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# UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

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## THESIS APPROVAL PAGE FOR MASTER OF SCIENCE IN ORAL BIOLOGY

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COVID-19 PANDEMIC AND PERCEIVED STRESS OF MILITARY DENTAL  
POSTGRADUATE RESIDENTS

by

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A thesis submitted to the Faculty of the  
Comprehensive Dentistry Graduate Program  
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Uniformed Services University of the Health Sciences  
In partial fulfillment of the requirements for the degree of  
Master of Science  
in Oral Biology  
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## **DEDICATION**

To my beautiful wife, Jackie and wonderful son, Samuel whose support, encouragement and unconditional love made this endeavor possible.

## **DISCLAIMER**

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# ABSTRACT

Covid-19 Pandemic and Perceived Stress of Military Dental Postgraduate Residents

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**Introduction:** Stress can be a positive stimulant that improves focus and cognitive function fostering learning and growth. However, when the stresses exceed a person's abilities to manage and cope in a healthy manner, they become detrimental and potentially debilitating. Whether perceived or physiologic, stress can manifest as depression, anxiety, hostility, and medical errors. Multiple studies have focused on medical residency stressors, very few have focused on dental residents and fewer examining the unique stressors of COVID-19 pandemic. **Objective:** This objectives of this study were to determine the impact of COVID-19 on the perceived stress of residents of a military graduate dental residency program and explore the correlation between the resident's perceived stress and reported measures of anxiety, depression, sleep quality and social support. **Methods:** From June 2017 through June 2021, 20 residents of NPDS were enrolled in this study. With the onset of COVID-19 pandemic, the study was re-focused on January 2020 through June 2021 and the perceived stress of the subjects. Quarterly the subjects would complete self-assessments consisting of the following: Generalized Anxiety Disorder (GAD-7), Patient Health Questionnaire-9 (PHQ-9), Perceived Stress Scale (PSS), Fatigue Symptom

Inventory (FSI) and Duke-Social Support Questionnaire (DUKE-SSQ). **Results:** 12 subjects (60%) scored a PSS>13 which indicates moderate to high perceived stress and had higher GAD, PHQ and FSI scores with lower DUKE-SSQ scores compared to the lower PSS subjects (<13).

**Conclusions:** Over the course of the pandemic, the higher perceived stress subjects had greater reactivity in their self-assessment scores. Higher DUKE-SSQ scores appear to have an inverse relationship with perceived stress levels and possibly a buffering effect to minimize reactivity to changes in stressor levels and intensity. These findings suggest that post-graduate dental training programs should develop social support programs to reduce the perceived stress and increase the mental health of their residents.

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## LIST OF ABBREVIATIONS

PS	Perceived Stress
PSS	Perceived Stress Scale
GAD	Generalized Anxiety Disorder
FSI	Fatigue Symptom Inventory
ISI	Insomnia Severity Index
DUKE-SSQ	DUKE Social Support Questionnaire
SD	Standard Deviations
PPE	Personal Protective Equipment
COVID-19	Coronavirus Disease of 2019
NPDS	Naval Postgraduate Dental School
WRNMC	Walter Reed National Medical Center
IRB	Institutional Review Board
DNA	Deoxyribonucleic Acid
SD	Standard Deviations

## CHAPTER 1: Introduction

The COVID-19 pandemic has exerted tremendous, often devastating effects on every corner of the globe. No facet of human existence has not been impacted; from the sheer loss of life to forced isolations and quarantines of our decidedly socially-driven species. Education, in particular, graduate-level medical sciences residency training faced significant challenges to both their curriculums and their residents. A 2021 scoping review of 135 articles on the impact of COVID-19 on dental education found the issues of stress and psychological effects on residents was a common thread (Farrokhi, 2021). An already mentally and emotionally demanding residency life has faced almost unprecedented levels of stress and uncertainty. The effects of the varied stressors exerted by the pandemic on resident's life demands examination.

Stress can be described as any external strain or pressure placed upon an individual that elicits an emotional, physical, or psychological response. Perceived Stress has been defined as the degree to which events in a person's life are assessed as stressful, unpredictable and uncontrollable (Cohen et al, 1983) or the extent to which a person appraises that the demands being placed upon them exceed their ability to cope with those demands. Stress, in the right proportions and frequency, can be a positive stimulant that improves focus and cognitive function fostering learning and growth (Rudland 2020). However, when the stresses exceed a person's abilities to manage and cope in an appropriate and healthy manner, they become detrimental and potentially debilitating. Whether perceived or physiologic, stress can manifest as depression, anxiety, hostility, and medical errors (Raimo 2018). While stress, perceived stress and possible mitigating strategies have been extensively studied in undergraduate health science programs,

medical residencies and practicing health care providers since the 1970s, only a small percentage have examined the stresses inherent in post-graduate dental residency programs and possible mitigators to those stressors. Additionally, the study of the unique stresses of residency training and their impacts on residents during the COVID-19 pandemic is still in its infancy.

The original intent of this study was to gather psychological data on the residents at the Naval Postgraduate Dental School (NPDS) over a three year period starting in 2018. However, the onset of the COVID-19 pandemic and with the unique baseline pre-pandemic dataset already captured, the focus of the research was shifted to measuring the effects of COVID-19 on the Perceived Stress (PS) of NPDS residents from March 2020 through June 2021. The influence of several covariates, including anxiety, depression, fatigue, sleep quality and social support on PS were explored via self-report assessments. Given this new focus, two unique aims were developed:

AIMS:

- 1) Determine the impact of COVID-19 on the Perceived Stress of residents of a military graduate dental residency program.
- 2) Explore the association between the resident's Perceived Stress and self-reported measures of depression, anxiety, sleep quality, fatigue and social support.

Based upon recently published similar studies looking at the impact of COVID-19 on civilian post-doctoral medical and dental programs (Huntley et al (2020), Chew et al (2020), Rana et al (2020) and our own observations of our unique military environment,

two separate working hypotheses were developed. First, all residents will report and present with an increase in perceived stress during the COVID-19 pandemic. Secondly, it is expected that those residents identified as experiencing high Perceived Stress will demonstrate higher levels of depression, anxiety and fatigue and lower levels of sleep quality and social support relative to their low PS counterparts.

## **REVIEW OF LITERATURE**

Post-graduate residency training in the health sciences can be the most stressful period in any resident's life and no residency training has been studied more thoroughly than that of a medical physician. For hundreds of years, medical residency was expected (maybe even required) to be excessively demanding and stress, fatigue, sleep deprivation and even burnout were considered normal sequela of a resident's journey through their training program. (Butterfield, 1988).

A study in 2002 illustrated a higher incidence of depression, anger and hostility in medical residents when compared to similar age groups in the general population (Collier, 2002). A more recent study in 2017 surveyed general surgery residents and found that 28% reported weekly feelings of emotional exhaustion and one in seven considered leaving their residency at least once a week (Shapiro, 2017). However, some studies have shown that dental residents may experience more stress and burnout than their medical counterparts (Birks et al., 2009 & Schmitter 2008). A study on Greek dental residents by Divaris et al. in 2011, found overall rates of emotional exhaustion was 40%, decreased personal accomplishment of 38% and depersonalization/cynicism was 13%. These numbers, while not specifically looking at perceived stress, were significantly higher than those of medical residents and are clear indicators that further study into

dental residents' stressors and exploration of mitigating strategies to combat perceived stress are critically needed.

The long-term negative health effects of stress has been extensively studied. Toker et al. (2012) outlined growing evidence between chronic stress and increased incidence of cardiovascular disease. A prospective cohort study by Raimo et al. (2018) showed that stress and burnout experienced during residency had lasting effects ten years into the graduate's professional practice careers. Another longitudinal cohort study of 250 intern's DNA changes during the first year/internship year of residency revealed that the mean telomere attrition during that year was six times the typical annual attrition rate (Ridout et al., 2019).

The effects of the COVID-19 pandemic on post-graduate residency training have already been examined in hundreds of studies and articles but only a small number have focused on its impact on post-graduate dental residency training. Ludwig, et al. completed a national survey of 160 Oral and Maxillofacial Surgery residents which revealed that the prospective 2022 graduates were most concerned with completing graduation requirements, lack of adequate Personal Protective Equipment (PPE) and decreased number of surgical opportunities due to the COVID-19 shutdown. Complete cessation of elective surgeries, a critical source of oral surgery training, was reported by 97.7% of respondents. In addition, 94.2% of the residents reported a web-based shift for their didactic courses with only 47% reporting increased value in the didactic experience (Ludwig, 2021). This significant decrease in direct patient encounters is concerning as the majority of dental training is predominantly direct patient care-driven involving the oral cavity and oropharynx which are two of the main conduits for the spread of the COVID-

19 virus. Any disruptions in a residency training program's continuity in its ability to provide hands-on dental treatment opportunities may be potentially damaging to the quality of the dental education and training received, and to the mental health of its residents.

The stresses placed upon health care professionals continue to grow at an alarming rate spurred even further by the COVID-19 pandemic. The incidence of burnout in the world's population has grown at such a rate that in 2019, the World Health Organization included burnout syndrome as an occupational phenomenon (but not a medical diagnosis) in its 11<sup>th</sup> revision of the International Classification of Diseases (ICD-11). Studies by Hall et al., in 2016 & Dawkins and Burdess in 2020 concluded that the increasing rates of burnout in the health care professions equated to a "ticking time bomb" that could have high negative effects on the health care system. Fortunately, extensive studies have been performed in the area of mediators to combat the stress and burnout experienced by health care professionals with some very encouraging results. In the area of social support, studies by Holt-Lunstad et al. (2010) & Mikkola et al. (2018) demonstrated that social support can reduce the negative health effects of stress. A January 2021 study by Ruisoto et al. explored the mediating effects of social support on health effects of burnout on Ecuadorian physicians and determined that social support significantly reduced the effects of exhaustion on overall health and significantly predicted lower health problems in general. The study also reinforced previous findings that emotional exhaustion was "the single best predictor of general health in health care professionals"; therefore, any mediators or therapies, such as social support, that decrease emotional exhaustion will produce health care professionals who are in better general

health and less prone to burnout. Unfortunately, the COVID-19 pandemic removed a significant amount of social support from residents who were single and isolated from friends and family. The camaraderie and social interaction with their co-residents, faculty and staff were suddenly removed for an extended period during the initial lockdown. This loss of one stress buffer brought to light the possible significance of others mediators; such as mindfulness, cognitive behavior strategies and self-awareness coping skills which could be utilized to protect against Perceived Stress.

Given the sum total of the findings of hundreds of studies of stress in the health professions resident, one would assume that a concerted effort by training institutions would be raised to address this health crisis within their ranks, but they would be wrong. Some of the difficulties in truly understanding perceived stress and its negative mental and physical health effects and developing a universally effective combatting strategy lies within the subjects and the studies themselves. A decided challenge to the study of residency stressors is the sheer diversity of the residents themselves. The natural heterogeneity of resident populations from field of study to age to cultural differences make clear cross-correlation between studies and their findings is difficult at best. The addition, of the stigma of admitting mental distress, intense competition seen in some residencies and limited studies in dental residencies, in particular, makes the development of an effective combatting strategy against perceived stress a daunting task. However, the need to reduce the stresses of residency training and to develop successful coping skills, social support and other mediators is vital to the future success of health professionals and the health care system as a whole.

## **CHAPTER 2: Materials and Methods**

### **PARTICIPANTS**

Twenty first or second year residents attending Naval Postgraduate Dental School (NPDS) for two or more consecutive academic years starting in June of 2017 volunteered for the study. NPDS has been in operation for 94 years. It is the primary generator of the US Navy's operationally ready cadre of dental specialists trained and prepared to serve around the world, on shore and at sea. The school has six residency programs that are either two or three years in duration and includes endodontics, periodontics, prosthodontics, oral and maxillofacial pathology, orofacial pain, and comprehensive dentistry. NPDS typically has about 20 new residents each year and the academic year runs from July-June. Residents are active duty military dentists; the majority from the US Navy, with inter-service training offered to Army and Air Force dentists as necessitated by service needs. All residents were individually asked if they were interested in participating in this study. If a resident was interested in participating in the study, they then signed an informed consent obtained according to the IRB/HIPAA guidelines. This research protocol received approval from the Walter Reed National Military Medical Center (WRNMMC) Institutional Review Board (IRB), protocol # WRNMMC-16-00206.

Inclusion Criteria: Age  $\geq 18$ . All residents enrolled in NPDS were eligible to participate in this study.

Exclusion Criteria: Pregnant or breast-feeding women

## **STUDY PROCEDURES**

After consent, all participants were scheduled for a baseline study assessment. All study participants completed study self-report measures. Details of each self-report measure are described below and the self-report measures are listed in Table 1.

## **SELF-REPORT ASSESSMENTS**

**Demographics and Health History Questionnaire:** All participants completed a brief demographics and health history questionnaire after study enrollment.

**Perceived Stress Scale (PSS):** The PSS is a 10-item measure used to assess perceived stress over the previous month. The PSS is the most frequently used measure of perceptions of stress and has been translated into many languages. The scale has acceptable psychometric properties. (Roberti et al, 2006).

**Patient Health Questionnaire-9 (PHQ-9):** The PHQ-9 is a 9-item measure of the presence and severity of depressive symptoms over the previous two weeks. Test-retest reliability, internal consistency, and convergent validity have been established (Kroenke et al, 2001).

**Generalized Anxiety Disorder (GAD-7):** The GAD-7 is a 7-item measure used to assess presence of symptoms of generalized anxiety over the previous two weeks. The GAD-7 is a widely used assessment instrument and has demonstrated good psychometric properties in clinical and research applications (Spitzer et al, 2006).

**Fatigue Symptom Inventory (FSI):** The FSI is a 14-item measure used to assess the severity, frequency, and daily pattern of fatigue as well as its perceived interference with

quality of life over the previous week. The FSI has been used in many research and clinical applications and has demonstrated good psychometrics (Donovan et al, 2011).

Insomnia Severity Index (ISI): The ISI is a brief instrument that assesses the severity of both nighttime and daytime components of insomnia. It has been validated for use as a screening tool to detect sleep disturbances in research and clinical settings (Bastien et al, 2001).

Duke-Social Support Questionnaire (DUKE-SSQ). The DUKE-SSQ is an eight-item widely used social support questionnaire. The scale ranges from “much less than I would like to” to “as much as I would like.” The DUKE-SSQ yields a total score and alpha has ranged from 0.86 to 0.88.

## **STATISTICAL ANALYSES**

Confidentiality was maintained on all materials through the use of participant ID numbers. Descriptive statistics (means with standard deviations (SDs)) were reported for measures of perceived psychological stress by assessment time, among the full cohort and by PSS strata defined by the presence of moderate to higher stress (PSS score >13) at the baseline assessment. Linear mixed effects models were used to estimate associations of PSS strata with measures of perceived stress over the follow up periods. Separate models for each perceived stress measure as the outcome included a random intercept for subject and fixed effects for PSS strata, categorical time, and their interactions. Restricted maximum likelihood estimation was used with an unstructured covariance structure and degrees of freedom were estimated with the Kenward-Roger method. Least square means for each outcome measure were compared by PSS strata at each follow up time

using contrast t-tests, with p-values corrected for comparisons at multiple time points using Bonferroni adjustment. Analyses were performed in R (Vienna, Austria) using the lme4 package (Bates et al., 2015), with p-values reported from the lmerTest package (Kuznetsova et al, 2020) and contrasts generated by emmeans (Lenth et al, 2020).

## CHAPTER 3: Results

Table 1A reports means with SDs for measures of perceived stress over the follow up period, overall and by baseline PSS strata. Of the 20 enrolled subjects, 12 subjects (60%) had a baseline PSS score  $>13$  and 8 subjects (40%) had a baseline PSS score  $\leq 13$ . The overall mean (SD) PSS score was 16 (8.3) and 15 (10.0) at final follow up. Tables 1B & 1C show model estimated mean scores for each perceived stress measure by follow up time and baseline PSS strata. Subjects who had moderate or higher stress compared with low stress had higher GAD, PHQ and fatigue scores at March 2020 assessment; higher PSS scores at March 2020 and June 2021 assessments; and lower DUKE scores at March 2020 and May 2020 assessments ( $p < 0.05$  for all comparisons).

In mixed effects models of perceived stress measures, baseline PSS score  $>13$  versus  $\leq 13$  was associated with higher GAD, PHQ, and PSS scores, and lower DUKE scores over the follow up period ( $p \leq 0.01$  for each; Table 2). Fatigue scores varied among the full cohort by assessment time ( $p < 0.01$ ), with lowest estimated mean scores in both PSS strata at May 2020 assessment. Interactions of PSS strata with time in each model were not statistically significant. I.e., Trajectories of changes in scores over time did not statistically differ between PSS strata.

Figure 1 provides a visual progression of Perceived Stress levels on the Y axis against the X axis which tracks NPDS significant date points from Pre-COVID 19 levels of March 2020 through the graduation of the last research subjects in June 2021. Significant dates are the March 2020 transition point from pre-pandemic baseline to the halt of normal clinical operations, on through May 2020 as significantly curtailed clinical operations continued. August 2020 saw the return of in-person classes and limited patient

care. November 2020 denotes return to basically normal didactic and clinical operations and finally the June 2021 graduation of the last study subjects. The dates with the asterisks were chosen for their statistical significance and to refine the delivery of the findings in this setting. Based on Perceived Stress Scale criteria, pre-pandemic assessments of residents who had scores greater than or equal to 13 were deemed high. Perceived Stress residents and will be denoted in red on following figures while those with 12 and below were recognized as low Perceived Stress residents and represented in blue. This scoring is based on normative data for the Perceived Stress Scale (Cohen, 2012).

On the Perceived Stress Scale, the higher Perceived Stress individuals saw a significant initial drop in stress levels from March to May 2020. These higher stressed subjects could have welcomed the reprieve from their stressful environment, no matter what the reason, at least for a short period of time before the old stressors of residency returned along with some new ones to raise the Perceived Stress back towards pre-pandemic levels by August of 2020. From the March 2020 baseline, the lower Perceived Stress subjects experienced a steady increase in Perceived Stress, peaking at August 2020 before returning to their original pre-COVID baseline levels. This increase could be attributed to the removal of these individuals from their normal mentally healthy/low stress residency environment which increased their stress levels as they could no longer progress and function at their normal, comfortable rate. A further contributor to a return to pre-pandemic levels of Perceived Stress could be attributed to familiarity with the situation of the ongoing pandemic reduced overall anxiety as seen in the Chew et al. 2020 study on PS during the COVID-19 environment (Chew, 2020).

Higher PHQ-9 scores indicate higher levels of symptoms of depression with scores from 5 to 10 indicate symptoms of mild depression; high Perceived Stress residents at NPDS scored above 5 across the entire duration of this study. These scores are in correlation with a Bashir et al. study from 2020 where all 523 health sciences students from a global cross-sectional study scored between mild and severe depression on the PHQ-9 scale; 12.4% had severe depression scores (Bashir, 2020). The high Perceived Stress subjects showed an initial significant improvement in PHQ-9 findings but slowly headed back to normal higher levels as their stress-filled resident life steadily returned to normal after the initial lockdown. The lower PS residents saw small negative changes in depression levels which could be expected during the trials of a prolonged pandemic.

Results from the GAD-7 showed limited but negative effects on general anxiety of low Perceived Stress residents while high Perceived Stress residents experienced decreases in anxiety levels as they continued to enjoy the removal of some of the more stressful requirements of their programs. The low Perceived Stress residents were possibly experiencing some limited increases in anxiety due to prolonged separation from their programs of study and inability to continue moving forward in their graduation requirements. As residency slowly returned to pre-pandemic levels, each group began trending back to baseline levels.

The low Perceived Stress individuals had the highest levels of social support which took a dip between May and August of 2020 which correlates to the decrease in the constant daily family support during the shutdown as the residents increased their time back at the schoolhouse. Their DUKE scores rebounded from August 2020 to June

2021 as daily life resumed a semblance of normal. The high Perceived Stress residents started with low social support so the initial and ongoing negative effects of isolation and limited interaction may have been less impactful on their daily lives. The statistically insignificant improvement in social support over time, could be accounted to the gradual return to normalcy of an in-person training program and/or increased routine contact (possibly only virtually) with loved ones and family members triggered by the pandemic. Again, both high and low Perceived Stress residents saw a marked decrease in their fatigue level during the initial COVID lockdown period with, unsurprisingly, the largest change occurring in the high Perceived Stress residents. From May to August 2020 in-person classes and some clinical operations resumed, the fatigue symptom levels of both the high and low Perceived Stress residents had risen to essentially equal points; this is potentially due to the return to daily operations back at the schoolhouse and reality check concerns in meeting graduation, research and training requirements; during shutdown free time was in abundance and residency requirements were in the background. The more marked increase in fatigue from May to August 2020 for the low Perceived Stress residents may indicate a more aggressive, long hour re-engagement of clinical, lab and research requirements in an effort to catch back up as quickly as possible. Once they felt back on track and assimilated back into the routine of residency, their fatigue symptoms decreased. Whereas, the high Perceived Stress residents continued to their steady climb back to higher fatigue levels as they returned to towards their normal residency stress levels.

Both groups saw a drop in Insomnia Severity between March and May 2020 with High Perceived Stress subjects again showing the most significant drop; presumably

since the vast majority of the residency program stressors (long hours, deadlines, examinations, patient care, lab work, etc.) were removed as the curriculum essentially stopped for over three months. From May to August 2020, the high stressed residents continued to enjoy improved sleep quality while the low Perceived Stress began a steady rise back towards baseline potentially as they began spending those longer hours back at school in an effort to catch up on requirements. The high Perceived Stress residents perhaps returned back towards normal residency at less exuberant pace; trying to maintain their new found lower stress levels for as long as they could. Between August 2020 and June 2021 as the program evolved to a new normal; residents sleep quality returned towards their baselines as the rigors and individual Perceived Stress reactions of the residency fully returned.

## CHAPTER 4: Discussion

The aims of this study were two-fold: First, determine the impact of COVID-19 on the Perceived Stress of residents of a military graduate dental residency program and, secondly, explore the correlation between the resident's Perceived Stress and self-reported measures of depression, anxiety, sleep quality, fatigue and social support. In conjunction with these aims, two hypotheses were developed: First, all residents will report and present with an increase in perceived stress during the COVID-19 pandemic. Secondly, it is expected that those residents identified as high Perceived Stress will demonstrate higher levels of depression, anxiety and fatigue and lower levels of sleep quality and social support relative to their low Perceived Stress counterparts.

The first hypothesis was proven to be inaccurate, at least during the initial lockdown period from March to May 2020, with the unexpected decrease in Perceived Stress in the identified high Perceived Stress residents. Upon review of the various mental health predictor assessments, our study found the high Perceived Stress residents saw a marked decrease in stress levels. However, this improvement in mental health must be measured relative to an overall positive mental state as their mean Perceived Stress Scale scores never dropped below 13 and progressively returned towards the high pre-pandemic levels as the rigors of the residency returned. Those residents assessed as low Perceived Stress based on pre-pandemic assessments saw an equally transient increase in Perceived Stress but never surpassing the mean threshold score of 13. This group's Perceived Stress scores conversely returned back to lower, healthier levels as they were able to return to the new normalcy of the residency program.

The second hypothesis of the study also proved only partially accurate. The high Perceived Stress residents initially experienced the exact opposite effects on their depression, fatigue, anxiety and sleep quality levels seeing improvements in all four areas. However, these improvements were again short-lived and this group experienced the loss of all these improved mental health predictors and approached pre-pandemic levels of each. Additionally, it should be noted that their PHQ-9 scores never dropped below 5 which is the minimum threshold for symptoms of mild depression. While these elevated PHQ-9 scores is in congruence with other studies, they also illustrate a difference between a military and civilian dental residency training program. A study by in 2021 showed PHQ-9 scores of 18.29 +/- 2.88 in dental GME residents in a New York City hospital training program. Our study revealed scores of 10 +/- 2.5 which could correlate to decreased concerns of job security, future professional prospects and access to medical care. This study also illustrates the tremendous need to devote research to the stresses of dental residency; their data showed that the dental residents had PHQ-9 scores 8 times higher than their medical counterparts (Bhalla, 2021).

The association of social support and the Perceived Stress levels of the residents in the face of the COVID pandemic warrants separate review and future investigation. As previously mentioned, social support is a recognized negative predictor of elevated Perceived Stress as well as other indicators of mental health concerns. In a study by Chew et al. study from 2020, the authors showed that two negative predictors of Perceived Stress were living with others and seeking social support (Chew, 2020). The high Perceived Stress residents DUKE Social Support scores were significantly lower than their lower stress counterparts and experienced little to no fluctuation during the

period of this study. The low Perceived Stress residents exhibited high levels of social support but did experience some decreases in their DUKE scores as they left their support structure after over three months of at home lockdown to return to an in-person residency program. This decrease quickly recovered as the demands of residency returned back to pre-pandemic levels. Additionally, the results of our study demonstrates the potential buffering or leveling effect of social support on the residents reactions to increased levels in stress. The high Perceived Stress residents demonstrate much more markedly significant reactions, both positive and negative, to changes in residency dictated by the COVID pandemic. The low Perceived Stress residents reacted to the same changes but in a more gradual, and perhaps even predictable manner.

#### **LIMITATIONS**

Limitations of the present investigation include the relatively small subject sample size (n=20) and that there was minimal variation within the subjects themselves when compared to a civilian dental specialty residency training program (i.e.; overall good physical and mental health required of active duty military members, similar ages and experience levels, etc.). Since our data sets were gathered from only subjective self-assessments, the lack of objective physiologic testing results limits the verification of our conclusions. Given the unique position of active duty military postgraduate dental residents relative to civilian residents in postgraduate training, caution should be used in extrapolating our findings to the civilian residency experience. A 2021 study of 250 civilian post-graduate residents found that 88% were scored as either moderate or severe on the PS scale and 41.6% of the students had considered leaving the dental profession upon graduation (Juneja, 2021). Due to contractual service obligations for military

residents, there is a minimum service payback period before they are eligible to resign their commission.

## CHAPTER 5: Conclusions

In conclusion, the results of the study suggest that the COVID-19 pandemic affected the Perceived Stress levels of the Naval Postgraduate Dental School residents to varying degrees. In particular, those residents who were identified as having high Perceived Stress showed marked initial decreases in Perceived Stress, Depression, Anxiety, Fatigue and Insomnia. As the pandemic progressed and the residency program slowly returned to a semblance of normalcy, the early improvements in Perceived Stress and other negative predictors of mental health reverted back towards pre-pandemic levels. This regression could be attributed to improved online classes, development and implementation of protective PPE protocols, access to vaccines, a return to more routine patient care and an overall desensitization to the pandemic in general which basically allowed the residency to return back to a new “normal”. The high PS residents returned towards their pre-pandemic levels as their stressors increased but positive mental health predictors, such as social support remained largely unchanged.

In the future, the results from this study could be used to develop specific stress-minimization programs focusing on the identified positive and negative influences on Perceived Stress. A study by Cohen et al. presented a stress-buffer hypothesis that focuses on the identification of and frequent contact with residents who live alone may help to buffer the negative mental health effects of stress (Cohen et al, 1984). Potentially, incoming residents could be given these initial self-assessments to establish their baseline with a repeat assessment at the 6 month mark to screen for negative trends. These assessments could help identify at-risk residents for whom tailored strategies could be

developed to mitigate the stressors before they become a more serious mental health problem.

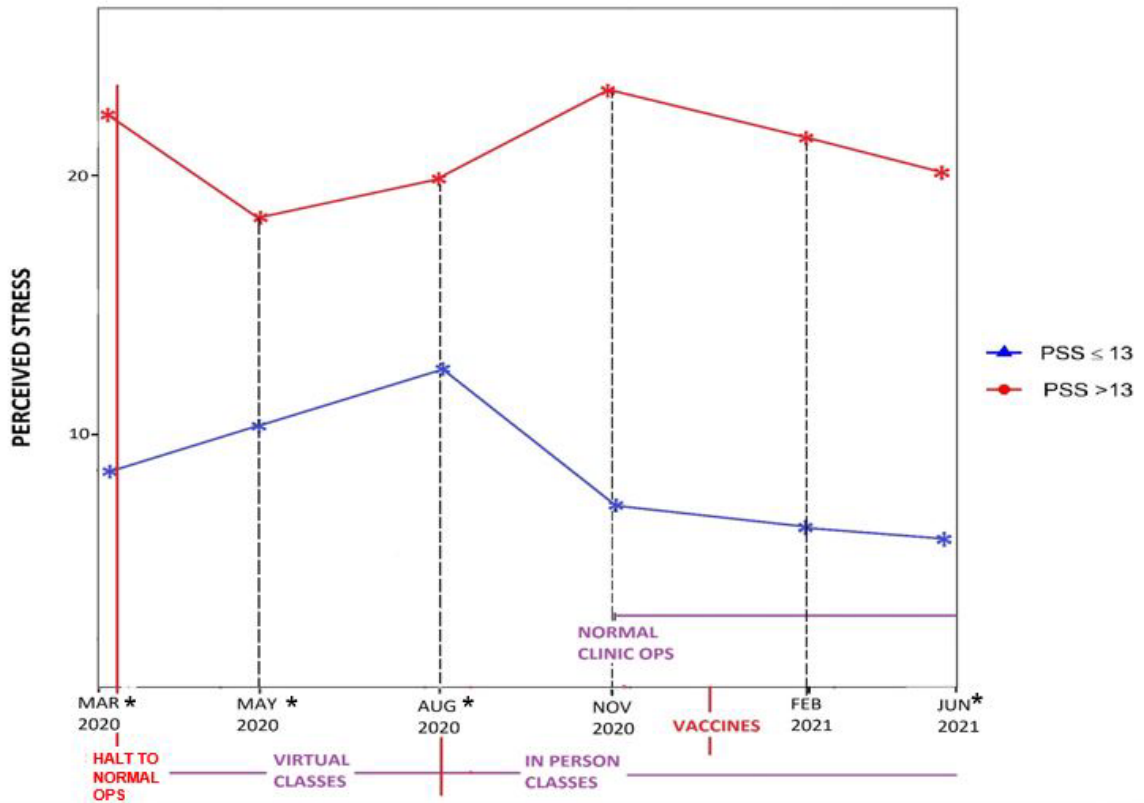
**Table 1.** Data for Measures of Perceived Stress. 1A describes the full cohort, 1B describes characteristics of subjects above baseline and 1C describes subjects below baseline.

<b>Table 1A. Characteristics by assessment among the full cohort.</b>				
	<b>3</b>	<b>4</b>	<b>5</b>	<b>8</b>
	<b>(n=20)</b>	<b>(n=20)</b>	<b>(n=20)</b>	<b>(n=20)</b>
<b>GAD Sum</b>	6.1 ± 5.4	5.4 ± 4.9	5.4 ± 5.3	5.3 ± 5.1
<b>PHQ Sum</b>	6.4 ± 6.1	4.9 ± 4.8	5.4 ± 5.2	6.3 ± 6.2
<b>PSS Sum</b>	16 ± 8.3	14 ± 8.3	17 ± 9.3	15 ± 10
<b>DUKE Sum</b>	34 ± 6.1	34 ± 7.2	33 ± 6.7	34 ± 5.7
<b>Avg Fatigue</b>	4.2 ± 2.4	2.2 ± 1.9	3.6 ± 2.5	3.7 ± 2.3
<b>ISI Sum</b>	9.3 ± 5.5	6.7 ± 5.3	7.1 ± 5.9	8.6 ± 6.3
<b>Table 1B. Characteristics by assessment among subjects with baseline PSS &gt;13.</b>				
	<b>3</b>	<b>4</b>	<b>5</b>	<b>8</b>
	<b>(n=12)</b>	<b>(n=12)</b>	<b>(n=12)</b>	<b>(n=12)</b>
<b>GAD Sum</b>	8.8 ± 5.1	7.3 ± 5.4	6.9 ± 6.0	7.3 ± 5.4
<b>PHQ Sum</b>	9.8 ± 5.8	7.1 ± 4.8	7.4 ± 5.6	8.6 ± 6.9
<b>PSS Sum</b>	22 ± 5.5	17 ± 8.6	20 ± 9.4	20 ± 10
<b>DUKE Sum</b>	31 ± 6.2	31 ± 8.0	31 ± 6.9	31 ± 5.8
<b>Avg Fatigue</b>	5.3 ± 2.3	2.6 ± 2.2	3.7 ± 2.3	4.6 ± 2.3
<b>ISI Sum</b>	11 ± 5.8	8.0 ± 5.7	7.5 ± 6.1	10 ± 5.9
<b>Table 1C. Characteristics by assessment among subjects with baseline PSS ≤13.</b>				
	<b>3</b>	<b>4</b>	<b>5</b>	<b>8</b>
	<b>(n=8)</b>	<b>(n=8)</b>	<b>(n=8)</b>	<b>(n=8)</b>
<b>GAD Sum</b>	2.0 ± 2.1	2.9 ± 2.7	3.3 ± 3.4	2.1 ± 2.7
<b>PHQ Sum</b>	1.4 ± 1.3	2.0 ± 2.9	2.6 ± 3.1	2.7 ± 2.4
<b>PSS Sum</b>	8.1 ± 3.6	11 ± 6.3	13 ± 8.0	7.6 ± 5.7
<b>DUKE Sum</b>	38 ± 2.4	38 ± 2.1	36 ± 5.6	38 ± 3.3
<b>Avg Fatigue</b>	2.6 ± 1.6	1.5 ± 1.2	3.4 ± 2.8	2.1 ± 1.3
<b>ISI Sum</b>	6.0 ± 3.1	4.9 ± 4.4	6.5 ± 6.0	6.1 ± 6.6
Data are reported as mean ± SD.				

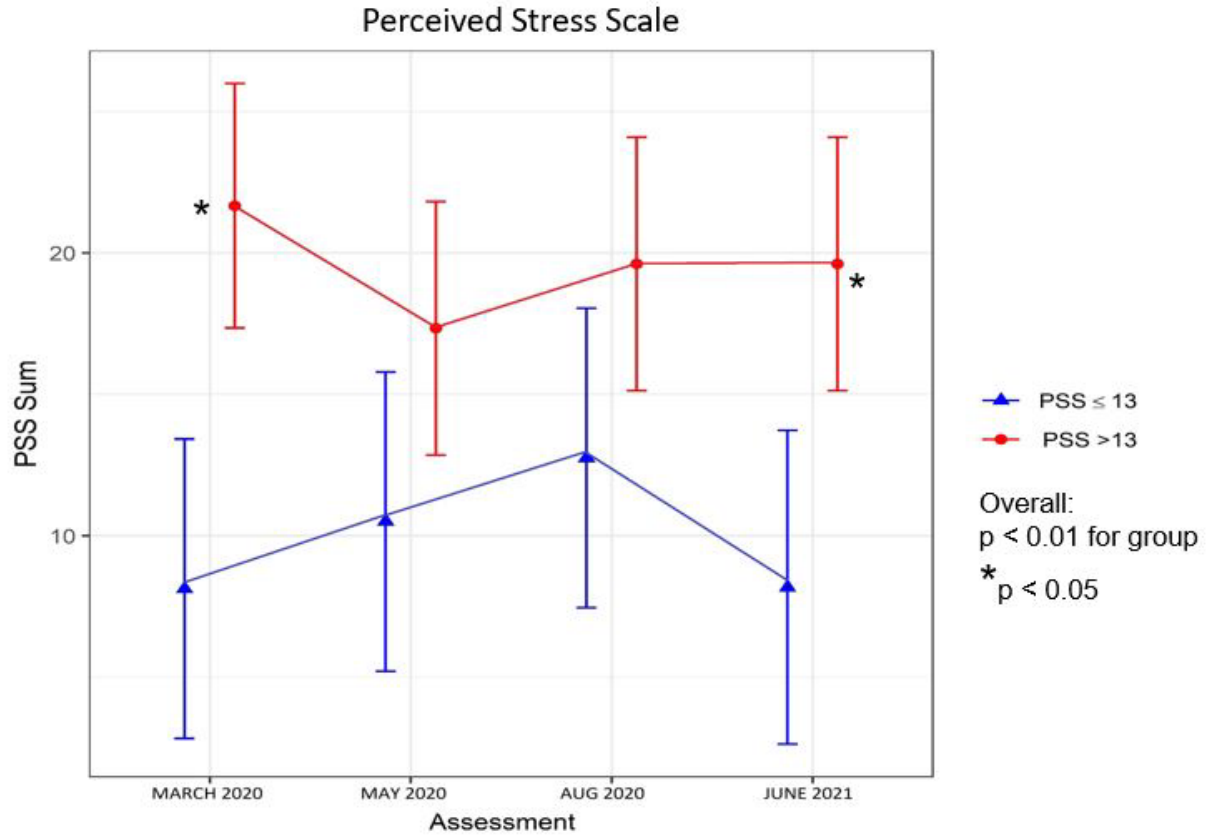
**Table 2.** Estimates from separate linear mixed effects models of baseline PSS and time as independent variables and assessment scores as the dependent variable.

	<b>F</b>	<b>Df num</b>	<b>Df res</b>	<b>P</b>
<b>GAD Sum</b>				
PSS>13	7.6	1	17.8	<b>0.01</b>
Time	0.1	3	50.4	0.94
PSS>13*Time	1.1	3	50.4	0.35
<b>PHQ Sum</b>				
PSS>13	10.5	1	17.8	<b>&lt;0.01</b>
Time	0.6	3	50.5	0.62
PSS>13*Time	1.5	3	50.5	0.23
<b>PSS Sum</b>				
PSS>13	12.6	1	17.7	<b>&lt;0.01</b>
Time	0.7	3	50.6	0.57
PSS>13*Time	1.7	3	50.6	0.18
<b>DUKE Sum</b>				
PSS>13	7.7	1	17.8	<b>0.01</b>
Time	0.4	3	50.5	0.78
PSS>13*Time	0.5	3	50.5	0.69
<b>Avg Fatigue</b>				
PSS>13	4.1	1	17.7	0.06
Time	5.4	3	50.6	<b>&lt;0.01</b>
PSS>13*Time	2.4	3	50.6	0.08
<b>ISI Sum</b>				
PSS>13	2.0	1	17.8	0.17
Time	1.7	3	50.5	0.17
PSS>13*Time	1.3	3	50.5	0.28

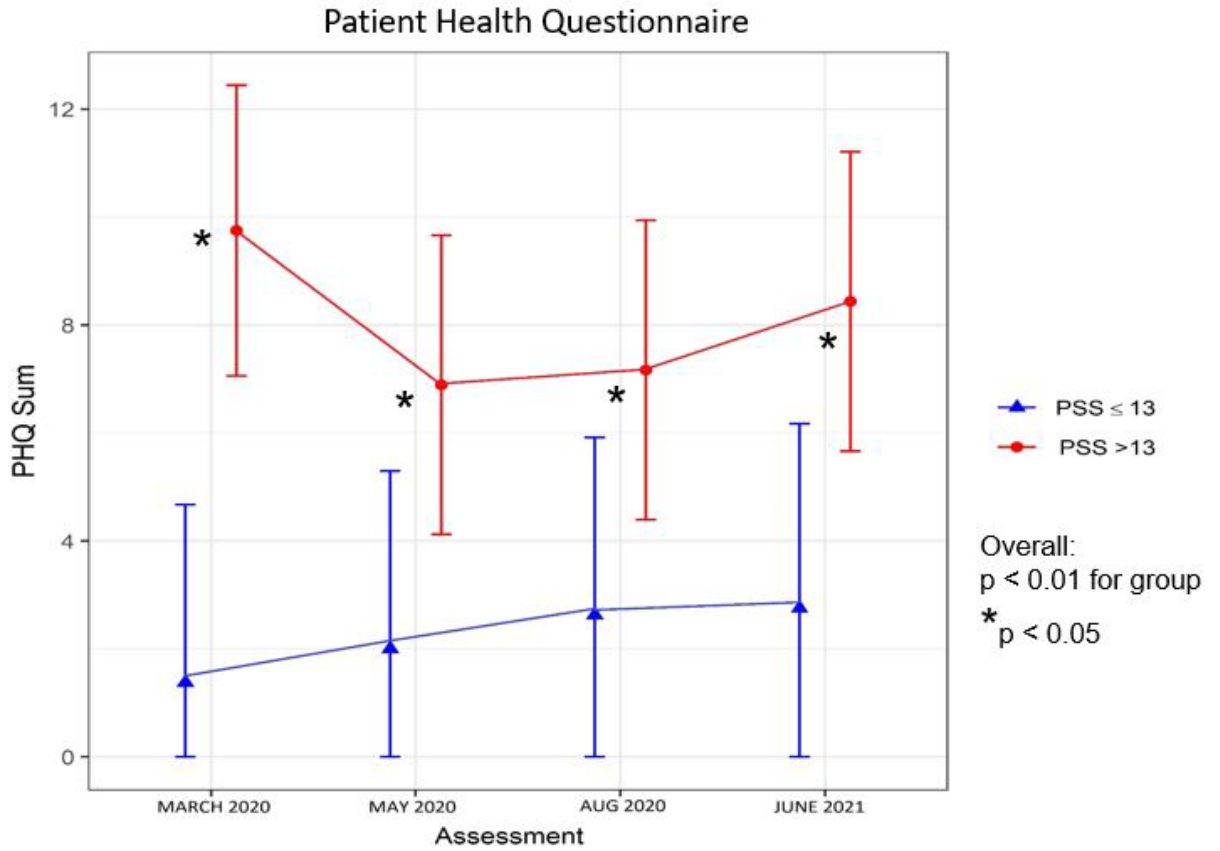
### Overview of Perceived Stress Progression



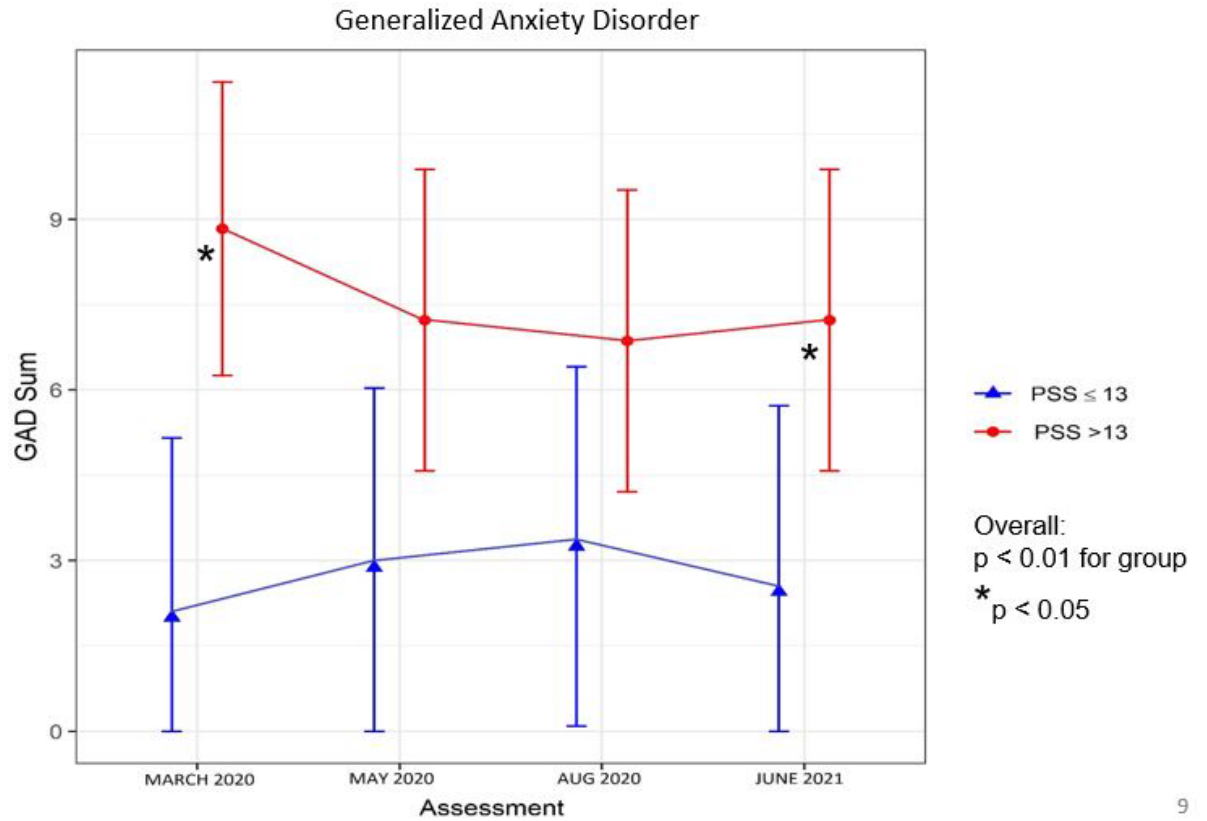
**Figure 1. Overview of Perceived Stress Progression.** Visual progression of Perceived Stress levels on the Y axis against the X axis which tracks NPDS significant date points from Pre-COVID 19 levels of March 2020 through the graduation of the last research subjects in June 2021.



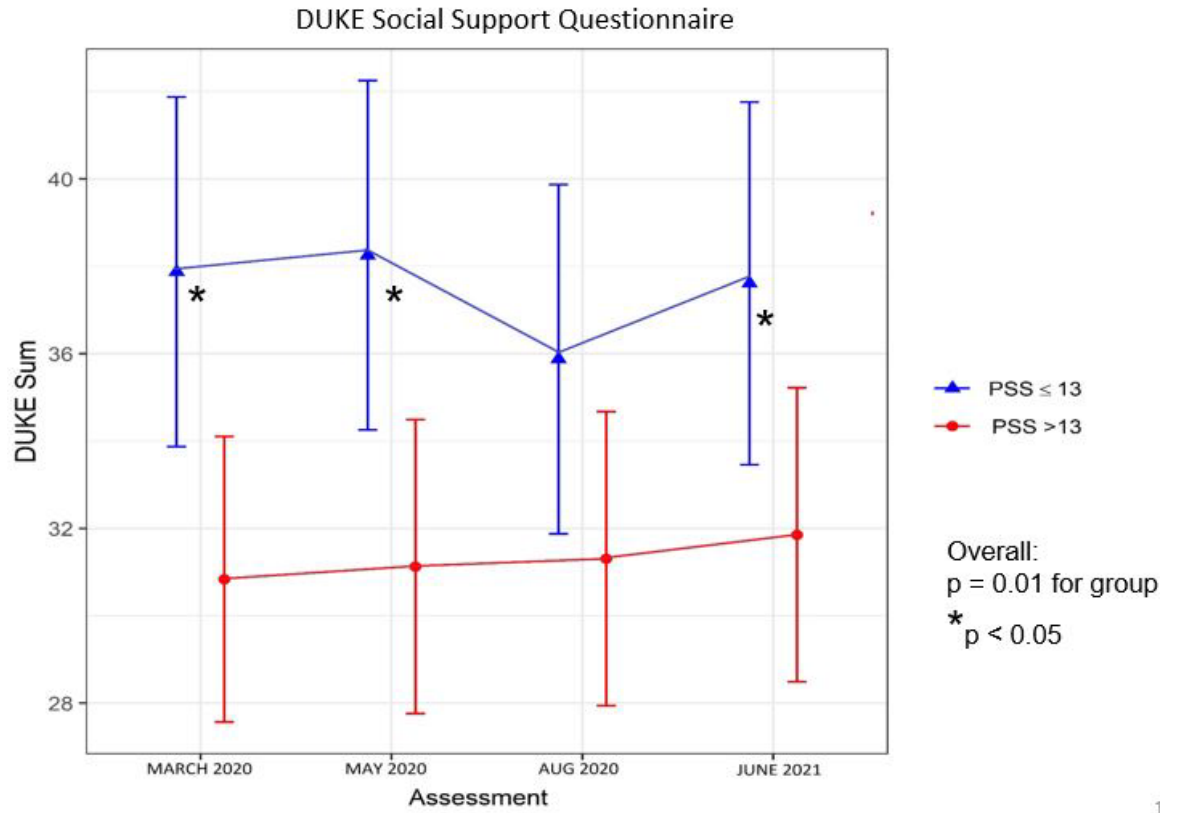
**Figure 2. Perceived Stress Scale.** Demonstrates the variations in Perceived Stress of both High and Low PS residents on Y axis over the course of focused timeline of March 2020-June 2021 statistically significant dates noted on X axis.



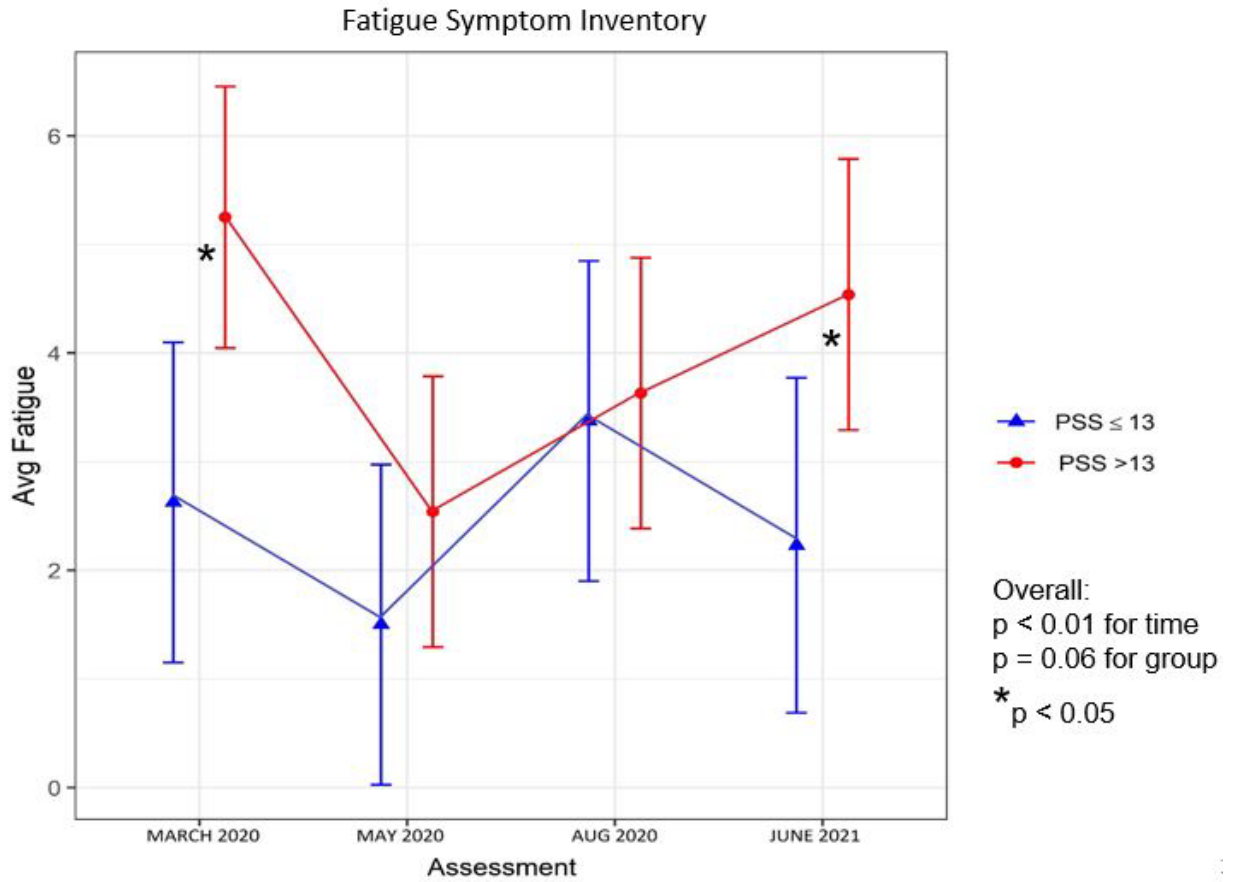
**Figure 3. Patient Health Questionnaire.** Illustrates levels of depression symptoms on Y axis against the chosen significant dates along the X axis timeline.



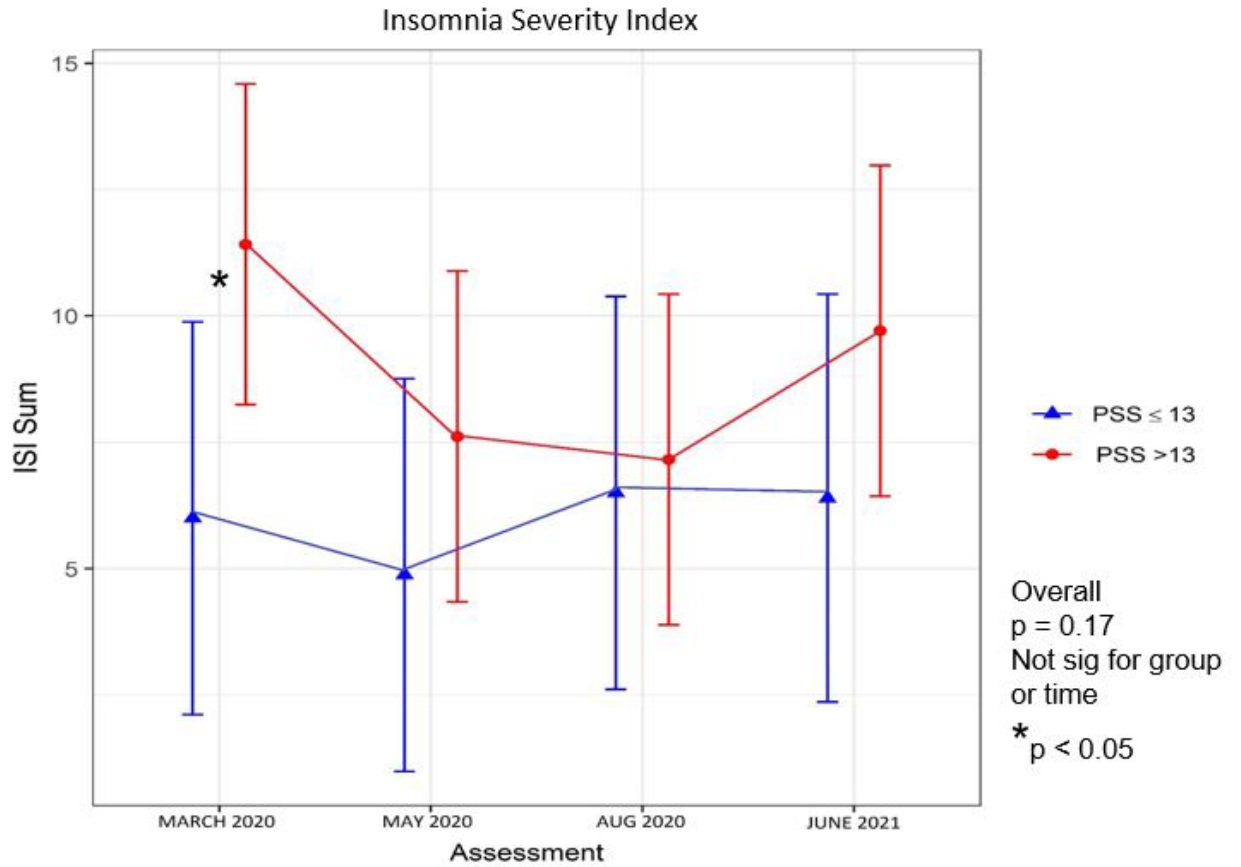
**Figure 4. Generalized Anxiety Disorder.** Tracks the variations in generalized anxiety levels for high and low Perceived stress residents on Y axis with the statistically significant dates of timeline denoted on X axis.



**Figure 5. DUKE Social Support Questionnaire.** Visual progression of social support levels for both high and low stress residents on Y axis plotted against the statistically significant date line on the X axis.



**Figure 6. Fatigue Symptom Inventory.** Represents the variations in fatigue symptoms of high and low PS residents on across Y axis across the significant date timeline on X axis.



**Figure 7. Insomnia Severity Index.** Tracks the changes in sleep quality and duration on Y axis against the statistically significant timeline dates on X axis.

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