

Stressors and Support Experienced by Active Duty U.S. Navy Sailors at Sea

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ABSTRACT

Introduction:

High occupational stress is generally associated with poorer mental health and reduced performance in military personnel, whereas access to support resources is associated with positive outcomes. However, little research has examined the unique stressors and supports experienced by sailors on ships while underway at sea. The objectives of this study were to (1) identify sailors' underway stressors and supports and (2) examine how these differ as a function of demographic and operational factors.

Materials and Methods:

Active duty U.S. Navy sailors reporting an underway period lasting at least 30 days within the last 5 years ($n = 441$; 74.7% male, 90% enlisted) completed an anonymous retrospective survey. Sailors completed measures assessing underway stressors (25 items) and supports (9 items), as well as demographic, military, and operational characteristics (sex, rank, ship type, and underway duration). The study protocol was approved by the Naval Health Research Center Institutional Review Board in compliance with all applicable federal regulations governing the protection of human subjects.

Results:

Overall, the stressors rated as most problematic were exposure to loud noises, inability to rest when needed, unavailability of quality mental and physical health care, and not having enough people to complete the mission. Sailors perceived the most available supports to be opportunities to socialize, safety while performing duties, and finding ways to relieve stress. Female and enlisted personnel, relative to male and officer personnel, respectively, generally perceived stressors as more problematic and support resources as less available. Nearly half of the sample (48.3%) reported that services and programs to help them deal with stress while at sea were inadequate.

Conclusion:

Sailors experience many stressors while underway. Increasing the resources available to underway sailors may be warranted, especially for female and enlisted personnel. Additional research is necessary to develop targeted interventions and resources. Possible recommendations include noise mitigation, berthing area improvements, sleep and/or scheduling interventions, improved access to mental and physical health care, and interventions to reduce the stigma associated with seeking mental health care.

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INTRODUCTION

Military service necessitates exposure to stressors, both acute (e.g., trauma, combat) and chronic (e.g., separation from family, relocations). Research on military personnel has provided evidence that operational exposures are associated with increased workload, long hours, lack of resources and privacy, separation from family, and interpersonal conflict, including issues with leadership.¹⁻³ Compared with the other branches of the U.S. Armed Forces, naval personnel report the highest rates of serious psychological distress (i.e., 21.2% vs. 16.4%), highlighting the need for additional research on the unique

subjects. Research data were derived from approved Naval Health Research Center Institutional Review Board protocol number NHRC.2018.0016.

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stressors they experience.⁴ Additionally, recent service-wide issues with recruitment and retention contribute to the undermanning of U.S. Navy ships, a factor that likely exacerbates existing stressors. However, little research has examined the experiences of service members in the U.S. Navy,⁵ and even less so the unique experiences of sailors assigned to Navy ships.⁶

The lack of research on shipboard environments is surprising given that, on average, each of the roughly 341,000 members of the U.S. Navy spends over a year at sea, or “underway,” across their careers.⁷ These “underway periods” include at-sea training exercises, travel between ports, and deployments. Deployments refer to periods when a naval vessel is operating on the open ocean, away from home port for an extended period of time as part of a larger military operation. While sailors underway may experience some of the same stressors as other service members, the shipboard environment presents unique stressors, such as poor habitability, noise, and demanding schedules that leave inadequate time for sleep and rest.^{5,8,9}

It is essential to understand shipboard operational stressors due to their potential adverse impacts on mental and behavioral health, resilience, readiness, and performance in sailors at sea.^{8,10} For example, longer periods underway may be associated with greater stress, which is consistent with evidence that longer military deployments are associated with worse physical and psychological health outcomes.¹¹ A recent systematic review of evidence from studies of sailors (largely merchant mariners) found that duration at sea was associated with a variety of negative effects, including fatigue, mental health issues, and lower job and life satisfaction.⁵ Two studies of shipboard U.S. sailors found results consistent with this; in one, mood worsened significantly while underway,¹² and in the other, sleep duration was negatively associated with time on board (though the sample included ships in port).¹³ Additionally, ship type could influence the stressors and support that sailors experience, though no studies have explicitly examined this.⁶ Limited focus group data from two recent studies of U.S. sailors suggest supportive resources may be perceived as scarcer aboard smaller ships.^{9,14} Previous research also suggests that the availability of support can mitigate adverse effects of stress on health and performance in service members.^{15,16}

To address a critical gap in the literature, we sought to characterize sources of stress and support in a shipboard environment, including analyses of whether stressors and supports varied across demographic (sex, rank) and operational (underway duration, ship type) characteristics. While this was an exploratory study, based on limited prior research,^{5,10} we hypothesized that concerns related to privacy, habitability, and undermanning would be perceived as sources of stress. Due to previous findings that active duty service-women generally report higher levels of psychological distress and mental health symptoms than servicemen,^{4,17} we expected that female sailors would report greater stress than

their male counterparts. Based on evidence, though sparse, that rank relates to specific shipboard stressors, we hypothesized that enlisted personnel would report higher levels of underway stressors than officers^{5,17–19} and that perception of available support aboard ships would likewise vary by these factors.

METHODS

Study Design

An anonymous questionnaire was administered to shipboard U.S. Navy sailors in January 2021 as part of a larger, mixed-methods study.^{14,20} All crew members (approximately 2,500) of a U.S. naval aircraft carrier were offered the opportunity to complete the questionnaire assessing challenges associated with going underway. The carrier was docked in its home port, undergoing regular maintenance between deployments. Participation was voluntary, advertised via flyers and announcements, and compensated (as it was off-duty). A total of 956 sailors participated. Study procedures were approved by the [organization name removed for journal anonymized review] Institutional Review Board.

Measures

Demographic and operational characteristics

Several items assessed demographic characteristics, including sex (male/female) and rank (enlisted/officer). Participants were asked the number of times they had gone underway on a ship for at least 30 days since September 9, 2011. Individuals were included in this quantitative sub-study if they reported going underway for at least 30 days in the last 5 years ($N = 441$). Regarding the most recent underway period, participants reported the date of return, underway duration (1–2 weeks, 2–4 weeks, 1–6 months, or 6+ months), and the type of ship to which they were assigned.

Underway stressors

A list of possible underway stressors was generated based on a review of the existing research literature,⁶ assessments previously used in service member populations (Deployment Risk and Resilience Inventory,²¹ Navy Quality of Life Surveys^{10,18}), discussions with stakeholders and subject matter experts, and focus groups with sailors with shipboard experience.^{9,14} For each of the resulting 25 specific stressors, participants received the following prompt: *During your most recent underway period, how much of a problem were the following for you? Not a problem at all (1), A little bit of a problem (2), A moderate problem (3) A big problem (4), and A very serious problem (5).*

Underway support

The underway supports measure was also developed as described above. The resulting nine items assessed the level

Table 1. Ratings of underway stressors, overall and by sex and rank.

	Overall	Sex		<i>d</i>	Rank		
	Mean (SD)	Male	Female		Enlisted	Officer	<i>d</i>
Exposure to loud noises	3.40 (1.29)	3.36 (1.32)	3.56 (1.20)	0.16	3.42 (1.30)	3.32 (1.25)	0.06
Not being able to rest	2.90 (1.36)	2.87 (1.37)	2.98 (1.35)	0.08	2.94 (1.37)	2.50 (1.25)	0.40
Access to mental health care	2.87 (1.54)	2.72 (1.52)	3.33 (1.51) [§]	0.40	2.96 (1.53)	1.94 (1.26) [§]	0.70
Access to physical health care	2.86 (1.49)	2.74 (1.49)	3.23 (1.47) [^]	0.34	2.95 (1.48)	2.03 (1.39) [§]	0.61
Not enough people	2.79 (1.39)	2.75 (1.42)	2.88 (1.32)	0.09	2.75 (1.40)	3.18 (1.35) [*]	0.18
Lack of privacy	2.77 (1.37)	2.62 (1.36)	3.21 (1.32) [§]	0.44	2.79 (1.38)	2.54 (1.35)	0.30
Personal storage space	2.77 (1.31)	2.67 (1.32)	3.07 (1.21) [^]	0.31	2.82 (1.29)	2.21 (1.34) [^]	0.59
Difficulty communicating back home	2.73 (1.27)	2.66 (1.26)	2.92 (1.26)	0.21	2.75 (1.29)	2.53 (1.06)	0.23
Concerns about family and friends at home	2.63 (1.30)	2.52 (1.33)	2.91 (1.17) [^]	0.30	2.64 (1.32)	2.50 (1.33)	0.16
Maintaining relationships at home	2.58 (1.34)	2.52 (1.34)	2.74 (1.32)	0.17	2.62 (1.35)	2.18 (1.18)	0.35
Lacking tools to do job	2.58 (1.34)	2.53 (1.36)	2.69 (1.27)	0.12	2.59 (1.36)	2.42 (1.24)	0.26
Access to bathroom/showers	2.56 (1.31)	2.33 (1.26)	3.18 (1.22) [§]	0.68	2.60 (1.31)	2.08 (1.24) [*]	0.45
Temperature in work area	2.55 (1.29)	2.45 (1.28)	2.80 (1.27) [^]	0.27	2.57 (1.30)	2.26 (1.11)	0.38
Temperature in berthing	2.53 (1.22)	2.38 (1.21)	2.93 (1.18) [§]	0.45	2.54 (1.22)	2.26 (1.20)	0.28
Exposure to chemical smells	2.49 (1.29)	2.43 (1.28)	2.65 (1.30)	0.17	2.52 (1.29)	2.11 (1.20)	0.33
Not being able to PT	2.44 (1.32)	2.41 (1.30)	2.52 (1.37)	0.09	2.46 (1.34)	2.26 (1.16)	0.20
Boredom	2.41 (1.29)	2.38 (1.26)	2.53 (1.35)	0.12	2.50 (1.30)	1.50 (0.73) [§]	0.78
Access to produce	2.40 (1.24)	2.34 (1.26)	2.57 (1.17)	0.19	2.41 (1.24)	2.18 (1.27)	0.26
Uncomfortable living conditions	2.33 (1.11)	2.26 (1.12)	2.55 (1.02) [*]	0.27	2.35 (1.10)	2.05 (1.11)	0.25
Insufficient training	2.19 (1.30)	2.11 (1.27)	2.41 (1.36) [*]	0.23	2.19 (1.31)	2.18 (1.27)	0.08
Getting along with coworkers	2.19 (1.16)	2.07 (1.09)	2.55 (1.26) [§]	0.42	2.22 (1.18)	1.79 (0.86) [^]	0.42
Air quality in berthing area	2.07 (1.13)	1.98 (1.10)	2.34 (1.18) [^]	0.33	2.10 (1.14)	1.68 (0.81) [^]	0.31
Air quality in work area	1.99 (1.14)	1.96 (1.14)	2.04 (1.11)	0.06	2.01 (1.16)	1.68 (0.74) [*]	0.38
Overhead lights in berthing	1.70 (0.96)	1.63 (0.89)	1.86 (1.06) [*]	0.24	1.72 (0.97)	1.53 (0.83)	0.22
Financial problems	1.69 (1.06)	1.65 (1.03)	1.76 (1.12)	0.10	1.74 (1.09)	1.21 (0.47) [§]	0.43

**p* < 0.05.[^]*p* < 0.01.[§]*p* < 0.001.PT, physical training; SD, standard deviation; *d*, Effect size (Cohen's *d*).

of agreement with statements about access to support, including services, friends, and leadership (e.g., *The last time I was underway, adequate services and programs were available to me to help me deal with stress*; see **Tables 3** and **4** for support items). Sailors rated their agreement with each item on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree).

Analyses

Independent t-tests compared mean ratings on a scale of 1–5 for the two sets of items (stressors and support) between demographic and operational groups of interest (i.e., male vs. female, enlisted vs. officer, carrier vs. other ship types, underway <30 days vs. >30 days), with corrections for unequal variances when appropriate. Carriers were contrasted with all other ships because most respondents (87.5%) had most recently gone underway on a carrier. A *post facto* sub-analysis compared stressors and support in sailors who went underway during (March 2020 and later) versus before (2016–March 2020) the COVID-19 pandemic.

For each individual who responded to all items of interest, grand means were computed to generate overall indices of both perceived stress and perceived support while serving underway, and bivariate correlation was used to examine the relationship between underway stress and support.

RESULTS

Demographics

The sailors in this sub-study (*N* = 441) were predominantly male (73.5%) and enlisted (90.7%). Table S1 describes the demographic characteristics. The majority were underway most recently for <1 month (73.6%) and served aboard an aircraft carrier (87.5%). The second and third most common ship types were destroyers (4.5%) and amphibious warfare ships (4.3%). Most participants (84.6%) went underway most recently before the peak of the COVID-19 pandemic; 15.4% went underway after.

Underway Stressors

Tables 1 and **2** show mean ratings and associated statistics of the 25 underway stressors. Those rated most distressing were exposure to loud noises, not being able to rest when needed, lack of availability of quality mental and physical health care, and not having enough people to complete the mission. These were closely followed by lack of privacy and personal storage space, difficulty communicating with, or having concerns about friends and family back home.

In general, female sailors were more likely than male sailors to perceive underway circumstances as stressful.

Table 2. Ratings of underway stressors by ship type and underway duration.

	Ship Type			Underway Duration		
	Carrier	Other	<i>d</i>	Carrier	Other	<i>d</i>
Exposure to loud noises	3.44 (1.31)	3.17 (1.17)	0.17	3.44 (1.31)	3.17 (1.17)	0.17
Not being able to rest	2.91 (1.35)	2.84 (1.45)	0.01	2.91 (1.35)	2.84 (1.45)	0.01
Access to mental health care	2.90 (1.53)	2.65 (1.60)	0.14	2.90 (1.53)	2.65 (1.60)	0.14
Access to physical health care	2.91 (1.48)	2.52 (1.54)	0.22	2.91 (1.48)	2.52 (1.54)	0.22
Not enough people	2.79 (1.39)	2.78 (1.42)	0.03	2.79 (1.39)	2.78 (1.42)	0.03
Lack of privacy	2.75 (1.36)	2.96 (1.46)	0.18	2.75 (1.36)	2.96 (1.46)	0.18
Personal storage space	2.79 (1.30)	2.62 (1.36)	0.16	2.79 (1.30)	2.62 (1.36)	0.16
Difficulty communicating back home	2.71 (1.25)	2.85 (1.38)	0.13	2.71 (1.25)	2.85 (1.38)	0.13
Concerns about family and friends at home	2.65 (1.31)	2.48 (1.24)	0.12	2.65 (1.31)	2.48 (1.24)	0.12
Maintaining relationships at home	2.56 (1.34)	2.71 (1.32)	0.12	2.56 (1.34)	2.71 (1.32)	0.12
Lacking tools to do job	2.58 (1.35)	2.57 (1.32)	0.03	2.58 (1.35)	2.57 (1.32)	0.03
Access to bathroom/showers	2.58 (1.32)	2.42 (1.26)	0.10	2.58 (1.32)	2.42 (1.26)	0.10
Temperature in work area	2.60 (1.28)	2.15 (1.29)*	0.36	2.60 (1.28)	2.15 (1.29)*	0.36
Temperature in berthing	2.55 (1.22)	2.35 (1.26)	0.17	2.55 (1.22)	2.35 (1.26)	0.17
Exposure to chemical smells	2.48 (1.30)	2.58 (1.26)	0.06	2.48 (1.30)	2.58 (1.26)	0.06
Not being able to PT	2.44 (1.31)	2.42 (1.39)	0.03	2.44 (1.31)	2.42 (1.39)	0.03
Boredom	2.46 (1.31)	2.04 (1.07)†	0.34	2.46 (1.31)	2.04 (1.07)†	0.34
Access to produce	2.40 (1.21)	2.33 (1.45)	0.02	2.40 (1.21)	2.33 (1.45)	0.02
Uncomfortable living conditions	2.31 (1.08)	2.47 (1.30)	0.16	2.31 (1.08)	2.47 (1.30)	0.16
Insufficient training	2.19 (1.29)	2.20 (1.39)	0.03	2.19 (1.29)	2.20 (1.39)	0.03
Getting along with coworkers	2.12 (0.98)	2.12 (0.98)	0.07	2.12 (0.98)	2.12 (0.98)	0.07
Air quality in berthing area	2.11 (1.14)	1.83 (1.00)	0.24	2.11 (1.14)	1.83 (1.00)	0.24
Air quality in work area	2.04 (1.16)	1.62 (0.89)†	0.35	2.04 (1.16)	1.62 (0.89)†	0.35
Overhead lights in berthing	1.70 (0.95)	1.73 (1.05)	0.06	1.70 (0.95)	1.73 (1.05)	0.06
Financial problems	1.72 (1.08)	1.50 (0.87)	0.20	1.72 (1.08)	1.50 (0.87)	0.20

* $p < 0.05$.† $p < 0.01$.PT, physical training; SD, standard deviation; *d*, Effect size (Cohen's *d*).

Female sailors rated all underway stressors as more problematic; 13 of these were statistically significant (all $p < 0.05$), the majority of which had small effect sizes ($d = 0.24$ – 0.45 ; access to bathrooms/showers $d = 0.68$).²² Enlisted sailors rated nine underway stressors higher than officers (all $p < 0.05$), with largely small-to-medium effect sizes ($d = 0.18$ – 0.78).²²

While some stressors varied by ship type and underway period, most did not, and effect sizes were mostly small ($d = 0.23$ – 0.36).²² Sailors aboard carriers were more likely to report boredom ($t_{(74.80)} = 2.60$, $p < 0.05$) and problematic temperatures and air quality in work areas ($t_{(417)} = 2.36$, $p < 0.05$ and $t_{(78.21)} = 3.10$, $p < 0.01$). Sailors who had been underway at least 1 month (compared with <1 month) were more likely to report not having enough people to complete the mission ($t_{(198.67)} = 2.49$, $p < 0.05$), concerns about family and friends back home ($t_{(202.83)} = 2.35$, $p < 0.05$), and uncomfortable living conditions ($t_{(418)} = 2.00$, $p < 0.05$). In contrast, sailors who had been at sea for <1 month perceived access to quality mental health care while underway as more problematic than did those who had been underway longer ($t_{(201.46)} = 2.64$, $p < 0.01$). Lastly, sailors underway during COVID-19 were marginally more likely to report concern for family and friends back home ($p = 0.05$) than those pre-pandemic.

Underway Support

Nearly half of the sample (48.3%) reported that services and programs to help deal with stress while at sea were inadequate. Additionally, 47.3% and 44.5%, respectively, disagreed with the statements “the quality of leadership from my immediate senior enlisted leaders was high” and “the quality of leadership from the ship's officers was high.” The statement most endorsed by all participants was “I had adequate opportunities to socialize with friends on the ship” (56.6% overall agreed). Tables 3 and 4 provide means for all support items.

Male sailors reported greater support than female sailors did for 5 items, though effect sizes were all small ($d = 0.24$ – 0.25).²² In addition to opportunities to socialize with friends ($t_{(413)} = 2.11$, $p < 0.05$), these items included “adequate services and programs were available to help keep me physically healthy” ($t_{(413)} = 2.28$, $p < 0.05$), “I found ways to relieve my stress” ($t_{(407)} = 2.08$, $p < 0.05$), “adequate services and programs were available to help me deal with stress” ($t_{(407)} = 2.08$, $p < 0.05$), and “adequate support services were available to my family” ($t_{(362)} = 2.05$, $p < 0.05$).

Officers endorsed six support statements at higher levels than enlisted sailors did: “the quality of my immediate senior enlisted leaders was high” ($t_{(46.9)} = 6.10$, $p < 0.001$), “the quality of leadership from my ship's officers was

Table 3. Ratings of underway support, overall and by sex and rank.

Overall	Mean (SD)	Sex			Rank		
		Male	Female	<i>d</i>	Enlisted	Officer	<i>d</i>
Adequate opportunity to socialize	3.48 (1.20)	3.56 (1.19)	3.28 (1.19)*	0.24	3.45 (1.19)	3.79 (1.30)	0.24
Felt safe performing duties	3.39 (1.23)	3.41 (1.20)	3.31 (1.30)	0.08	3.32 (1.21)	3.97 (1.22)^	0.59
Found ways to relieve stress	3.28 (1.25)	3.35 (1.23)	3.05 (1.28)*	0.24	3.21 (1.25)	3.95 (1.04)\$	0.51
Adequate service available for physical health	3.17 (1.21)	3.24 (1.19)	2.94 (1.23)*	0.25	3.13 (1.19)	3.47 (1.43)	0.30
Adequate service available for family	3.07 (1.16)	3.14 (1.20)	2.86 (1.12)*	0.24	3.00 (1.17)	3.65 (1.18)^	0.57
Quality of officer leadership	2.79 (1.36)	2.79 (1.34)	2.80 (1.43)	0.00	2.70 (1.34)	3.47 (1.35)\$	0.70
Quality of senior enlisted leadership	2.72 (1.40)	2.77 (1.41)	2.60 (1.37)	0.12	2.60 (1.38)	3.78 (1.07)\$	0.88
Adequate service available for stress	2.69 (1.26)	2.76 (1.26)	2.46 (1.23)*	0.24	2.63 (1.25)	3.26 (1.27)^	0.46

* $p < 0.05$.^ $p < 0.01$.\$ $p < 0.001$.PT, physical training; SD, standard deviation; *d*, Effect size (Cohen's *d*).**Table 4.** Ratings of underway support, by ship type, and underway duration.

	Ship Type			Underway duration		
	Carrier	Other	<i>d</i>	<1 Month	≥1 Month	<i>d</i>
Adequate opportunity to socialize	3.46 (1.19)	3.58 (1.26)	0.10	3.51 (1.15)	3.38 (1.32)	0.11
Felt safe performing duties	3.40 (1.21)	3.32 (1.35)	0.07	3.42 (1.20)	3.30 (1.31)	0.10
Found ways to relieve stress	3.24 (1.23)	3.46 (1.37)	0.17	3.21 (1.25)	3.49 (1.23)*	0.23
Adequate service available for physical health	3.16 (1.21)	3.22 (1.25)	0.05	3.14 (1.18)	3.25 (1.30)	0.09
Adequate service available for family	3.08 (1.15)	3.04 (1.38)	0.03	3.06 (1.15)	3.10 (1.29)	0.04
Quality of officer leadership	2.77 (1.36)	2.86 (1.41)	0.07	2.78 (1.34)	2.80 (1.44)	0.02
Quality of senior enlisted leadership	2.66 (1.40)	3.10 (1.36)*	0.32	2.67 (1.39)	2.85 (1.42)	0.12
Adequate service available for stress	2.69 (1.25)	2.67 (1.29)	0.02	2.69 (1.27)	2.69 (1.23)	0.00

* $p < 0.05$.PT, physical training; SD, standard deviation; *d*, Effect size (Cohen's *d*).

high" ($t_{(412)} = 3.37$, $p < 0.001$), "I found ways to relieve my stress" ($t_{(412)} = 4.09$, $p < 0.001$), "adequate services and programs were available to me to help me deal with stress" ($t_{(408)} = 2.97$, $p < 0.05$), "adequate support services were available to my family" ($t_{(362)} = 3.19$, $p < 0.05$), and "I felt safe while performing duties" ($t_{(413)} = 3.15$, $p < 0.05$). Effect sizes ranged from small to large ($d = 0.46$ – 0.88).²²

Endorsement of the underway support statements was similar among individuals who had most recently served on an aircraft carrier versus other ship types, including both groups highly endorsing, "I had adequate opportunities to socialize with friends on the ship." One exception was that participants most recently on a carrier had lower agreement than those on other ships with the statement, "the quality of my immediate senior enlisted leaders was high" ($t_{(410)} = 2.07$, $p < 0.05$; $d = 0.32$).

For participants most recently underway for <1 month, the support statements most and least agreed with, respectively, were "I had adequate opportunities to socialize with friends on the ship" and "the quality of my immediate senior enlisted leaders was high." Participants most recently underway for >1 month endorsed the statement "I found ways to relieve my stress" more than did those underway <1 month ($t_{(414)} = 2.00$, $p < 0.05$; $d = 0.23$).

Only one support was different between post- and pre-pandemic underway periods: sailors post-pandemic agreed less that "adequate services and programs were available to help keep me physically healthy" than did pre-pandemic participants ($t_{(416)} = -2.11$, $p < 0.05$). Lastly, there was an overall negative association between perceived underway stress and perceived underway support ($r_{(420)} = -0.51$, $p < 0.001$; [Supplementary Figure S1](#)).

DISCUSSION

The present study addresses a significant research gap regarding the experiences of sailors serving at sea. To that end, we examined sailors' perceptions of stressors and supports within an underway environment. Further, we examined both individual and operational characteristics that may impact the extent to which underway stressors are perceived as problematic and underway supports sufficient to meet sailors' needs. In general, our findings show it is the small daily inconveniences in the shipboard environment (such as noise) reported as most stressful. In identifying aspects of military shipboard service that could either threaten or bolster psychological health among service members, this novel study provides critical contextual information that could be used to refine policies, practices, and programs available to support

the seafaring community. In general, these results parallel research findings from shore deployments and law enforcement communities, where non-combat-related stressors during deployment or duty, respectively, can increase risk for adverse outcomes.^{23,24}

Findings suggest that it may be especially beneficial to reduce noise in underway environments, as this was the single stressor deemed most problematic by respondents in this study, though it is unknown whether this reflects work or living spaces, or both. Occupational noise is a commonly cited source of stress for shipboard sailors,^{5,8} negatively impacting physical health, causing sleep disruption and leading to possible hearing loss, tinnitus, and even cardiovascular disease.²⁵ Encouraging compliance with proper use of hearing protection while on duty may mitigate the health impacts of extreme noise exposure.²⁵ Additionally, while earplugs or noise-canceling technology in berthing areas could improve sleep quality (a known risk factor for health issues), this is not feasible due to operational and safety requirements. However, promotion of quiet hours and assignment of berthing areas based on work schedules might reduce the impact of noise. Other proposed interventions to improve habitability include modifications to berthing areas, such as improving mattress quality.¹³

Another stressor participants reported as highly problematic was not being able to rest. Sleep, fatigue, and circadian disruption are prevalent in the U.S. military and are associated with impaired job performance, errors that interfere with mission execution,^{26,27} and adverse physical and mental health outcomes.²⁷ The present results highlight the need for improving sleep in the shipboard environment, such as adopting circadian watch schedules, mandating protected sleep time, and increasing sleep health education efforts.^{28–30}

Sailors also perceived poor access to mental and physical health care. Given the high rates of military suicide, including within the Navy, efforts to improve health care access on ships are urgently needed. Possible strategies may include increasing the number of trained mental health professionals assigned to ships or expanding telehealth opportunities when internet access is possible.⁵ Targeted stigma reduction interventions to promote treatment seeking may also be effective, especially if directed toward those less likely to seek help.^{14,31} Additionally, the Navy could expand or refine the stress reduction or health promotion programs while underway to prevent development or exacerbation of symptoms.

A novel aspect of this study was the assessment of sources of support at sea. Overall, sailors were most satisfied with their opportunities to socialize, and the majority found ways to relieve stress. Though causation cannot be inferred, the inverse association between perceived support and stressors indicates that bolstering support could mitigate some of the stress of serving at sea. Research has shown that sailors with high levels of social support had better self-reported physical and mental health and lower stress, fatigue, and problematic alcohol use than their shipmates.⁵ Thus, we recommend

implementing strategies to increase support during deployment, including dedicated time for social activities and team building.⁵

This study is also among the first to explore differences in shipboard experiences by sex and rank. Enlisted and female sailors reported significantly higher levels of stress due to access to mental and physical health care, opportunities to relieve stress, privacy, and access to restrooms and showers, compared with officer and male sailors, respectively (all $p < 0.05$). These results are consistent with previous service-wide research, indicating female and enlisted personnel have more serious psychological distress and suicidal ideation and are more likely to perceive an unmet need for mental health services.⁴ Additionally, leadership was identified as inadequate. While it is unclear if these results generalize to other commands because leadership characteristics could well be ship specific, these findings are consistent with previous research in other operational contexts.^{1,2} Thus, interventions targeting leadership, specifically as a source of support for enlisted sailors, could also be helpful.

This study has several limitations. First, the self-reported measures of shipboard stressors and support were subjective and retrospective and may therefore be subject to bias. To reduce recall bias, sailors were asked about experiences occurring within the last 5 years only (61.2% were in the last 2 years). Second, these data were collected at a single time point and may not be representative of stressors or supports across the ship's operational cycle. Longitudinal data across the entire ship cycle would provide additional context for how sources of stress and support may change throughout a sailor's career. Third, while this sample is demographically consistent with the larger Navy population and includes data about multiple ship types from individuals of all ranks, results may not be generalizable to the entire fleet, given that the majority had most recently gone underway aboard an aircraft carrier. The size and mission requirements of service aboard an aircraft carrier likely result in significant differences in stress and support than on a smaller vessel. Finally, some selection bias in the sample is possible, though we attempted to mitigate that with compensation for survey completion. Despite these limitations, this study provides a novel account of the shipboard experience among a select group of sailors.

CONCLUSIONS

To ensure their health and safety, all sailors should be provided access to equipment, training, programs, services, and an environment that is designed to mitigate the stresses innate to shipboard service. This, in turn, should enhance performance, psychological health, and overall force readiness. This study found that many sailors receive adequate support while at sea but that there are also many opportunities for improvement. More research is necessary in this area so that targeted interventions and resources can be developed to reduce stress and increase the support experienced by shipboard sailors. Specifically, longitudinal data from multiple ships are required to

determine how sources of stress and support may change over the ship's operational cycle or by ship type and unique command culture. Additionally, qualitative research could help to garner richer information about specific challenges as well as interventions that might be most beneficial.

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SUPPLEMENTARY MATERIAL

Supplementary material is available at *Military Medicine* online.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY

The datasets generated and/or analyzed during the current study are not publicly available due to security protocols and privacy regulations, but they may be made available on reasonable request by the Naval Health Research Center Institutional Review Board (contact phone +1 619 553 8400).

INSTITUTIONAL REVIEW BOARD (HUMAN SUBJECTS)

The study protocol was approved by the Naval Health Research Center Institutional Review Board in compliance with all applicable federal regulations governing the protection of human subjects. Research data were derived from approved Naval Health Research Center Institutional Review Board protocol number NHRC.2018.0016.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC)

Not applicable.

INSTITUTIONAL CLEARANCE

Institutional clearance approved.

INDIVIDUAL AUTHOR CONTRIBUTION STATEMENT

EMH, EAS, RME, and CJT initiated the project and contributed to study design. RME and VGP collected the data. LMH, VGP, and CJT conducted the statistical analysis. LMH and EMH were responsible for drafting the manuscript. All authors contributed to the manuscript and read and approved the final manuscript.

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