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Sleep health and its association with performance and motivation in tactical athletes enrolled in the Reserve Officers' Training Corps

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ABSTRACT

Objective: To examine habitual sleep health and investigate how habitual sleep duration impacts performance and motivation in Reserve Officers' Training Corps (ROTC) tactical athletes.
Design: Observational.
Setting: A large, state university.
Participants: Fifty-four young tactical athletes enrolled in ROTC.
Measurements: Participants wore wrist actigraph devices and completed sleep diaries for 7 days prior to completing a cognitive/motor test battery.
Results: The mean objective total sleep time of the participants was 6.17 ± 0.69 hours, with only 7.4% of participants averaging ≥7 hours of sleep per day. A mean sleep quality rating between "Poor" and "Fair" was reported by 22.2% of participants. The mean Epworth Sleepiness Scale rating was 8.80 ± 3.24, with 27.8% of participants reporting scores >10. Controlling for age and gender, the average objective total sleep duration was significantly associated with performance on the Symbol Digit Modalities Test ($P = .026$) and with motivation levels to perform the cognitive/motor battery ($P = .016$), but not with performance on the Psychomotor Vigilance Test, Flanker task, Trail Making Test, or Standing Broad Jump.
Conclusions: ROTC tactical athletes habitually sleep less than the recommended 7 hours per day with roughly one-fourth reporting excessive daytime sleepiness and one-fifth reporting poor sleep quality, which may increase their risk for future adverse health outcomes. Longer sleep durations were associated with higher motivation levels and better cognitive processing speed performance; however, they were not associated with executive function, psychomotor vigilance, or broad jump performance.

Introduction

In order to promote optimal health and performance, it has been recommended that adults consistently sleep at least 7 hours per night [1]. Optimal health and performance is especially important in military service members, who are often referred to as "tactical athletes" [2]. Military service members are at an increased risk of insufficient sleep duration [3]. This is of concern considering marksmanship accuracy has been shown to decrease following sleep restriction [4,5] and short sleep durations have been related to the development of mental disorders following combat deployments in a military population [6]. Chronic insufficient sleep has also been associated with sleepiness, mood changes, and cognitive impairments in memory, attention, and alertness [7–9]. In addition to the cognitive consequences of sleep loss, impaired physical performance has been reported, including skill execution, submaximal strength, and muscular power [10]. Considering what can be at stake in military performance, both in the cognitive and physical domains, the consequences of insufficient sleep are of great concern.

The Reserve Officers' Training Corps (ROTC) is the largest commissioning source of officers among all military branches of service [11] and trains tactical athletes to become leaders and decision makers within

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the US military. While it is known that college students, collegiate athletes, and US service members have been found to habitually sleep less than the recommended 7 hours per night [3,12–14], little is known about the sleep health of ROTC tactical athletes. Knowledge about the sleep health in this population will provide awareness and may help develop, test, and implement strategies to optimize the health and readiness of this population. Because these individuals will be in leadership roles in the military, their sleep health has the potential to affect the well-being, health and performance of both themselves and their subordinates.

The objective of this study was to assess sleep health of tactical athletes enrolled in ROTC and to determine whether habitual sleep patterns are associated with cognitive/motor performance and motivation levels. It was hypothesized that ROTC tactical athletes would sleep less than the recommended amounts and that longer sleep durations would be associated with better performance on a cognitive/motor test battery and motivation levels.

Methods

Participants

Students (age 18–30 years) enrolled in a ROTC program at the University of Maryland, College Park were invited to participate in the study. Participants were excluded at the initial screening if they self-reported any of the following: history of psychiatric disorder, take medications with sleep-related side effects, use illicit drugs, average more than 8.5 hours of sleep per 24-hours, extend their sleep by more than 90 minutes per night on weekend nights compared to weekday nights, or if they would not be able to comply with the study procedures after the details were explained to them. The study was approved by the University of Maryland Institutional Review Board and written informed consent was obtained from all participants. A total of 57 participants, who were members of each ROTC branch (Air Force, Army, Navy) provided written consent to participate in the study. Of those, three participants did not complete the study and were excluded from the analyses (two did not wear the wrist actigraph during the study and one actigraph malfunctioned). A total of 54 (20.07 ± 1.75 years, 29 male, 25 female) ROTC tactical athletes completed the study. Table 1 provides demographic information and characteristics of the study population.

Table 1
Demographic Information of Participants

Total study participants	
No. of participants, n	54
Gender	
Male	29 (53.7%)
Female	25 (46.3%)
Age, years	20.07 ± 1.75
Height (m)	1.71 ± 0.09
Weight (kg)	69.19 ± 10.85
BMI (kg/m^2)	23.61 ± 2.59
Trait Anxiety (STAI Y2)	33.44 ± 9.35
State Anxiety (STAI Y1)	31.35 ± 8.85
Ethnicity	
African American	5 (9.3%)
Asian/Pacific Islander	9 (16.7%)
Caucasian/White	39 (72.2%)
Multiracial	1 (1.9%)
ROTC Branch	
Air Force	11 (20.4%)
Army	32 (59.3%)
Navy	11 (20.4%)
College Year	
Freshman	8 (14.8%)
Sophomore	14 (25.9%)
Junior	17 (31.5%)
Senior	12 (22.2%)
Graduate	3 (5.6%)

Data are presented as mean ± standard deviation unless otherwise indicated.
BMI = body mass index. STAI = State–Trait Anxiety Inventory.

Sleep–Wake Monitoring

With the goal of measuring sleep–wake patterns in the participants' natural sleep environment, participants wore wrist actigraphs and completed the Consensus Sleep Diary [15] for 7 days prior to performing a cognitive/motor test battery. Actigraphy is known to be a reliable and valid measure to study sleep in natural (e.g., home) environments [16,17] and has been validated against polysomnography [18]. All monitoring started on a Monday to ensure that all participants were on the same weekday/weekend cycle prior to testing. Participants were instructed to wear the Actiwatch 2 (Philips Respironics, Andover, MA) wrist actigraph continuously for the duration of the study with activity data collected in 1-minute epochs. Sleep–wake status for each 1-minute epoch was computed using the Actiware 5.59 scoring algorithm (Actiware software, Philips Respironics, Andover, MA). In conjunction, participants used a sleep diary to record their sleep–wake activity and daily sleep quality (Scored as: 1 = Very Poor, 2 = Poor, 3 = Fair, 4 = Good, 5 = Very Good), and were asked to annotate the diary anytime they removed their wrist actigraph. The consensus sleep diary was used primarily to help validate scoring the actrigraphic data. For example, if there was missing actigraph data (which was minimal), the diary was used to clarify if it was an active period (ie, removing it for a sport competition). Participants received daily reminders via text messaging to keep their actigraph watches on and keep up-to-date on their sleep diaries.

Performance Testing

Every participant conducted testing on a Monday, after the 7 nights of sleep monitoring. Testing was conducted in the same laboratory room with consistent temperature/lighting/noise/etc. To control for the effects of caffeine on performance, participants were instructed to refrain from caffeine ingestion for 6 hours prior to testing.

Testing order and procedures were identical for all participants. Upon arrival for testing, participants confirmed they had not consumed caffeine during the previous 6 hours and completed questionnaires on subjective sleepiness (Epworth Sleepiness Scale (ESS) [19] and Karolinska Sleepiness Scale (KSS) [20]), and anxiety (State–Trait Anxiety Inventory (STAI) [21]). Upon completion of the questionnaires, the participants performed the *Cognitive/Motor Test Battery* with subtests administered in the following order: Psychomotor Vigilance Test (PVT) [22]–5-minute version, Flanker Task [23], the Trail Making Task (A and B) [24], Symbol Digit Modalities Task (SDMT) (written and oral versions) [25], and a maximum standing broad jump (3 times). Following the cognitive/motor test battery, participants were asked to annotate their motivation levels to perform the cognitive tasks (as a whole) and the standing broad jumps using a 100-mm Visual Analogue Scale (VAS) (anchors = No motivation, Highest possible motivation). The average of these two was considered the participant's average motivation level to perform the cognitive/motor battery.

Daytime sleepiness was recorded using the ESS and the KSS. The ESS measures subjective sleep propensity in 8 standardized situations on a 0–3 scale, with higher scores reflecting greater sleepiness. It is a simple and reliable method for measuring sleepiness in adults [26]. The KSS assesses subjective sleepiness on a 9-point scale ranging from 1 (Extremely alert) to 9 (Extremely sleepy, great effort to keep awake, fighting sleep) and has been shown to be a valid measure of extant sleepiness [27]. The STAI was used to measure trait and state anxiety [21] prior to performing the cognitive/motor battery.