Waking up to the Possibility that Sleep Deprivation May Contribute to the Onset of Alzheimer’s Disease

**Tag Words:** Alzheimer’s disease, chronic sleep deprivation, Beta-amyloid plaques, tau tangles, REM sleep, sleep quality, caffeine.

**Authors:** Sirani Miller, Jamal Perkins and Julie M. Fagan, Ph.D.

**Summary:** Get your zzzzzz’s! Several scientific investigations now show that a lack of sleep may contribute to the development of beta amyloid plaques and tau tangles in the brain. Beta-amyloid plaques and Tau tangles make communication in the brain’s neurons difficult to do, which in time can lead to cell death and brain shrinkage and Alzheimer’s Disease. To bring awareness to the possible sleep deprivation-Alzheimer’s connection, we answering Alzheimer’s related questions on the question-based websites Yahoo Answers and Quora, and have submitted commentary on this issue to The Huffington Post and to a research team at Harvard Medicine.

**Video Link:** https://youtu.be/ltAOpn3ZEKo

**The Issue: Will poor sleep make me more prone to getting Alzheimer’s disease?**
People in America and all over the world are getting less and less sleep. Relatively recent research studies have shown is that sleep is not only essential for survival but that a lack of sleep appears to be associated with the development of Alzheimer’s disease (AD). People need to be more aware of the importance of sleep quality and quantity and make lifestyle changes to get the sleep needed to maintain good health.

**What is Alzheimer’s disease? (JP)**
Alzheimer’s disease (AD) is a neurodegenerative disease which, according to the Alzheimer’s Association, is the most common cause of dementia. Dementia is an umbrella term describing a set of symptoms regarding memory loss and the inability to perform everyday activities. As of today, it makes up between 60 - 80% of all dementias in all age groups. It should be noted that out of the 5.3 million Americans who have AD, 5.1 million of these people are 65 years of age or older (1). The end result of AD is typically brain cell (neuronal) death, and finally human death. Some clinical manifestations that can help determine if someone has AD are agnosia (loss of sensory perception), the inability to understand the meaning and use of different objects, and the inability to use words comprehensively (1). There are treatments available to treat these symptoms; some of these treatments (drugs) target the problems of sleeplessness, agitation, wandering, anxiety, and depression (2). Other drugs are classified as acetylcholinesterase inhibitor, which has been shown to slow down the progression of the illness (1). It has been shown that those who have AD lose most of the neurons that fire off the neurotransmitter
acetylcholine (3). These particular neuronal cells are termed cholinergic neurons, and it is believed that the brain chemical acetylcholine may be crucial for maintaining one’s memory (1).

When it comes to diagnosing a person with AD, neurological and psychiatric evaluations are used to determine if a brain defect has developed. It is believed that doctors can correctly diagnose Alzheimer’s disease as high as 90% of the time if the correct tests are used. These tests include brain scans, urine, blood, or spinal fluid results, tests to measure memory, problem solving, attention and counting, and asking questions about the person’s general health. Past medical problems, and the ability to carry out daily activities are also used in the evaluation process (1). With all of this being said, it should be noted that once somebody develops AD, they cannot be cured. To add onto this, when the brains of recently deceased people were checked, the pathological structures that categorize AD were observed as well (1). The distinguishing feature about these deceased people was that they showed no clinical signs or symptoms of AD; suggesting that the relationship between these structural precursors and AD are not consistent in every person.

Characteristics of Alzheimer’s disease: Beta-amyloid plaques and tau tangles (SM)
What distinguishes Alzheimer’s from other cognitive disorders is the formation of amyloid plaques and tau tangles. Beta-amyloid (starch-like) plaques are aggregated masses of the protein amyloid-beta peptide (usually denoted Aβ), which is found on the fatty surface membrane of nerve cells. Theses plaques, especially in larger amounts, lie in between nerve cells and their synapses, which inhibits the neuron’s most important functions including synaptic signaling and may even activate immune cells to destroy nerve cells (3).

Tau tangles are another key characteristic of Alzheimer’s disease. Tau is a protein that travels along “tracks” called microtubules, found along the axons that run the length of nerve cells in the brain. These proteins are responsible for stabilizing microtubules to allow axonal transport, in which other proteins carry the cell’s organelles and nutrients to and from its cell body. Beta-amyloid plaques also interfere with tau proteins, and when the plaques react with tau, the tau proteins fall off of the microtubule tracks and accumulate to form neurofibrillary tangles. With both of these structures forming in the brain, they prevent the nerves cells from staying nourished, communicating with one another, and accommodating for early damage. Thus, as the disease progresses, more nerve cells die and the individual experiences extreme memory loss, changes in behavior, and inability to perform simple motor tasks (3).

Who does Alzheimer’s affect? (SM)
Alzheimer’s is typically diagnosed among people 65 and over, and in 2015, an estimated 5.3 million Americans of all possible ages had Alzheimer’s. About 96% of all Alzheimer’s patients are 65 and over while around 200,000 (around 4%) people are 64 and younger. (4). There also happens to be a higher prevalence of the disease among men than women, however this is
common for most chronic diseases because women tend to have longer lifespans on average, and thus are more likely to contract a chronic illness. However, in the case of Alzheimer’s, there may be other biological factors than can contribute such as ethnicity, family history, chronic disease and results from brain trauma (4).

Misconceptions: Normal Aging vs. Alzheimer’s Disease (SM)
While the mechanisms leading up to the brain damage caused by Alzheimer’s are still being understood, it is definitely known that Alzheimer’s is not a normal part of aging. Many people, who are concerned for their loved ones as they enter old age, tend to confuse Alzheimer’s with normal aging, or assume that a family member has the disease when they are actually just aging normally.

During normal aging, one’s intelligence remains intact, but brain cells and cell communication become less plastic overtime. For example, one may find it difficult to remember names of acquaintances or details of events or conversations that happened over a year ago. However, someone with dementia cannot remember details of more recent events or conversations and cannot recognize their family members. In fact, someone aging normally is aware of their memory problems and is concerned, but someone suffering from dementia is typically unaware of their memory loss (5).

The extreme cases of memory loss caused by dementia and Alzheimer’s can be accounted for by the extreme amount of nerve cell damage in the brain. When looking at a healthy person’s brain and comparing it with that of someone with Alzheimer’s, the sulci (grooves) and ventricles (cavities housing fluid) in the brain are widened and the overall size of the brain is much smaller than a healthy brain (6). As the disease progresses, the brain shrinks even more, which causes more gradual loss in memory and basic motor function. The complications of advanced Alzheimer’s can be fatal as people become disoriented and eventually forget how to do things as simple as eating or walking. (7)

Complications and Setbacks of Alzheimer’s Research (SM)
The fact that Alzheimer’s disease is chronic and that its symptoms are very progressive, it is difficult for physicians to detect and often goes undiagnosed. Only 45% of people or their caregivers are aware of their diagnosis of Alzheimer’s by a physician (4). The only guaranteed way to tell that an individual has the disease is with an autopsy. Technology and procedures are being tested and developed as new data and discoveries are underway (8). Unfortunately, however, Alzheimer’s disease remains to be incurable, unpreventable, and irreversible.

What are the causes of Alzheimer’s Disease? (SM)
According to the Alzheimer’s Association, only less than one percent of Alzheimer’s cases are the result of genetic mutations, which would contribute to early onset Alzheimer’s disease that
can be diagnosed in people under the age of 65 (4). Other risk factors are considered modifiable, meaning that individuals can take the necessary measures to reduce risk on their own. Such factors include cardiovascular disease, diabetes, and Mild Cognitive Impairment (MCI), which can be influenced by chronic sleep deprivation (4). While maintaining a healthy lifestyle (i.e. eating a well-rounded, balanced diet and regular exercise) is essential for overall physical and mental stability, one of the main contributors to impaired cognitive function is consistent lack of sleep.

**Importance of sleep for optimal brain function**

**The purpose of sleep (SM)**

Sleep is crucial for memory restoration and retention, and since about one-third of a human’s life is spent sleeping, it is important that it be understood and appropriately scheduled in order to perform with the utmost efficiency in the two-thirds of our awake and active time spent. Understanding how important sleep is for the human body can be shown with experiments and everyday accounts of sleeping less for short periods of time. Even with around 24 hours of sleep loss with a week (about 5 hours each night), subjects in sleep studies show significantly decreased ability in problem solving, reaction time, verbal creativity and cognition (9). Differences in physiology can be seen in just a 24-hour period of no sleeping with an increase in impulsive behavior and decreased reaction time. After about 48 hrs. of no sleep, declines in efficient immune function can be seen in healthy individuals, as well as a decrease in glucose metabolism (10). One of the major public health problems caused from lack of sleep is “drowsy driving”: people who slept an average of 5.2 hours a night have reported falling asleep while driving, and drowsy driving. In 2013, drowsy driving was responsible for 700,000 car accidents, with up to 6,000 fatal accidents per year (11). People who are more likely to drive sleepy, aside from those with sleep disorders, are those who work late shifts and commercial drivers, such as bus drivers or truck drivers (11). This gives us insight as to how sleep refines attentiveness and overall body performance in day to day life, but also that common lifestyle and culture can influence one’s activities during day and night times that result in sleep deprivation.

In terms of dissecting the process of sleep itself, there are different stages of sleep, and each stage serves a different purpose. The four stages of sleep are NREM-1, NREM-2, NREM-3, and REM (rapid-eye movement) that repeat in approximately 90-minute cycles. NREM-1 is more of a wakeful state, lasting one to seven minutes, in which a person begins to nod off (12). NREM-2 shows higher voltages wave on an EEG (electroencephalograph) called sleep spindles showing bursts of brain activity, and in this stage someone becomes less responsive to external stimuli (12). Out of the four stages of sleep, the most beneficial stages of sleep are the NREM-3 (NREM standing for non-rapid eye movement) stage in which slow waves are observed on an EEG, and REM, which is associated with more rapid brain waves and dreaming. These stages are hypothesized to decrease synaptic activity to allow more plasticity and bodily repair, which
happens during NREM-3, or adjustments in neural gap junctions, to cleanse certain regions from irrelevant information facilitate long-term memory, which occurs during REM sleep. (13).

**Quality vs. Quantity? (JP)**

Over the years, researchers have found that there is a strong link between the lack of sleep in the elderly, and the risk for developing Alzheimer’s disease (14). What has been debated for the most part is whether it is the quality of sleep or the quantity of sleep that affects beta plaque formation. Based on the current data, there is a strong indication that the quality of sleep (i.e. sleep disturbances) affects the deposition of beta amyloid plaque formation. Most of the studies that have been performed so far have been in people 50 years of age and older. In terms of memory, it has been shown that lack of sleep and poor quality of sleep causes a reduction in synaptic plasticity and memory processing (15).

It seems that the reason sleep is so important for brain health is due to the fact that when humans are sleeping, the metabolic toxins that build up between the cerebrospinal fluid and interstitial fluid are removed (14). These toxins are removed twice as fast during sleep than if the person were awake. To give an example, the results of a previous study where a group of healthy young men were sleep deprived for one night resulted in higher blood concentrations of neurodegenerative proteins (14). Another observational study performed in 2014 75+ year old Swedish men showed that a reduction in sleep duration meant a two-fold increase in AD risk (14).

It should be noted that all of these studies are associative, meaning that it has not been shown that poor sleep duration alone CAUSES AD. As explained earlier, scientists have several potential hypotheses that try to explain why poor sleep quality/quantity results in greater AB deposition. Another hypothesis that has been brought up is that as the brain utilizes glucose for its own energy, metabolic toxins such as hydrogen peroxide begin to accumulate. It is the hydrogen peroxide that is toxic to the nerve cell, and what ultimately leads to neuronal death. While these hypotheses are still being tested to differentiate between cause vs association, what is known for sure is that poor sleep volume in anybody can alter not only one’s physiology, but psychology (i.e. mood) as well. More sleep is better than less sleep.

**How much sleep do adults need vs. what adults usually get? (SM)**

Throughout adulthood, including young adulthood, people should be getting 7-9 hours of sleep a night, according to the National Sleep Foundation. Sleep disturbances, such as sleep apnea and insomnia, can contribute to the decline in total hours of sleep needed, and those disturbances can be developed from drug use, work, and lifestyle, which will be discussed later (16). In sleep studies, individuals that sleep about 8 hours a night on average show much higher performance and scores on cognitive tests compared to experimental groups, who have either fallen asleep during experiments or displayed similar cognitive limitations as someone considered legally
drunk after nights of 4 hours and 6 hours of sleep, respectively. With gradual decreased hours of sleep, for example regularly sleeping 5 hours a night over several months, can make it difficult to make up for the hours lost, which leads to what has been referred to as “sleep debt” (17).

According to a 2014 documentary entitled *Sleepless in America*, created by National Geographic and the National Institutes of Health, about 40% of American adults are sleep deprived (18). Also, in a 2014 study, the hours of sleep per night for Americans between 13 and 32 years old were recorded, and it was found that an increase in participants reporting sleeping less than 6 hours a night from adolescence into adulthood (19). This information was to highlight that a shift in lifestyle, other than biological changes, most likely occurs that around early adulthood. If poor sleeping habits are consistent from then on, and if it becomes relatively normal amongst the young adult demographic, it eventually contribute to a more drastic decline in cognition that relates to the development of Alzheimer’s disease.

**How does lack of sleep relate to AD?**

**Poor quality sleep is associated with an increased risk of dementia (JP)**

Scientists believe that when you are asleep, you get rid of the toxic metabolites that develop during the day. These metabolites can be found in the cerebrospinal fluid and interstitial spaces of the brain. Two metabolites that have been shown to increase after a short overnight sleep are neuron-specific enolase and nervous system protein S100 calcium binding protein B (14). The blood concentrations of these 2 metabolites have been found in people who show signs of brain degeneration, suggesting that poor sleep quality is linked to potential brain damage.

As of right now, there is only an association between poor sleep quantity and quality and the development of beta-amyloid (Aβ) plaques. There is no evidence of causality, meaning there are no studies that have proven that poor sleep habits “exclusively” create Aβ bundles. With this being said, one study has shown that when they adjusted for different variables, poor sleep quality and quantity was linked to more Aβ plaques causing damage (14). This goes to show that even though someone may not show clinical symptoms of AD, this does not mean that the biochemical markers are not developing at an early age.

**Causation vs Association (SM)**

It should be noted that since the research examining direct causation between chronic poor sleep and signs for markers related to Alzheimer’s disease (plaques and tangles) is more recent and still ongoing, there has not been any data so far that concludes sleep deprivation as a definitive cause of Alzheimer’s Disease. However, there are many studies that have examined the presence of plaques in the brains of individuals with sleep disturbances, with and without Alzheimer’s, and scientists are aware that there is an occurrence of molecular buildup around the brain, which can impair cognitive ability. Thus, there is reliable evidence in correlations found that can allow everyone to take sleep more seriously to reduce the onset of dementia later in life.
A team at Johns Hopkins University specializing in research about Alzheimer's amyloid-plaque buildup in relation to sleep have collected data that supports the relationship between an increase in beta-amyloid plaques as the result of poor sleep. In one experiment, seventy adults between 52 and 91 years of age answered questions on the length and quality of their sleep. Researchers then measured beta-amyloid deposits in the brain using PET (positron emission tomography) imaging (See Figure 1). They found that sleep traits associated with greater amyloid build-up included shorter sleep duration and poor sleep quality and that their results were consistent with those from animal research showing that sleep deprivation was related to increased amyloid beta level in interstitial fluid (20).
Researchers state that the pathogenesis of Alzheimer’s can begin 10 to 15 years before clinical symptoms first appear, and this information also allowed for research on middle aged individuals. This particular study involved a 22-year follow up to measure the impact of sleep on cognitive ability: Researchers studied sleep duration, sleep quality, and use of hypnotics in 2,336 middle-aged (mean age = 52.3 years) twins. Twenty years later (mean time = 22 years), investigators assessed the subjects’ cognitive function and found that lower cognitive scores were found in individuals who reported the short (<7 hours) or long (>8 hours) hours of sleep at midlife compared to 7-8 hours per day. The sleep survey was completed before preclinical AD pathology would be expected to develop, so researchers concluded that their findings support the hypothesis that sleep quality and/or duration impact the development of AD (21). While there is not a definitive answer to explain that sleep deprivation has a direct causation for Alzheimer’s disease, partly due to experimental constraints, what has been found currently is sufficient for our understanding of precautions that hinder the onset of the disease.

Sacrificing sleep for efficiency and social life in Western Culture

Siestas: What effects do they have on overall health? (JP)
Not only is sleep potentially good for optimal brain health, it can also be good for those with and without hypertension (22). In regions of the world like China, Spain, and Italy, taking naps in the middle of the day is common practice. This habit is generally referred to as a siesta, which in the Chinese culture is considered healthy. In these countries siestas usually occur during the afternoon, and usually during the hottest hours of the day. In a study conducted by scientists in China, 1175 elderly people were monitored during their siesta period for changes in their blood pressure levels (22). It should be noted that in the study, the average siesta period lasted 52 minutes, and over half of the participants stated that they took a siesta at least 3 times a week. What the results showed was that there was a significant association between siesta sessions and the reduction of systolic blood pressure levels. The only downside to this study was that they couldn’t prove cause-and-effect; that having more siestas for longer periods of time solely reduced blood pressure levels. Nonetheless, this study provides an example of why making rest and sleep should be made a top priority for long-term health.
Keeping daytime naps in mind, this is not to say that everyone is on board for this idea. For instance, there are some scientists that believe that daytime naps can result in restlessness at night, sleepiness in the daylight, and even depression and cardiovascular mortality (23). On the flip side, other studies have shown that daytime naps can improve cognitive health and even alleviate certain cardiac issues. With all of this being said, is seems that the jury is still out in regards to daytime napping and its role in health. On a personal level, it may be wise to get professional advice and guidance from a physician or sleep specialist.

**How does Caffeine play into this? (JP & SM)**

Caffeine is one of the most popular and successful psychoactive drugs in the world (24). One of the reasons for this is due to the fact that it is added into the many different foods and beverages consumed daily (25). These include soft drinks, coffee, energy drinks and shots, tea, baked products, and caffeinated alcoholic beverages. Based on an FDA study, between 2005 and 2006, the mean daily intake of caffeine was around 200 milligrams (25). During this same time period, the highest consumers of caffeine were males between the ages of 50-59; with males between the ages of 40-49 coming in second.

The main reason people around the world use caffeine are to stay awake. It has been shown that even with lack of sleep; consumption of high doses of caffeine can increase one’s alertness, attentiveness, mood, and excitability level (26). However, the lingering effects of caffeine last a long time, as it has a half-life of about 4-7 hours (12). Caffeine works by blocking the receptors of the neurotransmitter adenosine, which naturally builds up in the brain while one is awake and binds to its receptors to induce sleepiness at the end of the day. Caffeine’s structure is similar to that of adenosine, but it does not induce the sleepiness when binding to receptors, resulting in a wakeful feeling (26). The use of caffeinated products, especially when consumed at night, interfere with the onset of sleep and result in fragmented sleep, in which slow wave stages are shorter, and individuals can find themselves waking up in the middle of the night (12). The lack of deep sleep can also lead to grogginess when waking up in the morning, since the brain was hindered from complete repair. When people repeat the cycle of caffeine intake to relieve sleepiness, it can eventually lead to plaque buildup in the brain after enough years of consistent use.

**Increased Technology Use and Sleep Loss (SM)**

According to a 2013 study discussing the effect of sleep quality due to technology use, it was found that college students lost two hours of sleep each night on average with regular use of technological devices. Consistent accumulation of sleep debt can impair cognition and focus, along with the likelihood of induced anxiety and depression (27). This impact is important to consider not only for cognitive tasks in the short term, but also for the long term as increased technology use and sleep debt can decrease performance in tasks expected later in adulthood.
Part of what governs our ability to fall or stay asleep after using technological devices, such as smartphones and TV screens, is their effect on circadian rhythm. Circadian rhythm, also known as the biological clock, is a 24-hour cycle found in all living species that is influenced by light and dark patterns throughout the day. It is controlled by the Suprachiasmatic Nucleus (SCN) in the human brain, which is a group of cells located in the hypothalamus that contains biological clock cells that receive information from the optic nerve determining how much light the eye is being exposed to. These signals are integrated from the SCN to the corresponding parts of the brain that produce hormones in response to light cycles, such as gonadotropins (reproductive hormones), hormones that regulate body temperature and metabolism, and most importantly, melatonin, which builds up during the evening to elicit sleepiness (28).

The light emitted from digital screens, in addition to the general engagement in late-night technology use, has been hypothesized to influence the later bedtimes of university students in a 2015 study. Researchers conducted surveys of self-reported hours of sleep and bedtimes, along with keeping track of the duration and types of activities being done on the participants’ devices, such as reading, email, texting, listening music, and using social media. They found that the use of digital devices before hours of sleep contributes to instances of poor sleep quality or disrupted sleep, poor cognitive performance, and less sleep time (29). Another study focusing on digital technology use and sleep quality observed the effects ebooks had on their participants’ sleep patterns. They noticed that the amount of EEG theta and delta waves, which are characteristics of much needed slow-wave sleep, decreased and that melatonin levels were suppressed during the times participants were reading the ebooks. Sleep latency and decreased morning alertness were also observed in those who read ebooks at bedtime compared to those reading printed books (30).

**Helpful Tip from Experts on how to get a better Night’s Sleep (JP)**

In today’s world, especially Western civilization, there are self-help gurus popping up everywhere; added to this list are people who refer to themselves as “sleep coaches.” What these self-professed “sleep coaches” do is come to your house, evaluate your sleeping environment, and consult with you on how to change your surroundings for better sleep (31). According to Dr. Shalini Paruthi of the Pediatric Sleep and Research Center at St. Louis University, studies have shown that hiring a sleep coach for $75-$150 an hour doesn’t automatically guarantee results. In fact, most of these sleep coaches have never worked in health care before, and are not actually licensed to practice (31). Instead, Dr. Paruthi believes that anyone who is having issues sleeping should first go to their doctor and see if they can get referred to a therapist trained in cognitive behavioral therapy.

With all of this mind, there are several tips that actual experts have gathered to help people get a good night’s sleep (31).
**Morning:**
1. In order to set a good biological clock for the day, try to expose yourself to sunlight as early in the day as you can.
2. It is believed that exercises tires out the body, and makes it more prone to sleep better. The only warning that experts have given is to not engage in physical activity a couple of hours before bedtime. This will increase one’s alertness, and actually make it harder to sleep.
3. If you are a caffeine drinker, try to consume it 6 hours before you intend on going to bed. Coffee during the daytime is okay, though.

**Noon/Afternoon**
4. Try to get as much natural sunlight as possible throughout the day. Having sunlight exposure will make the body’s natural sleep-wake cycle stronger.
5. While it may seem hard to do, try to resist the urge for an afternoon nap. Even if you didn’t get a lot of sleep the night before, it’s best to stick with your normal sleep routine.
6. Try not to have dinner so close to before you go to bed. Experts say that dinner should be light, and alcohol can be consumed as long as you’ll be awake for a couple hours. Keeping this in mind, alcohol may increase the chances of waking up in the middle of the night.

**Night**
7. It turns out that electronic devices like cell phones and laptops emit blue light, which has been shown to lower the levels of the sleep hormone melatonin. It is advised that electronic devices be turned off 2 hours before bedtime. If using your device is of necessity, try to dim the light, and/or keep the screen a foot away from your eyes.
8. In order to get into the “mood” for sleep, try to dim the lights in your room an hour before. One can also read a book that is non-electronic, and have a warm, non-caffeinated beverage.
9. In order to fully concentrate and minimize any distractions, using earplugs, eyeshades, or turning on a fan can help one’s sleep.
10. Watching an alarm clock, or waiting for one’s cell phone to go off is bad for getting a good night’s sleep. It is best to try avoiding looking at the time. The best way to accomplish this is to place a cell phone or alarm clock far away from the bed. This way you won’t be tempted to reach for it and look at the time.

**Middle of the Night**
11. If you unexpectedly wake up in the middle of the night, and can’t go back to sleep after 20 minutes, experts say that you move to another room, and perform a relaxing activity. Once you feel yourself becoming tired again, this is an indication that you can go back to sleep.

Given that all of the facets of our culture; from our perception of the necessity of sleep to our fast-paced digital lifestyles, it is important that we all take heed on what needs to be done to improve our sleeping habits. Alzheimer’s is a serious, irreversible disease that, while not currently curable, should be made aware to us all if we expect to continue a similar lifestyle decades down the road.
Community Action
As our audience is very general and this problem applies to anyone at any age who is concerned about their sleeping habits and sleep quality, one way for us to reach out is to use question and answer forums to provide answers to a specific question regarding sleep deprivation and Alzheimer’s disease. The idea is that when people search for information on this topic on a search engine, such as Google or Bing, or on the site themselves, they will be directed to our answer with a similar question that we have created. We have posted our question and answer on Yahoo Answers and Quora. There, people can find an appropriate answer based on the information we have found. Our question and answer:

Q: Will poor sleep make me more prone to getting Alzheimer’s Disease?

A: Recent studies indicate that there may indeed be a correlation between chronic insufficient sleep and an increased risk of developing Alzheimer’s disease later on in life. Researchers at Johns Hopkins University found an increase in beta-amyloid plaques in those getting less than 6h of sleep. It is thought that chronic sleep deprivation can lead to a buildup of waste products including the plaques and tangles of certain proteins that are responsible for the onset of Alzheimer's disease. So, people should be more cognizant of their sleeping habits and work toward getting "enough" sleep to enable the sleeping mode of the brain to remove these waste products.

Some useful links:
The Wu Lab at Johns Hopkins: www.markwulab.net/alzheimer-s
Documentary "Sleepless in America" explaining the detriments of sleep deprivation:
http://www.aasmnet.org/articles.aspx?id=5233

Although we will not be able to determine the impact of our question and answer and the numbers of people that read what we posted, we hope that our post remains active on their sites so that the information remains available.

Secondly, as the mechanism explaining how chronic sleep deprivation can cause Alzheimer’s disease is still be researched, we’ve reached out to Rutgers University Associate Professor of Immunology, Dr. Long-Jun Wu. Dr. Wu has worked with a research team at Harvard Medical School that specializes in glia cells and their immune response to neuronal damage and, most recently, their role in mediating synapses in an Alzheimer’s brain. To inspire more research studies and somehow allow Harvard Med, and possibly Rutgers as well, to brainstorm experiments that can contribute to this research on sleep deprivation and AD, we sent Dr. Wu an email for him and his team explaining the goal to our literature research and the video we made summarizing the information we have compiled on this topic:
Hello Dr. Wu,

I am excited to have learned about the work being done at Harvard Medical School regarding glia cells and their role in Alzheimer's Disease. It so happens that in my Ethics in Science colloquium class this semester, I learned of a possible connection between sleep deprivation and the accumulation of tangles and amyloid plaques in the brain from my professor Julie Fagan. I have been reviewing this literature and hope that more research is done on this particular connection. One of our assignments for this class is to produce a video about our findings. If you have a few minutes, check it out. https://youtu.be/ltAOpn3ZEKo. Anyway, we hope that more research is done in this area - seems that, if research shows that sleep deprivation does impact the accumulation of tangles and plaques, then people should be made more aware how important getting enough sleep is.

Thank you for your consideration.

Sincerely,
Sirani Miller
Senior majoring in Biological Sciences, Rutgers University
with
Julie M. Fagan, Ph.D
Associate Professor
Rutgers University

Dr. Wu later replied with:

Hi, Sirani,
The video on sleep deprivation and AD is very interesting. One of my collaborators is working on microglia function in sleep. I think all things are connected now.

Best,
Longjun

Also, Arianna Huffington, co-founder of The Huffington Post recently released a book entitled The Sleep Revolution, in which she addresses the commonality of sleep deprivation in the United States in the hopes of changing the way people consider getting proper rest. As an attempt to contribute to the conversation about sleep deprivation and the long-term detriments that can emerge from it, we submitted a condensed version of our findings from the literature cited in this paper to The Huffington Post staff:

Submitted May 1, 2016 to The Huffington Post

Pitch a Blog to The Huffington Post
Thanks for sending us your pitch!
Waking up to the Possibility that Sleep Deprivation May Contribute to the Onset of Alzheimer’s Disease

We applaud Arianna Huffington’s book *The Sleep Revolution* on the importance of sleep - it’s advice we should all listen to. It’s one thing to know what we should do, but it’s another to act upon it and to make lifestyle changes. And we all know how hard it can be to make lifestyle changes…

Readers: there’s real reason to get your zzzz’s! We’re not speaking to the increased chance of your running off the road because you’ve fallen asleep at the wheel. It’s about the lack of sleep and developing Alzheimer’s disease. Alzheimer’s disease (AD) remains incurable and irreversible. Frightening. According to a 2015 fact sheet from the Alzheimer’s Association, only about 1% of Alzheimer’s cases are the result of genetic mutations, suggesting that the other 99% of AD cases are due to other factors at play that contribute to the development of AD. Several scientific investigations now show that a lack of sleep may contribute to the development of beta amyloid plaques and tau tangles and the formation of neurofibrillary tangles in the brain which, in time, can lead to the cell death and brain shrinkage that classically characterizes Alzheimer’s disease. Significant increases in the buildup of plaques and tangles unique to Alzheimer’s were found in chronically sleep-deprived brains than those of subjects with proper rest (Wu Lab at Johns Hopkins). Scientists hypothesize that during sleep, the brain removes the toxic metabolites found in the cerebrospinal fluid and interstitial spaces of the brain that are precursors to plaques that have accumulated during the day. So, the conversation that AD can be prevented is an important topic for conversation and should be a focus of more research. Maybe now, the forty percent of Americans that are reportedly sleep-deprived should actually (not just think about) shut off their technological devices and whatever else and get the 7-9 hours of sleep per night recommended by the National Sleep Foundation.

Sirani Miller, Jamal Perkins, Julie M. Fagan, Ph.D.
School of Environmental and Biological Sciences
Rutgers University
New Brunswick, NJ

Profile

Dr. Julie Fagan is an Associate Professor at the School of Environmental and Biological Sciences at Rutgers University. She works with students to learn about and provide solutions for important issues. Sirani Miller and Jamal Perkins, both students at Rutgers University, contributed to the post about sleep deprivation and Alzheimer’s disease.
Original (not sent) condensed version below:
Sirani Miller, Jamal Perkins, Julie M. Fagan, PhD.
Rutgers University,
New Brunswick, NJ 08901
April 18, 2016

Dear Huffington Post Staff:

We are writing to you today to contribute to the conversation about sleep deprivation and the costs it can have to one’s health down the road. It is very common to not get shuteye in the midst of our short-term and long-term goals- be it class assignments, data analytics, grading papers, or writing a novel- that we all feel are worth risking sleep for. As we all know, sleep is a wonderful, and very essential aspect of life and it is needed to function optimally. However, researchers have found that 40-percent of Americans are sleep deprived, and given our workaholic attitudes and frequent use of electronics, that proportion may be on the rise.

This biggest concern we want to shine a light on is the correlation between Alzheimer’s Disease and chronic sleep deprivation. As Alzheimer’s is an incurable and irreversible disease, it is important to recognize the environmental factors that may contribute to its onset later in life, along with other cognitive impairments. According to a 2015 fact sheet from the Alzheimer’s Association, only about 1% of Alzheimer’s cases are the result of genetic mutations, suggesting that whatever other factors are at play can be modified to reduce risk. The research detailing the correlation between sleep deprivation has been documented very recently, and we have been reading the literature by the researchers of The Wu Lab at Johns Hopkins that specialize on this topic. They have reported that there has been a significant increase in the buildup of plaques and tangles unique to Alzheimer’s in chronically sleep deprived brains than those of subjects with proper rest. To give you a better background and history of these links, we wanted to share with you a summary that we have compiled:

Alzheimer’s disease (AD) is a neurodegenerative disease which, according to the Alzheimer’s Association, is the most common cause of dementia today, and it makes up between 60 - 80% of all dementia cases in all age groups, with its ultimate result is premature death. What distinguishes Alzheimer’s from other cognitive disorders is the formation of amyloid plaques and tau tangles. Beta-amyloid (starch-like) plaques are aggregated masses of the protein amyloid-beta peptide (usually denoted Aβ), which is found on the fatty surface membrane of nerve cells. Tau is another protein responsible for stabilizing microtubules, which are “tracks” along neuronal axons to facilitate nutrient transport to brain cell bodies. Beta-amyloid plaques react with tau, and the tau proteins fall off of the microtubule tracks and accumulate to form neurofibrillary tangles. These plaques, especially in larger amounts, lie in between nerve cells...
and their synapses, which inhibits nerve cell communication and may even activate immune cells to destroy nerve cells. Thus, as the disease progresses, more nerve cells die and patients experience extreme memory loss, changes in behavior, and inability to perform simple motor tasks.

Throughout adulthood, including young adulthood, people should be getting 7-9 hours of sleep per night, according to the National Sleep Foundation. But people report to sleep 6 hours or less per night more often as they enter adulthood and regular work hours. The fact of the matter is that many Americans are walking around tired and sleep deprived. This lack of sleep can mostly be attributed to our Western culture. Arianna Huffington, cofounder of the Huffington Post has stated that during the first industrial revolution, it was believed that people should work like “machines,” and that down time should to be minimized. What this meant was that the act of sleeping was put on the backburner, and wasn’t a priority or necessity for millions of people, and especially not booming businesses.

Scientists believe that when you are asleep, your brain gets rid of the toxic metabolites that develop during the day. These metabolites can be found in the cerebrospinal fluid and interstitial spaces of the brain. Additionally, with the increased consumption of caffeine, in products like coffee and energy drinks, and how often we stare at our computer, phone, and TV screens, our sleep cycles can be thrown off dramatically. Allowing drugs and the light from digital screens to affect our biological clock can disrupt deep sleep stages throughout the night. If we expect to continue our sleep-inflicting lifestyles for years to come, we may contribute to the rise in dementia cases, including that of Alzheimer’s disease.

We hope to join you in the effort to raise awareness on the effects of poor sleep that we all subject ourselves to in many ways. After we found out about Arianna Huffington’s The Sleep Revolution, we figured we could chime in on educating everyone about sleep and how it is key to our health and wellness and to reducing our risk for cognitive impairments in the future. The effects of Alzheimer’s Disease are a very difficult thing to bear for both the patient and their loved ones, so if we expect to live healthily into old age, we must encourage everyone to do what they can do to fix our sleeping habits, as it can be just as good for our brains as it is for our bodies.

Sirani Miller, Jamal Perkins, Julie M. Fagan, Ph.D.
School of Environmental and Biological Sciences
Rutgers University
New Brunswick, NJ

References
16. National Sleep Foundation. How Much Sleep Do We Really Need?. https://sleepfoundation.org/how-sleep-works/how-much-sleep-do-we-really-need/page/0/1


http://eds.b.ebscohost.com/eds/pdfviewer/pdfviewer?sid=842c7f22-8aaf-419e-90d5-4ef80b188422%40sessionmgr103&vid=2&hid=114