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TITLE:

Risk Factors and Comorbidities of Eating Disorders in a Large Military Cohort

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14. ABSTRACT Given the capacity for eating disorders to significantly impact service member and family readiness, it is critical to understand which factors may confer increased risk for the development of eating disorders, as well as those that may precede or co-occur with eating disorders. This study analyzed longitudinal data from the Millennium Cohort Study and the Millennium Cohort Family Study to track service members and spouses for up to 15 years to address three main aims: 1) identify demographic, military, and behavior factors that are associated with the development of BN (Bulimia Nervosa), BED (Binge Eating Disorder), or OSFED (Other Specified Feeding and Eating Disorders) among service members, 2) determine the temporal relationship between eating disorders and comorbid conditions among service members, and 3) examine risk and protective factors for the development of BED among military spouses. Risk factors (Aim 1) that were significantly associated with increased risk for all three eating disorders among service members included active-duty component, serving in the Army, Marines or Navy, deployment with combat experience, feeling bothered by lack of social support, experiencing one or more stressful life events, and screening positive for probable PTSD, probable depression, or problem drinking. Experiencing a sexual assault was also a significant risk factor for BN and BED among service members. For comorbidities (Aim 2), bidirectionality between eating disorders and mental health disorders was consistently observed; however, the magnitude of these prospective associations varied by BED and BN. Specifically, mental health disorders more strongly predicted subsequent BED, whereas BN more strongly predicted subsequent mental health outcomes. Among spouses (Aim 3), factors significantly associated with higher likelihood of screening positive for probable BED at follow-up included screening positive for probable PTSD, reporting an adverse childhood experience, being a former smoker, and being married to a service member who either deployed and experienced combat or has not deployed, compared with service members who deployed and did not experience combat. These results highlight the need for targeted screening for eating disorders as well as interventions to improve coping skills and target mental health conditions among service members and military spouses, especially those experiencing stressful life events or those with low social support, to mitigate risk factors associated with eating disorders. Early detection and prevention of eating disorders and other mental health disorders may help to delay or avert the development of secondary conditions, reduce medical separations, and bolster coping skills among service members, veterans, and spouses; ultimately improving service member and family functioning and readiness.					
15. SUBJECT TERMS Eating Disorders, Bulimia, Binge Eating Disorder, Anorexia Nervosa, Service Members, Military, Veterans, Mental Health, Family, Spouses, Stressors, Prevalence					
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1. INTRODUCTION:

The prevalence of eating disorders (EDs) is higher in military personnel than in civilians. Despite the higher prevalence rates, estimates are inconsistent, risk factors for both military personnel and their families are not fully understood, and temporal patterns of comorbidity remain unclear. This research determined the prevalence of EDs among military personnel and examined risk factors for their onset and recurrence, especially military-specific exposures. It additionally described the patterns of comorbidity between EDs and other mental health conditions (e.g. PTSD, depression, and problem drinking), particularly regarding order of onset. Finally, it explored whether certain family system stressors, individual or relationship factors, are associated with EDs in military spouses. This study provides important information for the future development of prevention and treatment of eating disorders that will be helpful for military leadership and commands as well as mental health clinicians who care for military personnel and their families.

2. KEYWORDS:

Eating Disorders, Bulimia, Binge Eating Disorder, Anorexia Nervosa, Service Members, Military, Veterans, Mental Health, Family, Spouses, Stressors, Prevalence

3. ACCOMPLISHMENTS:

What were the major goals of the project?

The main goal of this proposal is to use a longitudinal cohort design to better understand prevalence rates, risk factors, and associated comorbidities in military personnel. The project work has been divided into 7 main tasks:

1. Complete and submit study proposal to Millennium Cohort's Scientific Committee for review and approval ... 100% completed, completed year one
2. Build analytic dataset using all panels and waves of available data (N = ~202,00) ... 100% completed, completed year one
3. Conduct analyses to determine prevalence and risk factors for BN, BED, and OSFED ... 100 percent completed, completed in years two and three
4. Conduct analyses to determine relationship between eating disorders and comorbid conditions ... 100 percent completed, completed in years two and three
5. Create analytic dataset (N = ~9800) ... 100% completed, completed year one
6. Perform analyses on risk and protective factors for BED and OSFED in military spouses ... 100 percent completed, completed year two
7. Prepare reports and manuscripts to disseminate research findings to appropriate end users ... 100 percent completed, completed year three

What was accomplished under these goals?

Aim 1: Determine the prevalence of BN and BED among military personnel and examine risk factors for their onset and recurrence, especially military-specific exposures.

For aim one we found that military factors significantly associated with increased risk for all EDs included active duty component (vs Reserve/Guard); serving in the Army, Marines, or Navy/Coast Guard (vs Air Force); and combat deployment (vs deployment without combat). Associated psychosocial factors included lack of social support, experiencing at least one life stressor, and screening positive for posttraumatic stress disorder or problem drinking. Detailed information on our methods and findings can be found in our appended paper titled: *“Risk and Protective Factors for the Development of Eating Disorders in a Large U.S. Military Cohort.”* Prevalence estimates for eating disorders among active-duty service members can be found in Table 1 of this paper. Table 2 of the paper shows the population characteristics for each probable eating disorder.

Additional paper for aim one: Although sex differences are noted in ED prevalence in military and civilian samples, mixed findings have emerged when evaluating racial and ethnic differences. This paper entitled, *“Racial and, Ethnic and Sex Differences in Eating Disorder Onset Among U.S. Military Service Members,”* examined independent associations and interactions between sex, race, ethnicity, and ED onset. Models showed main effects of female sex, non-Hispanic Black race, Multiracial race, and Hispanic ethnicity in BN onset. Interactions revealed higher odds of BN in Hispanic/Latinx compared to non-Hispanic/ Latinx White counterparts was driven by men. Interaction models further revealed that lower odds of BED in Black service members, relative to non-Hispanic or/ Latinx White counterparts, were more prominent in men than women. Please see additional details in our appended paper.

Aim 2: Describe the patterns of comorbidity between BN or BED and other mental health conditions over time (e.g. PTSD, depression, anxiety, and problem drinking) among military personnel.

For aim two we investigated temporal associations between EDs (BN, BED) and mental health (posttraumatic stress disorder, anxiety, depression, and problem drinking) using a cross-lagged panel model approach. Results indicated consistent bidirectional associations between most mental health disorders and EDs; however, the magnitude of these cross-lagged associations varied across BN and BED. Cross-lagged effects of mental health on subsequent BED were significantly stronger than BED to mental health cross-lagged effects. In contrast, cross-lagged effects of BN on subsequent mental health were stronger than mental health to BN. The appended paper *“Bidirectional Associations between Eating Disorders and Mental Health Among Military Service Members and Veterans”* includes detailed methods and findings.

Exploratory Aim 3: Determine whether certain family system stressors, individual factors, or relationship factors are associated with BED risk among military spouses.

For our exploratory third aim we found that spouses with probable posttraumatic stress disorder, adverse childhood experiences, or who were former smokers had increased risk of developing probable BED at follow-up. Spouses whose service member had a

deployment with combat exposure, or had not deployed, had higher risk of probable BED than spouses whose service member deployed without combat exposure. Older age appeared to be a protective factor against the development of probable BED among military spouses. The results are outlined further in the attached appended paper titled: *“Risk and Protective Factors for the Development of Probable Binge Eating Disorder in US Military Spouses: Findings From the Millennium Cohort Family Study.”* Table one of this paper shows characteristics of patients with probable binge eating disorder and Table two shows unadjusted and adjusted odds ratios for the development of probable binge eating disorder by spouse and service member characteristics.

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

Nothing to report.

How were the results disseminated to communities of interest?

We wrote four papers for this grant, all of which are currently under review. We will present a poster on all three papers to the military community at the 2023 Military Health System Research Symposium (MHSRS) conference. We also submitted a presentation to the International Society of Traumatic Stress Studies (ISTSS) conference and are waiting to hear back. Later this year we will submit another conference presentation that will disseminate our findings to the eating disorder community as well.

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

Study is complete.

4. IMPACT:

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

Through our papers under review for publication and our conferences presentations we plan to make the DoD, VA, mental health community, and the eating disorders community aware of the importance of targeted screening and treatment for eating disorders and related mental health issues. We will also continue to emphasize the importance of tracking mental health conditions that confer greater risk for the development of eating disorders.

What was the impact on other disciplines?

In addition to public health and mental health, our findings have important implications for DoD and VA leadership, given that eating disorders are associated with multiple functional problems and healthcare costs for service members, Veterans and spouses. We plan to disseminate these results to leadership as well (see transition plan).

What was the impact on technology transfer?

Nothing to report.

What was the impact on society beyond science and technology?

Our results highlight the crucial need for targeted eating disorder screening, and increased treatment for eating disorders and associated mental health stressors and disorders. We also identified the mental health conditions that are most commonly associated with eating disorder development (BED), and vice versa, the type of eating disorder (BN) that confers greatest risk for subsequent mental health issues. Knowing that there is an additional risk for eating disorder development in those with pre-existing mental health conditions is imperative as it can guide earlier targeted screening and identification of eating disorders, which can lead to more timely and effective treatment.

5. CHANGES/PROBLEMS:

Changes in approach and reasons for change

We added analyses looking at the intersectionality of race, ethnicity, and gender on eating disorder development. This helped us achieve Aim 1 (determining eating disorder risk factors) and was an additional analysis that we executed to complement our existing Aim 1 paper. These additional analyses went above and beyond our original aim to expand our understanding of the demographic factors of sex and race and ethnicity by examining the intersectionality of these two factors.

Actual or anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that had a significant impact on expenditures

Nothing to report.

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

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use of biohazards and/or select agents

Nothing to report.

6. PRODUCTS:

- **Publications, conference papers, and presentations**

Journal publications.

Ray, T.N., Esquivel, A.P., McMaster, H.S., Jacobson, I. G., & Maguen, S. Risk and Protective Factors for the Development of Probable Binge Eating Disorder in US Military Spouses: Findings From the Millennium Cohort Family Study. Under review.

Sharifian, N., Ray, T.N., Jacobson, I. G., Klimek-Johnson, P., McMaster, H.S., Geronimo-Hara, T.R., Rull, R.P., & Maguen, S. Bidirectional Associations between Eating Disorders and Mental Health Among Military Service Members and Veterans. Under review.

Jacobson, I. G., Geronimo-Hara, T.R., Sharifian, N., McMaster, H.S., Mehlman, H., Rull, R.P., Maguen, S. Risk and Protective Factors for the Development of Eating Disorders in a Large U.S. Military Cohort. Under review.

Klimek-Johnson, P., Jacobson, I. G., Geronimo-Hara, T. R., Sharifian, N., McMaster, H. S., Rull, R. P., & Maguen, S. (in preparation). Racial, Ethnic and Sex Differences in Eating Disorder Onset Among U.S. Military Service Members. *American Journal of Epidemiology*.

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

Nothing to report.

Other publications, conference papers and presentations.

Ray, T.N., McMaster, H.S., Esquivel, A., Jacobson, I.G., & Maguen, S. (2022, September). Predictors of probable binge eating disorder among active duty military spouses. Poster accepted for presentation at the Military Health System Research Symposium 2022 Annual Meeting, Kissimmee, Florida.

Jacobson, I.G., Sharifian, N., McMaster, H.S., Ray, T.N., Geronimo-Hara, T.R., Esquivel, A., Klimek-Johnson, P., Mehlman, H., Rull, R.P. Risk factors and comorbidities for eating disorders among military service members and their spouses. Poster accepted to be presented at the Military Health System Research Symposium 2023 Annual Meeting, Kissimmee, Florida.

- **Website(s) or other Internet site(s)**

Nothing to report.

- **Technologies or techniques**

Nothing to report.

- **Inventions, patent applications, and/or licenses**

Nothing to report.

- **Other Products**

Nothing to report.

7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Name: Shira Maguen

Project Role: Principal Investigator, San Francisco VAMC

Nearest person month worked: 4.7

Contribution to Project: Dr. Maguen has provided coordination, oversight, and management of all tasks outlined in the research plan, working closely with her co-investigators. She was involved in all four manuscripts reviewed in this report, working closely with all co-authors on publications and presentations.

Name: Rudy Rull

Project Role: Principal Investigator of the Millennium Cohort Study, Naval Health Research Center

Nearest person month worked: 1.8

Contribution to Project: As PI of the Millennium Cohort Study, Dr. Rull is responsible implementation and compliance, ensuring that all NHRC personnel are properly trained and qualified, data interpretation, and the publication and dissemination of study findings.

Name: Isabel Jacobson

Project Role: Co-Investigator

Nearest person month worked: 6

Contribution to Project: Ms. Jacobson is responsible for assisting with the design of the study, data interpretation, and scientific manuscript preparation, as well as assisting with the statistical analyses.

Name: Hope McMaster

Project Role: Co-Investigator

Nearest person month worked: 1.8

Contribution to Project: Dr. McMaster is responsible for overseeing the execution of the exploratory aim for this project, consisting of evaluating risk factors for the development of binge eating disorders in military spouses. In addition, she will be integral in drafting the manuscript related to the Family Study exploratory aim.

Name: Travis Ray

Project Role: Data Analyst

Nearest person month worked: 6

Contribution to Project: Mr. Ray provides analytic and writing support.

Name: Neika Sharifian

Project Role: Co-Investigator

Nearest person month worked: 6

Contribution to Project: Dr. Sharifian is responsible for analyses specific to examining the temporal sequence of eating disorders in relation to other mental health disorders. She is also responsible for checking code of other analysts on the project, and writing reports and scientific manuscripts for peer-reviewed professional journals and presentations.

Name: Toni Rose Geronimo-Hara

Project Role: Data Analyst

Nearest person month worked: 4

Contribution to Project: Ms. Geronimo-Hara provides statistical and analytical support, assists in processing and maintenance of research databases; and will assist in writing of reports and scientific manuscripts for peer-reviewed professional journals and presentations.

Name: Alex Esquivel

Project Role: Data Analyst

Nearest person month worked: 4.2

Contribution to Project: Mr. Esquivel provides statistical and analytical support, assists in processing and maintenance of research databases; and assists in writing of reports and scientific manuscripts for peer-reviewed professional journals and presentations.

Name: Gia Gumbs

Project Role: Data Analyst/Study Coordinator

Nearest person month worked: 1.2

Contribution to Project: Ms. Gumbs is responsible for assisting with coordinating data management. In addition, she is responsible for arranging meetings, teleconferences, and other communication necessary for the project. She also assists with filing of documents and other files related to manuscript planning, writing, and submission.

Name: Haley Mehlman

Project Role: Study Coordinator

Nearest person month worked: 6

Contribution to Project: Ms. Mehlman is responsible for multiple administrative aspects of the project. She is responsible for arranging meetings, teleconferences, and other communication necessary for the project. She also assists with maintaining the IRB, assisting with reports, and tracking important project deadlines.

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

Dr. Maguen received VA funding for a clinical trial of Brief Behavioral Treatment for Insomnia in Veterans with PTSD. There is no overlap with this grant.

What other organizations were involved as partners?

Nothing to report.

8. SPECIAL REPORTING REQUIREMENTS

Award Charts: Please see attachments.

9. APPENDICES:

Publications: Please see four journal articles in the appendices (3 under review, 1 in preparation).