



Impact Paper

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Corresponding author:

Michael Jackson Oliveira de Andrade;
Email: michael.andrade@uemg.br

Sustainable development goals and sleep: an integrative review of sleep health disparities and social, economic, and environmental sustainability

Michael Jackson Oliveira de Andrade

Neuroscience, Chronobiology, and Sleep Psychology Laboratory, State University of Minas Gerais, UEMG, Brazil

Abstract

Sleep is a topic of scientific and technological relevance, as it is closely related to cognition, emotional well-being, and human health. In addition, health-related geopolitical and social changes have significant implications for sleep research, which in turn is linked to the sustainable development goals (SDGs). An integrative review is conducted to analyze multidisciplinary studies in the field of sleep, considering the socioecological model of sleep health and the SDGs. Sleep was found to play a key role in promoting several SDGs: (1) Social and economic inclusion: sleep is linked to poverty eradication, food security, reducing inequalities, and promoting peace and justice; (2) Promoting well-being and quality of life: sleep quality directly affects health, education, gender equality, environmental protection, and combating climate change; (3) Economic and environmental sustainability: Adequate sleep contributes to decent work, innovation, infrastructure, responsible consumption, sustainable communities and collaboration through partnerships. This thematic organization provides an overview of the different aspects of the intersection between sleep health disparities and the SDG.

Introduction

Sleep health has a direct impact on human health, well-being, and performance. We emphasize that adequate sleep is essential for the cognitive, emotional, and physical functioning of humans throughout their lifespan. However, many people struggle with sleep-related problems, such as insomnia and chronic sleep deprivation, due to a variety of factors including hectic lifestyles, stress, and adverse environmental conditions. By promoting healthy sleep and improving our understanding of sleep-related factors, we can ensure a higher quality of life for individuals and contribute to a more sustainable future for everyone.

Sleep research plays a fundamental role in addressing socio-political and environmental challenges in accordance with the principles of the United Nations 2030 Agenda. The 2030 Agenda consists of 17 sustainable development goals (SDGs) that encompass a wide range of areas, including health and well-being promotion, quality education, clean water and sanitation, affordable and clean energy, decent work and economic growth (United Nations, 2015a). A collaborative dialogue between various fields of knowledge facilitates a more profound comprehension of the factors that influence human well-being and aids in the formulation of public policies for sustainable development. Thus, a multidisciplinary approach is critical for developing innovative and sustainable solutions that guarantee long-term quality of life. Collaboration between health, environmental, political, economic, and social sciences is essential to address the complex issues of sleep health disparities and well-being worldwide.

In this text, we aim to explore the relationship between promoting sleep health and achieving the SDGs, highlighting the importance of sleep for a more sustainable future. This article discusses the role of sleep and sleep quality by defining the contributions of sleep ecology to the study and advancement of sleep quality, how to incorporate sleep into the promotion of sustainable development, and the integration of sleep science in advancing the SDGs. However, our goal is to provide information and perspectives that can foster future discussions and deepen our understanding of sleep ecology. It is important to emphasize that sleep is a constantly evolving field of research, with new discoveries and approaches being made regularly.

Sleep

Sleep is a complex process that involves more than just closing your eyes. It is an easily reversible state of reduced responsiveness and interaction with the external environment compared to the waking state (Markov and Goldman, 2006). Various theories attempt to explain why we sleep, including theories on energy conservation, neural reorganization, brain development, as well as evolutionary adaptation to the environment during the light-dark cycle (Brinkman et al., 2023).

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The mechanism by which sleep is generated and maintained is based on the balance between two main systems: homeostatic processes and the circadian rhythm. Homeostatic processes represent the body's "need for sleep," building up sleep pressure the longer a person stays awake. The circadian rhythm, in turn, is an internal biological clock that regulates the sleep-wake cycle, synchronizing it with the external environment. Together, these systems interact to ensure that sleep occurs at appropriate times and effectively, responding to both the organism's internal needs and environmental influences. In this way, contextual characteristics of the environment, such as family dynamics, social cohesion, safety, socioeconomic status, and hunger, can shape and/or impact sleep patterns (Grandner et al., 2016). Physical characteristics, such as light, noise, traffic, and pollution, are related to sleep disturbances (Pirrer et al., 2014). Furthermore, it is likely that some of the neurobiological processes that occur during sleep, in interaction with the physical and social environment, may contribute to delayed sleep-related behaviors or early waking. These factors are essential for maintaining human physical and cognitive health (Johnson et al., 2018).

Human ecology and sleep

Sleep behavior and architecture clearly have strong biological determinants. However, sleep is embedded in socially and culturally constructed environments that define the ecology of sleep. Additionally, the diurnal pattern of sleep is shaped by a series of organizational and social characteristics that vary throughout life, including work demands, social activity schedules and rituals, status differentiation and roles, and beliefs about the nature and functions of sleep. Thus, the field of sleep ecology investigates the impact of the environment on sleep and how sleep patterns adjust to a set of physical, cultural, and biotic factors under which people sleep. The consequences of sleep deprivation on wakefulness and human survival have adapted over the course of evolution (Loftus et al., 2022). Therefore, studying sleep allows us to understand its adaptive function, as it reflects the evolutionary trade-offs of sleep in humans and other species (Aulsebrook et al., 2016). This approach considers the benefits and advantages that inform sleep-related decisions in various settings.

It is important to keep in mind that the study of sleep ecology is still in its infancy in the field of health sciences and is interdisciplinary in nature. However, we emphasize the socio-ecological relationship between sleep and its ecological aspects. For example, disturbances caused by urbanization, such as noise, light pollution, and air pollutants, have been studied for their effects on sleep patterns and overall quality of life. Studies have shown that these factors can have a negative impact on the quality and duration of sleep in urban populations. In addition, studies have demonstrated the detrimental effects of noise on sleep quality and overall well-being (United Nations, 2015b; Loftus et al., 2022). Frequent exposure to aircraft, road, highway, and railroad noise has been associated with an increased incidence of hypertension and cardiovascular disease, as well as cognitive impairment (Hughes & Jones, 2003).

Promoting sustainability by incorporating sleep into sustainable development

The socio-ecological model of sleep emphasizes the complex interaction between individual, social, and environmental factors that play a critical role in influencing the quality and duration of

sleep (Hale & Do, 2020). As discussed previously, sleep deprivation can have negative impacts on productivity, health, education, and aging in society, thereby affecting social and economic sustainability (Patrick et al., 2017).

The socio-ecological model offers an approach that considers individual behavior in relation to social factors, such as social networks (e.g., family and work), which are interconnected and embedded in larger networks (e.g., community and religion) (McHugh & Lawlor, 2013). Social network systems exist within a social context that is influenced by various factors, such as laws, technology, and economics (Bronfenbrenner, 1977). Additionally, human development is shaped by cultural and ethnic contexts (Bronfenbrenner & Morris, 2006), environmental factors, and biotechnological factors (Bronfenbrenner, 1977). The socio-ecological approach identifies the key components of these systems that are believed to influence sleep at the individual, social, and societal levels.

To achieve the SDGs on health, education, decent work, and social well-being, it is essential to develop policies and actions that promote healthy and high quality sleep. These include implementing public policies, educational programs, creating sleep-friendly environments, and raising awareness about the importance of good sleep (Hirshkowitz et al., 2015). By considering sleep as an essential aspect of sustainable development, we can formulate strategies that guarantee sustainable sleep for everyone.

Integrating sleep research into the human impact of the SDGs can help achieve these goals in several ways, including promoting sleep health as an essential component of overall well-being. These include improving health, preventing disease, ensuring equitable access to the resources needed for adequate sleep, and reducing environmental impacts associated with energy use (United Nations, 2015b). Thus, incorporating sleep research into these sustainable strategies can lead us to a healthier and more sustainable future for all (Elsie, Isabelle, & Bronwyn, 2020; Cunningham et al., 2020). Actions based on this knowledge have the potential to improve people's quality of life while having a positive impact on the environment and the global economy (Ta & Habicht, 2018).

Indeed, recognizing sleep as a fundamental aspect of sustainable development is crucial for achieving optimal sleep quality (McHugh & Lawlor, 2013). In this context, actions aimed at reducing poverty and improving living conditions play a crucial role. Among these actions, the promotion of a sleep-friendly environment stands out. These include ensuring access to safe and adequate housing, reducing noise pollution, and improving public safety. These measures are fundamental to addressing poverty and promoting overall well-being (Cappuccio et al., 2010).

Integrating sleep health into the achievement of social, economic, and global well-being

The integration of sleep research as an interdisciplinary field has far-reaching implications for various areas of society. It addresses both social and economic issues, aiming to improve the quality of life for people worldwide. We present an integrative review of topics that align with sustainable development: (1) Social and economic inclusion, which encompasses poverty eradication, food security, reducing inequalities, and promoting peace and justice; (2) Promoting well-being and quality of life, which includes health, education, gender equality, environmental protection, and climate change mitigation; and (3) Economic and environmental sustainability, which involves decent work, innovation, infrastructure,

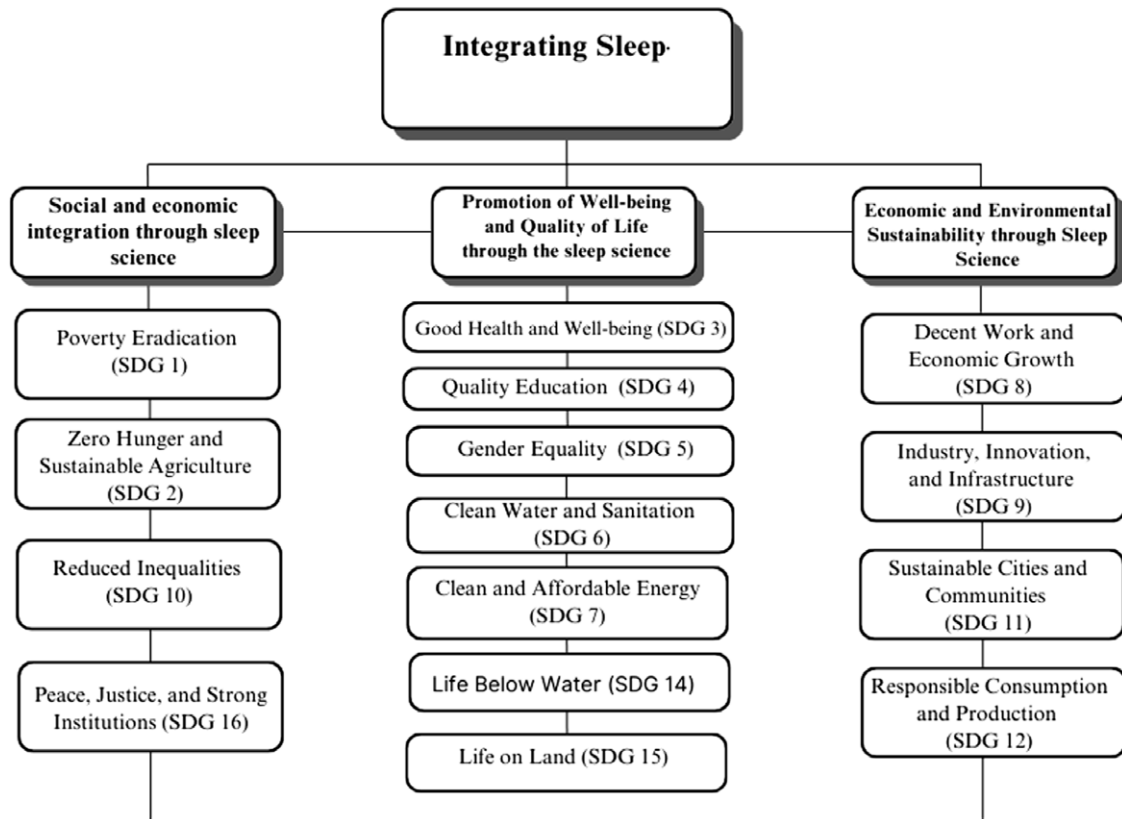


Figure 1. Integrating sleep quality into achieving social, economic, and global well-being.

responsible consumption, sustainable communities, through multilateral partnerships and collaborations. This outline categorizes the themes based on their thematic commonalities and provides an overview of the various aspects of integration between sleep science and the SDGs (Figure 1).

1. Social and economic integration for sleep health

Table 1 provides a detailed description of the categories related to sustainable development, with a focus on eradicating poverty in sleep research. This category highlights key areas where sleep plays a critical role in finding sustainable solutions (Hale et al., 2014). In addition, food insecurity has been observed to have a negative impact on quality of life. The lack of access to sufficient and nutritious food can result in physical and mental health issues (Ta & Habicht, 2018). This can impact sleep quality, as inadequate nutrition can contribute to sleep disturbances. To address food insecurity and improve quality of life, it is important to promote equitable access to nutritious food, invest in social support programs, promote sustainable agriculture, and strengthen food supply chains (Moraes et al., 2018).

The table also highlights that social inequality can affect sleep quality. This emphasizes the importance of inclusive policies, equitable access to basic services, investment in mental health, adoption of healthy habits, and awareness to improve the overall sleep quality of the population (McHugh, & Lawlor, 2013). Additionally, it emphasizes the importance of addressing socioeconomic inequalities and distributing health resources and services equitably to ensure better sleep quality for all (Moraes et al., 2018).

The interaction between peace, justice, effective institutions, and people’s well-being is relevant. Studies show that stress, conflicts, and violence have a negative impact on sleep quality, while access to fair justice and satisfactory living conditions are associated with improved sleep (Wu et al., 2015). Policies and measures to promote sleep health are crucial, including educational programs and the reduction of detrimental factors. Additionally, sufficient sleep influences decision-making abilities and institutional functioning (Ta & Habicht, 2018). These connections highlight the importance of addressing peace, justice, and effective institutions in relation to sleep, as they contribute to individual well-being and societal functioning.

2. Promotion of well-being for sleep health

Table 2 highlights the connection between health, well-being, and sleep health, emphasizing the importance of raising awareness about sleep health disparities and identifying solutions to address the challenges impacting sleep quality. When sleep quality is compromised, various aspects of health, including physical, mental, and emotional well-being, can be negatively impacted (Elsie, Isabelle, & Bronwyn, 2020). Therefore, potential solutions involve educating individuals on sleep hygiene, promoting sleep-friendly environments, establishing consistent sleep routines, managing stress, and adopting a holistic approach to health by acknowledging the significance of sleep quality in overall well-being (Cunningham et al., 2020).

Table 2 also highlights the role of sleep quality in relation to learning challenges in schools and educational contexts (Cunningham et al., 2020). It is important to note that before

Table 1. Social and economic integration for sleep health

Poverty eradication (SDG 1)	
Impacts of poverty on sleep quality	Poverty can lead to a lack of access to sufficient resources to ensure quality sleep.
	Sleep deprivation can result in difficulties at work, school, and in terms of productivity, perpetuating the cycle of poverty.
	The lack of proper sleep can have a negative impact on the physical and mental health of individuals living in poverty.
The importance of adequate sleep in poverty eradication	Quality sleep contributes to both physical and mental health, enhancing learning capacity and performance at work and school.
	Promoting environments that enable equitable access to quality sleep can be an important strategy for alleviating poverty.
Measures to promote healthy sleep in poverty-stricken contexts	Improvement of living conditions includes access to safe and adequate housing, reduction of noise pollution, and enhancement of public safety.
	Education on sleep and providing resources to enhance sleep quality.
	Reducing disparities in access to quality sleep between individuals living in poverty and those who do not face these challenges.
Actions needed to promote healthy sleep and eradicate poverty	Construction of safe and affordable housing.
	Provision of food and clean drinking water.
	Promotion of education on sleep health and the prevention of sleep disorders.
	Policies and practices that foster an environment conducive to quality sleep and poverty eradication.
Zero Hunger and Sustainable Agriculture (SDG 2)	
Food insecurity and quality of life	Food insecurity can have a detrimental impact on people's quality of life.
	Insufficient access to food can lead to fatigue, anxiety, stress, and malnutrition.
Food insecurity and sleep quality	Insufficient access to food can have a negative impact on sleep quality.
	Hunger can cause eating disorders and lead to poor sleep quality.
The relationship between a healthy diet and sleep quality	A healthy and balanced diet can improve the quality of sleep.
	Foods rich in tryptophan, magnesium, and calcium can help promote sleep.
Sustainable agriculture and sleep quality	Sustainable agriculture can improve air and water quality and promote a healthier environment.
	Adopting sustainable agricultural practices can reduce exposure to toxic chemicals and improve the quality of sleep.
Food policies and sleep quality	Policies and programs aimed at improving access to food and reducing food insecurity can significantly impact sleep quality.
Reduced Inequalities (SDG 10)	
Impact of social inequality on sleep quality	Lack of access to basic resources, such as clean water, adequate sanitation, and proper nutrition, can lead to poor health conditions that have a negative impact on sleep quality.
	Lack of economic and social security can cause stress and anxiety, which can also impact sleep.
Promotion of inclusive policies and ensuring equitable access to basic services	The promotion of inclusive policies and equitable access to basic resources is essential for improving the population's sleep quality.
	The availability of resources such as clean water, adequate sanitation, access to healthcare services, public safety, and proper housing directly influence the quality of sleep.
Inclusive Policies to Improve Sleep Quality	Investing in sanitation and ensuring access to clean drinking water is essential to prevent diseases and promote personal hygiene, which are determining factors for good sleep quality.
	Reducing socioeconomic inequalities, such as income redistribution and improving working conditions, can contribute to enhancing sleep quality.
	Investing in mental health policies and promoting healthy habits are also measures that can improve sleep quality.
Impact of the Unequal Distribution of Resources and Healthcare Services	The unequal distribution of resources and healthcare services can have a negative impact on the quality of sleep among the population, particularly for those residing in areas with limited resources.
The Importance of Public Policies and Awareness	Increasing awareness of the importance of sleep and providing information and resources to improve sleep habits are crucial for promoting a healthy lifestyle.
Peace, Justice, and Strong Institutions (SDG 16)	
Impact of Stress, Conflicts, and Violence on Sleep Quality	Stress, conflicts, and violence can have a detrimental effect on sleep quality, leading to disorders such as insomnia and mental health issues.

(Continued)

Table 1. (Continued)

Peace, Justice, and Strong Institutions (SDG 16)	
Access to justice and sleep	Lack of access to fair and impartial justice systems can have a detrimental effect on sleep, as individuals may experience stress due to prolonged legal disputes or unresolved conflicts.
The Relationship Between Human Rights and Sleep	Protecting human rights and ensuring adequate living conditions are associated with better sleep quality. This includes access to safe conditions, suitable housing, dignified work, and a balance between work and personal life.
The Impact of Adequate Sleep on Decision-Making and Institutional Functioning	Adequate sleep positively influences the ability to make informed decisions, participate in democratic processes, and contribute to the effectiveness of institutions.

* SDG: Sustainable Development Goals.

sleep can positively impact learning, sustainable development must successfully expand access to basic education. It is essential to consider the social and behavioral factors that influence students' sleep quality, such as irregular schedules, excessive workload, inappropriate use of electronic devices, poor nighttime sleep and eating habits, and a lack of awareness about the importance of adequate sleep quality and quantity, especially for school-aged children and adolescents. To address this issue, it is crucial to raise awareness about the importance of sleep and develop effective adaptive strategies to promote sleep health (Curcio, Ferrara, & De Gennaro, 2016). This may include creating sleep-friendly environments in schools, such as adjusting class schedules, reducing workload, and providing suitable rest spaces. Additionally, these initiatives align with the SDGs, which aim to ensure quality education for all students (Akerstedt, Kecklund, & Johansson, 2004).

The relationship between gender equality and sleep health seeks to promote greater equity by recognizing and addressing the specific differences and challenges in sleep quantity and quality faced by men and women due to sociocultural issues (Shen, Barbera, & Shapiro, 2006). Social and cultural norms play a significant role in this context, affecting sleep timing and quality differently for each gender. For example, expectations about gender roles, unequal division of household tasks, daytime and nighttime work demands, and parenting responsibilities can significantly impact women's sleep quality compared to men's (Kravitz et al., 2003). It is crucial to ensure that both men and women have equal access to sleep-related healthcare, including psychoeducation, assessment, and treatment of sleep disorders. This is an important step in addressing gender disparities in this area (Table 2).

Emphasized the importance of having sufficient access to sanitation for improving people's sleep quality (Reinberg, Smolensky, & Touitou, 2005). The absence of proper sanitation facilities and limited access to clean water can create unhealthy conditions, contribute to the spread of diseases, and impair sleep quality. To address this issue, it is essential to consider relevant variables, develop evidence-based policies, and implement practices that meet the needs of communities (Prüss-Ustün et al., 2019). This integration seeks to ensure a healthy environment and promote sleep quality through adequate access to sanitation. It underscores the importance of investments and effective actions in this area.

Kumar, Gupta and Singh (2019) organized information on the connections between clean energy, sleep science, and sustainable development. The authors discuss various topics related to electricity access and sleep quality, including clean energy and sleep quality, the effects of dirty energy production on sleep

disorders, the intersection of sleep science and clean energy, and the integration of clean energy, sleep science, and sustainable development. These topics explore the impact of energy generation and electricity access on sleep quality and the role of sleep science in understanding this relationship. The challenge is to ensure that populations have reliable and sustainable access to electricity without compromising sleep quality. This involves the development of accessible, reliable, and low-impact energy solutions that do not disrupt people's sleep (Wang & Zhang, 2019).

Additionally, Table 2 illustrates how climate change and inadequate water resource management can influence people's sleep quality. The table highlights that policies and strategies to address climate change can contribute to creating healthier and more sustainable environments, which, in turn, may indirectly improve sleep quality by reducing environmental stressors such as extreme temperatures (Wolska & Smith, 2019). The importance of sustainable water resource management and access to clean water and sanitation is also emphasized, as these are essential factors for overall health and may have indirect impacts on sleep quality, especially in health and well-being contexts (Jiménez-Cisneros et al., 2014; Vörösmarty et al., 2010). To address these complex challenges, an integrated approach is necessary, with cooperation among countries, international organizations, and communities, focusing on sharing knowledge, resources, and specific practices to tackle environmental and health issues (Brown & Meeks, 2015).

The interaction between aquatic life and sleep science highlights the significance of aquatic ecosystems in climate regulation, global biodiversity conservation, and sleep quality. The impacts of climate change, exposure to toxic metals, and water quality can negatively affect sleep quality. This highlights the importance of protecting and preserving aquatic environments to promote healthy and sustainable sleep (Ozbayram et al., 2022). This integration is understood through various perspectives, including categories such as aquatic biodiversity and climate change, the importance of aquatic ecosystems, the relationship between sleep quality and the aquatic environment, the impact of exposure to toxic metals on sleep quality, and the connection between water quality and sleep quality (Hysing et al., 2016).

Lastly, Table 2 highlights the interaction terrestrial life and sleep health, emphasizing the importance of terrestrial ecosystems in efficiency, environmental issues, and their impact on sleep quality, the promotion of sleep quality and well-being, and the conservation of terrestrial ecosystems and biodiversity (Scott et al., 2012). The importance of protecting terrestrial ecosystems and preserving biodiversity is emphasized, as it is crucial for the preservation of life on land and for ensuring adequate sleep quality and promoting human well-being (Kecklund, & Axelsson, 2016). The integration between terrestrial ecosystems and sleep science is

Table 2. Promotion of well-being for sleep health

Good Health and Well-being (SDG 3)	
The importance of sleep for health and well-being	Health and well-being are fundamental aspects for achieving good sleep quality
	Sleep quality enhances mental health.
	Both quantity and quality of sleep are important for health.
	Inadequacy in sleep quantity or quality can impair immune, cognitive, emotional function, and the ability to cope with stress.
The relationship between sleep and physical and mental well-being is bidirectional.	
Strategies for promoting Healthy sleep	Taking care of physical and mental health, having a proper nutrition, engaging in regular physical activity, establishing routines, and creating a sleep-friendly environment.
	Measures such as establishing a consistent sleep schedule, creating a quiet and dark sleeping environment, limiting the use of electronic devices before bedtime, ensuring a balanced and healthy diet, and promoting recreational and social activities are recommended.
Taking care of sleep quality to maintain physical and mental health	Healthy practices include maintaining a regular sleep routine, creating a comfortable sleep environment, avoiding excessive technology use before bedtime, and managing stress and anxiety.
	Paying attention to obtaining good-quality sleep, without excessive sleepiness, without the need for more sleep, and with sufficient depth is important.
Quality Education (SDG 4)	
The importance of quality education	Quality education is crucial for human development, poverty and inequality reduction, and sustainable economic growth.
	Quality education has a positive impact on the health, well-being, and social and economic development of individuals.
	To ensure equal opportunities, education must be inclusive and equitable.
Impact of sleep on learning and academic performance	Sleep quality directly affects students' academic performance and learning.
	Sleep plays a fundamental role in memory consolidation and retaining knowledge acquired during the day.
Factors affecting students' sleep quality	Excessive use of electronic devices before bedtime can impair sleep quality due to the blue light emitted by these devices, which interferes with melatonin production.
	The busy routines of students can lead to a lack of time for sleep, negatively impacting sleep quality and academic performance.
Raising awareness of the importance of sleep and strategies to promote healthy sleep	It is important to promote awareness of the importance of sleep and encourage the adoption of healthy sleep practices.
	Individual circadian rhythm preferences can affect academic performance, and schools should be aware of these differences and develop appropriate strategies.
Measures to create a sleep-conducive environment in schools	Establishing regular sleep schedules and creating a quiet and comfortable sleep environment are essential in schools.
	Balancing study, leisure, and sleep is crucial to promoting academic success.
Gender Equality (SDG 5)	
Impact of sleep quality on gender equality	Sleep quality can have a significant impact on gender equality.
	Gender differences in sleep quality can perpetuate inequalities in everyday life.
Gender differences in sleep quality	Women have a shorter circadian rhythm than men, resulting in daytime sleepiness and difficulty maintaining restful sleep at night.
	Women tend to have more rapid eye movement (REM) sleep than men, possibly due to hormonal differences.
	Women report more sleep problems such as insomnia, sleep apnea, and restless legs syndrome than men.
	Women often have more difficulty sleeping well than men, due to caregiving responsibilities, menstruation, pregnancy, menopause, and gender-specific sleep disorders.
Promoting gender equality through improving sleep quality	Improving sleep quality is important for both women and men, providing everyone with equal opportunities.
	Guidelines on maintaining a healthy sleep routine, including creating an appropriate sleep environment and practicing relaxing habits before bedtime, are essential.
	Awareness of the specific sleep issues faced by both genders is crucial.
Clean Water and Sanitation (SDG 6)	
The importance of access to clean water and adequate sanitation	The availability of clean water and proper sanitation is essential for human health.
	Lack of access to basic sanitation can lead to various diseases and complications, such as diarrhea, cholera, and typhoid fever.
	The absence of adequate sanitation facilities can hinder personal hygiene and affect sleep quality.

(Continued)

Table 2. (Continued)

Clean Water and Sanitation (SDG 6)	
Impact of lack of adequate sanitation access on sleep quality	Lack of proper sanitation access can lead to health problems that impact sleep.
	Lack of personal hygiene due to lack of access can result in health issues that compromise sleep.
Benefits of access to clean water and adequate sanitation for sleep quality	Access to clean water and proper sanitation can improve hygiene and health conditions.
	Clean water and proper sanitation can result in a more peaceful and restorative sleep.
Variables influencing the relationship between sanitation and sleep quality	The relationship between sanitation and sleep quality may vary depending on cultural, social, and economic contexts.
Need for further research and policies/practices	It is necessary to develop policies and practices that promote the availability of clean water and proper sanitation as a means to improve sleep quality and overall health of the population.
Clean and Affordable Energy (SDG 7)	
Access to electricity and sleep quality	Access to reliable electrical energy can improve living and working conditions, including providing adequate lighting for quality sleep.
Clean energy and sleep quality	Clean energy sources, such as solar and wind power, can contribute to reducing air pollution, which negatively affects sleep quality and respiratory health.
	Renewable energy sources may have some potential health impacts, but they are generally considered to be smaller than those associated with non-renewable energy sources.
Dirty energy production and sleep disorders	Dirty energy production, such as from fossil fuels, can contribute to greenhouse gas emissions, which can have negative impacts on human health, including sleep disorders.
Sleep sciences and clean Energy	Research in sleep sciences can lead to better practices and policies to promote sleep quality and people's health.
	Investments in clean and affordable energy sources can promote health and improve sleep quality for individuals.
Climate Action (SDG 13)	
Water resources and healthy sleep	Sustainable water resources management is essential for quality of life and healthy sleep.
	Access to clean water and sanitation facilities is fundamental for sleep quality.
Impact of climate change on sleep quality	High temperatures associated with climate change can disrupt sleep.
	Prolonged drought can cause respiratory problems like snoring and sleep apnea.
	Water and air pollution resulting from poor water resources management can affect sleep quality.
Impact of climate change on water resources	Climate change significantly impacts water resources worldwide.
	The increase in global average temperature alters rainfall patterns, leading to prolonged droughts and floods.
	Prolonged droughts can affect the availability and quality of freshwater.
Consequences of inadequate water resources management	Water scarcity compromises personal hygiene, including sleep hygiene.
	Lack of hygiene increases the risk of infectious diseases and other health conditions that impact sleep.
Innovative policies and strategies	Implementing innovative policies and strategies is crucial to promoting sustainable water resources management and improving access to clean water and sanitation facilities.
Life Below Water (SDG 14)	
Aquatic Biodiversity and Climate Change	Aquatic biodiversity reflects climate changes and diverse conditions in aquatic environments.
	Climate change affects aquatic ecosystems through rising temperatures, sea levels, monsoon variations, and extreme weather events.
Importance of Aquatic Ecosystems	Aquatic ecosystems play a crucial role in climate regulation.
	Aquatic ecosystems are essential for conserving global biodiversity.
Sleep Quality and Aquatic Environment	Sleep quality can be influenced by the environment we sleep in.
	Seas and rivers can indirectly impact sleep quality, depending on geographic location and environmental conditions.
	Living near areas with constant noise from boat traffic or the sound of waves can disrupt sleep.
Exposure to Toxic Metals and Sleep Quality	Plants growing in substrates with high concentrations of toxic metals face ecological and environmental risks.
	Exposure to toxic metals is associated with the prevalence of sleep disorders.

(Continued)

Table 2. (Continued)

Life Below Water (SDG 14)	
Water Quality and Sleep Quality	Water quality, including the presence of pollution or toxic algae, can affect the air quality around it and impact sleep quality.
Life on Land (SDG 15)	
Terrestrial ecosystems and sleep quality	Preserved and healthy ecosystems promote good sleep quality.
	Green areas provide spaces conducive to rest and relaxation.
Environmental issues and sleep quality	Degradation of terrestrial ecosystems results in air and soil pollution.
	Negative impact on sleep quality, such as respiratory disorders.
Promoting sleep quality and well-being	Preservation of biodiversity, reduction of pollution, and natural environments conducive to rest.
	Improvement of sleep quality and promotion of overall well-being and health.
Conservation of terrestrial ecosystems and biodiversity	Contribution to the preservation of life on land.
	Promotion of healthy and sustainable sleep for present and future generations.

essential to understand how life on land directly influences human sleep and how their preservation is fundamental to the health and balance of the planet.

3. Economic and environmental sustainability for sleep health

Table 3 emphasizes the importance of ensuring appropriate working conditions, including safe and decent jobs, while also recognizing the impact of night and shift work on workers' health and sleep quality (Tyrväinen et al., 2014; Costa, & Sartori, 2007). The table addresses the following points: the negative impact of a lack of safe and decent jobs; the impact of night and shift work on health and sleep quality; the negative impact of a lack of workplace safety and exposure to occupational hazards; the importance of decent work and research in sleep science; and the connection between decent work, sustainable economic growth, and investment. The text emphasizes the significance of ensuring suitable employment, considering the effects of night and shift work on workers' health and sleep quality. Additionally, it emphasizes the importance of promoting workplace safety and investing in decent work and conducting research on sleep science as ways to promote sustainable development for both individuals and the economy.

The adoption of measures focused on sleep health and technological innovation can bring significant benefits to both workers and companies, such as the development of low-cost, sustainable, and easy-to-implement solutions. These actions have the potential to improve quality of life, well-being, and productivity in the workplace, particularly in economically and sustainably developing countries. In summary, the main points addressed in the text emphasize the importance of implementing measures that promote workers' health and well-being. This includes the application of advanced technologies, process automation, the use of light therapies, and health monitoring (Kecklund, & Axelsson, 2016). These strategies aim to improve workers' sleep quality, reduce occupational risks, and boost productivity (Duffy, Zitting, & Chinoy, 2018; Sjösten, Nordin, & Åkerstedt, 2016).

The significance of individual, interpersonal, community, and environmental factors in sleep quality, as well as the positive impact of sustainable development goals on quality of life, including sleep quality, is emphasized in Table 2. It is important to note that SDGs (Bronfenbrenner, & Morris, 2006; Hirshkowitz et al., 2015), and (Industry, Innovation, and Infrastructure; Reduced Inequalities; Sustainable Cities and Communities) are

interconnected and have a direct impact on people's quality of life, including the promotion of quality sleep. Furthermore, there is an emphasis on the importance of creating healthy urban environments and ensuring equal access to essential services to promote improved sleep quality and overall quality of life.

Furthermore, Table 3 examines the correlation between responsible consumption and production, pollution, energy efficiency, thermal comfort, and sustainability awareness. It demonstrates how these factors can impact individuals' quality of life and sleep quality. Overall, the significance of embracing conscious and sustainable consumption practices, minimizing waste, and utilizing natural resources responsibly is emphasized (Hysing et al., 2016; Duffy, Zitting, & Chinoy, 2018).

When addressing partnerships and the implementation of SDG 17 in relation to sleep, it is important to emphasize the significance of interdisciplinary collaboration among healthcare professionals, researchers, governments, the private sector, and civil society. These partnerships promote awareness, research, and the implementation of healthy sleep policies. Investment in research is crucial for understanding sleep disorders, identifying risk factors, and determining the best treatment practices. Public education is essential, with partnerships aimed at developing educational programs and campaigns that emphasize the importance of healthy sleep. Integrating sleep into public policies aims to create environments that are conducive to sleep and prevent associated health problems (Hysing et al., 2016). Technology and innovation aid in sleep monitoring and provide access to information on sleep hygiene (United Nations, 2015a). Partnerships are vital for implementing monitoring and evaluation systems and adjusting intervention strategies.

Final considerations

In conclusion, the impact of sleep disparities is intricately linked to a diverse array of factors, including individual, social, and environmental elements. Emphasizing the role of sleep science and its impact on health, productivity, and well-being enables the development of policies and interventions that promote healthy sleep practices. By spreading knowledge about sleep, we can increase awareness of its significance and promote efforts to achieve the SDGs. Addressing social and economic disparities, while promoting sleep-friendly environments, is crucial for ensuring equal access to high-quality sleep for everyone.

Table 3. Economic and environmental sustainability for sleep health

Decent Work and Economic Growth (SDG 8)	
Impact of the lack of decent and secure jobs	The lack of decent and well-paying jobs can negatively impact people’s quality of life and mental health
	The lack of job security and exposure to occupational risks can have adverse effects on both physical and mental health.
Impact of night and shift work on sleep quality and health	Night and shift work can have negative impacts on sleep quality and individuals’ health.
	Workers on irregular shifts may experience sleep disorders and related health issues such as diabetes, obesity, and cardiovascular diseases.
	Employees with irregular or shift schedules may find it challenging to maintain a regular and healthy sleep routine, which can lead to sleep-related problems such as insomnia.
Impact of lack of job safety and exposure to occupational risks	The lack of job safety and exposure to occupational risks can have significant impacts on individuals’ physical and mental health.
	Workplace accidents and occupational diseases are associated with a wide range of mental health issues.
	Exposure to occupational risks and the lack of job safety can cause health problems that negatively affect sleep, such as snoring and sleep apnea.
Importance of decent work and research in sleep science	Investing in decent work policies and practices can positively impact the health and well-being of workers.
	Research in sleep science can lead to better practices and policies to improve workers’ sleep quality, resulting in health and well-being benefits.
Connection between decent work, sustainable economic growth, and investment.	The connection between decent work and sustainable economic growth is undeniable.
	Improving the sleep quality of shift and night workers can have significant benefits for health, well-being, productivity, and economic performance.
	Investing in decent work policies and sleep science research can promote health, well-being, and sustainable economic development.
Industry, Innovation, and Infrastructure (SDG 9)	
Promotion of health and well-being of workers	The implementation of advanced and efficient technologies in an industrial context can reduce occupational risks and improve working conditions.
	The use of advanced technologies and health monitoring can contribute to the control of risks related to workers’ sleep health.
Process automation and job reduction	Process automation is a solution that can reduce the need for shift and night work, which is associated with sleep health issues.
	The implementation of advanced technologies can contribute to controlling risks related to workers’ sleep health.
Health monitoring technologies	Health monitoring technologies can be utilized to detect sleep-related issues among workers.
	These technologies enable early interventions to prevent or treat sleep problems.
Technological innovation and solutions for shift/night workers	A Technological innovation plays a crucial role in developing solutions to improve workers’ sleep quality.
	Light therapy and special lights can be used to regulate workers’ circadian rhythm and enhance sleep quality.
	The implementation of advanced technologies can increase productivity and the economic performance of companies.
Sustainable Cities and Communities (SDG 11)	
Development of sustainable and healthy urban environments	The development of sustainable and healthy urban environments not only contributes to the quality of sleep but also to the overall health and well-being of people living in these communities.
Equitable access to basic services	Equitable access to basic services, such as clean water, proper sanitation, healthcare services, public safety, and adequate housing, plays a crucial role in improving sleep quality and overall quality of life.
Responsible Consumption and Production (SDG 12)	
Impact on quality of life and sleep	Responsible consumption and production have a positive impact on people’s quality of life, including sleep quality.
Reduction of pollution and carbon footprint	There is a need to reduce air and noise pollution, as well as decrease greenhouse gas emissions, aiming to provide a healthier and more comfortable sleep environment.
Use of renewable energy sources	Emphasizes the use of solar, wind, and other renewable energy sources as a way to reduce air pollution and, consequently, improve sleep quality.

(Continued)

Table 3. (Continued)

Responsible Consumption and Production (SDG 12)	
Energy efficiency and thermal comfort	Highlights that energy efficiency can contribute to the thermal comfort of environments, providing a more restful sleep in cool and well-ventilated spaces.
Awareness of consumption, production, and sustainability	The importance of raising awareness among people about responsible consumption, production practices, and sustainability, leading to a healthier lifestyle, which can also positively influence sleep quality.
Partnerships and Means of Implementation (SDG 17)	
Interdisciplinary collaboration and partnerships	Consider the importance of collaboration among healthcare professionals, sleep researchers, governments, the private sector, and civil society. Promote awareness, research, and implementation of policies related to healthy sleep.
Investments in research	Conduct epidemiological studies, clinical trials, and intervention research to better understand sleep disorders, risk factors, and best treatment practices.
Education and public awareness	Develop educational programs and campaigns that emphasize the importance of healthy sleep, its health benefits, and strategies to improve sleep hygiene.
Integration of sleep into public policies	Incorporate considerations of healthy sleep into policies related to health, work, education, and well-being. Create sleep-friendly environments and prevent health problems associated with sleep deprivation.
Technology and innovation	Develop devices, apps, and therapeutic interventions that assist in sleep monitoring and access to information about sleep hygiene.
Monitoring and evaluation of policies and programs	Implement monitoring and evaluation systems to track progress in promoting healthy sleep. Identify gaps and adjust intervention strategies to achieve better outcomes.

Through research and technological innovation, accessible solutions can be developed to monitor and improve sleep quality in various social and economic contexts. Integrating the importance of sleep into sustainable development efforts is crucial for promoting healthier and more sustainable sleep patterns worldwide.

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