

Dermatologic Implications of Sleep Deprivation in the US Military

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PRACTICE POINTS

- Sleep deprivation may have negative effects on skin function and worsen dermatologic conditions.
- Proposed mechanisms of action for these negative effects include dysregulation of the hypothalamic-pituitary-adrenal axis, impairment of cutaneous barrier function, and alteration of cutaneous immune function.
- Members of the US Military are at an increased risk for sleep deprivation, especially during training and overseas deployments.

Short sleep duration is common among US adults and is even more common among people working in protective services and the military. Military service predisposes members to disordered sleep due to the rigors of deployments and field training. In this article, we explore possible mechanisms by which sleep deprivation may affect the skin. We also review the potential impacts of sleep deprivation on specific topics in dermatology, including atopic dermatitis (AD), psoriasis, alopecia areata, physical attractiveness, wound healing, and skin cancer.

Cutis. 2023;111:146-149.

Sleep deprivation can increase emotional distress and mood disorders; reduce quality of life; and lead to cognitive, memory, and performance deficits.¹

Military service predisposes members to disordered sleep due to the rigors of deployments and field training, such as long shifts, shift changes, stressful work environments, and time zone changes. Evidence shows that sleep deprivation is associated with cardiovascular disease, gastrointestinal disease, and some cancers.² We explore multiple mechanisms by which sleep deprivation may affect the skin. We also review the potential impacts of sleep deprivation on specific topics in dermatology, including atopic dermatitis (AD), psoriasis, alopecia areata, physical attractiveness, wound healing, and skin cancer.

Sleep and Military Service

Approximately 35.2% of Americans experience short sleep duration, which the Centers for Disease Control and Prevention defines as sleeping fewer than 7 hours per 24-hour period.³ Short sleep duration is even more common among individuals working in protective services and the military (50.4%).⁴ United States military service members experience multiple contributors to disordered sleep, including combat operations, shift work, psychiatric disorders such as posttraumatic stress disorder, and traumatic brain injury.⁵ Bramoweth and Germain⁶ described the case of a 27-year-old man who served 2 combat tours as an infantryman in Afghanistan, during which time he routinely remained awake for more than 24 hours at a time due to night missions and extended operations. Even when he was not directly involved in combat operations, he was rarely able to keep a regular sleep schedule.⁶ Service members returning from deployment also

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The authors report no conflict of interest.

The views expressed in this publication are those of the authors and do not necessarily reflect the official policy of the Department of Defense, Department of the Air Force, Department of the Army, US Army Medical Department, Defense Health Agency, or the US Government.

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report decreased sleep. In one study (N=2717), 43% of respondents reported short sleep duration (<7 hours of sleep per night) and 29% reported very short sleep duration (<6 hours of sleep per night).⁷ Even stateside, service members experience acute sleep deprivation during training.⁸

Sleep and Skin

The idea that skin conditions can affect quality of sleep is not controversial. Pruritus, pain, and emotional distress associated with different dermatologic conditions have all been implicated in adversely affecting sleep.⁹ Given the effects of sleep deprivation on other organ systems, it also can affect the skin. Possible mechanisms of action include negative effects of sleep deprivation on the hypothalamic-pituitary-adrenal (HPA) axis, cutaneous barrier function, and immune function. First, the HPA axis activity follows a circadian rhythm.¹⁰ Activation outside of the bounds of this normal rhythm can have adverse effects on sleep. Alternatively, sleep deprivation and decreased sleep quality can negatively affect the HPA axis.¹⁰ These changes can adversely affect cutaneous barrier and immune function.¹¹ Cutaneous barrier function is vitally important in the context of inflammatory dermatologic conditions. Transepidermal water loss, a measurement used to estimate cutaneous barrier function, is increased by sleep deprivation.¹² Finally, the cutaneous immune system is an important component of inflammatory dermatologic conditions, cancer immune surveillance, and wound healing, and it also is negatively impacted by sleep deprivation.¹³ This framework of sleep deprivation affecting the HPA axis, cutaneous barrier function, and cutaneous immune function will help to guide the following discussion on the effects of decreased sleep on specific dermatologic conditions.

Atopic Dermatitis—Individuals with AD are at higher odds of having insomnia, fatigue, and overall poorer health status, including more sick days and increased visits to a physician.¹⁴ Additionally, it is possible that the relationship between AD and sleep is not unidirectional. Chang and Chiang¹⁵ discussed the possibility of sleep disturbances contributing to AD flares and listed 3 possible mechanisms by which sleep disturbance could potentially flare AD: exacerbation of the itch-scratch cycle; changes in the immune system, including a possible shift to helper T cell (T_{H2}) dominance; and worsening of chronic stress in patients with AD. These changes may lead to a vicious cycle of impaired sleep and AD exacerbations. It may be helpful to view sleep impairment and AD as comorbid conditions requiring co-management for optimal outcomes. This perspective has military relevance because even without considering sleep deprivation, deployment and field conditions are known to increase the risk for AD flares.¹⁶

Psoriasis—Psoriasis also may have a bidirectional relationship with sleep. A study utilizing data from the Nurses' Health Study showed that working a night shift

increased the risk for psoriasis.¹⁷ Importantly, this connection is associative and not causative. It is possible that other factors in those who worked night shifts such as probable decreased UV exposure or reported increased body mass index played a role. Studies using psoriasis mice models have shown increased inflammation with sleep deprivation.¹⁸ Another possible connection is the effect of sleep deprivation on the gut microbiome. Sleep dysfunction is associated with altered gut bacteria ratios, and similar gut bacteria ratios were found in patients with psoriasis, which may indicate an association between sleep deprivation and psoriasis disease progression.¹⁹ There also is an increased association of obstructive sleep apnea in patients with psoriasis compared to the general population.²⁰ Fortunately, the rate of consultations for psoriasis in deployed soldiers in the last several conflicts has been quite low, making up only 2.1% of diagnosed dermatologic conditions,²¹ which is because service members with moderate to severe psoriasis likely will not be deployed.

Alopecia Areata—Alopecia areata also may be associated with sleep deprivation. A large retrospective cohort study looking at the risk for alopecia in patients with sleep disorders showed that a sleep disorder was an independent risk factor for alopecia areata.²² The impact of sleep on the HPA axis portrays a possible mechanism for the negative effects of sleep deprivation on the immune system. Interestingly, in this study, the association was strongest for the 0- to 24-year-old age group. According to the 2020 demographics profile of the military community, 45% of active-duty personnel are 25 years or younger.²³ Fortunately, although alopecia areata can be a distressing condition, it should not have much effect on military readiness, as most individuals with this diagnosis are still deployable.

Physical Appearance—Studies where raters evaluate photographs of sleep-deprived and well-rested individuals have shown that sleep-deprived individuals are more likely to be perceived as looking sad and/or having hanging eyelids, red and/or swollen eyes, wrinkles around the eyes, dark circles around the eyes, pale skin, and/or droopy corners of the mouth.²⁴ Additionally, raters indicated that they perceived the sleep-deprived individuals as less attractive, less healthy, and more sleepy and were less inclined to socialize with them.²⁵ Interestingly, attempts to objectively quantify the differences between the 2 groups have been less clear.^{26,27} Although the research is not yet definitive, it is feasible to assume that sleep deprivation is recognizable, and negative perceptions may be manifested about the sleep-deprived individual's appearance. This can have substantial social implications given the perception that individuals who are viewed as more attractive also tend to be perceived as more competent.²⁸ In the context of the military, this concept becomes highly relevant when promotions are considered. For some noncommissioned officer promotions in the US Army, the soldier will present in person before a board

of superiors who will “determine their potential to serve at the recommended rank.” Army doctrine instructs the board members to “consider the Soldier’s overall personal appearance, bearing, self-confidence, oral expression and conversational skills, and attitude when determining each Soldier’s potential.”²⁹ In this context, a sleep-deprived soldier would be at a very real disadvantage for a promotion based on their appearance, even if the other cognitive effects of sleep deprivation are not considered.

Wound Healing—Wound healing is of particular importance to the health of military members. Research is suggestive but not definitive of the relationship between sleep and wound healing. One intriguing study looked at the healing of blisters induced via suction in well-rested and sleep-deprived individuals. The results showed a difference, with the sleep-deprived individuals taking approximately 1 day longer to heal.¹³ This has some specific relevance to the military, as friction blisters can be common.³⁰ A cross-sectional survey looking at a group of service members deployed in Iraq showed a prevalence of foot friction blisters of 33%, with 11% of individuals requiring medical care.³¹ Although this is an interesting example, it is not necessarily applicable to full-thickness wounds. A study utilizing rat models did not identify any differences between sleep-deprived and well-rested models in the healing of punch biopsy sites.³²

Skin Cancer—Altered circadian rhythms resulting in changes in melatonin levels, changes in circadian rhythm-related gene pathways, and immunologic changes have been proposed as possible contributing mechanisms for the observed increased risk for skin cancers in military and civilian pilots.^{33,34} One study showed that UV-related erythema resolved quicker in well-rested individuals compared with those with short sleep duration, which could represent more efficient DNA repair given the relationship between UV-associated erythema and DNA damage and repair.³⁵ Another study looking at circadian changes in the repair of UV-related DNA damage showed that mice exposed to UV radiation in the early morning had higher rates of squamous cell carcinoma than those exposed in the afternoon.³⁶ However, a large cohort study using data from the Nurses’ Health Study II did not support a positive connection between short sleep duration and skin cancer; rather, it showed that a short sleep duration was associated with a decreased risk for melanoma and basal cell carcinoma, with no effect noted for squamous cell carcinoma.³⁷ This does not support a positive association between short sleep duration and skin cancer and in some cases actually suggests a negative association.

Final Thoughts

Although more research is needed, there is evidence that sleep deprivation can negatively affect the skin. Randomized controlled trials looking at groups of individuals with specific dermatologic conditions with a very short sleep duration group (<6 hours of sleep per

night), short sleep duration group (<7 hours of sleep per night), and a well-rested group (>7 hours of sleep per night) could be very helpful in this endeavor. Possible mechanisms include the HPA axis, immune system, and skin barrier function that are associated with sleep deprivation. Specific dermatologic conditions that may be affected by sleep deprivation include AD, psoriasis, alopecia areata, physical appearance, wound healing, and skin cancer. The impact of sleep deprivation on dermatologic conditions is particularly relevant to the military, as service members are at an increased risk for short sleep duration. It is possible that improving sleep may lead to better disease control for many dermatologic conditions.

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