



Review Article

Determinants of sleep quality in college students: A literature review

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ABSTRACT

Purpose: To review the various determinants of sleep quality among college students.**Methods:** The PubMed, Web of Science and Cochrane Library databases were searched with the search string “sleep quality” AND “college students” for articles published between January 2007 and October 2017. Articles were excluded if they (1) examined sleep quality as a risk factor for other outcomes or (2) involved inpatients or participants under medical care.**Results:** The 112 identified studies were classified into categories according to the investigated determinants and their effect on sleep quality. Physical activity and healthy social relations improved sleep quality, while caffeine intake, stress and irregular sleep-wake patterns decreased sleep quality. Less consistent results were reported regarding eating habits and sleep knowledge, while proper napping during the day might improve overall sleep quality.**Conclusions:** College students are vulnerable to different risk factors for sleep quality. When designing interventions to improve sleep quality among college students, the main determinants need to be taken into consideration.© 2020 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Introduction

Sleep problems are common and are likely to increase.^{1–3} Over the past few years, sleep quality among young adults has been decreasing, as revealed by several studies and reports.^{4–6} Despite the common use of the term sleep quality, it does not have a widely accepted definition; it is mostly defined as an individual's general level satisfaction with the sleep experience, and its main components are the quantity of sleep, sleep continuity, and revitalizing feeling upon awakening.⁷

Sleep duration is an important element of sleep quality.⁸ The prevalence of short sleep duration (<9 h for children aged 6–12 years; <8 h for teens aged 13–18 years and <7 h for adults aged 18–60 years old) is high (72.7%) in the US.^{9–10} A recent survey investigated sleep duration in university students from 26 low-, middle- and high-income countries and reported that the prevalence of ≤6, 7–8, and ≥9 h sleep durations was 39.2, 46.9, and 13.9%, respectively.¹¹ In addition to sleep duration loss, sleep initiation and maintenance problems – which are aspects of sleep continuity – and morning tiredness are the main features of decreased sleep quality.⁷ Furthermore, sleep problems are common among college students,¹²

and more than half of college students suffer from poor sleep quality.¹³ Therefore, it can be asserted that poor sleep quality is becoming a considerable problem among college students.

Greater academic and social pressures and irregular schedules render students susceptible to sleep disturbances and deprivation. The social life of college students involves a variety of entertainment opportunities and products that reduce sleep quality. University life is characterized by substantial freedom, minimal supervision, unhealthy habits such as smoking and drinking, and leisure activities that are conveniently available and accessible (e.g., student clubs, concerts, night bars). Energy drinks, which are targeted to young adult consumers,¹⁴ and higher drinking motives predict poorer sleep quality.¹⁵ Based on present knowledge, caffeine consumption is associated with common symptoms of poor sleep quality, including insomnia¹⁶ and sleep disturbances.¹⁷ Additionally, screen-based technologies are often used among young people, and low physical activity and high screen time are significantly positively correlated with poor sleep quality.¹⁸ Although there are many reasons for reduced sleep quality, nighttime media use is frequently cited as one probable cause.¹⁹ Smartphone overuse not only results in sleep problems but also contributes to physical inactivity, which in turn contributes to poor sleep.²⁰ Rapid lifestyle and behavioral changes can lead to poor sleep patterns in college students.²¹ Several studies have demonstrated the relationship between sleep problems and chronotype; people with an evening chronotype have more sleep debt and

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more subjective somnolence compared to morning types.²² The results have consistently shown that the sleep quality of evening types was worse than that of morning types.²³

Attending college can be a stressful time for many students, and mental health problems have been highlighted because college students' need for mental health care has increased dramatically.²⁴ Research reveals that sleep problems are common and are associated with poorer mental health even among young people²⁵ and college students.^{26–28} However, students, due to ambiguous help-seeking behaviors, may not be willing to admit that they need psychological treatment.²⁹ It is reasonable to assume that the mental health problems of college students exceed the current estimates reported in the literature. Currently, there is convincing evidence that there is a bidirectional relationship between mental health and sleep quality. As mentioned, sleep problems are associated with poor mental health^{25–29}; furthermore, it has been demonstrated that poor mental health could result in poor sleep quality.³⁰ Supplementary evidence for sleep quality determinants from multiple angles (e.g., sleep quantity³¹) was examined by previous studies.

Thus far, determinants of sleep quality among college students have not been systematically reviewed, and it is very important to study these factors since nurturing physically and mentally healthy young generations is crucial for public health promotion. Scoping reviews can be useful in evidence synthesis when the aim of the review is to “identify knowledge gaps, scope a body of literature, clarify concepts or to investigate research conduct”. Scoping reviews may also be antecedents to systematic review.³² The purpose of this review was to analyze the current literature and identify the main determinants of sleep quality among college students. Therefore, a scoping review is a reasonable research strategy to fulfil the research goals.

Method

Data sources

The PubMed, Web of Science and Cochrane Library databases were searched for articles published between January 2007 and October 2017 using the following search string: (sleep quality) AND (college students).

Study selection

We coded all of the articles from the PubMed ($n = 207$), Web of Science ($n = 327$) and Cochrane Library ($n = 29$) databases with numbers in the sequence listed in the search results from the three databases. Articles were recorded with labels and were classified into several categories. Fig. 1 shows the study selection process and the number of articles. For instance, we excluded articles that considered sleep quality as a risk factor for other variables; nevertheless, the noncollege population, questionnaire reexamination, intervention studies and prevalence investigation were not considered in this review.

Inclusion and exclusion criteria

Studies of all designs that were accessible online were included if they met the following criteria: (1) published in English, (2) involved college students, (3) examined the risks factors for reduced or constrained sleep quality, sleep health, and sleep efficiency, etc. Articles were excluded if their target population included off-campus students. For example, students who were participating in internships at companies or medical students who were practicing in hospitals were excluded. Articles showing the correlation between sleep and risk factors were carefully checked, and only articles with sleep quality as the dependent variable were taken into consideration.

In PubMed, after sorting and labeling all the articles, eight categories were created according to the nature of the articles: 1. sleep risk factor

articles ($n = 58$), 2. intervention studies ($n = 22$), 3. sleep quality was considered as a risk factor and not as an outcome ($n = 28$), 4. simple cross-sectional studies on sleep quality ($n = 24$), 5. questionnaire reexaminations ($n = 13$), 6. high school-/middle school-based studies ($n = 6$), 7. reviews/meta-analyses ($n = 3$) and 8. irrelevant studies ($n = 53$). A number of articles were excluded for various reasons, e.g., 28 articles examined sleep quality as a determinant of other factors (e.g., school performance, mental health, stress, quality of life). Although we searched the literature with targeted and specific terms related to college students, 6 articles examined middle/high school students, and 53 articles were not related to sleep quality among college students. Only two categories from PubMed ($n = 61$), including sleep risk factor articles ($n = 58$) and reviews ($n = 3$), remained for further discussion in our review.

Of the Web of Science articles, 127 were duplicates of PubMed articles. Of the remaining 200 articles, only articles discussing sleep risk factors were included in our review. The categories were as follows: 1. risk factors for poor sleep quality ($n = 50$); 2. intervention strategies ($n = 6$); 3. sleep quality scale reexaminations ($n = 6$); 4. sleep quality prevalence ($n = 25$); and 5. articles that examined sleep quality as a risk factor for other variables ($n = 46$) (e.g., academic performance, psychosocial dysfunction, anxiety, etc.); and 6. non-college-based studies ($n = 25$). In addition, 42 articles were completely biased on the intended theme (e.g., lifestyle factors to mental health, experience of living with chronic insomnia, psychology and suicide, health habits) and were excluded from the database. Finally, 50 articles about categories of sleep factors were included in this review.

Only one article from the Cochrane Library was taken into consideration after excluding 4 intervention studies, 22 duplicate articles from PubMed and Web of Science and 2 studies that were not related to sleep quality.

Data extraction

The creation of the data extraction categories was based on the characteristics and the nature of the studies. Before categorization, all of the search results from each database were manually coded, and only studies and reviews on sleep risk factors were included in this review.

Data synthesis

The thematic coding method was used to identify and record the determinants reported in each included article. The most significant factors were identified and grouped based on the results of the studies. The determinants were categorized based on content analysis, and then, the coding of each category was conducted based upon the synthesized information grouped in these categories. The outcomes were synthesized into three categories (i.e., positive, negative and no effect/not enough data). The first author coded and identified all determinants in each article, and then, the two authors sorted out and grouped the determinants. For example, perceived stress is identified in article A with reduced sleep quality, and it will be marked as “stress_reduceSQ_articleA”. In addition, in case physical activity is also identified in article A with an improved effect of sleep, it will be marked as “physical activity_improveSQ_articleA”, that is, one article could be cited twice or more times depending on how many determinants were identified.

Results

Sleep quality can be influenced by several short-term and long-term risk factors. Table 1 summarizes these factors based upon the results of our literature review and the number of relevant articles. Risk factors were classified into four domains: lifestyle (e.g., smoking, physical activity, eating habits, body mass index (BMI), caffeine and stimulant use, alcohol drinking, media use, sleep-wake patterns, sedentary behavior and napping) ($n = 71$), mental health (e.g.,

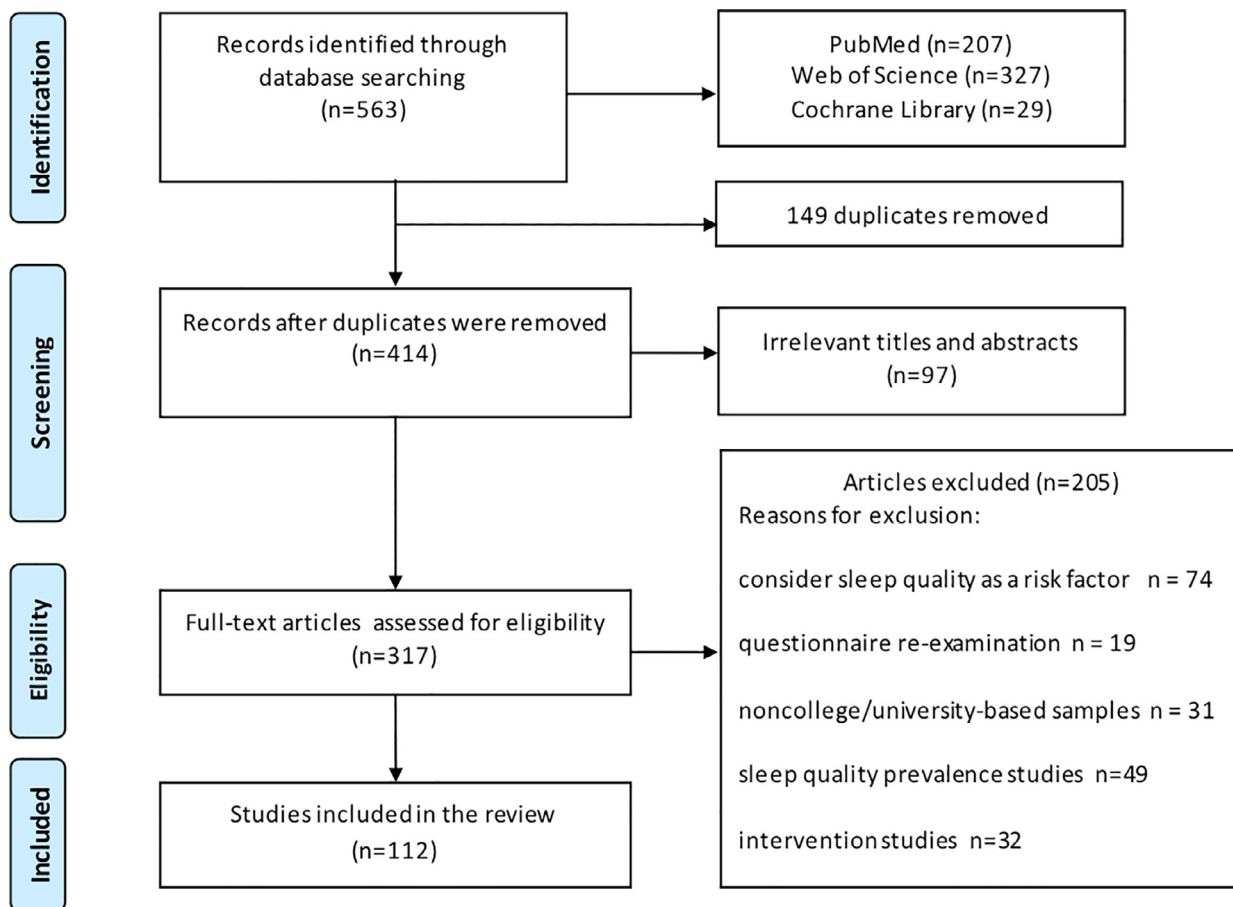


Fig. 1. Flow chart of identified and excluded articles.

Note: Adapted from the PRISMA flow diagram.

Source: <http://prisma-statement.org/PRISMAStatement/FlowDiagram.aspx>.

depression, psychiatric disorders, perceived stress, anxiety) ($n = 31$), social factors (e.g., racial discrimination, social relations, academic performance and sleep knowledge) ($n = 16$), and physical factors (e.g., pain and fatigue, sleep medication) ($n = 8$). The effects of these risk factors on sleep quality (SQ) were distributed into three categories (improves SQ; reduces SQ; no effect/not enough data). Furthermore, three articles investigated the connection between SQ and demographic factors, such as age,³³ gender³⁴ and ethnic background³⁵; however, in this case, the direction of the effect (i.e., positive or negative) could not be judged, but according to the literature, women experienced worse sleep quality than men.³⁶

Lifestyle determinants

Lifestyle factors most strongly affected sleep quality among college students, followed by mental factors, social factors and physical factors. Smoking and sedentary behavior had negative effects on sleep, as revealed by a single article³⁷ and a few articles,^{94,95} respectively. In addition, caffeine and stimulant use, media use (e.g., smartphone addiction, problematic internet use, lying position, nighttime use, screen time), alcohol use, and irregular sleep-wake patterns had negative effects on sleep.^{18,38,57–68,72–75,79–84,87–92} An irregular sleep-wake pattern is defined as a disordered form of circadian rhythm, which is characterized by the relative absence of a circadian pattern in an individual's sleep-wake cycle.¹⁴⁸ Additionally, higher amounts of technological device use predicted poorer sleep quality.⁸³

Physical activity was identified as a factor that could have both positive and negative effects on sleep, which depends on the intensity, type, and length of the activity. Aerobic exercise, such as Tai chi

and Pilates, showed beneficial effects on sleep quality.⁴¹ A relatively large number of studies^{18,38–42} reported on the positive effects of physical activity on sleep, while only one article⁴³ reported negative results. A national study³⁶ found that exercise effects vary between sexes, age groups, etc. Nevertheless, the baseline physical activity level of participants, as well as the exercise type, onset time, duration, and adherence, were also determinants of sleep amelioration. With the present knowledge, there is a high chance that physical activity improves sleep quality, but more evidence is required on the details of the intensity and quantity of physical exercise. Eating habits and nutrient intake both had positive and negative effects, but the positive effects outnumber the negative effects. It appeared that competent eating habits could improve sleep quality⁴⁷ because competent eaters had good overall sleep quality. Food addiction is not helpful for good sleep,⁴⁸ and poor sleep quality is associated with elevated emotional eating.^{50–52} Five articles discussed the relationship between BMI and sleep quality; four^{46,54–56} out of five articles showed negative effects of nonnormal BMI, and the remaining one article³⁷ presented a positive effect of normal BMI. Alcohol consumption did not benefit sleep, and higher drinking motives were closely associated with poor sleep quality.^{65, 72–75} It might be a good choice to have a short nap during the day, but nap length and nap frequency also impacted sleep quality.^{96–98}

Determinants related to mental health

As mentioned above, mental disorders showed a significant effect on sleep quality. Mental problems such as depression, psychiatric disorders (assessed by the Psychiatric Diagnostic Screening

Table 1

The number of relevant articles regarding the determinants of sleep quality (SQ) and their effect on sleep, with reference numbers.

Determinant	Improves SQ	Reduces SQ	No effect or not enough data
Lifestyle			
Smoking		1 ³⁷	
Physical activity	6 ^{18,38–42}	1 ⁴³	3 ^{44–46}
Eating habits	1 ⁴⁷		
Competent eating			
Food addiction		1 ⁴⁸	
Night eating			2 ^{37,49}
Emotional eating		3 ^{50,52}	1 ⁵³
Body Mass Index			
Normal	1 ³⁷		
Higher or lower		4 ^{46,54–56}	
Caffeine and stimulants		13 ^{57,68}	3 ^{69–71}
Alcohol drinking		5 ^{65,72–75}	1 ⁷⁶
Media use habits		2 ^{77,78}	1 ⁷⁹
Smartphone addiction		3 ^{80,82}	
Problematic internet use		1 ⁸³	
Lying position		2 ^{84,85}	1 ⁸⁶
Nighttime use			
Low screen time	2 ^{18,38}		
Irregular sleep-wake pattern		6 ^{87,92}	1 ⁹³
Sedentary behavior		2 ^{94,95}	
Napping	3 ^{96,98}	1 ⁹⁹	
Mental health			
Depression		5 ^{100,104}	
Psychiatric disorders		3 ^{105,107}	
Perceived stress		14 ^{75,101,108,109–119}	4 ^{120,123}
Anxiety		4 ^{99,124–126}	1 ¹²⁷
Social factors			
Racial discrimination		3 ^{128,130}	1 ¹³¹
Social relations	4 ^{132,135}		
Academic performance		2 ^{114,136}	
Sleep knowledge	2 ^{137,138}	3 ^{117,139,140}	1 ¹⁴¹
Physical factors			
Pain		1 ¹⁴²	
Fatigue		3 ^{92,113,143}	
Sleep medication	2 ^{144,145}	1 ¹⁴⁶	1 ¹⁴⁷

Questionnaire and General Health Questionnaire–12), stress and anxiety were negatively associated with sleep quality based on 25 articles (Table 1).^{75,99–119,124–126} Four articles showed no effect with perceived stress,^{120–123} and no studies found positive results between mental disorders and sleep quality. Relying on the concrete results above, it is reasonable to conclude that mental health problems are closely negatively associated with sleep.

Social determinants

Many social factors were correlated with sleep quality. As indicated in Table 1, healthy social relations^{132–135} positively affected sleep, while racial discrimination acted as a risk factor for poor sleep quality.^{128–130} Unsatisfying academic performance could also be a risk for poor sleep quality.^{114,136} Better sleep knowledge, which can also be understood as good sleep hygiene practice, was correlated with good sleep habits, while there was also a possibility that poor sleep was a result of poor sleep hygiene, which comprised a variety of habits that were necessary for good nighttime sleep quality.^{117,137–140} Additionally, students' attitudes and poor knowledge of sleep were also identified as risk factors for poor sleep quality.^{117,139,140}

Physical determinants

Physical factors such as pain and fatigue were significant risk factors for worse sleep quality,^{92,113,142,143} but the source of physical disorders was not investigated. Physical discomfort was an apparent risk factor, as shown in Table 1. Moreover, sleep medication use showed both positive and negative effects on sleep quality,^{144–146} which may be due to the illicit use of the prescribed medication.¹⁴⁴ An irregular circadian rhythm caused either by a psychiatric medication or an unorganized lifestyle was identified as a potential risk factor for poor sleep.^{87,106}

Discussion

This literature review provides evidence regarding the determinants of sleep health among college students by identifying risk factors reported in the literature. In a recent review about the determinants of children's sleep behavior, a categorization of the determinants was used that was similar to the one used in our study, thus supporting our results.¹⁴⁹ Pooled comparisons were made based on positive and negative sleep outcomes. The four domains of sleep determinants indicated that lifestyle factors were the most frequently investigated domain in sleep quality research, followed by mental health and social and physical factors. Different effects on sleep outcomes (i.e., improves or reduces sleep quality, no effect/insufficient data) were found, and positive and negative correlations were marked accordingly.

In summary, well-organized physical activity and healthy social relations improve sleep quality, while caffeine intake, stress and irregular sleep-wake patterns reduce sleep quality, which emphasizes existing findings that unhealthy or risky life behaviors are negatively associated with sleep health.⁸⁶ Eating habits and sleep knowledge were reported as determinants of sleep quality. For college students, nutrition intake and academic performance are correlated with social jetlag, which should be emphasized for college health,^{150,151} and according to a study, morning-type campus residents have worse well-being than other campus residents due to social jetlag.⁹³ In addition, a recent finding revealed that a heavy lunch and rapidly absorbing carbohydrates enhance sleepiness, and a light evening meal rich in carbohydrates may help one fall asleep.¹⁵² Better information about nutritional issues must be taken into consideration in terms of sleep health promotion. Additionally, proper napping during the day might strengthen overall sleep quality, but more effort is needed to provide guidance for proper napping. Pain and fatigue were also identified as possible causes of poor sleep.

Mental health problems (such as depression, psychiatric disorders, perceived stress, and anxiety) are undoubtedly hazardous to sleep quality, a previous publication highlighted the relationship between mental health and sleep quality.¹⁵³ Based on these results, more attention should be given to the importance of mental health in relation to sleep quality. Given the abundance of evidence suggesting that poor mental health impairs sleep quality, interventions to improve mental health status are highly recommended.

Despite the substantive findings above, the controversial sleep outcomes of certain determinants need to be taken into account. Several reasonable explanations could be as follows. First, the measurement of the predictors was not consistent. For instance, perceived stress was measured by the Depression Anxiety Stress Scale (DASS 21),¹⁰⁹ the Perceived Stress Scale (PSS-10)¹²² or simply by one sentence (“At the moment, I feel stressed out”) on a scale from 1 (not at all) to 5 (very).¹¹⁴ In the case of physical activity, existing evidence demonstrated that its dimensions (i.e., frequency, intensity, and duration) are associated with self-reported sleep parameters.¹⁵⁴ Furthermore, the quality of the included studies may have differed. Additionally, the use of different sleep quality measurements should also be considered.¹⁵⁵ In fact, a majority of the included articles adopted the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality and sleep components, but other scales or equipment were also utilized to measure sleep quality. The reliability and validity of different measurements are supposed to be varied. However, the quantitative comparison of the positive and negative outcomes provides directive and solid evidence on determinants of sleep quality.

The present study has several implications and significance. In this study, a number of studies related to sleep determinants were identified. This study examined research-based evidence regarding sleep interventions and health promotion. The practical implications of the present study include fostering healthy life habits and formulating a conception of sleep health. Another implication of the current study is that it highlighted the importance of various factors that may influence sleep quality. Therefore, when conducting sleep interventions, potential confounding factors should be taken into consideration. Education is important for promoting sleep health and improving sleep quality among college students. The significance of the present study mainly includes synthesizing the existing literature on sleep determinants and providing accumulative evidence for sleep health interventions.

This review also has limitations. First, when selecting articles from the three databases (PubMed, Web of Science and Cochrane Library), publication bias (i.e., studies with positive results have a higher chance to be published) can be a potential risk that, unfortunately, cannot be avoided. Second, different methods were used to measure sleep quality in the included studies, which can limit comparability. Additionally, the review did not distinguish demographic factors that contribute to sleep quality, which could be a limitation. Third, institutional factors such as the education system and study field of college students may also violate sleep outcomes. Last but not least, the included studies were mostly cross-sectional studies.

Conclusions

This study examined the determinants of sleep quality by using the scoping review method. To the best of our knowledge, this is the first review of the scientific literature to synthesize the main determinants of sleep quality among college students. We categorized the relevant studies and summarized the positive and negative effects on sleep quality of the different determinants. The determinants of sleep quality are diverse, and we found that lifestyle factors closely affect sleep quality, and mental health factors, social factors and physical factors were also significant elements associated with sleep quality in college populations. One of the important findings of this study is that physical activity, as a determinant of sleep quality, has both

positive and negative effects. This result may lead to future studies and directions for sleep interventions. This study provided additional evidence to clarify the main risk factors for poor sleep quality. Lifestyle confounders should be taken into consideration before launching sleep quality intervention studies. Particularly for college students, more investigations on social jetlag by combining the identified determinants are recommended. These findings can be useful for planning interventions to improve sleep quality, and through the improvement of sleep quality, the general health and academic performance of college students can also be enhanced.

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