the number of dreams that a person may have.

Melatonin is a natural hormone found in the human body. It is produced by the brain when in darkness ("Melatonin: What You Need To Know"). However, some people use supplemental melatonin when experiencing jet lag or changes in work shifts. Evidence suggests that although melatonin is a helpful sleep aid, there is little research compared to other sleep medications about the drug itself. These unknown areas include the dosage (how much one person should take) and how it is not a regulated medication. Information regarding the effect of melatonin is not prevalent concerning the number of images a person sees each night.

Thus, this paper will examine, *to what extent does taking supplemental melatonin impact the number of dreams experienced each night?*

The question will be addressed through the investigation of the overall implication of melatonin on the human body in addition to how the sleep cycle works. A variety of academic studies will be consulted for the research aspect of the essay and will be further analyzed. In addition, professional doctors within the field of sleep medicine will be contacted in regards to the topic of investigation.

The question being covered in this essay will be studied in the area of Sports, Exercise, and Health Sciences, specifically Health Sciences. Health Sciences is the concept of how medicine is practiced and administered to individuals through the "application of science, engineering, mathematics, and technology" ("What Is Health Science?"). The topic will address how our bodies, specifically our brains, function during periods of rest.

Methodology

Taking supplemental melatonin increases the amount of rapid eye movement (also referred to as REM) occurred in each sleep cycle that a person experiences every night; therefore, resulting in additional unconventional dreams. REM sleep is when one's brain activity is functioning very high, almost as if one were awake when sleeping, thus resulting in intense dreams ("Sleep Basics"). The subject being investigated is composed of three principal points: melatonin, dreams, and rapid eye movement.

A prominent focus in the investigation is that melatonin plays a notable role in the functioning of the human body, whether in natural or supplemental form. Scientists learned melatonin is linked to being able to recall memories more effortlessly as well as process them faster; in their experiment, they tested the hypothesis of melatonin improving brain power on mice. The mice were shown objects for the same amount of time and then given melatonin. The next day, the mice that took the melatonin were more successful at remembering the object that they had seen the day before (Dental University and Tokyo Medical). This study looks at melatonin from an educational standpoint, not just a medical one, thus offering different viewpoints on why this drug could be beneficial in more than one intended way.

In addition, when melatonin is ingested in supplemental doses, it produces a change in the human body and is academically proven to increase and be the causation of vivid dreams during the sleep cycle (Zaleska). Furthermore, vivid dreams tend to typically span over a short period, thus increasing both the length of the sleep cycle and the number of cycles that occurred. Due to the increase in sleep cycles from supplemental melatonin, the body experiences more time in the REM stage, causing an increase in dreams. Concise dreams and an increase in the

REM stage of sleep contribute to how melatonin triggers the body to have an abnormal amount of dreams when taken.

The question addressed will be answered with a variety of sources from a multitude of networks. Prominent medical institutions such as John Hopkins and the Mayo Clinic help develop a base understanding of knowledge. Then smaller, specialized doctors will be consulted, including such as Dr. Alex Dimitriu, a board-certified psychiatrist who specializes in sleep medicine. The research and studies that factor into this investigation are already available, but they have not been connected. This essay will bring several diverse sources to introduce a new medical/ health science idea into the field.

To come to a consensus on the area being examined, assumptions regarding the research will be made. One essential assumption is that all melatonin is the same chemically, regardless of the brand or dosage; the brand and dosage are not specific to the research question, therefore, all melatonin in the study is assumed to be the same composition. Another assumption made is that when referring to the effects of melatonin on an individual, that individual is a healthy, functioning member of the society with no pre-existing tolerance to melatonin. This means that the individual could have taken melatonin on an occasional basis, but not on a routine basis. Therefore, the individual would not have any unnatural immunity to melatonin.

Basics of Melatonin

The main focus of the research is explaining how the dots can be connected from supplemental melatonin to vivid dreams to an increased number of dreams; however, to fully understand how the process of an increased number of dreams works, one has to understand the medical mechanics behind melatonin.

Melatonin plays a key role in the functioning of the human body and the processing of dreams. Melatonin is a natural hormone that is released into the bloodstream after being produced in the pineal gland in the human brain (Suni). Melatonin helps promote sleep while putting the user in a state of quiet wakefulness ("Melatonin for Sleep: Does It Work?"). Moreover, on the functional side, the production of melatonin along with its release is correlated to what time of day it is which is controlled by each person's circadian rhythm ("Melatonin"). Melatonin is not just a natural hormone, it can also be produced synthetically in a laboratory. The effects of melatonin are the same regardless of if it is natural or artificial as both promote healthy sleep cycles.

The uses of melatonin are various; melatonin has a wide array of uses ranging from curing jet lag to insomnia as well as helping with high blood pressure ("MELATONIN: Overview, Uses, Side Effects, Precautions, Interactions, Dosing, and Reviews"). Melatonin has many different purposes, including some outside of the sleep field; it has formally been referenced as a drug administered to help regulate sleep, but recently has been looked into regarding its possible use to help cure memory diseases such as Alzheimer's and Dementia (Auger). It has lately been unveiled that melatonin may provide memory boosters that help to prevent cognitive decline (Dental University and Tokyo Medical). This would make waves in the medical community, but additional research is required to come to a complete consensus if

melatonin would be at all effective when treating diseases regarding memory loss. This would enable memories and images to be processed faster each night when supplemental melatonin is taken. This allows the body an opportunity to experience more dreams each night, however, other factors can influence the impact of melatonin on the human body.

Although melatonin is one of the most commonly used over-the-counter supplements, there is only a handful of studies on the effects of smaller doses of melatonin on individuals. For example, when a person is experiencing jet lag from traveling or a quick, one-time occasion shift in a work shift, it is recommended by nurses and sleep medicine specialists to use low doses of melatonin supplements (Goldfarb). Another topic that has been looked into is one addressing rest regulation concerns: “experts suggest taking 0.5 milligrams two to three hours before bed” (Goldfarb). These two recommendations (for jet lag and sleep regulation) are both reinforced by Behavioral Health Nurse Practitioner Ann Pressler. Concerning dreams, the dosage of melatonin has not been looked into yet. It is possible that depending on the dosage of melatonin a person ingests before bedtime, it could impact the number of sleep cycles they experience positively or negatively (meaning a person could have more or fewer sleep cycles than normal).

However, there is less research regarding high doses of melatonin. “It should be noted that most research has only tested melatonin levels up to 12mg, so the risks of taking melatonin at much higher doses are largely unknown” (Likarish). Since there is not a lot of research done on large doses of melatonin in general, it is harder to study/ investigate the implication and side effects of melatonin on a large scale in regards to the aspect of dreams. A higher dosage of melatonin could potentially mean more dreams or less, but until further research is conducted the effect of dosage amount on dreams is unknown.

There are two different side effects when regarding supplemental drugs: short-term and long-term. It is easy to study and learn the short-term side effects of a drug such as melatonin because they present themselves shortly after the supplemental drug is administered. Some of the common short-term side effects of melatonin are dizziness, nausea, drowsiness, and headaches ("Melatonin"). Furthermore, if too much melatonin is taken, then short-term side effects can include reduced focus and feeling cold/ chilled (Presser). Nevertheless, the most important side effect is melatonin's ability to invoke vivid dreams (Jewell). While vivid dreams are an essential side effect of melatonin, there is still limited research on the long-term effects

The long-term effects of melatonin are still hardly known to doctors since melatonin is an over-the-counter-drug and has not had any grave/ deadly side effects reported by users. In addition, melatonin is only supposed to be used for a short period(one or two days, not more so than a week straight), and therefore, as a result, its long-term effects have not been studied and deciphered ("Melatonin). Even the government does not always know the full extent of melatonin, regardless of its relation to dreams. "The possible long-term side effects of melatonin use are unclear" ("Melatonin: What You Need To Know"). Although a multitude of side effects are unknown, some of the most vital research has concluded that there is a correlation between melatonin and vivid dreams.

Taking supplemental melatonin, even if in a very small dosage, can lead to a large enough change in the body's natural melatonin levels to cause an increase in memory cognition and REM sleep and thus vivid dreams; in unison, an increase in vivid dreams and REM are directly linked to an increase in dreams each night.

Vivid Dreams and Sleep Cycles

The sleep cycle is an essential part of human functioning as, without it, humans would not be able to survive. Within the sleep cycle, dreams can occur and some happen at faster rates than others, leading to more time for other dreams to take place. Within the topic, there are some outside things that can influence the sleep cycle including sleep medicine, specifically melatonin.

A result of taking supplemental melatonin is the occurrence and causation of vivid dreams. Dreams are very important parts of nighttime routines. Every human goes through the four cycles of sleep and particularly the fourth stage which dreaming occurs. Melatonin invokes an increase in rapid eye movement sleep, which is when most vivid dreams occur. However, vivid dreams are not the only dreams that a person may experience. In addition, there are also lucid dreams too, but many still do not fully comprehend the differences between the types of dreams.

When classifying the type of dream, it falls into one of two categories: vivid or lucid. The main difference between lucid dreaming and vivid dreaming is that vivid dreams often feel realistic and like real-life memories, as well as being easy to understand where oneself is ("Dreams: Why We Dream & How They Affect Sleep"). On the other hand, in the case of lucid dreaming, although the sleeper is actively aware of their whereabouts of dreaming, they do not leave the dream situation (Pacheco). In addition, there are external factors that can cause each dream, such as sleep supplements and medications.

Dreams (both vivid and lucid) occur after one to two hours of slumber when an individual reaches the fourth stage in the sleep cycle, REM ("Stages of Sleep"). There are many complex features in the brain when dreaming so best to break down the sleep cycle by each individual stage. As an overview, there are two fundamental varieties of sleep: rapid eye

movement (REM) and non-rapid eye movement (non-REM). There are three stages of non-REM sleep and one stage of REM sleep (Dresden). Altogether, there are four stages that make up the sleep cycle, and the average person experiences this sequence anywhere from four to six times each night (Suni).

The first stage of sleep is the first of three non-REM stages (Dresden). This stage on average lasts around five minutes. It is the transition period between being awake and slumber so thus it is easy to wake an individual up during this stage (Felson).

The second stage in the sleep cycle is also a non-REM stage which is where the body is preparing itself to transition into a deep sleep (Dresden). The body adjusts to its surroundings by having the heart rate and body temperature of each individual drop during the second stage. This stage lasts anywhere from 20 to 25 minutes in time (Felson).

The third stage of the sleep cycle is the last stage of non-REM sleep and provides many benefits to the body. This is the regenerative stage of the sleep cycle that allows a person to feel refreshed in the morning when they wake up (Dresden). The third stage lasts about 20 to 40 minutes and is when an individual is in a deep stage of sleep. The body repairs itself in this stage by building muscles and bones as well as regrowing tissue (Felson).

Stage four marks the last stage of the sleep cycle as well as the stage in which REM occurs (Dresden). During REM, vivid dreams are more likely to transpire as they are noted as "prolific and intense" during the fourth stage ("Dreams: Why We Dream & How They Affect Sleep."). These intense dreams are a result of the brain being stimulated in areas that assist with learning and the assembly of proteins (Felson). Furthermore, since most dreams occur in the REM stage, the body is temporarily paralyzed in the arm and leg muscles to prevent individuals from "acting out" during the time period of their dream (Dresden). The fourth stage lasts

anywhere from 10 minutes during the first cycle of sleep up to 60 minutes during the last cycle of sleep each night; the number of sleep cycles an individual has is directly proportional to the amount of time spent in REM (Felson).

There are many factors that can play into how much time a person spends sleeping each night as well as how much time a person spends in each stage of the sleep cycle. One of the most common influencers is sleep medicine such as melatonin.

Melatonin is a known medication that will increase the amount of time that an individual spends in the fourth phase of the sleep cycle which is also known as the REM stage. A clinical study conducted by *The Journal of Clinical Endocrinology & Metabolism* found that the indication of melatonin "did increase REM continuity" (Kunz). This experiment was performed twice on 28 people in total, all of which scientifically proved that taking supplemental melatonin will allow one to spend more time in the REM stage of sleep each night. This is one of the main studies that has been done linking melatonin to REM sleep, however, more clinical studies are in the works as of summer 2021 in regards to this topic.

Since REM is proven to cause vivid dreams, a result of the increase of time spent in REM means an increase of vivid dreams. As vivid dreams are typically shorter than lucid dreams, more vivid dreams are able to take place when REM is increased. Because melatonin has been shown to increase REM, it indirectly increases vivid dreams (Kunz). During the fourth stage of sleep, vivid dreams tend to be unusual as well as involve factors of "waking life" ("Dreams"). Overall, melatonin helps to increase the amount of time spent in REM as well as increase the vividness of dreams.

Taking supplemental melatonin will impact the type of dreams that one has, but this does not account for the possibility that dreams still may not be remembered until later in the day or

even at all. Melatonin in many cases is the cause for an increase in vivid dreams, thus the number of dreams experienced; however, in some instances (not often occurrences) lucid dreams can occur while taking melatonin as well (they take place less often).

Melatonin to REM to Dreams

Melatonin causes an indirect increase in dreams through its production of REM sleep. There are scientific sources that have studied the effect of melatonin on REM sleep; their findings were that when patients were given melatonin rather than the placebo, those patients had a substantial increase in the REM sleep percentage (Kunz). REM is known for being the deep sleep stage along with the stage where most dreams transpire.

Primarily, people dream when they reach the fourth stage of sleep, REM, however, one can experience less memorable dreams in stage three (Dresden). REM is the main time when vivid dreams occur, typically lasting anywhere from 20 to 25 minutes on average (Walker). Lucid dreams on the other hand can last up to an hour and have been questioned if they take place in the fourth stage of sleep (Martins). Therefore, since the REM stage can only last up to 90 minutes and vivid dreams are more prevalently observed in the fourth stage (in addition to being faster than lucid dreams), the number of dreams experienced each night should increase when supplemental melatonin is taken.

Even though the implications of supplemental melatonin affect everyone by more time in REM each night, other factors play a role in the number of dreams an individual experiences nightly. One factor that contributes to the number of potential dreams each night is the age of the human. For instance, someone who spends a long time sleeping is more likely to experience more stages of REM, therefore, having a higher chance of having more dreams. An infant needs about 16 hours of sleep each day whereas adults need on average seven to eight hours a day (“Sleep Basics”). One can infer that since an infant spends more time sleeping than an adult, they should process more dreams each day. Time is one of the main factors that influence dreams as well.

Although different factors can play a role in the number of dreams an individual has nightly, the effect of taking supplemental melatonin is assumed to be the same across all patients. When melatonin is taken, it causes an increase in REM sleep which correlates to vivid dreams. Vivid dreams are typically shorter than other types of dreams, therefore it can be reasonably deduced that more dreams take place when supplemental melatonin is taken.

Conclusion

Melatonin causes an increase in rapid eye movement (REM) during sleep which is the stage responsible for producing dreams. An increase in REM is directly correlated to vivid dreams, which are very realistic ("Dreams: Why We Dream & How They Affect Sleep"). On average, vivid dreams last anywhere from 20 to 25 minutes and thus making the sleep cycle faster (Walker). There have been many inquiries about suggested amounts of melatonin to take and how it would affect each stage of sleep, but due to the U.S. Food and Drug Administration deeming it an over-the-counter drug, the studies have been limited as it is not deemed as the primary cause of concern within the medical field. The results of many studies regarding the increase of dreams due to melatonin have been far limited and inconclusive. A vast majority of the work revolving around melatonin and dreams has been done, but the uniting of these studies and points has not been conducted. However, with scientific research already done and with some connecting of the dots, it can be confirmed that taking any dosage of supplemental melatonin will increase the number of sleep cycles each person experiences a night, therefore increasing the number of dreams that are able to occur each night.

An increase in nightly dreams occurs when supplemental melatonin is taken due to the increase in vivid dreams from more consistent and frequent full rotations of the sleep cycle.

Overall, the human brain is a complex part of the human body; it is an intricate piece and can be molded and influenced by many different substances and drugs such as melatonin. Different substances have a variety of effects on the brain, good and bad. In addition to the complexity of the human brain, during sleep there becomes more intricacy; there are many different stages of sleep, the REMt stage specifically when dreaming occurs. Although it is a

very complicated task to dive deeper into the brain's inner workings, with more research and clinical studies, the brain is slowly becoming more studied and understood on a deeper level.

In order to gain more insight into the question, recommendations of more clinical studies would be recommended. Things such as taking a test group and alternating between variables could impact exactly how many dreams can occur each night. One possible factor would be the dosing of melatonin, also referred to as how much in milligrams that an individual takes of a drug (before bed each night in the case of melatonin). In a study reviewing the effects of the amount of supplemental melatonin, the dosage amount given to each every night would be altered on occasion and then clinical patients would have their sleep patterns recorded and analyzed by specialists in the sleep medicine field. For further investigation, the FDA needs to look into not just the side effects of melatonin but the implications of melatonin on age, gender, weight, height, medical history, and other important health factors. Many of these areas have little importance in regards to melatonin from the Food and Drug Administration because it is known as a safe drug, with no known overdoses or deaths attributed to it. This makes it particularly hard to study as it is not a necessary area of study in the medical field to live. However, if these areas were looked into, it could influence how we can control the number of dreams we have each night.

In conclusion, melatonin is a very useful supplement that is versatile and can be used by a variety of people, however, it does come with implications. Melatonin causes an increase in the rapid eye movement stage of sleep, therefore causing dreams, specifically vivid, thus invoking a faster sleep cycle allowing there to be more dreams experienced by each nightly.

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