

COMMENTARY

The Power of Sleep to Transform Learning and Knowledge Retention

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I was lying awake one night recently, staring at my ceiling, wondering when my mind would finally shut off and I would be able to fall asleep. A million thoughts were racing through my head, most of them related to matters I dealt with at work, though something I watched on television or read during the day may have made an appearance. Regardless, those thoughts were unwelcome as I was trying to relax and shut off my brain to sleep. At some point, I began to wonder if I would be able to fall asleep at all. In my own lived experience with sleeping difficulties, this question of whether sleep will ever come during the night is the immediate precursor to the inevitability of not sleeping. This specific night was no different, as that prophecy became self-fulfilling, and I was unable to sleep. The clock continued to tick away through the night into the next morning, and my alarm sounded its siren call to alert me to get ready for the upcoming workday.

For anyone who has experienced insomnia, even temporarily, the feeling of powerlessness as the mind and body fight for dominance is not just frustrating but also self-defeating, as every minute that ticks by reminds the sufferer of the issue and how inescapable the insomnia feels. According to the National Sleep Foundation, the recommended amount of sleep for adults ages 18-60 years is at least seven hours per day.^{1,2} A sleep duration of less than seven hours per day on average is termed “short sleep duration.” According to 2020 data, the most recent available, roughly one-third of all US adults (approximately 33%) reported short sleep duration.³ This was less common among those aged ≥ 65 (26.1%) but was highest among adults aged 25-44 years and 45-64 years (36.4% and 34.5%, respectively). The next highest prevalence of short sleep duration was in adults aged 18-24 years (29.7%), a common age range for undergraduate and some graduate-level college students.³

In his book *Why We Sleep: Unlocking the Power of Sleep and Dreams*, Dr Matthew Walker, a professor of

neuroscience and psychology at the University of California, Berkeley and director of the Center for Human Sleep Science, details the history of humanity’s fascination with sleep and its mysteries.⁴ Modern neuroscience and scientific investigation techniques have been able to elucidate the essential nature of sleep, both in the short-term and long-term, and how sleep affects nearly every facet of our existence, from our internal chemical and biologic functions to how we interact with the world around us through our behavior and choices. One of the key takeaways from the book is how vitally important sleep, specifically high-quality sleep of appropriate depth and duration, is to learning and memory retention.⁵⁻⁹ Interestingly, research shows that even on an hour-for-hour basis, time spent in high-quality sleep is more effective for long-term memory than additional study time. Though much is still unknown about sleep, it appears that sleep is when our long-term memories are recorded and organized.¹⁰ An apt analogy might be that sleep converts a temporary pencil drawing into a permanent ink version that is then indexed and filed according to its themes and potential for later utility. Our brains spend our waking time constantly receiving and processing new information, relying on sleep then to make sense of that information. Following this analogy, dreams are thought to be our brains attempting to find associations between the new information and the information that is already known and classified. The resulting scenarios that play out in dreams are our lived experience of this process. This theory would help explain how dreams tend to relate to experiences we have had but incorporate new or novel information into those experiences.

One of the largest and most significant barriers to understanding the impact of sleep and assessing its value is the inherently subjective nature of sleep quality. Comprehensive brain scans or other invasive mechanisms that attempt to objectively evaluate sleep provide only a partial picture of its overall quality and utility in our daily function. One of the most widely used subjective assessments of sleep quality is the Pittsburgh Sleep Quality Index (PSQI), a 19-item self-report instrument that asks respondents to rate the quality of their sleep over the previous one-month period prior to the time the instrument is

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administered.¹¹ Each item in the PSQI belongs to one of the seven following domains: daytime dysfunction, habitual sleep efficiency, sleep disturbances, sleep duration, sleep latency, subjective sleep quality, and use of sleeping medication. Each statement is rated by respondents on a frequency scale corresponding to zero to three points per item. Overall scores on the PSQI range from 0 to 21, with higher scores indicating more acute and significant sleep disturbances. Instrument designers have suggested that a PSQI score of five or more indicates poor sleep quality. While certainly a helpful tool in evaluating the duration and quality of sleep, assessments like the PSQI are still limited in their ability to detect more intermittent sleep disturbances (ie, affecting perhaps a full week but only every few months) and rely on individual recall of the specific factors, which may be limited, particularly in the case of severe sleep disturbances.

Even with the significant shift that pharmacy programs have experienced in recent years to focus more on student and faculty well-being, one aspect that has not been as deeply explored is how well our students and faculty members are sleeping and whether there are measures we can take to promote sleeping as critical to learning and overall well-being. To date, relatively few assessments of sleep duration and quality have been done in student pharmacists, and none on pharmacy faculty members have been published. Cates and colleagues surveyed students (N=253) across three years of a US Doctor of Pharmacy (PharmD) program using the PSQI.¹² A majority (55%) of students who responded to the survey reported a PSQI of five or greater, indicating poor sleep quality, and the overall mean was 6.2 (SD=2.9). Interestingly, the researchers found no significant differences between male and female students in overall PSQI score and found no significant differences in scores among the number of years students had been in the pharmacy program. However, students in the lowest third of grade point average (GPA) ranges studied (2.00-2.99) had significantly higher PSQI scores than students with higher GPAs.¹² Mnatzaganian and colleagues also assessed sleep quality in student pharmacists (N=96) across three years of a US PharmD program but administered the assessment twice in the study period (once during a perceived low-stress period and another time during a perceived high-stress period).¹³ This study found significant worsening of the PSQI overall scores between low- and high-stress periods across all classes, and a significant difference was found for the third-year students in the study. Sleep duration in mean hours per day ranged from 5.9-6.8, all less than the recommended sleep duration of at least seven hours per day for adults over 18 years of age.

The use of biometrics, such as smart watches or other passive monitoring instruments, may provide a less invasive way of tracking sleep, though privacy issues exist with any such potentially identifiable information. Nemeč and colleagues recently described the use of fitness trackers to assess sleep duration (among other factors) in one cohort of student pharmacists at a single pharmacy program.¹⁴ Doroudgar and colleagues recently published a study detailing the use of more formal sleep monitoring via actigraphy in a 2021 pilot study that included 35 students at one pharmacy program.¹⁵ Others have tried leveraging technology to “nudge” students to develop and maintain better overall health habits (including sleep), though the systematic use and widespread adoption of effective monitoring and tracking is lacking.¹⁶

Rather than treating sleep as a necessary evil (or just a required part of life) and something that gets in the way of student learning, we should treat sleep as an indispensable part of the learning process and just as fundamental as attending class and studying or completing activities. Sleep is an essential component in the recipe for student success and should be elevated in our discourse not just about overall well-being but educational achievement as well. As we discuss changes to curricula and cocurricula to enhance opportunities for students, we should simultaneously be emphasizing and creating the environment in which achieving the optimal period of sleep per day, at least seven hours, is attainable.

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