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Review

Cultural Approaches to Addressing Sleep Deprivation and Improving Sleep Health in Japan: Sleep Issues Among Children and Adolescents Rooted in Self-Sacrifice and Asceticism

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Abstract: This review explores the issue of sleep deprivation among children and adolescents in Japan, examining its cultural background and evaluating the current status of sleep education and interventions. It highlights the profound influence of bushido spirit, emphasizing self-sacrifice and asceticism, as a fundamental cause of sleep undervaluation in Japanese society. While educational efforts and interventions emphasizing the importance of sleep exist, there are limitations in improving sleep habits. Particularly among children and adolescents, despite significant impacts on mental health and academic performance, sleep issues remain unresolved. Therefore, this study examines the effectiveness of personalized approaches using optimal sleep duration calculations and proposes practical steps towards improving sleep duration. Furthermore, it discusses the cultural framework rooted in bushido spirit to address serious health risks associated with sleep deprivation, advocating for a consciousness shift beyond self-sacrifice and asceticism. Ultimately, it emphasizes the need for specific approaches to enhance sleep among children and adolescents, highlighting the necessity for cultural transformation and suggesting directions for future research and practice.

Keywords; Bushido; optimal sleep duration; sleep health literacy; Yōjōkun

Introduction

"To all those who sacrifice sleep to keep fighting." This phrase appeared in a pillow advertisement in 2024 [1]. A message found on beverages sold to elementary and junior high school students since 2000, which was reconsidered in 2016, also featured the phrase: "Keep going, even when you're tired! For elementary and junior high students" [2]. Additionally, the famous slogan for a nutritional drink released in 1988, "Can you fight for 24 hours?" became widely popular in 1989 [3]. From the perspective of sleep health literacy [4], these slogans are clearly unusual. In fact, Japan is one of the leading countries in the world for short sleep duration [5], including among children [6]. Despite numerous reports highlighting the challenges of sleep deprivation [7,8], why do such unusual slogans continue to circulate in Japan, and why has short sleep duration not improved? In Japan, the number of sleep-related products and discussions about sleep has rapidly increased, and not a day passes without encountering new articles about sleep online. However, the style in which these issues are reported often lacks sincerity, giving the impression that sleep is being undervalued. Is this simply an overreaction on the author's part?

This review first outlines the current state of sleep education and then explores the historical roots of sleep undervaluation in Japan. The author undertakes this attempt out of concern that without understanding the underlying causes of Japan's culture that condones short sleep, the situation will not change. Subsequently, this review introduces a simple method for determining an individual's optimal sleep duration (OSD) recently reported for children and adolescents, aiming for a concrete solution to their sleep problems.

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I. Sleep Education

The importance of sleep must be discussed in terms of both quantity and quality [9]. In particular, the impact of sleep duration on mental health and quality of life is more pronounced in adolescents than in older adults [10], emphasizing the importance of securing OSD during this critical developmental stage. Furthermore, sleep quality in early adolescence has been shown to be (1) significantly associated with mental distress and (2) influential in the development of white matter pathways, such as the uncinate fasciculus, which connects the amygdala and prefrontal cortex. These findings suggest that poor sleep quality in early adolescence may play a pivotal role in the onset of anxiety disorders [11]. Therefore, special attention must be paid to the sleep of children and adolescents, with a comprehensive focus on both quantity and quality, as emphasized by numerous experts [12–15]. Sleep problems among children and adolescents are also linked to unhealthy lifestyle behaviors, such as skipping breakfast, frequent consumption of fast food and sugary snacks, and increased screen time [16–18], underscoring the urgent need for effective intervention programs [19–21]. According to Perez Zarate et al. [19], insufficient sleep among high school students is largely attributable to the demands of academic and extracurricular activities, as well as nighttime use of electronic devices. Macharla et al. [22] have acknowledged the potential benefits of smartphones in terms of social connectivity, educational tools, and financial applications. Nonetheless, they stress the critical importance of counseling adolescents about the harmful effects of smartphone use before bedtime and the role of adequate sleep in supporting academic success. Indeed, many school-based sleep education programs published since 2020 have successfully improved students' knowledge about sleep [23–32]. However, with few exceptions [31,32], these programs have failed to produce meaningful behavioral changes related to sleep. Given these limitations, it may be necessary to explore complementary approaches that address the academic and extracurricular burdens placed on students [19]. These burdens are often shaped by cultural factors. For instance, the intense competition surrounding university entrance exams is well documented in countries like China [33] and South Korea [34]. Such pressures are deeply embedded in societal values and the attitudes of educators, which also significantly influence students' behaviors.

In Japan, the number of children and adolescents with disrupted circadian rhythms has increased significantly [4,35,36]. While some studies have reported modest positive effects of sleep education on children [37] and adolescents [38], the overall impact remains limited. Although Japan's 2018 work style reform legislation introduced a "working interval regulation" [39], by 2024, over 80% of companies still had no plans to implement it [40]. A television program broadcast on June 11, 2024—Suffering Bureaucrats: What is Happening in the Heart of the Japanese Government?—highlighted the excessive overtime faced by government officials [41].

This issue extends beyond the corporate and governmental sectors to include the education system. Teachers, who are frequently subjected to long working hours due to a culture of self-sacrifice, serve as role models for children and adolescents, who may consequently adopt similar lifestyle patterns [42]. The author expresses concern that this deeply rooted cultural norm of overwork, grounded in self-sacrifice, may be passed down intergenerationally. Without structural intervention, sleep will continue to be undervalued in Japanese society, and this trend is likely to persist. Alarmingly, limited sleep literacy is not confined to Japan. For instance, even occupational therapists in other countries have demonstrated insufficient knowledge regarding sleep assessment and practical interventions [43].

II. Perception of Sleep in Japan

1. Sleep in Japan Before the Emergence of Yōjōkun

Classical Japanese literature, terms such as "nemachizuki" and "fushimachizuki" were used to refer to times indicative of bedtime. These elegant expressions refer to the moon visible four days after the full moon of the eighth month in the lunar calendar (the 19th day of the moon) [44]. The

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names are believed to have originated from the custom of going to bed when the moon finally rose in the evening. The earliest record of "nemachizuki" appears in the 25th chapter of Tōtō Nikki, dating back to 957 AD [45]. According to calculations by the National Astronomical Observatory of Japan [46], the moonrise on the 19th day of the eighth lunar month in 957 occurred at 20:32, which corresponds to the time for sleeping or retiring for the night, suggesting that it reflects the bedtime of the aristocracy in the Heian period. For reference, sunset on that day was at 17:56, indicating that Heian aristocrats likely went to bed approximately 2.6 hours after sunset.

In the book Early Rising [47], the warrior Tōdō Takatora (1556–1630), who was active during the Sengoku and early Edo periods, wrote, "One should rest by 8 PM." Furthermore, a passage from the book Bushikokoroe is quoted, advising, "One should go to bed early at night." Based on the title, this book is thought to have been written in the early Edo period. During this period, the health benefits and restorative effects of sleep were widely emphasized, with similar descriptions found in the Korean medical text Dongui Bogam, which was well-known in Japan [48]. In the early Edo period, there seems to have been no widespread tendency to undervalue sleep.

2. Yōjōkun

Yōjōkun is a widely known text in Japan [49]. The author, Kaibara Ekiken (1630–1714), was a Confucian scholar based in Fukuoka during the Edo period. Yōjōkun was written in 1712 when Kaibara was 83 years old, based on his own experiences. The philosophy of Yōjōkun seeks to explore the methods and techniques for promoting physical and mental health and achieving longevity. Its intellectual roots are traced to the natural philosophy of Laozi, and its fundamental principles can be seen in the opening lines of the Huangdi Neijing Suwen, which state: "Eating and drinking in moderation, maintaining regularity in daily activities, and avoiding excessive labor" [50]. In Chapter 23, "Xuanming Wuqi Pian" of Huangdi Neijing Suwen, it is written that "Excessive sleep depletes the qi," warning against oversleeping. This caution aligns with recent epidemiological studies, which have revealed that insufficient sleep increases the risks of obesity, ischemic heart disease, cerebrovascular disorders, type 2 diabetes, hypertension, and mortality [51,52]. On the other hand, excessive sleep has also been associated with higher risks of these conditions and mortality [52,53]. While the exact reasons for this relationship remain unclear, it appears that achieving an individual's OSD minimizes the risks of illness and death. Chapter 2, "Si Qi Tiao Shen Da Lun", recommends sleep patterns according to the seasons. In spring and summer, it suggests a later bedtime and earlier wake-up time, while in autumn, one should go to bed early and wake up early. In winter, bedtime should be slightly earlier, and wake-up time later, aligning with sunrise and sunset. This advice is consistent with a study conducted on 55,000 individuals in Germany, which showed that sleep duration fluctuates with the seasons, being 20 minutes longer in winter than in summer [54]. Additionally, research on hunting-gathering societies in Africa and South America found that they woke up before dawn and went to bed approximately 3.3 hours after sunset [55], which means winter sleep duration was about one hour longer than in summer. Huangdi Neijing reflects these natural human tendencies, not undervaluing sleep. Recent studies have also suggested a relationship between sleep duration and lunar phases, with sleep duration being longest before the new moon and shortest before the full moon [56], though this connection is not mentioned in Huangdi Neijing.

In contrast, Yōjōkun tends to undervalue sleep. To put it drastically, the underlying message of Yōjōkun is "Do not sleep." Kaibara Ekiken served the Kuroda clan and also lectured in Confucianism. Moreover, during the early Edo period, the concept of explaining the lord-servant relationship through Zhu Xi's Confucianism was established by figures such as Yamaga Sokō. Confucianism emphasizes asceticism and spiritual cultivation, and it is believed that this asceticism is reflected in Yōjōkun.

In Yōjōkun, sleep is mentioned 16 times across eight volumes. It is noted that overeating, excessive drinking, and excessive sleep can harm one's health. In particular, Volume 1, Section 24 warns, "Excessive sleep causes illness and shortens life." In Section 28, it is encouraged to reduce sleep in order to improve health, asserting that the need for sleep decreases with willpower. Kaibara Ekiken

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seems to view sleep as a passive activity, not acknowledging its active role. In contrast, in Huangdi Neijing's Ling Shu, sleep is recognized not merely as a countermeasure against wakefulness, but as an active process that requires energy (qi). In Volume 2, Section 1, it is stated, "Do not lie down and relax after meals. Resting or sleeping for long periods will disturb your mood and lead to illness." Section 6 advises against napping during long summer days, and Section 16 emphasizes that an important aspect of a healthy life is to avoid lying down at inappropriate times and ensuring proper meals. Section 17 states, "Food nourishes the body, while sleep nourishes the mind," and continues, "Those who practice proper health management rise early, sleep late at night, do not nap during the day, avoid overeating, and maintain discipline in their sleep and eating habits. This is the foundation of a healthy life." Ultimately, Section 51 concludes, "Reducing desires, not worrying, keeping the body active through work, and minimizing sleep are the four fundamental principles of a healthy life." In Volume 4, Section 34, it advises against lying down after eating, which contrasts sharply with the common Edo period saying, "A nap after meals is the best remedy for all diseases." Post-meal sleepiness may be linked to decreased orexin secretion associated with an increase in blood glucose levels [57]. Lying down might promote parasympathetic nervous system dominance, which could aid digestion. While the exact reason for avoiding post-meal naps is unclear, if we adhere to the guidance from Yōjōkun, it may align with recent chronobiological findings suggesting that late-night meals are harmful. In Volume 5, Sections 6 and 7, there are instructions regarding sleep posture and the number of times one turns over during sleep—matters that are difficult to consciously control. Section 8 warns about exposure to light during the night, advice that remains relevant today. Section 29 offers practical guidance, stating that one should not be exposed to wind during sleep. However, in Section 32, it repeatedly states, "Even if you feel drowsy after eating, you should not lie down." In Volume 6, Section 9, it teaches that "The bedroom should protect against wind, cold, heat, and humidity, and should always remain comfortable."

Why did Yōjōkun adopt such a dismissive stance toward sleep? One important factor is that Ekiken belonged to the samurai class. The samurai were a group whose profession was warfare, and within this group, the concept of "Bushidō" (the Way of the Warrior) developed [58]. The term Bushidō is first recorded in the early Edo period in Kōyō Gunkan [59]. It is likely that Kaibara Ekiken was familiar with Kōyō Gunkan. With the advent of the Edo period, intense warfare subsided, and the samurai no longer needed to refine their combat skills. As a result, the samurai spirit shifted from martial techniques to Bushidō, which became increasingly refined. Bushidō is characterized by the spirit of self-sacrifice, exemplified by the well-known practice of seppuku (ritual suicide). The ideology of the ruling class gradually permeated the common people. Yōjōkun, which incorporates not only the principles of Zhu Xi's Confucianism but also the spirit of Bushidō, likely spread to the general population.

3. From Yōjōkun to the End of World War II

The 1832 publication Byōka Suchi [60], Japan's first home medical encyclopedia and guide for home nursing, recommends going to bed early at night and rising before sunrise. From a modern perspective, this advice reflects a more balanced view of sleep. The author, Hirano Shigeaki, was born into a samurai family but did not take up a public office, instead dedicating himself to treating the common people as a town doctor. His approach contrasts with the spiritual perspective of Yōjōkun, suggesting a shift in views on sleep in the broader social context.

In Hito to Tegami [61], written about the author of Nanso Satomi Hakkenden, Takizawa Bakin (1767–1848), it is stated that "Bakin and his family strictly adhered to a bedtime of 10:00 PM for many years". Additionally, Bakin's diary records, "Due to today's heat, I stopped writing and spent the day reading. I went to bed around 8:00 PM." This suggests that Bakin's habits were not aligned with the principles in Yōjōkun.

The Iyo History Association website [62] introduces a diary written by Saionji Genjūrō, a figure involved in the Uwajima Domain during the late Edo period, covering June 1 to June 6. According to this diary, during these six days, the individual did not stay awake past 10:00 PM, indicating that the

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late Edo society was not universally affected by sleep deprivation, contrary to the warnings of Yōjōkun about excessive sleep.

During the Meiji period, prominent figures also took sleep seriously. Fukuzawa Yukichi was known to go to bed by 10:00 PM, and Morimura Shizaemon, based on personal experience, recommended 8 hours of sleep [47]. In 1912, a popular elementary school song, Mura no Kajiya, depicted a blacksmith maintaining his health through regular sleep patterns [63]. Additionally, the rules of the Early Rising Youth Association, founded in 1920, encouraged waking up early while also emphasizing that securing 8 hours of sleep was essential for health maintenance [47].

In the late Meiji period, with the advancement of modernization, Ninomiya Sontoku (also known as Kanjiro) became an influential figure regarding sleep. Descriptions of him can be found in elementary school choral songs [64] from 1911 and in elementary school morality textbooks [65] from 1918. In these descriptions, his early-life efforts, diligence, and self-reliance are emphasized, portraying him as an idealized figure embodying perseverance and moral virtues. From 1924 onwards, Ninomiya Sontoku became a symbol of Japan's moral education, with statues erected in schools across the country [66]. He is often depicted reading while keeping a fire burning, emphasizing diligence and self-sacrifice through late-night studying and early rising. However, this portrayal lacked biological or empirical evidence regarding the influence of circadian rhythms or sunlight on sleep cycles. Instead, it reflected Confucian and Bushidō-based ascetic and moralistic ideologies, which implicitly spread the undervaluation of sleep by associating laziness with poor moral character.

Within the historical context in which self-sacrifice and asceticism were highly valued, a critical remark on sleep appears in a 1939 publication [67]. The author states: "I often encounter individuals who pride themselves on their sleep, yet such people frequently lack mental clarity even when awake and tend to doze off during conversations. These individuals are akin to those who eventually get run over by a car" [67].

4. After World War II

Before World War II, asceticism based on Confucian principles and Bushido was strongly emphasized in Japan, and it was expected that a backlash would occur following the country's defeat in the war. However, the 1948 school anthem "Song of Youth", created by my alma mater, included the phrase "Furei kokku", meaning "strive with effort" [68]. This phrase is derived from the power of will emphasized by Mencius. In Confucianism, following Mencius' teachings, the pursuit of personal moral cultivation and academic achievements was emphasized. Japan, long influenced by strong will and asceticism, continued to press forward even after the war, with a trend of reducing sleep hours that persisted in the post-war era. As symbolized by the 1989 slogan "Can you fight for 24 hours?" [3], Japan rapidly advanced toward becoming an economic powerhouse. This social trend is likely tied to the spirit of Bushidō as well.

The tragic case of Matsuri Takahashi, a Dentsu employee who died by suicide due to overwork in 2015 [69], has become an important theme in my lectures at the women's university. Reflecting on Matsuri's case, especially when observing students of a similar age, I am always strongly reminded that we must not let history repeat itself. One student's reflection after a lecture noted the pressures that new employees face, the sense of responsibility toward their work, and the inability to ask for help. The student also mentioned that living alone, like Matsuri, can lead to being overlooked and not receiving support, which could result in similar tragic outcomes. This response highlights the importance of mental health support systems in the workplace. Below is an excerpt from a student's writing: "The headline of a reference article, 'You may be pushing someone to their limits' [70], was shocking. I was surprised to learn that 90,000 people a year are involved in re-delivery, with approximately 10% of delivery workers spending time on it. Also, the words of a former Dentsu employee resonated with me: 'Clients are treated like 'gods,' while staff and subcontractors meet unreasonable demands through inhumane efforts. But they are also human. Even seemingly trivial demands can take someone's time and push them to their limits. Everyone should imagine that.'"

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5. Conclusion

Looking back at the history of sleep undervaluation in Japan, it becomes clear that this attitude is rooted in the aesthetic of self-sacrifice and asceticism, first exemplified in Yōjōkun. The author posits that this book may represent an early manifestation of Japan's tendency to undervalue sleep in contemporary society. While there have been periods when the importance of sleep was emphasized, the general attitude in Japanese society has not been to revere sleep, often viewing it as a form of laziness. This attitude is not simply the result of Yōjōkun itself but stems from Japan's unique, irrational metaphysical aesthetics—namely, the cultural acceptance of self-sacrifice and asceticism. The deeply ingrained spirit of Bushidō also plays a role in maintaining and supporting this concept of self-sacrifice. Transforming such deeply rooted cultural values is not easy, but recognizing that this cultural background is at the root of sleep deprivation in Japan is crucial to mitigating the harmful effects of sleep deficiency. Of course, sleep deprivation among children and adolescents is a global issue, and addressing it solely through Japan's unique cultural lens may present challenges. However, Japanese educators must recognize that in order to improve the sleep of future generations, they must break free from the tradition of revering self-sacrifice and asceticism that has unconsciously permeated their own culture.

III. Strategies

As previously mentioned, numerous attempts have been made in recent years to alleviate sleep deprivation through educational methods and other approaches [22–29]. However, among these attempts, only a limited number have shown favorable results [30,31,37,38,71,72]. This study has highlighted that the Bushidō spirit, which emphasizes self-sacrifice and asceticism, presents a significant obstacle to various approaches aimed at alleviating sleep deprivation in Japan. To address this issue, an analysis of the root causes is essential. Without a clear understanding of these causes, it will be difficult to find effective solutions. This does not mean rejecting the principles inherent in Bushidō, but rather emphasizes the importance of recognizing and addressing its potential harmful effects. In particular, a shift in the mindset of those in positions of education, particularly for children and adolescents, is urgently needed. Educators must fully understand the issues discussed above and recognize the serious problems caused by the excessive glorification of Bushidō. Based on this understanding, the following proposes five critical steps necessary to foster awareness that transcends self-sacrifice and asceticism, aimed at reducing sleep deprivation in Japan (see Table 1).

Table 1.

Step 1. Acquiring knowledge about the detrimental effects of sleep deprivation (despite the abundance of available information).

Step 2. Achieving personal relevance regarding the harms of sleep deprivation (a challenging task).

Step 3. Understanding simple three indicators of sleep deprivation (serving as potential triggers for awareness).

Step 4. Monitoring one's own sleep duration on a weekly basis (crucial).

Step 5. Upon determining one's own optimal sleep duration, recognizing the abnormality of one's previous sleep patterns. = Experiencing the difficulty outlined in step 2.

STEP 1 focuses on increasing knowledge of the fundamental problems caused by sleep deprivation. Sleep deprivation in children and adolescents has a wide range of negative effects, including impaired cognitive function, poor academic performance, increased behavioral problems, mental instability, increased risk of accidents, obesity, and negative impacts on cardiovascular, immune, and metabolic systems [7]. Maric et al. [73] conducted a study involving 14 right-handed male students aged 18 to 28 (average age 21.9 years) with an average sleep duration of 7.7 hours. The study examined the effects of chronic sleep deprivation (5 hours of sleep for 7 days) and acute sleep deprivation (40 hours of continuous wakefulness) on risk-taking behavior and brainwave activity. The findings suggested that chronic sleep deprivation increases risk-taking behavior and leads to a

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decrease in delayed wave amplitude in the right prefrontal cortex, indicating that chronic sleep deprivation adversely affects decision-making. Furthermore, sleep deprivation can lead to distractibility, diminished executive function, difficulty in emotional regulation (including increased suicidal ideation), increased engagement in health-risk behaviors such as alcohol and drug use, and a higher risk of accidents and sports-related injuries [8]. I also introduced seven basic key points for achieving sleep health literacy in 2024 [74].

While STEP 1 may increase knowledge of the issues related to sleep deprivation, it does not necessarily motivate individuals to take action to address sleep deprivation. This is because the knowledge gained in STEP 1 has not yet been internalized as a personal issue, which means STEP 2 has not been achieved. Therefore, STEP 3 proposes three practical tips for individuals to recognize sleep deprivation: 1) sleeping excessively on holidays, 2) feeling sleepy during the day on weekdays, and 3) falling asleep extremely quickly at night. Upon recognizing these signs, individuals should become aware that they are facing significant sleep deprivation and should make efforts to increase their sleep time. However, recognizing these three points alone does not necessarily lead to the practice of increasing sleep time. By combining cognitive-behavioral therapy, such as sleep diaries, some positive effects may be achieved. For example, if an individual recognizes their sleep deprivation in STEP 3 and begins efforts to increase sleep time—such as acknowledging that "getting 8 hours of sleep will prevent me from falling asleep in class" or "if I sleep before midnight, I can wake up at 7:30 AM"—it can be considered an important achievement. However, even if an individual recognizes their sleep deprivation and begins efforts to increase sleep time, it often takes considerable time to repay sleep debt and see effective results when the period of sleep deprivation has been long. This process highlights the importance of STEP 4, where goal-setting is necessary. However, the recommended sleep durations by age are too general (see Table 2) [75–77] to be useful as individual references. What is needed is the presentation of each individual's OSD. Traditionally, determining the OSD required many days, but recent methods propose estimating the OSD by inputting current individual data [78,79].

Table 2. Sleep duration recommendations (in hours) for children and adolescents.

National sleep foundation [75].			**American academy of sleep medicine [76]**			Centers for Disease Control and Prevention [77]	
Age	MBA	Rec	MBA	Age	Rec	Age	Rec
6-13	7-8=<	9-11	<=12	6-12	9-12	6-12	9-12
14-17	7=<	8-10	<=11	13-18	8-10	13-17	8-10
18-25	6=<	7-9	<=10-11			18-60	7 or more

MBA: may be appropriate; Rec: recommendation.

IV. Methodology

The premise underlying these studies [78,79] is based on the observation that there is a U-shaped relationship between Body Mass Index (BMI) and sleep duration, suggesting that individuals who achieve their OSD would not show significant deviations from the average BMI value of their population. Data from 2,540 students in grades 5 through 11 (approximately ages 10 to 17) were analyzed [78,79]. Students who did not feel sleepy during class and whose BMI, standardized based on gender and grade, fell within ±1.5 were classified as "ideal students" (id-St). The "non-ideal students" (non-di-St) were categorized into 11 groups based on sleepiness scores (1 = never feel sleepy, 2 = occasionally, 3 = frequently, 4 = always) and standardized BMI [high (≥1.5), medium (±1.5), low (≤-1.5)].

The difference in average sleep duration between ideal and each of these non-ideal student groups was added to the habitual sleep duration (HSD) of each non-ideal student, and their "assumed daily OSD" was calculated. A multiple regression model was then calculated using the

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least squares method for predicting “estimated OSD”, with “assumed daily OSD” as the dependent variable and the following as explanatory variables: grade, gender, sleepiness score, actual BMI, self-reported academic performance, after-school activity (hours/week), breakfast frequency score, defecation frequency score, physical activity (days/week), screen time (both on schooldays and non-schooldays), bedtimes before both schooldays and non-schooldays, and waking times on schooldays and non-schooldays [79]. In this calculation, bedtimes and wake times were measured in hours. For example, bedtimes of eleven forty-five PM (23:45), twelve fifteen AM (0:15), and three fifteen AM (3:15) were represented as 23.75, 24.25, and 27.25, respectively, while wake times of six thirty AM (6:30) and eleven AM (11:00) were represented as 6.50 and 11.00, respectively.

A total of 666 ideal students (id-St) were identified, and it was found that their average weekly sleep time was longer than that of non-id-St students: 62.0 hours for elementary school students (compared to 61.2 hours for non-id-St), 55.6 hours for middle school students (compared to 54.1 hours for non-id-St), and 50.1 hours for high school students (compared to 48.6 hours for non-id-St), all of which exceeded the National Sleep Foundation’s lower level of an appropriate range (49 hours per week for children aged 6-17) [75]. Two key findings were confirmed: first, that the sleep duration of id-St students was within an appropriate range, and second, that id-St students slept longer than non-id-St students. The difference in average daily sleep duration between the id-St group (8.49 hours) and the 11 non-id-St groups ranged from 0.04 hours to 1.92 hours.

A highly predictive linear equation was formulated to predict "estimated OSD" (adjusted R^2 = 0.996, $p < 0.001$): 23.375 - 0.710 * (bedtime before schooldays) - 0.286 * (bedtime before non-schooldays) + 0.714 * (wake time on schooldays) + 0.281 * (wake time on non-schooldays) + 0.513 * (sleepiness score; 1-4) + 0.009 * [gender (male: 1; female: 2)] + 0.003 * (BMI). This equation facilitates the straightforward estimation of individual OSD levels based on wake-up times on schooldays and non-schooldays, bedtime before schooldays and non-schooldays, sleepiness during class, gender, and BMI [79]. Unlike the prior formula [78], which involved standardized BMI and social jetlag, thereby increasing computational complexity, the updated formula simplifies these calculations. The equation indicates that individual daily OSD is positively correlated with earlier bedtimes, later wake times, increased sleepiness, female gender, and higher BMI. Regarding gender differences in OSD, this formula aligns with the findings of Franco et al. [80], which suggests that girls tend to sleep longer and experience less sleep fragmentation compared to boys from infancy to adolescence.

While there are challenges, such as the target group being limited to students in grades 5 through 11, further research and replication studies are necessary. Nonetheless, this individualized approach, in contrast to the more generalized values presented in Table 2, shows promise and is considered valuable for practical application.

Another important point is to assess OSD on a weekly, rather than daily, basis. In the previously discussed equation and in Table 2, OSD is presented on a daily basis, but modern lifestyles, particularly among adolescent populations, involve accumulating sleep debt during weekdays (the difference between HSD and OSD, i.e., the amount of sleep lost) and typically compensating for this sleep debt by sleeping in on weekends or holidays. This "weekend sleep-in" is not simply a way to "catch up on sleep," but rather a means of repaying sleep debt accumulated during weekdays (sleep compensation). From a sleep science perspective, maintaining a consistent rhythm is ideal, but this is often unrealistic. Therefore, it is more practical to understand appropriate sleep time on a weekly rather than daily basis. To demonstrate this concretely, for example, assuming the daily OSD derived from Table 2 or the proposed formula is 8 hours, the weekly total would be 56 hours. If an individual wants to sleep 1.5 hours longer on weekends than on weekdays, the calculation would be: 56 - (1.5 × 2) = 53 hours. Dividing this by 7 gives an average of 7 hours 34 minutes on weekdays and 9 hours 4 minutes on weekends.

Finally, STEP 5 is crucial. This step pertains to the change in awareness that occurs when an individual achieves their OSD. By experiencing this knowledge firsthand, individuals will deepen their understanding from STEP 2, and abstract knowledge will become more concrete through personal experience.

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V. Future Prospects

There has been criticism that behavioral sleep interventions for children and adolescents have not been widely implemented [81]. Behavioral sleep interventions include sleep hygiene education (guidance on good sleep habits, corresponding to the proposed STEP 1), relaxation techniques (such as progressive muscle relaxation and deep breathing), and cognitive behavioral therapy for insomnia, all of which aim to address thoughts and behaviors affecting sleep. These approaches aim to improve sleep patterns and reduce stress. Zhou et al. [82] have pointed out that engaging in physical activity can help alleviate sleep problems in adolescents. Poor sleep habits are associated with low socioeconomic status [83] and low life satisfaction [84]. Additionally, mood, stress, and exposure to light at night are key factors influencing adolescent sleep, health, and well-being [85]. Reducing exposure to artificial light at night is particularly important for adolescents, as their lenses are more transparent and sensitive to light [86]. By implementing these strategies, adolescents may be able to improve their sleep and reduce stress [85]. A more comprehensive approach to addressing sleep problems in children and adolescents is needed.

Finally, children and adolescents with neurodevelopmental or medical issues, who are at higher risk of sleep disturbances, have not been sufficiently addressed in sleep interventions [87–89]. Approaches to sleep disorders in these groups remain unresolved.

Conclusions

The background of sleep undervaluation in Japan is hypothesized to be rooted in the aesthetics of self-sacrifice and asceticism (Bushidō spirit). To break away from this aesthetic, it is necessary not to blindly revere the Bushidō spirit, but to critically evaluate its modern shortcomings and make appropriate adjustments to convey them to future generations. An important task for children and adolescents is the introduction of methods for calculating each individual's OSD. A key element is the various experiences individuals encounter when sleep deprivation is resolved. Without these experiences, it may be difficult to break free from this metaphysical aesthetic. However, once these experiences are gained, it becomes difficult to return to the previous aesthetic, making it challenging to abandon the enjoyment derived from it. While further research and replication studies are required, the proposed methods do not require special equipment and are worth attempting.

Sleep deprivation among children and adolescents is not a phenomenon unique to Japan. However, in examining the reasons why sleep deprivation has spread across all generations in Japan, the concept of Bushidō was ultimately identified as a key factor. It is clear that addressing sleep deprivation in youth on a global scale cannot be solved by focusing solely on Bushidō. This discussion represents just one perspective on interpreting sleep deprivation through the lens of self-sacrifice and asceticism.

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