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SHORT REPORT

Self-reported sleep and sleep deficiency: Results from a large initiative of sailors attached to U.S. Navy warships

Dale W. Russell[1] | Rachel R. Markwald[2] | Jason T. Jameson[2,3]

[1]Department of Psychiatry, Uniformed Services University of the Health Sciences, Bethesda, MD, USA

[2]Warfighter Performance Department, Naval Health Research Center, San Diego, CA, USA

[3]Leidos, Warfighter Performance Department, Naval Health Research Center, San Diego, CA, USA

Correspondence
Dale W. Russell, Department of Psychiatry, Uniformed Services University of the Health Sciences, 4301 Jones Bridge Road, Bethesda, MD, 20814, USA.
Email: dale.russell@usuhs.edu

Summary

Chronic insufficient sleep is known to lead to a broad range of negative consequences (e.g. poor health and cognitive performance). While insufficient sleep and associated fatigue are present in many diverse populations, it is of special concern in high-risk military environments, where a mishap can result in catastrophic outcomes. Although many studies have been conducted to characterise sleep in general military populations, relatively few have been conducted using a large representative sample of sailors assigned to United States Naval warships. The present cross-sectional study characterises self-reported sleep parameters in sailors (N = 11,738) and explores the role of possible contributors to insufficient sleep. The results indicate that sailors, across a variety of different subgroups, do not obtain the amount of sleep that they report requiring for feeling well-rested. Of the many potential factors thwarting sleep, workload and an uncomfortable mattress are the most promising candidates to target for improvement.

KEYWORDS
compromised operations, crew endurance, inadequate sleep, mishap, readiness

1 | INTRODUCTION

The prevalence of insufficient sleep raises significant public health and human performance concerns across all demographics, and can be linked to many factors, including work-life demands and electronic stimulation (Banks & Dinges, 2007; Chokroverty & Ferini-Strambi, 2017; Durmer & Dinges, 2005). Insufficient sleep is especially problematic for high-risk occupations that require uninterrupted operations in which long-hours and circadian rhythm disruption likely affect sleep quantity and quality (Luckhaupt et al., 2010; Roberts, 1990). Fatigue is a direct outcome of insufficient sleep and contributes to errors and mishaps in both commercial and military maritime operations (Andrei et al., 2020; U. S. Navy, 2017).

While the United States Navy's aviation community has been at the forefront of monitoring sleep and mitigating fatigue, its Surface Force (SURFOR), which comprises all warships except for aircraft carriers and submarines, has been slower at doing so. This shortfall came to the fore following two major mishaps in 2017 and moved SURFOR to undertake efforts to examine sleep and fatigue-related issues (U. S. Navy, 2017). Shortly thereafter, SURFOR mandated the use of circadian-based (24-hr) watchbills to minimise the sleep loss and fatigue associated with circadian rhythm disruption. However, whether this change had a measurable effect on sleep, remains unknown.

Additionally, despite evidence that habitability issues (e.g. noise) negatively impact sleep quantity and quality (Matsangas & Shattuck, 2021), many questions remain about the disruptive role of other operational elements (e.g. workload). The present study sought to explore these questions, characterise self-reported sailor sleep, and identify plausible causes of disrupted shipboard sleep.

2 | METHODS

2.1 | Participants

Active duty SURFOR sailors were invited by email to complete an online survey. The Commanding Officer of each ship received a standardised survey invitation by email and was directed to forward it to their crew via the ship's email system. The invitation explained the purpose of the survey and highlighted that it was voluntary and anonymous, and that the leadership would only be provided with aggregate-level data to ensure that no individual could be identified. This activity was approved by the Naval Medical Center Portsmouth Institutional Review Board (NMCP.2020.0051). The email invitation resulted in 11,738 respondents from 147 ships; of note, it is not possible to calculate a response rate, as it is unknown how many sailors actually received the invitation.

2.2 | Demographics

Demographics included sex, age, paygrade, months served on-board the current ship, total years of military service, whether it was a sailor's first shipboard assignment, the shipboard assignment, ship type, and operational phase.

2.3 | Self-report measures

2.3.1 | Sleep

Participants were asked four sleep-related questions: (1) "How many hours of sleep do you require to feel well-rested?" (Sleep Required); (2) "On average, how many hours of sleep per day do you get when sleeping at home?" (Sleep Obtained-Home); (3) "On average, how many hours per day are available for you to sleep when on-board your current ship?" (Sleep Opportunity-Shipboard); and (4) "On average, how many hours of sleep (to include naps) per day do you get when sleeping on-board your current ship"? (Sleep Obtained-Shipboard).

2.3.2 | Operational shipboard factors

Using a 5-point Likert-type scale from 1 (not at all) to 5 (extremely), respondents rated the degree to which shipboard factors interfered with sleep: (1) ambient noise; (2) 1 Main Circuit (1MC) announcements (i.e. ship-wide announcements); (3) crewmate noise; (4) uncomfortable mattress; (5) cold temperature; (6) hot temperature; (7) invasive lighting; (8) workload; (9) required meetings; (10) required inspections; and (11) drills (e.g. General Quarters).

2.3.3 | Open-ended responses

Participants were invited to answer the open-ended question, "What other factors (not listed above) disrupt your sleep while on-board your current ship?".

2.4 | Data analyses

Descriptive statistics for the demographics (*N*, mean, and standard deviation [*SD*]) were calculated across the primary sleep variables. To quantify insufficient sleep, the ratio of the Sleep Obtained-Shipboard to Sleep Required was calculated.

To characterise the potential role of operational factors in interfering with sleep, complementary perspectives were explored, inspired by recent multiple-model approaches (e.g. Simonsohn et al., 2015; Young & Holsteen, 2017). First, the relationship between factor ratings and sleep obtained was quantified using Pearson product-moment correlations. Second, the percentage of personnel by ship who identified an operational factor as prominent was calculated. A prominent factor was defined as providing a rating of either 4 or 5 (i.e. responding either "quite a bit" or "extremely" on the 5-point Likert-type scale). The mean percentage across all factors within a particular ship was then calculated, which provided a method to rank ships by overall problem severity. The mean value of a prominent factor was then calculated across all ships. Third, the percentage of individuals per ship who listed a factor as prominent (e.g. workload) was paired with the mean Sleep Obtained-Shipboard for the same personnel aboard the same ship. A regression line was then fit to the data to capture the anticipated negatively decreasing trend. Fourth, as a complementary method to identify candidate causes, a word cloud was generated from the open-ended question "What other factors (not listed above) disrupt your sleep while on-board your current ship?" The word cloud displays the size of words as a function of how frequently a word was mentioned across all responses. Misspelled words were replaced with corrected versions and strings that were either uninterpretable (e.g. "ue") or irrelevant (e.g. "even") were omitted. Results were generated in *R* using the *tidyverse* suite of packages, *ggstatsplot*, and the *wordcloud* package (Patil, 2018; Wickham et al., 2019).

3 | RESULTS

3.1 | Sleep outcomes

Overall, individuals reported a mean (*SD*) 327 (92) min of sleep while shipboard (Sleep Obtained-Shipboard). Figure 1 shows the distributions for the main sleep measures. The distribution for Sleep Required follows an expected normal curve, centred near 7 hr, which is a typical lower bound for recommended sleep (i.e. 7–9 hr, with some variation by age). In addition, more mass is concentrated in the range between 7 and 9 hr (Paruthi et al., 2016). The distribution for

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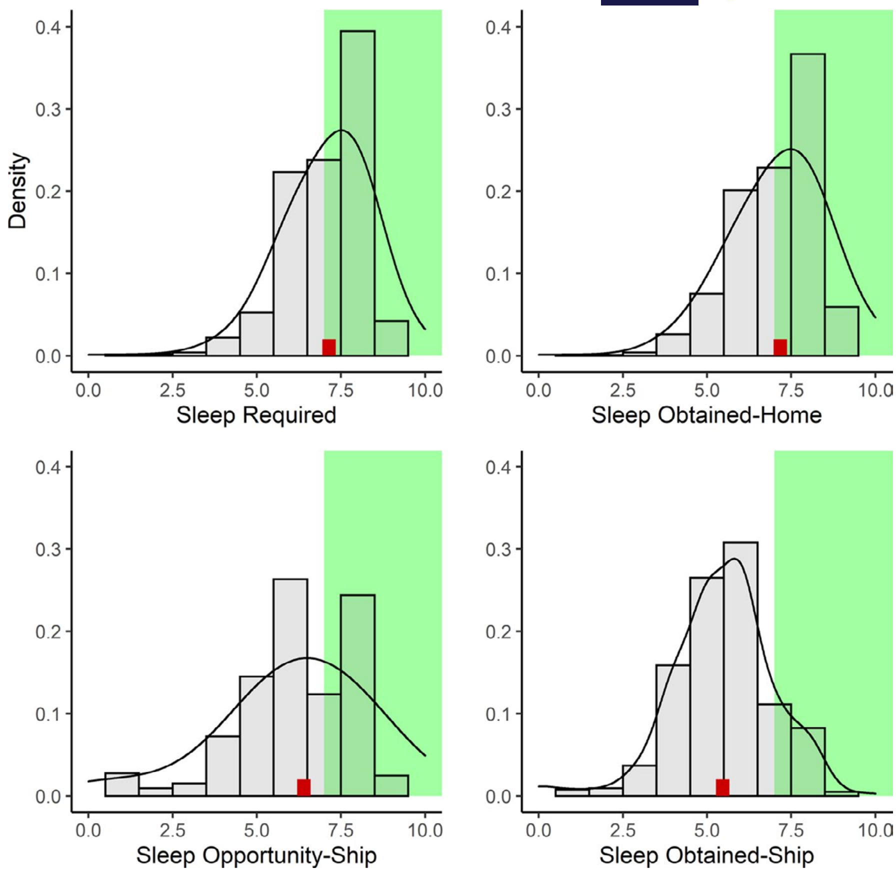

FIGURE 1 Distributions of all primary sleep variables. The shaded regions represent a target sleep range of at least 7 hr. The red box indicates the mean of each distribution

the Sleep Obtained-Home closely mirrors the distribution of Sleep Required, but this was not the case for Sleep Obtained-Shipboard, which reflected less sleep overall.

3.2 | Sleep profile across ship cycles

As shown in Table 1, insufficient sleep is clearly prevalent across all demographic subgroups, with all groups obtaining a fraction of required sleep. Of particular interest for naval operations, inadequate sleep is prevalent during all operational phases: that is, sleep is generally less available across all cycles, with no phase exceeding 80% of required sleep.

3.3 | Operational factors

Table 2 provides the correlations between factor ratings and sleep obtained, ranked by strength of the relationship. As anticipated, all correlations are negative, indicating that greater assigned ratings were related to obtaining less sleep. Also, work-related requirements exhibited the strongest correlations, with uncomfortable mattress leading the berthing and environmental factors. Table 3 provides the prominence for each candidate cause, grouped by problem severity. The results of both analyses suggest that workload (and specific work requirements), along with uncomfortable mattress, are plausible candidates interfering with sleep.

The regression analyses over ships bolster this claim (Figure 2), as indicated by the negatively decreasing trend for both workload (total respondents, N = 11,551) and mattress (N = 11,555), and results from the word frequency analysis of the open-ended question (the word cloud in Figure 3).

4 | DISCUSSION

This cross-sectional analysis of self-reported sleep and sleep deficiency in sailors explored factors that potentially interfere with their sleep. Multiple approaches were undertaken to explore plausible rank-ordered lists of converging candidate factors. The findings advance the understanding of sleep and sleep deficiency attached to United States warships by highlighting possible issues to target for future interventions. For example, while underway, sailors reported obtaining 1–2 fewer hours than the amount of sleep they required to feel well-rested; and such a pattern held across many different subgroups and ship cycles.

Four complementary analyses identified workload and uncomfortable mattress as prominent candidates for disrupting shipboard sleep. Future research should investigate how combinations of workload characteristics (e.g. number, frequency, timing for meetings, drills, and inspections) may interact to undermine sleep, which will help target mitigation efforts. Which aspects of the mattress most interfere with sleep is another important avenue for future exploration. Unfortunately, implementing mattress modifications to

TABLE 1 Descriptive summary of self-reported primary variables. The "% of Req. Sleep" is the ratio of Sleep Obtained to Sleep Required: values <100% indicate insufficient sleep

Variable	Sleep required *N*	Sleep required Mean (*SD*)	Sleep available *N*	Sleep available Mean (*SD*)	Sleep obtained *N*	Sleep obtained Mean (*SD*)	% of Req. sleep
Sex							
Female	2210	7.38 (1.35)	2201	6.19 (2.73)	2196	5.35 (1.58)	72
Male	9356	7.09 (1.32)	9309	6.45 (2.49)	9297	5.48 (1.51)	77
Age, years							
17–21	1820	7.37 (1.53)	1818	6.58 (2.79)	1811	5.66 (1.68)	77
22–25	3190	7.18 (1.35)	3177	6.41 (2.51)	3176	5.46 (1.51)	76
26–30	2420	7.19 (1.23)	2404	6.38 (2.54)	2402	5.41 (1.51)	75
31–35	2058	7.05 (1.24)	2046	6.29 (2.47)	2041	5.33 (1.48)	76
36–40	1347	6.99 (1.24)	1340	6.32 (2.49)	1332	5.43 (1.47)	78
41–45	590	6.88 (1.19)	584	6.41 (2.26)	588	5.51 (1.34)	80
46–50	180	6.71 (1.31)	179	6.46 (2.32)	180	5.56 (1.43)	83
>51	30	7.17 (2.04)	30	6.77 (2.94)	30	5.10 (1.86)	71
Paygrade							
E1–E3	1712	7.49 (1.53)	1701	6.48 (2.72)	1701	5.66 (1.72)	76
E4–E6	6308	7.17 (1.33)	6282	6.35 (2.65)	6269	5.35 (1.57)	75
E7–E9	1569	6.85 (1.26)	1563	6.28 (2.47)	1556	5.36 (1.45)	78
Officer/CWO	2067	7.00 (1.11)	2052	6.57 (2.01)	2054	5.69 (1.21)	81
Time on-board							
0–3 months	1081	7.21 (1.47)	1070	6.85 (2.53)	1063	5.81 (1.68)	81
4–6 months	1303	7.16 (1.27)	1289	6.72 (2.39)	1290	5.68 (1.49)	79
7–12 months	2112	7.13 (1.40)	2101	6.36 (2.55)	2099	5.48 (1.54)	77
1–2 years	3737	7.15 (1.32)	3722	6.29 (2.54)	3715	5.37 (1.53)	75
>2 years	3359	7.13 (1.27)	3352	6.29 (2.56)	3350	5.36 (1.45)	75
Years military service							
0–2	3103	7.32 (1.40)	3085	6.52 (2.61)	3083	5.61 (1.57)	77
3–5	3383	7.23 (1.32)	3374	6.37 (2.55)	3363	5.42 (1.52)	75
6–10	1630	7.08 (1.25)	1618	6.45 (2.56)	1620	5.43 (1.55)	77
11–15	1687	6.98 (1.26)	1681	6.26 (2.49)	1674	5.31 (1.47)	76
16–20	1162	6.98 (1.25)	1152	6.34 (2.50)	1153	5.43 (1.46)	78
>20	631	6.76 (1.39)	629	6.37 (2.23)	627	5.43 (1.46)	80
First shipboard assignment							
No	5258	7.00 (1.27)	5227	6.32 (2.47)	5216	5.40 (1.52)	77
Yes	6343	7.27 (1.36)	6316	6.47 (2.59)	6309	5.51 (1.53)	76
Department							
Combat capabilities	5920	7.14 (1.29)	5891	6.55 (2.54)	5882	5.49 (1.47)	77
Engineering	2348	7.06 (1.30)	2335	5.92 (2.32)	2334	5.11 (1.45)	72
Mission capabilities	1247	7.24 (1.52)	1245	6.33 (2.68)	1239	5.56 (1.69)	77
Ship and crew support	2100	7.21 (1.35)	2088	6.54 (2.64)	2084	5.68 (1.60)	79
Ship class							
Amphibious	3536	7.27 (1.40)	3522	6.54 (2.63)	3521	5.55 (1.55)	76
Ashore/staff	66	6.70 (1.24)	66	7.14 (2.84)	65	5.65 (1.94)	84
CG	1418	7.11 (1.34)	1410	6.16 (2.74)	1412	5.29 (1.69)	74

(Continues)

TABLE 1 (Continued)

Variable	Sleep required		Sleep available		Sleep obtained		% of Req. sleep
	N	Mean (*SD*)	*N*	Mean (*SD*)	*N*	Mean (*SD*)	
DDG	5085	7.10 (1.29)	5059	6.42 (2.42)	5044	5.45 (1.46)	77
ESB	222	7.24 (1.43)	221	6.76 (2.91)	216	5.70 (2.07)	79
LCS	743	6.99 (1.16)	738	6.32 (2.23)	741	5.45 (1.27)	78
MCM	319	6.99 (1.25)	318	5.67 (2.14)	316	5.10 (1.40)	73
PC	131	7.24 (1.41)	128	5.77 (2.91)	129	5.22 (1.45)	72
PCU	144	7.21 (1.49)	144	6.26 (2.99)	144	5.49 (1.80)	76
Operational phase							
Advanced	436	7.08 (1.28)	435	6.46 (2.13)	435	5.44 (1.29)	77
Basic	1715	7.10 (1.25)	1711	6.21 (2.37)	1705	5.38 (1.32)	76
Deployed	2192	7.04 (1.32)	2184	6.90 (2.15)	2184	5.64 (1.30)	80
Integrated	294	7.12 (1.21)	294	6.17 (2.25)	295	5.28 (1.33)	74
Maintenance	3010	7.19 (1.35)	2993	6.13 (2.80)	2989	5.30 (1.66)	74
Sustainment	1216	7.07 (1.30)	1209	6.57 (2.25)	1209	5.62 (1.38)	79

CG, Ticonderoga-class cruisers; CWO, chief warrant officer; DDG, guided-missile destroyer; ESB, Expeditionary Sea Base; LCS, littoral combat ship; MCM, mine countermeasures; PC, patrol class; PCU, pre-commissioning unit.

TABLE 2 Relationship between factor ratings and sleep obtained (Pearson product-moment correlation coefficient)

Factor	Pearson *r*	Spearman ρ
Workload	−0.33	−0.39
Required meetings	−0.26	−0.30
Required inspections	−0.25	−0.29
Drills	−0.24	−0.28
Uncomfortable mattress	−0.17	−0.20
Invasive lighting	−0.15	−0.17
Environment	−0.13	−0.15
Ambient noise	−0.13	−0.14
Crew mate noise	−0.12	−0.13
1MC announcements	−0.11	−0.13

1MC, 1 Main Circuit, i.e. ship-wide announcements.

enhance sleep is difficult as these may be limited to the ship design layout and depend on numerous enterprise-wide requirements. A more readily and operationally feasible solution for enhancing sleep while underway would be to improve workload scheduling and requirements.

The finding that habitability factors (e.g. temperature) were less prominent sources of sleep interference diverge from previous findings (Matsangas & Shattuck, 2021), although that research did not directly compare habitability and workload factors. This incongruity could be attributed to many reasons, such as survey design (Likert-scale versus a "select all that apply" approach) and sample differences as Matsangas and Shattuck (2021) targeted four warships while the present study included 147 warships. Respondents may also not have recognised the deleterious effect of these factors (e.g. repeated disruptions during sleep may not always be remembered) or they may simply have acclimated to environmental intrusions. It may also be that the results do not conflict, but rather that workload factors are simply more prominent than habitability factors. Nonetheless, the considerable variation in sleep across ships signals the need for more research to tease apart the interplay between workload, habitability, and other sleep-hindering factors.

This effort had two notable limitations. First, the cross-sectional nature of the study precluded an analysis of longitudinal sleep pattern variations. Second, only self-reported sleep data were collected, which presents the possibility of recall error and therefore may not accurately reflect objective sleep data, especially as reported in previous research (Matthews et al., 2018). Although previous studies have used research-grade actiography devices to capture objective sleep data at sea (Matsangas & Shattuck, 2021; Shattuck & Matsangas, 2016), this approach is challenging in large-scale maritime studies as it requires post-processing and interpretation expertise. The ability to collect both self-report and objective large samples at sea would provide a more comprehensive picture of sleep.

5 | CONCLUSION

In sum, SURFOR, like other high-tempo military and commercial maritime communities, faces a threat of widespread insufficient sleep, which in turn can impact safety and mission success. While the change in mandate to a 24-hr aligned watchbill schedule is important progress towards improving sleep while underway, changes in policies and practices related to optimising workload scheduling may further help to enhance sleep in this environment.

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TABLE 3 Proportion of individuals endorsing each operational factor as interfering with sleep; 20 ships, 10 with the greatest sleep severity problems, 10 with the least

Ship	Ambient noise	1MC	Crew noise	Uncomf. mattress	Light	Workload	Required meetings	Required drills	Enviro.	Problem severity
Most severe										
1	0.17	0.17	0.50	0.75	0.17	0.67	0.33	0.92	0.58	0.47
2	0.20	0.44	0.38	0.44	0.30	0.70	0.66	0.64	0.38	0.46
3	0.00	0.00	0.50	0.50	0.00	1.00	1.00	0.50	0.50	0.44
4	0.00	0.25	0.25	0.75	0.00	0.75	0.75	0.75	0.50	0.44
5	0.16	0.36	0.44	0.64	0.32	0.60	0.76	0.48	0.16	0.44
6	0.14	0.27	0.21	0.61	0.32	0.66	0.59	0.68	0.43	0.43
7	0.30	0.39	0.28	0.41	0.26	0.76	0.46	0.67	0.35	0.43
8	0.39	0.33	0.22	0.50	0.33	0.72	0.61	0.44	0.22	0.42
9	0.23	0.23	0.36	0.56	0.33	0.58	0.46	0.61	0.40	0.42
10	0.26	0.22	0.37	0.44	0.22	0.81	0.70	0.52	0.19	0.42
Overall	0.19	0.27	0.35	0.56	0.23	0.73	0.63	0.62	0.37	0.44
Least severe										
1	0.03	0.07	0.05	0.12	0.07	0.05	0.07	0.07	0.05	0.07
2	0.00	0.00	0.12	0.00	0.00	0.25	0.25	0.12	0.00	0.08
3	0.07	0.12	0.09	0.18	0.14	0.09	0.07	0.15	0.07	0.11
4	0.11	0.05	0.11	0.16	0.05	0.21	0.21	0.16	0.16	0.13
5	0.14	0.08	0.17	0.36	0.10	0.23	0.13	0.13	0.21	0.17
6	0.12	0.12	0.06	0.65	0.12	0.24	0.12	0.12	0.12	0.18
7	0.00	0.11	0.11	0.56	0.00	0.44	0.22	0.22	0.00	0.19
8	0.06	0.14	0.14	0.29	0.17	0.31	0.31	0.09	0.23	0.19
9	0.09	0.07	0.09	0.32	0.07	0.48	0.30	0.25	0.14	0.20
10	0.20	0.10	0.20	0.30	0.10	0.40	0.30	0.10	0.10	0.20
Overall	0.08	0.09	0.11	0.29	0.08	0.27	0.20	0.14	0.11	0.15

Enviro., environmental factors; 1MC, 1 Main Circuit, i.e. ship-wide announcements; Uncomf., uncomfortable.

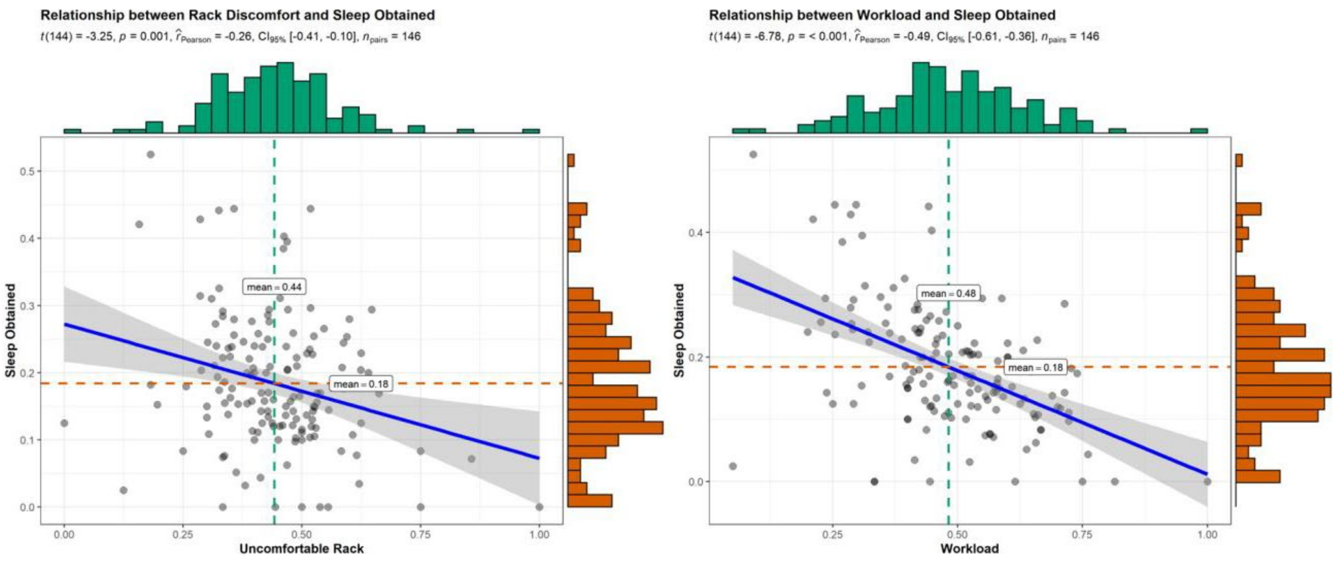

FIGURE 2 Linear relationships between mattress, workload, and sleep obtained while underway. Values reported in each figure include the t statistic, degrees of freedom, and the corresponding p value; the Pearson product-moment correlation and the associated 95% confidence interval; and the number of paired observations

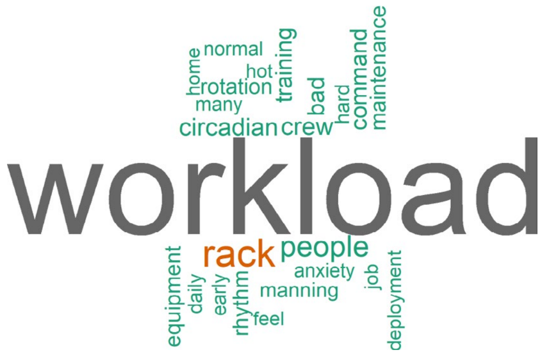

FIGURE 3 Word cloud representing the most frequently expressed words in an open-ended response, "What other factors (not listed above) disrupt your sleep while on-board your current ship?"

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CONFLICT OF INTERESTS

None of the authors have conflicts of interest to report.

AUTHOR CONTRIBUTIONS

DR developed the survey, collected the data, analysed the data, and co-authored the manuscript; RM interpreted the data and co-authored the manuscript; JJ analysed the data, created the tables and figures, and co-authored the manuscript.

DATA AVAILABILITY STATEMENT

Due to confidentiality agreements, supporting data can only be made available to bona fide researchers subject to a non-disclosure agreement. Details of the data and how to request access are available from the corresponding author.

ORCID

Dale W. Russell https://orcid.org/0000-0003-4289-1270

REFERENCES

Andrei, D. M., Griffin, M. A., Grech, M., & Neal, A. (2020). How demands and resources impact chronic fatigue in the maritime industry. The mediating effect of acute fatigue, sleep quality and recovery. *Safety Science*, *121*, 362–372.

Banks, S., & Dinges, D. F. (2007). Behavioral and physiological consequences of sleep restriction. *Journal of Clinical Sleep Medicine*, *3*, 519–528.

Chokroverty, S., & Ferini-Strambi, L. (Eds.) (2017). *Oxford textbook of sleep disorders*. Oxford University Press.

Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, *25*, 117–129. https://doi.org/10.1055/s-2005-867080

Luckhaupt, S. E., Tak, S., & Calvert, G. M. (2010). The prevalence of short sleep duration by industry and occupation in the National Health Interview Survey. *Sleep*, *33*, 149–159. https://doi.org/10.1093/sleep/33.2.149

Matsangas, P., & Shattuck, N. L. (2021). Habitability in berthing compartments and well-being of sailors working on U.S. Navy surface ships. *Human Factors*, *63*(3), 462–473. https://doi.org/10.1177/0018720820906050

Matthews, K. A., Patel, S. R., Pantesco, E. J., Buysse, D. J., Kamarck, T. W., Lee, L., & Hall, M. H. (2018). Similarities and differences in estimates of sleep duration by polysomnography, actigraphy, diary, and self-reported habitual sleep in a community sample. *Sleep Health*, *4*, 96–103.

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., Malow, B. A., Maski, K., Nichols, C., Quan, S. F., Rosen, C. L., Troester, M. M., & Wise, M. S. (2016). Consensus statement of the American Academy of Sleep Medicine on the recommended amount of sleep for healthy children: Methodology and discussion. *Journal of Clinical Sleep Medicine*, *12*, 1549–1561. https://doi.org/10.5664/jcsm.6288

Patil, I. (2018). *ggstatsplot: "ggplot2" Based Plots with Statistical Details*. CRAN. Retrieved from https://cran.r-project.org/web/packages/ggstatsplot/index.html

Roberts, K. H. (1990). Managing high reliability organizations. *California Management Review*, *32*, 101–113. https://doi.org/10.2307/41166631

Shattuck, N. L., & Matsangas, P. (2016). Operational assessment of the 5-h on/10-h off watchstanding schedule on a US Navy ship: sleep patterns, mood and psychomotor vigilance performance of crewmembers in the nuclear reactor department. *Ergonomics*, *59*(5), 657–664. https://doi.org/10.1080/00140139.2015.1073794

Simonsohn, U., Simmons, J. P., & Nelson, L. D. (2015). *Specification curve: Descriptive and inferential statistics on all reasonable specifications*. Retrieved from https://ssrn.com/abstract=2694998

U.S. Navy. (2017). *Comprehensive review of surface force incidents*. Retrieved from https://s3.amazonaws.com/CHINFO/Comprehensive+Review_Final.pdf

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L., François, R., Grolemund, G., Hayes, A., Henry, L., Hester, J., Kuhn, M., Pedersen, T., Miller, E., Bache, S., Müller, K., Ooms, J., Robinson, D., Seidel, D., Spinu, V., … Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, *4*, 1686. https://doi.org/10.21105/joss.01686

Young, C., & Holsteen, K. (2017). Model uncertainty and robustness: a computational framework for multi-model analysis. *Sociological Methods and Research*, *46*, 3–40. https://doi.org/10.1177/0049124115610347

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