

**Stress in the Medical Profession:
An evaluation of Pre-medical students, Medical students, and Doctors**

**Divy Ravindranath
Environmental Sciences**

Abstract

This study evaluates stress in individuals at three stages of the medical profession: the pre-medical level, the medical student level, and the level of the practicing physician. The evaluation is done using a physiological measurement - the capnometer - and a set of survey based psychological measurements. Specifically, the survey measures anxiety, depression, and the three aspects of burnout: emotional exhaustion, cynicism, and decline in personal accomplishment. This study tests the hypothesis that overall stress increases as the individual progresses through the medical profession. Under the hypothesis, the stress indicators should be highest for practicing doctors and lowest for pre-medical students. The means of measuring these stress indicators could confound this assumption. Doctors view their stress as external to them, as if that stress is associated with a different person. It is assumed that this is not the case for undergraduate students. Thus, when asked about their stress, doctors will respond that their stress is minimal; survey based measurements should show declining stress as the individual progresses through medicine. The results show significant differences between physiological stress levels, depression levels, anxiety levels, and levels of burnout between the three groups in the population. However, as expected, the hypothesis of a trend toward more stress as one progresses through medicine is only supported by the physiological measurement. The statistically significant results from the survey indicate that stress decreases as the individual progresses through the profession.

Introduction

Characterization of Stress Most of us are not strangers to stress. Indeed, as our involvement in our immediate environment increases, we begin to feel stress and the mental disturbances, like anxiety and depression (Bhat 1999, pers. comm.) that stress entails.

While affecting our mental state, stress also has physiological implications. Stress registers as overstimulation of the sympathetic branch of the nervous system, the branch of the nervous system responsible for controlling the so-called “fight or flight” response. The sympathetic nervous system, when aroused, will trigger increased muscle tension and tone, decreased digestive and immune activity, increased heart rate, and increased oxygenation of blood. These physiological changes are mediated by biochemical factors, like stress hormones, and through direct neurological interface. A consistently stressed person will develop breathing habits that reflect this excess sympathetic arousal, i.e. that person will always be at the margin of hyperventilation. The resultant low blood levels of CO₂ cause vascular constriction, irritability and other chemical imbalances. The more stressed the person is, the closer that person will be to hyperventilation (Fried 1987). Hyperventilation causes hyperoxygenation, so the partial pressure of carbon dioxide in a hyperventilating person’s exhalations will be low. A normal exhaled P- CO₂, or end-tidal CO₂, reading is between 38 & 42 Torr, stressed individuals will have lower readings (Bhat 1999). The interaction between the physical and the psychological operates in a vicious cycle making it difficult to escape the impacts of stress.

The majority of our interaction with our immediate environment happens in an occupational setting. Job related stress can generate burnout, a particular condition in which the stress generated by the occupation causes the individual to resent the job itself. Where an occupation used to be a source of comfort, that occupation becomes the ultimate cause of psychological and physical discomfort (Farber 1991, Cherniss 1995).

Burnout is commonly associated with service professions. Thus, the analysis of two common service professions, teaching and ministry, can help determine the factors that cause this increase in burnout.

Sanford (1992) outlines numerous qualities of those who become ministers and the occupation of being a minister that makes ministers more likely to burn out. First, ministers are committed to a goal that does not necessarily have full definition or a logical end point.

Second, ministers conduct repetitive tasks to “heal” people who do not necessarily need healing. Finally, the persona of the religious figure must be worn at all times. This traps the minister in a two-dimensional life; the minister is a minister and nothing else.

The teaching occupation exhibits many qualities similar to ministry. Here, too, the teacher is committed to a goal that may not be easy to define. Second, teachers must engage in repetitive tasks. Finally, and most strikingly, the teacher must consistently wear the mantle of teacher. This persona also limits the majority of a teacher’s interpersonal interactions to children (Farber 1991, Cherniss 1995).

Stress in Medicine Medical professionals must endure an enormous amount of work-related stress. They have to be correct in all decisions. If they are wrong, a life could be lost. In addition, they have to be prepared to leave what they are doing at a moment’s notice to attend to a medical emergency. Also, there is a multitude of conflicting calls for their attention during a standard workday. Indeed, the profession is so stricken with “wounded healers” that the care of physicians has become a large field of work (Cejka 1999). Peters (1997) reports that, in a 1996 survey in the United Kingdom, 88% of general practitioners surveyed report that they have more stressful lives in the year of the survey than they did in 1991. Additionally, 69% of surveyed doctors have suffered from stress-related symptoms. Even as early as 1989, American estimates were that 1 in 10 physicians suffered from some sort of stress related impairment (Scott 1989).

Medical students are also exposed to numerous stressors. They spend long hours studying for exams that will determine their future. The medical curriculum is not simple and the stress of trying to comprehend the complex material can become overwhelming. Additionally, the first exposure to patients is very emotionally taxing. This exposure comes very early in the medical curriculum at many institutions. Many medical students overuse alcohol and have difficulties in their personal lives because of their stress. Numerous studies have revealed psychological morbidity in medical students including various neurotic symptoms. In a general health survey, over 50% of medical students surveyed reported high stress (Guthrie *et al.* 1998). The prevalence of emotional disturbance due to stress in medical students is reported as 31.2% in British medical students. A similar number was reported for American medical students (Firth 1986).

Progression through the medical profession demands emotional and personal sacrifice for intellectual gain. That process starts in the individual's pre-medical years (Scott 1989). The pressure of preparing to be a doctor forces the individual into comfort with a high stress lifestyle. The medical schooling system is designed to slowly whittle away those students who cannot excel in a high stress environment (Lamberg 1999). Beck (1995) sought to determine the causes of burnout in second year undergraduate nursing students by asking nursing students to "describe a situation in which you experienced 'burnout' during your undergraduate nursing program." They determined that the biggest cause of stress was trying to juggle their school requirements, especially around exam time. Also, these students had patient contact, similar to medical students. It is important to note that there is a paucity of research about stress in other undergraduate students, especially undergraduate students intending to enter the medical profession.

Psychologists treating doctors suffering from stress often report that their patients report their symptoms as if they are presenting one of their patients to another doctor (Lamberg 1999). This kind of detachment implies that doctors actively mask their own stress. Thus, when asked about their own mental stress level, doctors will say that it is low. Through years of training, they have come to be comfortable in high stress environments. By learning to operate in high stress environments, doctors have learned to "beat" stress surveys.

As shown earlier, three common characteristics of burnout-susceptible populations are lack of measurable goals, repetitive tasks, and the permanent persona. These characteristics are present in medicine. Doctors aim to treat the ill, but the extent of that treatment is somewhat nebulous. In other words, the definition of "health" is subjective. Additionally, commonplace conditions are treated in a regimented manner. Doctors follow an established protocol; this can become repetitive. Finally, doctors are expected to speak from behind a scientific façade at all times. Patients do not want to hear that their illness is just some random act; rather, they seek the comfort of a logical explanation couched in medical terminology. Of course, medical school is where doctors learn these characteristics of their trade; it is where they learn the habits that make them susceptible to burnout (Bhat 1999, pers. comm.).

It is possible that the profession of being an undergraduate student will fall into the category of being prone to burnout. Undergraduate students engage in learning, a practice

previously described as being vague. Additionally, they are still questioning the direction of their life. As such, there is much uncertainty in the goal of their education. Second, the tasks of going to lecture, preparing for exams, etc. are very repetitive. Finally, students are always expected to act like students.

Hypothesis Based on the characteristics of stress, the belief that psychological stress as measured by survey decrease while overall physiological stress and burnout rates increase as the individual progresses through medicine will be tested.

Although doctors are under more pressure (lives are at stake) they have been trained to live with that pressure. Undergraduates, on the other hand, are exposed to a great deal of pressure but that population has not been whittled down to those that excel in that environment. The survey measures how well one's mind responds to stress, so doctors should have learned how to "beat the test." By this logic, medical student stress levels as measured by survey will fall in between those of pre-medical students and doctors. That population has been through one wave of weeding, resulting in a more resilient group.

Surveys measure "beatable" components of stress; for example, mild stomach irritation due to anxiety will feel less intense when the person being surveyed is used to feeling that condition. The capnometer is a direct physiological measurement; there is no way to beat this test. It is my assumption that actual practice is more stressful than being a student; therefore, doctors should have the lowest end-tidal CO₂ values.

Burnout is more common in service professions than in non-service professions. Students are not service professionals. Medical students begin to see patients as a component of their studies, so they should have burnout rates in between the rates of the other two groups.

Methods

A survey was developed to evaluate the aspects of stress previously discussed. The Maslach Burnout Inventory, which has separate indices to evaluate emotional exhaustion, cynicism, and personal accomplishment, was adapted to each subgroup: pre-medical students, medical students, and doctors (Maslach & Jackson 1986). The only real changes that had to be made involved the replacement of reference terms, like work, with terms that would make sense to each group respectively, like studies for students. The Beck Depression

Inventory and the Beck Anxiety Inventory, each a clinical tool, were integrated into the survey to evaluate depression and anxiety (Beck & Steer 1987, Beck & Steer 1993).

In addition to the survey, a capnometer was used to measure the extent to which each person hyperventilated. Traditionally used in emergency rooms and intensive care units to make sure that the patient is breathing, the capnometer is a sensitive measure of the partial pressure of carbon dioxide being exhaled, among other variables. Other physiological measurements to evaluate possible confounding factors for CO₂ analysis were judged to be superfluous. It is assumed that conditions that would cause end-tidal CO₂ amounts to vary, like asthma, occur with the same incidence in the three populations. Therefore, a large enough sample size should account for these conditions.

Doctors were found at a seminar about burnout and in the doctor's lounge at two hospitals. Medical students were drawn from their respective programs. Pre-medical students were drawn from and evaluated after a meeting of a class commonly taken by pre-medical students. Each participant in this study did so voluntarily and with full knowledge that the methods of this project are innocuous and approved by an institutional review committee. Signed release forms were obtained from each participant before the data were collected.

The numerical data were tabulated as per the instructions for tabulation for each standardized assay in the survey. Tabulation yielded subscores for emotional exhaustion, cynicism, personal accomplishment, anxiety, and depression. End-tidal CO₂ values were also compiled for each participant.

The tabulated information was then analyzed using multivariate analysis (MANOVA) with the SBSS version 9.0 statistics software. The alpha value was set at 0.05. There was one independent variable with three levels, one level for each group and six dependent variables, one for each tabulated score. Analysis was performed on 16 individuals in each group. All 16 available samples for the medical student group were used; 16 randomly selected samples were used for the other two groups. The only consideration in random selection was to have an even number of male and female samples in each group. Gender affects stress studies among medical professionals in an indeterminate manner (Gross 1997). Additionally, a T-test with the same alpha as the MANOVA test was performed on 32

samples from the pre-medical group and the doctor group for the end-tidal CO₂ variable to determine if a larger sample size would yield more significant results.

Results

Table 1 reports the means for each variable for each group. High emotional exhaustion and cynicism subscores are related to high burnout; high anxiety and depression subscores are related to high stress. The other variables tested, end-tidal CO₂ and personal accomplishment, correlate to stress and burnout, respectively, in the opposite direction. Statistical data for the first analysis, which included all of the variables, are reported on Table 2; significance values less than or equal to .05 are in **bold**. The means and statistical data for the second analysis of end-tidal CO₂ and respiration rate (N=32) are reported on Table 3; significance values less than or equal to .05 are in **bold**. Figures 1, 2, and 3 report the means for the statistically significant variables within each group.

	Pre-Medical Students	Medical Students	Doctors
End-Tidal CO ₂ (Torr)	35.5	34.4	33.7
Emotional Exhaustion	21.1	16.7	11.3
Cynicism	11.2	11.3	6.1
Personal Accomplishment	25.9	28.6	32.0
Anxiety	16.9	9.5	4.0
Depression	3.7	2.6	0.6

Table 1. Means for each variable tested divided by group. N = 16.

	Univariate Tests		Pairwise Comparison Significance		
	Observed Power	Significance	PreMed vs. Med	Med vs. Doc	PreMed vs. Doc
End-Tidal CO ₂ (Torr)	0.281	0.263	0.937	1.000	0.322
Emotional Exhaustion	0.992	<0.001	0.990	0.022	<0.001
Cynicism	0.736	0.017	1.000	0.038	0.041
Personal Accomplishment	0.922	0.002	0.295	0.116	0.001
Anxiety	0.979	<0.001	0.043	0.191	<0.001
Depression	0.986	<0.001	0.357	0.013	<0.001

Table 2. Statistical Information for three groups. N = 16; Alpha =.05

	Pre-Medical Mean	Doctor Mean	Observed Power	Significance
End-Tidal CO ₂ (Torr)	35.3	33.5	.704	0.014

Table 3. T-Test for PreMed vs. Doctors for End-Tidal CO₂. N = 32; Alpha =.05

Discussion

Differences in the anxiety, depression, and burnout variables proved to be significant among the three groups. Further analysis showed that a larger sample size provides a significant difference in end-tidal CO₂ between pre-medical students and doctors.

Figure 1 shows that there is a trend away from burnout as the individual progresses through the medical profession. Emotional exhaustion and cynicism subscores are both lower for doctors than they are for pre-medical students; personal accomplishment subscores are lower for pre-medical students than they are for doctors. For each of these subscores, the medical student mean falls between the scores of the other two groups. This trend is in contrast to the expected pattern; the hypothesis being tested states that doctors are supposed to be more burned out than students. This study shows that the opposite is true. Once again, there is a very significant difference between pre-medical students and doctors for all three variables. The lack of a significant difference between pre-medical students and medical students indicates that the change in how prone the individual is to burnout occurs after the individual begins to practice medicine. This interpretation is supported by the fact that there

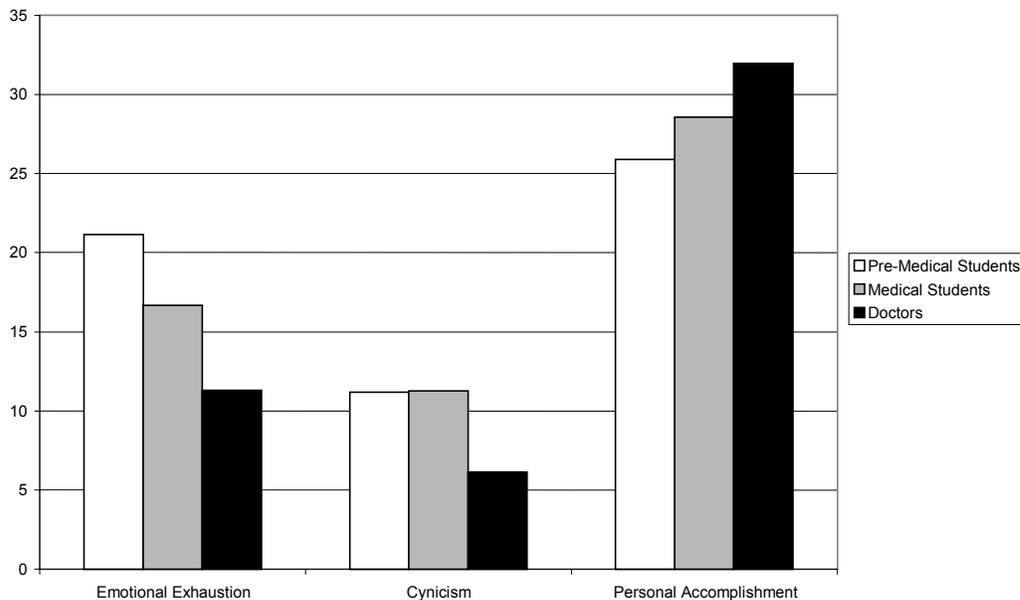


Figure 1. Burnout Variable Means (unitless). N = 16.

is a significant difference between medical students and doctors for two of the three burnout subscores. This change may happen earlier because, in this particular data set, there was no contribution to the medical student information from students in their third or fourth year of medical education. These two years are when the student has the most patient contact, a key theoretical determinant for burnout. However, this determinant is supposed to operate in the opposite direction; patient contact is supposed to increase burnout.

It is important to note that the fact that some of the doctor data were collected from doctors interested in burnout would not alter this conclusion. If these doctors attended the seminar because they felt that they were burning out, the burnout trend from pre-med to physician would have been biased in the opposite direction. At worst, in representing the spectrum of doctors, the data presented here would depict the more burned out end of the doctor population.

From Figure 2, there is a downward trend in anxiety and depression as the individual progresses through the medical profession. This is the trend that was expected. Pairwise comparisons show significant differences between pre-medical students and medical students for anxiety but not for depression and between medical students and doctors for depression but not for anxiety. It appears that medical students are indeed somewhere between pre-

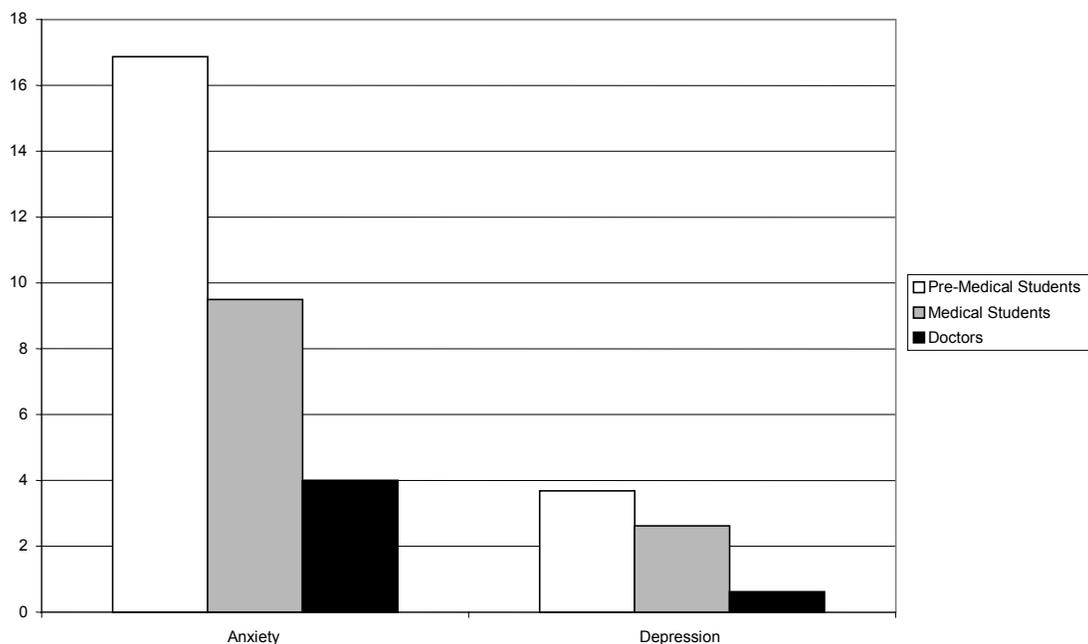


Figure 2. Anxiety & Depression Means (unitless). N = 16

medical students and doctors in terms of psychological stress, especially in light of the fact that there is a very significant difference between pre-medical students and doctors for both variables.

The use of a survey to assess psychological components of stress may have affected the accuracy of the data. People tend to accentuate the positive in their responses to surveys designed to test personality. For example, when asked how often they feel sad, some individuals may have made a lower estimate than would be warranted. Thus, the depression score for that person is lower than it should be. To a larger extent, this may also explain why the trends for the burnout variables are in the opposite direction than expected. Doctors will have more experience with psychological surveys than pre-medical students, so they would be more likely to recognize any particular question, no matter how cleverly phrased, as a measure of positive or negative psychological characteristics. As previously described, doctors train themselves to see their own stress externally. Because medical students are closer to being doctors than pre-medical students, their level of internal protection from stress falls in between the doctor group and the pre-medical group, explaining why their survey scores fall in between the doctor group and the pre-medical group.

In contrast to the survey based psychological information, the trend in the end-tidal CO₂

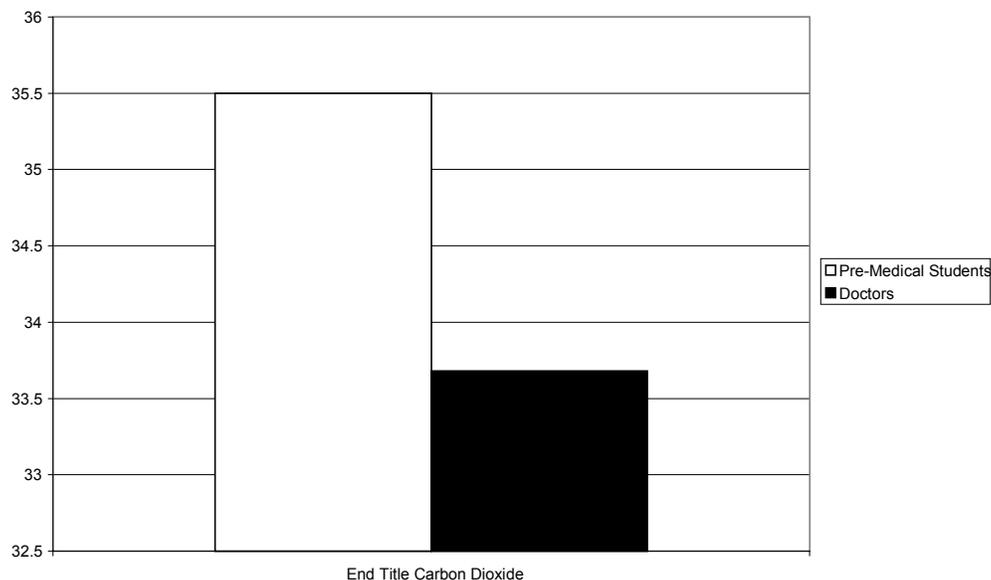


Figure 3. End Title Carbon Dioxide Means (in torr). N = 32

variable as reported in Figure 3 is as suggested by the hypothesis. Doctors feel more physiological stress than students do and pre-medical students feel less stress than medical students do. Pairwise analysis was only significant for a larger sample size between pre-medical students and doctors. Therefore, it is not safe to assume that the difference between medical students and either of the other two groups is significant. However, the fact that the two ends of the trend do have a significant difference with a sample size larger than the one used in the original test seems to show that more research in this area will reveal a truly significant trend. It can be concluded that being a doctor is more stressful than actually preparing to be a doctor.

A possible confounding factor, however, is age. Doctors are older than medical students, who are in turn older than pre-medical students. Age can adversely affect the oxygenation efficiency of blood and muscles thereby artificially depressing end-tidal CO₂ values. Also, the prevalence of conditions that would adversely affect end-tidal CO₂ is probably greater in older people than in younger people as is often the case for diseases in general. This factor could not be controlled within the scope of this project.

Conclusion

This study tested the trends in stress as people progress through medicine, starting with the pre-medical years and concluding with the practicing years. A significant upward trend in physiological stress but a significant downward trend in psychological stress was observed. Because the burnout trend is significantly in the opposite direction from the proposed trend, it can be tenuously concluded that burnout is not necessarily restricted to the service professions. The self-perception trained into physicians is likely to have tainted these results. Because of this and other difficulties experienced in this research, including the limits of small sample size and the problems of comparing people of different age groups, no real conclusions can be drawn without further research. It would be prudent to investigate each variable under more controlled conditions. It would also be prudent to produce more background information for the student populations. There is a paucity of hard research about the stress levels of students.

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