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14. ABSTRACT

The Oregon Military Employee Sleep & Health Study (MESH) was an RCT and ran from 2016-2021, focusing on full time members of the Oregon National Guard, Army and Air. The intervention combined a training on supportive supervision for leaders as well as individual feedback on sleep. The intervention demonstrated positive effects on sleep health, well-being, and work outcomes, as well as improvements in couple functioning.

15. SUBJECT TERMS
Supervisor Support, Sleep Health, Work-Family, Leader Training

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1. INTRODUCTION:

The goal of the funded research project - The Oregon Military Employee Sleep & Health Study (MESH) - was to improve safety, health, and well-being of service members (including Military Technicians and Active Guard Reserves) in the Oregon National Guard (Army and Air) and their families. Our research team, based at Oregon Health & Science University (OHSU), adopted a comprehensive and integrative approach that was designed to impact multiple risk behaviors, as well as health and work-family outcomes. The clinical trial directly addressed the vision of the PH/TBIRP with its focus on psychological health, wellness, and overall quality of life for Service members and their families. It specifically addressed the JPC-5/MOMRP psychological health and resilience research portfolio and is focused on prevention, treatment, and recovery of Service member and military family behavioral health, which is critical to force health and readiness. Furthermore, this project addressed prevention/health promotion interventions and systems-level approaches for use within the military context. The main goal of the clinical trial was to develop and test the effectiveness of a Behavioral Health Leadership training intervention (health protection), combined with an individual Service member health promotion intervention based on actigraph sleep tracking and cognitive effectiveness feedback, on risk behaviors, psychological health, and workplace outcomes of Service members within the context of the Oregon National Guard (ORNG; includes Army and Air Force). *Figure 1* below is our Conceptual Model.

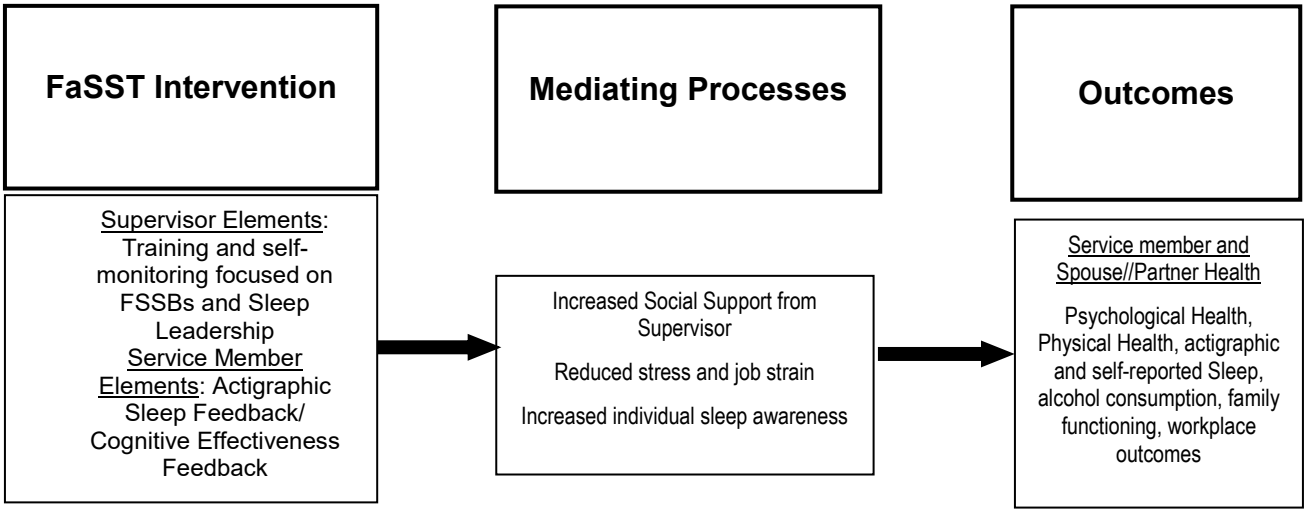

Figure 1. Military Employee Sleep and Health Study (MESH) Conceptual Model

The MESH Study was a randomized controlled trial, where we developed and tested the effectiveness of (1) a family-supportive supervisor behavior (FSSB)/sleep leadership

training intervention, and (2) an individual-level intervention using actigraphic sleep tracking and personalized sleep/cognitive effectiveness feedback. The intervention, called Family and Sleep Supportive Training (FaSST) was expected to contribute to improvements in service members' sleep health, risk behaviors, mental and physical health, and injury, as well as to service members' and their spouse/partners' work-family experiences, and overall health and well-being. We examined the effects of the intervention based on survey assessments conduced at baseline, 4- and 9-month post-baseline; the intervention was conducted approximately 1-month post-baseline (see *Appendix A* for Study Design Overview). We also used the actigraphic data collected at baseline and 9-month post-baseline to evaluate the intervention effects. The study adopted a waitlist-control experimental design, so the training was made available to all supervisors in the control group after the final survey data collection. Additionally, the waitlist-control group did not receive the individual-level actigraphic feedback until after the final survey data collection. We also received supplemental funding in July 2020 to collect one more wave of survey data (no actigraphy) from service members and spouse/partners to assess the impact of the novel coronavirus on health, well-being and organizational outcomes. These data were collected in November 2020 and are discussed in more detail under "Major Task 7: *Supplemental COVID-19 Data Collection*" section below.

As will be seen, ***we were successful in meeting all recruitment goals and in completing all tasks noted in our Statement of Work*** (see *Appendix B*). While analyses of data and peer-reviewed paper submissions will be continuing for some time, we have been able to provide reports of results from all Specific Aims. In summary, results indicate that ***the intervention had a positive impact on the treatment group with regard to sleep outcomes, mental health and well-being, and work outcomes, such as job satisfaction and retention***. In addition, intervention effects spilled over and improved couple functioning and family processes.

This report summarizes the work on the Oregon MESH Study over the past five years. We also provide a summary of our dissemination efforts and the impact of the findings on the field of occupational health psychology and beyond.

2. KEYWORDS:

Supervisor Support; Sleep; Leadership; Health Protection; Health Promotion; Military Health; Work-Family; National Guard; Family-Supportive Supervisor Behavior; Actigraphy; Leader Training; Randomized Controlled Trial

3. ACCOMPLISHMENTS:

What were the major goals of the project?

We have successfully completed all of our Specific Aims. Below is a summary of what was accomplished for each one.

Aim 1: To assess the effects of the FaSST intervention on Service members' and their supervisors' sleep using self-report and actigraphy measures; risk behaviors such as drinking, smoking, and unsafe driving; and mental and physical health (physical symptoms, functional impairment, PTSD symptoms, depression symptoms), and injury.

Results indicate that the intervention had a *significant positive impact* on:

- Improved sleep leadership support, both supervisor and service member reports
- Sleep outcomes, including sleep duration, satisfaction with sleep, reduction in sleep impairment and stress before bed
- Personal and social functional impairment
- Reduced loneliness and higher life satisfaction
- Reduction in anger and improved resilience in service members
- Reduced accidents and injuries

Aim 2: To assess the effects of the FaSST intervention on Service members' and their spouse/partners' global family processes (e.g., marital satisfaction) and spouse/partner mental and physical health (physical symptoms, self-reported indicators of stress, functional impairment, depression symptoms).

Results thus far indicate that the intervention had a *significant positive impact* on:

- Higher perceived partner responsiveness (i.e., marital satisfaction)
- Reduced loneliness and higher life satisfaction for both members of the couple

Aim 3: To assess the effects of the FaSST intervention on Service member, supervisor, and spouse/partner workplace outcomes (job satisfaction, organizational commitment, absenteeism, safety/injuries).

Results thus far indicate that the intervention had a *significant positive impact* on:

- Service member job satisfaction
- Reduced turnover intentions
- Workplace safety, including safety participation, motivation, and compliance
- Reduced workplace injury and accidents

Below is a summary table of completion of tasks, their target completion date, and actual completion date.

Table 1. Completion of MESH Study Tasks from the Statement of Work

	Timeline (Months)	Target Completion Date	Actual Completion Date	% Complete
Major Task 1: Adapt and Integrate Trainings				
Subtask 1: Prepare Regulatory Documents and Research Protocol for Study 1	1-8	MAY 2017	JAN 2017	100%
Coordinate with Sites for cooperative research and development agreement (CRADA)	1-3	DEC 2016	JAN 2017	100%
If Applicable, coordinate with Sites for material transfer agreements (MTAs) or clinical trial agreements (CTAs) submission	1-3	DEC 2016	OCT 2016	100%
If Applicable, coordinate with Sites for nondisclosure agreements (NDAs).	N/A	---	---	---
Subtask 2: Review and integrate training materials	1-4	JAN 2017	OCT 2017	100%
Review Sleep Leadership training materials	1-4	JAN 2017	JAN 2017	100%
Work with Oregon National Guard leadership to identify most critical pieces of existing training	1-4	JAN 2017	FEB 2017	100%
Develop and test website for training delivery	2-8	MAY 2017	SEP 2017	100%
Milestone: Pretest training with small group of stakeholders	6-8	MAY 2017	JUL 2017	100%
Major Task 2: Staffing				
Subtask 1: Hiring and Training of Study Staff	1-9	JUN 2017	MAY 2017	100%
Coordinate with Sites for job descriptions design	1-4	JAN 2017	JAN 2017	100%
Advertise and interview for project related staff	4-8	MAY 2017	APR 2017	100%
Milestone: Hire and Train Research Staff	5-9	JUN 2017	MAY 2017	100%
Major Task 3: Human Subjects Review				

Table 1. Completion of MESH Study Tasks from the Statement of Work

	Timeline (Months)	Target Completion Date	Actual Completion Date	% Complete
Refine eligibility criteria, exclusion criteria, screening protocol	1-2	NOV 2016	NOV 2016	100%
Finalize consent form & human subjects protocol	1-2	NOV 2016	NOV 2016	100%
Coordinate with Sites for IRB protocol submission	1-3	DEC 2016	NOV 2016	100%
Milestone: Submit for approval for review at OHSU, PSU and CSU	1-3	DEC 2016	NOV 2016	100%
Milestone: Coordinate with Sites for Military 2nd level IRB review (ORP/HRPO)	3-6	MAR 2017	DEC 2016	100%
Submit amendments, adverse events and protocol deviations as needed	As Needed	Ongoing	Ongoing	n/a
Coordinate with Sites for annual IRB report for continuing review	Annually	Annually	Annually	n/a
Major Task 4: Data Collection and Intervention Implementation				
Coordinate with Sites for flow chart for all study steps, web data collection and database requirements	3-8	MAY 2017	DEC 2017	100%
Finalize assessment measurements	1-3	DEC 2016	JAN 2017	100%
Milestone: Begin subject recruitment	10-28	JAN 2019	AUG 2019	100%
Administer baseline assessment	12-30	MAR 2019	SEP 2019	100%
Randomize sites into treatment and control conditions	13-31	APR 2019	SEP 2019	100%
Participants and supervisors in treatment condition complete training, behavior tracking, and actigraphy trial and feedback	7-30	MAR 2019	OCT 2019	100%
Milestone: Complete follow-up assessments about 4 months after baseline survey	18-32	MAY 2019	DEC 2019	100%
Milestone: Completed follow up assessments about 9 months after baseline survey	20-38	NOV 2019	MAY 2020	100%

Table 1. Completion of MESH Study Tasks from the Statement of Work

	Timeline (Months)	Target Completion Date	Actual Completion Date	% Complete
Provide supervisor training to waitlist control sites	38-45	JUN 2020	JUN 2020	100%
Major Task 5: Data Analysis and Results Reporting				
Clean data sets and match data sources	13-40	JUN 2020	JUN 2020	100%
Share data with partners according to CRADA and IRB specifications	38-42	SEP 2020	SEP 2020	100%
Milestone: Run analyses and report findings on intervention effects	38-48	SEP 2020	DEC 2021	100%
Major Task 6: Dissemination				
Work on dissemination of findings (abstracts, presentation, publications, DOD)	40-48	SEP 2020	DEC 2021	100%
Milestone: Report results from data analyses	40-48	SEP 2020	DEC 2021	100%
Major Task 7: Supplemental COVID-19 Data Collection*				
Create updated survey to ask about COVID-specific issues	48-60	---	DEC 2020	100%
Milestone: Completed follow up COVID supplemental survey	48-60	---	DEC 2020	100%
Clean data set and match data sources	48-60	---	MAR 2021	100%
Analyze data and report findings	48-60	---	JUL 2021	100%
Milestone: Disseminate findings from data analyses	48-60	---	SEP 2021	100%

**Part of the supplemental funding awarded 13-AUG-20. No specific target dates were noted in the supplement.*

What was accomplished under these goals?

Below is a breakdown of all Major Tasks from *Table 1* above by year and a summary of what was done over the past five years.

Major Task 1: ADAPT AND INTEGRATE TRAININGS

The training/intervention portion of our study included both a health protection and a health promotion portion. Health protection was a computer-based training for supervisors called **FaSST**. Health promotion was in the form of education –

providing **individualized sleep quality feedback** to both supervisors and service members after wearing an actigraphy device for 3 weeks.

Supervisor Training Development and Content Overview

The first stage of development involved reviewing existing materials, including the Family Supportive Supervisor Behavior model developed by Dr. Hammer and her colleague, Dr. Ellen Kossek. We also reviewed and integrated existing materials from our partners at Walter Reed Army Institute of Research (WRAIR), Joint-Base Lewis Mc-Chord at WRAIR-West, and other Army training on sleep health and on leadership shared with us by our Oregon National Guard (ORNG) partners.

Using some of our previous supervisor trainings, we developed an outline and structure for the training, development several modules for supervisors to proceed through. We also developed a pre- and post-test in order to gauge learning, as well as several interim quiz questions as learning checks and reinforce learning. *Figure 2* below provides an overview of the training content areas.

Once the major areas of training content were established, our research assistant, Phoenix Rain Bird, integrated this information into a purchased training platform, Articulate, which we reviewed at weekly team meetings and provided feedback. The platform allows for a more dynamic training process that is interactive and supported multiple media sources. We created several scenario examples that were military-specific.

Finally, we created a behavior tracking exercise that supervisors engaged in after the core training was complete. Supervisors were instructed to log the number of supportive behaviors they engaged in with their staff over a two-week period. Definitions of each type of supportive behavior were provided (see *Appendix C*). This exercise assists with transfer of learning into action and creates the ‘habit’ of being intentionally supportive.

Once the training was programmed, we had several content experts review it, including our study consultants. Our research assistant at the time, Marcus Ling, was a 1st LT in the ORNG and provided excellent feedback and wording suggestions reflective of language used in the military environment. We also sought feedback from key personnel in the ORNG and WRAIR.

Screen shots of the most recent version of FaSST, both the military and civilian versions, are included in *Appendix D*.

The FaSST was largely complete by the end of Year 1, with final touches and implementation occurring in Year 2 with the first half of the sample (i.e., Oregon Army National Guard (ORARNG); see Major Task 4 below for details). We made some minor modifications (just stylistically, not to content) with the visuals because of the bandwidth at some of the smaller armories made it difficult for the training to run. For the Oregon Air National Guard (ORANG), we also created a downloadable version as we encountered some firewall issues at the Air base in Klamath Falls.

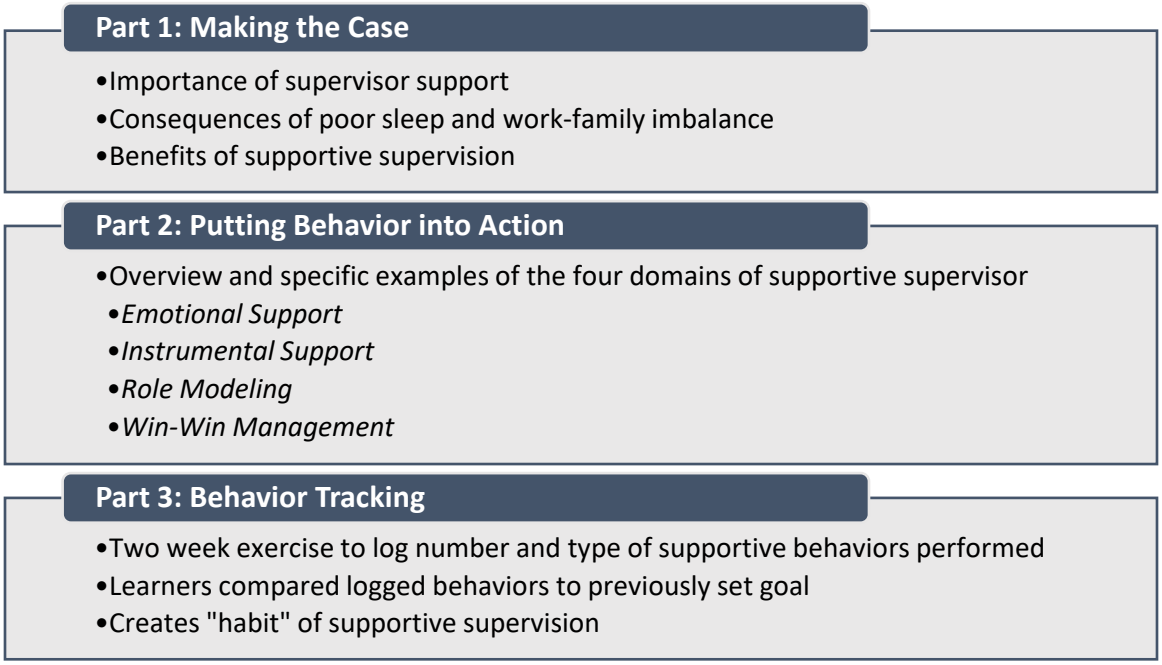

Figure 2. FaSST Content Overview

Website Development

We hired a local company, SimB, with a good reputation at OHSU, who was familiar with the extra security reviews required by our institution. They created a public website: www.meshstudy.org. The training not only provided information about the study – and continues to be an essential tool for dissemination (see Dissemination section below) – but also housed the training itself. We worked intently with SimB to not only ensure we could collect data from our training to assess its effectiveness, but also to create a secure dashboard that is easily understandable for supervisors to *track* their supportive behaviors after completing the online training. Screen shots of the dashboard can be found in *Appendix E*. We were able to successfully download relevant supervisor data from the website to use in our assessment of the training (see *Section 4. Impact* for more information).

Individual Sleep Feedback

Creating sleep reports that were individualized for each participant involved developing both content for the reports, but also learning the technical aspects of actigraphy devices and the subsequent data. Fortunately, based on relationships we had developed with WRAIR, we were able to start with existing reports developed and produced by their Sleep Research Center (SRC), using their proprietary algorithm. Use of the algorithm, as well as a fleet of approximately 160 Phillips II actigraphy devices was included under the CRADA we developed and signed with WRAIR. These devices were used by WRAIR because they were not cloud-based (i.e., connected to the internet); previous devices considered shared data with websites which created security concerns. All

motion data collected from these devices remained on the devices until we physically connected them to our computers to download onto our secure servers. No location data were collected. We also purchased, installed and learned the IGOR software used by SRC to process sleep data and generate reports.

With the guidance of Amy Adler at WRAIR and MAJ Matt LoPresti and his team at WRAIR-West at Joint Base Lewis-McChord (JBLM) in 2016-2018, we reviewed the existing report used in previous studies and customized content and provided feedback. We provided feedback and worked with WRAIR personnel to create a feedback report that fit the needs of the MESH study and the ORNG population. In tandem, we developed a detailed protocol and script for MESH staff to provide individual standardized feedback to participants (see *Appendix F*) and then trained staff.

We piloted feedback with group of graduate students and staff at PSU who were not part of the MESH team and made modifications to our protocols based on that feedback. We created a process where our team would first review the report, in particular the actogram that included the 3 weeks of sleep and activity data, to identify potential sleep issues. Based on recommendations from our sleep experts, we focused on three key components of sleep health and developed standards –***duration, fragmentation, and consistency of sleep onset/wake times***. We created concrete standards to determine if any of these areas of sleep health were a potential issue. *Figure 3* below summarizes the domain and what constitutes each level of concern. If a reviewer noted an issue, this was noted in the summary sheet that was used in the feedback session.

Sleep Health Construct:	**Operationalized as:**	**Is an issue?**		
		Yes	Maybe	No
DURATION	Number of days' participant received less than 6 hours of sleep	>6 nights	3-5 nights	<2 nights
FRAGMENTATION	# of nights PPT had 'fragmented' sleep			
CONSISTENCY	# of times in one-night sleep/wake varied by 2+ hrs			

Figure 3. Operationalization of Sleep Constructs in Feedback

Other sections of the report included a *Mental Acuity graph* which related the participants sleep over the 3 weeks to their cognitive effectiveness. We also provided some summary measures on average sleep duration, average time it took to get to sleep, the percent of time in bed the device rated them as asleep, and their overall Sleep Efficiency, which was a composite measure. The report also provided comparisons for these measures to the rest of their unit for context.

We also created a goal setting task at the end of the report to have participants take some sort of action based on the information they received.

A full sample Sleep Report is included in *Appendix G*.

We developed a training protocol and script for all research assistants providing feedback to ensure consistent delivery of information. Dr. Steve Shea, our team sleep expert was heavily involved in the script and the training of our team on providing sleep feedback, as well as answering questions we had about specific sleep reports as they arose. We held extensive training and role playing sessions with our research assistants on delivering feedback. More information about the actual delivery of feedback is in Task 4 below.

Major Task 2: Staffing

Throughout the project, though we turned over several team members, we remained fully staffed. A full list of all staff who worked on the project can be found in *Section 7. Participants and Other Collaborating Organizations*. In our first year, we hired and trained our core research team. This also includes several research assistants at Portland State University and Colorado State University, some of whom did not receive funding directly from this grant, but who worked on the grant. This is differentiated in Section 7.

All PIs and Co-I's remained consistent throughout the study. Dr. Leslie Hammer was PI of the entire project and the primary center at OHSU. Drs. Cynthia Mohr was PI of the PSU center, supported by our statistician, Dr. Todd Bodner. Dr. Tori Crain was PI of the CSU center, though in the final year of the study she obtained a position at PSU, but her role overseeing the actigraphy portion of the study remained the same. We also had Dr. Steven Shea, Director of the Oregon Institute of Occupational Health Sciences and a world-renowned sleep expert who provided his expertise.

Dr. Krista Brockwood, an Army Veteran, was Project Manager for the duration of the study, along with Phoenix Rain Bird who focused primarily on training development and implementation. Other primary positions included our Recruitment and Logistics Coordinator, who was first staffed by Marcus Ling, who was a member of the ORNG and his experience and knowledge with the Guard was invaluable. After Mr. Ling left for another position, Shalene Allen was hired to take his place and remained for the duration of the study. Ms. Allen entered graduate school at PSU and is currently in her 3rd year of the Industrial/Organization program at PSU, using MESH data for her Master's Thesis. Jason Malach-Fuller was hired as our Training Coordinator to assist with training implementation, but he also took on other roles as well, including maintaining our fleet of ~180 actigraphy devices.

We had several post-doctoral researchers/data analysts over the duration of the study, which is not surprising given that these positions are designed to provide further training and opportunity to publish, and are more short term. Our post docs included Drs. Janelle Cheung, Marjaana Sianoja, Jacquelyn Brady, and Rebecca Brossoit. Drs. Brady and Brossoit both were graduate students of PSU and CSU respectively and working on MESH, who became post docs after they defended their dissertations. Both have found academic positions; Dr. Brady is now at San Jose

State University and Dr. Brossoit is at Louisiana State University. Both are leading on MESH publications. Dr. Cheung took a job in industry and Dr. Sianoja returned to Finland.

For the PSU center, there have been several GRAs, but the primary student assigned to MESH has been AnnaMarie O'Neill (nee Greenhalgh), who recently defended her dissertation using MESH data and is preparing for a research position in industry. The CSU center also provided employment and learning opportunities to several graduate and undergraduate students. Of note, Jacquelyn Wong led on a baseline paper (see Products section) and a host of other students gained hands-on experience coding and cleaning actigraphy data.

We also made it a priority to hire a team with military experience when possible. This includes:

Dr. Krista Brockwood, Army Veteran

Marcus Ling, 1LT ORNG

James Lee, Army Veteran

Sheila Umemoto, Army Veteran

Luke Mahoney, Marine Veteran

As noted previously, a full list of all staff who worked on the project is in Section 7, as well as a list of all training and development opportunities which is listed below. Opportunities for learning, development and building effective resumes and CVs has always been a priority in our research lab.

Major Task 3: Human Subjects Review

Throughout the project, we have maintained compliance with the Human Subjects regulatory environment.

Approval was received from OHSU's IRB on 10-NOV-2016. Continuing Review was submitted and approved each subsequent year prior to the expiration date so there was no lapse at any time. Several minor amendments were submitted and approved over the course of the study, but none that changed participant risk level (e.g., finalization of survey measures and recruitment materials).

Sub-awardees (Colorado State University & Portland State University) obtained letters from their IRB offices ceding IRB oversight to OHSU in January 2017.

The Department of Defense (HRPO) reviewed and provided approval for the IRB protocol on 27-DEC-2016. We have also submitted and received approval for annual compliance documents to HRPO.

The protocol remains active at OHSU per their requirements, as we are still analyzing data for publications. The HRPO protocol is now closed.

Major Task 4: Data Collection and Intervention Implementation

This task comprises the bulk of the work completed on the study. This section also comprises our methodology.

Timelines

The focus the first year was on developing the timelines and processes for recruitment for service members and their spouses, data collection and implementation of the intervention components. This included both high level and detailed timelines for recruitment, data collection, and intervention delivery and tracking. Because of the limited number of actigraphy devices and locations of unit throughout the state, we planned a rollout over several years, starting with Army units, then switching to Air. In late August 2017 we began recruiting our first participants. A high level timeline can be found in *Appendix H*.

After developing a high level timeline of a study roll out plan, we worked closely with Human Resource personnel at the Oregon National Guard (ORNG) to determine unit structures, locations, numbers of Active Guard Reserves (AGRs), military technicians and supervisors, and drill schedules. With this information, we created a detailed timeline with specific dates for each unit/location (see *Appendix I*). A diagram of the overall study design is in *Appendix A*, along with an example of the steps and timing for one unit to proceed through the study (*Appendix J*).

Over the course of the study we encountered many real-world obstacles, as is common with field research, and especially so with the National Guard. We encountered issues where units were deployed overseas and domestically for hurricanes, wildfires, and most recently for assistance with COVID-19 issues (e.g., vaccinations and hospital staffing). More detail is provided in *Section 5. Challenges/Problems*.

In order to standardize and document our processes, we developed several Standard Operating Procedures (SOPs), which were organized and continually updated in a larger Manual of Procedures over the study. Given the size of the document, we have not included in this report, but are happy to share upon request.

Data Collection start and completions dates for Army National Guard:

- Baseline survey/actigraphy: *September 2017 – March 2018*
- 4-month survey only: *January 2018 – July 2018*
- 9-month survey/actigraphy**:** *May 2018 – November 2018*
- Supplemental COVID survey only: *November 2020*

Data Collection start and completions dates for Air National Guard:

- Baseline survey/actigraphy: *January 2019 – September 2019*
- 4-month survey only: *June 2019 – December 2019*
- 9-month survey/actigraphy**:** *October 2019 – May 2020*
- Supplemental COVID survey only: *November 2020*

Measures

For our survey instruments, we chose validated measures with good reliability. We ensured we had measures that would fulfill our SOW requirements and hypotheses, focusing on work, family, personal physical and mental health and several potential moderators (e.g., military contextual factors, family composition and responsibilities). We piloted the survey instrument for readability and timing, taking about 45 minutes to complete. A list of measures can be viewed in *Appendix K*.

For actigraphy, data were downloaded from devices then cleaned using a strict protocol whose development was led by Dr. Tori Crain, our actigraphy expert. Dr. Crain, in consultation with the Sleep Research Center at WRAIR, created sleep metrics to use as outcome measures.

Recruitment Process

One of our first tasks in recruitment was to create a brand for our study, starting with the creation of a study name with a memorable acronym: the Oregon Military Employee Sleep & Health Study – the MESH Study. We engaged the same graphic designer who worked with us on SERVe to create a MESH logo and recruitment materials. We have found that having a 'brand recognition' enhances buy in and participation in our studies.

We first briefed senior leadership at the onset of the study and got their support for the study. We then created a unit-level recruitment process that started with engaging unit leaders and informing them about the MESH study and what would be asked of them and available to them. Our goal was to minimize the effort on the part of unit leaders s provided an email template for unit leaders to send out to all full time personnel with a link to sign up for the study (see *Appendix L*), as well as information and an FAQ about the MESH Study. We screened potential participants for eligibility (e.g., full-time employee of the National Guard, their unit was currently queued up).

We used the sign up as an opportunity to recruit spouses and partners of NGs in the recruiting process to ensure we reach our target sample size of 270. We asked if they were married or living with someone 6 months or more. If affirmed, they could provide their spouse/partner contact information or provide them with a link to participate in the survey. We also had a flyer and FAQ (*Appendices M - P*) that they or we could send depending on their preference.

Lastly, we also recruited on site when we delivered the actigraphy devices to those who had signed up. We arranged a time and place with the unit leader, brought food and made a quick pitch for the study and answered any questions. We brought flyers for both service members and spouse/partners. This approach proved particularly effective and helped us reach out goal of 500 pairs of service members and supervisors, and 270 spouse/partners (see SOW, *Appendix B*).

Data Collection

After signing up, participants were sent a link to the online survey through REDCap Survey software, where informed consent was also provided. The baseline survey was open for approximately 3 weeks or up to a month in some

cases. Participants were directed to complete the survey off of work time as they were compensated $25 for each survey and actigraphy data collection.

Actigraphy devices (Phillips Actiware II – see *Appendix Q* for information) were handed out in person and care instructions were provided (e.g., avoid extreme temperatures, caution when working on machinery). We returned three weeks later to pick up devices and hand out incentive cards. At 4 months another survey was emailed, but no actigraphy. At 9 months another survey was emailed, and we also delivered actigraphy devices in person for another data collection. We provided postage-paid boxes to return devices if someone was out the day we were there.

For the 4-month follow up survey (no actigraphy), we emailed a link to the survey and gave participants about 2 weeks to complete the survey. We created tracking sheets and sent follow up email reminders and made calls to those missing the survey, usually the weekend before the survey was to close. We then loaded another $25 onto their gift card, or sent them a new one if they lost or threw away the previous one.

At 9-months, we also collected actigraphy data again, so we both sent out the survey link and visited sites in person to deliver the devices, then again 3 weeks later to pick them up. Thus, the survey window was open for a longer time period for the 9 month survey, and we were also able to remind service members in person if they had not yet completed their survey.

Recruitment and Retention Rates

We met and exceeded our recruitment and retention rates that we set in our SOW.

Service Members/Supervisors Surveys

Overall, we are extremely pleased with the interest and enthusiasm the service members showed for the MESH Study. In order to reach our target goal of 700 participants (500 service members and 200 supervisors), we were aiming for 40% of the eligible population of full-time ORNG employees. *Appendix R* is a graph of our targeted, cumulative response rate for each Army group (i.e., 40% of unit population), along with actual cumulative response rate. **We have met and exceeded our projections** (details below). *Tables 2 and 3* list the response and retention rates for all 3 waves of the surveys for service members and spouse/partners, respectively.

Service Member Recruitment rates: The total eligible population was 1770 full time employees. Of those, 975 completed the pre-screener and qualified to participate (55.1%). A total of 919 completed surveys were returned, which is 51.9% of the total eligible population.

While Air comprised slightly more of the entire sample (n=502; 54.6%) compared to Army (n=417, 45.4%), the Army SMs were slightly more likely to participate than Air SMs (57.4% vs. 48.1%, respectively). Recruiting for Army populations often occurred in smaller groups, perhaps making participation more likely.

Service Member Retention rates: Our goal was at least 80% retention at each wave, which we met. At 9-months (i.e., Wave 3), with 20% attrition at each wave, our goal was 64%. The retention rate at 4-months was 83.4% and 78.7% at 9-months.

661 SMs completed all 3 survey waves (71.9% of the sample).

The final survey and actigraphy data collection for the last 3 groups occurred during the COVID-19 outbreak. Luckily the survey was online, so people were largely able to access, but the stress of the times may have effected response rates. For Group 4, we were able to deliver the actigraphy devices to the base in Portland, but had to mail them to Klamath Falls, which proves problematic with delivery to the base and then distribution. For Group 5, we decided to forego actigraphy data collection due to the potential risk of losing the devices which were on loan to us.

Spouse/Partners Surveys

Our ultimate target for spouse/partner sample size at baseline was 270 (about 54% of our anticipated sample size of service members, not including supervisors). We asked our service members if they were married or partnered during the sign up process, and if so, to provide contact information. If not provided, we followed up at several points during the recruitment and data collection process to obtain that information and provide a spouse recruitment brochure and FAQ to be shared with their spouse/partner. Spouses did NOT participate in the actigraphy portion of the study. *Table 3* lists sample sizes and response rates for Spouse/Partners.

Spouse Recruitment: A total of 76.2% of eligible SMs indicated they were married (*n*=743) and **365 spouse/partners completed the baseline survey** across the two branches. This is 49.1% of the eligible sample, which is slightly lower than our target, but **exceeded our goal of 270**. Of the partner baseline, only 7 did not have a SM complete a baseline survey, resulting in **358 dyads** with matching data.

Spouse Retention: As with SMs, the retention rate goal was 80% of the previous survey wave. For the second survey at 4-months, the retention rate was 79.2%, which is right at our target (80%). The spouse/partner retention rate at 9-months is 76.7%, which is much higher than our anticipated 64% over the two waves of data.

266 of spouse/partners completed all 3 survey waves (72.9%). For couples, 230 BOTH completed all 3 survey waves (63.9%).

Actigraphy

Response rates for the actigraphy portion of data collection overlapped a great deal between surveys and actigraphy. *Table 4* includes the numbers for baseline and the 9-month follow up for actigraphy.

644 SMs completed both baseline and 9 mos. actigraphy (70.1% of total sample). 546 SM completed ALL 3 surveys and both actigraphy (59.5% of total sample).

Table 2. Data Collection Response and Retention Rates for Service Member Employees

Group	Unit Size	Signed Up & Qualified %[a]	Baseline Survey Completers % [a]	4-Month Survey Completers %[c]	9-Month Survey completers %[c]
ARMY:					
1.1	98	69	64	53	49
		70.4%	*92.8%*	*82.8%*	*76.6%*
1.2	131	91	87	79	75
		69.5%	*95.6%*	*90.8%*	*86.2%*
1.3	164	67	66	62	60
		40.9%	*98.5%*	*93.9%*	*90.9%*
1.4	154	100	97	85	74
		64.9%	*97.0%*	*87.6%*	*76.3%*
1.5	180	107	103	82	84
		59.4%	*96.3%*	*79.6%*	*81.6%*
Army Totals:	**727**	**434**	**417**	**362**	**342**
		59.7%	***96.1%***	***86.8%***	***82.0%***
AIR:					
2.1	190	116	114	99	89
		61.1%	*98.3%*	*86.8%*	*78.1%*
2.2	279	141	128	115	100
		50.5%	*90.8%*	*89.8%*	*78.1%*
2.3	170	78	74	46	50
		45.9%	*94.9%*	*62.2%*	*67.6%*
2.4	284	120	111	88	90
		42.3%	*92.5%*	*79.3%*	*81.1%*
2.5	120	86	75	57	52
		71.7%	*87.2%*	*76.0%*	*69.3%*
Air Totals:	**1043**	**541**	**502**	***405***	**381**
		51.9%	***92.8%***	***80.7%***	***75.9%***
GRAND	**1770**	**975**	**919**	**766**	**723**
TOTALS		***55.1%***	***94.3%***	***83.4%***	***78.7%***

[a]Denominator = Unit Size; [b]Denominator = Baseline Survey Total Completers; [c]Denominator = Baseline Survey Total Completers, adjusted for number of groups completed thus far: *Still in progress

Table 3. Data Collection Response and Retention Rates for Spouses/ Partners

Group	Qualified SMs who are married	S/P contact info provided	S/P Survey Completers	S/P 4 month survey completers	S/P 9 month survey completers
	%[d]	%[e]	%[e]	%[f]	%[f]
ARMY:					
1.1	52	38	24	23	20
	75.4%	73.1%	63.2%	*95.8%*	*83.3%*
1.2	72	59	42	33	33
	79.1%	81.9%	71.2%	*78.6%*	*78.6%*
1.3	52	45	34	25	26
	77.6%	86.5%	75.6%	*73.5%*	*76.5%*
1.4	79	57	47	39	38
	79.0%	72.2%	82.5%	*83.0%*	*80.9%*
1.5	79	60	37	25	22
	73.8%	75.9%	61.7%	*67.6%*	*59.5%*
Army Totals:	***334***	**259**	**184**	***145***	***139***
	77.0%	***77.5%***	***71.0%***	***78.8%***	***75.5%***
AIR:					
2.1	86	65	43	34	32
	74.1%	75.6%	66.2%	*79.1%*	*74.4%*
2.2	101	77	46	37	35
	71.6%	76.2%	59.7%	*80.4%*	*76.1%*
2.3	63	47	18	13	12
	80.8%	74.6%	38.3%	*72.2%*	*66.7%*
2.4	96	79	49	39	42
	80.0%	82.3%	62.0%	*79.6%*	*85.7%*
2.5	63	44	25	21	20
	73.3%	69.8%	56.8%	*84.0%*	*80.0%*
Air totals:	***409***	***312***	***181***	***144***	***141***
	75.6%	***76.3%***	***58.0%***	***79.6%***	***77.9%***
GRAND TOTALS	**743**	**571**	**365**	**289**	**280**
	76.2%	***76.9%***	***49.1%***	***79.2%***	***76.7%***

SM = Service member; S/P = Spouse/Partner

[d]Denominator = Signed Up & Qualified from Table 1; [e]Denominator = Qualified SMs who are married; [f]Demoninator = Spouse Survey Completers

Table 4. Actigraphy Data Collection Response and Retention Rates for Service Members

Group	SMs Actigraphy Sign-Ups	Baseline Actigraphy Completers % [a]	9-Month Actigraphy Completers % [a]
Army Totals:	**417**	**397**	**341**
		95.2%	***81.8%***
Air Totals:	**502**	**476**	**330**
		94.8%	***65.7%***
GRAND TOTALS	**919**	**873**	**671**
		95.0%	***73.0%***

[a]Denominator = SMs Actigraphy Sign-Ups

Randomization

Randomization occurred right after the end of baseline recruitment to ensure there would be no unintentional bias in recruiting or in participants' survey responses. We took a cluster randomization approach, where clustered of units grouped together geographically and/or by unit functions (e.g., HR, mechanics), as well as by total group size. Dr. Brockwood would provide Dr. Bodner, our statistician, with the total number recruited for each group, as well as the size of the treatment and control groups to that point to ensure approximate balance in group size. Dr. Bodner used a random number generator and informed Dr. Brockwood of the results, who then informed the Training Coordinator, Mr. Malach-Fuller so he could make arrangements with the unit(s) for intervention delivery. The final randomization occurred in August 2019.

CONSORT diagrams for service members (supervisors removed) and another for Matched Couples are in *Appendices S and T*.

Intervention Implementation

After randomization was complete, the Training Coordinator notified the unit leaders in the treatment group that they were selected and provided further information on next steps. The intervention was in two parts: 1) a computer-based training for all supervisors within a unit on Family & Sleep Supportive Training (FaSST), and 2) individual sleep feedback, given in person by our trained staff. Our training coordinator worked with the unit leader to coordinate both pieces.

Army units went through the intervention from OCT 2017 through MAY 2018; Air units went through from MAR - MAY 2019. Luckily all treatment groups were completed well prior to the COVID-19 pandemic, and thus the intervention

delivery was not affected, though there was a small effect on the last two Air groups for the follow up data collection (see section on Challenges).

Family & Sleep Supportive Training (FaSST) Implementation

For FaSST, we confirmed that the general time frame would work and also identified unit supervisors. We used any organizational charts we received from the ORNG HQ, as well as a list of supervisors identified by our survey participants. Supervisors who oversaw processes but not people were generally not included. Once a final list was generated, we ensured we had all supervisor work emails. We emailed a personalized link to the online training, along with general study information and supervisors had up to a month to complete the 1-hour training. While the training was 'mandatory', we asked for informed consent to use data related to the training in our evaluation efforts. If supervisors chose not to provide consent, we asked they still complete it, but did not include their data in the final data sets.

To ensure completion, we emailed reminders, placed calls to see if there were any technical issues and to also remind supervisors to complete the training, and, finally, the Joint Chief of Staff would ask leaders to complete the training, noting the TAG for the ORNG endorsed the training and requested that all supervisors complete it.

We also included a behavior tracking exercise after completion of the training and was also online. This part of the intervention occurred after the computer-based training and had supervisors track the number of supportive behaviors they engaged in with their subordinates every work day over two weeks. They could see how many behaviors they have done already on the secure website dashboard. This part of the training aims to increase the transfer of what was learned in the training into practice.

Individual Sleep Feedback Implementation

For the **sleep feedback**, we scheduled a time and date to come to the unit, usually during lunch, and communicated with participants when we would be there. In the time leading up to the sessions, our team of trained research assistants review all the sleep reports using a standardized process to identify potential sleep issues around duration, fragmentation and consistency of sleep/wake times and developed a summary. This way, any team member could easily give feedback to any participants in a consistent and informed manner. More information about the sleep report is below and a template report is in *Appendix G*. Also see above in the section on Intervention Development (Major Task 1).

Upon arrival, we set up with stations spaced apart as much as possible for confidentiality. For larger groups, we had a greeter who would locate the participant's sleep report and pass them to a researcher. Following the 'script' guide or talking points (see *Appendix F*), the feedback session took about 10-15 minutes on average. We asked participants to set a couple of concrete sleep

goals which we recorded for our records and so we could follow up in 2 weeks to see if they had accomplished them. We also asked them to complete a few reaction questions rating the feedback (see *Table 6* below for a summary). Participants kept their Sleep Report.

For those not present while we were on site, we left their Sleep Report in a sealed envelope either on their desk, a mail slot or with the unit POC. We then followed up by email to schedule a follow up by phone. If we were unable to reach them by phone after several attempts, we emailed information on how to interpret the sleep report (*Appendix U*).

Waitlist Control Group Delivery

We also completed the delivery of the supervisor training and sleep feedback to the waitlist control group for the Air side in Year 4.

After all data collection was complete for a Group, we provided the sleep feedback to participants in the waitlist control group, including both the baseline and 9-month actigraphy reports; the treatment group also received their 9-month report. Our training coordinator brought hard copies of the sleep reports to the units and did a group presentation on reading and interpreting the report, and answered any questions they had. We also developed written instructions for interpreting the actograms for those not able to attend in person (see *Appendix U*), which we also sent via email if needed.

For the supervisor training, we sent email invitations to the training to all supervisors and included automatic reminders to participate, but did not involve senior leadership for this group, as we provided the training to the control group as a courtesy.

FaSST Intervention Participation Rates and Reaction Data

Table 5 below lists the response rates for the intervention delivery for all the treatment groups, which was completed October 2019.

Sleep feedback:

Across all groups, we provided sleep feedback either in person or by phone for **83.6% (*n*=398)** of SMs. Generally, if SMs were not present it was due to illness, vacation, or TDY. Sleep reports were emailed to the remainder of the participants in the treatment group, after repeated attempts to contact them. We also provided contact information if they had any questions.

At the conclusion of the feedback, we asked SMs to set two goals related to sleep health (e.g., no computer use two-hours before bedtime). Two weeks later, we sent them a very brief survey asking if they were successful with those goals and if they felt it had helped their sleep health. Of the 398 above who received feedback in person or on the phone, 239 responded (60.0%).

We also asked several questions related the perceived helpfulness of the sleep report, and reactions were overwhelmingly positive (see *Table 6*).

Table 5. Intervention Response Rates for Treatment Group

Group	Participating SMs in Treatment Group	Received Sleep Feedback in Person or by Phone	Supervisor training invites	Supervisor training completes
ARMY				
1.1	21	17 *81.0%*	*11*	11 *100%*
1.2	44	39 *88.6%*	*27*	23 *85.2%*
1.3	31	29 93.5%	*19*	15 78.9%
1.4	54	43 79.6%	*29*	20 69.0%
1.5	43	35 81.4%	*19*	18 94.7%
ARMY TOTAL	**193**	**163** ***84.5%***	***104***	**87** ***83.8%***
AIR				
2.1	70	61 *87.1%*	*32*	28 *90.0%*
2.2	69	62 *89.9%*	*39*	23 *59.0%*
2.3	27	26 96.3%	9	2 22.2%
2.4	72	58 80.6%	7	6 85.7%
2.5	45	28 62.2%	21	8 38.1%
AIR TOTAL	***283***	***235*** ***83.0%***	***108***	***67*** ***67.8%***
GRAND TOTAL	***476***	***398*** ***83.6%***	***212***	***154*** ***72.6%***

Supervisor training:

We were very pleased with the participation rates of our supervisor training. **Overall, 72.6% of all invited supervisors completed the online training (*n*=154)**. The support and involvement of the ORNG senior leadership, as well as repeated reminders by project staff, was instrumental in achieving this rate. We did see a higher participation rate in the supervisor training for Army (83.8%) compared to Air (67.8%).

We also asked supervisors to provide reaction feedback to the training, which is summarized in *Table 6* below.

In addition to favorable reactions to the training, supervisors demonstrated evidence of having learned a significant amount of information from the training as well. We saw a 22% increase in learning with an average pre-test score of 71.05 compared to the average post-test score of 86.13. This is a large effect size (Cohen's *d*=.88).

Table 6. Intervention Reactions: Sleep Report Feedback and FaSST

SLEEP REPORT FEEDBACK	Agree/Strongly Agree	
The sleep report….	***N***	**%***
…was helpful	360	94.7%
...has made me more aware or my sleep schedule	332	87.6%
...has motivated me to improve my sleep habits	326	85.5%
...identified sleep issues that I can target for improvement	337	88.7%
...made me aware of how being sleep deprived impacts my risk of accidents or making serious errors	323	85.0%
SUPERVISOR TRAINING REACTIONS		
Rated training as....	***N***	**%****
...Good or Excellent	124	87.0%
….Useful	142	88.8%
….Relevant	144	90.0%
Would recommend training to co-workers	132	82.6%

*Denominator is *N*=380; ** Denominator is *N*=160

Major Task 5: Data Analysis and Results Reporting

Data Cleaning

We developed internal SOPs for managing and cleaning survey data and created/updated codebooks, SPSS syntax for data cleaning, as well as data issues logs to note any anomalies with data.

The actigraphy team, led by Dr. Tori Crain, developed extensive cleaning protocols for the actigraphy data, also in consultation at WRAIR. WRAIR worked with our team to share some macros to create actigraphy-related variables for analysis.

In addition to our main data sources (survey and actigraphy), we also have data from other sources, such as from the supervisor training (e.g., learning, reaction), information from providing sleep feedback (e.g., summary information, engagement). Final checks and codebook updates were complete by end of October 2020.

Matching Data Sources

As discussed above, we had many data sources to link. The majority of these are easily linked by the use of specially created unique IDs to link SM's own data across many sources (e.g., surveys, actigraphy, sleep feedback), as well as SM's and their Spouse/Partners, and finally SMs and their Supervisors. We created protocols to ensure the proper procedures to create linked data sets and set systems in place to ensure these links are done correctly.

A primary focus was on linking SMs and supervisor, as there are several ways to do this. When recruited and completing the survey, we did not differentiate between the two; they completed identical surveys, with a few supplementary questions on leadership style if they self-identified as a supervisor. This allowed us maximum flexibility in who we considered a SM or a supervisor, depending on the focus of the analyses at hand. We also asked on the survey who their direct supervisor is. We used the name of the supervisor to see if the supervisor was also a participant; if they were, we used the ID of the supervisor as part of the ID of the SM. If the supervisor did not participate in the study, we created a new ID for them, beginning with a '9' so we would know right away they did not complete the surveys or actigraphy. Once we had the IDs to work with, we had to decide who would be considered a supervisor and when (e.g., for which analysis).

We approached the identification of supervisors in two ways:

1. For our intent-to-treat model, we discussed with our statistician, Dr. Todd Bodner, who suggested we consider someone a supervisor if they were identified as and sent the supervisor training, or in the case of the control group, *would have been sent the training*. We then set up a data set removing those supervisors, giving them a new supervisor ID number, then linking the supervisor with their one-or-more SMs.
2. For analyses that are more of a 'dose-response', we want to be able to see if, for instance, if having a supervisor who completed the training and/or participated in the sleep feedback portion as well, has more of a positive effect on the outcomes of their employees has. In this case, we went we went through each unit and mapped out the supervisory structure using who each participant named as their supervisor, as well as organizational charts, if available. Next, we noted if the named supervisor participated in the 1) baseline survey, 2) baseline actigraphy, and/or 3) supervisor training if in the treatment condition. Then we noted cases where there were cases of a

supervisor's supervisor (or higher) participating as well (i.e., 'sandwiched' supervisors) and determined if someone would end up in the supervisor or employee database. The decision was first based on maximizing the total number of supervisor-subordinate links and then, if the number of links were equal, choosing supervisors who were at the lowest level.

Our goal was 500 supervisor-subordinate pairs. Using the Intent-to-Treat approach, listed above in #1, 704 subordinates are linked to 215 supervisors, meeting this goal.

Data sharing

Based on the CRADA we developed at the onset of the study, we have successfully and securely shared deidentified data with our partners at WRAIR-West. They are currently developing a paper on the use of actigraphy data in research.

Analyses and Intervention Papers

Under the guidance of our statistician, Dr. Todd Bodner, we developed a process for conducting our intervention analyses, using an intent-to-treat approach. Our post docs, Drs. Brossoit and Brady, created a detailed SOP for running the analyses in Mplus. Dr. Brossoit also conducted training sessions with several of our graduate students on running these analyses. She recorded these sessions and left detailed notes and slides allowing for further use on future projects and with other students.

Our team also carefully examined our Specific Aims in the SOW and planned specific papers that would answer each of the aims. These are detailed in Significant Results section below and also summarized in the beginning of this report.

Although we have run the analyses and developed papers that cover our Specific Aims, we intend to keep moving forward with more manuscripts, exploring potential moderators of the study and dose response analyses.

The data for this study were generated from a cluster randomized experimental design with all participating supervisors and their subordinate service members within a unit cluster randomly assigned to either an intervention or usual practice control condition. Standard general linear and generalized linear mixed model approaches for cluster randomized designs (i.e., hierarchical linear models, multilevel models; Murray, 1998; Murray, Varnell, and Blitstein, 2004) were used for data analysis for Specific Aims to account for the nesting structure in the data. As these models are now widely used and understood and are available in numerous statistical software packages, our discussion here on the specifics of these analyses will be brief. In each case, link functions for these models were determined by the scaling of each outcome variable. Furthermore, in each analysis we used the outcome variable at baseline as a predictor in the model to adjust for unexpected imbalance from randomization and to increase the statistical power for and precision of parameter estimates. As needed, depending on attrition and missing data, this basic generalized linear mixed model will be extended in the analysis of the specific aims as mentioned in a prior section (e.g.,

multiple imputation for missing predictor variable values, FIML estimation for missing outcome variable values).

Major Task 6: Dissemination

Our primary focus of dissemination efforts have focused on publications and conference presentations (see below in PRODUCTS section) to share the results of our study, but we also have several intervention papers either under review or in various stages of completion for publication.

Our other focus has been on 'packaging' our intervention for use by the military at large, as well as translating the training and feedback to more general audiences.

Phoenix Rain Bird, our RA in charge of training development and programming, has created a sharable version of our Family and Sleep Supportive Training f (FaSST), now called Sleep Support Training for Military Leaders, and a civilian version called Sleep Support Training – promoting employee well-being through effective leadership. Each training title includes a behavior tracking component and can be seamlessly integrated into any organization's existing Learning Management System. This training is available through our study specific website: www.meshstudy.org and our general training website www.supportiveleadership.org

We have devoted a significant portion of our website to guiding users through monitoring and tracking one's own sleep using various commercially available devices (e.g., FitBit, iWatch, Google Nest) and interpreting the information. We have created downloadable printouts for users to use, including a written sleep log if they prefer to avoid electronic devices, and provide education on setting sleep goals and promoting healthy sleep hygiene habits under both normal and challenging circumstances. We have divided the website into a military focused section and a civilian or general audience section in order to keep our language and overall look and feel consistent and targeted towards our specific audience. We also include study information, publication summaries, and curated resources. All logos and branding for each population were developed with the help of HUB Collective. A design agency based in Portland.

Screenshots from FaSST, as well as the updated MESH website can be viewed in *Appendices D* and *V*, respectively.

We are actively working with organizations, such as SHRM (Society for Human Resource Management) to highlight the availability of the FaSST training and its evidence. We created a new website, noted above, and called the *Center for Supportive Leadership* to use as a new platform to house and market our validated trainings. We have also been working with Amy Adler at WRAIR to brainstorm some ideas of directions to proceed.

Shalene Allen, previously our Recruitment Coordinator and now a second-year doctoral graduate student in the Psychology Department at PSU, has worked closely with our training developer, Phoenix Rain Bird, on the creation of a DIY version for sleep feedback that can be utilized using a variety of sleep tracking devices beyond the Philips Actiwatch II used in this study (e.g., Fitbits and Garmin). They based this

on materials we created for our feedback sessions, as well as personal experience giving the feedback, as a basis for these materials (see Appendix W).

Major Task 7: Supplemental COVID-19 Data Collection

We also received supplemental funding in July 2020 to collect one more wave of data (no actigraphy) from service members, supervisors, and spouse/partners to assess the impact of the novel coronavirus on health, well-being and organizational outcomes. We will also examine differences in the treatment and control groups to see if the intervention had a positive effect. The Supplement Narrative is included in *Appendix X*.

We hired a part time RA, Philip Bouleh, to work on updating the survey with COVID-specific items, and to create a database of various COVID rates by date and county in Oregon so these metrics can be used in participant data. Mr. Bouleh had previously been volunteering in Dr. Cynthia Mohr's lab at PSU while he is preparing for graduate school

Surveys were sent to all participants who had completed the baseline survey; survey window was open from 12-NOV-20 through 30-NOV-20. *Table 7* lists the response rates. As noted in previously, we reached our target of 700 baseline surveys for service members, as well as our goal of less than 20% attrition at each wave. For the COVID supplemental survey, we didn't specify a goal per se, but the additional 20% attrition in this wave would put us right at about 51%. We are very pleased that just over **50%** of the original sample returned surveys (*n*=467). Some of the participants had completed their last survey up to 2 year ago, so we find the participation rate quite remarkable.

Similar to Service members, data collection was previously completed for spouse/partners with our target of 270 met. We also send the follow up COVID survey to spouse/partners and an impressive **58.9%** of the original baseline sample returned surveys.

Data were cleaned and matched with participant's previous survey and merged. Initial analyses of these data were being conducted for a conference submission to the Military Health Systems Research Symposium and the Work-Family Researchers Network, and is being developed into a full manuscript for publication. A summary of findings is included in the next section.

Table 7. Survey Response Rates by Wave including COVID data

	Baseline	4-months	9-months	COVID
Service Member	919	766	723	**467**
% of BL		*83.4%*	*78.7%*	***50.8%***
Spouse	365	289	280	**215**
% of BL		*79.2%*	*76.7%*	***58.9%***

Significant Results/Key Outcomes

Summary of Intervention Effects

This section integrates all intervention effect findings thus far. For a breakdown of findings by each of the three Specific Aims, see *Accomplishments Section* above.

We saw marked **improvements in leaders' knowledge** post-training (Cohen's *d*=.88; pre-test=71.05, post-test=86.13), and leaders also reported an increase of their own sleep leadership and FSSB behaviors on the post-intervention surveys (ΔR^2=.04; *d*=.41).

Based on rigorous intent-to-treat analyses we demonstrated that the intervention improved employees' reports of sleep leadership support, leading to improved sleep-related outcomes, including sleep duration and satisfaction with sleep, as well as a reduction in sleep-related impairment and stress before bed (Crain et al., in preparation). Results also indicate a variety of improvements in the well-being of those in the treatment group compared to the control group, including reductions in personal and social functional impairment (see Hammer et al., 2021).

The effects of the intervention also spilled over to the spouses/partners of employees, where couples in the treatment group reported less loneliness, higher life satisfaction, and greater perceived partner responsiveness (O'Neill et al., under review). Additionally, the training was related to organizational outcomes, such as higher job satisfaction, reduced turnover intentions, and increased safety behaviors at work (Brossoit et al., under review; Hammer et al., 2021).

Finally, a manuscript in preparation used the supplementary COVID-19 data, collected in November 2020 (see *Major Task 7* above for additional information). We found that even though supervisors were not explicitly trained on supportive supervision during an event like the pandemic, those service members in the intervention group rated their supervisors higher in COVID-19 leader behaviors.

Below are findings from individual intervention papers. The first paper (Hammer et al., 2021) is published, three more are under review, and several others are in preparation for submission with more planned for the future. We will continue to provide copies and updates of all published work to our science officer as they become available.

Published Papers

Hammer, L. B., Brady, J. M., Brossoit, R. M., Mohr, C. D., Bodner, T. E., Crain, T. L., & Brockwood, K. J. (2021). Effects of a Total Worker Health® Leadership Intervention on Employee Well-Being and Functional Impairment. *Journal of Occupational Health Psychology,* 26, 582–598. *DOI: 10.1037/ocp0000312*

Findings: The intervention ***improves supervisors' sleep leadership 4 months*** following the intervention, and the intervention ***improves employee job satisfaction, reduces turnover intentions, reduces stress before bed, reduces personal functional impairment, and reduces social functional impairment 9 months*** after the intervention via the intervention effect on supervisors' sleep leadership.

See *Appendix Y* for a full copy of the paper.

Papers Under Review

Brossoit, R.M., Hammer, L. B., Bodner, T. E., Crain, T. L., & Brockwood, K, J. (Under review) *The Effects of a Total Worker Health® Intervention on Workplace Safety: Mediating Effects of Sleep and Supervisor Support for Sleep*.

Findings: There were indirect effects of the intervention on ***greater safety participation and safety motivation, and reduced accidents and injuries at 9-months***, through reduced sleep-related impairment and reduced dissatisfaction with sleep at 4-months. Additionally, there was an indirect effect of the intervention on ***safety compliance and safety participation*** at 9-months through greater sleep leadership from one's supervisor at 4-months. Finally, there was an indirect effect of the intervention on ***safety participation*** at 9-months through greater supervisor sleep education at 4- months.

Crain, T. L., Hammer, L., B., Brossoit R. M., Brockwood, K. J., Mohr, C. D., Bodner, T. E., Allen, S., Dretsch, M. N., & Shea, S. A. (Under review). *Optimizing Employee Sleep: A Total Worker Health® Randomized Controlled Trial*.

Findings: We found that service member ***sleep duration, dissatisfaction with sleep, and sleep-related impairment were all significantly improved at 4-months*** post-baseline in the intervention group. We also found significant ***reduction in dissatisfaction with sleep at 9-months post-baseline***. Although there were no significant intervention effects on sleep duration and sleep-related impairment at the 9-month post-baseline time point, our analyses did indicate that intervention effects were not significantly different across the two time points**.** In addition to direct intervention effects, **branch of the military (i.e., Army or Air National Guard) and combat exposure moderated** some of the intervention effects on sleep outcomes.

O'Neill, A. S., Mohr, C. D., Brady, J. M., Bodner, T. E., Crain, T. C. & Hammer, L. B. (Under review). *Improving well-being in military couples through a Total Worker Health® Intervention*.

Findings: The intervention had multiple beneficial effects on the psychosocial well-being for the service members and their spouses, collectively referred to as couples. Couples in the intervention group reported ***lower loneliness and a closer and more satisfying relationship with their romantic partner*** (i.e., higher perceived partner responsiveness), compared to couples in the control group 9 months following the intervention. Additionally, ***couples also reported higher life satisfaction at 4- and 9- months following the intervention***, compared to couples in the control group. Initial models revealed significant reductions of PTSD symptom severity for service members in the intervention group compared to those in the control group but these main effects did were not retained after applying model constraints consistent with our model building approach. All analyses controlled for both employees' and spouses' baseline values of the dependent variable.

Manuscripts in Preparation for Submission

In addition to the manuscripts listed above, several other intervention papers are in preparation and are anticipated to be submitted for publication shortly.

Brady, J.M., Hammer, L.B., Crain, T.L., Brossoit, R.M., Bodner, T. E., & Allen, S. J. (In preparation). *Intervention Effects on Supervisors' Sleep*.

Findings: There was a significant main effect such that supervisors in the intervention group demonstrated ***higher sleep leadership education at 4-months. Additionally, supervisors in the intervention group reported lower levels of insomnia symptoms***, and ***sleep related impairment*** at 9-months.

Allen, S. J., Hammer, L. B., Bodner, T. E., Brady, J. M., Mohr, C. D., & Brockwood, K. J. (In preparation) *Employee Anger and Resilience: The Effects of a Total Worker Health® Intervention*.

Findings: The intervention i***mproved service member employee anger and resilience 9 months*** following the intervention. Employees in the intervention group reported improvements in their anger and resilience 9-months following the intervention. Additionally, supervisors' baseline reports of ***family-to-work conflict (FWC) moderated*** intervention effects, showing improvements in employee anger at 4-months and employee resilience at 9-months for employees' supervisors who reported low FWC at baseline.

One intervention paper thus far used the supplementary data collected during the **COVID-19** pandemic in Nov 2020:

Hammer, L. B., Brossoit, R. M. Bodner, T. E., Mohr, C. D., Crain, T. L., Brady, J. M., Brockwood, K. J., & Adler, A. B. (In preparation). *The Effects of Pre-COVID Sleep Leadership Training on COVID Leadership: Results from the Military Employee Sleep and Health Study*.

Findings: While results failed to demonstrate a significant main effect of the intervention on psychological distress at the follow up data collection that occurred during the COVID pandemic, there was a significant main effect of the intervention on ***service member reports of their supervisors' positive COVID-19 leadership behaviors***. Furthermore, service member reports of COVID-19 leadership behaviors were significantly associated with ***lower reports of psychological distress*****,** but COVID-19 leadership did not moderate the intervention effects on psychological distress. Lastly, there was a significant indirect effect of the intervention on service member reports of their supervisors' positive COVID-19 leadership behaviors via supervisor support for sleep.

Baseline Data/Non-Intervention Papers

We have also published, or have in development, several other papers that do not include the examination of intervention effects, that explore important research questions.

Published or In Press Papers**:**

Sianoja, M., Crain, T. L., Hammer, L. B., Bodner, T., Brockwood, K. J., LoPresti, M., & Shea, S. A. (2020). The relationship between leadership support and employee sleep. *Journal of Occupational Health Psychology, 25*, 187–202. https://doi.org/10.1037/ocp0000173

This was our first published paper on the study, using baseline data from the ORARNG. We examined the relationship of sleep leadership and family-supportive supervisor behaviors (FSSB) to employees' sleep. As outcomes we measured objective sleep quality and quantity using validated wrist actigraphy methods, as well as self-reported sleep hygiene, subjective sleep quantity, and subjective sleep quality (sleep disturbance and sleep-related impairment). As a novel contribution to the literature, we included both supervisors' self-reports and employees' reports of supervisors' engagement in sleep leadership and FSSB. Contradicting our hypotheses, our results show that ***higher employee ratings of FSSB were related to shorter objective sleep time***. Regarding self-reported sleep outcomes, ***higher employees' ratings of sleep leadership were associated with less sleep disturbance and less sleep-related impairment among employees***. ***Higher supervisors' self-ratings of FSSB, in turn, were related to better sleep hygiene and less sleep-related impairment among employees***. Overall, our study demonstrates the importance of supportive supervisor behaviors for employees' sleep quality.

See *Appendix Z* for a full copy of the paper.

Wong, J. R., Crain, T. L., Brossoit, R. M., Hammer, L. B., Bodner, T. E., & Brady, J. M. (In press). Beyond Just Resilience: The Important Role of Work-Family Resources for Military Service Members. *Occupational Health Science.*

Findings: Drawing from baseline data, ***more resilient service members experience lower work-to-family conflict and family-to-work conflict*** as well as greater work-to-family enrichment and family-to-work enrichment. Further, the relationship between resilience and family-to-work enrichment was significant and stronger for service members who perceive their work climate as family-supportive compared to the relationship for those who do not.

Manuscripts under Development:

Brady, J.M., Hammer, L.B., & Westman, M. (In preparation). *Crossover Effects of Supervisor Resilience to Employees' Resilience and Well-being: A Time Lagged Investigation*. Submission Expected by April 2022.

Findings: Data from military service member employees (N = 741) were matched to linked supervisors (N = 393). We found that ***baseline supervisor resilience predicted employee resilience at 4-months***, and was indirectly associated with employee distress, and life-satisfaction at 4 months via the effect it had on employee resilience.

O'Neill, A. S., Mohr, C. D., Bodner, T. E., Crain, T. C. & Hammer, L. B. (In preparation). *Does perceived supervisor supportiveness provide additional health benefits after considering perceived partner supportiveness? An examination of*

partnered service members' support perceptions on sleep dissatisfaction, PTSD symptom severity, and psychological distress.

Findings: Supervisor supportiveness was found to have additional beneficial effects on workers' mental health beyond that of romantic partner supportiveness. Specifically, ***baseline supervisor supportiveness negatively associated with subsequent worker psychological distress (i.e., a global indicator of mental health) at 4- and 9-months***. Parallel benefits were not detected for PTSD or sleep outcomes, which is likely due to floor effects for these issues. The models controlled for the stability each of the variables over time, romantic partner supportiveness and the bidirectional relationship of sleep and mental health outcomes.

What opportunities for training and professional development has the project provided?

The MESH Study has provided a great many staff members and students the opportunity to participate in many facets of research, from direct contact with participants (e.g., recruiting, sleep feedback) to coding data to developing and writing manuscripts. Now that data collection is complete, several theses and dissertations using MESH Study data are planned over the next year.

Several staff have received extensive training on sleep-related issues by the sleep experts on our grant, Drs. Steven Shea and Tori Crain. They were trained on providing feedback on the sleep reports developed specifically for this study and assisting participants in identifying behaviors that could improve sleep health. Several staff were trained on the IGOR software and actigraphy software (i.e, Actiware).

Several staff, graduate research assistants, and undergraduate research assistants across multiple campuses (Oregon Health and Science University, Portland State University, and Colorado State University) were trained in cleaning actigraphy data.

Graduate students and project staff received experience in performing research on military bases.

Graduate Research Assistants continue to receive training from senior staff on research methodology, particularly the design and implementation of a randomized control trial.

Several graduate students are utilizing MESH Study data in the completion of their thesis and/or dissertation requirement for their degree program. AnnaMarie O'Neill is using MESH data for her dissertation and at present 3 of our students are using MESH data for their thesis proposals.

Table 8 below details out the experiences and opportunities for each team member as appropriate.

Table 8. MESH Study Staff: Employment/Research Opportunities Gained

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
Jacquelyn Brady	Post-doctoral Researcher, OHSU	Ph.D.	• Received training in various components of this project, from the initial training, material developments, actigraphy coordination, deep cleaning of actigraphy data • Trained in mentoring undergraduate and graduate students • Trained in the complexity of the raw multi-level data we obtained • Enhanced analytical skills and understanding of intent-to-treat analyses under Co-Pi Todd Bodner's supervision • Gave multiple invited talks for MESH related data findings and supervisor interventions more broadly, including one at the Occupational Health Summer Institute • Published as a co-author on Dr. Leslie Hammers Intervention Paper • Served as a co-author on Jacqueline Wong's Resilience paper • Served as a co-author on multiple MESH related presentations at SIOP and other conferences • Directly and closely mentored by Dr. Leslie Hammer resulting in advanced understanding of grant requirements and large scale intervention projects • Obtained position as an Assistant Professor at San Jose State University in Fall 2020 • Served as the primary/sole intervention analyst for 1 year • Trained additional intervention analysts and continued working as an analyst • Trained Mplus analyses to RAs
Philip Bouleh	Research Assistant 2, OHSU	BS	• Developed writing and scientific reasoning skills by collaborating with Leslie Hammer and Shalene Allen on a paper examining the relationship between family supportive supervisor behaviors

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			and psychological distress across four occupational samples, including the MESH sample • Developed data gathering and management skills by creating a data set for COVID risk metrics over time within each county in Oregon • Improved communication skills by interacting with research participants via phone check ins • Learned how to organize and track measurements and questionnaires through managing the MESH codebook and creating the common measures codebook • Developed greater competence using research assistance software (i.e., Zotero) and statistical software (i.e., SPSS) • Conducted countless literature reviews, thereby learning how to utilize various search engines to locate studies of interest
Marjaana Sianoja	Post-doctoral Researcher, OHSU	Ph.D.	• New experience and training in the area of sleep and complex multi-level data • With Dr. Hammer as her mentor she further developed her expertise in occupational health psychology, particularly in family supportive supervisor behaviors and sleep leadership • First author on baseline paper
Rebecca Brossoit	Graduate Research Assistant, CSU/ OHSU, Research Associate and Post-doc OHSU	Ph.D.	• Served as an OHSU research associate and then post-doc • Obtained a position as an Assistant Professor at Louisiana State University following her post-doc role on the MESH project • Received training on multilevel intent-to-treat intervention analyses and received mentoring from both Dr. Crain and Dr. Hammer.

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			• Developed skills for creating standard operating procedure documents and training personnel on actigraphy data cleaning • Presented on challenges and recommendations related to collecting actigraphy data in intervention work, based on lessons learned from the MESH study • Organized a conference symposium on challenges and recommendations for applied safety and health projects and invited a presenter (Shalene Allen) to discuss the MESH study • Strengthened psychometric skills from exploring the factor structures of self-reported sleep quality measures used in the MESH study • Gave two invited guest lectures in graduate occupational health courses, where she presented about the MESH study and more broadly about sleep research and intervention work • Co-authored Jacq Wong's resilience paper • First author on intervention paper assessing safety outcomes
Lindsey Alley	Senior Research Associate, OHSU	M.S.	• Involved in developing a proposal to support the dissemination-implementation of a scalable version of the MESH intervention • Assisted in establishing new partnerships within the VA Puget Sound and the OHSU Department of Family Medicine, which will be the first dissemination-implementation study pursued by the Hammer Lab
Luke Mahoney	Graduate Research Assistant, PSU	M.S. (Ph.D. in progress)	• Learned actigraphy software and how to clean actigraphy data • Learned about sleep quality measurement and visualization

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			• Developed skills in R summarizing and reporting data • Reviewed and summarized intervention analysis methodology for the research group (intent-to-treat methods) • Worked directly with research participants in providing sleep feedback
Sheila Umemoto	Graduate Research Assistant, PSU	M.S. (Ph.D. in progress)	• Coordinating with Participants and Delivering Feedback • Poster Presentation at 2020 SPSP Existential Psychology Preconference. New Orleans, LA. • Master's Thesis Proposal: Mother's Drinking Motives (in progress) • Working on manuscript presenting findings from Master's Thesis study: Umemoto, S., Mohr, C., Bodner, T., & Hammer, L. Mother's *Drinking Motives: A study of National Guard spouses*. Manuscript in preparation.
AnnaMarie O'Neill	Graduate Research Assistant, PSU	Ph.D. (in progress, ABD)	• Learned to process actigraphy data (e.g., learning to flag it for certain issues like shifting of bedtime or fluctuations) • Collaborated with sleep experts by having discussions about topics like how long or intense a waking period should be for it to be considered a "sleep fragmentation" rather than simple bedtime movement • Presented sleep feedback to participants to help them connect their sleep patterns to cognitive functioning as well as to aid them in goal setting to improve their sleep hygiene and manage barriers to obtaining high-quality sleep (e.g., PTSD symptoms, partners with conflicting preferences for the sleeping environment regarding temperature and light) • Learned how to create coding syntax to clean data, to flag for potential issues,

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			and to create composites of individual items • Created a workshop to teach other students and investigators how to assess intervention effects in dyadic data (e.g., improvements for the well-being of workers and their romantic partners)
Emily Denning	Graduate Research Assistant, PSU	M.S. (Ph.D. in progress)	• Worked directly with research participants in providing sleep feedback • Learned to interpret actigrams on sleep quantity and quality • Learned how to apply intervention analysis methodology for the research group (intent-to-treat methods) • Collaborated with sleep experts and became knowledgeable in evidence-based sleep recommendations and optimal sleep hygiene behaviors
James Lee	Graduate Research Assistant, PSU	M.S. (Ph.D. in progress)	• Poster Presentation: Lee, J. D., Mohr, C. D., & Hammer, L. B. (2020, August). The Battlefield at Home: Examining Anger and Psychological Aggression in Military Couples. Poster to be presented at the International Association for Relationship Research (IARR) Conference, London, UK. (Conference Postponed) • Worked directly with research participants in providing sleep feedback • Learned to interpret actigrams on sleep quantity and quality
Kiplin Kaldahl	Graduate Research Assistant, CSUJ	MS	• Obtained full-time Research Associate Position at the National Opinion Research Center (NORC) at the University of Chicago following time on MESH project as a research assistant • Learned to clean actigraphy data, creating validated cleaning procedures

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			• Generally learned more about large-scale intervention studies
Jacqueline Wong	Graduate Research Assistant, CSU		• Working on R&R for a manuscript: **Wong, J. R.**, Crain, T. L., Brossoit, R. M., Hammer, L. B., Bodner, T. E., & Brady, J. M. (under review). Beyond just resilience: The important role of work-family resources for military service members. *Occupational Health Science* • Received training on multilevel regression analyses and structural equation modeling, while being mentored by Drs. Crain, Hammer, and Bodner
Jordyn Leslie	Graduate Research Assistant, CSU/PSU	MS (in progress)	• Learned how to obtain and effectively communicate relevant statistical information by conducting analyses in SPSS and writing sample paragraphs for the MESH annual review • Developed data entry skills through entering data into REDcap for over 1,500 individualized sleep reports • Organized the study codebook and obtained relevant descriptive statistical by conducting analyses in SPSS • Developed data cleaning skills and created new datasets by using untouched data (i.e., behavior tracking information from supervisor trainings) and inputting into new, clean dataset • Learned how to create new, testable models using archival data for my thesis project • Cleaned supervisor-employee matched data set • Learned how to run multilevel and intervention analyses in Mplus • Collaborated with members of the team as a coauthor to prepare an intervention manuscript for publication

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
Shalene Allen	Graduate Research Assistant, OHSU/PSU	M.S. (Ph.D. in progress)	• Lead Recruitment and Logistics Coordinator (RLC) for the MESH study • Assisted with the supervisor training and delivered personalized sleep feedback to participants • Learned data management techniques and gained experience examining large datasets • Learned to develop testable research models and learned how to conduct analyses in SPSS & Mplus • Worked with other members of our team to develop conference submissions • Collaborated with experts on our team to develop the sleep feedback dissemination toolkit for employees • Assisted with manuscript preparations • Currently working on publishing the employee and supervisor focused intervention paper
Jason Malach-Fuller	Senior Research Assistant, OHSU		• Entrusted to work and uphold research protocols within OHSU lab, among research collaborators, and study participants • Assisted with database organization to track study progress and have been asked to produce and assist in the development of follow-up survey using REDCap • Led our team of 10+ employees deliver personalized sleep feedback to more than 450 individuals • Administered training and fielding questions for 212 supervisors with a 72.6% completion rate
Lev El-Askari	Research Assistant, OHSU	BS from Willamette University	• Presented symposium: El-Askari, L. M., Brady, J.M., & Hammer, L.B. (2020, June). The effects of role ambiguity on health, distress, and turnover intentions on veterans in the workplace. Submitted to be presented as part of a symposium

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			titled: Mental Health in the Workplace. Symposium presented at the 35th annual Society for Industrial and Organizational Psychology conference, Austin, TX. • Delivered personalized sleep feedback reports and facilitated sleep goal setting for the Oregon Military Employees Sleep & Health Study (MESH) • Configured sleep tracking actigraphy watches, cleaned sleep data, and assisted senior lab personnel with literature reviews and data management projects
Erika Schemmel	Graduate Research Assistant, PSU	MS (in progress)	• Learn/understand the research process by attending all meetings and listening to the PI's and research assistants discuss the study • Learn/understand how to obtain and communicate relevant statistical information by conducting analyses in SPSS • Learn/understand how to organize a codebook and what relevant descriptive statistical information is needed by conducting analyses in SPSS • Learn how to create a testable model with new ideas and relationships using archival data for my thesis project • Learn about basic actigraphy research methods and data cleaning • Received training on multilevel intent-to-treat intervention analyses and received mentoring from both Dr. Crain
Phoenix Rain Bird	Senior Research Assistant, OHSU		• Attended Adobe elearning conference on instructional design • Attended Adobe Max conference to receive training on Adobe Creative Suite and principles of User experience and interface (UX/UI)

Name	Role	Degrees Obtained During Study Period	Employment and research opportunities received based on experience/training from SERVe
			• Received training from Articulate in instructional development and programming • Strengthened skills in website development • Assisted with database organization to track participants at each point in the study • Worked directly with participants to set up ongoing compensation via Greenphire Clincard
Marcus Ling	Research Assistant/Recruiting and Logistics Coordinator OHSU		• Learned about basic actigraphy research methods and data cleaning • Gained additional training development experience • Gained additional recruitment experience
Tim Oxendahl	Summer Intern at OHSU		• Learn/understand the research process by attending all meetings and listening to the PI's and research assistants discuss the study • Received training in giving sleep feedback • Worked directly with participants to give sleep feedback • Received certification in Human Subjects Research

How were the results disseminated to communities of interest?

At present, dissemination has been primarily through conference presentations and manuscripts, one published, another submitted and several in progress. In addition to academic journals, we have also written articles for lay audiences, including on the website, The Conversation (https://theconversation.com/supporting-worker-sleep-is-good-for-business-130101), and plan on targeting website and publications that are either for the general public as well as industry-specific, such as for the military or HR groups.

We also plan on disseminating through our study website (www.meshstudy.org) and through our newly branded lab website Center for Supportive Leadership

(www.supportiveleadership.org). This website houses all of our supportive supervision training programs and allows employers and individuals to browse training titles that suit their needs. These training programs will be hosted on Docebo LMS, a learning management system platform that allows users to complete training directly on our site or through their organization's portal. The training files can also be integrated directly into an organization's LMS.

We are disseminating information about our study and training through our Institute, the Oregon Institute of Occupational Health Science and the Oregon Healthy Workforce Center.

We also plan on having the supervisor training available to download for free from our website, as well as an instructional video on how to replicate what we did for the sleep feedback portion, using various devices (e.g., Fitbit, Apple Watch).

What do you plan to do during the next reporting period to accomplish the goals?

- This is the final report.

4. IMPACT:

What was the impact on the development of the principal discipline(s) of the project?

The principal disciplinary fields represented by researchers on this study include industrial-organizational psychology (i.e., workplace psychology), occupational health psychology, social psychology, and family studies. ***Results suggest that the intervention that was developed and administered in this project had a positive impact on sleep leadership behaviors and well-being, health, sleep, and work-related outcomes of employees, some of which extend to favorable outcomes for employees' spouses.*** Therefore, the intervention results provide support for theory and previous research in these disciplines related to supervisor and leadership support and the National Institute for Occupational Safety and Health (NIOSH) *Total Worker Health*® approach. There is also potential for the intervention effects to generalize and apply to other industries and occupational samples.

What was the impact on other disciplines?

More broadly, results from this study are likely to make an impact on other disciplinary fields, including public health, basic sleep science, and military studies. Additionally, this study informs future randomized controlled trial interventions, interventions that use an intent-to-treat analytic strategy, studies that employ cluster randomized intervention procedures, and interventions using NIOSH's *Total Worker Health*® framework.

The WRAIR-West team at Joint Base Lewis McChord is currently working on a paper using both our survey and actigraphy data to examine novel ways to conceptualize sleep health.

What was the impact on technology transfer?

Impact on public use: This project is likely to make an impact on pubic use given it has shown important direct effects on supervisor sleep leadership, health, work, well-being, and even spouse outcomes. We have created a 'civilian' version of the FaSST which is housed on both the MESH Study website (meshstudy.org) and our newly developed Center for Supportive Leadership (https://www.supportiveleadership.org/).

We have worked with OHSU Technology Transfer office to ensure we can safely and legally share our training, in which we currently have no financial interest. We are dedicated to ensuring that the products of this research (e.g., the resulting behavioral health leadership program and all new knowledge generated through associated data analyses) will be maximally useful for the betterment of both force health and readiness, as well as the health and well-being of society in general. In line with the CRADA we developed with the Walter Reed Army Institute of Research (WRAIR), we have and will

continue to share our deidentified data, algorithms we have developed for the actigraphy data, and training-related products.

We are capitalizing on our long-standing relationship with the ORNG, as well as our collaboration with the WRAIR, to ensure that there is awareness and availability for the unrestricted use of our FaSST program through our website. We also have created a version of the training that can be housed within the training platform of organizations. Recently, we had a meeting with the suicide prevention team at the ORNG to find out more about our training, as the link between sleep and suicidal ideation has received attention, particularly from the National Institute of Mental Health (NIMH). In addition, the previous Adjutant General for the ORNG is General Daniel Hokanson, who is currently the head of the National Guard Bureau. We are in the process of reaching out to his office, as well as other relevant staff at the NGB, to promote our training.

Impact on adoption of new practices: Two time-separated actigraphy data collections were conducted in this study. Actigraphy is a non-invasive way to measure sleep in which participants wear a wristwatch device with a built-in accelerometer to assess activity levels. Actigraphy is therefore considered an objective measure of sleep that is appropriate for use in field studies. However, because the topic of sleep has only recently been introduced into research in organizational sciences disciplines (e.g., industrial-organizational psychology, occupational health psychology), extensive and rigorous cleaning of actigraphic data is not a norm in these fields. To ensure that the actigraphic sleep data in this study were reliable and valid, researchers developed comprehensive, rigorous protocols for how to clean actigraphic sleep data in a way that addresses device errors and participant non-compliance. Our protocols also included various methods for assessing the quality of the actigraphic data cleaning decisions. A paper with evidence-based recommendations for how to clean actigraphic data for use in applied field studies is currently being developed. Measuring sleep in a reliable and valid way is imperative for the fidelity of research findings and subsequent applications in practice. Therefore, this project will make an impact on the use of objective sleep data in future field studies.

What was the impact on society beyond science and technology?

There are a number of ways in which the results from this project are likely to make an impact on society. First, this study has implications for the health, well-being, and effectiveness of members of the US military and their families. Relatedly, this project may influence larger health-centered culture change initiatives in the military. These impacts may extend to the general population, as research support for the benefits of supervisor and leader support, as well as sleep health, can signal the importance of these areas for individual people, employers, and organizations. Furthermore, the individual actigraphic sleep behavior-tracking component of the intervention may generalize to the general public through the use of commercial sleep tracking devices (e.g., FitBits) or sleep logs as methods for eliciting behavior change that would improve sleep. More broadly, this study will contribute to workplace stress, health, and well-being initiatives, interventions, and policies that protect and promote the safety, health, and well-being of workers, their families, and communities.

5. CHANGES/PROBLEMS:

In our experience conducting longitudinal field research, change is inevitable. We did have many changes over the course of the 4 year study, some very minor and others more impactful (e.g., COVID-19 pandemic). However, our team was very experienced in conducting this type of research as was able to adapt and pivot as needed, accomplishing all our objectives.

Changes in approach and reasons for change

Only one change over the course of the study required a change to the SOW after its initial approval in March 2017. Based on the number of actigraphy devices and other logistical challenges around staffing, we determined we needed to have all Army units go through the entire study, including all follow up. Once they were complete, then we could proceed with the Air NG units. This didn't change any of the tasks per se, but did change some of the anticipated completions of tasks. We submitted these changes and the updated SOW (see *Appendix B*) was approved January 2019. Specific aims did not change.

The other change was due to COVID-19, which occurred in February/March of 2020. We were extremely fortunate on the timing as all data collection activities except for the 9-month data collection for the final two Air groups was complete. Data collection both in the field and electronically was impacted due to stay-at-home orders from Oregon Governor for all non-essential workers in March 2020. This change inhibited our team from traveling to Portland Air National Guard and Kingsley Field to meet with participants in person for device delivery/collection and sleep feedback meetings. Prior to Oregon stay-at-home directives, device delivery and collection scheduled through each individual to be delivered to their preferred location (home or base). The foremost potential problem with this method is tracking devices that were not sent direct and retrieving equipment that never made it to the intended individual. Secondly, device delivery and retrieval was difficult to manage in as timely of a manner as in prior groups, this meant that data download, cleaning, and report creation was later than previously expected.

Devices for the penultimate group were already in the field when the stay-at-home order came into effect, so we were able to still collect data from this group, but had to send prepaid boxes to participants to return them. For the final group, we made the decision to have them complete the survey only and NOT wear the actigraphy devices due to concerns about them getting lost and around timing. Ultimately, COVID had little impact on our data collection efforts, for which we are very grateful.

We were actually able to utilize the opportunity and applied for some additional funding to collect an additional wave of survey data to examine the impact of the pandemic on the health and well-being of ORNG service members and their families. This is reflected in the *Accomplishments* and *Impact* sections.

Actual problems or delays and actions or plans to resolve them

In Year 2 we had some issues with response rates for data collection in the summer, so we left the data collection window open a couple of weeks later than planned to allow respondents time to complete their surveys.

The overall structure of culture of the Oregon Air National Guard presented several challenges for our team, which we feel we were able to adapt to without sacrificing scientific integrity:

Supervisor-Subordinate Links: In our first Air groups, the number of direct supervisor-subordinate links were lower that we would like and what we had seen in Army units. As we proceeded through different units, we did uncover that the first units, HQ in particular, were more unique and the leadership structure less defined. We made sure to include language emphasizing the importance of supervisor participation in the voluntary portion of the study (survey and actigraphy) and how it will enhance the mandatory portion (supervisor training) for them personally. We are also looking at the influence of the intervention in ways beyond the individual supervisor-subordinate link, including unit-level participation rates and secondary supervisor links (i.e., if the supervisor of their supervisor participated).

Recruitment of Maintenance Units: Recruitment in the Maintenance Units, which are very large and in secure locations where our staff needed to be escorted, was challenging. We were able to adapt to a shorter recruiting pitch, using flyers more than we had previously and relying on our POCs to assist getting the word out. Our POCs for each unit were extremely helpful and provided us as much access as possible. We feel we have done all we could possibly do without being intrusive or overbearing and have taken notes on barriers and observations of culture within each unit to help us interpret any differential results we might see in these units. We also learned one of the air bases in particular is under a lot of pressure to repair several aircraft, so the response rate for Group 2.3b was particularly low. We did not want to add to their stress, particularly for the supervisor training, so did not continue to push for participation.

Spouse/Partner Participation: We also noticed more hesitancy to participate in research at the Air Base in Klamath Falls, which may be due to the more rural location and the current climate of distrust of research and science in general. Recruitment of spouses/partners, was more difficult than other locations/units. Our research assistant who interacted with spouses by email and phone noted they were very definite in their decision not to participate, more so than in other groups. We did all we could do to ensure the highest participation rate possible, without damaging our relationship with the ORNG. We are pleased that we met our target recruitment rates for employees and for spouses, though we are mindful of representation. We will examine any group differences by branch and location in our analyses.

Actigraphy Safety Concerns: We had some challenges with Actigraphy data collection for Oregon Air Maintenance units. All maintenance units at both bases had a mandated rule to remove all jewelry, watches, rings, bracelets, etc. during their shift as they work with highly classified aircraft and machinery. Maintenance unit's schedules are also scattered, with some participants working day, swing, and night shifts making it challenging to determine when the Actigraphy devices would need to be removed and

put back on. We created MESH inserts tailored specifically for participants in the maintenance groups detailing when to take the device off and put it back on for safety reasons. As a reminder, we also told participants in-person several times about the process for wearing the device. Overall, we have had no major issues with the maintenance units following these instructions and this turned out largely to be a non-issue.

COVID-19 effect on participants: Because we had data and effects from an intervention related to supervisor support, we were interested to see if the intervention would continue to have ameliorating effects on stressors related to COVID-19. We obtained a supplement to collect an additional wave of data which will be launched in November 2020. We also created several variables to indicate if someone completed their final survey during the statewide shutdown, at specific times, to enable us to look at possible differences.

Changes that had a significant impact on expenditures

None, with the exception of the COVID-19 supplement

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Significant changes in use or care of human subjects

- No significant changes

Significant changes in use or care of vertebrate animals

- Not applicable

Significant changes in use of biohazards and/or select agents

- Not applicable

6. PRODUCTS:

Note that all publications and presentations included the following statement:

"The U.S. Army Medical Research Acquisition Activity, 820 Chandler Street, Fort Detrick, MD 21702-5014 is the awarding and administering acquisition office. This work was supported by Office of the Assistant Secretary of Defense for Health Affairs, through the Psychological Health and Traumatic Brain Injury Research Program—Comprehensive Universal Prevention/Health Promotion Interventions Award, under Award No. W81XWH-16-1-0720. Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the Department of Defense."

Publications, conference papers, and presentations

Journal publications

Published manuscripts/In press:

Hammer**,** L. B., Brady, J. M., Brossoit, R. M., Mohr, C. D., Bodner, T. E., Crain, T. L., & Brockwood, K. J. (2021). Effects of a Total Worker Health® Leadership Intervention on Employee Well-Being and Functional Impairment. *Journal of Occupational Health Psychology,* 26, 582–598. *DOI: 10.1037/ocp0000312*

Sianoja, M., Crain, T. L., Hammer, L. B., Bodner, T., Brockwood, K. J., LoPresti, M., & Shea, S. A. (2020). The relationship between leadership support and employee sleep. *Journal of Occupational Health Psychology, 25*, 187–202. https://doi.org/10.1037/ocp0000173

Wong, J. R., Crain, T. L., Brossoit, R. M., Hammer, L. B., Bodner, T. E., & Brady, J.M. (In press). Beyond just resilience: The important role of work-family resources for soldiers. *Occupational Health Science.*

Manuscripts under review:

Brossoit, R.M., Hammer, L. B., Bodner, T. E., Crain, T. L., & Brockwood, K, J. (Under review). *The Effects of a Total Worker Health® Intervention on Workplace Safety: Mediating Effects of Sleep and Supervisor Support for Sleep*.

Crain, T. L., Hammer, L., B., Brossoit R. M., Brockwood, K. J., Mohr, C. D., Bodner, T. E., Allen, S., Dretsch, M. N., & Shea, S. A. (Under review). *Optimizing Employee Sleep: A Total Worker Health® Randomized Controlled Trial*..

O'Neill, A. S., Mohr, C. D., Brady, J. M., Bodner, T. E., Crain, T. C. & Hammer, L. B. (Under review). *Improving well-being in military couples through a Total Worker Health® Intervention*.

Note: Journal names intentionally omitted for manuscripts under review as to not to unblind the reviewing process.

Manuscripts currently in preparation for submission in 2022:

Allen, S. J., Hammer, L. B., Bodner, T. E., Brady, J. M., Mohr, C. D., & Brockwood, K. J. (In preparation, 2022) *Employee Anger and Resilience: The Effects of a Total Worker Health® Intervention*.

Bouleh, P. G., Allen, S. J., & Hammer, L. B. (In preparation, 2022). *The Relationship Between Family Supportive Supervisor Behaviors and Psychological Distress Across Four Occupational Samples*.

Crain, T. L., Brossoit, R. M., Leslie, J. J., Bodner, T. E., Shea, S. (In preparation, 2022). *Considerations for cleaning actigraphic sleep field data within organizational settings*.

Ganulin, M., Merrill, J., MacDonald, J., & Dretsch, M. (In preparation, 2022). *Characterizing sleep in the National Guard*.

Mohr, C., Bodner, T., & Hammer, L. (In preparation, 2022). *Trajectories of stress, health and well-being among National Guard service members and partners: Assessing the impact of COVID-19*.

O'Neill, A. S., Mohr, C. D., Bodner, T. E., Crain, T. C. & Hammer, L. B. (In preparation, 2022). *Does perceived supervisor supportiveness provide additional health benefits after considering perceived partner supportiveness? An examination of partnered service members' support perceptions on sleep dissatisfaction, PTSD symptom severity, and psychological distress.*

Part of doctoral dissertation for A. S. O'Neill

Umemoto, S., Mohr, C., Bodner, T., & Hammer, L. (In preparation, 2022). *Mother's Drinking Motives: A study of National Guard spouses*.

Part of S. Umemoto's Master's Thesis

Books or other non-periodical, one-time publications.

Hammer, L. B., Allen, S. J., & Leslie, J. J. (In press, 2022). Occupational Stress and Well-Being: Workplace Interventions Involving Managers/Supervisors. In L. Lapierre & C. Cooper (Eds.). *Cambridge Companion to Organisational Stress and Well-Being* (ch.11). Cambridge, United Kingdom: Cambridge University Press.

Hammer, L.B. & Brady, J. M. (2021). Worker well-being and work-life issues. In L. Koppes Bryan (Ed.), *Historical perspectives in industrial and organizational psychology* (2nd ed., pp. 270-291). Routledge.

Hammer, L. B., Lee, J. D., Mohr, C. D., & Allen, S. J. (2021). Anger and the role of supervisors at work. In A. B. Adler & D. Forbes (Eds.), *Anger at work: Prevention, intervention, and treatment in high-risk occupations* (pp. 141–171). American Psychological Association. https://doi.org/10.1037/0000244-006

Other publications, conference papers, and presentations.
Presented at conference:

Allen, S. J., Brady J. M., Hammer L. B. (2021, April). J*ob Security as a Moderator of a Worksite Intervention on Work-Family Enrichment.* In M. L. White, W. J. Casper, & J. Wayne, The Role of Motives and Resources in the Work and Family Domains. Symposium presented at the virtual 36th annual Society for Industrial and Organizational Psychology (SIOP) conference, New Orleans, LA.

*Brossoit, R. M., Hammer, L. B., Bodner, T. E., Crain, T. L., & Brockwood, K. J. (2021, November). *The Effects of a Total Worker Health® Intervention on Workplace Safety: Mediating Effects of Sleep and Supervisor Support for Sleep.* Poster presented at the bi-annual Work, Stress and Health Conference.

Crain, T. L., Brossoit, R. M., & Stevens, S. C. (2021, April). Understanding When Objective Measures of Sleep Are Not So Objective. In Trainer, H. M. (Chair) *Toolkits for Physiological Measurement, Behavioral Coding, and Computational Modeling.* Alternative session submitted to the annual meeting of the Society for Industrial Organizational Psychology, New Orleans, LA.

*Crain, T. L., Hammer, L., B., Brossoit R. M., Mohr, C. D., Bodner, T. E., Allen, S., McKeon, A. B., & Shea, S. A. (2021, April). Effects of a Workplace Intervention on Objective and Subjective Sleep Outcomes. In Burnett, C. & Fletcher, K. A (Co-Chairs) Sleep and the Workplace. Symposium submitted to the annual meeting of the Society for Industrial Organizational Psychology, New Orleans, LA.

*****Hammer, L. B., & Brockwood, K. J. (September, 2021). *Effects of a Total Worker Health® Leadership Intervention on Employee Well-Being and Functional Impairment.* Virtual presentation at the bi-annual meeting of Work, Stress, and Health Conference.

*Hammer, L. B., Brockwood, K. J., Mohr, C. D, & Brady, J. (2021, March). *Effects of a Workplace Intervention on Couple Health and Well-Being Outcomes.* Paper to be presented at the biannual meeting of the Work & Family Researchers Network, New York, NY. *NOTE: Conference was virtual.*

*Hammer, L. B., Brossoit, R. M., Bodner, T. E., Mohr, C. D., Crain, T. L., Brady, J. M., Brockwood, K. J., & Adler, A. B. (2021, August). *The Effects of Pre-COVID Sleep Leadership Training on COVID Leadership: Results from the Military Employee Sleep and Health Study.* Virtual poster at the annual meeting of the Military Health System Research.

*Mohr, C.D., Samson, M.A., O'Neill, A.M., Lee, J., Hammer, L., & Umemoto, S. (2021, September). *Social network support for drinking among National Guard spouses*. Poster presented at the annual meeting of the International Association for Relationships Research.

*Allen, S. J., Brady J. M., Hammer L. B., Lee, D. L., & Mohr, C. D. (2020, June). *Supportive Supervisor Intervention: Moderating Effects of Sleep Hygiene on Veteran Anger.* In K. A. Horan & L. B. Hammer's, Exploring Implementation

Level in Intervention Research. Symposium presented at the virtual 35th annual Society for Industrial and Organizational Psychology (SIOP) conference, Austin, TX.

*Mohr, C. D., O'Neill, A. M. S., Lee, J.D., Hammer, L. B., Umemoto, S. K. (2020, February). *Social network support for drinking: evidence from a survey of National Guard/Reserve spouses.* Presentation at the Society for Personality and Social Psychology Convention Health Pre-conference, New Orleans, LA.

O'Neill, A. S., Mohr, C. D., Bodner, T. & Hammer, L. B. (2020, February). Perceived Partner Responsiveness, Sleep and Pain: A Dyadic Study of Military-Connected Couples.* Poster submitted to the 21th annual Society for Personality and Social Psychology Convention, New Orleans, LA.

*Umemoto, S., Denning, E., Mohr, C., Hammer, L., Bouleh, P., & Rounds, T. (2020, February 27) *Mortality salience among U.S. military combat veterans: A terror management perspective* [Poster presentation]. 2020 SPSP Existential Psychology Preconference. New Orleans, LA.

Allen, S. J., Brockwood K. J., Hammer L. B., & Crain T. L. (2019, November). *The Oregon Military Employee Sleep and Health (MESH) Study: Intervention Observations, Successes & Challenges.* In R. M. Brossoit (Chair), *Applied Health and Safety Research Projects, Challenges, and Recommendations*. Paper presented at the 13th International Conference on Health Work, Stress and Health, Philadelphia, PA.

Brady, J. M., Hammer, L. B., Sianoja, M., & Westman, M. (2019, November). *A Broadened Examination of the Dyadic Spillover-Crossover Model.* Poster presented at the 13th International Conference on Health Work, Stress and Health, Philadelphia, PA.

Brady, J. M., Hammer, L. B., Westman, M., & Mohr, C. D. (2019, August). *The crossover effects of supervisor resilience to employee and family well-being.* In E.E. Kossek, L.L. Mechem, C.E. Kleshinski (Chairs). Interpersonal Perspectives on Work-Nonwork Dynamics: Theoretical and Empirical Explorations, at the 80th annual Academy of Management Meeting.

Hammer, L. B., Sianoja, M., & Westman, M. (2019, May). *Crossover of Resilience, Distress, and Life Satisfaction between Supervisors and Employees.* Presentation at the 19th European Association for Work & Organizational Psychology, Turin, Italy.

*Sianoja, M., Crain, T. L., Hammer, L. B., Bodner, T., Brockwood, K. J., LoPresti, M., & Shea, S. A. (2019, November). *The Relationship Between Supervisor Support and Employee Sleep.* In M. Sianoja (chair), Improving employees' health through supervisor support. Symposium conducted at the 13th International Conference on Work, Stress and Health conference, Philadelphia, USA.

*Wong, J. R., Crain, T. L., Brossoit, R. M., Hammer, L. B., Bodner, T. E., & Brady, J.M. (2019, April). *Beyond just resilience: The important role of work-family resources for soldiers.* Poster presented at the 34th annual Society for Industrial and Organizational Psychology Conference, National Harbor, MD.

Brossoit, R. M., Hammer, L. B., Brockwood, K. J., & Crain, T. L. (June, 2018). *The Oregon Military Employee Sleep and Health (MESH) Study: A Total Worker Health® intervention.* Paper presented at the biannual meeting of the Work & Family Researchers Network, Washington, DC.

**Developed/planned development into manuscript for publication*

Accepted to future conference:

Allen, S. J., Hammer, L. B., Bodner, T. E., Brady, J. M., Mohr, C. D., & Brockwood, K. J. (2022, April). *Effects of a Total Worker Health® Intervention to Promote Employee Emotional Well-Being*. In S. J. Allen (co-chair), L. B. Hammer (co-chair), & W. J. Casper (discussant), Calling for Support of Work-Nonwork Roles: Protecting Employee Health and Well-Being. Symposium to be presented at the 37th annual Society for Industrial and Organizational Psychology (SIOP) conference, Seattle, WA.

Brady, J.M., Hammer, L.B., Allen, S.J., Crain, T.L., Brossoit, R.M., & Bodner, T. E. (2022, April). *Promoting Leader Sleep Health*. In C. Burnett & K. Fletcher. Leadership and Health Outcomes: Exploration of the Far-Reaching Impact of Leadership. Symposium accepted for presentation at the 37th annual Society for Industrial and Organizational Psychology (SIOP) conference, Seattle, WA.

Hammer, L.B., Brady, J.M., & Westman, M.L. (2022, July). *Crossover Effects of Supervisor Resilience to Employees' Resilience and Well-being: A Time Lagged Investigation*. To be presented at the 15th Annual European Academy of Occupational Health Psychology Conference, Bordeaux, France.

Hammer, L. B., Brossoit, R. M., Bodner, T. E., Mohr, C. D., Crain, T. L., Brady, J. M., Brockwood, K. J., & Adler, A. B. (2022, June). *The Effects of Pre-COVID FSSB and Sleep Leadership Training on COVID Leadership Effectiveness.* Paper submitted to the bi-annual meeting of the Work and Family Researchers Network, New York City, NY.

Leslie, J. J., Crain, T. L., Hammer, L. B., & Mohr, C. D. (2022, June). *Sleeping to Support: An Examination of the Relationship Between Leader Sleep and Positive Support Behaviors.* Poster to be presented at the biannual meeting of the Work and Family Researchers Network in New York, New York.

Conference presentation that was accepted but conference canceled:

Brady, J. M., Hammer, L. B., Westman, M., & Mohr, C. D. (2019, August). *The crossover effects of supervisor resilience to employee and family well-being.* In

E.E. Kossek, L.L. Mechem, C.E. Kleshinski (Chairs). Interpersonal Perspectives on Work-Nonwork Dynamics: Theoretical and Empirical Explorations, at the 80th annual Academy of Management Meeting.

Hammer, L.B., Brady, J.M., Brockwood, K.J., & Mohr, C.D. *The Effects of a Family and Sleep Supportive Supervisor Intervention on Military Employee and Spouse Job Outcomes*. Accepted for the annual meeting of Military Health System Research Symposium (canceled).

Submitted to conferences:

Mohr, C., & Hammer, L. (2022). *Influences of COVID-related stress and family-to-work conflict on psychological distress among National Guard service members and buffering effects of perceived partner responsiveness*. Paper submitted to be presented at the annual meeting of the International Association for Relationships Research. London, UK.

Mohr, C., Hammer, L., & Denning, E. (2022). *Agitation as a predictor of harmful alcohol outcomes among U.S. National Guard/Reserve Service Members*. Paper submitted to be presented at the annual meeting of the Kettil Bruun Society. Warsaw, Poland.

Other Presentations:

Brossoit, R. M. (2021, March). *Studying Sleep in Applied Occupational Health Psychology Research.* Presentation for the Oregon Institute of Occupational Health Sciences Seminar Series, Portland, OR (virtual).

Hammer, L. B. (2021, March). *The Military Employee Sleep and Health Study (MESH): The negative and positive impact of COVID on a Randomized Controlled Trial*. Presentation for the University of North Carolina.

Hammer, L.B., Mohr, C. & Brockwood, K. (2021, June). Virtual Presentation of MESH findings to Joint Chief of Staff and Director of Behavioral Health ORNG.

Hammer, L.B. (2021, October). Leading Well: How Managers Can Strategically Use Wellness (& Make Their Performance Review Shine). U.S. Department of State. Virtual webinar presentation.

Brady, J.M. (2020, July). *The critical role of supervisors in shaping employee safety, health, and well- being*. Invited seminar presented at the 8th annual Occupational Health Psychology Summer Institute, Portland, OR.

Brossoit, R. M. (2020, September) *Sleep Research in Occupational Health Psychology*. Guest lecture provided for the graduate-level Spectrums of Professions Protecting and Promoting Worker Health course at Colorado State University.

Hammer, L. B. (2020, September). *Supervisor and Co-worker Support for Employees during and after COVID-19 Return to Work*. Society for Occupational Health Psychology. Virtual Webinar.

Brady, J.M. (2019, September). *Taking work home: Same and cross-domain effects of work-family resources*. Seminar presented at Oregon Institute for Occupational Health Sciences.

Brossoit, R. M. (2019, October) *Occupational Stress*. Lecture provided for the undergraduate-level Organizational Psychology course at Colorado State University.

Hammer, L. B. (2018, May). Plenary Speaker: *Building strong interventions: Work environment, individual & social intervention strategies*. Symposium (Kent Anger, Chair): TWH® Intervention Strategies – What Works for the Centers of Excellence? Bethesda, MD.

Hammer, L. B. (2018, September). Keynote Address. *A Review of Work-Family and Job Stress Workplace Interventions within Total Worker Health® and Occupational Health Psychology Frameworks*. European Academy of Occupational Health Psychology (EA OHP). Lisbon, Portugal.

Brockwood, K. (2018, November). Presentations to Wing Commanders and Senior Leaders for the 173rd and 142nd Fighter Wing at Portland and Klamath Falls, Oregon.

Ling, M. (2017, July). Presentation to Oregon National Guard Brigade Commanders and Executive Officers and other senior officials.

Brossoit, R. M. (2017, October) *Sleep Research in Occupational Health Psychology*. Guest lecture provided for the graduate-level Spectrums of Professions Protecting and Promoting Worker Health course at Colorado State University.

Hammer, L.B. (2016, October). Presentation to The Adjutant General of the Oregon National Guard, MG Stencel, as well as other key senior leader for Army and Air Guard.

Blog posts and online articles:

Montgomery, D. (2022, January 19). New publication on Total Worker Health® leadership intervention by Dr. Leslie Hammer and team. Oregon and the Workplace. https://blogs.ohsu.edu/occupational-health-sciences/2022/01/19/new-publication-on-total-worker-health-leadership-intervention-by-dr-leslie-hammer-and-team/

Hammer, L.B., Alley, L., Nelson, J., & MacDonald, L. (2021, October 13). Supportive leaders drive organizational improvements and employee health and well-being. NIOSH Science Blog. https://blogs.cdc.gov/niosh-science-blog/2021/10/13/supportive-leaders/

Hammer, L.B., & Alley, L. (2020, February 26). Supporting worker sleep is good for business. The Conversation. https://theconversation.com/supporting-worker-sleep-is-good-for-business-130101

Schukers, H. (2020, November 11). Thanking our Veterans. Oregon and the Workplace. https://blogs.ohsu.edu/occupational-health-sciences/2020/11/11/thanking-our-veterans/

Cheung, J. (2016, October 24). Oregon military sleep and health study (MESH). https://blogs.ohsu.edu/occupational-health-sciences/2016/10/24/oregon-military-employee-sleep-and-health-mesh-study/

Websites or other Internet sites

Primary MESH Study website: www.meshstudy.org

This is the public website of the MESH Study. During the study the website included the secure portal for the leader training, where supervisors would log in, take the training and log their supportive behaviors.

Since the completion of the study, we have updated the training and created a version that is available for any site visitor to complete at no cost. In addition, we have created a civilian/non-military version of the FaSST.

On the website, we also provide information about the study and our team, as well as summaries of all of our publications in one-page downloadable versions.

Additional websites within our institution that includes links to and information about the MESH Study:

Center for Supportive Leadership: https://www.supportiveleadership.org/

Dr. Hammer's faculty page: https://www.ohsu.edu/oregon-institute-occupational-health-sciences/leslie-b-hammer-lab

Oregon Healthy Workforce Website, an affiliated program: https://www.yourworkpath.com/affilatedendorsedprograms

Oregon Institute for Occupational Health Sciences, our institutional website that has often featured our work (see Blog Posts above): https://www.ohsu.edu/oregon-institute-occupational-health-sciences

Technologies or techniques

- Comprehensive, rigorous protocols for how to clean actigraphic sleep data were developed for this project. A paper with evidence-based recommendations for how to clean actigraphic data for use in applied field studies is currently being developed.
- The Family & Sleep Supportive Training (FaSST) created in Articulate, a state-of-the art Learning Management System. Screen shots included in *Appendix D*. Complete training can also be access through the MESH website or the Center for Supportive Leadership (see above).

Inventions, patent applications, and/or licenses

Nothing to report

Other Products

- Deidentified actigraphy data set with matched survey data, available upon request

7. PARTICIPANTS AND OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Below are all the personnel who have worked on the grant over the past five years in various capacities. They are broken out by the three original centers listed in the SOW: OHSU, PSU and CSU. Several personnel moved between centers during the project and are listed in each center, broken down by the Total Person Months they worked in that center, as well as which years of the grant they worked at each location. Here is a summary list:

- Dr. Tori Crain, PI for the CSU center Years 1-4, moved to PSU in Year 5
- Shalene Allen worked at the OHSU center Years 1-4, then moved to PSU Year 5 for graduate school
- Rebecca Brossoit, GRA at CSU Years 1-4, moved to OHSU in Year 5
- Jacquelyn Brady, GRA at PSU Years 1-3, moved to OHSU Year 4-5. After receiving her doctorate, Dr. Brady obtained a position at San Jose State University but still worked on manuscripts for the MESH Study through the end of the study
- Sheila Umemoto, worked full time for 3 months in Year 3 of the grant at OHSU, then switched to PSU part time in Years 4-5 during graduate school

Individuals below whose grant work was funded through sources outside the grant completely are marked with an *; those with funding from both the grant and other sources are marked with an ^.

OHSU Center:

Name:	Leslie Hammer, Ph.D.
Project Role:	Principal Investigator
Researcher Identifier:	eRA Commons ID hammerl
Nearest Person Month Worked (Total):	20
Grant Years Worked	1-5
Contribution to Project:	Dr. Hammer oversaw all aspects of project, including logistical and financial aspects of grant

Name:	Krista Brockwood, Ph.D.
Project Role:	Project Manager
Researcher Identifier:	None
Nearest Person Month Worked (Total):	40

Grant Years Worked	1-5
Contribution to Project:	Dr. Brockwood oversaw the daily management of the study with a primary responsibility of coordinating with the Oregon National Guard to enact the study.

Name:	Phoenix Rain Bird
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	39
Grant Years Worked	1-5
Contribution to Project:	Ms. Rain Bird has worked on training development, creating data collection protocols and participant tracking

Name:	Marjaana Sianoja, Ph.D.
Project Role:	Post-Doctoral Researcher
Researcher Identifier:	None
Nearest Person Month Worked (Total):	11
Grant Years Worked	2 and 3; employment ended JUL 2019
Contribution to Project:	Dr. Sianoja oversaw the data management and analyses for primary papers.

Name:	Janelle Cheung, Ph.D.
Project Role:	Post-Doctoral Researcher
Researcher Identifier:	None
Nearest Person Month Worked (Total):	15
Grant Years Worked	1 and 2; employment ended DEC 2017
Contribution to Project:	Dr. Cheung was primarily responsible for Human Subjects approval, survey development,

	actigraphy and other aspects of research project functioning as needed.

Name:	Shalene Allen
Project Role:	Research Assistant/Recruiting and Logistics Coordinator
Researcher Identifier:	None
Nearest Person Month Worked (Total):	22
Grant Years Worked	2-4
Contribution to Project:	Ms. Allen assisted with training development and creating participant recruitment timelines and protocols. She was primarily responsible for recruiting participants in the field and coordinating with leadership at units for onsite visits. She used study data for her Master's thesis.

Name:	Jason Malach-Fuller
Project Role:	Research Assistant/Training Coordinator
Researcher Identifier:	None
Nearest Person Month Worked (Total):	38
Grant Years Worked	1-5; employment ended JUN 2021
Contribution to Project:	Mr. Malach-Fuller was responsible for coordinating with units in the treatment groups and delivering intervention elements, as well as configuring actigraphy data and running reports.

Name:	Dr. Steven Shea
Project Role:	Co-Investigator
Researcher Identifier:	eRA Commons ID SAS123
Nearest Person Month Worked (Total):	5

Grant Years Worked	1-5
Contribution to Project:	Dr. Shea is an expert on sleep research and he assisted with the sleep-related aspects of the study, including development of the intervention, selection of appropriate self-report sleep measures, and assisted with the interpretation of the actigraphy data.

Name:	Dr. Kathleen Carlson
Project Role:	Co-Investigator
Researcher Identifier:	eRA Commons ID vhamincarlsk
Nearest Person Month Worked (Total):	2
Grant Years Worked	1-5
Contribution to Project:	Dr. Carlson is an epidemiologist at the Portland VA and provided guidance on measurement and training materials.

Name:	Marcus Ling
Project Role:	Research Assistant/Recruiting and Logistics Coordinator
Researcher Identifier:	None
Nearest Person Month Worked (Total):	12
Grant Years Worked	1 and 2; employment ended MAY 2018
Contribution to Project:	Mr. Ling assisted with training development and creating participant recruitment timelines and protocols. He was primarily responsible for recruiting participants in the field and coordinating with leadership at units for onsite visits and actigraphy device delivery.

Name:	Jackie Brady, Ph.D.
Project Role:	Post-Doctoral Researcher
Researcher Identifier:	None

Nearest Person Month Worked (Total):	18
Grant Years Worked	3 and 4; employment ended JUN 2020
Contribution to Project:	Dr. Brady worked with actigraphy and survey data, taking over some of the data management tasks, as well as working on the development of manuscripts. *NOTE: Dr. Brady switched from the PSU center in the summer of 2019 (listed below) when she completed her doctorate requirements and became a full time OHSU employee.*

Name:	Lev El-Askari^
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	4
Grant Years Worked	3 and 4
Contribution to Project:	Mr. El-Askari was a summer intern in 2019, and worked as a student worker summer of 2020. He assisted with cleaning actigraphy data, recruitment, sleep feedback and developing academic manuscripts.

Name:	Sheila Umemoto
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	3
Grant Years Worked	3; employed ended MAY 2020
Contribution to Project:	Ms. Umemoto assisted in the field with recruitment and feedback delivery, as well as general research support. She is an U.S. Army Veteran.

Name:	Tim Oxendahl*
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	1
Grant Years Worked	3; employment ended SEP 2020
Contribution to Project:	Mr. Oxendahl was a summer intern through OHSU in 2020. He assisted with a variety of tasks on the project, including data coding, reviewing sleep reports, providing sleep feedback to participants and assisting in the field.

Name:	Rebecca Brossoit, Ph.D.
Project Role:	Graduate Research Assistant/Post-Doctoral Researcher
Researcher Identifier:	None
Nearest Person Month Worked (Total):	9
Grant Years Worked	5 (at OHSU)
Contribution to Project:	Ms. Brossoit took over for Dr. Brady as the lead analyst and became our post-doc when she defended her dissertation in Dec 2020. In September 2020, her employment moved from CSU to OHSU at half time, then full time after her defense.

Name:	Philip Bouleh
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	6
Grant Years Worked	5
Contribution to Project:	Mr. Bouleh was hired specifically to work on the COVID-supplemental data. He worked on the survey, data cleaning and assisting with the development of manuscripts. He worked as a volunteer with Dr. Mohr for several months prior to being hired officially at OHSU.

PSU Center:

Name:	Dr. Cynthia Mohr
Project Role:	Co-Investigator; PSU Sub-Award PI
Researcher Identifier:	eRA Commons ID cdmohr
Nearest Person Month Worked (Total):	11
Grant Years Worked	1-5
Contribution to Project:	Dr. Mohr contributed to project protocol and training development, survey creation and supervised graduate assistants.

Name:	Dr. Todd Bodner
Project Role:	Co-Investigator
Researcher Identifier:	ORCID ID 0000-0002-7001-274X
Nearest Person Month Worked (Total):	9
Grant Years Worked	1-5
Contribution to Project:	Dr. Bodner is our statistician and assisted with research design, sample selection, measurement development, and was lead on the survey data preparation and analysis.

Name:	Tori Crain, Ph.D.^
Project Role:	Co-Investigator
Researcher Identifier:	ORCID ID 0000-0003-1859-9632
Nearest Person Month Worked (Total):	2
Grant Years Worked	5
Contribution to Project:	Dr. Crain has performed work related to the intervention content design, guidance around actigraphy procedures, managed the actigraphy cleaning and analysis, and has developed manuscripts for publication. NOTE: In Summer 2020 Dr. Crain changed her employment from

	CSU to PSU. Her effort for CSU is listed under that center for the appropriate time period.

Name:	Jacquelyn Brady, M.S.
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	13
Grant Years Worked	1-3; employment at PSU ended JUN 2019
Contribution to Project:	Ms. Brady contributed by inputting survey measures, performing background research, data cleaning, and data management. *NOTE: Ms. Brady is also listed under OHSU, as she became a post-doctoral researcher full time after receiving her doctorate.*

Name:	AnnaMarie O'Neill (nee Greenhalgh), M.S.
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	22
Grant Years Worked	1-5
Contribution to Project:	Ms. Greenhalgh performed work in the area of conducting background research and assisting with survey development for the veteran and spouse participants. She is also assisting with recruitment, retention, as well as development of intervention materials and delivery.

Name:	Luke Mahoney, M.S.^
Project Role:	Graduate Research Assistant
Researcher Identifier:	None

Nearest Person Month Worked (Total):	6
Grant Years Worked	1-5
Contribution to Project:	Mr. Mahoney assisted with data management, actigraphy deep cleaning and intervention delivery.

Name:	Shalene Allen^
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	4
Grant Years Worked	5 (at PSU)
Contribution to Project:	Ms. Allen moved to PSU from OHSU when she was in graduate school in Year 5. At PSU, she primarily focused on manuscript development, dissemination and reporting. She used study data for her Master's thesis, which was developed into a publication submission.

Name:	Emily Denning^
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	6
Grant Years Worked	1-5
Contribution to Project:	Ms. Denning assisted with intervention preparation and delivery, and manuscript development.

Name:	James Lee^
Project Role:	Graduate Research Assistant
Researcher Identifier:	None

Nearest Person Month Worked (Total):	10
Grant Years Worked	1-5
Contribution to Project:	Mr. Lee has assisted with intervention preparation and delivery, and manuscript development.

Name:	Sarah Haverly, M.S.*
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	4
Grant Years Worked	1
Contribution to Project:	Ms. Haverly worked primarily on the piloting of the actigraphy devices, as well as developing the protocols for data processing.

Name:	Sheila Umemoto
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	8
Grant Years Worked	4 and 5
Contribution to Project:	Ms. Umemoto assisted in the field with recruitment and feedback delivery, as well as general research support. She is an U.S. Army Veteran. Note: Ms. Umemoto was also hired by the OHSU center for a brief time to assist with recruitment in year 3

Name:	Derek Brown*
Project Role:	Graduate Research Assistant
Researcher Identifier:	None

Nearest Person Month Worked (Total):	1
Grant Years Worked	1
Contribution to Project:	Mr. Brown transitioned from another project and assisted with recruitment. He was largely involved in intervention delivery.

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Name:	Jordyn Leslie*
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	2
Grant Years Worked	5
Contribution to Project:	Ms. Leslie has assisted with reviewing sleep reports, coding data and assisting with the development of conference submissions and publications. She is using MESH data for her thesis.

CSU Center:

Name:	Tori Crain, Ph.D.
Project Role:	Co-Investigator; Colorado State University Subaward PI
Researcher Identifier:	ORCID ID 0000-0003-1859-9632
Nearest Person Month Worked (Total):	18
Grant Years Worked	1-5
Contribution to Project:	Dr. Crain has performed work related to the intervention content design, guidance around actigraphy procedures, managed the actigraphy cleaning and analysis, and has developed manuscripts for publication. *NOTE: In Summer 2020 Dr. Crain changed her employment to PSU*

Name:	Rebecca Brossoit^
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	10
Grant Years Worked	1-5
Contribution to Project:	Ms. Brossoit assisted in the development of the actigraphy protocols, sleep feedback reports, assisted with the management of the actigraphy cleaning and analysis, and has developed manuscripts for publication. In September 2020, her employment moved to OHSU at half time.

Name:	Jacqueline Wong*
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	3
Grant Years Worked	2-5
Contribution to Project:	Ms. Wong has assisted in the cleaning of the actigraphy data and developing manuscripts for publication.

Name:	Kiplin Kaldahl*
Project Role:	Graduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	5
Grant Years Worked	2-5
Contribution to Project:	Ms. Kaldahl has assisted in the cleaning of the actigraphy data and developing manuscripts for publication.

Name:	Faviola Robles-Saenz
Project Role:	Undergraduate Research Assistant

Researcher Identifier:	None
Nearest Person Month Worked (Total):	2
Grant Years Worked	3-5
Contribution to Project:	Ms. Robles-Saenz has assisted in the cleaning of the actigraphy data.

Name:	Maddie Lesjak
Project Role:	Undergraduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	2
Grant Years Worked	3-5
Contribution to Project:	Ms. Lesjak has assisted in the cleaning of the actigraphy data.

Name:	Jedidiah Knode
Project Role:	Undergraduate Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	2
Grant Years Worked	3-5
Contribution to Project:	Mr. Knode has assisted in the cleaning of the actigraphy data.

Name:	Erika Schemmel
Project Role:	Research Assistant
Researcher Identifier:	None
Nearest Person Month Worked (Total):	1
Grant Years Worked	4 -5
Contribution to Project:	Ms. Schemmel has assisted in the cleaning of the actigraphy data.

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Not in PIs or senior/key personnel. Note that Dr. Tori Crain, CO-PI and lead on the Colorado State University center has changed employment to Portland State University in Fall 2020, though her role in the study remains the same.

What other organizations were involved as partners?

- **Organization Name:** Portland State University
- **Location of Organization:** Portland, OR
- **Partner's contribution to the project**
  - **In-kind support -** departmental computers and software available used by project staff
  - **Facilities -** lab and meeting space
  - **Collaboration -** partner and project staff work closely with one another, providing support and assistance with many aspects of the project, as well as assistance with project activities, such as recruitment in the field and intervention delivery (e.g., individual feedback on sleep reports)

- **Organization Name: Colorado State University**
- **Location of Organization:** Ft. Collins, CO
- **Partner's contribution to the project**
  - **In-Kind Support –** use of Actiware software
  - **Collaboration -** oversee with actigraphy portion of the study, including consultation and training of OHSU and PSU staff, development of protocols. *Please note that Dr. Tori Crain, Co-PI of the CSU center changed her employment to PSU in Fall 2020.*

- **Organization Name: Walter Reed Army Institute of Research (WRAIR) and WRAIR-West**
- **Location of Organization:** Silver Spring, MD and Joint Base Lewis McChord, WA
- **Partner's contribution to the project**
  - **In-kind support** - use of large fleet (220) of Phillips Actiwatch actigraphy devices, use of proprietary algorithms and information for sleep reports. Devices were shipped back to WRAIR in late September 2020 at the completion of data collection.
  - **Collaboration - *Dr. Amy Adler and MAJ Matt LoPresti*** (named on the CRADA that was developed for this project) have both provided extensive expertise and training to our project staff regarding the supervisor training and the actigraphy. We've held multiple meetings with project staff and WRAIR partners at both JBLM and OHSU. MAJ Mike Dretsch, who took over for MAJ LoPresti at JBLM, has been calling in to our monthly team meetings. Research assistants Michelle Ganulin and Julie Merrill at WRAIR-West have also joined monthly calls/meetings.

- Our actigraphy team, lead by Dr. Tori Crain, has been working closely with analysts at WRAIR to share macros and variable creation for actigraphy data.

- **Organization Name: Oregon National Guard**
- **Location of Organization:** Salem, OR (Headquarters)
- **Partner's contribution to the project**
  - **Facilities -** use of rooms for recruitment and intervention delivery at ORNG locations across the state
  - **Collaboration -** continued to work closely ORNG staff and leadership to ensure participation in the study and, in particular, the Supervisor training. There have been several changes in senior leadership at the ORNG, but we continue to have close contact with them.

Academic Consultants

- **Thomas Britt, Ph.D., Clemson University**, contributed his expertise in the area of psychological research with military personnel with a focus on resiliency and well-being. He was an active duty research psychologist in the U.S. Army for five years and is currently working on several funded research projects in the military.

- **Ellen Ernst Kossek, Ph.D., Purdue University**, contributed her expertise in the area of work-family policies and programs and organizational sciences. She developed the original FSSB training with Dr. Hammer, on which the current training is partially based and will provide input on the development of the current training.

- **Robert Sinclair, Ph.D., Clemson University**, contributed his expertise in Occupational Health Psychology, as well as that in the area of military psychology, serving in the Marines and later working as a research consultant for WRAIR for the past 13 years.

8. SPECIAL REPORTING REQUIREMENTS

- **COLLABORATIVE AWARDS:** Not applicable.
- **QUAD CHARTS:** Finalized and uploaded separately

NOTE: Appendices included in separately uploaded document due to file size.