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The Research Review of the Association between 2 Types of Carbohydrates (Natural and Refined Carbohydrates) and Sleep Quality in Humans

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ABSTRACT: The rising prevalence of insomnia has inspired this research on identifying the best food for improving sleep quality in humans. However, there is still no direct evidence to conclude specific food recommendations for sleep. Therefore, this study's objective is to unravel the relationship between diets, particularly carbohydrate foods, and sleep.

Following PRISMA guidelines, a search was conducted on PubMed, Embase, Scopus, and the Cochrane Central Register of Controlled Trials, which focuses mainly on the effects of natural and refined carbohydrates on sleep in order to avoid redundancy with previous reviews.

The findings suggest that diets rich in natural carbohydrates, such as kiwi fruits, tart cherries, rice, and milk, enhance sleep quality. White rice, with its complex carbohydrate structure, increases REM sleep and reduces SWS. On the contrary, processed carbohydrates found in noodles, confectionery, carbonated drinks, and processed foods are positively associated with sleep disruptions due to greater insulin response and reduced tryptophan availability.

In conclusion, natural carbohydrates have a positive impact on sleep, while refined carbohydrates and specific carbohydrate-containing foods may have negative effects. However, the multifaceted roles of sleep-inducing hormones and their crucial contribution to the circadian rhythm should also be considered aside from the mechanism of carbohydrates in sleep.

KEYWORDS: carbohydrates, natural carbohydrates, refined carbohydrates, sleep, sleep quality, sleep pattern

INTRODUCTION

"Humans spend around 1-3 of their lives sleeping," which is why quality sleep is so important. However, It is rather disappointing that most individuals forget one of the most important factors in sleep quality, which is "food". Nowadays, there have been several studies suggesting that the food we eat can affect our sleep quality and our sleep patterns can also influence our food choices. For example, in 2020, American researchers discovered a relationship between the type of energy-boosting food and sleep quality, or a study suggesting that tart cherry juice improves sleep efficiency and quality of sleep.[1] These are just some small examples of research in this field that tends to increase in numbers and have an opportunity to further develop in the future.

Currently, the number of people who suffer from insomnia is on an upward trend. It is evident from the 1993-2015 survey in the United States showing an 11-fold increase in the number of cases (from approximately 800,000 to 9.4 million).[2] Moreover, there was also a long-term survey conducted between 2002 and 2012 in Canada, which showed a 42% overall increase in the number of insomnia patients.[3] This is because our health is fundamentally impacted by both nutrition and sleep. Therefore, numerous studies have been conducted to try to find the best food by sleep researchers, including nutritionists and sleep specialists. Although these studies provide essential clues, there is still no direct evidence about a specific diet good for sleep to conclude their findings. To exemplify, a study of Japanese adults revealed that people eating rice regularly sleep more effectively compared to those who eat bread or noodles.[4] While this study show a correlation and could not indicate causation, it corroborates earlier studies that suggest consuming a high-glycemic index meal around 4 hours before nighttime helps sleep. For such reasons, this research aims to elucidate the correlation between dietary intake and sleep, especially carbohydrates since several carbohydrate diets can either enhance or aggravate sleep quality.

From this research review, we are interested in studying different kinds of carbohydrate diets that have effects on the human body and help with sleep quality. Since the trend of insomnia increases, this study will include the comprehensive mechanism of nutrients in carbohydrate foods that play an important role in enhancing sleep quality from various research studies and the data or experimental results required to analyze in greater depth and draw conclusions on this topic.

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METHODOLOGY

The following review was conducted according to PRISMA guidelines. A literature search was conducted from inception to April 2023 using various sources of information, such as PubMed, Scopus, Embase and the Cochrane Central Register of Controlled Trials. Retrieved findings from our search were limited to the language of English. In order to not overlap with the existing review, we chose to investigate the effect of different types of carbohydrate intake (natural and refined carbohydrates) on sleep quality.

Documents were selected by the following process:

(1) Studies contained the provided keywords: (carbohydrate / glycemic index / refined carbohydrates / natural carbohydrates / highly processed carbohydrates / starch) and (sleep / sleep quality / sleep quantity / sleep habits / sleep pattern) (2) Article's abstract is associated with a research objective.

(3) Journal sites and article approvals are reliable.

(4) Methodology of research

   a. For quantitative research, surveys or databases provide appropriate sample sizes with consideration to details in order to reduce bias.
   b. For qualitative research, methods need to be relevant to objectives.

(5) Context in the results is related to former studies (experiment, literature, or peer review).

(6) Conclusion determines a final, logical answer from the analysis of the results.

The collected information from retrieved records after screening must be within the following criteria:

(1) Studies were written in English

(2) Carbohydrate intervention was managed by researchers and explained according to our criteria of studies

(3) The studies follow the international ethical research guideline.

Articles are, however, excluded if:

(1) The participant shows a record of major diseases, surgery, or modification that may affect the influence of carbohydrates on a person

(2) Nutrition intervention was affected by other nutrients

(3) The results of such data were manipulated, transcribe or present the evidence leading to believe an intervention was according during recording.

RESULTS

1. Overview of Sleep Cycle

Sleep is a sophisticated physiological process controlled by both cellular and molecular systems. It is widely agreed that sleep is crucial for several important physiologic processes, including growth, energy conservation, immune response regulation, cognition, etc.[5] To explain, a variety of factors, such as prior sleep patterns, circadian timing, environmental signals, and internal demands, which entail homeostatic, circadian, and motivational processes that affect sleep behaviors, determine whether a person enters a certain sleep or wake state.[6]

To elaborate, the process of sleep can be divided into 5 different stages, consisting of wake, N1, N2, N3, and REM.[7]

Wake/Alert

Whether the eyes are open or closed at this stage is dependent. Beta waves dominate when the eyes are still open, whereas alpha waves become dominant as people snooze and close the eyes.

N1 (Stage 1) - Light Sleep (5 %)

This is known as the lightest stage. The skeletal muscles are toned, and breathing usually happens continuouslyThis stage takes 1 to 5 minutes.

N2 (Stage 2) - Deeper Sleep (45%)

It illustrates how lowering body temperature and heart rate leads to deeper sleep. The overall mechanism of this stage is believed to be integral to synaptic plasticity. In addition, it is asserted from several studies that sleep spindles are vital for the consolidation of memories, mainly procedural and declarative memory. This stage lasts around 25 minutes, which is about 45% of total sleep.

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N3 (Stage 3) - Deepest Non-REM Sleep (25%)

Commonly referred to slow-wave sleep (SWS), it is the deepest state of sleep and is marked by delta waves. Undeniably, it is the hardest to wake from, despite loud noises. This is the stage when the body develops bone and muscle, regenerates tissues, and enhances the immune system. Furthermore, sleepwalking, night terrors, and bedwetting may occur during the N3 stage as well.

REM (25%)

REM is not considered as a restful sleep stage due to its connection to dreaming. During this stage, the skeletal muscles are not moving, except for the eyes and diaphragm. However, the respiratory pattern becomes more erratic as well. This stage of REM typically begins 90 minutes after falling asleep, with each REM cycle getting longer as the night progresses. Dreaming, nightmares, and penile tumescence could happen in this stage.

Turning to the sleep-inducing hormones, the pineal gland in the brain produces the hormone melatonin. It is principally in charge of controlling your body's circadian rhythm to regulate a typical human sleep cycle. To elaborate on the process, there is a rapid rise in sleep inclination during the night, which occurs 2 hours after human melatonin production starts. The length of nocturnal melatonin transmits night-length information to the brain and numerous organs, including the suprachiasmatic nucleus (SCN). Functionally, melatonin works to aid in sleep by suppressing the circadian clock's wake-promoting signal at the SCN. Additionally, it affects the default mode network (DMN) areas of the brain, resulting in changes in precuneus activation that simulate sleep and weariness.[8] In addition, melatonin is also occasionally prescribed to patients with sleep disturbances and is beneficial in treating various sleep disorders like jet lag and insomnia in the elderly.[9] There was a crossover trial conducted among shift-work nurses by examining the effects of 5 mg of melatonin administered 30 minutes prior to bedtime on insomnia parameters. In comparison to a placebo, the results showed a substantially lower sleep onset latency (SOL) and higher sleep quality, which indicates a substantial improvement in sleeping.[10]

Moreover, there exists another crucial hormone that helps modulate sleep quality, which is known as “Serotonin”. Created from an amino acid called “Tryptophan”, it is a chemical nerve cell produce that sends signals between your nerve cells. Utilized by tryptophan hydroxylase to produce 5-hydroxy-L-tryptophan, tryptophan is the first step in serotonin production.[11] Subsequently, this chemical produces 5-HT through Aromatic L-amino acid decarboxylase, which can be found in many parts of your body, such as the central nervous system, blood platelets, and the gastrointestinal tract.[12] It appears to be vital for the functioning of the human central nervous system (CNS) and the body as a whole, such as bowel function, mood, blood clotting, bone health, and even sleep quality in humans.

Additionally, one study found that ghrelin hormone (GH) stimulates the release of cortisol, growth hormone, and slow-wave sleep in young, healthy men. Slow-wave sleep increased throughout the whole night after the ghrelin administration, while accumulated delta-wave activity increased in the second half of the night. Additionally, plasma levels of prolactin and GH surged throughout the night, and the level of cortisol rose in the first phase of the night.[13]

2. Overview of Carbohydrates

Carbohydrates are compounds that typically have a 1:2:1 ratio of carbon, hydrogen, and oxygen. It is regarded as one of the primary nutrients that offer the human body a variety of nutritional benefits and take on various forms as well. Foods like bread, milk, cookies, soft drinks, and cherry pie are examples of both healthy and unhealthy foods that contain them. These illustrations suggest that starches, fiber, and sugars are the three types of carbohydrates that are most prevalent in nature.

It is undeniable that foods rich in carbohydrates are an essential component of a balanced diet since they give the body glucose, which is eventually transformed into energy for maintaining bodily functions. In addition to providing energy, carbohydrates are also crucial components for an organism. When it comes to the classification of carbohydrates, they can be categorized into simple and complex carbohydrates based on the number of molecules in the structure of carbohydrates. However, in this research, we are going to classify carbohydrates into natural and refined carbohydrates in order to have a greater understanding of the benefits and drawbacks of both categories of carbohydrates and help analyze which type is advantageous for sleep quality in humans.

2.1. Natural Carbohydrates

Natural carbohydrates are carbohydrates that can be found in plant-based diets. Sometimes, they are also known as good carbohydrates since they contain more nutrients such as fiber and starch, which are nutritionally beneficial to the human body. In addition, when such carbohydrates are digested into sugars, they may also provide some essential vitamins and minerals needed in

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our body as well. Natural carbohydrates are noticeable in both simple and complex carbohydrates,[14] which will be explained further in the next paragraph.

Starting with simple carbohydrates, which have a very basic chemical structure, they can be found in both monosaccharides and disaccharides.[14] Due to its uncomplicated structure, it is easy to be digested and absorbed into the bloodstream. Such carbohydrates may exist in many plant-based foods, including fruits, dairy products, corn syrup, fruit juice, honey, and some vegetables; however, some sugars in processed foods, known as added sugars,[15] are considered simple carbohydrates normally provide little nutritional value and easily lead to other health problems like obesity and weight gain as well.[16,17,18] Candy, carbonated beverages, table sugar, and baked treats like cookies are mainly considered simple carbohydrates that might be unhealthy for bodily functions.

Turning to complex carbohydrates, they generally have longer saccharide chains, meaning that it takes longer to digest complex carbohydrates into smaller compounds. Being digested more slowly, it helps release glucose slowly into the bloodstream and therefore has a more gradual effect when it comes to blood sugar rise. This type of carbohydrate is likely to be discovered in polysaccharides or oligosaccharides,[14] in which starch and fiber are good examples of complex carbohydrates.[15] Additionally, when it comes to the immense health benefits both starch and fiber provide, numerous studies demonstrate that starch and fiber can benefit intestinal health,[19] maintain the efficiency of glycemic management, or even enhance carbohydrate and lipid metabolism,[19,20] which can become vital for many obese patients and other individuals who have cardiovascular disease and diabetes.

2.2. Refined Carbohydrates

Refined carbohydrates are processed carbohydrates that lack fiber and other nutrients. Contrary to naturally occurring carbohydrates, which are digested more slowly, these result in a highly processed product that can be quickly absorbed into the bloodstream. They are primarily found in refined sugar and grains. A grain is considered refined if the bran and germ have been eliminated, reducing the amount of fiber, iron, and B vitamins in the grain. The grain, however, provides a finer texture and a lengthy storage life. Wheat flour, white bread, and cereal are a few examples. [15] According to a study, consuming more added sugars, starches, and refined grains was linked to a higher risk of developing insomnia, whereas consuming more fiber, whole grains, and vegetables was significantly linked to preventing insomnia.

Refined sugar is a form of sugar that has been extracted from its natural sources, mainly cane, sugar beets, and corn, which are then processed to separate the sugar. Pastries, bread, sweetened beverages, pasta, tomato sauce, and other diet foods frequently include this sugar to give them a sweeter flavor. However, it has been discovered that refined sugars offer virtually no nutritional value, including nutrients, minerals, and fiber, so foods containing them frequently lack the necessary amounts of fiber to facilitate digestion. Furthermore, because the body digests and absorbs refined sugars so quickly, eating them can cause blood sugar to spike. This could eventually result in symptoms like obesity, high blood pressure, clogged arteries, and heart failure.[22,23]

3. A comparison of the effects on sleep quality between 2 types of carbohydrates

3.1. Natural Carbohydrates

Focusing on natural carbohydrates, there are a number of them that improve human sleep quality, though we only provided a few examples, including kiwifruit, tart cherries, rice, and milk. A self-controlled diet approach was used in one study at Taipei Medical University to assess the impact of kiwifruit intake on various sleep quality metrics. For a period of four weeks, subjects had to consume two kiwis 1 hour before bedtime each night. The findings of this study showed that kiwi consumption for 4 weeks increased sleep efficiency (SE) and total sleep time (TST) considerably in adult subjects, resulting in significantly better sleep quality. Additionally, the results of radio-enzymatic serotonin analyses have shown that Kiwis have high levels of serotonin. Potentially offering an answer to the sleep-improving results of kiwi fruits.[24]

One study tested a tart cherry juice with procyanidin as a sleep aid using a randomized, placebo-controlled clinical trial on tart cherries in order to measure its effectiveness on sleep. 11 healthy middle-aged male or female participants with chronic insomnia who typically went to bed between 9 p.m. and 12 a.m. were recruited for this trial. After two weeks of cherry juice consumption, the subjects went through an overnight polysomnographic sleep study. The results showed an increase of around 84 minutes in sleep time measured by polysomnography and lower plasma levels of kynurenine with higher levels of tryptophan. The findings imply that the procyanidin B-2 in cherry juice, which inhibits indoleamine 2,3-dioxygenase (IDO), enhances sleep quality. Additionally, cherry juice high in procyanidin B-2 can increase the bioavailability of tryptophan for the synthesis of serotonin, which could

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contribute to mood-enhancing effects.[25] Another investigation using Montmorency tart cherry juice on professional female field hockey players shows a similar outcome in terms of sleep quality. Significant interaction effects from the sleep quality variables and the amount of time utilized in bed overall, waking up after falling asleep, and movement index were observed. According to the study, drinking tart cherry juice may help athletes with busy schedules recover from injuries sustained while playing and improve the quality of their sleep.[26]

Furthermore, rice, which is a staple food for the majority of Thai people, is crucial for improving the quality of sleep. One study in Japan used the Sleep Quality Index questionnaire to evaluate employees' dietary intake from their consumption of rice, noodles, and wheat foods as well as their sleep to unravel the relationship between carbohydrate food intake (bread, rice, and noodles) and quality of sleep in humans. The results indicated that higher consumption of rice was linked to a higher glycemic index (GI), glycemic load, and intake of carbohydrates. Additionally, it was linked to lower ratings for short sleep duration, but not to other sleep quality aspects. Another indicator that rice intake has a favorable relationship with higher-quality sleep is the fact that the multivariate-adjusted odds ratios for the prevalence of poor sleep from rice intake were quite low. 59% of the Japanese diet's dietary glycemic index is made up of rice, particularly white rice. As a result, rice consumption would have an impact on sleep quality due to its high glycemic index. In addition, tryptophan in rice has a high melatonin content, which is boosted by eating carbohydrates with a high glycemic index. It is well known for controlling human circadian rhythms and promoting sleep.[4] This outcome is also consistent with a clinical trial that was carried out in South Korea to examine the efficiency of a supplement made from rice bran extract (RBS) that contained r-oryzanol standardized for adults with insomnia. As previously stated, 50 adults with sleep issues were enrolled in this study. In this type of transient insomnia, they discovered that the RBS given to the subjects significantly improved PSG-defined sleep onset, duration, and maintenance. The total sleep time (TST) and sleep latency (SL), as well as sleep efficiency (SE), portrayed satisfactory improvements. The RBS prolonged NREM sleep for longer SE, which was typical of physiological sleep. Eventually, it led to a rise in TST without affecting the REM sleep.[27]

In an extensive study carried out in Japan, researchers aimed to verify the distinct connections between difficulty initiating sleep (DIS) and attending leisure-time physical activity (LTPA), as well as the consumption of milk and milk products. Furthermore, they sought to determine if the combined adoption of these two habits exhibits a more robust correlation with a decreased prevalence of DIS. To achieve this, a group of 421 Japanese individuals aged 65 years or older were recruited for participation in this survey. The survey involved a self-reported questionnaire that inquired about the consumption of milk and milk products over the preceding months, and the quality of sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI). The findings indicated a positive association between a lower prevalence of DIS and milk intake, while no significant correlation was observed with yogurt, cheese, or overall dairy consumption. The report revealed that individuals who consumed a substantial amount of milk were less likely to experience DIS, even after adjusting for engagement in LTPA and the consumption of yogurt and cheese.[28] Interestingly, among the milk products known to enhance sleep quality, Horlicks, a sweet malted milk hot drink powder, emerged as one of the most popular options. Another study confirmed that consumption of Horlicks before bedtime led to less restless sleep among young adults and longer, less interrupted sleep among the elderly.[29]

3.2. Refined Carbohydrates

Turning to those providing refined carbohydrates classified into refined grain and refined sugar, they can be found in many of the foods we consume daily. However, its effect on sleep quality is opposite to that of natural carbohydrates. Starting with the same Japanese study that also applied their experimental techniques to noodles, the findings showed that while bread did not significantly correlate with sleep quality, noodles were likely to contribute to poor sleep in humans. A higher intake of noodles had a significant correlation to more sleep disturbances ($p<0.001$), a greater level of daytime dysfunction ($p=0.005$), poorer subjective sleep quality ($p=0.021$), and longer latency in sleep ($p=0.049$). In addition, the odds ratios of noodle intake were found to be pretty high compared to rice. These results clearly indicated a negative association between noodles consumption and sleep quality. [4]

Moreover, there is a Japanese study that reveals the connection between food habits and the quality of sleep among middle-aged female workers. A diet history questionnaire (DHQ) was developed to examine respondents' general eating habits and their frequency of consumption and portion sizes for 151 foods and beverages, while the PQSI questionnaire was utilized to assess sleep quality look at factors such as subjective sleep quality, subjective sleep latency, sleep duration, disruptions, medicine usage, and any daytime dysfunction. The survey's findings showed that participants with poor quality of sleep who had the highest carbohydrate intake ate more confectionery (refined sugar) and less rice (natural carbohydrates) than participants in the category with the best

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quality of sleep. This includes carbohydrates or glycemic index components that might have an effect on how well they sleep. Additionally, a little consumption of vegetables (natural carbohydrates) and a high intake of snacks (processed sugar) were found to be related to decreased sleep duration.[30]

According to a cross-sectional study on the relationship between sleep quality, sleep duration, and food intake among Korean adolescents, poor quality of sleep was linked to more carbonated drinks and junk food consumption. It was discovered that participants who slept less than 6 hours consumed more soft drinks five times per week, while also consuming more fast foods on average. When compared to other food categories, sugar- sweetened beverages, and fast foods typically have higher energy levels but fewer micronutrients, especially sweetened beverages, which are mostly liquid calories provided by sugars and contain very few nutrients. Additionally, it was suggested that eating fast food with high salt content and low levels of other micronutrients might shorten and degrade sleep duration and quality.[31] In a multinational study encompassing 64 countries, researchers conducted an investigation to explore the potential relationship between sleep disturbance caused by stress among adolescents and their consumption of soft drinks and fast foods. The study's outcomes mirrored previous findings, but it's essential to approach this topic with caution. Utilizing a questionnaire to assess both stress-related sleep disturbance and the frequency of junk food and soft drink consumption, the data revealed that a small percentage of adolescents (7.5 %, with 6.6% being males and 8.4% females) claimed to encounter sleep disturbance due to stress in the past year. Among those consuming carbonated soft drinks frequently (≥ 3 times per day), the prevalence of sleep disturbance was slightly higher for females (13.6%) compared to males (9.6%). Similarly, among individuals with a high frequency of fast food consumption (≥ 4 days in the past 7 days), sleep disturbance was reported by 10.5% of males and 10.7% of females. To summarize, this study suggested a potential link between increased intake of soft beverages and fast food and a higher likelihood (55%) of experiencing accentuate-related sleep disturbance compared to individuals with infrequent consumption, which contribute to the potential impact of regular consumption of carbonated beverages and fast foods on the sleep patterns of adolescents. However, further research is necessary to establish a definitive causal relationship.[32]

DISCUSSION

Over the past decades, multiple researchers have investigated the associations between dietary intake, specifically carbohydrates, and sleep quality in humans. The purpose of our review was to enhance the understanding of these associations. The results of our review indicate a promising influence of carbohydrates on sleep, with natural carbohydrates demonstrating a positive impact on sleep quality. Conversely, refined carbs exhibit a negative overall influence.

During the investigation of refined carbohydrates, there was a pattern suggesting similarities to high glycemic index (HGI) foods. Both refined carbohydrates and HGI foods were found to stimulate blood sugar levels and decrease sleep onset latency (SOL).[33] On the other hand, natural carbohydrates showed similar findings to low glycemic index (LGI) diets. The proposed explanation for this pattern is that the consumption of refined carbohydrates leads to significant fluctuations in blood sugar levels and elicits a greater insulin response, which affects the availability of tryptophan.[34] Consequently, this influences the synthesis of serotonin and melatonin since both hormones depend on a sufficient supply of tryptophan.[35,36] These hormones play a crucial role in the uptake of sleep function in large neutral amino acids (LNAA), and their production is thought to be stronger when the LNAA ratio is higher, as proposed by Fernstrom and Wurtman.[36]

However, this proposed mechanism may not be entirely viable considering the multifaceted roles of serotonin in various sleep stages and its contribution to the circadian rhythm.[37] These roles involve interactions in maintaining sleep but may as well lessen sleep quality.[38,39] Another vital hormone is melatonin, which has been mostly found in different parts of plants like fruits or seeds.[40] Additional confirmation arises from the study involving tart cherries, which concluded that exogenous melatonin can improve sleep.[25] However, practically achieving the minimal active dosage of exogenous melatonin would require consuming as least 38 kg of tart cherries, which will disappear within an hour of consumption.[41] Despite these limitations, it is important not to disregard the proposed mechanism, as it still exerts a significant influence on the circadian rhythm and sleep stages.

Another intriguing finding in our review is about white rice and noodles. This pairing clearly illustrates the aim and rationale of our study. White rice, specifically milled rice with its husk, bran, and germ removed, can still be considered a form of natural carbohydrate in terms of its nutritional state. Noodles, on the other hand, are a byproduct of rice processed into refined carbohydrates. The difference in their effects on sleep could be the complexity of carbohydrate structure. Although white rice maintains a high glycemic index, it possesses a more intricate structure. The results revealed that white rice increased the amount of rapid eye

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movement (REM) sleep and reduced slow-wave sleep (SWS), while noodles exhibited a negative influence on sleep, including longer SOL and more frequent daytime sleepiness.[4] This difference could be partially explained by the ghrelin hormone, which stimulates food desire and is released to combat hunger or an empty stomach. Ghrelin contains several properties, including raising blood glucose levels and worsening glucose tolerance,[42] which should not be overlooked. Notably, individuals with diabetes are closely associated with insomnia, with at least half of diabetics experiencing poor sleep quality or insomnia. Moreover, studies have also suggested a positive influence of ghrelin on human sleep.[13,43] Therefore, ghrelin may be considered a potential influencing factor in sleep stages.

The strength of our review is that it contains a concise and comprehensible summary of data focusing on two main types of carbohydrates: natural carbohydrates and refined carbohydrates. The presented information is readily available without the need for additional payment or subscription. In addition, our data were collected through systematic filters, which ensure reliability, and the selection criteria for the chosen sources also help enhance the credibility of the information obtained from various sources. Furthermore, the study offers a thorough explanation of the mechanisms of how carbohydrates can impact sleep quality in humans.

Nevertheless, the limitation of this study is the need for more cases of similar experiments conducted on a wider range of carbohydrate diets. This is because the current study primarily focuses on natural and refined carbohydrates. Thus, the inclusion of additional examples would eventually strengthen our findings. Another noticeable limitation is the absence of original experiments, which should be conducted to directly compare the results with other studies. Conducting such experiments would help provide a robust foundation for the findings presented. Additionally, the lack of peer-reviewed research papers to compare the results of this research limits the ability to assess the findings within the scientific literature. Lastly, it should be noted that the association between natural and refined carbohydrates and sleep quality cannot be fully concluded due to other important factors aside from carbohydrates that have not been accounted for in this study.

CONCLUSION

The current results highlight the importance and the impact of 2 different types of carbohydrates that play a vital role in human sleep quality. This research concluded that natural carbohydrates have a positive influence, whereas refined carbohydrates and certain carbohydrate-containing diets may have negative effects on sleep quality. The establishment link between the effect of carbohydrates and the mechanism of the body has yet to unveil itself, or rather be found. The discovery of this link would help to instigate fighting back against the rising cases of insomnia via reliable and affordable methods. Nevertheless, while it is idealistic to have one's nutrient control one function of the human body, the reality is that nutrients play each part in our body differently. It is unlikely that we will find a clear one-to-one relationship between these two, but we have laid the ground. Therefore, we should investigate further the clear function of the hypothalamus and its approach to nutrition in the meal as a whole.

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