Distribution Statement

Distribution A: Public Release.

The views presented here are those of the author and are not to be construed as official or reflecting the views of the Uniformed Services University of the Health Sciences, the Department of Defense or the U.S. Government.

RELATIONSHIP BETWEEN BMI/PHYSICAL ACTIVITY AND BURNOUT IN DENTAL RESIDENTS

by

Omeed Adam Rezaie Tirabadi
Lieutenant Commander, Dental Corps
United States Navy

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

MASTER'S THESIS

This is to certify that the Master's thesis of

Omeed Adam Rezaie Tirabadi

has been approved by the Examining Committee for the thesis requirement for the Master of Science degree in Oral Biology at the June 2020 graduation.

Research Committee:

SCHMIDT.JOHN.ENNIS.JR.1040088918 Digitally signed by SCHMIDT.JOHN.ENNIS.JR.1040088918 Date: 2020.07.21 07:25:45 -04'00'

John E. Schmidt, PhD, M.S.
Chair, Department of Psychology
Research Committee Chair

HAMLIN.NICHOLAS.JAMES.1283653362 Digitally signed by HAMLIN.NICHOLAS.JAMES.1283653362 Date: 2020.07.20 15:32:59 -04'00'

Nicholas J. Hamlin, Ph.D., D.D.S., M.S.
LCDR, DC, USN
Chair, Research Department

RUDMANN.MICHAEL.EDWARD.1022311006 Digitally signed by RUDMANN.MICHAEL.EDWARD.1022311006 Date: 2020.07.21 07:26:09 -04'00'

Michael E. Rudmann, D.M.D., M.S.
CAPT, DC, USN
Chair, Comprehensive Dentistry

AVILLO.ANDREW.JAMES.1039513079 Digitally signed by AVILLO.ANDREW.JAMES.1039513079 Date: 2020.07.21 08:25:38 -04'00'

Andrew J. Avillo, D.D.S, M.S.
CAPT, DC, USN
Program Director, Comprehensive Dentistry

The author hereby certifies that the use of any copyrighted material in the thesis manuscript titled:

RELATIONSHIP BETWEEN BMI/PHYSICAL ACTIVITY AND BURNOUT IN DENTAL RESIDENTS

is appropriately acknowledged and, beyond brief excerpts, is with the permission of the copyright owner.

RESIDENT SIGNATURE

REZAIETIRABADI.OMEED.ADAM.1501497289 Digitally signed by REZAIETIRABADI.OMEED.ADAM.1501497289 Date: 2020.07.21 09:05:08 -04'00'

LCDR Omeed Rezaie Tirabadi
Comprehensive Dentistry Graduate Program
Naval Postgraduate Dental School
05 June 2020

NAVAL POSTGRADUATE DENTAL SCHOOL
OMEED ADAM REZAIE TIRABADI

2020

ABSTRACT

RELATIONSHIP BETWEEN BMI/PHYSICAL ACTIVITY AND BURNOUT IN DENTAL RESIDENTS

LCDR OMEED REZAIE TIRABADI
COMPREHENSIVE DENTISTRY, 2020

Directed by: JOHN E. SCHMIDT, CHAIR, DEPARTMENT OF PSYCHOLOGY
Naval Postgraduate Dental School

Introduction: Burnout is a stress-related entity that is highly prevalent in the health care field, with most existing studies looking at physicians and medical residencies and a dearth of data at present on dentists. The limited information to date has found a burnout prevalence of 40-50% among dental students at the undergraduate and postgraduate levels. Burnout has been linked to severe health consequences including heart disease and even premature death. It has also been shown to increase the incidence of medical errors, potentially putting patients treated by a burnout sufferer at risk. There is some evidence of a possible protective effect of physical fitness/activity. Various measures of physical fitness have been found to improve cardiovascular recovery from stress and reduce risk of burnout. **Objective:** The aim of this study is to explore the relationship between body composition, physical activity levels, and risk of burnout. **Methods:** Postgraduate dental residents (n=14; 9 males, 7 females) were followed during the first 18 months of residency training. Participants were assessed every three months using self-report measures of physical activity and symptoms of burnout. At baseline, all participants provided Body Mass Index (BMI). **Results:** Preliminary results of this ongoing study suggest a weak positive correlation between baseline BMI and burnout symptoms over time, but this association was not significant (p=0.16). A weak negative association was also found between

overall physical activity and burnout symptoms (p=0.06). **Conclusions:** While preliminary data are inconclusive, these findings suggest regular physical activity during postgraduate dental residency training may serve as a protective mechanism against the severity of symptoms of burnout. Future studies could incorporate wearable fitness trackers to get a more accurate picture of physical activity and a more robust physical fitness assessment including VO2 max test for cardiorespiratory fitness and DEXA scan for body composition.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BMI	body mass index
BM-SV	Burnout Measure, Short Version
DEXA	Dual-energy x-ray absorptiometry
ENT	ear, nose & throat
HIPAA	Health Insurance Portability and Accountability Act
HPA	hypothalamic-pituitary-adrenal
IRB	Institutional Review Board
NPDS	Naval Postgraduate Dental School
PAI	Physical Activity Index
PAT	Physical Activity Tests
PPAS	Paffenbarger Physical Activity Scale
SPSS	Statistical Package for the Social Sciences
VO2max	maximal oxygen consumption

Chapter 1: Review of the Literature

Burnout as a result of chronic stress is a significant issue faced by today's healthcare professionals. Burnout is characterized by any combination of one or more of the following; emotional exhaustion, depersonalization, and a reduced sense of personal accomplishment. Beyond the inherently negative nature of these three characteristics of burnout, it has been shown to put both the provider and his/her patients at risk for poor health outcomes. (Hall et al., 2016). Hall et. al reported in their systematic review that medical errors were significantly associated with health practitioner burnout. In light of the current focus in the healthcare community on minimizing risk of errors, which have the potential to be catastrophic due to the nature of the field, this finding warrants further attention. As for the burnout sufferer, in a systematic review of prospective studies, Salvagioni concluded that burnout is a significant predictor for hypercholesterolemia, type 2 diabetes, coronary artery disease, hospitalization due to cardiovascular disorder, musculoskeletal pain, changes in pain experiences, prolonged fatigue, headaches, gastrointestinal issues, respiratory problems, severe injuries and mortality below the age of 45 years. (Salvagioni et al., 2017)

One method of assessing burnout is the Burnout Measure, Short Version. It has been shown to be both a valid and reliable tool. (Malach-Pines et al., 2005) The incidence of burnout has been extensively studied in medical students and medical residents, but limited information is available for both dental students, and dental residents. For physicians, studies have found incidence rates between 15% for ENT and neurology (Rodrigues et al., 2018), to as high as 69% for general surgery residencies. (Appelbaum et al., 2019) In a systematic review and meta-analysis, Rodrigues found the overall prevalence of burnout for physicians across all specialties to be 35.7%. Although limited information is available on the prevalence of burnout among

dentists, some studies that looked at both populations side by side suggest that the prevalence is similar and may be higher than for physicians. One study which compared medical and dental students at the same university in Germany found that dental students had a more pronounced increase in chronic stress than medical students (Schmitter et al., 2008). A study by Montiel-Company et al. found the prevalence of burnout to be 50.3% and 40.4% for dental and medical students respectively. In a study of Greek dental residents, Divaris et. al found that 40% of dental residents scored high enough on a standard burn-out measure to be considered a burnout 'case' and found perceived stress to be positively correlated with all dimensions of burnout (Divaris et al., 2011). Given such alarming numbers, it is clear that something needs to be done to protect our healthcare providers, specifically in the dental field given the potentially higher prevalence of burnout. Finding fulfillment in one's work, performing at the highest level, and being protected from unnecessary strain and risk of disease should not be mutually exclusive. The next step is to further explore the scope of the problem in dental residents in different settings/populations.

While a deeper understanding of the scope of the problem is needed, the data makes clear that burnout is in fact a problem that needs to be addressed. The search for protective factors and effective interventions is ongoing and needs to be continued. Physical activity, cardiorespiratory fitness, and body composition have all been linked to improvement in various indicators of stress and recovery such as burnout and heart rate variability. (Gerber et al., 2018, Fohr et al.,2016,Teisala et al, 2014). A review article by Tonello in 2014 came to the conclusion that heart rate variability itself has been shown to be inversely related to work related stress. One proposed mechanism for this protective effect is called "cross-stressor adaptation." According to

this theory, repeated bouts of exercise lead to physiological adaptations that improve a person's responses both to exercise and psychological stressors. The assumption is that both stressors involve overlapping physiological pathways such as the hypothalamic pituitary adrenocortical response, and the balance between the sympathetic and parasympathetic nervous system components. (Sothman et al.,, 1996) This theory has been supported by other studies that have linked physical fitness to attenuated heart rate and blood pressure reactivity to a stressor, as well as a more rapid heart rate recovery to baseline. (Forcier et al., 2006) Further support for the physiological link between stress and exercise were found by Sasse et al. in a series of lab rat experiments in 2008 and 2013. They found that exercise trained rats demonstrated similar initial corticosterone responses to a stressor, but then an exhibited an accelerated habituation of the HPA axis response specifically at the level of the adrenal cortex. They concluded that this accelerated habituation resulted in on overall reduction in the amount of glucocorticoids to which the rats were exposed. In 2009, Reul et al. showed that glucocorticoids interact with epigenetic processes in the brain to enhance memory formation in response to stressful stimuli. This suggests that the complex neurochemical interactions in the brain that occur as a result of stress can tangibly be affected by the presence of glucocorticoids. (Reul et al., 2009)

Whatever the underlying mechanism, the current evidence suggests that exercise exerts a protective effect on burnout. It would stand to reason that exercise should also be considered as an intervention in response to burnout. However, to date evidence of its efficacy in treating burnout is yet to be found. In a meta-analysis by Ochentel et al. in 2018, they examined the impact of exercise on stress related outcomes and concluded that there is insufficient evidence to support exercise therapy as an intervention modality to reduce symptoms of burnout. Ochentel

also noted that more high-quality studies are necessary due to variability of the prescribed exercise modalities which varied from yoga, to various aerobic and strength training regimens. These findings could mean that despite a protective effect for exercise therapy, the lack of quality of the current evidence obscures this effect through confounding variables. Alternatively, it could mean that fitness and BMI exert a protective effect from burnout, but do not effectively treat burnout once symptoms begin to emerge. Further study is needed to determine the potential utility of specific types of exercise such as cardiovascular and resistance training in the treatment of burnout.

Study Aims

Aim 1: To explore the prevalence of burnout in postgraduate dental residency at the Naval Postgraduate Dental School.

Aim 2: To explore the relationship between body composition, physical activity levels and burnout risk.

Chapter II: Materials and Methods

This study was approved by the Walter Reed National Military Medical Center (WRNMMC) Institutional Review Board (IRB), IRB# WRNNMC-2017-0074.

Participants: 14 first or second year residents attending Naval Postgraduate Dental School for two or more consecutive academic years starting in June of 2018 volunteered for the study. The Naval Postgraduate Dental School (NPDS) is the US Military's premier postgraduate dental training institution and has been in operation for 95 years now. The school has five 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 are Navy dentists, with the occasional Army or 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. Our study included 7 males and 7 females.

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: Written informed consent was obtained from eligible and interested residents after the start of the academic year in accordance with IRB/HIPAA guidelines. After consent, all

participants were scheduled for a baseline study assessment. All study participants completed a series of self-report measures which are described in detail below and listed in table 1. Subsequently, the self-report measures were taken every 3 months through the first 18 months of residency training.

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 as well as questions about medical and surgical history, current medications, and current use of non-prescription supplements.

The Burnout Measure, Short Version (BM-SV): The BM-SV is a 10-item measure of burnout at work. The items are scored on a 1-7 Likert scale ranging from "never" to always. This measure is scored by averaging the scores on all 10 items giving an average burnout index score. Norms for this measure indicate that scoring at or above a 4.0 is indicating of burnout (Malach-Pines, 2005). The BM-SV has good psychometrics and is commonly used assessment tool in work stress and burnout research applications (Malach-Pines, 2005).

Paffenbarger Physical Activity Scale (PPAS): The PPAS is a 4-item measure of perceived physical activity. The measure has several open and closed-ended items that ask the participant to estimate their usual levels of daily physical activity, frequency, and exertion. Participants also list any sports or recreational activities. The PPAS provides a Physical Activity Index (PAI) which is calculated based on number of flights of stairs climbed (X8) and city blocks walked (X4) plus the time in minutes spent in either mild (X5), moderate (X7.5), and vigorous (10.0)

physical activities over the previous week. The PPAS has good psychometrics and is a commonly used in physical activity research (Simpson, 2013).

Table 1: Self-Report Measures
Demographics and Health History
Burnout Measure – Short Version (BM-SV)
Paffenbarger Physical Activity Scale (PPAS)

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 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 $p<0.05$. Our first aim was to explore the prevalence of burnout in our sample, which was completed by comparing mean scores to the norms provided by the measure authors. Aim two was to explore the associations among body composition, physical activity, and burnout. Repeated measures correlation was used to make these comparisons.

Chapter III: Results

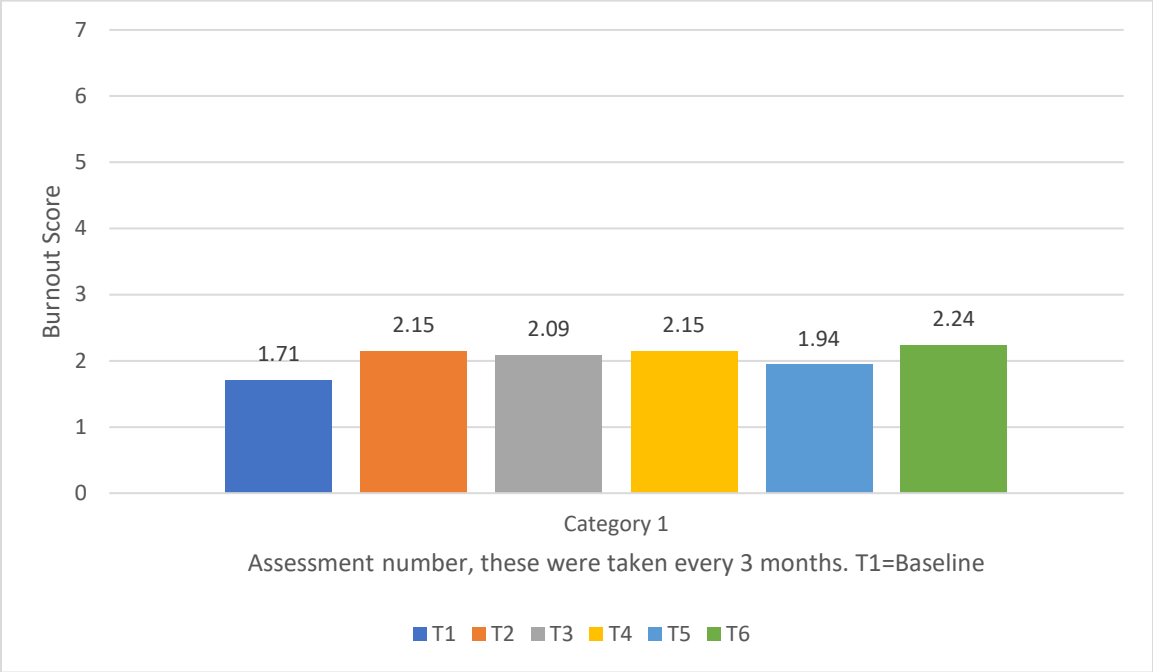

Figure 1. Mean Burnout Score Over Time. Mean burnout score among residents ranged from 1.71 at baseline to 2.24 at time point 6. This difference was not found to be statistically significant. (F(1,13)=3.48, p=0.085)

The prevalence of burnout among our study population at baseline was 0%, with no residents scoring at or above the cut-score of 4.0 which is indicative of significant symptoms of burnout (mean=1.71, SD=0.6, Range=1.10-3.20). At the final assessment, two residents, or 14% of the study population scored above the cut-score suggesting significant symptoms of burnout. However the mean burnout score among all residents remained below this score (mean=2.24, SD=1.1, Range=1.00-4.50). The difference in mean burnout between the two time points was examined using repeated measures analysis of variance, but was not found to be statically significantly different (F(1,13)=3.48, p=0.085). Please see Figure 1 for the change in mean burnout across study assessments.

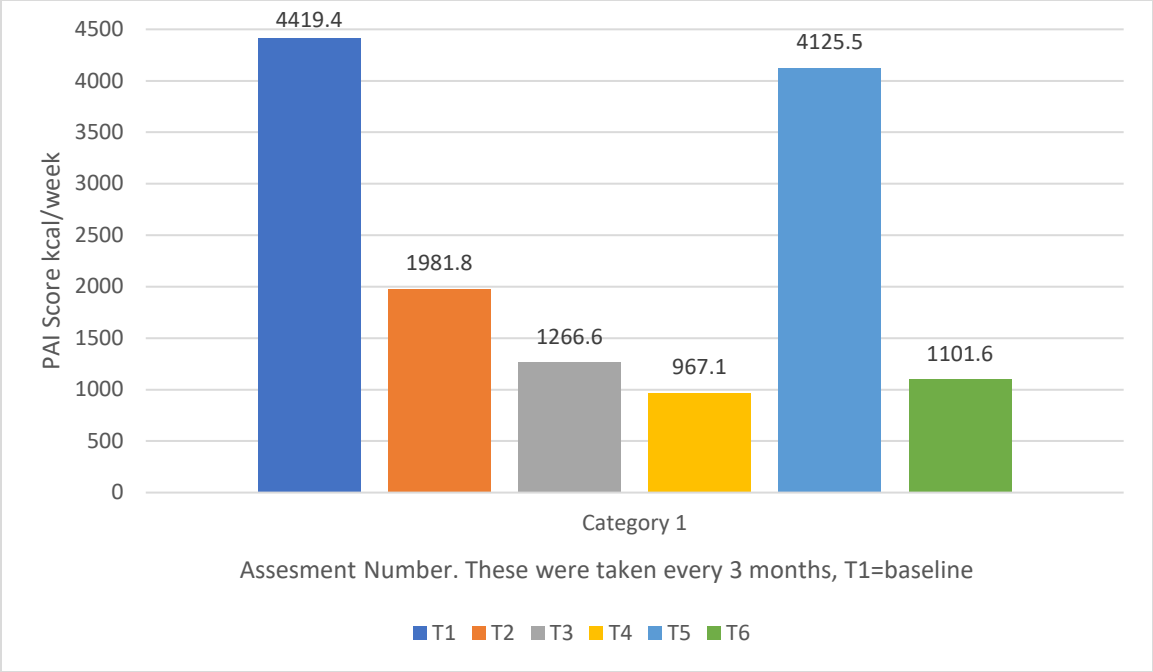

Figure 2. Mean PAI Scores Over Time. The chart above exhibits the overall average PAI score of the group as the study progressed. The spike at time point 5 coincides with the Physical Fitness Assessment.

Overall, the sample was physically active. The PAI based on the PPAS means over the study assessments are shown in Figure 2.

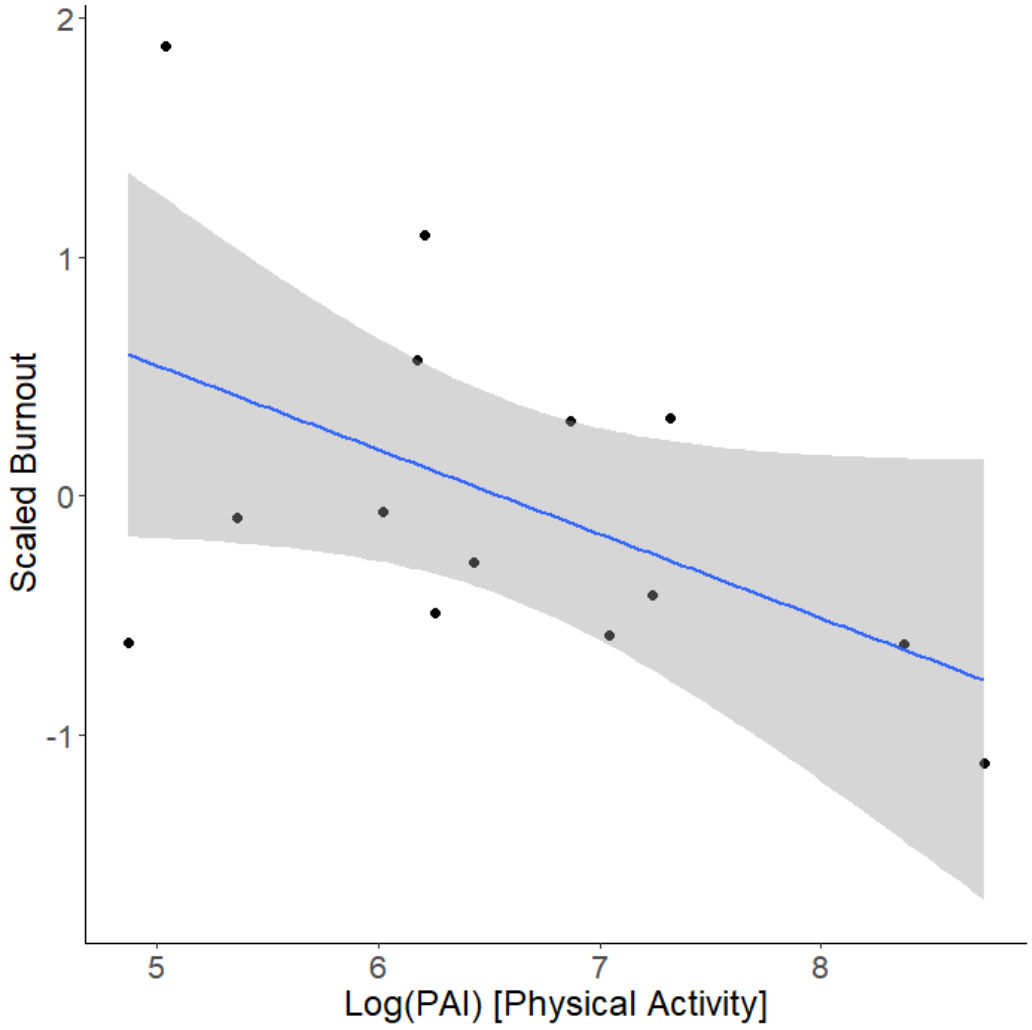

Figure 3. Scaled Burnout Plotted Against Overall PAI Score for Each Participant. The chart above represents the overall mean burnout for each participant compared to their overall physical activity level over the course of the study. The result was an R of .19 and P value of .06, or marginally significant. Linear regression suggests a negative correlation.

To examine the relationship between physical activity and burnout, we plotted the overall PAI score over the course of the study for each resident vs the overall normalized burnout scores for each resident using repeated measures correlation and found an R of .19 and a P value of .06, which was marginally significant. The linear regression line is indicative of a negative

relationship between burnout and physical activity. This suggests that residents that engaged in regular and consistent physical activity over the course of the 18 month assessment period reported lower burnout symptoms at the final assessment.

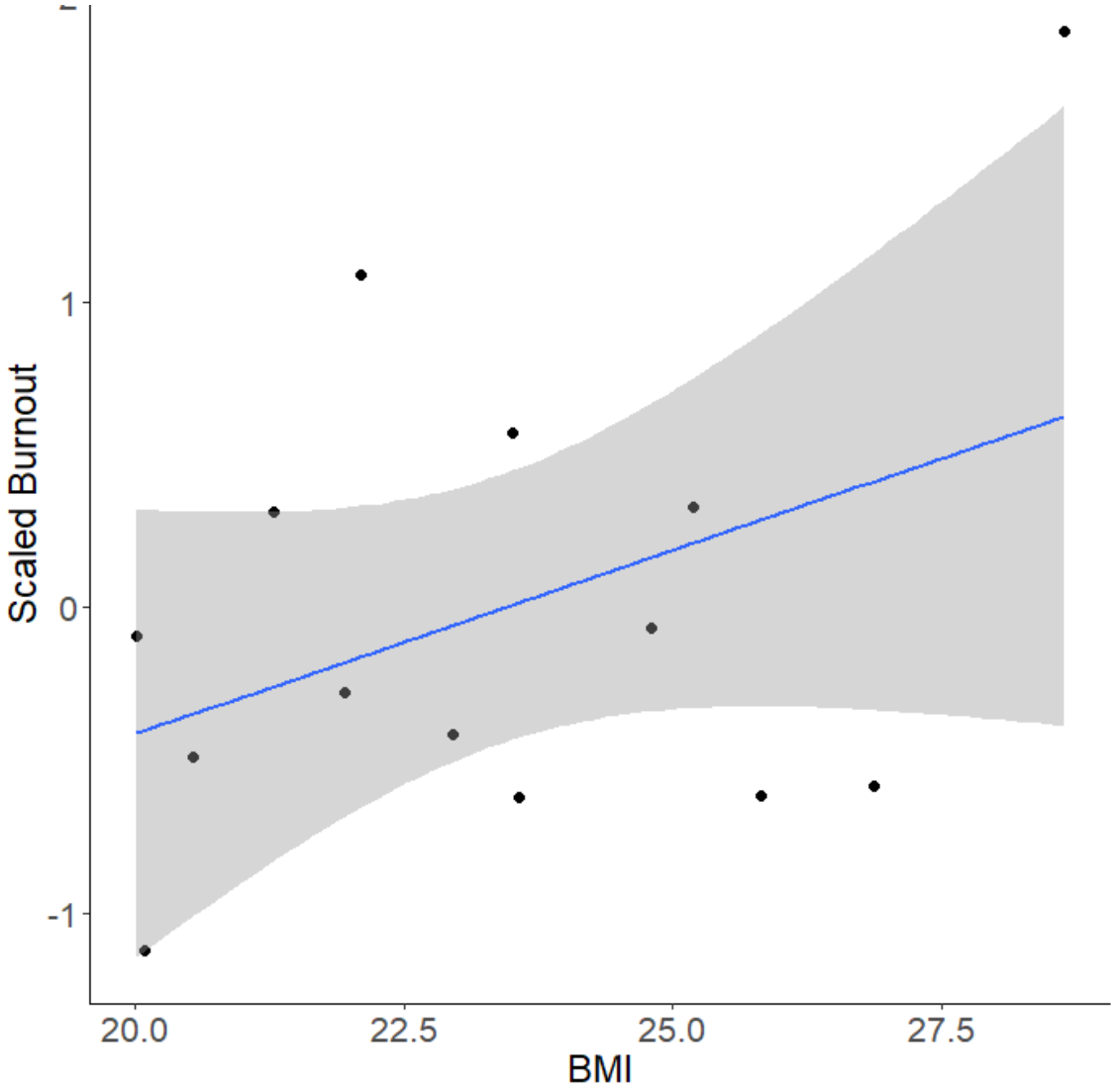

Figure 4. Scaled Burnout Plotted Against Overall BMI of Each Participant. The chart above represents the overall mean burnout for each participant compared to their overall BMI over the course of the study. R value was .19 which was not a significant correlation (p=0.16). The linear regression suggests a positive association between the two variables if it was statistically significant.

The BMI of our subjects ranged from 20.01 to 28.65 with a mean of 23.65 (SD=2.58). We plotted BMI of our participants vs. normalized burnout scores using repeated measures correlation and obtained an R value of .19 which was not a significant correlation (p=0.16). The slope of the linear regression is suggestive of a positive association between overall burnout experience over the course of the study and overall BMI over the course of the study, but this did not reach statistical significance. See Figure 4.

Chapter IV: Discussion

The aims of the current study were to examine the prevalence of burnout among residents at the Naval Postgraduate Dental School, and to examine associations between BMI, physical activity and burnout. The first aim adds to a limited body of evidence examining the prevalence of burnout in the dental profession. Our data suggest a relatively low burnout prevalence of 14%, compared to 40% found by Divaris in the only other study that looks specifically at postgraduate dental residents (Divaris, 2014). Our second aim explored the association between both BMI and physical activity with burnout. Although previous studies have found a positive correlation between BMI and burnout, this relationship was not supported in our study. Similarly, the negative correlation between physical activity and burnout also failed to reach statistical significance, although this difference was marginally significant.

The significant discrepancy between burnout prevalence in the current study and the literature on the topic, specifically the Divaris study, is striking. Perhaps some of the discrepancy could be explained by the use of different burnout measures and the relatively small sample size in our study, but it seems unlikely that these factors alone would result such a large difference. It is a possible that the culture at the Naval Postgraduate Dental School, or that of the military itself that accounts for some of the difference. All the participants in this study were active duty dental residents and are expected to maintain a healthy BMI and be physically fit with regular assessments for accountability. Further study comparing a larger sample size from the Naval Postgraduate Dental School as well as other military training programs to both each other and to civilian residencies could begin to hint at the role that these cultural differences may play. The lack of statistically significant associations between BMI, physical activity and burnout could have a few explanations. The most obvious is that the sample size of the present study was too

small to show the effect size of these associations. Another possibility is that the relatively narrow BMI range of the subjects reduced the impact of BMI on burnout. Previous studies have found a positive correlation between BMI and burnout, but it is possible that the relationship is not linear. Rather, it could be that there is a certain BMI that when exceeded puts a person at greater risk of burnout. If this is the case, the graphical relationship between the two variables would look more like an exponential relationship, with a smaller effect size observed at lower BMI levels that increases sharply somewhere in the overweight to obese region. Further study on the nature of this connection could be useful in guiding public policy decisions and medical advice that doctors give to their patients.

The participants in the current study are also distinct from the civilian population in that maintaining certain physical fitness standards is mandatory. One reflection of this is the spike in physical activity levels among the study population at the time points that correlate with the Physical Activity Tests, or PAT as seen in Figure 2. This minimum fitness threshold, and the associated physical activity required to maintain it, could have a similar homogenizing effect on the data as we have observed with BMI. It is very difficult to be truly sedentary in the military without failing the PAT and the many negative career ramifications that come with such a failure. Because of this, the difference between a relatively sedentary and a relatively active individual is likely smaller in the military than in the civilian population. This likely homogeneity could partially obscure the negative association between physical activity and burnout, especially in a smaller sample size such as the one in the current study. It is important to note, however, that the correlations for both BMI and physical activity follow the same general trend shown in most of the literature on the subject, even though they fail to reach statistical significance.

Future studies should include a larger sample size to show if there is truly a difference between burnout prevalence in the military and civilian dental population. Another limitation of the current study is the reliance on self-report data. Future studies could incorporate more objective measures of physical activity, cardiorespiratory fitness and body composition such as fitness wearables, VO2max testing, and DEXA scans.

Chapter V: Conclusion

In the current study there was no statistically significant connection found between BMI or physical activity and burnout. However, the data did follow the general trends exhibited in the preponderance of current literature and the discrepancy may be the result of a small sample size. The results of the present study also highlight some intriguing differences between the military and civilian populations that could be leveraged creatively to attempt to tease out some of the nuances of the relationships between body composition, physical activity and burnout in future studies.

REFERENCES

Appelbaum, N. P., Lee, N., Amendola, M., Dodson, K., & Kaplan, B. (2019). Surgical Resident Burnout and Job Satisfaction: The Role of Workplace Climate and Perceived Support. *Journal of Surgical Research, 234*, 20-25. doi:10.1016/j.jss.2018.08.035

Divaris, K., Polychronopoulou, A., Taoufik, K., Katsaros, C., & Eliades, T. (2011). Stress and burnout in postgraduate dental education. *European Journal of Dental Education, 16*(1), 35-42. doi:10.1111/j.1600-0579.2011.00715.x

Forcier, K., Stroud, L. R., Papandonatos, G. D., Hitsman, B., Reiches, M., Krishnamoorthy, J., & Niaura, R. (2006). Links between physical fitness and cardiovascular reactivity and recovery to psychological stressors: A meta-analysis. *Health Psychology, 25*(6), 723-739. doi:10.1037/0278-6133.25.6.723

Föhr, T., Pietilä, J., Helander, E., Myllymäki, T., Lindholm, H., Rusko, H., & Kujala, U. M. (2016). Physical activity, body mass index and heart rate variability-based stress and recovery in 16 275 Finnish employees: A cross-sectional study. *BMC Public Health, 16*(1). doi:10.1186/s12889-016-3391-4

Gerber, M., Isoard-Gautheur, S., Schilling, R., Ludyga, S., Brand, S., & Colledge, F. (2018). When Low Leisure-Time Physical Activity Meets Unsatisfied Psychological Needs: Insights From a Stress-Buffer Perspective. *Frontiers in Psychology, 9*. doi:10.3389/fpsyg.2018.02097

Hall, L. H., Johnson, J., Watt, I., Tsipa, A., & O'Connor, D. B. (2016). Healthcare Staff Wellbeing, Burnout, and Patient Safety: A Systematic Review. *Plos One, 11*(7). doi:10.1371/journal.pone.0159015

Kassam, A., Horton, J., Shoimer, I., & Patten, S. (2015). Predictors of Well-Being in Resident Physicians: A Descriptive and Psychometric Study. *Journal of Graduate Medical Education, 7*(1), 70-74. doi:10.4300/jgme-d-14-00022.1

Malach-Pines, A. (2005). Burnout Measure—Short Version. *PsycTESTS Dataset*. doi:10.1037/t00766-000

Maslach, C., & Leiter, M. P. (2016). Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry, 15*(2), 103-111. doi:10.1002/wps.20311

Ochentel, O., Humphrey, C., & Pfeifer, K. (2018). Efficacy of Exercise Therapy in Persons with Burnout. A Systematic Review and Meta-Analysis. *Journal of Sports Science and Medicine, 17*, 475-484.

Rodrigues, H., Cobucci, R., Oliveira, A., Cabral, J. V., Medeiros, L., Gurgel, K., Gonçalves, A. K. (2018). Burnout syndrome among medical residents: A systematic review and meta-analysis. *Plos One, 13*(11). doi:10.1371/journal.pone.0206840

Salvagioni, D. A., Melanda, F. N., Mesas, A. E., González, A. D., Gabani, F. L., & Andrade, S. M. (2017). Physical, psychological and occupational consequences of job burnout: A systematic review of prospective studies. *Plos One, 12*(10). doi:10.1371/journal.pone.0185781

Sasse, S. K., Greenwood, B. N., Masini, C. V., Nyhuis, T. J., Fleshner, M., Day, H. E., & Campeau, S. (2008). Chronic voluntary wheel running facilitates corticosterone response habituation to repeated audiogenic stress exposure in male rats. *Stress, 11*(6), 425-437. doi:10.1080/10253890801887453

Sasse, S. K., Nyhuis, T. J., Masini, C. V., Day, H. E., & Campeau, S. (2013). Central gene expression changes associated with enhanced neuroendocrine and autonomic response habituation to repeated noise stress after voluntary wheel running in rats. *Frontiers in Physiology, 4*. doi:10.3389/fphys.2013.00341

Schmitter, M., Liedl, M., Beck, J., & Rammelsberg, P. (2008). Chronic stress in medical and dental education. *Medical Teacher, 30*(1), 97-99. doi:10.1080/01421590701769571

Simpson, K., Parker, B., Capizzi, J., Thompson, P., Clarkson, P., Freedson, P., & Pescatello, L. S. (2015). Validity and Reliability of Question 8 of the Paffenbarger Physical Activity Questionnaire Among Healthy Adults. *Journal of Physical Activity and Health, 12*(1), 116-123. doi:10.1123/jpah.2013-0013

Sothmann, M. S., Buckworth, J., Claytor, R. P., Cox, R. H., White-Welkley, J. E., & Dishman, R. K. (1996). Exercise Training and the Cross-Stressor Adaptation Hypothesis. *Exercise and Sport Sciences Reviews, 24*. doi:10.1249/00003677-199600240-00011

Teisala, T., Mutikainen, S., Tolvanen, A., Rottensteiner, M., Leskinen, T., Kaprio, J., Kujala, U. M. (2014). Associations of physical activity, fitness, and body composition with heart rate variability–based indicators of stress and recovery on workdays: A cross-sectional study. *Journal of Occupational Medicine and Toxicology, 9*(1), 16. doi:10.1186/1745-6673-9-16

Tonello, L., Rodrigues, F. B., Souza, J. W., Campbell, C. S., Leicht, A. S., & Boullosa, D. A. (2014). The role of physical activity and heart rate variability for the control of work related stress. *Frontiers in Physiology, 5*. doi:10.3389/fphys.2014.00067