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ORIGINAL CONTRIBUTION

The Impact of Burnout on Human Physiology and on Operational Performance: A Prospective Study of Soldiers Enrolled in the Combat Diver Qualification Course

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INTRODUCTION

In the course of training and in their work, military personnel are often required to spend considerable time under intense conditions with other people. Due to the performance demands and the intensity of the situations, the interactions between individuals may become charged with negative feelings of frustration, anger, as well as a sense of being without support. When these feelings are experienced for extended periods of time, they can be draining to an individual and can lead to burnout.

Maslach and her group [1, 2] argue that our current concept of stress is too broad and subject to misinterpretation, since some stress might be “difficult” but positive in nature, or negative in nature etc. (the idea of eustress and distress). She has developed the concept of burnout to address how well a person is

able to relate to his or her environment and has assessed this along an axis of emotional exhaustion, cynicism (or depersonalization — a sense of disconnection from conspecifics) and personal accomplishment. Within this framework one might conceive of a situation where a person feels stress, but will react differently to that challenge depending on the balance between their sense of emotional exhaustion, disconnection from others, and personal accomplishment. In this vein of thought, we may have a higher capacity to tolerate very difficult situations as long as we feel we are accomplishing something worthwhile and as long as we are supported by those to whom we feel connected.

Burnout is a non-psychiatric syndrome that has been mainly observed in individuals whose professional demands include a both

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^f Abbreviations: CDQC, combat diver qualification training; HPA, hypothalamic-pituitary-adrenal axis; HRV, heart rate variability; LF/HF ratio, low frequency/high frequency ratio; MBI, Maslach Burnout Inventory.

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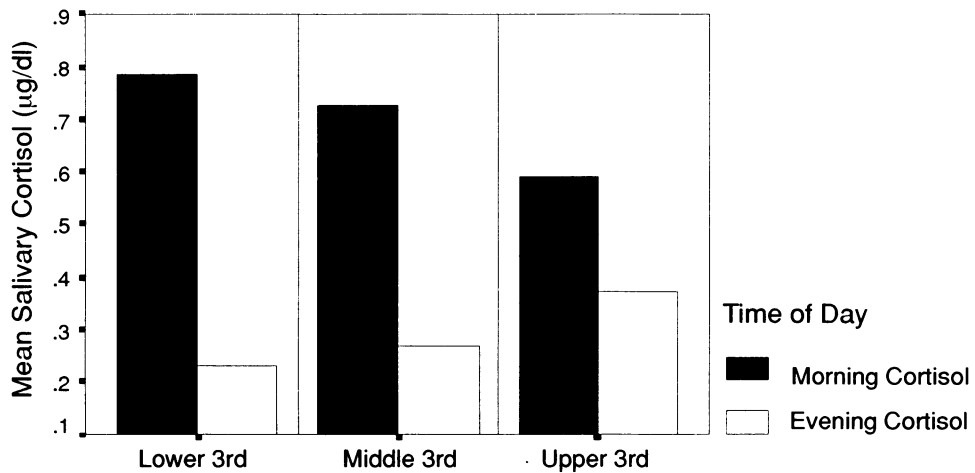


Figure 1. Diurnal variation of cortisol and symptoms of burnout. Group divided by Burnout Scores (higher ranking = more symptoms).

a high sense of ideals and a high degree of interaction with other people (such as teachers, firefighters, police, military and medical personnel). It is characterized by symptoms of emotional exhaustion (e.g., feeling emotionally drained by work, feeling used up at the end of the day), depersonalization (e.g., feeling more callous toward other people, feeling hardened emotionally), as well as a reduced sense of personal accomplishment (e.g., feeling that one's work is not making a impact, dealing less effectively with problems of peers) [1, 2]. Individuals experiencing burnout may also have physical symptoms of nonspecific pain, reduced attention span, and disturbed sleep [3, 4]. Several researchers have reported that the consequences of burnout are potentially serious for workers, their clients (or peers), and the institutions in which they function in so far that individuals suffering from burnout may exhibit inappropriate attitudes or behavior toward their clientele/peers, show a loss of idealism, and quit their profession at higher rates than individuals with less burnout [5, 6]. Further, several investigators have shown that symptoms of burnout significantly impair one's relationships with people in general, both on and off the job [7, 8].

Although many of the psycho-social aspects of burnout have been well characterized, surprisingly little is known about the patho-physiology of the syndrome. Because of similarities between the symptoms of burnout and those described in individuals suffering from chronic fatigue syndrome (physical exhaustion, irritability, reduced accomplishment, concentration difficulties) or from combat related stress disorders, one group of researchers [9], investigated hypothalamic-pituitary-adrenal (HPA) axis functioning and found that teachers who scored high in burnout were significantly lower in the regulation of cortisol — one of the body's major stress hormones. Although they did not link this to performance, the dysregulation of cortisol did explain some of the physical health complaints of the teachers. Their study suggests that perception of physical health is strongly linked to hormone regulation. Further, they suggest that alterations in the modulation of the sympathetic system may also be involved in burnout.

If little is known about the patho-physiology of burnout, even less is known about the actual impact of burnout on military operational performance. This is due to a lack of studies focused on military per-

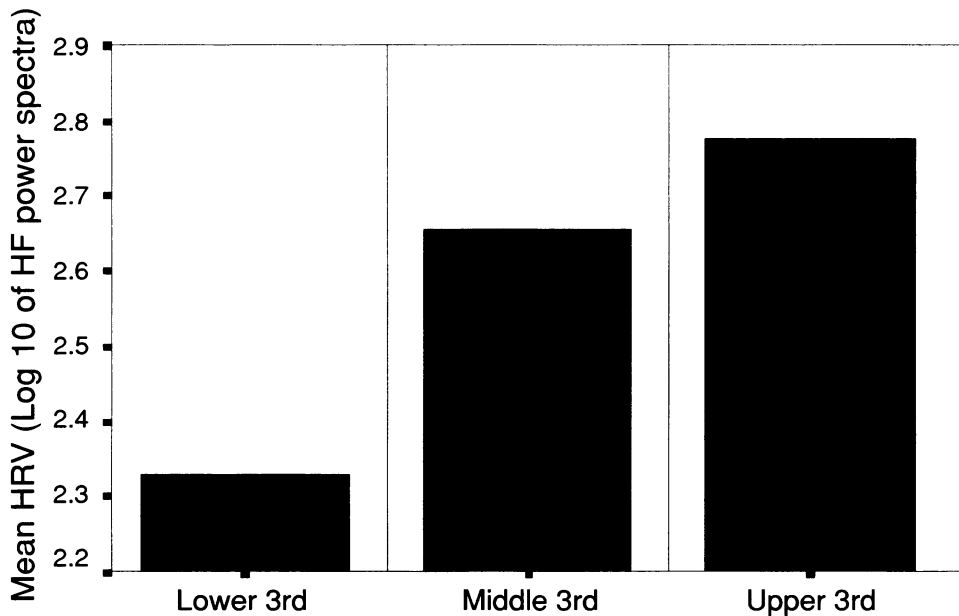


Figure 2. Heart rate variability and burnout scores at baseline. Group divided by Burnout Scores (higher ranking = more symptoms).

formance. Whether or not soldiers may feel symptoms of burnout is one thing — whether this state actually affects how they do their job is another. Within the current environment (reduced forces, increased training rates, increased deployment rates, extended tours) we believe that military personnel may be at significant risk for the development of burnout. Further, we wondered if there was a demonstrable impact of burnout on actual military performance as well as on human physiology. The present study was part of a larger investigation designed to assess the neurobiology of stress in soldiers participating in Combat Diver Qualification Training (CDQC). The portion of the study that we present here is that dealing with the assessment of burnout, HPA axis functioning and actual performance.

41 soldiers enrolled in CDQC were the subjects of this study. After having the study explained to them, subjects provided written, informed consent. Symptoms of burnout were assessed using the Maslach

Burnout Inventory (MBI) at “baseline,” 4 days before commencement of CDQC. On the morning and evening of the baseline assessment day, subjects also provided saliva and blood samples so that we could assess hormone data relevant to HPA axis functioning. Finally, and in order to assess parasympathetic and sympathetic “tone” in subjects, we measured heart rate variability. This was done by recording heart rate for a 10-minute period while subjects rested quietly in a supine position. The variability (or timing of the spaces between successive heart beats) was calculated using time domain and power spectra methods.

The above noted measures (burnout, salivary and plasma cortisol, heart rate variability) were compared to one another at baseline in order to assess whether individuals scoring higher in burnout would have significantly different patterns of cortisol regulation or of para-sympathetic or sympathetic tone. Next, we tested whether Burnout scores would predict significant differences in how soldiers actually performed

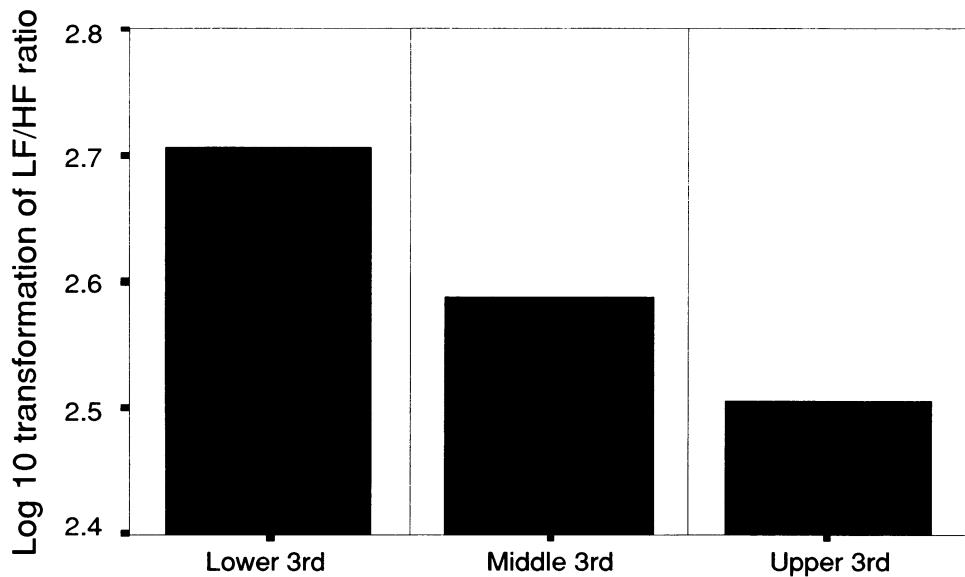


Figure 3. Sympathetic tone and level of burnout in subjects. Group divided by Burnout Scores (higher ranking = more symptoms).

during CDQC. The performance measures we used were: written examination scores, ocean swim scores, NO-GO scores (or mistakes made by students), and Underwater Navigation Scores while using the Draeger (the accuracy with which a student was able to arrive at the target site on the beach head after swimming 3 miles underwater at night in the ocean while on a re-breather system). Students were not able to surface in order to orient themselves and were not able to swim parallel to the beach if they arrived off target).

RESULTS

For the group as a whole ($n = 41$), the total burnout score was 31 ($SD = 13$). The sub-scale scores for Emotional Exhaustion, Depersonalization and Personal Accomplishment were 14 ($SD = 7.3$), 7 ($SD = 4.5$) and 37 ($SD = 7.0$) respectively. These values compare to the known civilian norms on the MBI of 12, 8, and 32, respectively. Burnout was significantly associated with alterations of HPA axis functioning. Subjects with higher levels of burnout (the upper

third of the group) had significantly lower morning cortisol levels and significantly higher evening cortisol levels compared to soldiers with less burnout. As shown in Figure 1, this resulted in a reduced difference between morning and evening cortisol levels in burnout subjects — also referred to as a reduction of diurnal variation of cortisol.

As shown in Figure 2, increased levels of burnout were also significantly associated with heart rate variability. The bars indicate that individuals with higher levels of burnout had significantly higher heart rate variability. (Note that the data are presented as a Log 10 value and thus represent larger differences than might be inferred from the figure.) Figure 3 depicts the relationship between Burnout and the Low Frequency/High Frequency ratio (LF/HF ratio) of heart rate variability. The LF/HF ratio represents the balance between sympathetic and parasympathetic influence on the heart and indicates the level of sympathetic tone. The higher the ratio, the higher the sympathetic to parasympathetic ratio, and thus, the higher the sympathetic tone. Subjects with lower levels of burnout had significantly higher sympa-

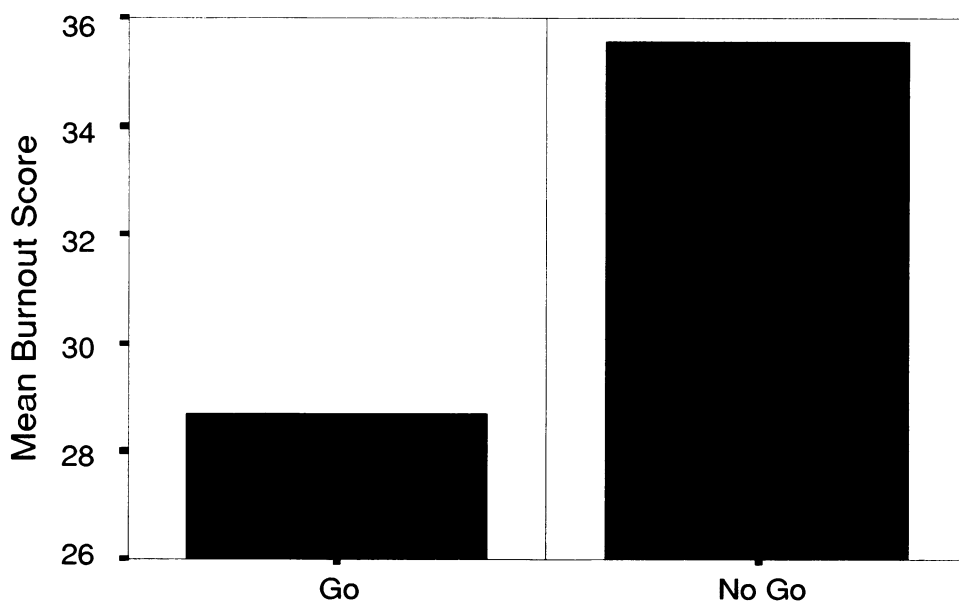


Figure 4. Burnout and status in CDQC. Group according to receipt of Go/No Go Scores.

thetic tone compared to those with increased levels of burnout.

As shown in Figures 4, 5, and 6, individuals who reported more burnout at baseline, exhibited significantly more errors, significantly slower swim times and poorer underwater navigation ability during CDQC. Although subjects with lower written examination scores tended to be higher in burnout at baseline, this difference was not significant.

DISCUSSION

Burnout (and specifically one's sense of "depersonalization") was associated with significantly lower morning cortisol, whereas burnout was positively associated with evening cortisol. This reduction in morning cortisol and elevation in evening cortisol reflects a flattening of normal diurnal variation of cortisol that has been described in patients suffering from chronic stress [10, 11]. These data replicate the findings of Preussler et al. [9] and add weight to the argument that disruptions of HPA axis regulation exist in individuals with burnout and

that such alterations may inform us about the patho-physiology of the disorder.

Burnout was significantly associated with increased heart rate variability. That is, individuals reporting the most symptoms of burnout had greater variability in timing of their heart beats. Because a number of studies have associated high variability with health and resilience, and low variability with states of anxiety and stress, the present data require some explanation.

Under normal conditions, the vagus nerve exerts a "braking" or slowing effect on the heart and maintains a low heart rate. Optimally, when an animal is threatened and it prepares to engage with or run from the threat, vagal inhibition of the heart is diminished and heart rate accelerates and variability between beats is reduced. One possible explanation for the association between high variability and burnout is that the "baseline" assessment is not a true baseline, but instead represents a state of preparation to "engage threat" — since soldiers are waiting for CDQC to start. Within this context, individuals who were not as prepared to engage in CDQC exhibited an inap-

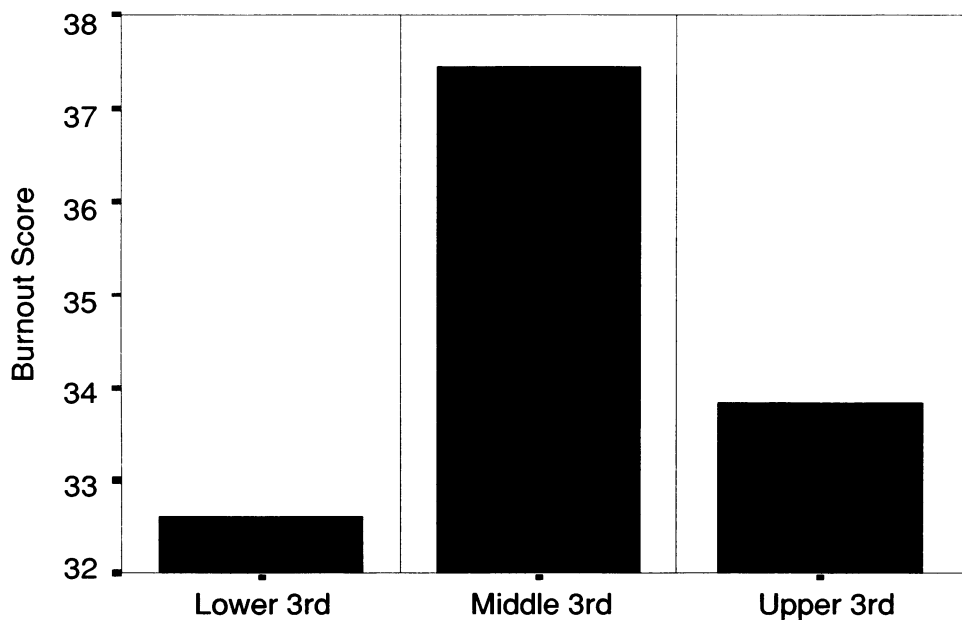


Figure 5. Burnout and swim times at CDQC. Group according to swim-time rankings.

appropriate level of vagal inhibition of the heart — which resulted in the increased variability.

The strong relationship between heart rate variability (HRV) and burnout suggests that one might objectively assess burnout and exhaustion in soldiers and improve decision-making about which individuals might be in need of an intervention more than individuals with less burnout. Burnout has been thought to reflect “goodness of fit” with one’s environment. The HRV data are consistent with this idea. Some people are not ready to perform operationally, and this lack of readiness may express itself in self-report measures of burnout or in enhanced heart rate variability when preparing for a stressful training experience.

Army medics are often in an ideal position to assess the medical and psychological state of the members of an operational military team. Keeping the concept of burnout in mind as well as its sub-components of emotional exhaustion, depersonalization, and personal accomplish-

ment, the Army medic might be able to identify early signs of the syndrome and thereby prevent burnout-related performance decrements that may ensue. Although at the present time there are no controlled studies assessing which countermeasures are the most effective, early identification of the signs of burnout may prevent significant performance deficits that might ensue. One might suppose that time out for recreation, psycho-education, and social support may each reduce a person’s sense of burnout and also support normalization of HPA axis regulation and of para-sympathetic tone [12].

The results of this preliminary CDQC study illustrate the need for future studies of burnout and human physiology. Such studies will help increase our understanding about the extent to which military operational performance may negatively affected by burnout. Such studies may help us understand the degree to which these findings may apply to job performance in the civilian area. Future studies may also enhance our understanding about the association between

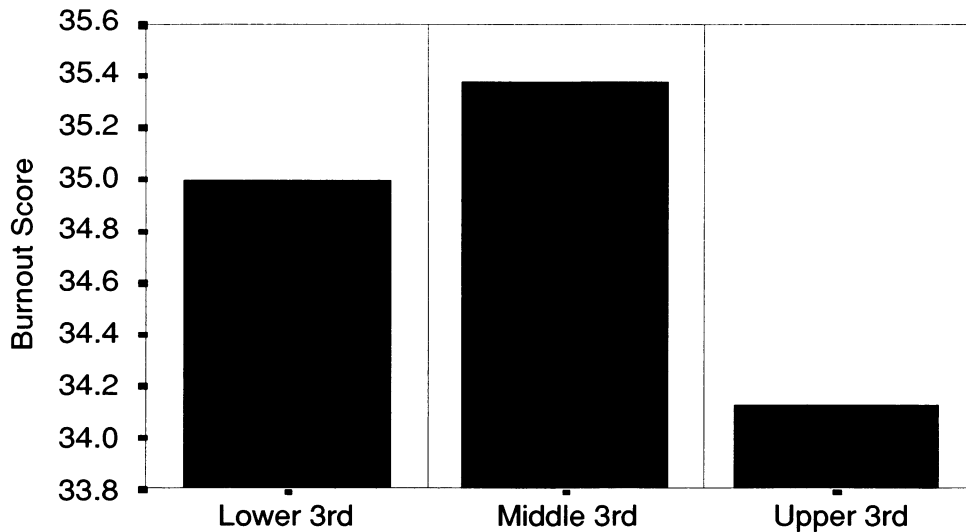


Figure 6. Underwater navigation rankings and swim times at CDQC. Group according to underwater navigation score rankings.

the condition of burnout and the abnormalities in HPA axis functioning and in HRV noted in the present study, in that we do not know if burnout is only associated with these biological alterations or whether it causes them. Increased medical knowledge about the patho-physiology involved in burnout may lead to the development of effective treatments for a condition that is linked to, and which predicts a decrease in optimal job performance.

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