

Sleep and Academic Performance in U.S. Military Training and Education Programs

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ABSTRACT—This review examines the effects of military training regimes, which might include some degree of sleep deprivation, on sleep-wake schedules. We report a 4-year longitudinal study of sleep patterns of cadets at the United States Military Academy and the consequences of an extension of sleep from 6 to 8 hr per night at the United States Navy's Recruit Training Command. These studies provide an opportunity to observe sleep in a college-age population and also to record sleep patterns over an entire 4-year college experience, adding to our understanding of the changes in sleep patterns over the life span.

INTRODUCTION

Most sleep specialists agree that, although adult humans require approximately 8 hr of sleep per day, sleep patterns of adolescents and young adults differ from those of their adult counterparts in several ways, including a need for increased sleep (Carskadon, 2002). Additionally, research findings suggest that adolescents undergo a phase delay in sleep onset accompanied by increased irregularities in their sleep patterns, further jeopardizing sleep sufficiency in this population (Wolfson & Carskadon, 1998). These physiologically determined changes in adolescent sleep patterns result in a net increase of 0.5–1.25 hr, equating to 8.5–9.25 hr of sleep required per night during adolescent and young adult stages of life.

If one considers the phase shift (i.e., the change in circadian chronotype or morningness–eveningness preference) as the marker for this adolescent/young adult sleep stage, phase delay coincides with pubertal onset, but the tendency to sleep late continues well into the 20s (Roenneberg et al., 2004). The U.S. military is filled with individuals who fall into this category, and this trend is especially pronounced when examining military members who are undergoing training and education. Recent data show that more than 65% of the U.S. Marines who are serving in Iraq and Afghanistan today are younger than 24 years of age (Buzzell & Preston, 2007).

Most of those in military education or training programs are the youngest and least experienced members of the military. In these settings, as in civilian high school and college, there is an educational focus where classroom settings, pedagogy, homework, and tendencies to sleep in class are important considerations. These military educational settings are diverse in scope and duration. Training in which junior enlisted personnel learn a specific skill may last for a few weeks; military education in which officer candidates take college courses leading to a bachelor's degree will last for 4 years or more. A common military myth is that such young people, some as young as 17 years of age, need to be hardened as part of their indoctrination into the military culture. This process usually involves sleep deprivation and, sometimes, even severe sleep deprivation. How prevalent is sleep deprivation in military training and education programs? How does sleep deprivation affect these individuals in terms of their educational and training outcomes and academic performance? These questions are the focus of this article in which we address sleep issues in military education and training programs. The article summarizes research conducted at the United States Military Academy (USMA) at West Point, NY, and in the United States Navy's (USN) Recruit Training Command (RTC) at Great Lakes, IL. The article concludes by discussing how these

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findings may be generalized to other adolescent and young adult populations and the implications for civilian education and training programs.

SLEEP IN MILITARY EDUCATION AND TRAINING

Although numerous studies have examined the impact of sleep deprivation in combat (see review in Miller, Matsangas, & Shattuck, 2008), there is little information on sleep deprivation in military education and training environments. In the United States, basic training or boot camp for those who enlist in military service varies from a 6-week regimen for Air Force recruits to 13 weeks for Marine recruits. At the other end of the continuum are military service academies. In the United States, these academies include those operated by the Army, Air Force, Navy, and Coast Guard. The typical 4-year curriculum at these highly selective and prestigious service academies culminates in a bachelor's degree. The attendees (referred to as cadets or midshipmen) are similar in age to students attending traditional colleges.

Although it is believed that all the students in the U.S. military service academies face similar challenges with respect to restricted sleep, an extensive sleep research effort has focused on cadets attending the USMA at West Point, NY. Although each service academy has a slightly different mission and set of traditions, they have many similarities and it is expected that many of the issues discussed in this article could also be present at those institutions.

SLEEP RESEARCH AT THE USMA

Cadets at the USMA, West Point, NY, have few opportunities to sleep. Unlike other college students, cadets at the USMA awaken in the early morning, with their first mandatory formation at 6:45 a.m. Although this schedule sounds grueling enough, in reality, many cadets are awake even earlier for other activities such as athletic training. Unlike their counterparts at civilian universities, USMA cadets are required to

attend all academic classes and meals, further cutting into opportunities for naps and catch-up sleep.

Recognizing the need to assess sleep patterns in this population, in the summer of 2004, a 4-year longitudinal study was initiated to study the sleep patterns in this population and to assess how these patterns may change over their 4 years of study at the USMA. This study included questionnaires focusing on the sleep histories of the entering class (approximately 1,300 students) and wrist activity monitoring (i.e., actigraphic recordings) for 30 days during the fall and spring semesters of a stratified, random sample of the cadets ($n = 80$). Academic and military performance scores, class ranking, and attrition rates were also collected to allow investigators to examine relationships between sleep and performance. Additional information such as involvement in sports activities was also collected. The principal investigators, Miller and Shattuck (2005), have reported the results of the first year of the study in the journal *Sleep*. Details of intermediary findings of the study may be found in Master's thesis efforts (Godfrey, 2006; Kenney & Neverosky, 2004; Miller, 2005), which were directed by the investigators. The 4-year longitudinal study concluded in June 2007, and final results are still being generated; however, some preliminary findings are included in this article.

The study provides conclusive evidence that sleep deprivation is pervasive in the cadets who attend the USMA. Using actigraphic measures and averaging across all 4 years, the 80 cadets who wore wrist activity monitors received only 324 min of sleep each night ($SD = 85$ min). This equates to just more than 5 hr of sleep per night, well below the amount of sleep reported prior to entering the USMA and much less than the 8 hr of night sleep recommended by sleep experts. The distribution of average nightly sleep over the entire 4-year period is seen in Figure 1.

Over the course of their 4 years at the USMA, cadets sleep more with each consecutive year, receiving nearly an hour more sleep over the 4-year period. The average amounts of sleep per year are shown in Figure 2. Although it is commonly accepted that the first year of study is extremely demanding, the sleep deprivation received by those cadets in their first year at the USMA is extreme and represents a dramatic decrease

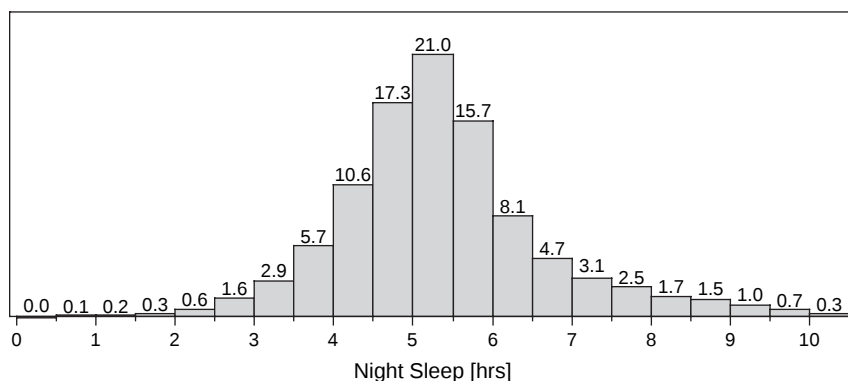


Fig. 1. Average duration of sleep during nighttime hours across a 4-year period.

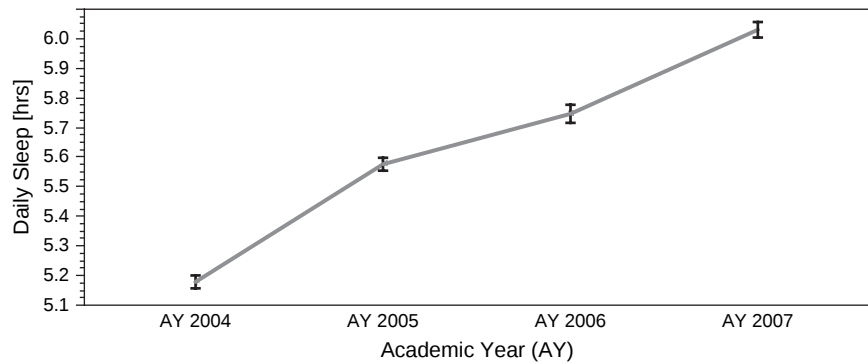


Fig. 2. Average daily sleep amount by academic year.

from the amount of sleep they reporting receiving prior to their enrollment at the USMA. It is not surprising that the attrition rate is very high during this period of time.

Figure 3 shows the average amount of sleep received by the cadets in the actigraphy cohort ($n = 80$) over the fall and spring semesters for the entire 4-year period. Although the first year has the lowest amount of sleep and very little sleep for both the fall and the spring semesters, results for the remaining 3 years show readily discernible seasonal differences between fall and spring sleep amounts. This distinctive pattern indicates that cadets sleep less during the spring than during the fall. It is not clear whether this pattern may be due to differences in activities, differences in lighting caused by seasonal shift in northern latitudes, or other unexplored causes.

There are also differences according to gender. Females, who represent only 15% of the student body, were oversampled in the actigraphic portion of the study. Females get more sleep than males in both the fall and the spring semesters (Figure 4). This same trend is seen when comparing night sleep or total daily sleep (i.e., nighttime sleep combined with naps during the day). Again, the differences in sleep amounts between males and females are clear and consistent, although explanations for these differences remain to be explored.

The findings of this study have been helpful in informing administrators at the USMA who make changes in the schedule of these cadets. One of the policies that emerged after the first year of the study was a midnight lights-out policy that served to encourage cadets to sleep earlier. Cadets also received

brochures that addressed the importance of getting adequate sleep and the benefits of napping. As these sleep policies are instituted and become ingrained into the pattern of cadet life, it is hoped that good sleep hygiene practices will filter into the Army at large.

SLEEP RESEARCH IN USN ENLISTED TRAINING

All USN enlisted recruits are trained at the RTC in Great Lakes, IL. During this training regimen, approximately 9 weeks or 63 days in length, recruits are taught basic military knowledge and practice skills that prepare them to serve in the USN. They are tested periodically while they are undergoing this training, using standardized tests of military training material to determine their proficiency and readiness to enter active duty service in the USN. Approximately 50,000 recruits each year undergo this training in preparation for Naval service.

Until the 1980s, USN recruits attending boot camp received 8 hr of sleep per night. Sometime during the 1980s, it was determined that more information could be presented and more activities accomplished if the sleep regimen was decreased to 6 hr of sleep per night. Also, because recruits were sometimes required to stand watches (i.e., stay awake and vigilant) during some nights, the amount of sleep individual recruits could receive was further restricted. Enlistees are subjected to a series of activities that test their willingness to endure hardship and deprivation during

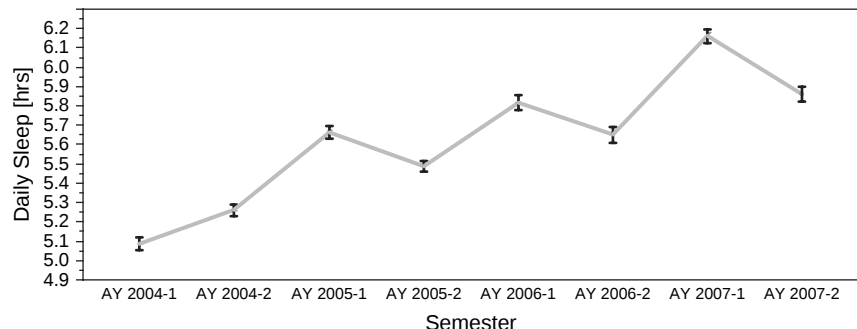


Fig. 3. Average daily sleep amount by academic semester.

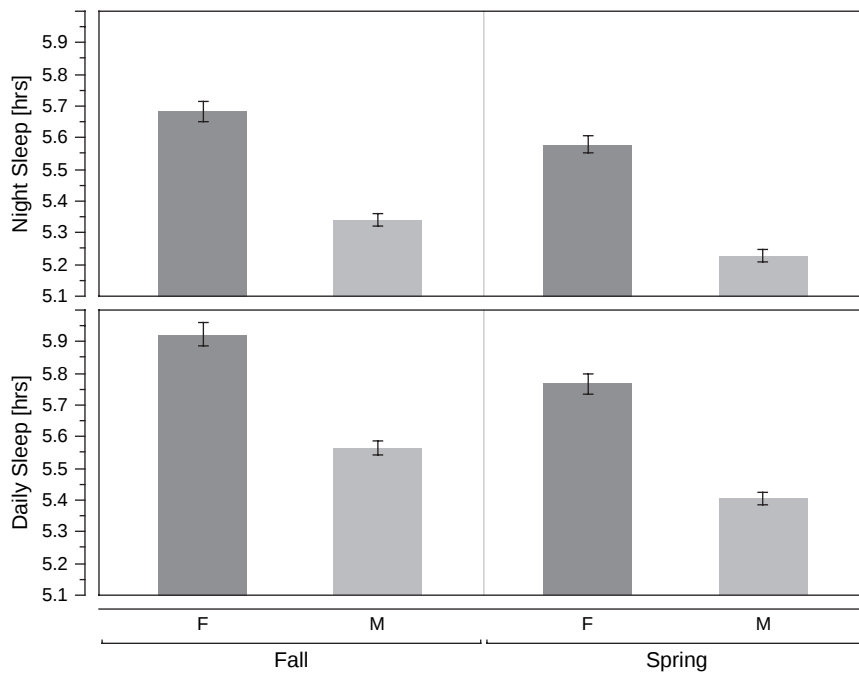


Fig.4. Gender differences in sleep by season.

their training, and sleep restriction is a deliberate part of this testing period. Sleep restriction may represent an attempt to weed out those individuals who might not be able to cope with the stressful conditions of life at sea. By exposing recruits to stressful conditions, underlying psychological pathologies may emerge and be identified; sleep deprivation thereby serves as a screening tool to rule out candidates unsuitable for military life.

In December 2001, following expert testimony to the USN Admiral who commanded the RTC, a decision was made to change the amount of sleep allowed by recruits from 6 to 7 hr of sleep per night (i.e., bedtime was from 21:00 to 04:00 hr). Shortly thereafter, in early 2002, the sleep regimen was changed to 8 hr per night, with bedtime at 21:00 hr and waking at 05:00 hr). In May 2002, the sleep regimen was finalized to 8 hr from 22:00 to 06:00 hr. This last modification was selected to coincide with the acknowledged recognized adolescent/young adult circadian rhythms. During this time period, actigraphic recordings were conducted on recruits undergoing the training. Although recruits were allotted 8 hr of sleep per night, the study showed that recruits actually receive 5.8–6.7 hr of sleep (Baldus, 2002). More details of this descriptive study of sleep in USN recruits are described in the thesis, although they have not been published in the open literature.

After this first descriptive study of sleep patterns of recruits following the shift from 6 to 8 hr of sleep each night, another study was conducted specifically to examine the academic performance associated with these two sleep regimens (Andrews, 2004). Given the scientific findings that link memory consolidation with sleep, we predicted that

academic performance would improve when recruits got more sleep. Consequently, this second study examined the impact of the new 8-hr sleep regimen on an objective measure of performance: standardized test scores. One year of data with the 8-hr sleep regimen (year 2003) was compared to two separate years when only 6 hr of sleep was allowed (years 2000 and 2001).

Average test scores by division and month were compared across the 3 years under investigation. Standardized test scores for each recruit were examined, controlling for Armed Services Vocational Aptitude Battery (ASVAB) Score, year, and month. The ASVAB scores and month were included in an attempt to adjust for seasonal variation and differences in intelligence and aptitude in the recruits under the different sleep policies. Results are displayed in Figure 5, and they show that recruits receiving 6 hr of sleep per night score significantly lower than the recruits receiving 8 hr of sleep per night, $F(2, 33) = 29.82, p < .0001$. In short, recruits who receive 8 hr of sleep per night scored on average 11% higher than their counterparts who receive only 6 hr of sleep, supporting our hypothesis that more sleep was associated with significantly better academic performance. Other administrative and procedural changes that occurred during this same time period (e.g., waterless hand washing before meals and sleeping in new barracks) and these changes may have contributed to changes in the test scores as well. Extending the study to continue comparisons across several years is an important effort still to be undertaken. Additional research efforts to examine accidents and mishaps between the sleep regimens could be an important extension of the study but was beyond the scope of this initial study.

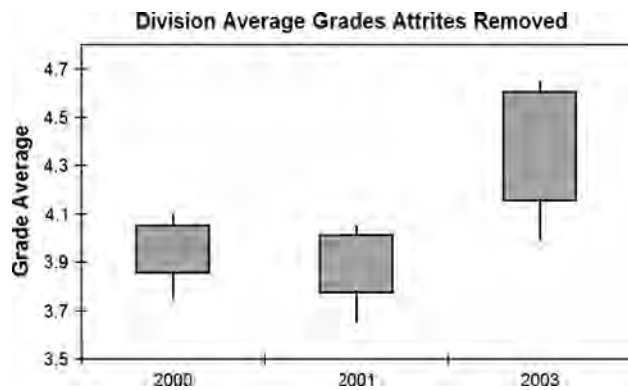


Fig. 5. Average standardized test scores by year. United States Navy recruits in years 2000 and 2001 were allocated 6 hr of sleep per night, whereas recruits in year 2003 were allocated 8 hr of sleep per night.

CONCLUSIONS

An ever-growing body of scientific evidence supports the positive relationship between sleep and learning, especially with respect to memory consolidation. Empirical studies have demonstrated that recollection of novel information is facilitated by adequate amounts of sleep. These findings have far-reaching consequences for academic environments, especially those involving adolescents and young adults. When this population is subjected to the rigorous academic and physical demands of the military training regimes such as that seen in military basic training or in military academies, their sleep patterns are continually disrupted with foreshortened sleep periods and inflexibility in opportunities for recuperative sleep.

The results in this article provide a snapshot from two studies of young adult populations who are involved in military training and education. The first study reported on a 4-year longitudinal research effort to investigate sleep patterns of cadets at the USMA. The second study examined what happened when the sleep period at the USN RTC was extended from 6 to 8 hr per night. These studies provide an

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