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Stress Assessment in Postgraduate Dental Residency

by

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A thesis submitted to the Faculty of the
Comprehensive Dentistry Graduate Program
Naval Postgraduate Dental School
Uniformed Services University of the Health Sciences
in partial fulfillment of the requirements for the degree of
Master of Science
in Oral Biology

June 2020

Naval Postgraduate Dental School
Uniformed Services University of the Health Sciences
Bethesda, Maryland

CERTIFICATE OF APPROVAL

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MASTER'S THESIS

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This is to certify that the Master's thesis of

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NAVAL POSTGRADUATE DENTAL SCHOOL
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ABSTRACT

Stress Assessment in Postgraduate Dental Residency
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Comprehensive Dentistry, 2020

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Background:

Dentists in residency training face many challenges and stressors that parallel those experienced by medical residents. The amount and level of stress may lead to burnout, a syndrome that includes emotional exhaustion, depersonalization, and reduced personal accomplishment. While plenty of literature exists documenting perceived stress and related physiological markers for physicians and students, there are limited studies that capture dental residents in this discussion.

Aims:

The purpose of this study is to determine the relationship and association between the stress experienced by dental residents and the physiologic/psychologic changes demonstrated over the course of their respective programs. A secondary aim is to explore any risk factors as well as potential protective factors that may palliate symptoms of stress or burnout.

Materials and Methods:

This is a prospective study of dentists from one-, two-, or three-year residency programs at the Naval Postgraduate Dental School. Baseline study assessments were collected via

self-report measures and a brief physiologic evaluation. Residents were reassessed quarterly to track changes in measurements during the first 18 months of their program.

Results:

Perceived stress increased from baseline values but did not exceed moderate levels and peaked after six months in residency ($p>0.05$). Physiologically, all residents showed a steady decline in parasympathetic activity over residency, but this finding was also not statistically significant ($p>0.05$). Higher depression and anxiety scores were associated with increased levels of perceived stress ($p<0.05$), while social support measures had an inverse relationship with perceived stress but was not statistically significant ($p>0.05$).

Conclusion:

Although dental residents reported only low to moderate levels of perceived stress over the course of the study, results suggest the ability to keep physiological stress response in balance decreased over time. Further, results suggest that low psychological distress and strong social support may act as protective factors to perceived stress.

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The education and training necessary to become a medical professional have gained notoriety for their rigorous demands physically, mentally, emotionally, and psychologically. Detrimental effects from the stress of school and residency have been well-documented, often taxing those individuals who decide to navigate this challenging environment with an increased prevalence of anxiety, depression, and suicidal ideations [1]. Unfortunately, most of the literature that can be found focuses mainly on physicians and their training. Even high levels of stress in dental students have been documented, with one study highlighting up to 40% of dental students meeting criteria for burnout, 9% exhibiting symptoms for moderate depression, and 6% expressing clinically significant suicidal ideation [2]. Advanced education in dentistry often has many parallels with the difficulties and pressures inherent in medical residency programs, but the physical and psychological burden on dental residents have been largely unexplored. With a reported 35% of medical residents displaying up to five depressive symptoms and 61% becoming more cynical during their training, it is imperative to investigate the effects and implications of stress on dental residents [3]. Outside of residency, dentists already experience chronic occupational stresses related to working with limited time, treating anxious patients, dealing with physical demands, and having a heavy workload, all of which can result in clinical disorders such as burnout, anxiety, and depression [4,5]. With approximately one in practicing dentists observed to be burned out [6] and a sobering correlation of burnout with more frequent patient safety incidents in physicians [7], we recognize the importance of intervening before the well-being of both patients and healthcare providers is compromised.

For the purpose of this study, burnout is defined as a multi-faceted relationship between depersonalization, emotional exhaustion, and low personal accomplishment or poor self-esteem [8,9]. It is important to note that burnout's specific involvement with an individual's connection to their work is distinct from depression, which affects a person's life as a whole [10]. Feeling dissatisfied with one's chosen specialty and working 50-60 hours per week, which are not unusual events for dental residents, were linked to higher levels of depersonalization and emotional exhaustion [11]. In addition to experiencing burnout, responses to stress include an activation of the sympathetic nervous system. This would produce physiologic indicators such as increased heart rate, blood pressure, cardiac response, and respiration rate as well as dilation of the bronchial tubes [12]. These changes allow adaptation to acute and chronic psychological or physical stress. The body's effort to maintain homeostasis is mediated by hormones via the hypothalamic-pituitary-adrenal (HPA) axis, autonomic nervous system (ANS), and various immune and metabolic systems. Though protective under normal circumstances, stress response mechanisms have the potential to be severely damaging when dysregulated, failing to cease even after stressors are removed and creating an autonomic imbalance. With a hyperactive sympathetic nervous system, the parasympathetic nervous system loses its ability to inhibit the fight-or-flight response. Autonomic imbalance and diminished parasympathetic tone, along with an individual's sensitivity and reactivity to stress, are all inextricably linked to the pathogenesis of cardiovascular, metabolic, and immunologic diseases as well as psychopathologies such as depression, anxiety, and personality disorders [13]. Vagal tone has been reported to reflect the general level of

parasympathetic activity, and is commonly used to measure a person's autonomic balance [13,14]

Albeit, the collective evidence regarding the direct influence of stress on individuals entrusted with patient care is invaluable information, an argument can be made that observations of potential risk factors for and protective strategies against burnout may be more pragmatic. A systematic review conducted by Singh et al. identified younger age, male gender, and even certain personality types as factors associated with increased burnout in dental professionals [15]. Students who took a break of more than one year before medical training were almost twice as likely to experience burnout [16], which may not bode well for military dental residents who often continue their studies several years after graduation from dental school. One European investigation discovered that the top stressor in dental residents was a lack of leisure time, followed by meeting various program requirements. The same study revealed that although stress and burnout levels increased with more time in residency, older age was seen as a protective factor [17,18]. Medical residents often rated insufficient leisure time, lack of support from staff, and large patient load as their major stressors, with inadequate sleep as the most prevalent problem [16,19]. The inability to acquire enough rest and find free time for stress relievers, like a quick workout, is especially worrisome. Sleep and physical exercise are modifiable behaviors that have been demonstrated to be inextricably linked with psychiatric disorders, including depression and anxiety [20]. Decreased exercise frequency and lack of sleep significantly increased exhaustion, and including a positive depression screening, all were predictors of burnout in medical students [21]. It is no surprise then that regular exercise and plenty of sleep have been

shown to increase the quality of life and may protect against burnout in training physicians [22]. Other coping mechanisms to combat stress often reported by residents include talking to others, seeing the humor in situations, and maintaining a "survival attitude" [18,19].

This study further improves and explores the complex relationship between perceived stress and quantifiable measures of physiologic response during postgraduate dental residency. The factors of anxiety, depression, and social support are all evaluated in hopes of gaining a better understanding of the stress exposure in dental residents and promoting possible interventions that may increase the safety of both specialists in training and their patients.

This investigation has two aims: 1) Assess the severity of perceived and physiological stress experienced by dental residents over the course of their respective programs, and 2) Explore associations among stress and other psychological characteristics (anxiety, depression, social support).

Chapter II: Materials and Methods

Participants were volunteers from Naval Postgraduate Dental School (NPDS), Navy Medicine Professional Development Center, matriculated in one-, two-, or three-year residency programs starting in July 2018. NPDS is home to seven postgraduate training pipelines that include comprehensive dentistry, endodontics, oral pathology, orofacial pain, periodontics, and prosthodontics. On average, the military institution welcomes about 20 new residents every July, mainly composed of active duty military dentists from the United States Navy. All new residents were given the opportunity to participate in the study. Written informed consent was obtained from individuals interested in participating in the study at the commencement of their respective training programs in accordance with IRB/HIPAA guidelines.

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

Exclusion Criteria: Pregnant or breast-feeding women, or those residents who decided they do not wish to participate in the study.

Study procedures: Baseline study assessments were collected via self-report measures and a brief physiologic evaluation. Residents were reassessed quarterly to track changes in measurements during the first 18 months of their program. The details of each self-report assessment are described below.

Self-Report Assessments

Demographics and Health History Questionnaire: All participants completed a brief demographics and health history questionnaire after study enrollment. Information recorded here includes ethnicity, race, marital status, smoking, and alcohol use.

Generalized Anxiety Disorder (GAD-7): The GAD-7 is a seven-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 [23].

Patient Health Questionnaire-9 (PHQ-9): The PHQ-9 is a nine-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 [24].

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. [25].

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 [26].

Physiologic Assessment

All study participants completed an identical brief physiologic stress assessment. This minimally invasive assessment recorded ECG to measure HRV. The participant started

by quietly resting for ten minutes on a recliner inside a quiet room (Dr. Schmidt's office: building 2, 3rd floor, room 3260). During this baseline recording, the participant rested comfortably and minimized physical movement. To elicit a standardized cardiovascular response, the participant completed the Stroop Color Word test (described below). This activity was followed by ten minutes of physiological recording where the participant was instructed to rest quietly on the recliner while the cardiovascular recovery curve was monitored. The physiological assessment took approximately 35 minutes. Cardiovascular activity was recorded using a three-lead electrocardiogram (Biopac ECG100C) placed in the Lead II configuration and sampled at 1000hz.

Stroop Color Word Test: This test evaluates ability to selectively identify the color of a word while filtering out its meaning. The interference of the word meaning when naming the color is called the Stroop effect. Recent interpretations of the Stroop effect are based on the parallel distributed processing model. This theory states capacity limitations as system-resource limits and views the Stroop effect as a decision process gathering evidence by the parallel processing of multiple sources of relevant and irrelevant information, which determines the length of processing time needed to respond to the Stroop words (Cohen, JD). This classic, well-validated cognitive challenge is an effective yet non-invasive way to elicit sympathetic arousal.

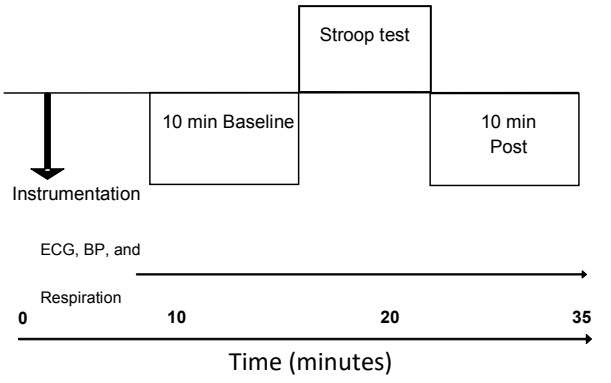


Fig 1. Stroop Color Word test administration

Statistical Analyses

Confidentiality was maintained on all materials through the use of participant ID numbers. Data were analyzed using the SPSS 24.0 statistical package (SPSS, Inc.). The first step in data analyses was to compute descriptive statistics including mean, and standard deviations of all demographic, physiological, and self-report data. Any outlying scores were compared to the original data to ensure there were no data entry errors. The alpha level for all analyses was set at $p<0.05$. Aim one was evaluated using a repeated measures analysis of variance (ANOVA) strategy comparing change in perceived stress and heart rate variability indices across the different assessments. Aim two was evaluated using the Pearson Correlation, which is the measure of linear correlation between two variables to evaluate the relationship between perceived stress and depression, anxiety, and social support.

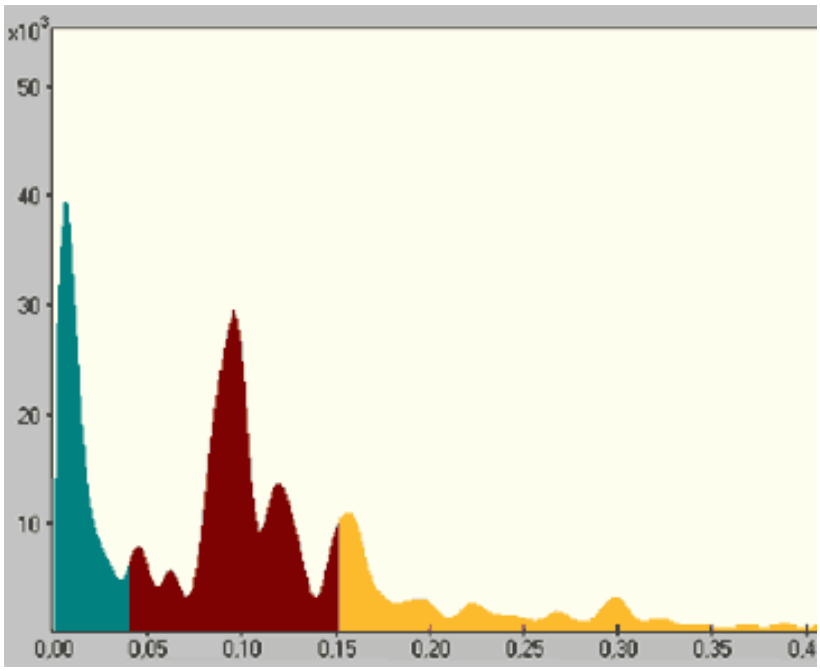


Fig 2. Root Mean Square of the Successive Differences (RMSSD) is a physiological marker of vagal tone, or parasympathetic activity. Low frequency heart rate oscillations (LF) are depicted in red, while high frequency heart rate oscillations (HF) is in yellow. LF/HF ratio indicates autonomic balance.

Chapter III: Results

There were a total of 16 participants in this study from all six postgraduate dental residency programs; nine males and seven females with an average age of 36.5 (SD=7.3) years old. Baseline assessments were taken at the start of residency in June 2018.

The cut-scores for the perceived stress scale are as follows: scores of 0-13 were considered low, 14-26 moderate, and 27-40 high. In all dental residents, the average perceived stress score at the initial assessment was 10.69 (SD=6.1). This mean gradually increased over the course of 12 months and peaked at approximately six months with a value of 15.31 (SD=6.1). Despite these increases, scores consistently remained in the low-to-moderate level. The changes over time in perceived stress were not statically significant ($F(4,12)=2.34$, $p=0.074$).

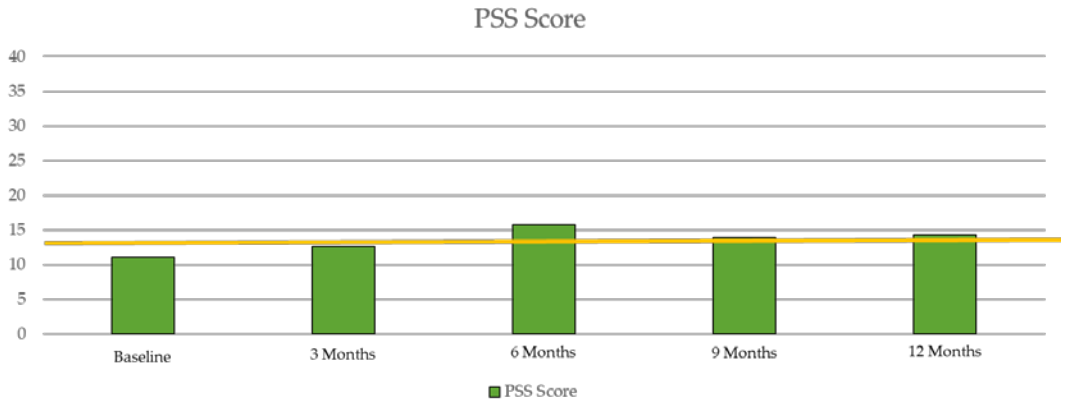


Fig 3. This graph illustrates Perceived Stress Scores (PSS), with the yellow line acting as the threshold for moderate stress.

The RMSSD is a physiological marker of vagal tone, and a lower value is an index of lower parasympathetic activity, suggesting a decreased ability to inhibit

sympathetic activity or stress response. Participants demonstrated a slow decline in RMSSD values over their first year of residency training, but these changes were not statistically significant ($F(4,12)=1.69$, $p=0.174$). These data were collected during the ten minute baseline section of the physiological stress assessment.

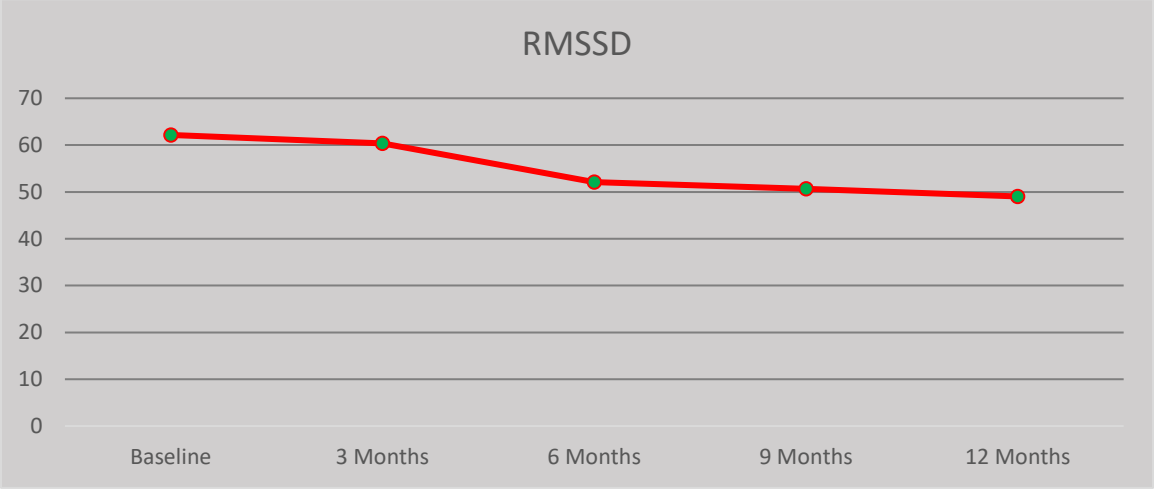
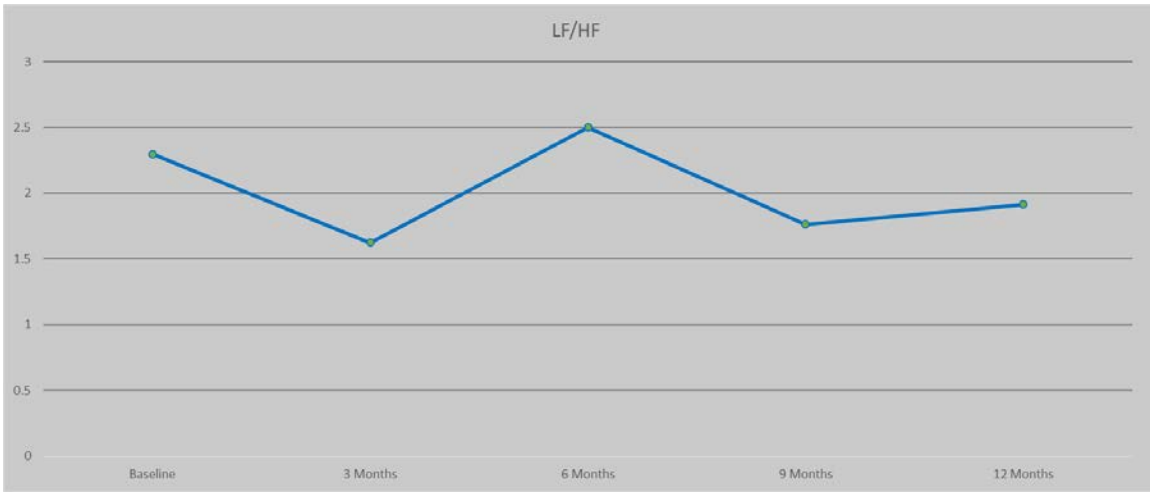


Fig 4. Vagal tone is represented here as RMSSD values and is a measurement of parasympathetic activity. Lower values suggest diminished ability to inhibit stress response.

The ratio of LF to HF heart rate oscillations indicates autonomic balance, and a higher ratio indicates more sympathetic activity and less parasympathetic activity. As such, higher values are suggestive of autonomic imbalance and a decreased ability to regulate stress. Participants displayed a rise in LF/HF ratio at six months relative to other time periods in residency, but these differences were not statistically significant ($F(4,12)=0.42$, $p=0.535$). These data were collected during the ten-minute baseline section of the physiological stress assessment.



Our second aim was to explore the associations among perceived stress with depression, anxiety, and social support. As depression scores for participants increased, the amount of perceived stress also increased ($p<0.05$). This positive and statistically significant correlation was also exhibited when plotting the relationship between anxiety and perceived stress scores ($p<0.05$). However, as reported levels of social support increased, the stress perceived by residents decreased, but this association was not statistically significant ($p>0.05$)

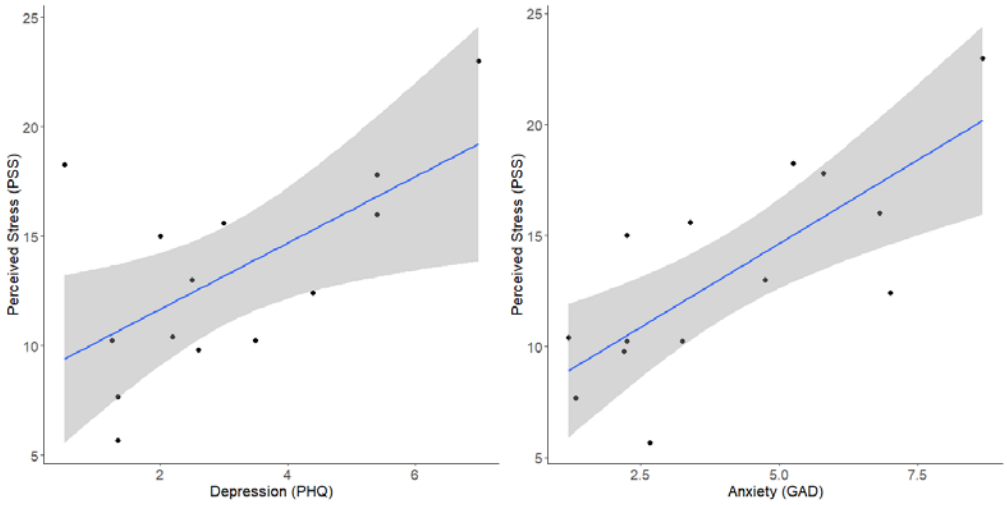


Fig 6. Depression and PSS had a positive correlation

Fig 7. Anxiety and PSS had a positive correlation

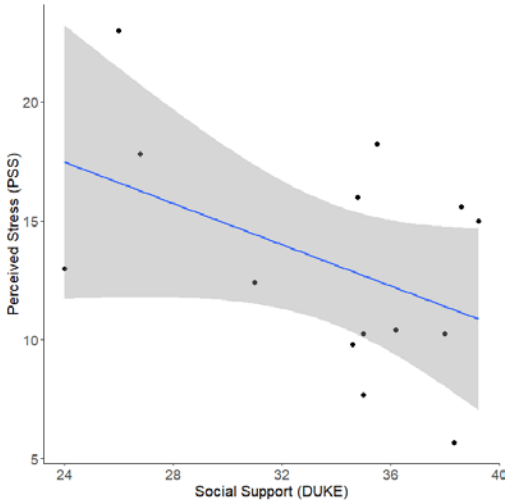


Fig 8. Social Support and PSS had an inverse relationship, but not statistically significant.

Chapter IV: Discussion

The primary intent of this study was to assess the stress among postgraduate dental residents during residency training, and explore its relationship with several psychological factors. This investigation demonstrated that levels of perceived stress for residents at Naval Postgraduate Dental School increased from baseline values but never exceeded moderate levels after one year in training. Considering that our study was limited to military participants, it is interesting to note the relatively minor elevations in perceived stress especially since residents working in government institutions have shown significantly higher emotional exhaustion and depersonalization compared to those in private institutions [11]. Perhaps the unique characteristics of military residents, either inherent with individuals attracted to the active duty lifestyle or learned from various military training pipelines, lend an advantage in high stress situations. Another possible explanation would be that the length of time observed (12 months) was too short to display a substantial increase in perceived stress scores. The study by Waheed et al. also determined that residents with greater than two years of postgraduate experience exhibited significantly more burnout symptoms than those with lesser experience [11]. Dental residents reported their highest level of perceived stress at six months, presumably reflecting the increased demands of residency during that time. A steady decline in vagal tone was demonstrated over one year of residency, suggesting a decreased ability to inhibit the stress response. Autonomic imbalance peaked at month six of training, supporting a similar trend in the levels of perceived stress. These results, albeit statistically not significant, may provide a quantitative framework to assess physiological

stress response in participants during their first year in dental residency training. However, it is important to emphasize that a single physiological indicator like HRV can only provide a very narrow representation of the total physiological stress response system [27].

Higher depression and anxiety scores were associated with increased levels of perceived stress, presumably from the greater psychological tax on individuals who suffer from these symptoms. As one of the most prevalent mental disorders, depression can cause trouble concentrating, a loss of interest in doing things, and feeling bad about oneself [24]. Generalized anxiety disorder, often a comorbidity of depression, can be just as debilitating by consuming an individual with feelings of nervousness, constant worry, and fear of something awful happening [23]. Residents who experience any depression or anxiety may be allocating mental resources that would have otherwise been utilized to handle the increased expectations and workload of postgraduate training. This decreased capacity to cope with stress may manifest as higher perceived stress scores. Unsurprisingly, social support measures had an inverse relationship with perceived stress, suggesting a potential protective factor against the effects of a stressful environment. Having someone to trust and rely on with personal difficulties, or just the presence alone of supportive family and friends may provide sufficient buffers to help neutralize the extra burdens of residency. Conversely, said individuals might also be the source of additional stress if relationship dynamics are not ideal.

Several limitations should be noted regarding this study. The relatively small sample size provides only a limited view of stress in dental residents. Despite having consistent assessments from the majority of participants, there were some data missing

that was compounded by the onset of the global COVID-19 pandemic. As all of the volunteers in this study are in the military, certain minimum levels of physical fitness and health have been met and should be taken into consideration. Along with specialized training and experiences, many having completed operational assignments before postgraduate dental residency training, the resiliency of this unique group may not be typical.

Chapter V: Conclusions

Although dental residents reported only low to moderate levels of perceived stress over the course of this study, results demonstrate the ability to keep physiological stress response in balance decreased over time. Furthermore, results also suggest that low psychological distress and strong social support may act as protective factors to perceived stress. Finally, future studies are necessary to capture more data over a longer timeframe and include additional associations to increase our understanding of stress in dental residency. Hopefully, this will lead to potential interventions that may protect both providers and patients.

References

1. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. Academic Medicine. 2006:81;354-373.

2. Deeb GR, Braun S, et al. Burnout, depression and suicidal ideation in dental and dental hygiene students. Eur J Dent Educ. 2018;22:e70-e74. https://doi.org/10.1111/eje.12259

3. Collier VU, McCue JD, et al. Stress in Medical Residency: Status Quo after a decade of reform? Ann Intern Med. 2002;136:384-390.

4. Bourassa M, Baylard JF. Stress situations in dental practice. J Can Dent Assoc. 1994;60:65–67, 70–1.

5. Rada RE, Johnson-Leong C. Stress, burnout, anxiety and depression among dentists. J Am Dent Assoc. 2004;135:788–794.

6. Calvo JM, Kwatra J, et al. Burnout and Work Engagement Among US Dentists. J Patient Saf. 2017;00:00-00.

7. Shanafelt TD, Hasan O, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. Mayo Clin Proc. 2015;90:1600–1613.

8. Maslach C. Burnout. Hum Behav. 1976;5:16-22.

9. Malach-Pines A. The Burnout Measure, Short Version. International Journal of Stress Management. Feb 2005:12(1);78-88.

10. Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory Manual. 3rd ed. Palo Alto, CA: Consulting Psychologists Pr; 1996.

11. Waheed K, Liaqat N, et al. Burnout among gynaecological residents in Lahore, Pakistan: A cross-sectional survey. JPMA. 2017;67:1318.

12. Anguilo J, Ferrer-Salvans P, et al. Project ES3: Attempting to quantify and measure the level of stress. Rev Neurol. 2015;61(9):405-415.

13. Teixeira RR, Díaz MM, et al. Chronic Stress Induces a Hyporeactivity of the Autonomic Nervous System in Response to Acute Mental Stressor and Impairs Cognitive Performance in Business Executives. Schmidt U, ed. PLoS ONE. 2015;10(3):e0119025. doi:10.1371/journal.pone.0119025.

14. Grossman P, Wilhelm FH, Spoerle M. Respiratory sinus arrhythmia, cardiac vagal control, and daily activity. American Journal of Physiology. Heart and Circulatory Physiology 2004. 287 (2): H728–34.

15. Singh P, Aulak DS, et al. Systematic review: factors contributing to burnout in dentistry. Occupational Medicine. 2016;66:27-31.

16. Shanafelt TD, Bradley KA, et al. Burnout and Self-Reported Patient Care in an Internal Medicine Residency Program. Ann Intern Med. 2002;136(5):358-367.

17. Divaris K, Polychronopoulou A, et al. Stress and burnout in postgraduate dental education. Eur J Dent Educ. 2012;16:35-42.

18. Divaris K, Lai CS, et al. Stress and burnout among Swiss dental residents. Schweiz Monatsschr Zahnmed. 2012;122:610-615.

19. Schwartz AJ, Black ER, et al. Levels and Causes of Stress Among Residents. Journal of Medical Education. 1987;62:744-753.

20. ZailinawatiAH, Teng CL, et al. Daytime sleepiness and sleep quality among Malaysian medical students. Med J Malaysia. 2009;64(2):108–10.

21. Wolf MR, Rosenstock JB. Inadequate Sleep and Exercise Associated with Burnout and Depression Among Medical Students. Acad Psychiatry. 2017;41:174-179.

22. Weight CJ, Sellon JL, et al. Physical activity, quality of life, and burnout among physician trainees: the effect of a team based, incentivized exercise program. Mayo Clin Proc. 2013;88(12):1435–42.

23. Spitzer RL, Kroenke K, et al. A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. Archives of Internal Medicine. 2006;166:1092-7.

24. Kroenke K, Spitzer RL, Williams JBW. The PHQ-9: Validity of a brief depression severity measure. Journal of General Internal Medicine. 2001;16:606-613.

25. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983;24:385-96.

26. Parkerson GR, Broadhead WE, Tse CK. Original contributions. Validation of the Duke Social Support and Stress Scale. Fam Med. 1991;23(5):357–60.

27. Boregowda S, Handy R, et al. Measuring entropy change in a human physiological system. Journal of Thermodynamics. 2016. 1-8.