

# Breaking Free from “Sacrificing Sleep to Achieve”: Toward an Approach Grounded in Sleep Health Literacy

Jun Kohyama

Department of Pediatrics, Tokyo Bay Urayasu Ichikawa Medical Center, Chiba, Japan  
Email: info@j-kohyama.jp

**How to cite this paper:** Kohyama, J. (2025) Breaking Free from “Sacrificing Sleep to Achieve”: Toward an Approach Grounded in Sleep Health Literacy. *Journal of Biosciences and Medicines*, 13, 359-377. <https://doi.org/10.4236/jbm.2025.131028>

**Received:** December 19, 2024

**Accepted:** January 24, 2025

**Published:** January 27, 2025

Copyright © 2025 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). <http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

Sleep health literacy encompasses the knowledge, motivation, and skills required to promote healthy sleep and recognize sleep disorders. In Japan, sleep-related issues are a significant contributor to prolonged student absenteeism, underscoring the urgent need to address these challenges within school health programs. This review explores the historical evolution of Japan’s perspectives on sleep, shedding light on misconceptions rooted in Neo-Confucianism (Shushigaku), such as the notion of “sacrificing sleep for achievement”. While the 2018 Work Style Reform Act has introduced measures to ensure workplace rest, similar initiatives for students remain absent, perpetuating a culture of sleep deprivation. Misunderstandings surrounding adolescent sleep patterns, chronotypes, and sleep-related health factors are addressed. The review concludes by proposing seven core principles for advancing sleep health literacy: 1) Exposure to morning light; 2) Engagement in daytime physical activity; 3) Resting in darkness at night; 4) Consuming breakfast and avoiding late-night meals; 5) Maintaining regular elimination; 6) Minimizing stimulants and excessive media use; 7) Respecting pre-sleep rituals. Enhancing sleep health literacy, particularly within educational settings, is vital for tackling adolescent sleep challenges and fostering long-term well-being. School health professionals must take the lead in driving this transformative initiative.

## Keywords

Adolescence, Asceticism, Insufficient Sleep Syndrome, Optimal Sleep Duration, Shushigaku

## 1. Introduction

Health literacy was defined by Nutbeam [1] as the cognitive and social skills that

determine individuals' motivation and ability to access, understand, and use information in ways that promote and maintain good health. The World Health Organization enhances and advances health literacy by offering technical support and guidance to Member States, aiming to ensure effective management and promotion of health literacy across personal, organizational, and systemic levels [2]. According to the Tokyo Medical Association, health literacy involves the capacity to obtain, comprehend, and apply accurate health and medical information, which is associated with disease prevention and the extension of healthy life expectancy [3]. Bonuck *et al.* [4] define "sleep health literacy" as the knowledge, motivation, and competencies necessary to promote healthy sleep and recognize sleep disorders. It has been noted that even healthcare professionals with limited sleep health literacy may encounter various challenges in clinical practice [5].

A recent study has reported that the impact of sleep duration on mental health and quality of life is particularly significant during adolescence, compared to early adulthood, middle age, or older adulthood [6]. Therefore, it is essential for adolescents to be especially attuned to and mindful of their sleep, in contrast to individuals at later stages of life. However, the heavy burden of homework and academic pressure forces many students to stay up late, overstimulating their minds before bed and leading to difficulties in falling asleep. Excessive use of electronic media [7] and engagement in sports activities [8] can further reduce sleep duration. In addition, during adolescence, there is a pronounced shift towards eveningness, characterized by a delayed sleep onset [9]. Consequently, these students often struggle to wake up in the morning, resulting in school absences or battling sleepiness during class. It is not uncommon for them to be diagnosed with insufficient sleep syndrome (ISS) [10] [11].

In Japan, the number of elementary and junior high school students who missed 30 or more school days in a single academic year has been steadily rising, reaching a record high of 299,048 students (3.2% of the total student population) in fiscal year 2022 [12]. These figures in 2023 were 346,482 (3.7%) [13]. The primary reasons for these prolonged absences in 2022 are lethargy and anxiety (154,772, 51.8%), followed by disruptions in daily rhythms, engagement in recreational activities, and delinquency (33,999, 11.4%) [12]. In 2023, 111,631 students (32.2%) sought counseling for issues such as a lack of motivation toward school life, while 79,638 students (23.0%) consulted about disruptions in their daily rhythms—a significant increase in the latter [13]. Daily routine rhythms are intricately tied to fundamental physiological processes, particularly sleep, and sleep plays a crucial role in maintaining both physical and mental health [14]. In addition, disturbances in sleep patterns are significantly associated with long-term absenteeism from school [15].

Given the complex sleep challenges facing adolescents in Japan, addressing these issues within the framework of school health is an urgent priority. This review begins with an examination of the historical perspective on sleep in Japan, followed by an exploration of how modern society perceives sleep. Based on these

findings, strategies for addressing the sleep challenges currently faced by adolescents are discussed through the lens of sleep health literacy.

## 2. The Evolution of Perspectives on Sleep in Japanese Society

### 2.1. From the Heian Period to the Era Preceding the Publication of the *Yōjōkun*

The terms *Ne-machizuki* and *Fushimachizuki* refer to the moon four days after the full moon, following poetic names such as *Izayoi*, *Tachimachizuki* (standing moon), and *Imachizuki* (sitting moon) [16]. These names reflect the progressively later moonrise each day, with the fourth day's moonrise occurring late in the evening, aligning with bedtime, hence the association with sleep. During the Heian period in Kyoto, the moon on this day rose at approximately 10 PM in spring, 11 PM in summer, 9 PM in autumn, and 8 PM in winter. Given seasonal variations in sleep duration—shorter in summer and longer in winter [17]—these times roughly correspond to the typical bedtime of Heian aristocrats.

In the Sengoku and early Edo periods, Takatora Tōdō (1556-1630) recommended resting by the fifth hour of the evening (around 8 PM) [18]. Similarly, the *Donguibogam* [19], a 17th-century Korean medical text widely known in Edo Japan, underscores the importance of sleep for health and recovery. It advises against excessive eating or drinking before bed and highlights the need to enter sleep in a relaxed state.

### 2.2. The Mid-to-Late Edo Period

The *Yōjōkun* (1712) written by Ekiken Haibara cautions that “excessive eating, idleness, and sleep lead to blockages and stagnation” (volume 1, section 13) [20]. Section 24 advocates rising early and sleeping late, warning that overindulgence in sleep leads to illness and shortened lifespan. In section 28, Ekiken contends that few recognize the importance of moderating sleep for optimal health. He asserts that reducing sleep improves the circulation of energy, although this claim lacks empirical evidence. Volume 2, section 17 warns that excessive or poorly timed sleep drains vital energy. The *Yōjōkun* consistently promotes sleep reduction as essential for mental clarity and health. Ekiken consistently minimizes the importance of sleep throughout the text, reflecting a dismissive stance. Ekiken also delivered lectures on Confucianism. From the early Edo period onwards, the concept of the hierarchical relationship between a lord and his retainers was increasingly explained through the moral framework of Zhu Xi's Neo-Confucianism (*Shushigaku*), and these *Shushigaku* values seem to be reflected in the ascetic aspects of *Yōjōkun*.

However, in the 1832 publication *Byōka Sūchi* (*A Family Guide for the Sick*), it is noted that “one should go to bed early at night and rise before the sun has fully risen in the morning”, offering a more balanced view on the value of proper sleep [21].

### 2.3. Post-Meiji Period

Fukuzawa Yukichi (1835-1901) emphasized the importance of sleep by stating, “One must go to bed by 10 PM at the latest” [18]. The second verse of the elementary school song *The Village Blacksmith* (1912) praises a healthy village elder for his routine of early rising and early sleeping.

However, from 1924 onwards, statues of Ninomiya Sontoku (Kinjiro), a symbol of diligence and late-night labor, were erected at elementary schools nationwide. The launch of Radio Taiso on November 1, 1928, likely contributed to resetting the biological clock through morning light exposure, stimulating serotonin, and promoting breakfast consumption—key elements for a stable sleep-wake cycle [22]. Nevertheless, as Kuroda Isamu noted, Radio Taiso also functioned as a tool to “transform individual bodies into a collective social body” in alignment with national policy [23].

Before World War II, the ethos of late-night work and early rising, epitomized by Ninomiya Kinjiro, was promoted as a moral and ethical ideal grounded in self-discipline and asceticism. However, a striking critique from a 1939 publication [24] highlighted the adverse effects of insufficient sleep, noting that individuals who boast of sleep deprivation often lack mental clarity, doze off inappropriately, and are more prone to accidents, such as being struck by vehicles.

### 2.4. Post-War Period

In postwar Japan, a backlash against Shushigaku’s ascetic values might have been expected. However, my alma mater’s 1948 school anthem [25] includes the phrase *fūrei kokku* (“perseverance and toil”), derived from Mencius and embraced by Shushigaku, illustrating the enduring influence of asceticism even in the immediate postwar period. This philosophical foundation underpinned Japan’s postwar pursuit of economic power, often at the expense of sleep, epitomized by the 1989 corporate slogan, “Can you fight for 24 hours?” [26]. This mindset persists in contemporary society, reinforced by the relentless demands of modern communication technologies [27].

Amidst this backdrop, with a growing body of foundational knowledge on sleep [22], the Early Rising Promotion Association was established in 2002 [28], followed by the formation of the National Council for Early to Bed, Early to Rise, and Breakfast in 2006 [29]. However, adult society failed to break away from the detrimental custom of “working at the expense of sleep”, an unsustainable practice from the standpoint of sleep health literacy. This expectation extended to children as well, ultimately contributing to the tragic overwork-related suicide of a young female employee at Dentsu in 2015 [30]. Despite this tragedy, there has been little in the way of genuine reflection on such harmful practices. Based on the Work Style Reform Act enacted in 2018, the Act on the Arrangement of Working Hours, etc., was amended to include a provision that obliges employers to make efforts to ensure a certain period of rest (the interval between shifts) between the end of work on one day and the start of work on the next, with sleep being a primary

example [31].

Additionally, the COVID-19 pandemic has triggered an unprecedented sleep boom. Despite this growing momentum to reassess sleep, even in Japan, where sleep has traditionally been neglected due to the influence of Shushigaku's asceticism, no corresponding initiative, such as a "Learning Style Reform" aimed at ensuring sufficient sleep for children and adolescents, has yet been undertaken. In addition, unfortunately, according to the 2024 edition of the Ministry of Health, Labour and Welfare White Paper, the proportion of companies that have no plans to implement, nor are considering the implementation of, the work interval system still exceeds 80% [32].

## 2.5. In the Wake of the 3/11/2011 Disaster

There is a noteworthy account related to the 2011 Tōhoku earthquake and tsunami in Bungei Shunjū. This dialogue between two of Japan's leading intellectuals provides important insights. I will quote an extended passage [33].

Hando: "I would like to discuss Japanese organizational behavior in times of crisis, using the Fukushima nuclear disaster as an example. When Charles Casto, Director of Site Support from the United States, first met Masao Yoshida, Director of Fukushima Daiichi Nuclear Power Plant, his initial question was, 'Are the workers getting enough sleep?' Yoshida was surprised, and frankly, so was I (laughs). I thought, 'So this is what Americans worry about?' They were clearly approaching the crisis with a long-term strategy in mind. In contrast, Japan's approach was to focus intensely on the present, to push through today and to continue pushing tomorrow, with no thought of sleep. The difference in crisis management was stark: whether to prepare for a long-term endurance battle or opt for a short-term, high-intensity approach. This distinction is significant."

This quotation highlights two key issues. First, Japan's crisis response often prioritizes short-term urgency, epitomized by the mindset that "there is no time to sleep", over long-term strategy. Second, the reaction of Japanese experts, who laughed at the U.S. emphasis on sleep, underscores the deep-rooted trivialization of sleep in Japan, particularly during crises. This attitude, likely influenced by Shushigaku's ascetic principles, undermines the critical role of sleep in effective decision-making and long-term crisis management.

## 2.6. Summary

The casual manifestation of sleep undervaluation in various aspects of Japanese society, along with its deep-rooted presence even among the nation's foremost intellectuals, underscores the formidable challenge of eradicating this mindset. Broadening perspectives and transitioning from irrational ascetic spiritualism to logical and scientific thinking is a crucial step toward enhancing sleep health literacy.

## 3. Sleep Health Literacy

The following chapter examines various sleep-related misconceptions that

contradict sleep health literacy, including the analogy of the “Tortoise and the Hare”, the myth of growth hormone’s “Cinderella time”, the diagnosis of adolescents who struggle to wake up in the morning, and the timing of going to bed. It will also explore considerations in data interpretation, including the relationship between sleep duration and body mass index (BMI), as well as variations in chronotypes. The importance of individuals reflecting on their own required sleep duration will be emphasized, and finally, seven key points that should form the foundation of sleep health literacy will be introduced.

### **3.1. The Tortoise and the Hare**

Most people in Japan are familiar with the song “The Tortoise and the Hare”, published in 1901 in the second volume of *Shonen Shoka* and sung for over 120 years. Common lessons drawn from the song include the idea that the tortoise won due to persistent effort—promoting diligence—while the hare lost due to overconfidence, laziness, and falling asleep—implying that sleep is synonymous with slacking off. But are these interpretations correct? Please consider the timing of the race. The text [34] stated nothing on the race time. However, if the race took place at night, the cold-blooded tortoise would have been unable to move. Conversely, as crepuscular animals, hares are naturally inclined to sleep during the day. Thus, the hare’s sleep was not due to laziness but rather a physiological need. The true lesson of this fable lies in the tortoise’s strategic insight, recognizing that the hare would likely sleep during the day. The tortoise demonstrated proficiency in the core components of health literacy—“to access, understand, and use information”. These competencies are equally fundamental to sleep health literacy. Unquestioning adherence to conventional interpretations can result in significant misconceptions, as illustrated by this fable. The tale of the tortoise and the hare exemplifies the erroneous belief that drowsiness is synonymous with laziness. Therefore, it is imperative to promote better sleep health literacy.

### **3.2. Growth Hormone**

Growth hormone is secreted in large amounts during the initial deep sleep after falling asleep. The secretion of growth hormone is triggered by the onset of sleep, whether the sleep onset occurs earlier or later than usual, or if there is a re-initiation of sleep after a disturbance [22] [35]. The timing of secretion is not determined by specific times. Consequently, staying up late does not result in a loss of secretion. Thus, it is incorrect to assert that “growth hormone is most abundantly secreted between certain times”.

### **3.3. Adolescents Who Can’t Wake Up in the Morning**

When Japanese school officials hear the term “children who can’t wake up in the morning”, they are likely to think of Orthostatic Dysregulation (OD) [36]. But is this assumption correct? The author is aware of a junior high school student who,

despite being a member of the track team and consistently participating in early morning practices, frequently collapsed during morning assemblies and was subsequently diagnosed with OD. The equation “inability to wake up in the morning = OD” does not always seem appropriate [36]. In fact, a study conducted at the author’s sleep clinic found that among 181 patients under 20 years old (including 14 diagnosed with OD at other institutions), the most common complaint was “inability to wake up in the morning”, reported by 58 patients (9 of whom had an OD diagnosis) [11]. Among these 58 patients, the most frequent final diagnoses were ISS in 35 patients (7 of whom had an OD diagnosis) and circadian rhythm sleep-wake disorders, including sleep-wake phase disorder, in 13 patients (2 of whom had an OD diagnosis). When considering children who can’t wake up in the morning, it is crucial to also pay attention to their sleep-related conditions. It should be noted that OD patients do not fail to wake up in the morning, but rather fail to get out of bed [36]. Moreover, prolonged and severe sleep inertia, known as sleep drunkenness, includes unresponsiveness, intense resistance or aggressive behavior, and verbal outbursts that the individual does not later recall. Initially considered specific to idiopathic hypersomnia, this condition is now documented in ISS patients, particularly adolescents [37]. However, to the best of my knowledge, there have been no reports of OD patients exhibiting sleep drunkenness.

### 3.4. Timing of Going to Bed

The guidelines for OD [38] recommend “making an effort to go to bed 30 minutes earlier than the usual bedtime, even if you are not sleepy at night”. However, the latest sleep health guide [39] advises that “being overly concerned with sleep duration or bedtime and forcing oneself to sleep without feeling sleepy can actually heighten brain arousal and worsen sleep onset. Trying to sleep without feeling sleepy can lead to excessive worry about not being able to fall asleep and may cause individuals to dwell on daytime concerns in bed, further exacerbating their inability to fall asleep [40]. If you find it difficult to fall asleep, it is recommended to temporarily leave the bed and spend time in a quiet, dimly lit, comfortable area until sleepiness returns, at which point you can go back to bed [41]”.

### 3.5. The Relationship between BMI and Sleep Duration Is U-Shaped

In 2004, it was reported that a U-shaped curve can be plotted with BMI on the vertical axis and sleep duration on the horizontal axis, where the minimum BMI is observed around 7.5 hours of sleep [42]. While this relationship might lead one to aim for 7.5 hours of sleep, it is important to note that this is a statistical summary and does not imply that no one with a sleep duration of 7.5 hours is obese, nor that all individuals with a sleep duration of 4 hours are obese. This graph does not indicate the sleep duration at which an individual’s BMI is minimized. This common misunderstanding highlights a basic consideration from the perspective of sleep health literacy.

### 3.6. Chronotype

Numerous studies have reported that individuals with a preference for evening activities tend to exhibit more irregular lifestyles compared to those with a morning preference [43]. Furthermore, individuals with evening tendencies often consume more fast food and caffeine, engage in irregular eating habits, and eat late at night, which has been associated with eating disorders and obesity [43]. Additionally, while some reports suggest that there is no significant correlation between chronotype and academic achievement [44], other studies indicate that evening-oriented individuals may have poorer academic performance [45] [46]. These findings may suggest that a morning-oriented lifestyle could be more advantageous. Given this, would it be appropriate for healthcare professionals to advise adolescents to adopt a morning-oriented lifestyle? Consider the example of obesity. Is it the case that all individuals with obesity are evening-oriented? Conversely, does it mean that all non-obese individuals are morning-oriented? A moment's reflection reveals that this is not the case. It is important to recognize that such observations are merely the result of statistical analysis. There are individuals with evening tendencies who are not obese, excel academically, and maintain a regular lifestyle. It is crucial to develop accurate sleep health literacy and address one's chronotype and its characteristics appropriately [47], rather than adopting incorrect assumptions (such as targeting morning orientation as a strategy for obesity management). It should be noted that chronotype has a strong biological basis, and attempts to forcefully alter it are often unsuccessful [47].

### 3.7. How Much Sleep Should Adolescents Get?

Recommending optimal sleep durations (OSD) for different age groups has long been a critical public health objective, given the importance of OSD for maintaining health [48]. Recent studies have highlighted both the impact and prevalence of deviations from OSD, particularly during adolescence [6]. In fact, between 25% and 84% of adolescents report feeling drowsy, with sleep deprivation identified as the primary contributing factor [7]. Therefore, adolescents should be especially sensitive to their OSD compared to other age groups. However, the widely recommended OSD guidelines [49] [50] (**Table 1**) are based on significant individual variability [51], resulting in a remarkably broad range. This broad range makes it impractical for individuals to use these guidelines as a benchmark for their own OSD. Furthermore, sleep duration is influenced by various factors, including seasonal changes [17], lunar phases [52], and ambient temperature [53]. While understanding one's own OSD is the first step in combating sleep deprivation, the current OSD guidelines are not sufficiently tailored for individual use.

Roffwarg *et al.* [54] demonstrated that total sleep time gradually decreases from infancy to old age. The reported values during adolescence are 10 hours for those aged 10 - 13 and 8.5 hours for those aged 14 - 18. However, these values reflect habitual sleep duration (HSD) in regular living environments rather than the biologically necessary OSD. When there is a substantial discrepancy between OSD

and HSD, cumulative sleep debt during weekdays inevitably increases, resulting in the increase of sleep duration on weekend, so-called catch-up sleep (CUS). If this sleep deficit is not adequately addressed by weekend CUS [55], it can lead to the onset of ISS.

**Table 1.** Sleep duration recommendations (hours) for ages 6 - 18 years old.

Age	National Sleep Foundation's sleep time duration recommendations [50]			A Consensus Statement of the American Academy of Sleep Medicine [49]
	Lower values for an appropriate range	Recommendation range	Upper values for an appropriate range	Recommendation range
6 - 12 yrs	7 - 8 hrs	9 - 11 hrs	12 hrs	9 - 12 hrs
13 yrs	7 - 8 hrs	9 - 11 hrs	12 hrs	8 - 10 hrs
14 - 17 yrs	7 hrs	8 - 10 hrs	11 hrs	8 - 10 hrs
18 yrs	6 hrs	7 - 9 hrs	10 - 11 hrs	8 - 10 hrs

hrs; hours, yrs; years of age.

Traditionally, the estimation of OSD has been derived through several methods: 1) Allowing individuals to obtain sufficient sleep over multiple nights to prevent the accumulation of sleep debt; 2) Using psychomotor vigilance tests to estimate the required nocturnal sleep duration by determining the maximum wakefulness time before sustained attention deficits emerge; 3) Estimating the necessary sleep duration to achieve optimal academic performance or maintain mental health. These results are summarized in **Table 2** [56]-[65]. However, regarding method (3), it remains unclear whether students with adequate OSD consistently achieve high academic performance. While sleep debt may be associated with poor academic outcomes, other factors such as individual abilities likely play a significant role. Indeed, research has shown that academic performance is more strongly associated with daytime sleepiness than sleep duration [46] [66] [67].

The author identifies three key indicators as a straightforward means to recognize inadequate sleep duration: 1) Excessive sleeping in on weekends; 2) Morning sleepiness; 3) Falling asleep within a very short time after going to bed. Indicator (1) suggests a high level of cumulative sleep debt, as previously noted as CUS. Indicator (2) is based on the fact that slow-wave sleep peaks twice throughout the day—once at the midnight and once in the afternoon [68]. Thus, it is not unusual to experience sleepiness between 2 - 4 AM or 2 - 4 PM even without sleep deprivation; however, as diurnal beings, humans generally should not feel drowsy in the morning. As for indicator (3), while some individuals might take pride in falling asleep within five seconds of lying down, such rapid sleep onset is a definitive sign of sleep deprivation. The presence of any of these indicators suggests inadequate sleep duration. To alleviate these symptoms, it is necessary to increase sleep time until these signs disappear.

**Table 2.** Reported optimal sleep duration (OSD).

Authors	maturational grade or years of age	OSD hrs. (range), SD hrs.
Carskadon <i>et al.</i> [56]	Tanner I	9.0, 0.5
	Tanner II	9.1, 0.4
	Tanner III	9.2, 0.3
	Tanner IV	9.1, 0.5
Wehr <i>et al.</i> [57]	20 - 36	8.2, 0.9
Barbato <i>et al.</i> [58] (detailed description by Dement [59])	29.0 (range: 23 - 34)	8.25
Klerman & Dijk [60]	18 - 30	8.9, 2.4
Short <i>et al.</i> [61]	15 - 17	9.1 (8.5 - 9.5) (10 hours in bed) 9.35 (7.3 - 12.6) (to sustain attention)
Kitamura <i>et al.</i> [62]	23.0 (range: 20 - 26)	8.4 (7.3 - 9.3)
Van Dongen <i>et al.</i> [63]	21 - 38	8.16, 0.73 (standard error)
Eide & Showalter [64]	12	8.3 - 8.4
	16	7.0 - 7.4
Fuligni <i>et al.</i> [65]	15.0 (standard deviation: 0.83 yrs)	7.0 - 7.5 (academic performance) 8.8 - 9.0 (mental health)

OSD; optimal sleep duration, SD; standard deviation, hrs; hours, yrs; years.

Recently, a formula estimating adolescent OSD has been proposed as follows [69];  $0.714 \times (\text{weekday prior sleep duration}) + 0.284 \times (\text{non-weekday prior sleep duration}) + 0.513 \times (\text{sleepiness score; } 1 - 4) + 0.002 \times (\text{grade; } 5 - 11) - 0.009 \times [\text{gender (male: } 1; \text{ female: } 2)] - 0.005 \times [\text{social jetlag (hours)}] + 0.008 \times (\text{both gender- and grade-standardized BMI (expressed in standard deviation)}) - 0.501$ . Sleepiness score assessed sleepiness during school based on four subjective categories: 1, never; 2, sometimes; 3, often; 4, always. Social jetlag was the difference of the midpoint time of sleep between non-school days and schooldays, calculated from bedtime and wake-up time data [8]. This model is based on the hypothesis that, due to the U-shaped relationship between BMI and sleep duration [42] [70] [71], individuals with an OSD should not have a BMI that deviates significantly from the mean. For example, estimated OSD of a grade-9-boy-student who had 6 hours sleep on schooldays, 9 hours sleep on non-school days, felt sleepiness sometimes in the class, social jetlag of 1.5 hours and had a standardized BMI of +1.3

was calculated as follows;  $(0.714 \times 6) + (0.284 \times 9) + (0.513 \times 2) + (0.002 \times 9) + (0.009 \times 1) - (0.005 \times 1.5) + (0.008 \times 1.3) - 0.501 = 7.3949$  hours (= 51.7643-hour weekly OSD). If a 1.5-hour CUS is permitted, we can recommend that the aforementioned student aim for 6.9663 hours of sleep on school days (=  $[51.7643 - (1.5 \times 2)]/7$ ) and 8.4663 hours of sleep on non-school days (=  $6.9663 + 1.5$ ). Current sleep recommendations [49] [50] (Table 1) focus on daily sleep duration, but maintaining consistent sleep patterns on both school days and non-school days can be challenging. For busy adolescents, expressing the OSD as a weekly total (51.7643 hours) may be more practical than as a daily average (7.3949 hours). By shifting the focus from daily to weekly sleep recommendations, adolescents may have greater flexibility in adjusting their sleep schedules according to individual circumstances, potentially reducing sleep debt. This formula could serve as a valuable tool for helping adolescents, including those with insomnia or sleep disorders (ISS), to better understand their OSD in the future, although further validation is required [68]. In the future, a comparison is planned between the OSD estimated from the sleep charts of ISS patients and the OSD calculated using the proposed formula.

### 3.8. Seven Key Points Essential to the Foundation of Sleep Health Literacy

As diurnal beings, humans require nighttime sleep for optimal health. Both the quality and quantity of sleep are critical factors. Recent discourse has emphasized the importance of the “feeling of restful sleep (restorative sleep)” as a crucial metric for evaluating sleep quality [39]. In contrast to sleep quantity, however, there are no well-defined guidelines for assessing sleep quality. Given the substantial individual differences in sleep needs, it is imperative—as previously discussed—to ascertain one’s own specific sleep requirements. The following delineates seven fundamental elements that are crucial for promoting healthy nocturnal sleep [72]. These seven items (Table 3), with the exception of the fifth, align with the principles outlined in the “Good Sleep Guide” [39] and are essential to establishing a robust framework for sleep health literacy. The fifth item recommended regular elimination. The survey included 2722 students from grades 5 through 12, classifying their defecation habits into four distinct categories: daily, every other day, once every 2 - 3 days, and less than twice per week [73]. A multiple comparison analysis showed that the group with bowel movements less than twice a week, meeting the international criteria for constipation [74], had the latest bedtimes and shortest sleep duration among the four groups. Specifically, their bedtimes were significantly later than those of the group with daily bowel movements on both school nights (23:13 vs. 22:46) and weekends (23:28 vs. 23:02). Their weekday sleep duration was also significantly shorter than that of the daily bowel movement group (7.29 hours vs. 7.63 hours) [72]. Taking the second, fourth [75], and fifth items into consideration, it reinforces the understanding that humans are creatures who sleep, eat, excrete, and engage in activities [76].

**Table 3.** Seven key points essential to the foundation of sleep health literacy.**1) Exposure to Morning Light**

The body's internal clock, located in the suprachiasmatic nucleus of the brain, operates on a cycle slightly longer than 24 hours. Morning light exposure, especially after the lowest body temperature is recorded, shortens this cycle to align with the Earth's 24-hour rhythm.

**2) Daytime Activity**

(1) Exposure to daylight during the day enhances nighttime melatonin production, a hormone responsible for inducing sleep, which begins secretion 14 - 16 hours after waking, once it gets dark. (2) Blue light during the day increases alertness. (3) Moderate physical activity during the day positively impacts nighttime sleep.

**3) Resting in Darkness at Night**

1) Melatonin secretion is suppressed in bright environments, even at night. 2) Exposure to light during the night, in contrast to morning light, lengthens the internal clock's cycle, making it harder to fall asleep. (3) The orange hue of sunset, however, does not increase alertness and instead promotes relaxation.

**4) Consuming Breakfast and Avoiding Late-Night Meals**

According to the latest findings in chrono-nutrition [75], establishing a healthy rhythm requires consuming breakfast while avoiding late-night meals.

**5) Regular Elimination**

Studies indicate that individuals who are suffering from constipation go to bed significantly later and have shorter weekday sleep durations than those with daily elimination [72].

**6) Avoiding Stimulants and Excessive Media Exposure**

Stimulants such as caffeine, alcohol, and nicotine, along with excessive media consumption, can impair sleep. Media content stimulates the sympathetic nervous system, making it harder to fall asleep, while light from electronic devices suppresses melatonin and prolongs the internal clock's cycle, delaying sleep onset. Research indicates that adolescents' lenses transmit light nearly five times more than those of individuals in their 70s without cataracts, making younger people more sensitive to light's effects on sleep

**7) Respecting Pre-Sleep Rituals**

Establishing a consistent pre-sleep routine is essential for signaling to the body that the environment is safe, which can facilitate a smoother transition into sleep.

## **4. Current Status and Future Directions for Sleep Health Literacy in School Health Settings**

Sleep guidance for elementary school students has been reported to prevent absenteeism in junior high school [77], while community-based initiatives addressing sleep have improved sleep habits, morning well-being, and self-esteem in

junior high students [78]. However, effective global interventions remain limited. Some studies indicate that school-based programs increase knowledge but fail to improve sleep indicators. [79] One study proposes three key approaches for adolescents—emphasizing benefits, fostering parental support, and adopting patience for delayed effects [80]—though no clear outcomes are reported. Cultural differences aside, Japan’s successful methodologies show significant potential [77] [78]. In addition, the eHealth app has demonstrated a positive impact on dietary habits and physical exercise [81]. Pokémon GO has been shown to positively influence physical activity levels [82]; however, further research is necessary to explore potential risks associated with excessive gameplay. Similarly, Pokémon SLEEP [83] may have beneficial effects on sleep, warranting further investigation. Similar approaches are anticipated to yield improvements in sleep habits as well.

Building on these findings, educators at the forefront of school health play a pivotal role in advancing sleep health literacy. To enhance the impact of such interventions, it is essential to prioritize the following: 1) Moving beyond Shushigaku-inspired ideals of asceticism; 2) Developing a thorough understanding of sleep physiology grounded in scientific evidence; 3) Providing education from a broad, comprehensive perspective. Educators must first acknowledge and address the harmful belief that sacrificing sleep for other activities is beneficial, then convey this understanding to students. Furthermore, sharing these principles with parents and collaborating with them, where possible, is strongly encouraged to deepen collective understanding and support.

Sleep is influenced by three interrelated factors: biological, psychological, and social. This approach is known as the “BPS (Biopsychosocial) model”, a concept proposed that human experiences, including issues related to illness and maladaptation, are shaped by the interaction of biological, psychological, and social factors [84]. While the present review primarily focuses on the biological aspects of sleep among adolescents, it is important to recognize that even with significant sleep deprivation (biologically driven sleepiness), one might be motivated to wake up and engage in activities like visiting a theme park with friends (psychological motivation). However, sustaining this for five days may become biologically untenable. The act of attending school reflects not only psychological but also social factors, and, of course, biological aspects are also relevant. It is hoped that this review contributes, at least in part, to the understanding of the biological aspects of sleep health literacy.

## 5. Conclusion

A historical review of sleep-related guidance and critiques in this country reveals that misunderstandings rooted in Neo-Confucian asceticism, such as the notion of “sacrificing sleep to engage in X”, continue to persist. This review addresses widely circulated yet potentially inaccurate perspectives on sleep from the standpoint of sleep health literacy. Although the realization of the “Workstyle Reform Act” remains a distant reality [32], the law has effectively challenged the culture

of sacrificing sleep for work [85], including among schoolteachers [86]. A similar shift away from the culture of sacrificing sleep for studying, intended through “Learning Reform”, should be led by school health professionals. Given the rising incidence of school attendance difficulties among adolescents, issues related to sleep, including ISS, are increasingly significant. The teachings of educators are inevitably passed on to the next generation [87]. It is imperative that education professionals take decisive action to prevent the transmission of this harmful culture (sacrificing sleep to achieve) to future generations. It is hoped that this review will contribute to equipping school health professionals with insights that can enhance their responses within educational settings.

### Conflicts of Interest

I have got consulting fee from the Japan sound sleep and life institute since 2022 financial year. The author declares no conflicts of interest regarding the publication of this paper.

### References

- [1] Nutbeam, D. (1986) Health Promotion Glossary. *Health Promotion International*, **1**, 113-127. <https://doi.org/10.1093/heapro/1.1.113>
- [2] World Health Organization (2020) Improving Health Literacy. <https://www.who.int/activities/improving-health-literacy>
- [3] Tokyo Medical Association (2024) What Is Health Literacy? <https://www.tokyo.med.or.jp/healthliteracy>
- [4] Bonuck, K.A., Schwartz, B. and Schechter, C. (2016) Sleep Health Literacy in Head Start Families and Staff: Exploratory Study of Knowledge, Motivation, and Competencies to Promote Healthy Sleep. *Sleep Health*, **2**, 19-24. <https://doi.org/10.1016/j.sleh.2015.12.002>
- [5] Richardson, C., Ree, M., Bucks, R.S. and Gradisar, M. (2021) Paediatric Sleep Literacy in Australian Health Professionals. *Sleep Medicine*, **81**, 327-335. <https://doi.org/10.1016/j.sleep.2021.02.035>
- [6] Wang, F., Sun, Z., Lin, F., Xu, Y., Wu, E., Sun, X., *et al.* (2024) Nonlinear Relationships between Sleep Duration, Mental Health, and Quality of Life: The Dangers of Less Sleep versus More Sleep. *Sleep Medicine*, **119**, 565-573. <https://doi.org/10.1016/j.sleep.2024.05.043>
- [7] Merdad, R.A., Akil, H. and Wali, S.O. (2017) Sleepiness in Adolescents. *Sleep Medicine Clinics*, **12**, 415-428. <https://doi.org/10.1016/j.jsmc.2017.03.014>
- [8] Kohyama, J. (2020) Pupils with Negative Social Jetlag in Japan Are Hypothesised to Constitute a Discrete Population. *Medical Hypotheses*, **144**, Article 110249. <https://doi.org/10.1016/j.mehy.2020.110249>
- [9] Cheung, F.T.W., Li, X., Hui, T.K., Chan, N.Y., Chan, J.W., Wing, Y.K., *et al.* (2023) Circadian Preference and Mental Health Outcomes in Youth: A Systematic Review and Meta-Analysis. *Sleep Medicine Reviews*, **72**, Article 101851. <https://doi.org/10.1016/j.smr.2023.101851>
- [10] Lee, Y.J., Park, J., Kim, S., Cho, S. and Kim, S.J. (2015) Academic Performance among Adolescents with Behaviorally Induced Insufficient Sleep Syndrome. *Journal of Clinical Sleep Medicine*, **11**, 61-68. <https://doi.org/10.5664/jcsm.4368>

- [11] Kohyama, J., Anzai, Y., Ono, M., Kishino, A., Tamanuki, K., Takada, K., *et al.* (2018) Insufficient Sleep Syndrome: An Unrecognized but Important Clinical Entity. *Pediatrics International*, **60**, 372-375. <https://doi.org/10.1111/ped.13519>
- [12] Ministry of Education, Culture, Sports, Science and Technology (2023) Survey on Problems Related to Guidance on Problematic Behaviors and School Absence of Pupils. [https://www.mext.go.jp/content/20231004-mxt\\_jidou01-100002753\\_1.pdf](https://www.mext.go.jp/content/20231004-mxt_jidou01-100002753_1.pdf)
- [13] Ministry of Education, Culture, Sports, Science and Technology (2024) Survey on Problems Related to Guidance on Problematic Behaviors and School Absence of Pupils. [https://www.mext.go.jp/content/20241031-mxt\\_jidou02-100002753\\_1\\_2.pdf](https://www.mext.go.jp/content/20241031-mxt_jidou02-100002753_1_2.pdf)
- [14] Pérez-Carbonell, L., Mignot, E., Leschziner, G. and Dauvilliers, Y. (2022) Understanding and Approaching Excessive Daytime Sleepiness. *The Lancet*, **400**, 1033-1046. [https://doi.org/10.1016/s0140-6736\(22\)01018-2](https://doi.org/10.1016/s0140-6736(22)01018-2)
- [15] Kinoshita, Y., Itani, O., Otsuka, Y., Matsumoto, Y., Nakagome, S., Osaki, Y., *et al.* (2021) A Nationwide Cross-Sectional Study of Difficulty Waking up for School among Adolescents. *Sleep*, **44**, zsab157. <https://doi.org/10.1093/sleep/zsab157>
- [16] Fujii, A. (2019) *Living with the Moon: Understanding the Moon and Following Its Rhythms* (Revised Edition). Seibundou Shinkousha.
- [17] Yetish, G., Kaplan, H., Gurven, M., Wood, B., Pontzer, H., Manger, P.R., *et al.* (2015) Natural Sleep and Its Seasonal Variations in Three Pre-Industrial Societies. *Current Biology*, **25**, 2862-2868. <https://doi.org/10.1016/j.cub.2015.09.046>
- [18] Yamamoto, R. (1925) *Early Rising*. Kibosha.
- [19] Sugawara, T. (2021) *Complete Translation of the Dongui Bogam by Heo Jun*. Seishin Shuppan.
- [20] Morishita, M. (2002) *Yojokun in Modern Language* by Ekiken Kaibara. Harashobou.
- [21] The Nursing History Research Group (2006) *A Family Guide for the Sick* by Shigezo Hirano, Modern Japanese Translation by Nosongyoson Bunka Kyokai, Tokyo.
- [22] Kohyama, J. (2015) *Clinical Physiology of Sleep*. Ver 3. Shindantochiryousha.
- [23] Kuroda, I. (1999) *The Birth of Radio Calisthenics*. Seikyusha. (in Japanese)
- [24] Morooka, S. (1939) *Healthy Eating, Sleep, and Bowel Movements*. Jitsugyo no Nihon Sha.
- [25] Shonan High School Anthem and Fight Song. <http://www.shoyukai.org/music-cd/cd.html>
- [26] Matsuoka, K. (2017) Dictionary of History-Making Popular Phrases. *Shuukan Asahi*, **5423**, 143-147.
- [27] Inoue, Y. (2023) Strategically Avoiding Fatigue from Work Breaks. *AERA*, **36**, 10-15.
- [28] Kohyama, J. (2015) Current Status of Sleep in Japanese Children: Insights from Early Bedtimes, Early Wake-Ups, and Exercise. In: Taniike, M. Ed., *Sleep Problems in Children and Adolescents*, Shindan to Chiryō Sha, 229-233.
- [29] Ministry of Education, Culture, Sports, Science and Technology (2006) Promotion of the “Early to Bed, Early to Rise, and Breakfast” National Campaign. [https://www.mext.go.jp/a\\_menu/shougai/asagohan/](https://www.mext.go.jp/a_menu/shougai/asagohan/)
- [30] Kawato, H. and Kanie, K. (2017) The Implications of the Dentsu Overwork Death Incident. *Monthly DIO*, **324**, 8-11. <https://www.rengo-soken.or.jp/dio/dio324-2.pdf>
- [31] Ministry of Health, Labour and Welfare (n.d.) Regarding the interval between work shifts. <https://www.mhlw.go.jp/content/11201250/000939799.pdf>
- [32] Ministry of Health, Labour and Welfare (n.d.) *The 2024 Edition of the Ministry of Health, Labour and Welfare White Paper*.

- <https://www.mhlw.go.jp/wp/hakusyo/kousei/23/dl/zentai.pdf>
- [33] Hando, K. and Funabashi, Y. (2013) The Fukushima Nuclear Accident and the Pacific War: Why Japanese Leadership Fails. *Bungei Shunjū*, **91**, 94-108.
- [34] Thomas, J. (1848) The Tortoise and the Hare. In Thomas, J. and Tenniel, J., Eds., *Aesop's Fables: A New Version*. John Murray.  
<https://archive.org/details/sopsfablesnewv00jame/page/n5/mode/2up>
- [35] Huang, L., Huang, Z. and Chen, C. (2019) Rhythmic Growth Hormone Secretion in Physiological and Pathological Conditions: Lessons from Rodent Studies. *Molecular and Cellular Endocrinology*, **498**, Article 110575.  
<https://doi.org/10.1016/j.mce.2019.110575>
- [36] Kohyama, J. (2023) Adolescents with Difficulty in Morning Awakening: Current Knowledge, Care Plan, and Future Problems from a Sleep Medicine Viewpoint. *No To Hattatsu*, **55**, 413-420.
- [37] American Academy of Sleep Medicine (2023) International Classification of Sleep Disorders. 3rd Edition, American Academy of Sleep Medicine.
- [38] Orthostatic Dysregulation Working Group (2015) Guidelines for Diagnosis and Treatment of Pediatric Orthostatic Dysregulation. (The Japanese Society of Psychosomatic Pediatrics). Guidelines of the Japanese Society of Psychosomatic Pediatrics. 2nd Revised Edition, Nankodo, 25-85.
- [39] Review Meeting on the Revision of Sleep Guidelines for Health Promotion (2024) Sleep Guide for Health Promotion 2023.  
<https://www.mhlw.go.jp/content/001293141.pdf>
- [40] Narisawa, H. (2013) Anxiety and Its Related Factors at Bedtime Are Associated with Difficulty in Falling Asleep. *The Tohoku Journal of Experimental Medicine*, **231**, 37-43. <https://doi.org/10.1620/tjem.231.37>
- [41] Edinger, J.D., Arnedt, J.T., Bertisch, S.M., Carney, C.E., Harrington, J.J., Lichstein, K.L., *et al.* (2021) Behavioral and Psychological Treatments for Chronic Insomnia Disorder in Adults: An American Academy of Sleep Medicine Systematic Review, Meta-Analysis, and GRADE Assessment. *Journal of Clinical Sleep Medicine*, **17**, 263-298. <https://doi.org/10.5664/jcsm.8988>
- [42] Taheri, S., Lin, L., Austin, D., Young, T. and Mignot, E. (2004) Short Sleep Duration Is Associated with Reduced Leptin, Elevated Ghrelin, and Increased Body Mass Index. *PLOS Medicine*, **1**, e62. <https://doi.org/10.1371/journal.pmed.0010062>
- [43] Furutani, M. (2009) Morning Type and Evening Type. In: Japan Sleep Society Ed., *Somnology*, Asakura Shoten, 380-383.
- [44] Gupta, S., Prithviraj, M., Gangwar, A. and Rath, R.S. (2023) Impact of Sleep Duration, Quality, and Chronotype on Learning and Academic Performance: A Cross-Sectional Study among First Year Medical Students of a Tertiary Care Institute. *Cureus*, **15**, e50413. <https://doi.org/10.7759/cureus.50413>
- [45] Jongte, L. and Trivedi, A.K. (2021) Chronotype, Sleep Quality and Academic Performances among Mizo Students. *Chronobiology International*, **39**, 398-408.  
<https://doi.org/10.1080/07420528.2021.2002350>
- [46] Cohen-Zion, M. and Shiloh, E. (2017) Evening Chronotype and Sleepiness Predict Impairment in Executive Abilities and Academic Performance of Adolescents. *Chronobiology International*, **35**, 137-145.  
<https://doi.org/10.1080/07420528.2017.1387792>
- [47] Hirano, A. (2020) Genetics of Sleep-Wake Rhythm Disorders and Chronotype. *Shounika Shinryou*, **83**, 1277-1282.

- [48] van de Langenberg, S.C.N., Kocevsk, D. and Luik, A.I. (2022) The Multidimensionality of Sleep in Population-Based Samples: A Narrative Review. *Journal of Sleep Research*, **31**, e13608. <https://doi.org/10.1111/jsr.13608>
- [49] Paruthi, S., Brooks, L.J., D'Ambrosio, C., Hall, W.A., Kotagal, S., Lloyd, R.M., *et al.* (2016) Recommended Amount of Sleep for Pediatric Populations: A Consensus Statement of the American Academy of Sleep Medicine. *Journal of Clinical Sleep Medicine*, **12**, 785-786. <https://doi.org/10.5664/jcsm.5866>
- [50] Hirshkowitz, M., Whiton, K., Albert, S.M., Alessi, C., Bruni, O., DonCarlos, L., *et al.* (2015) National Sleep Foundation's Sleep Time Duration Recommendations: Methodology and Results Summary. *Sleep Health*, **1**, 40-43. <https://doi.org/10.1016/j.sleh.2014.12.010>
- [51] Carskadon, M.A. and Dement, W.C. (2017) Normal Human Sleep: An Overview. In: Kryger, M., Roth, T. and Dement, W.C., Eds., *Principles and Practice of Sleep Medicine*, Elsevier, 15-24.E3. <https://doi.org/10.1016/b978-0-323-24288-2.00002-7>
- [52] Casiraghi, L., Spiouas, I., Dunster, G.P., McGlothlen, K., Fernández-Duque, E., Vallengia, C., *et al.* (2021) Moonstruck Sleep: Synchronization of Human Sleep with the Moon Cycle under Field Conditions. *Science Advances*, **7**, eabe0465. <https://doi.org/10.1126/sciadv.abe0465>
- [53] Fan, Y., Wang, Y., Gu, P., Han, J. and Tian, Y. (2022) How Temperature Influences Sleep. *International Journal of Molecular Sciences*, **23**, Article 12191. <https://doi.org/10.3390/ijms232012191>
- [54] Roffwarg, H.P., Muzio, J.N. and Dement, W.C. (1966) Ontogenetic Development of the Human Sleep-Dream Cycle. *Science*, **152**, 604-619. <https://doi.org/10.1126/science.152.3722.604>
- [55] Kohyama, J. and Anzai, Y. (2024) Weekend Catch-Up Sleep/Weekend Oversleep among Adolescents: Current Status and Future Problems. *No To Hattatsu*, **56**, 106-113.
- [56] Mary, A.C., Harvey, K., Duke, P., Thomas, F.A., Iris, F.L. and William, C.D. (1980) Pubertal Changes in Daytime Sleepiness. *Sleep*, **2**, 453-460. <https://doi.org/10.1093/sleep/2.4.453>
- [57] Wehr, T.A., Moul, D.E., Barbato, G., Giesen, H.A., Seidel, J.A., Barker, C., *et al.* (1993) Conservation of Photoperiod-Responsive Mechanisms in Humans. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, **265**, R846-R857. <https://doi.org/10.1152/ajpregu.1993.265.4.r846>
- [58] Barbato, G., Barker, C., Bender, C., Giesen, H.A. and Wehr, T.A. (1994) Extended Sleep in Humans in 14 Hour Nights (LD 10:14): Relationship between REM Density and Spontaneous Awakening. *Electroencephalography and Clinical Neurophysiology*, **90**, 291-297. [https://doi.org/10.1016/0013-4694\(94\)90147-3](https://doi.org/10.1016/0013-4694(94)90147-3)
- [59] Dement, W.C. (2005) Sleep Extension: Getting as Much Extra Sleep as Possible. *Clinics in Sports Medicine*, **24**, 251-268. <https://doi.org/10.1016/j.csm.2004.12.014>
- [60] Klerman, E.B. and Dijk, D. (2008) Age-Related Reduction in the Maximal Capacity for Sleep—Implications for Insomnia. *Current Biology*, **18**, 1118-1123. <https://doi.org/10.1016/j.cub.2008.06.047>
- [61] Short, M.A., Weber, N., Reynolds, C., Coussens, S. and Carskadon, M.A. (2018) Estimating Adolescent Sleep Need Using Dose-Response Modeling. *Sleep*, **41**, zsy011. <https://doi.org/10.1093/sleep/zsy011>
- [62] Kitamura, S., Katayose, Y., Nakazaki, K., Motomura, Y., Oba, K., Katsunuma, R., *et al.* (2016) Estimating Individual Optimal Sleep Duration and Potential Sleep Debt.

- Scientific Reports*, **6**, Article No. 35812. <https://doi.org/10.1038/srep35812>
- [63] Van Dongen, H.P.A., Maislin, G., Mullington, J.M. and Dinges, D.F. (2003) The Cumulative Cost of Additional Wakefulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation. *Sleep*, **26**, 117-126. <https://doi.org/10.1093/sleep/26.2.117>
- [64] Eide, E.R. and Showalter, M.H. (2012) Sleep and Student Achievement. *Eastern Economic Journal*, **38**, 512-524. <https://doi.org/10.1057/ej.2011.33>
- [65] Fuligni, A.J., Arruda, E.H., Krull, J.L. and Gonzales, N.A. (2017) Adolescent Sleep Duration, Variability, and Peak Levels of Achievement and Mental Health. *Child Development*, **89**, e18-e28. <https://doi.org/10.1111/cdev.12729>
- [66] Dewald, J.F., Meijer, A.M., Oort, F.J., Kerkhof, G.A. and Bögels, S.M. (2010) The Influence of Sleep Quality, Sleep Duration and Sleepiness on School Performance in Children and Adolescents: A Meta-Analytic Review. *Sleep Medicine Reviews*, **14**, 179-189. <https://doi.org/10.1016/j.smrv.2009.10.004>
- [67] Kohyama, J. (2020) Associations of Adolescents' Lifestyle Habits with Their Daytime Functioning in Japan. *Sleep Science*, **13**, 286-292.
- [68] Hayashi, M., Morikawa, T. and Hori, T. (2002) Circasemidian 12 H Cycle of Slow Wave Sleep under Constant Darkness. *Clinical Neurophysiology*, **113**, 1505-1516. [https://doi.org/10.1016/s1388-2457\(02\)00168-2](https://doi.org/10.1016/s1388-2457(02)00168-2)
- [69] Kohyama, J. (2024) A Proposal on the Novel Method to Estimate Optimal Sleep Duration Based on Self-Reported Survey Data. *Journal of Behavioral and Brain Science*, **14**, 227-239. <https://doi.org/10.4236/jbbs.2024.148014>
- [70] Chaput, J., Lambert, M., Gray-Donald, K., McGrath, J.J., Tremblay, M.S., O'Loughlin, J., *et al.* (2011) Short Sleep Duration Is Independently Associated with Overweight and Obesity in Quebec Children. *Canadian Journal of Public Health*, **102**, 369-374. <https://doi.org/10.1007/bf03404179>
- [71] Danielsen, Y.S., Pallesen, S., Stormark, K.M., Nordhus, I.H. and Bjorvatn, B. (2010) The Relationship between School Day Sleep Duration and Body Mass Index in Norwegian Children (Aged 10-12). *International Journal of Pediatric Obesity*, **5**, 214-220. <https://doi.org/10.3109/17477160903473739>
- [72] Kohyama, J. (2024) Fundamentals of Sleep Hygiene Guidance and Practical Approaches to Improvement. *Shouninaika*, **56**, 1209-1213.
- [73] Kohyama, J. (2020) Lifestyle Habits Associated with Poor Defecation Habit among Pupils in Japan. *Pediatric Gastroenterology, Hepatology & Nutrition*, **23**, 567-576. <https://doi.org/10.5223/pghn.2020.23.6.567>
- [74] Hyams, J.S., Di Lorenzo, C., Saps, M., *et al.* (2016) Childhood Functional Gastrointestinal Disorders: Children/Adolescents. *Gastroenterology*, **150**, 1456-1468.E2. <https://doi.org/10.1053/j.gastro.2016.02.015>
- [75] Furutani, A. (2023) Prospects for Nutritional Guidance Based on Chrononutrition. *Progress in Chrono-Nutrition*, **3**, 7-15.
- [76] Kohyama, J. (2011) The Four Keys to Wellness: Restoring Children's Healthy Sleep, Eating, Digestion and Activity. Shinyousha.
- [77] Maeda, T., Oniki, K. and Miike, T. (2019) Sleep Education in Primary School Prevents Future School Refusal Behavior. *Pediatrics International*, **61**, 1036-1042. <https://doi.org/10.1111/ped.13976>
- [78] Tsuneya, T., Sasahara, S., Karube, H., Handa, K. and Yakuwa, T. (2021) Tatenaka Power-Up Project: How Educational Programs Integrating Community and Family to Improve Lifestyle and Sleep Habits Enhanced Junior High School Students'

- Morning Physical Condition and Self-Esteem. *Yamagata Medical Association Journal*, **60**, 87-95.
- [79] Moseley, L. and Gradisar, M. (2009) Evaluation of a School-Based Intervention for Adolescent Sleep Problems. *Sleep*, **32**, 334-341. <https://doi.org/10.1093/sleep/32.3.334>
- [80] Seton, C. and Fitzgerald, D.A. (2021) Chronic Sleep Deprivation in Teenagers: Practical Ways to Help. *Paediatric Respiratory Reviews*, **40**, 73-79. <https://doi.org/10.1016/j.prrv.2021.05.001>
- [81] Benavides, C., Benítez-Andrades, J.A., Marqués-Sánchez, P. and Arias, N. (2021) Ehealth Intervention to Improve Health Habits in the Adolescent Population: Mixed Methods Study. *JMIR mHealth and uHealth*, **9**, e20217. <https://doi.org/10.2196/20217>
- [82] Liang, H., Wang, X. and An, R. (2023) Influence of Pokémon GO on Physical Activity and Psychosocial Well-Being in Children and Adolescents: Systematic Review. *Journal of Medical Internet Research*, **25**, e49019. <https://doi.org/10.2196/49019>
- [83] Pokémon SLEEP. <https://www.serebii.net/pokemonsleep/>
- [84] Engel, G.L. (1977) The Need for a New Medical Model: A Challenge for Biomedicine. *Science*, **196**, 129-136. <https://doi.org/10.1126/science.847460>
- [85] Komuro, T. and Kobayashi, T. (2020) Putting an End to “Sleep Deprivation Pride”: The Potential of Sleep in Supporting Work Style Reform. <https://forbesjapan.com/articles/detail/33407>
- [86] Special Subcommittee on Securing High-Quality Teachers, Elementary and Secondary Education Division, Central Council for Education (2024) Comprehensive Strategies for Creating an Environment That Ensures the Recruitment and Retention of High-Quality Teachers Responsible for “Reiwa-Era Japanese Education”. [https://www.mext.go.jp/content/20240524-mxt\\_zaimu-000035904\\_1.pdf](https://www.mext.go.jp/content/20240524-mxt_zaimu-000035904_1.pdf)
- [87] Nermin, K. (2021) An Examination of Values Education Based on the Experiences of Classroom Teachers. *Psycho-Educational Research Reviews*, **10**, 270-283.