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The Impact of COVID-19 on Health Behavior Engagement and Psychological and Physical Health Among Active Duty Military Enrolled in a Weight Management Intervention: An Exploratory Study

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ABSTRACT

Introduction:

The COVID-19 pandemic profoundly affected the health and well-being of people globally. Some studies suggest individuals with overweight or obesity may have been more adversely impacted by pandemic restrictions. Additionally, military personnel may have been more vulnerable to stress during the pandemic because of job demands (e.g., work in close quarters). Our research group was conducting a randomized clinical trial of a weight management intervention in active duty military personnel with overweight or obesity when the COVID-19 pandemic struck. Thus, we collected additional pandemic-related data from participants enrolled during the COVID-19 pandemic and conducted exploratory analyses to understand how the pandemic affected their stress levels and perceived abilities to engage in health behaviors like exercise and healthy eating. The aims of this exploratory study were to: (1) assess associations between pandemic-related stress and health behaviors with body fat percentage (BF%) and psychological and physical health, and (2) explore how pandemic-related stress and health behaviors affected BF% during and after the intervention.

Materials and Methods:

A total of 29 active duty Navy personnel (55% female, 69% White) were enrolled after the onset of pandemic restrictions and completed measures assessing pandemic-related stress and health behaviors as well as measures of general psychological and physical health before the intervention. BF% was collected at 5 timepoints, including baseline, during, and following the intervention. Bivariate correlations assessed associations at baseline. Linearmixed-effects longitudinal models explored how pandemic-related stress and health behaviors affected BF%. Post-hoc analyses evaluated the effects of pandemic factors on BF% at each timepoint.

Results:

Most participants perceived of the pandemic as increasing stress and detracting from their abilities to engage in health behaviors (i.e., exercise and healthy eating). Higher pandemic stress was significantly associated with reporting exercise and healthy eating as more difficult, worse overall health, and more anxiety and general stress. Reporting exercise as harder during the pandemic also was associated with more psychological distress at baseline. A linearmixed- effects model controlling for age, sex, and number of intervention sessions attended revealed endorsing "exercise as harder" was associated with higher BF%. Post-hoc regression analyses revealed rating "exercise as harder" significantly predicted higher BF% 3 months post-intervention ($B = 0.65$, $P = .01$), whereas pandemic stress was not significantly associated with higher BF% at 3 month ($B = 0.14$, $P = .08$) or 6 month ($B = 0.21$, $P = .09$) follow-up.

Conclusions:

As expected, most participants perceived of the pandemic as heightening stress and interfering with engagement in health behaviors. It is possible that pandemic-related stress may have exacerbated weight gain-promoting behaviors and/or interfered with achievement of desired weight management outcomes. Outside the context of the pandemic, it may be beneficial for healthcare providers to screen individuals for stress and perceptions of ease of engagement in health behaviors before enrollment in a weight management intervention. Further, tailoring interventions to mitigate stress and promote perceptions of ease in engaging in health behaviors may promote better weight management outcomes.

INTRODUCTION

The COVID-19 pandemic profoundly affected healthcare systems, the economy, social networks, and the health and well-being of individuals. Although some individuals reported increased stress and worsening mental and physical health through the pandemic,[1] others experienced no significant or

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lasting changes to mental or physical health.[2] Further, the pandemic appeared to have heterogenous effects on body composition and health behaviors like physical activity and healthy eating. Globally, approximately 20% of adults reported weight loss, whereas 50% reported weight gain during the first months of the COVID-19 pandemic. Weight gain during the early months of the pandemic was associated with increased food consumption and decreased physical activity.[3]

Weight status is a potential differentiator, such that individuals with overweight (OW) or obesity (OB) fared worse in terms of mental and physical health and were more likely to gain weight during the pandemic compared to those without OW/OB.[4–7] People's experiences of the pandemic appeared to influence their engagement in health behaviors (e.g., physical activity and healthy eating), which likely contributed to changes in body composition. Engaging in physical activity during the pandemic was associated with fewer mental health symptoms[8] and less weight gain[9] during the first year of the pandemic. However, increased stress related to the pandemic and pandemic restrictions (e.g., stay-at-home orders, fitness facility closures) may have interfered with engagement in physical activity for some.[10] In fact, researchers detected greater declines in engagement in physical activity for individuals with OB as compared to healthy-weight peers.[11] The pandemic also appeared to have varied effects on eating behaviors, which partially explained changes in weight.[5] For some, pandemic restrictions limited access to healthy foods, whereas for others, stay-at-home orders contributed to cooking more frequently and eating smaller portion sizes.[5,12] Individuals with OB appeared significantly more likely than their healthy-weight peers to report increased processed food intake and decreased fruit and vegetable consumption during the pandemic.[11]

Of those individuals with OW/OB enrolled in behavioral weight management programs during the pandemic, many reported increased difficulty engaging in weight management efforts (e.g., healthy eating and physical activity) because of pandemic-related stress.[5,13] On the other hand, one study found that participants reported greater dietary adherence and lost more weight than participants enrolled pre-pandemic.[14] Altogether, research suggests individuals with OW/OB were likely to be disproportionately affected by pandemic stressors; however, some of those enrolled in behavioral weight management programs may have been protected from the negative health behavior and weight-related effects of the pandemic because of access to treatment. Understanding factors associated with better outcomes in behavioral weight management programs during prolonged stressors, like the COVID-19 pandemic, can inform the development of future interventions that target the needs of this population.

Active duty military personnel enrolled in weight management interventions may be particularly motivated to lose weight to stay within established weight standards and maintain active duty status. On the other hand, active duty military personnel also may be more likely to experience pandemic-related stress because of job demands (e.g., living in close quarters) or changes in their work environments and other pandemic-related changes to their daily lives. To our knowledge, no studies have examined perceptions of COVID-19 pandemic-related stress and health behavior change in active duty military personnel in a weight management program. In March 2020, our research group conducted a clinical trial of a behavioral weight management intervention (including encouragement of physical activity, nutrition, and other behavioral changes in line with weight loss) with active duty military personnel.[15] As we transitioned the trial to virtual participation during the COVID-19 pandemic restrictions, we had the opportunity to query those participants who enrolled in the program after the initiation of the pandemic restrictions about their pandemic-related stress and health behaviors.[16] Using these data collected from active duty service members (SMs) in the first year of the COVID-19 pandemic, the aims of this exploratory study were to: (1) assess the associations between pandemic-related stress and health behaviors with body fat percentage (BF%) and psychological and physical health at baseline, and (2) explore how pandemic-related stress and health behaviors affected BF% during and after the intervention. We hypothesized that at baseline, endorsing high pandemic stress and reporting exercise and healthy eating as harder during the pandemic would be significantly positively associated with each other and with psychological distress (i.e., general stress, depressive symptoms, anxiety symptoms) and body composition (i.e., BF%) and significantly negatively associated with overall health. We also expected that higher levels of pandemic stress and reported difficulties engaging in exercise and healthy eating at baseline would be associated with worse intervention outcomes in the form of less BF% loss.

METHODS

Participants and Procedures

A total of 29 Navy SMs with OW/OB or who had failed or were at risk of failing the Physical Fitness Assessment were enrolled in the clinical trial after the onset of the pandemic restrictions. The design of the clinical trial, interventions used, and the transitions made during the pandemic are provided in detail elsewhere.[15,16] Baseline assessment included measures of demographic characteristics and BF%, psychological distress, and health as well as an investigator-created questionnaire about pandemic-related stress and health behaviors. BF% was also measured at the end of the 8-week intervention and at 3- and 6-month follow-ups. Study procedures were approved by the Institutional Review Board of VA San Diego Healthcare System, Navy Medicine Readi-ness and Training Command, San Diego, and the Research and Development Committee of VA San Diego HealthcareSystem and participants provided written informed consent.

Measures

Sociodemographic characteristics

Participants self-reported sociodemographic characteristics and military service details.

Body composition

Body fat percentage (BF%) was obtained using the Navy body fat calculator[17] using height, waist circumference, and neck circumference for men and height, waist circumference, hip circumference, and neck circumference for women.

Psychological distress and health

The 4-item Perceived Stress Scale[18] was used to assess stress, with higher scores indicating higher stress. The Patient Health Questionnaire 4-item Scale[19] was used to screen for depression and anxiety symptoms, where higher scores indicate a greater probability of depression and anxiety, respectively. Item one of the 12-item Short Form Health Survey (SF-12) was used to ask individuals to rate their general health on a scale ranging from excellent to poor; this is a commonly used single-item measure of overall health.[20]

Pandemic-related stress and health behaviors

The impact of COVID-19 on stress and health behaviors was assessed using a questionnaire created by the investigators based on others developed during the pandemic.[21] Participants were asked to respond to the following items as part of this COVID-19 pandemic impact questionnaire: "The Coronavirus pandemic has made exercising: "a lot easier" (5), "a little easier"(4), "not easier or harder"(3), "a little harder"(2), "or a lot harder"(1); "The Coronavirus pandemic has made eating healthy: "a lot better"(5), "a little better"(4), "not better or worse"(3), "a little worse"(2), or "a lot worse"(1); and "Overall, how much did changes you had to make because of Coronavirus (e.g., in your childcare, your work hours, how you exercise, or what you did for fun, etc.) impact your daily stress level: "a lot less stress" (1), "a little less stress" (2), "no change in stress" (3), "a little more stress" (4), and "a lot more stress" (5). The three items were scored continuously. The exercise and healthy eating variables were reverse-coded such that higher values represent perceptions of each behavior as harder.

Statistical Analyses

All analyses were conducted using SPSS v28. Bivariate correlations assessed associations at baseline. Linearmixed-effects models explored the longitudinal effects of pandemic-related stress and health behaviors on BF%. Because BF% differed by sex, sex was included as a covariate in longitudinal analyses in addition to age. The number of treatment sessions attended (M = 6.17, SD = 2.28) was also included as a covariate in longitudinal analyses to account for potential differences in BF% as a result of intervention participation. Post-hoc linear regression models evaluated the effects of pandemic factors on BF% at each timepoint of the intervention, controlling for baseline BF%. Missing data were handled using pairwise deletion. The statistical significance criterion was set at $< .05$.

RESULTS

The sample included 29 SMs with an average age of 33.83 years (SD = 6.64) and an average body mass index of 34.10 (SD = 3.86). Most participants were White (69%) and female (55%). At baseline, 15% of participants reported exercise as a little or a lot easier as a result of the pandemic, 7% reported no change, and 77% reported exercise as a little or a lot harder. At baseline, 11% reported healthy eating as a little or a lot easier, 30% reported no change, and 59% reported healthy eating as a little or a lot harder. At baseline, 8% reported a little or a lot less stress, 12% reported no change, and 80% reported a little or a lot more stress.

Bivariate correlations, means, and standard deviations of study variables at baseline are shown in Table I. Reports of more difficulty exercising as a result of the pandemic were associated with reports of greater difficulty with healthy eating and more pandemic-related stress as well as higher levels of general stress, depressive symptoms, and BF%. Reports of greater difficulty with healthy eating because of the pandemic were associated with worse overall health and higher levels of pandemic-related stress. Reports of more pandemic-related stress were associated with more general stress and anxiety and worse overall health.

Results from the linear mixed-effects model to explore the effects of pandemic stress and health behaviors on BF% over the course of the study, controlling for age, sex, and number of intervention sessions attended, revealed significant effects of sex, age, time, and exercise on BF%. Time was significantly associated with BF% at week 8 ($\beta = 2.26$, SE = 0.47, $P < .001$) and 6-month follow-up ($\beta = -3.04$, SE = 0.89, $P = .002$). Perceiving exercise as a lot harder ($\beta = 7.87$, SE = 1.70, $P < .001$) and as a little harder ($\beta = 7.19$, SE = 1.70, $P = .001$) during the pandemic were significantly associated with higher BF% (see Table II for means at each timepoint). Perceiving healthy eating as harder during the pandemic and pandemic stress was not significantly associated with BF%. Number of intervention sessions attended was also not significantly associated with BF%.

Because of the small sample size, a linear mixed-effects model including interaction terms between time and pandemic factors did not converge. Thus, post-hoc regression analyses were conducted to explore the effects of pandemic factors (i.e., stress, eating, and exercise) on BF% at each intervention time point, controlling for baseline BF%. Rating exercise as harder at baseline significantly predicted higher BF% at 3 month follow-up ($\beta = 0.65$, SE = 0.22, $P = .01$) but did not predict BF% at any other timepoint. Pandemic stress

TABLE I. Bivariate Correlations and Descriptive Statistics of Study Variables at Baseline

	Pandemic factors				Psychological distress and health				
	Age	**Exercise difficult**	**Healthy eating difficult**	**Pandemic stress**	**BF%**	**Overall health**	**Stress**	**Anxiety**	**Depression**
Age	–								
Exercise difficult	0.17	–							
Healthy eating difficult	0.17	0.41*	–						
Pandemic stress	−0.14	0.40*	0.49*	–					
Body Fat %	−0.11	0.42*	0.17	0.24	–				
Overall health	−0.30	−0.29	−0.44*	−0.47*	−0.39*	–			
Stress	−0.13	0.40*	0.06	0.40*	0.39*	−0.49**	–		
Anxiety	−0.06	0.32	0.26	0.47*	0.38*	−0.53**	0.68**	–	
Depression	−0.06	0.47*	0.09	0.23	0.31	−0.54**	0.82**	0.57**	–
Mean	33.83	4.00	3.67	4.23	37.35	2.41	6.83	2.28	1.76
SD	6.64	1.24	0.92	0.95	10.13	0.87	3.11	1.83	1.68

*P <.05,
**P <.01, $n = 29$.

TABLE II. Mean BF% at Each Timepoint of the Study by Rating of Perceived Difficulty Exercising During the Pandemic

BF%	**Exercise as a lot harder ($n = 12$) M (*SE*)**	**Exercise as a little harder ($n = 9$) M (*SE*)**	**No change in exercise ease ($n = 2$) M (*SE*)**	**Exercise as a little easier ($n = 2$) M (*SE*)**	**Exercise as a lot easier ($n = 2$) M (*SE*)**
Baseline	39.40 (0.73)	36.68 (0.62)	33.95 (0.72)	31.23 (0.97)	28.51 (1.29)
4 weeks	38.29 (0.65)	35.56 (0.51)	32.84 (0.63)	30.12 (0.90)	27.39 (1.24)
8 weeks	37.17 (0.60)	34.45 (0.44)	31.73 (0.57)	29.00 (0.86)	26.28 (1.21)
3-month follow-up	36.06 (0.59)	33.33 (0.43)	30.61 (0.56)	27.89 (0.85)	25.17 (1.20)
6-month follow-up	34.94 (0.64)	32.22 (0.48)	29.50 (0.59)	26.77 (0.88)	24.05 (1.21)

M = Mean, *SE* = Standard Error.

at baseline did not significantly predict higher BF% at 3-month ($\beta = 0.14$, $P = .08$) and 6-month ($\beta = 0.21$, $P = .09$) follow-up.

DISCUSSION

The overarching objective of this exploratory study was to understand how the COVID-19 pandemic affected active duty military SMs' perceived ability to engage in health behaviors and changes in their body composition during a behavioral weight management intervention. Most participants perceived the pandemic as increasing stress and detracting from their ability to engage in health behaviors (i.e., exercise and healthy eating). Consistent with our first hypothesis, higher pandemic stress was significantly associated with reporting exercise and healthy eating as more difficult, worse overall health, and more anxiety and general stress. Like previous studies,[5,13] reporting exercise as harder during the pandemic was also associated with more psychological distress among participants at baseline. Psychological distress may have interfered with SMs' engagement in physical activity and other weight management behaviors, perhaps exacerbating weight gain-promoting behaviors (e.g., emotional eating). Contrary to our first hypothesis, reporting healthy eating as harder at baseline was not significantly associated with BF%, although it was significantly positively associated with pandemic stress. It is possible that reporting difficulty with healthy eating does not translate to lower levels of engagement in healthy eating and thus might not affect BF% in this population.

We also explored the impact of pandemic stress and health behavior engagement on BF%. Consistent with our hypothesis, rating exercise as harder because of the pandemic was associated with higher BF% at baseline and significantly less change in BF% 3 months after the weight management intervention. It may be that individuals' perception of exercise as harder translated into reduced engagement in physical activity, which impeded BF% loss. Perception of exercise as harder was also associated with psychological distress, which may have interfered with engagement in the intervention and associated health behaviors (i.e., exercise). The results of this study align with previous research suggesting engagement in physical activity early in the pandemic supported mental health and weight maintenance or loss,[8,9,12] as participants who reported exercise as easier lost significantly more BF%. Unlike previous studies,[5,13] we did not find a significant association between pandemic stress and BF% at baseline. However, pandemic stress was significantly associated with

general stress and anxiety and perceiving exercise and healthy eating as harder during the pandemic. Based on previous studies, we expected high pandemic stress might impede engagement in health behaviors (i.e., exercise and healthy eating) and achievement of desired weight management outcomes; however, results were not significant at 3 or 6 month follow-up, possibly because of low power. Somewhat surprisingly, greater difficulty with healthy eating was not significantly associated with BF% outcomes.

Thus, we found that, for a minority of participants, COVID-19 restrictions facilitated engagement in health behaviors like exercise, which enhanced BF% loss. However, for most participants, the pandemic exacerbated stress, which may have interfered with weight management efforts and outcomes. Outside the context of the pandemic, it may be beneficial to inquire about individuals' perceived ease of engaging in exercise and stress before commencing a behavioral weight management intervention as these perceptions might influence outcomes. Targeting behavioral weight management interventions to those individuals who report greater ease of engagement in exercise at the time they begin an intervention may optimize intervention outcomes. On the other hand, for individuals experiencing higher levels of stress, implementing stress management interventions prior to weight management enrollment may promote better outcomes.

Strengths of the current study include the unique sample of active duty SMs enrolled in a weight management intervention during the COVID-19 pandemic and the longitudinal design. Research on the effects of prolonged stressors, like the COVID-19 pandemic, on health, health behaviors, and body composition during the course of an intervention is limited, and the results of the current study may contribute to our understanding of the heterogenous effects of the pandemic on health behaviors and weight management intervention outcomes. Nonetheless, there are several limitations. First, the sample size for this study was small because of the unique timeline the COVID-19 pandemic presented. As this study involved exploratory analyses of a sample collected as part of an ongoing study when the COVID-19 pandemic began, the study was not designed to be fully powered to detect effects but rather to offer preliminary insights. Despite this shortcoming, this study is the first to report on associations between health behaviors and stress in active duty SMs during the pandemic. Second, the novel measure of COVID-19 pandemic impact was not validated, again because of the unique COVID-19 pandemic circumstances. Results of this study need to be replicated with larger samples and in the context of other stressors and more robust measures. Third, there was limited variability in participants' reports of changes in their health behaviors and stress as a result of the pandemic. However, this limited variability did not preclude detecting some significant results. Perhaps a larger sample would have allowed for greater variability and power to detect additional significant patterns. Finally, we did not comprehensively measure potential sources of stress, correlates of health behavior engagement, or practical barriers to engaging in health behaviors, thus we do not know why participants rated stress as higher or exercise and healthy eating as harder. Variables like baseline fitness level, deployments, occupation, neighborhood, access to fitness facilities, and access to healthy food options should be assessed in future studies to better understand potential impediments to and facilitators of success in weight management interventions.

In sum, this exploratory study with a unique sample of active duty SMs adds to the limited literature on how individuals perceived the COVID-19 pandemic affecting stress and health behaviors related to weight management as well as body composition outcomes (i.e., BF% change). Results suggest that, for some, the pandemic made exercising and eating healthy easier, and reporting exercise as easier at baseline predicted greater BF% loss following the weight management intervention. On the other hand, the pandemic increased stress for many, and increased stress at baseline was associated with worse physical and psychological health and more perceived difficulty engaging in health behaviors. These results highlight the importance of screening for stress and perceptions of ease of engagement in health behaviors prior to a weight management intervention and tailoring interventions to mitigate stress and promote perceptions of ease in engaging in health behaviors.

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CLINICAL TRIAL REGISTRATION

NCT01757847.

INSTITUTIONAL REVIEW BOARD (HUMAN SUBJECTS)

All study procedures were approved by the Institutional Review Boards of VA San Diego Healthcare System, Navy Medicine Readiness and Training Command, San Diego, and the Research and Development Committee of VA San Diego Healthcare System.

INSTITUTIONAL ANIMAL CARE AND USE COMMITTEE (IACUC)

Not applicable.

INDIVIDUAL AUTHOR CONTRIBUTION STATEMENT

J.L.M. contributed to study conception and design, formal analysis, interpretation of results, and writing of original draft. J.S.W. and M.S.H. contributed to interpretation of results and editing. N.A. contributed to securing funding, data collection, conceptualization, interpretation of results, and editing. All authors read and approved the final manuscript.

INSTITUTIONAL CLEARANCE

Does not apply.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author.

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