SPECIAL MINDSET

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Timeline of Psychological and Physiological Effects Occurring During Military Deployment on a Medical Team

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ABSTRACT

Background: The negative effects of deployment on military mental health is a topic of major interest. Predeployment and postdeployment assessments are common, but to date there has been little to no intradeployment assessment of military members. This study attempts to determine the physiological and psychiatric effects on Servicemembers over the course of deployment, to provide a baseline data set and to allow for better prediction, prevention, and intervention on these negative effects. **Methods:** A retrospective analysis was performed on physiological and psychiatric data collected on a single deployed medical team between 16 January 2020 and 12 July 2020. Patient health screening questionnaires (PHQ-9) and physiological measurements were completed serially twice weekly on five active-duty military volunteers for the entirety of a scheduled 6-month deployment. **Results:** Depression symptom development followed a linear trend ($p = .0149$) and severity followed a quadratic trend ($p < .001$) over a length of a deployment. Weight ($p = .435$) and pulse ($p = .416$) were not statistically altered. Mean arterial pressure (MAP) had a statistically significant reduction ($p < .001$). **Conclusion:** In this specific population, there was a linear relationship between time deployed and depression symptoms and severity. Depression symptom severity decreases toward the end of deployment but does not return to baseline before deployment's end.

KEYWORDS: *mental health; deployment; depression; military; physiology; blood pressure; weight; pulse*

Introduction

Military mental health differs from that of the overall population and is an area of intensive study. Suicide remains an ongoing issue that seems to remain unsolved.[1] Military mental health research predominantly investigates veterans and their families before and after, but not during, deployment.[2,3] Questions remain unanswered about the relationship between the stress of deployment and psychological health.[4] The physiological changes associated with deployment are also largely unknown. This study aims to present a complete timeline of a deployment's effect on the psychology and physiology within a single cohort of military personnel. We hypothesized that psychological and physiological health changes correlate with time for the deployed population.

Methods

A retrospective analysis of a deployed team's intradeployment serial depression screening results and physiological measurements taken between January 2020 and July 2020. The study period is the scheduled deployment period of a single surgical team within United States Special Operations Command Africa (SOCAF). "Deployment" in this study is defined as being in a foreign country in support of military operations.

Depression symptoms were measured during the course of the deployment by serially completing the PHQ-9 questionnaire.[5] PHQ-9 is a standardized health questionnaire consisting of nine questions each with an answer score ranging from 0 to 3 (for a total score range of 0 to 27). The tenth question asks responders to rate the impact of the symptoms. A score of ≤ 4 suggests minimal depression symptoms that do not require treatment, while a score > 4 is a marker for mild to severe depression that may require intervention. Physiological measurements included weight, blood pressure, and pulse. Measurements were done on volunteer members of the team, and volunteers were able to opt out of any element of the testing at any time during the study period. Five members of the team had physiological measurements taken, while only four of the five underwent continuous PHQ-9 screenings throughout the entire time period. One of the five with physiological measurements did not have their weight measured. Measurements were done twice weekly between 1000 hours and 1700 hours (between 10 a.m. and 5 p.m. local time). The measurements started the day the volunteers assumed their deployed duties until the end of the deployment. The location was a noncombat zone. All volunteers were active-duty medical professionals. No medical histories were taken to maintain anonymity,

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but all members were qualified for international military deployment and in compliance with US Africa Command theater entry guidelines, which demanded a high standard of health. A known combat casualty care event occurred on 11 February 2020. To determine if the event on 11 February was associated with significant changes to the severity of symptoms, a Wilcoxon signed-rank test was used to compare the average severity of symptoms before and after that date. No substantial medical interventions or mental health outreach programs were known to be provided to the volunteers. The volunteers' duties over the course of the deployment included medical and surgical management of patients.

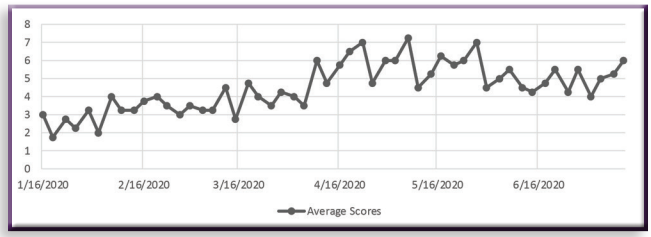
Repeated-measures analysis using generalized mixed models was applied to model whether deployment length in days was a statistically significant predictor of various outcome variables. These variables consisted of total depression symptom score (combination of depression symptoms scored together by adding scores from questions 1–9), depression severity score, pulse, weight, and MAP. Mode and ranges were calculated for each volunteer to provide descriptive measures for each individual. All analysis was completed using SAS version 9.4 (SAS; www.sas.com), and statistical significance was set at $p = .05$.

Results

The PHQ-9 questionnaire was divided into two sections. Questions 1–9 designated depression symptom scores, and question 10, in which responders rate the impact of the symptoms, designated the depression severity score. In addition to the PHQ-9 results, pulse, weight, and MAP were tabulated (Table 1).

The first generalized mixed model found the deployment length in days to be a statistically significant predictor of total depression symptom scores. Specifically, increased days of deployment was associated with higher depression symptom scores ($p = .015$) (Figure 1). In addition, fitting a generalized mixed model for depression severity score found the length of deployment in days to be a statistically significant predictor.

FIGURE 1 *Mean symptom scores of the total population over the deployment period. Symptom scores are the sum of PHQ-9 answers for questions 1–9.*



The quadratic trend of length of deployment in days was also significantly associated with depression severity scores, in which severity scores increased initially then decreased as days of deployment increased ($p < .001$) (Figure 2). Length of deployment was not a significant predictor on the variable pulse ($p = .416$). Similarly, the length of deployment in days was not a statistically significantly predictor of weight ($p = .435$). Last, the effects of length of deployment in days on arterial pressure was found to be statistically significant, in which increased days of deployment was associated with lower MAP ($p < .001$) (Figure 3). Spatial power covariance structures and compound symmetry covariance structures were the specified covariance matrices in the generalized mixed models that yielded the best fit for the various models. Depression symptoms for the population followed a positive linear pattern with respect to time, and severity scores followed a quadratic trend (Figures 1 and 2). To determine whether the historical event occurring on 11 February was associated with depression severity scores, the pooled mean depression severity score before 11 February was compared to the pooled depression severity score after 11 February 11. The Wilcoxon signed-rank test did not find the difference before 11 February and after to be significantly different (1.15 versus 1.61, $p = .125$).

Discussion

This study provides evidence of a linear relationship between duration of deployment and the frequency and severity of

TABLE 1 *Aggregate Data of PHQ-9 Results and Physiologic Test Results of Deployed Participants*

Variable	Volunteer (Mode, Range)				
	1	2	3	4	5
Question					
1. Little interest in doing things	1 (0–2)	0 (0–3)	1 (0–2)	0 (0–1)	*
2. Feeling down, depressed, hopeless	1 (0–2)	0 (0–3)	1 (0–3)	0 (0–2)	
3. Trouble falling or staying asleep	1 (0–2)	0 (0–3)	1 (0–2)	1 (0–2)	
4. Feeling tired or having little energy	1 (0–2)	1 (0–3)	1 (0–2)	1 (0–2)	
5. Poor appetite or overeating	0 (0–1)	0 (0–3)	1 (0–2)	0 (0–2)	
6. Feeling bad about yourself	1 (0–2)	0 (0–1)	0 (0–2)	0 (0)	
7. Trouble concentrating on things	1 (0–2)	0 (0–1)	0 (0–1)	0 (0–1)	
8. Moving or speaking slowly/fidgety	0 (0–2)	0 (0–1)	0 (0)	0 (0)	
9. Thoughts of being better off dead	0 (0)	0 (0)	0 (0)	0 (0)	
Total Symptom Score	**5 (0–11)**	**1 (0–15)**	**5 (0–11)**	**3 (1–8)**	
10. Difficulty caused by symptoms	2 (1–3)	1 (1–3)	1 (1–2)	1 (1–3)	
Physiologic Measurement					
Pulse (beats/sec)	90 (75–106)	75 (60–95)	75 (58–104)	50 (44–97)	60 (47–74)
Mean arterial pressure (mmHg)	105 (96.5–120.5)	100 (85.5–114)	96 (77–125.5)	101 (77.5–114)	98.5 (82.5–112)
Weight (kg)	169 (167–173)	180 (92–189)	215 (201–229)	—	188 (174–193)

The separate individuals are numbered with respective mode and ranges provided.

FIGURE 2 *Mean of population answers for PHQ-9 question 10 over the deployment period. Question 10 provided four nonnumerical options to evaluate the difficulty caused by depression symptoms. A numerical value was assigned to each answer from least (1) to greatest impact (4). Trendline equation included on figure.*

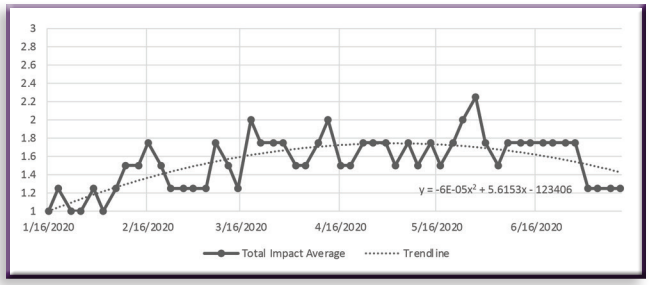
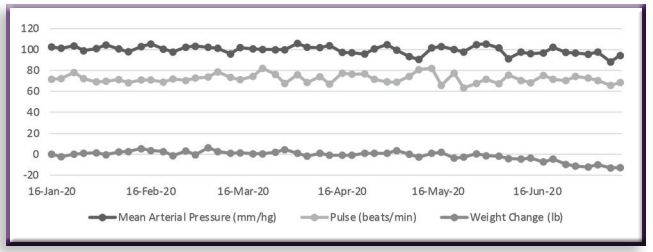


FIGURE 3 *The MAP, pulse, and weight change of the population plotted over the length of the scheduled 6-month deployment.*



depression symptoms in deployed personnel. The reported severity is mitigated towards the end of the deployment, but neither the presence of symptoms nor their reported severity return to baseline values. The presence of a time related effect on deployed members' mental health may allow for mitigation strategies based on time.

The personnel in this study were members of a medical team in a noncombat zone for a planned 6 months. While the team managed routine patient care and prepared for trauma, combat trauma casualties were not expected to occur. An additive effect of combat-related stress was less likely to be confounding factor. The findings in this study demonstrated that deployment alone has measurable, time-related psychological effects within this cohort. Since this is a small cohort, the relationship between deployment duration and mental health cannot yet be effectively generalized to other populations from this data. Shorter or longer deployments and different environments may reveal different trends. We theorize all deployment lengths would share a similar time–symptom curves of a deployment. Additionally, the preponderance of evidence demonstrates a significant mental health effect caused by combat stress during deployments.[6] We postulate that a different curve may appear within military units with frequent and severe stressors. Based on these data, though, the traumatic stress is likely exacerbating the underlying psychological and physiological effects of deployment duration itself.

The lack of a statistical effect of the combat casualty care event is notable. Stress is experienced differently by individuals. While some on the team may have experienced worsening symptoms, others on the team may have had reduced symptoms. The effects of the event may have been balanced within this cohort. Within a larger population, similar stressful events may have different results.

There is a well-described model of the "five emotional stages" of deployment, including predeployment, deployment, sustainment, redeployment, and postdeployment phases discussed in military counseling.[7,8] The predeployment stage is characterized by anticipation, time away from family, training, and a significant amount of uncertainty and anticipation that create stress. This is followed by the initial period of deployment, characterized by a new environment, new mission, team building, and feelings of disorientation and loneliness. In the sustainment phase, which is the bulk of the deployment, routines are established. During this time, independence, control, and patterns lead to some stability emotionally. The redeployment phase is typically in anticipation of coming home and is characterized by combination of excitement, apprehension, and instability. The postdeployment phase is supposed to be characterized by reestablishing the routines of home and work life outside of the plan environment. This data set looks primarily at the sustainment phase, which historically has been considered physiologically and psychologically static. Our data would indicate that this phase is in fact dynamic and that psychological stress progresses throughout this phase.

An interesting finding was depression symptom severity had a statistically significant decrease at the end of the deployment while the symptom presence did not. This finding may be important for postdeployment assessment accuracy.[9] First, deployers are likely continuing to have significant mental health symptoms from the previously described "redeployment" phase. The known reintegration stress encountered on return to their homes may exacerbate the present symptoms.[10] Second, if deployers returning from home perceive their symptoms to be insignificant, symptom reporting may be suppressed. This suppression may impact studies that have aimed to retrospectively determine a deployment affect.[11] Knowing the approximate peak of depression severity can allow targeted mental health improvement strategies at their peak. Ideally this would lower the peak effect, resulting in improvement in mental health both while deployed as well as leading to improved reintegration on return.

The PHQ-9 questionnaire is used frequently for depression screening, but the symptoms described in the questionnaire are nonspecific. Other psychiatric and somatic conditions may cause individual or multiple symptoms as described in the questionnaire. Even if another condition other than depression were causing the population to have increasing symptoms, the key finding is still that mental health deterioration is present and time dependent. Insomnia is associated with suicide alone, and other symptoms are common in mental health conditions associated with suicide.[12,13] A clear timeline of symptom development and severity in large, deployed populations may provide guidance as to when to efficiently intervene in deployed populations. Another limitation with repetitively questioning individuals is the possibility of response instability.[14] However, the authors believe that any individual inaccuracies from survey to survey are likely addressed by the number of surveys done over a prolonged period. This is similar to the concept that repetitive surveys for suicidal ideation may enable better prediction of suicide attempt.[15] More research is needed not only in measuring mental health during a deployment but also on what interventions have a clear benefit.

An individual's physiological findings varied over the course of a deployment. Statistical correlations between physiological

and psychological findings were not expected, as there has not been any strong evidence connecting chronic physiological findings and anxiety.[16] The only statistically significant finding was a diminishing MAP. Exercise equipment is often widely available and encouraged on military installations and may have contributed to this finding. A clear physiological finding that correlated with psychiatric symptom frequency or severity was not identified. A larger study of a population may identify other interesting deployment effects and be able to remove the confounder of improved physical fitness during deployment.

The COVID-19 pandemic began during this deployment and its effects would be reflected in the results. COVID-19 had a negligible direct effect within the area of the team during the time period. However, actions taken by the military to mitigate spread occurred during this period and may have had an effect.[17] The uncertainty of an unfolding pandemic, and the ability of other units to rotate into theater on time to replace them, may have contributed to the mental health symptom severity and frequency that may not be seen in other cohorts

The study data are from a limited population. The twice-weekly PHQ-9 survey proved to be an expedient and effective way of tracking symptoms but may not be an ideal method of serially tracking these data. A prospective study of a large, diverse population of currently deployed individuals would be beneficial in validating this study's findings and clarify any patterns. It would also better define the military mental health problem and illuminate why efforts to date have not been as effective as desired. During the course of data collection, important life events were not recorded by individuals. The single combat casualty care event was the only notable event that was known to have impacted all participants of the team. Life events impacting mental health and their clinical effects would an important measurement in future studies. Additional data points in any future study are preexisting conditions and demographics, which we anticipate impact the effect curve. Knowing the optimum timing of interventions with measured effects may allow for the efficient use of methods to improve resiliency, ameliorate the negative effects of deployment, or allow more ideal deployment planning. Finally, combat stress is a known risk factor for depression in deployed personnel. Within this specific group, there were possible stressors of combat casualty care, the COVID-19 pandemic, and more. The individual stressors were not recorded. However, with a small population, they may have played a significant part in the results.

Conclusion

Deployment time is related to depression symptom frequency and severity. Depression symptom severity statistically decreases at the end of deployment but does not reach baseline. A decrease in MAP is the only statistically significant physiological change identified in this population. Based on this research, mitigation strategies for depression symptoms should focus on reducing length of deployments, as well as measuring effectiveness and timing of targeted mental health therapies.

Author Contributions

AH conceived the study, collected data, and wrote the manuscript. IQ analyzed the data, RW and JG analyzed the data and provided critical revision. All authors read and approved the final manuscript.

Disclaimer

The opinions and assertions expressed herein are those of the author(s) and do not necessarily reflect the official policy or position of the Uniformed Services University of the Health Sciences or the Department of Defense.

Disclosures

No financial support was provided for this research. This research protocol was reviewed and approved by the Eglin Air Force Base Institutional Review Board (IRB) in accordance with all applicable Federal regulations governing human protections in research. This work was prepared by military or civilian employees of the US Government. The authors nor their family members have a financial interest in any commercial product, service, or as part of the individual's official duties. Therefore, it is in the public domain and does not possess copyright protection (public domain information may be freely distributed and copied; however, as a courtesy it is requested that the applicable institutions and the authors be given an appropriate acknowledgment).

Conflict of Interest

The authors have no conflicts of interest to report.

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The Special Operations Medical Association's Official Journal

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JOURNAL of SPECIAL OPERATIONS MEDICINE™

Fall 2021
Volume 21, Edition 3

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