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Make Changes Early! High Stress Levels Predict Lower Academic Performance in First-Year Physical Therapy Students: A Pilot Study

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Abstract

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ABSTRACT

Purpose: Evidence exists in the literature that allows admissions committees to predict which students will be most successful in entry-level physical therapy educational programs. Evidence linking modifiable predictors of academic performance to currently enrolled students allowing enhancement of their performance during enrollment is lacking. Previous healthcare education literature indicates that stress has a negative predictive relationship with academic performance, and that stress is the highest in the beginning of an academic program. Research studies with medical students report exercise assists in minimizing stress and improving academic performance, while the role of leisure time has also been investigated. No study has explored the role that stress, exercise, and leisure time may have in predicting academic performance in physical therapy students. **Method:** Physical therapy students ($N = 37$) who had successfully completed the first year of the program were recruited. Participants completed a questionnaire measuring their stress level and the time spent exercising and participating in leisure activities. Grade point average was used to measure academic performance. A hierarchical multiple regression was performed with each of the three predictor variables and the one outcome variable. **Results:** A significant negative predictive relationship was observed between stress ($M = 43.73$, $s = 15.90$) and GPA ($M = 3.75$, $s = .31$), $p = .042$. The stress predictor [$r = .293$, $r^2 = .086$], explained only 8.6% of the variance in GPA. **Conclusions:** Higher stress predicts decreased academic performance in first-year physical therapy students. Future research on stress modification could be beneficial in improving performance in students struggling in an academic program.

Keywords: academic performance, exercise, grade point average, leisure, physical therapy, stress

INTRODUCTION

The Importance of Identifying Factors Related to Academic Performance

Predicting the success of individual students enrolled in an entry-level physical therapy education program has long been a topic of research, with most studies advocating for the use of specific variables during the admissions process.¹⁻³ Previous research has also provided data enabling faculty to predict the risk of students having difficulty during their time in school.⁴ Additionally, although there are a variety of factors faculty can use to predict student success in a program, students having “difficulty” in school has been shown to predict those who will not pass the National Physical Therapy Examination (NPTE) upon graduation.⁵ This body of research has provided three main recommendations: 1) specific variables typically included in the admissions process can be used to predict academic success, 2) additional variables used in the admissions process can be used to specifically predict clinical success, and 3) variables observed during physical therapy school can be used to predict which students are more likely to have success on the NPTE.¹⁻³ For example, using a retrospective regression model, Balogun was able to demonstrate that preadmission GPA and an essay was best able to predict academic success.¹ The same was found for preadmission GPA and an admissions examination; however, preadmission GPA and interview scores were best for determining who was most likely to succeed in the clinic.² Additionally, Dockter was able to demonstrate that a student’s GPA at the end of the first year of school was the best predictor of success on the NPTE.³

Although this information has been helpful in the admissions process, it provides minimal guidance for faculty regarding issues which may arise during a student’s time in a program. This would include modifiable risk factors amenable to change during a student’s tenure in a program in order to optimize performance and success moving forward. If modifiable risk factors, which specifically predict either a decline or improvement in academic performance during a student’s time in a program exist, then tracking these variables would be beneficial. It would allow faculty to determine when to intervene, or when the student should take their own initiative in improving their chances of success. Faculty members serving as academic advisors in physical therapy education programs periodically find themselves in a situation where students need advice on how to improve their performance. Some have advocated that academic advisors serve as role models by taking a more active role in helping their students manage stress, build self-reflective strategies, and set goals, as part of improving academic success.⁶ Additionally, finding ways of improving academic performance through non-academic related activities could be explored as options of improving performance in programs.

Modifiable Risk Factors

Determining which risk factors for poor academic performance are modifiable while a student is enrolled must first be determined. First, factors such as pre-admission GPA, GRE score, interview ratings, etc. are easily classified as non-modifiable. Second, as previously mentioned, while a student’s GPA within the program and their classification as having “difficulty” is modifiable, these factors themselves are measures of academic achievement. Therefore, non-academic related risk factors, independent of grading and assessment measures, must be used. For example, research has shown that students in graduate science or healthcare programs have high stress levels.^{7,8} This can have a negative impact on academic performance.⁸ Students possessing good study skills, a sense of personal responsibility, and high self-efficacy predicts improved academic performance.⁹ Kelly et al demonstrated that after a stress modification program, medical students who had a relatively low exercise level increased their time spent exercising by the end of the investigation; however, they saw no increase in the time spent pursuing leisure.¹⁰ Of the non-academic factors discussed, stress levels, time spent exercising, and time spent in leisure activities were identified as the easiest to quantify.¹⁰ These three personal factors are all modifiable and related to academic performance, having been explored in previous investigations.

Risk Factors and Academic Performance

Stress levels have previously been examined in students enrolled in graduate healthcare programs (i.e., medicine, clinical psychology, and physical therapy).^{8,11-13} Several of these studies have specifically targeted students early in the curriculum and the role of stress in those formative years.^{8,12,13} Investigations have repeatedly targeted this population of new students in academic programs mostly from experiences of students in this situation needing to learn how to cope with their new environment. For example, first year undergraduate students across a variety of majors have been shown to require increased external support from others as compared to upperclassmen.⁹

Physical Therapy Students

There is relatively little research on modifiable risk factors for physical therapy student academic performance. One study by Van Veld et al explored the ability of students to cope with stress as they progressed through a curriculum.¹³ The authors emphasized the importance of both formal and informal coping strategies. Strategies discussed included exercise, support systems, and mental components (i.e., mindfulness, distractions, reflection), workload and examinations, and overall life balance.

Medical Students

Medical students have demonstrated lower academic performance when they have high stress levels.^{8,12} Traditionally, evidence-based methods for handling stress were not formally implemented.¹⁰ More recently, stress management has been advocated as a method of improving academic performance in this population.¹⁴ New research has indicated that interventions like mind-body classes, when practiced by students volunteering for intervention, can be beneficial in reducing the stress resulting from medical education.¹⁵ However, when mindfulness sessions were implemented as a mandatory component of the first-year medical curriculum, no positive benefit was observed.¹⁶ Additionally, Yusoff et al, in an investigation of medical students, showed students with neurotic tendencies were at an increased risk of coping poorly with the stress associated with medical school, and advocated for the early identification of these students so that support and stress management can be provided.¹⁷ Therefore, stress has clearly been identified as an important risk factor in medical students with regard to academic performance. However, other than agreeing on the principle that reducing stress is key, the means of doing so is less clear. Although this negative connection between stress and academic performance is true for medical students, not all graduate students respond identically to stress. Indeed, the opposite seems to be true in other graduate level disciplines.

Other Graduate Healthcare & Undergraduate Students

In a study by Nelson et al, higher stress levels were observed in American doctoral clinical psychology students (N = 53) with high academic outcomes.¹¹ Additionally, in first- and second-year undergraduate pharmacy students, self-perceived stress levels were negatively correlated with relationships and health.¹⁸ Two of the primary stressors reported by these undergraduates were the quantity of content required to learn and the lack of leisure time.

Healthy behavior, like sports participation in college, decreases stress levels associated with academics in freshman undergraduates.¹⁹ In another study of undergraduate students, Felez-Nobrega et al showed that greater than three hours per week of physical activity benefits working memory; however, this finding was not specifically related to academic performance.²⁰ Regardless, they did show that greater than three hours of sedentary activity during a weekday was inversely related to academic performance. Exercise is associated with decreased behavioral reactions to stress in undergraduate college students.²¹ Even though physical activity has been shown to have an effect on stress, the role of rest also must be considered.

Felez-Nobrega et al also examined the role of leisure time on academic performance and working memory, finding an inverse relationship.²⁰ Only screen time activities and sedentary activities were examined, without specifically taking into account time spent with family and friends or performing more active leisure activities not necessarily considered exercise. Misra and McKean demonstrated that participation in leisure activities is negatively correlated with school related stress in undergrads, and that students' reactions to that perceived stress were also lessened with increased leisure.²¹ Additionally, older students experienced with time management, and who had decreased anxiety and increased leisure, had lower psychological and physical reactions to stress. However, leisure was not shown to have a relationship with academic performance. Overall, some of the same factors explored in medical students show variable results when examined in other healthcare students. Additionally, the classification and time spent in the academic program also seem to play a role.

Measuring Stress

The methods of measuring stress are diverse, including various multi-item questionnaires.¹¹ This can also include those used in more formal psychological testing.¹² Previous investigations have explored easier, less onerous ways of measuring self-perceived stress levels to avoid these more complex diagnostic tests or the use of long questionnaires. This includes the use of a visual analog scale (VAS), a scale commonly used to measure pain in the clinical setting, adapted to measure occupational stress in French occupational health centres.^{22,23} Research shows that this adaptation of the VAS is able to detect increased stress levels at least as well as a clinical questionnaire.²³ The VAS stress scale has construct validity when compared to Cohen's Perceived Stress Scale, with the latter being cited as less useful clinically due to its length and complexity.²³ The VAS also has good inter-rater reliability.²⁴ The use of such a tool could be especially useful in academia since most faculty are not trained psychologists able to use more complex testing techniques. Using a familiar, easy to use clinical tool, like the VAS, to measure stress in students could aid in early detection and help start the process of modification.

Purpose of the Investigation

The purpose of this pilot study was to determine whether a predictive relationship exists between three modifiable risk factors (self-perceived stress level, time spent exercising, and time spent in leisure) and academic performance as measured via grade point average (GPA). Our hypotheses included the following: decreased perceived stress levels would predict increased academic performance, greater time spent exercising would predict increased academic performance, and greater time spent in leisure would predict increased academic performance.

METHODS

Subjects

Participants included physical therapy students (N = 37) completing their first year of school in an entry-level Doctor of Physical Therapy program. Exclusion criteria included those who did not wish to participate, or those who may not have completed the year due to attrition. Recruitment was performed via an e-mail sent out to all who met these criteria.

Research Design

This investigation explored the existence of possible predictive relationships between three mutually exclusive interval/ratio level predictor variables on a single interval/ratio level outcome variable. Therefore, a multiple regression was selected for data analysis. As this study was retrospective and did not place students at greater than minimal risk, the study was approved via expedited review by the Institutional Review Board. The investigators collected data at the end of the academic year in order to allow for a full review of the previous year's performance, and to take into account the long-term ratings provided by students for their stress, exercise, and leisure.

Questionnaire

Based upon the work by Lesage and Berjot (discussed earlier), an 80 mm long VAS using the same terminology was adapted to measure self-perceived stress, using the same labels "none" and "as bad as it could be" for the lowest (left side of the scale) and highest (right side of the scale) margins, respectively.^{22,23} This scale has been shown to be a valid measure of stress and to have good inter-rated reliability in previous studies.^{23,24} Additionally, the authors asked for the number of minutes and hours per week the students exercised and participated in leisure activities, respectively. Details on the operational definitions for each of these two variables were included. See Appendix A for the questions included on the data collection form. A portion of the questionnaire included an area for the investigators to record the students' GPA after the conclusion of the semester.

Recruitment and Procedures

All student participants attended a scheduled session where the informed consent was signed, and the questionnaire was completed. Informed consent was obtained from all individual participants included in the study. Data collection occurred during the last week of the spring semester immediately after the completion of the last final examination. The investigators awaited final grading to be completed before collecting final end-of-year GPAs. The questionnaires were then deidentified prior to data processing. The investigators measured, in millimeters, from the point on the far left of the VAS stress scale to the point at which the students' marked, indicating their perceived stress level. The ratings provided for exercise and leisure were also collected (Table 1).

Table 1. Descriptive Data for Outcome and Predictor Variables

Variable	N	Skewness	Kurtosis	Kolmogorov-Smirnov Testing	Mean (St. Dev)
GPA	37	-1.42 (.39)	1.35 (.76)	<.001	3.75 (.31)
Stress	37	-.48 (.39)	-.68 (.76)	.20	43.73 (15.90)
Exercise	37	.55 (.39)	-.57 (.76)	.032	217.70 (163.65)
Leisure	36*	1.31 (.39)	1.54 (.77)	.012	21.36 (15.81)

*Extreme case removed from analysis via pairwise comparison.

Data Analysis

Once data collection was complete, analysis was performed using SPSS version 25 (IBM, Armonk, NY, USA). Assumptions analysis included screening for normality, independent errors, homoscedasticity, and ensuring no perfect multicollinearity. All four variables had skewness and kurtosis values within the acceptable range of ± 2 ; however, there was some significance noted with Kolmogorov-Smirnov testing (Table 1). Since stress, the variable of most interest was normally distributed, GPA being naturally negatively skewed due to academic standards, and reliance upon the central limit theorem (greater than 30 participants), the investigators felt normality could be assumed when weighed with the acceptable skewness and kurtosis values. Independence of errors was assumed since Durbin-Watson testing revealed a score of 1.93, with 2.00 being ideal. Homoscedasticity was evaluated via studentized residual versus standardized predicted and studentized residual versus standardized predicted plots, with all data points falling between ± 2 . Finally, we screened for perfect multicollinearity via analysis of the correlations between all the variables (Table 2), and analysis of the tolerance and VIF for each variable (Table 3). All values were within acceptable ranges.

Table 2. Correlations

	GPA	Stress	Exercise	Leisure
GPA	1.00	-.29 (.039)	.083 (.312)	.081 (.320)
Stress	--	--	-.010 (.478)	-.27 (.059)
Exercise	--	--	--	-.20 (.118)

Values given are the Pearson correlation for each comparison, along with p-value in parentheses (one-tailed).

The predictor variables were entered via hierarchical input, with each being entered in order from highest evidence to lowest (stress, exercise, then leisure) according to their perceived relationship to academic performance based upon the literature review. Therefore, there were three models included in the analysis. Significance was assessed via an alpha level of .05, with the p-value provided by SPSS being halved due to the one-tailed, directional nature of the alternate hypotheses. One participant's response on the leisure questions was considered an extreme case since they recorded 550 hours of leisure per week. It was assumed this participant misunderstood the question, recording minutes instead of hours; therefore, this one response of theirs not included in the data analysis via pairwise comparisons.

RESULTS

Only model 1 of the multiple regression indicated a significant negative predictive relationship between stress ($M = 43.73$, $s = 15.90$) and GPA ($M = 3.75$, $s = .31$), $p = .042$, via our one-tailed alternate hypothesis. The data fit the regression line $y = -.006x + 4.001$ ($x = \text{stress}$ and $y = \text{GPA}$), demonstrating a GPA can be calculated (predicted) with this formula using the stress score obtained at the end of the first year of school (Figure 1). Although statistically significant, the stress predictor [$r = .293$, $r^2 = .086$], explained only 8.6% of the variance in GPA. Model 2 which included stress and exercise, and model 3 which included stress, exercise, and leisure were not significant (Table 3).

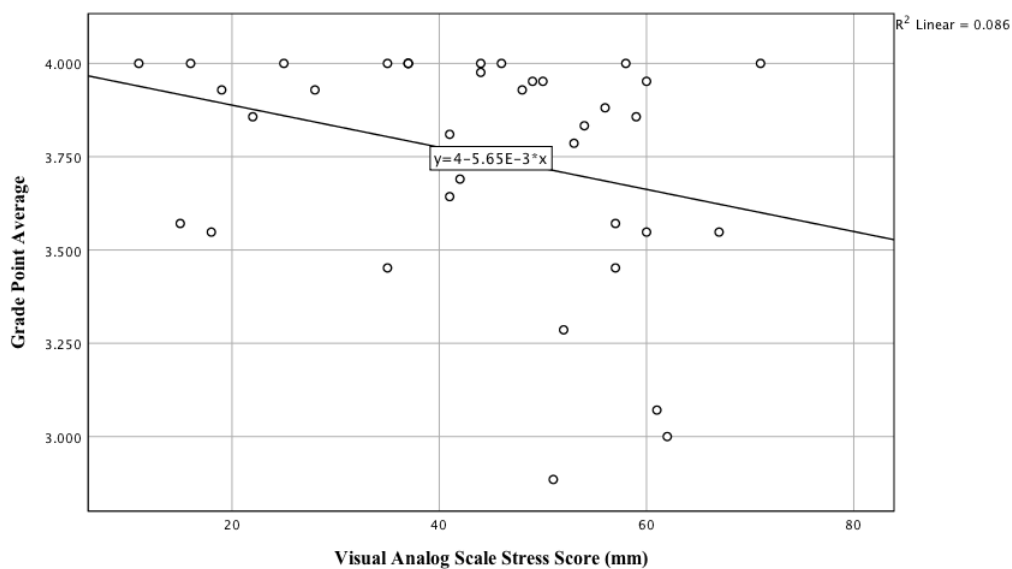


Figure 1. Visual Analog Stress Score in Millimeters

Table 3. Summary of Findings for Each of the Three Regression Models

Model	Predictor Variable	R-squared	Standardized Beta Weight	Tolerance*	VIF†	t-statistic	p-value
1	Stress	.086	-.293	1.00	1.00	-1.79	.042‡
2	Stress		-.292	1.00	1.00	-1.76	.044‡
	Exercise	.092	.081	1.00	1.00	.49	.31
3	Stress		-.287	.93	1.08	-1.64	.056
	Exercise		.085	.96	1.05	.49	.31
	Leisure	.093	.022	.89	1.13	.12	.45

*Values should not be less than .1 to assure no perfect multicollinearity.

†Values should not be greater than 10 to assure no perfect multicollinearity.

‡Significant at $p < .05$.

DISCUSSION

These results allow the investigators to accept the first alternate hypothesis, which stated that a negative predictive relationship would exist between students' self-perceived stress levels and their GPA at the completion of the first year in the program. However, only 8.6% of the variance in the GPA score was explained by stress. This suggests that other variables not included in this investigation should be explored to account for the remaining variation in GPA. This is because 91.4% of the variance in the GPA data remains to be explained. Additionally, determining whether these additional variables are modifiable or non-modifiable will be important. For example, Young-Jones et al showed that students with higher levels of self-efficacy and increased study skills were predicted to have increased success in school, as measured via GPA.⁹ Additionally, it was noted that advising can increase both of these measures, and therefore, could also play a role in improving GPA.

Surprisingly, exercise and leisure time, both thought to be methods of stress relief and with previous evidence indicating a possible relationship to academic performance, had no significant relationship to GPA. Therefore, the second and third null hypotheses were retained. Although the findings suggest that higher stress can predict a lower GPA, the investigators are unable to provide any advice on how to manage this stress since these additional two variables (exercise and leisure) thought to possibly have a positive predictive relationship with GPA, were non-significant.

The results of our study are similar to those observed by previous authors from other countries investigating the effects of stress on the academic performance of medical students, where a negative impact of stress on academics was observed.^{8,12} Since this negative relationship between stress and academic performance seems to be a common theme in graduate level healthcare education, regardless of degree program, early detection and the modification of stress levels is advisable. In a specific example from the literature, Zvauya et al found that graduate medical students are no more stressed than their undergraduate colleagues, but that they are more likely to use dangerous coping strategies, including alcohol and drugs.²⁵ Therefore, guiding students to successfully cope with stress in physical therapy programs is not just an effort to improve academic performance, as predicted by the results of this study, but needs to be further examined as a means of maintaining mental health and preventing students from seeking out high-risk coping strategies.

A recent study in the United States by Van Veld et al demonstrated that a single cohort of physical therapy students' ability to manage stress appeared to improve naturally over the course of the curriculum; however, the authors still advocated for interventional strategies to optimize this improved coping ability.¹³ A case report by Noonan et al describes a student mentoring program where older students aided first-year physical therapy students upon entering the program, which leads to decreased reports of stress associated with the transition to graduate level study.²⁶ One avenue of implementing these findings includes utilizing already existing structures unique to specific insitutions.²⁶ Studying such program modifications is a potential avenue for further investigation to determine whether forging mentoring relationships between new and more senior students within physical therapy programs fosters improved coping strategies, and hopefully lead to decreased stress levels as those observed by Noonan et al.²⁶

Limitations

Limitations of this study include the VAS scale used on our version being only 80 mm long, while that used by Lesage et al was 100 mm.²³ Despite this discrepancy, the same language labels were used. Additionally, there was the issue of recollection on the part of the students' having to remember, on average, how much exercise and leisure they participated in over the course of the year. We intentionally kept this investigation retrospective out of concern for the students modifying their behaviors regarding stress, exercise, and leisure after being informed of the nature of the study (i.e., Hawthorne effect). This will be considered in the multi-site follow-up study, where students will reflect upon a shorter time period retrospectively, and/or the employment of a prospective design. Lastly, although each question associated with one of the three predictor variables did prompt the student to reflect upon the entire year, the instructions at the heading asked them to reflect over the past semester. This is doubtful to have had an effect since all students were educated orally to reflect over the year in its entirety at the time of informed consent, and the predictor specific questions matched this instruction.

CONCLUSION

In conclusion, stress seems to have a negative predictive relationship with GPA, indicating that high stress levels can predict a lower GPA. This predictive relationship does not account for most (91.4%) of the variance in the GPA of first-year physical therapy students, so more factors should be investigated. The amount of time spent exercising and participating in leisure activities does not appear to have a predictive relationship to GPA, and therefore recommendations on these activities cannot be provided. Perhaps future studies should explore the role of these variables on decreasing stress levels, and not on their direct relationship to GPA. Follow-up investigations should focus on these same three predictor variables, and the role they may have in the academic performance of physical therapy students, and modes of modifying them to improve performance, across multiple cohorts and institutions to further develop these conclusions.

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APPENDIX A

1. Reflecting upon the first year in its entirety, please indicate how stressed you feel on the small ruler.

|-----|

“none” “as bad as it could be”

2. Over the course of the first year, how many minutes per week on average did you spend exercising? (This would include activities such as cardiovascular training exercises, resistance training exercises, intramural activities, yoga/pilates, walking your dog, riding your bike, etc).

_____ average # of minutes per week

3. Over the course of the first year, how many hours per week on average did you spend on leisure related activities? (This this would include activities outside of school and personal or professional obligations, such as hunting, fishing, watching TV, reading a book, etc. This does not include any version of exercise or sleep).

_____ average # of hours per week