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# Correlations between psychological measures of wellbeing, physical activity, and GPA in graduate health professions students: a pilot and feasibility study

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**Introduction:** Graduate student wellbeing is a critical concern related to academic success and burnout on college campuses. The purpose of this study was to examine how measures of psychological wellbeing correlate with physical activity and academic success in graduate health professions students.

**Methods:** This pilot study sampled healthy graduate health professions students enrolled in Occupational Therapy, Physical Therapy, and Physician Assistant programs at a metropolitan-based university. Participants completed a one-time electronic survey including demographic data, self-reported grade point average (GPA), self-reported physical activity, and a series of standardized measures on constructs of psychological wellbeing (optimism, resilience, general self-efficacy, academic self-efficacy, self-efficacy to regulate exercise, mindfulness, life satisfaction and stress). Demographic data were analyzed with descriptive statistics while Spearman correlational analyses were used to investigate relationships between measures of psychological wellbeing, physical activity, and GPA.

**Results:** Surveys were completed by 19% (68/350) of invited students. Participants were primarily female 86.7% (59/68) and white 91.2% (62/68). Correlational analyses revealed the following significant positive correlations: (1) vigorous physical activity and self-efficacy to regulate exercise ( $\rho = 0.508$ ,  $p \leq 0.001$ ); (2) moderate physical activity and self-efficacy to regulate exercise

( $\rho = 0.302$ ,  $p = 0.039$ ); (3) walking and optimism ( $\rho = 0.293$ ,  $p = 0.032$ ), mindfulness ( $\rho = 0.466$ ,  $p < 0.001$ ), resilience ( $\rho = 0.306$ ,  $p = 0.026$ ), and academic self-efficacy ( $\rho = 0.338$ ,  $p = 0.014$ ); (4) A significant negative correlation was found between perceived stress and graduate GPA ( $\rho = -0.286$ ,  $p = 0.018$ ).

**Discussion:** The results of this pilot study suggest walking is correlated to several measures of psychological wellbeing in graduate health professions students. These pilot study findings are critical for better understanding of wellbeing in graduate health professions students and how wellbeing may relate to physical activity and academic success. Additionally, these findings provide insight into recruitment challenges regarding graduate students and interpretation of these data is limited by self-selection bias, potentially missing students who face the greatest challenges to their wellbeing.

#### KEYWORDS

GPA, graduate student, health professions, physical activity, Physical Therapy, psychological wellbeing

## Introduction

Psychological wellbeing of students on United States college campuses is a serious concern that has been associated with academic success and student retention (Nagy et al., 2019). There are data that suggest both undergraduate and graduate student populations have been negatively impacted by challenges to psychological wellbeing. There is growing evidence in undergraduate student populations that psychological wellbeing is a concern that can be positively influenced with focused effort and interventions (Tinto, 1993). However, there is scant evidence on psychological wellbeing in graduate student populations (Hardré et al., 2019). Attrition rates in United States graduate programs currently range between 34% and 50% (Allum et al., 2013; Chrzanowski and Poudyal, 2018; Litalien and Guay, 2015; Tinto, 1993). Unfortunately, reasons for these high attrition rates are largely unknown, however, psychological wellbeing has been reported as a chronic concern for graduate students, potentially impacting academic success (Gewin, 2012; Evans et al., 2018; Nagy et al., 2019; Zhang et al., 2022). Limited data on psychological wellbeing and relationships to academic success in graduate student populations contribute to a critical gap in the literature. There is, however, data available related to adult populations to inform pilot and feasibility inquiries in the graduate student population. Such as adults who reported higher scores of hope, optimism, and gratitude reported more positive emotions, engagement, and goal accomplishment (Bazargan-Hejazi et al., 2023). Most studies of graduate students measure psychopathology, such as depression and burnout (Hansen and Virden, 2022) and very little data is available exploring the positive psychological factors of graduate students.

Common measures of psychological wellbeing in adults include optimism, resilience, self-efficacy, mindfulness, life satisfaction, and stress (Anderson and Feldman, 2020; Werner and Smith, 1982; Graff, 2019; Fried et al., 2022). The dichotomy of positive and negative psychological factors acknowledges that internal human experiences can be circumstantial, fluid between construct polarities, and that both experiences have the potential to create

positive outcomes (Ivtzan et al., 2016). For example, optimism and pessimism are considered polar opposite yet pessimism can have protective anticipatory effects that create positive behavior so long as it does not result in fatalism (Ivtzan et al., 2016). Similarly circumstances and nuances exist in positive psychological constructs, which leads into the constructs of this study.

The first positive psychological variable is optimism which is the belief that generally good things happen and generally the future appears positive (Scheier et al., 1994). Optimism has been examined in undergraduate student populations demonstrating positive correlations with accomplishment and engagement (Bazargan-Hejazi et al., 2023). Resilience is the second construct and is conceptualized as a process of achieving better outcomes, despite significant hardships (Rutter and Madge, 1976; Werner and Smith, 1982). In other words, some adversity results in better-than-expected outcomes (van Breda, 2018). The graduate timeline can encompass unexpected setbacks, pauses, or re-evaluations. Resilience scores of graduate students have shown to potentially impact the student-mentor relationship (Deuchar, 2008; Murphy et al., 2007; Wisker et al., 2010). Additionally, resilience has been reported to correlate with perceived academic progress in graduate students (Devos et al., 2017; McCray and Joseph-Richard, 2020). The third construct is self-efficacy and it ascertains that a person possesses the abilities and determination to reach a specific outcome and can be measured as a general belief about oneself or belief in a specific domain, such as academic abilities (Bandura, 1977; Schutte and Malouff, 2016). Studies have demonstrated that higher measures of self-efficacy are related to less academic procrastination and better academic performance (Graff, 2019; Honicke and Broadbent, 2016). Lastly, mindfulness is nonjudgmental awareness on the thoughts, feelings, and sensations of the present moment while silencing worries about the past and future (Kiken et al., 2015). Mindfulness has been linked to improved emotion regulation, cognitive function, and stress reduction (Babiy et al., 2025).

Similar, yet distinct, constructs to positive psychology, satisfaction with life is cognitive appraisal of a person's perceived quality of life based on criteria of their choosing (Diener et al., 1985). This measure of subjective wellbeing is

associated with higher measures of personal growth and better outcomes after college graduation (Mammadov et al., 2024). A factor that impacts life satisfaction is the ability to cope with stress, which has demonstrated a reduced quality of life when not managed effectively amongst undergraduates (Sun et al., 2011). Perceived stress is subjective appraisal of real or potential threats and challenges in relationship to readily available resources to cope with that threat (Cohen et al., 1983). Students reporting high perceived stress and fewer coping strategies also report more disengagement from their goals (Sun et al., 2011). Positive psychological constructs and perceived situational appraisal capture mental factors of wellbeing, while critically important, leads into the next factor that is well-documented to improve both psychological and physical wellbeing.

Physical activity has long been touted to improve physical and psychological wellbeing (McCray and Joseph-Richard, 2020; Fried et al., 2022) and it has shown to correlate with higher GPA specifically in graduate students (Al-Drees et al., 2016). Graduate students have reported external stressors potentially associated with the academic process, but much less is known about internal psychological factors and whether they are associated with measures of physical activity and academic success (Fried et al., 2022; Gardner, 2009). Though systemic factors should remain a topic of continued examination, this study examines the subjective personal experience between commonly used psychological measures and physical activity.

Due to the significant gap in the literature related to psychological wellbeing and graduate student success, the purpose of this study was to examine how measures of psychological wellbeing correlate with physical activity and academic success in graduate health professions students. To address this gap, we proposed the following hypotheses: (1) Higher measures of psychological wellbeing (optimism, self-efficacy, resilience, mindfulness, life satisfaction) and lower measures of stress will significantly correlate with higher measures of physical activity; (2) Higher scores of psychological wellbeing and lower measures of stress will significantly correlate with higher scores of academic success.

## Materials and methods

### Study design

This was a pilot feasibility study using cross-sectional survey design to collect data on a metropolitan college campus in the Midwest. A convenience sample of graduate students enrolled in a health professions program [Occupational Therapy (OT), Physical Therapy (PT), or Physician Assistant (PA)] completed a Qualtrics survey during the summer or fall semesters of 2023. To meet the inclusion criteria, participants had to be enrolled in a graduate health professions program. Participants were excluded if they were under 18 years of age or had not completed an undergraduate degree. This study was approved and deemed exempt according to the public health surveillance exemption by the Institutional Review Board (IRB) at Indiana University of Indianapolis (PROTOCOL: 19011).

## Recruitment

Participants were recruited using a standardized verbal script and written communication through in-class announcements, email listservs, and posted flyers in high traffic areas. Research assistants were granted access to students by instructors for in-class recruitment announcements. The students were provided information about the study and given an opportunity to ask questions during the in-class announcements. Students were also provided a flyer with the details of the study and a QR code that lead directly to the informed consent and study questionnaire. Emails containing standardized scripts about the study were also sent to department chairs and instructors requesting them to distribute via student listservs. Flyers were also posted in dining areas, bathrooms, vending areas, study areas, classroom areas, high traffic hallways, and on day-lockers. Students were made aware that their personal identifiers would be removed in aggregated data reporting and that there were no incentives to participating in this study.

## Procedure

Informed consent and data collection occurred electronically and remotely by students utilizing a Qualtrics questionnaire that was developed for this study. Upon opening the link, participants were immediately presented with the informed consent document and were instructed at the end of the document to acknowledge they had read and understood the informed consent before beginning the questionnaire. Students who did not provide consent were not granted access to the questionnaire. The questionnaire included demographic information (age, biological sex, college major, class standing, height, weight, employed hours), self-reported GPA, and the outcome measures of interest (see "Outcome measures" below). After completing the questionnaire, participants received a standardized message thanking them for their participation.

## Outcome measures

**Life Orientation Test-Revised (LOT-R):** This is a 10-item scale measuring trait optimism which asks participants to rate on a 5-point scale from 0 (strongly disagree) to 4 (strongly agree) to what extent they agree with statements capturing optimism (e.g., "Overall, I expect more good things to happen to me than bad"). The LOT-R has been tested for accuracy and has good validity (Chiesi et al., 2013; Scheier et al., 1994). Total scores range from 0 to 40 with higher scores indicating more optimism.

**Brief Resilience Scale (BRS):** This 6-item questionnaire measures from 1 (strongly disagree) to 5 (strongly agree) resilience as the ability to bounce back, resist illness, adapt to stress, or thrive in spite of adversity (e.g., "I usually come through difficult times with little trouble."). The BRS has demonstrated reliability, as well as good convergent and discriminant validity (Smith et al., 2008). Total score ranges from 6 to 30 with higher scores indicating more resilience.

**The Self-Efficacy Scale:** This 17-item, Likert scale measures from 1 (strongly disagree) to 14 (strongly agree) perceptions as a result of selection, interpretation, and integration of past accomplishments, social and verbal persuasion, and imagined

experiences (e.g., “If I can’t do a job on the first try, I keep trying until I can”). The self-efficacy scale has shown evidence of construct and criterion validity (Sherer and Maddux, 1982). Total score ranges from 17 to 238 with higher scores indicating more self-efficacy.

**Academic Self-Efficacy Scale:** This 37-item, Likert scale survey consists of thirty general items for all students and seven for students involved in the final thesis preparation of how they perceive their ability to learn and achieve educational goals. Students rate the strength of their beliefs on a 5-point scale ranging from 1 (perceived inability) to 5 (complete self-assurance in one’s ability) on statements such as “How well can you stay focused in class even when it’s noisy or crowded?” This scale has been shown to have adequate psychometric properties and moderate predictive validity (Greco et al., 2022). Total score ranges from 37 to 185 with higher scores indicating more academic self-efficacy.

**Self-Efficacy to Regulate Exercise Scale:** This 18-item questionnaire measures individual beliefs about their ability to perform and overcome barriers to exercise on a 100-point sliding scale that captures emotional issues and external factors (e.g., “How confident are you that you could exercise when in a bad mood?”) (Bandura, 2006). This scale has demonstrated good construct validity in cardiac patient populations (Everett et al., 2009). Total scores range from 0 to 1,800 with higher scores indicating more self-efficacy to maintain exercise.

**Freiburg mindfulness inventory (FMI):** This 14-item questionnaire ranging from 1 (rarely) to 4 (almost always) measures all aspects of mindfulness over a customizable time frame (e.g., “I pay attention to what’s behind my actions”). The FMI has been shown to be useful, reliable, and have acceptable convergent validity (Walach et al., 2006). Total scores range from 14 to 56 with higher scores indicating more mindfulness.

**Satisfaction with Life Scale:** This 5-item, Likert scale measures a person’s global assessment of their perceived quality of life according to their personal criteria (e.g., “I am satisfied with my life.”) from 1 (strongly disagree) to 7 (strongly agree). The satisfaction with life scale has been shown to be reliable and have satisfactory criterion validity (Diener et al., 1985). Total score ranges from 5 to 35 with higher scores indicating more satisfaction.

**Perceived Stress Scale (PSS):** This 4-item, Likert scale measures 0 (never) to 4 (very often) feelings and thoughts regarding life responsibilities within the last month (e.g., “Have you felt that things were going your way?”) (Cohen et al., 1983). The PSS has been reviewed and demonstrates acceptable psychometric properties for usefulness and feasibility (Lee, 2012). Total score ranges from 0 to 16 with higher scores indicating more perceived stress.

**International Physical Activity Questionnaire-Short form (IPAQ):** The IPAQ is a measure of physical activity that asks participants to recall the amount of time during the past week spent on vigorous activity, moderate activity, walking, and sitting (e.g., “During the last 7 days, on how many days did you walk at least 10 min?”) (Lee et al., 2011). Scores were calculated in terms of days and total minutes per week. Surveys that omitted activity duration were excluded from analysis. Participants who reported an average of more than 3 h of physical activity per day in each category were truncated to 180 min per day based in standard IPAQ scoring procedures. The IPAQ-SF has shown acceptable concurrent and construct validity and test-retest reliability (0.66–0.89) (Craig et al., 2003; Lee et al., 2011).

## Statistical analysis

Statistical Packages for Social Sciences (SPSS) version 31 was used for data analysis. Descriptive statistics were used for demographics (age, sex, race, program, cohort, and if they worked for pay outside of their program). Shapiro–Wilk test of normality was used to examine the distribution of outcome measures and key factors, such as enrolled program, employment, and GPA. Kruskal–Wallis test was used to analyze homogeneity between programs and outcome measures. Mann–Whitney U test was used to analyze data distribution between students who worked for pay outside of their program and those who did not by outcome measures. Bivariate Spearman rank two-tailed correlation analysis ( $p \leq 0.05$ ) was used to examine relationships between the outcome measures (optimism, resilience, general self-efficacy, academic self-efficacy, self-efficacy to regulate exercise, mindfulness, satisfaction with life, stress), physical activity (walking, moderate, vigorous), and GPA. Cases with missing values were removed pair-wise. This study is exploratory and no predictive analysis was performed for this study. We did not apply any correction for multiple comparisons to ensure we did not miss any potential relationships that could be vital for future studies. Effect sizes are reported to demonstrate the nuanced relationships of the statistically significant findings.

## Results

### Participant characteristics

Seventy-eight of 357 (21.8%) students completed the informed consent and started the questionnaire. Ten (12.8%) of those were not included in the analysis, leaving 68 participants in the study. Reasons for non-inclusion in the analysis included completing the survey twice ( $n = 1$ ) and completing only the demographic questions with no outcome measures ( $n = 9$ ). The age range of this sample was 21–38 years ( $x = 23.8$ ), primarily female 59 (86.7%), and mostly Caucasian 62 (91.2%). Response rate for PT ( $n = 15$ ) was 12.5%, OT ( $n = 18$ ) was 16.8%, and PA ( $n = 35$ ) was 26.9%. Table 1 displays the demographic outcomes of the participants. Having a paid job outside of school significantly differed between programs ( $p < 0.001$ ); the number of PT (73%) and OT (72%) students who had a job was much greater than PA (3%). None of the students in this sample remediated.

### Tests of normality and homogeneity

The psychological wellbeing outcome variables (Table 2) of optimism, life satisfaction, resilience, mindfulness, academic self-efficacy, self-efficacy to regulate exercise, and stress were distributed normally between programs. However, GPA, general self-efficacy, and physical activity outcomes (Table 3) were non-normally distributed. Kruskal–Wallis test of homogeneity revealed that all outcome variables did not differ between programs except for self-efficacy to regulate exercise  $X^2(2, N = 56) = 11.394, p = 0.003$  and vigorous physical activity  $X^2(2, N = 61) = 8.026, p = 0.018$ . A glaring difference between

TABLE 1 Demographics, GPA, and BMI of the whole sample and by individual program.

Variable	Sample (n = 68)	PA (n = 35)	PT (n = 15)	OT (n = 18)
Age (years)	23.8 ± 3.2	24 ± 4.3	23.4 ± 1.3	23.5 ± 1.1
Sex, % female	59 (86.7%)	31 (88.6%)	11 (73.3%)	17 (94.4%)
<b>Class</b>				
2023	45 (66.2%)	35 (100%)	4 (26.7%)	6 (33.3%)
2022	9 (13.2%)	0	7 (46.7%)	2 (11.1%)
2021	14 (20.6%)	NA	4 (26.7%)	10 (55.6%)
<b>Race</b>				
Caucasian	62 (91.2%)	32 (91.4%)	13 (86.7%)	17 (94.4%)
Asian	6 (8.8%)	3 (8.6%)	2 (13.3%)	1 (5.6%)
Job outside of school	25 (36.8%)	1 (2.9%)	11 (73.3%)	13 (72.2%)
GPA (1.0–4.0)	3.61 ± .49	3.59 ± .40	3.72 ± .33	3.57 ± .74
BMI (16.64–35.77)	24.46 ± 3.91	23.4 ± 3.19	27.17 ± 4.13	24.25 ± 4.13

TABLE 2 Psychological outcome variable range, mean and standard deviation for whole sample and each program.

Variable	Sample (n = 68)	PA (n = 35)	PT (n = 15)	OT (n = 18)
Optimism (0–40)	15.13 ± 3.48	15.37 ± 3.36	16.07 ± 3.83	13.89 ± 3.23
Resilience (6–30)	20.48 ± 3.51	20.8 ± 3.08	21.36 ± 4.68	19.12 ± 3.04
General SE (14–238)	138.18 ± 20.27	138.34 ± 24.35	139.13 ± 18.52	137.06 ± 12.19
Academic SE (37–185)	135.22 ± 16.44	135.65 ± 15.61	135.27 ± 18.9	134.25 ± 16.8
Exercise SE (0–1,800)	974.73 ± 340.09	977.07 ± 339.7	1,161.54 ± 334.62	796.57 ± 261.37
Mindfulness (14–56)	35.14 ± 7.02	35.69 ± 6.13	37.4 ± 8.8	31.81 ± 6.22
Satisfied w/ Life (5–35)	27.19 ± 5.06	28.06 ± 3.95	27.93 ± 4.3	24.94 ± 6.85
Stress (0–16)	6.29 ± 2.21	6.31 ± 1.78	5.6 ± 2.82	6.83 ± 2.36

TABLE 3 IPAQ outcome variable range, mean, and standard deviation of whole sample and each program.

Variable	Sample (n = 68)	PA (n = 35)	PT (n = 15)	OT (n = 18)
<b>IPAQ DAYS/week (0–7)</b>				
Walking	4.84 ± 2.02	4.83 ± 1.99	5.2 ± 2.15	4.56 ± 2.04
Moderate	2.94 ± 1.57	2.94 ± 1.63	3.67 ± 1.59	2.25 ± 1.13
Vigorous	3.34 ± 1.58	3.61 ± 1.56	4.13 ± 1.36	2.22 ± 1.17
<b>IPAQ MINUTES/week</b>				
Walking (0–1,680)	289.04 ± 331.81	171.11 ± 144.45	421.67 ± 479.75	356.66 ± 382.92
Moderate (0–840)	157.96 ± 146.38	134.62 ± 109.11	222.33 ± 212.73	130.38 ± 99.26
Vigorous (0–3,000)	258.44 ± 198.41	255 ± 201.11	364 ± 217.68	171.18 ± 129.69

programs was employment of which further *post-hoc* analysis was performed.

( $\rho = 0.306$ ,  $p = 0.026$ ), and academic self-efficacy ( $\rho = 0.338$ ,  $p = 0.014$ ) (Table 4).

### Psychological wellbeing and physical activity

We examined each sub-scale of the IPAQ individually (vigorous, moderate, walking) and the data suggests that vigorous physical activity positively correlated with self-efficacy to regulate exercise ( $\rho = 0.508$ ,  $p \leq 0.001$ ), moderate physical activity positively correlated with self-efficacy to regulate exercise ( $\rho = 0.302$ ,  $p = 0.039$ ), and walking positively correlated with optimism ( $\rho = 0.293$ ,  $p = 0.032$ ), mindfulness ( $\rho = 0.466$ ,  $p < 0.001$ ), resilience

### Psychological wellbeing and academic performance

Our data demonstrated that there was a significant negative correlation with the perceived stress scale and graduate GPA ( $\rho = -0.286$ ,  $p = 0.018$ ). Due to stress being the only significant correlation with GPA, we performed a *post-hoc* analysis on each individual item in the perceived stress scale to investigate if there were any patterns of stress in this sample. *Post-hoc* analysis revealed that two items “Have you felt that things were going your

TABLE 4 Spearman correlation table of psychological outcome variables, physical activity, and GPA.

Variable	Correlation & Sig. (2-tailed)	GPA	Optimism	Life Satisfaction	General self-efficacy	Academic self-efficacy	Exercise self-efficacy	Resilience	Mindfulness	Stress	Walking	Moderate activity
Optimism	$\rho$ $p$	0.032 0.798										
Life satisfaction	$\rho$ $p$	-0.124 0.318	0.365** 0.002									
General self-efficacy	$\rho$ $p$	0.046 0.712	0.330** 0.006	0.039 0.753								
Academic self-efficacy	$\rho$ $p$	-0.060 0.636	0.312* 0.011	0.213 0.091	0.050 0.690							
Exercise self-efficacy	$\rho$ $p$	-0.018 0.897	0.359** 0.007	0.235 0.085	0.104 0.445	0.295* 0.030						
Resilience	$\rho$ $p$	0.022 0.862	0.531** <0.001	0.270* 0.028	0.232 0.061	0.305* 0.014	0.296* 0.029					
Mindfulness	$\rho$ $p$	-0.180 0.148	0.617** <0.001	0.370** 0.002	0.282* 0.022	0.357** 0.004	0.331* 0.015	0.621** <0.001				
Stress	$\rho$ $p$	-0.286* 0.018	-0.529** <0.001	-0.283** 0.020	-0.210 0.086	-0.100 0.429	-0.355** <0.001	-0.406** <0.001	-0.417** <0.001			
Walking	$\rho$ $p$	-0.266 0.052	0.293* 0.032	-0.027 0.958	0.121 0.383	0.338* 0.014	0.006 0.965	0.306* 0.026	0.466** <0.001	-0.167 0.227		
Moderate activity	$\rho$ $p$	-0.100 0.474	0.220 0.109	-0.007 0.958	-0.043 0.755	0.274 0.052	0.302* 0.039	0.241 0.085	0.116 0.414	-0.027 0.846	0.397** 0.006	
Vigorous activity	$\rho$ $p$	0.042 0.746	0.151 0.242	0.065 0.624	0.029 0.825	0.091 0.498	0.508** <0.001	0.194 0.141	0.136 0.304	-0.221 0.086	0.236 0.099	0.400** 0.004

\*Correlation is significant at the 0.05 level (2-tailed). \*\*Correlation is significant at the 0.01 level (2-tailed).  $\rho$  = Spearman Rho,  $p$  = p-value.

way?” ( $\rho = -0.241, p = 0.048$ ) and “Have you felt that difficulties were piling up so high that you could not overcome them?” ( $\rho = -0.269, p = 0.026$ ) significantly correlated with graduate GPA. Both items were negatively correlated; higher measures of stress correlated with lower GPA scores (Table 5). Academic self-efficacy significantly correlated positively with self-efficacy to regulate exercise ( $\rho = 0.295, p = 0.03$ ). However, neither general self-efficacy or academic self-efficacy significantly correlated with GPA.

## Post-hoc variables when controlled for employment

Post-hoc Shapiro–Wilk test of normality between students who worked outside of school for pay and those who did not demonstrated that GPA, life satisfaction, general self-efficacy, and all physical activity variables were not normally distributed. Mann–Whitney U test revealed that outcome variables of psychological wellbeing and physical activity were homogenous between groups that had a job and those who did not. However, it did differ for the outcome variable GPA those who had a job tended to have higher GPA scores,  $z = -2.118, p = 0.034$ .

Initial test of normality revealed that employment was significantly different between programs. Analysis was completed while controlling for employment status revealing one notable difference in results, a significant negative Spearman rank correlations between GPA and walking ( $r = -0.325, p = 0.018$ ), as well as, GPA and stress ( $r = -0.245, p = 0.045$ ).

## Discussion

The findings from this pilot study provide important insight into how multiple dimensions of psychological wellbeing, physical activity, and academic performance are associated in graduate health professions students. Importantly, the pattern of results suggests that these constructs should not be interpreted as isolated factors. Instead, the data indicate that certain forms of physical activity, particularly walking, are associated with a constellation of psychological resources relevant to graduate student functioning. This integrative framing helps contextualize the observed correlations while remaining consistent with the exploratory, cross-sectional design of the study.

Across analyses, four significant findings emerged. First, moderate and vigorous physical activity correlated with self-efficacy to regulate exercise. Second, walking was associated with multiple psychological constructs, including optimism, mindfulness, resilience, and academic self-efficacy. Third, perceived stress demonstrated a negative correlation with GPA. Lastly, recruitment challenges underscored the feasibility constraints inherent in studying graduate student populations. Collectively, these findings underscore the importance of examining patterns of co-occurrence among behavioral and psychological variables rather than interpreting each relationship in isolation.

TABLE 5 Correlation table of GPA by each item of the perceived stress scale.

Variable	Correlation & sig. (2-tailed)	GPA	Stress 1	Stress 2	Stress 3
Stress 1	$\rho$ $p$	-0.168 0.171			
Stress 2	$\rho$ $p$	-0.169 0.168	0.265* 0.029		
Stress 3	$\rho$ $p$	-0.241* 0.048	0.439** <0.001	0.429** <0.001	
Stress 4	$\rho$ $p$	-0.269* 0.026	0.583** <0.001	0.273* 0.024	0.472** <0.001

\*Correlation is significant at the 0.05 level (2-tailed). \*\*Correlation is significant at the 0.01 level (2-tailed).  $\rho =$  Spearman Rho,  $p =$  p-value.

## Physical activity and psychological wellbeing

### Moderate and vigorous physical activity

The American College of Sports Medicine recommends at least 150 min of moderate physical activity or 60 min of vigorous physical activity for health benefits (Ozemek et al., 2025).

Consistent with a large body of research on the psychological benefits of exercise, our data demonstrate that moderate and vigorous physical activity were positively associated with self-efficacy to regulate exercise. Additionally, self-efficacy to regulate exercise was positively associated with and academic self-efficacy, suggesting that self-efficacy beliefs may cluster across domains rather than operate independently. This pattern is consistent with previously reported data demonstrating reciprocal or overlapping relationships between domain-specific and more generalized self-efficacy constructs (Schutte and Malouff, 2016). Although a relationship between academic self-efficacy and GPA was not demonstrated in this sample, studying physical activity and supporting physical activity habits may represent a broader profile of adaptive functioning among graduate students. Importantly, these findings do not imply that physical activity enhances academic self-efficacy or vice-versa. Instead, they suggest that students who report greater confidence in managing exercise also tend to report stronger confidence in managing academic responsibilities.

### Walking as an integrative behavioral context

Walking demonstrated several correlations with measures of psychological wellbeing, including optimism, resilience, academic self-efficacy, and mindfulness. This may be an impactful finding as walking is a widely accessible, low-barrier form of physical activity that can easily be implemented into daily routines. In part, this may potentially explain its broader associations with psychological wellbeing in this population. Importantly, these data merely suggest a relationship between measures of psychological wellbeing and walking but do not suggest causality or prediction. Rather, the findings indicate that students who report more walking also tend to report higher levels of several adaptive psychological constructs. While prior research has linked participation in walking programs to physiological

changes, such as increases in brain-derived neurotropic factor, reductions in C-Reactive protein, and improvements in stress outcomes in healthcare providers (Noushad et al., 2022), the current study did not address such mechanisms. However, it reasons that these physiological changes could potentially explain the higher scores of psychological wellbeing as well. Further experimental research is needed to support the relationships suggested in this study and to establish causality or prediction.

## Stress and academic performance

Perceived stress was the only psychological construct associated with GPA in this sample, demonstrating a negative correlation such that higher perceived stress was associated with lower GPA scores. *Post-hoc* analyses suggested that *feeling that things were not going their way* and *that difficulties were piling up so high that they could not overcome them* emerged as the strongest contributors to perceived stress. Within the integrative framework of this study, stress may be conceptualized as a countervailing psychological demand that operates alongside, but distinctly from, the resource-oriented constructs associated with physical activity and self-efficacy.

The Perceived Stress Scale is not designed exclusively to measure academic stressors and likely captures more than just the pressures related to school. However, the observed association between stress and GPA is noteworthy. Feeling overwhelmed has been previously cited as a consistent concern for graduate students (Hardré and Pan, 2017; Jones, 2019), and prior work suggests that students will need to learn to manage high workloads, as well as professional and personal stressors to be successful in their education (Jones, 2019; O'Keefe, 2013; Tinto, 1993). Moreover, while students are preparing for healthcare careers, faculty may need to lead and explore ways of providing support throughout the education of health professions programs (Hardré and Pan, 2017; Noonan et al., 2012). Although the cross-sectional nature of the data in the current study precludes conclusions about whether stress contributes to lower GPA, whether academic difficulties increase stress, or whether both are influenced by unmeasured contextual factors, our findings highlight stress as an important variable for further investigation. Greater understanding of stress appraisal may inform the development of programs to support students in cultivating habits that will support the transition into their professional roles as healthcare workers.

## Post-hoc analyses controlling for employment

*Post-hoc* partial correlation analysis when controlling for employment status revealed similar results to correlations when employment was not considered. Walking continued to correlate with several positive psychological factors, including optimism, resilience, mindfulness, and academic self-efficacy. However, a negative correlation was revealed between walking and GPA when employment was controlled, indicating that as reports of walking increased, GPA decreased within the context of employment. This finding suggests that situational factors,

such as time allocation and workload demands associated with working outside of school, may influence how physical activity relates to academic performance. In other words, walking does not appear to independently relate to GPA; rather, employment may be a key situational factor shaping this relationship. Nevertheless, walking remained consistently associated with positive psychological outcomes regardless of employment status.

## Graduate recruitment and feasibility

These data highlight graduate student populations as an important target for further research related to psychological wellbeing. However, recruitment remains a critical challenge for addressing feasibility of engaging this student population. Despite multiple mechanisms to recruit and engage students in this study, recruitment rates were low. This is consistent with previous reports that engaging graduate students in research participation is challenging and the average survey response rate is 21% (Scholder and Maguire, 2009). Notably, our study demonstrated that once the survey was initiated, 88% completed it, suggesting that the primary challenge may be initial engagement and not survey burden.

Some factors that have been reported to impact response rates include campus setting, timing of collection, incentives, student satisfaction, and perception of graduation likelihood. Unlike undergraduate students, Scholder and Maguire (2009) noted that graduate students are more difficult to recruit and may require larger financial incentives to participate. Unfortunately, higher payments may introduce sampling bias and be unsustainable for researchers. A potential strategy is to standardize programmatic questionnaires related to wellbeing offered at program orientation, annually, and immediately before graduation. Though voluntary, this would create a culture of research participation throughout the entire graduate experience and capture longitudinal data. This study was deemed exempt by the IRB, but standardizing surveys would require a more intensive IRB process. Additional innovative solutions will need to be developed and tested to enhance graduate student participation in research and minimize non-response bias.

## Limitations

Several limitations should be considered when interpreting these findings. Participants in this study were primarily white, female, and from a small convenience sample of graduate students at a single metropolitan university. Although pilot samples of this size are common in graduate populations, the modest response rate poses a risk for non-response bias. For example, students who were most time-poor, stressed, and academically at risk during recruitment may not have participated. Notably, all participants were meeting competency standards, suggesting that students undergoing remediation were not represented in this sample; a particularly important subgroup for understanding stress and academic performance. Expanding the reach to different recruitment periods and more institutions may increase sample diversity and size; however,

response rates may remain an inherent limitation in graduate student research.

Another limitation of this study is reliability of self-reported physical activity and GPA data which may be susceptible to reporting bias, such as social-desirability and recall (Brenner and DeLamater, 2014; Hatos and Gyarmati, 2023). Studies demonstrate mixed findings whether self-reported GPA may be inflated (Hatos and Gyarmati, 2023) or comparable to university record and does not significantly impact study outcomes (Honicke and Broadbent, 2016). Although self-reported GPA accuracy is debatable future research can minimize this bias and objectively collect GPA from official records. The physical activity data gathered in our study informs future investigations that investments are worth pursuing in graduate student research. Actigraphy could provide a clearer understanding by collecting continuous, objective, information rich physical activity data such as time, intensity, location, and duration which can only be partially reported on the IPAQ.

Another limitation is determining the path of our hypothesis since this pilot study only analyzed correlations we cannot confirm which factors preclude other outcomes. These data suggest that physical activity correlates with psychological wellbeing, however, we may have primarily recruited students who innately do well in school and thus have more time to invest in physically activity and research. Similarly, stress correlated with GPA, however, we cannot deduce whether higher stress leads to low GPA, vice versa, or if there are unmeasured confounding factors. Future research should consider piloting a randomized longitudinal study using predictive designs to analyze integrative effects of walking, psychological wellbeing, and academic success.

An uncontrollable limitation that should be discussed is how this sample had an education impacted by the 2020 COVID-19 pandemic response. Students in this sample were currently enrolled or entered their graduate program during the unprecedented pandemic response. This event specifically impacted students, faculty, and programs that interact with patients during clinical training, such as health professions. These cohorts were required to practice in unprecedented circumstances which should be considered when interpreting the data. The responses of this sample may be partially reflecting their COVID-19 pandemic experience, and may not be replicable in future studies. Discerning generational changes, particularly after 2020, and understanding students is critical for program and institutional longevity.

Lastly, we intended to measure hope using Snyder's Adult Hope Scale, however, an error occurred in the electronic survey omitting the last four hope responses of each participant. This incomplete measure of hope produced only one of the two sub-scales of hope and should be interpreted with such scrutiny. *Post-hoc* analysis for the hope pathways subscale revealed a significant negative correlation with stress ( $\rho = -0.252, p = 0.040$ ) and a significant positive relationship with walking ( $\rho = 0.293, p = 0.032$ ). The best take-away suggests that hope measures should be retained in future graduate student studies.

## Conclusion

This pilot study identified several associations among psychological wellbeing, physical activity, and academic performance in graduate health professions students. Walking was associated with higher measures of optimism, resilience, academic self-efficacy, and mindfulness, while moderate and vigorous physical activity were positively associated with self-efficacy to regulate exercise. Perceived stress demonstrated an inverse association with academic performance. Although causal inference is not supported by the cross-sectional design, these results suggest that behavioral and psychological variables may cluster in meaningful ways within this population. Replication in larger and more diverse sample across multiple institutions is needed to determine the stability and generalizability of these findings. Collectively, this study supports existing evidence that psychological wellbeing is an important consideration in health professions programs and underscores the need for continued investigation into specific stressors that may impact student success, psychological wellbeing, and professional development.

## Future directions

Future studies should investigate details of graduate student stressors and how institutions can respond supportively to graduate student wellbeing. Structured interviews to collect thematic factors associated with academic stressors may yield important details about student experiences. Our sample demonstrated a correlation that suggests employment may factor into the relationship between walking and GPA. The next step should explore this relationship further and utilize actigraphy to understand situational details of walking. Similarly, formal GPA would provide data unaffected by recall and social-desirability bias. Overall, more research is needed regarding physical activity in graduate students, specifically longitudinal studies exploring associations to wellbeing and academic success. Lastly sustainable innovations in recruiting higher rates of graduate student research participants is critical. Non-response bias is concerning and methods that respectfully recruit students who are academically high-risk should be a high priority in graduate student research. Improvements in research recruitment rates would strengthen future graduate student studies and enhance the interpretations of prior reports that experienced low recruitment challenges.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

The studies involving humans were approved by the Indiana University Indianapolis Internal Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

CB: Writing – review & editing, Data curation, Conceptualization, Writing – original draft, Project administration, Formal analysis. AK: Writing – review & editing, Writing – original draft. MY: Writing – review & editing, Writing – original draft. MM: Writing – original draft, Writing – review & editing. TD: Writing – original draft, Methodology, Writing – review & editing. KM: Formal analysis, Writing – original draft, Data curation, Supervision, Writing – review & editing, Conceptualization.

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## Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

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