Predictors of stress, anxiety, depression, study engagement and academic performance in physiotherapy students, including a subgroup receiving a mindfulness training program

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Abstract

Introduction: Student wellbeing is a growing concern for physiotherapy and other health professional students, with potential impacts on academic success, patient care and future personal wellbeing. The purpose of this study was to determine the predictors of future stress, anxiety, depression, study engagement and academic performance in physiotherapy students, including a subgroup who undertook a mindfulness training program.

Methods: Predictors of outcome were obtained from a prospective cohort study involving 83 penultimate-year physiotherapy students, who could volunteer to participate in a 6-week mindfulness training program during semester (n = 17) or complete outcome measures without mindfulness training (n = 66). Baseline predictors of outcome were obtained at the start of Semester 1: age, gender, trait mindfulness, study engagement, training (mindfulness training or no training), stress, anxiety and depression. Outcomes were measured at the end of Semester 1 (study engagement, stress, anxiety, depression, grade point average) and at the end of the course (grade point average). Multiple regression was used to determine the ability of baseline characteristics to predict outcomes.

Results: Psychological distress (stress, anxiety and depression) increased across the full study cohort between the start and end of the semester as exams approached ($p < .05$). Completion of mindfulness training was significantly associated with better academic performance and lower levels of depression at follow-up. Female gender, lower baseline depression scores and higher study engagement were also significant predictors of superior academic performance, while older age and higher trait mindfulness predicted greater study engagement at end of semester ($p < .05$).

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Conclusions: Potentially modifiable factors (study engagement, depression and mindfulness training) were associated with future wellbeing and academic success in physiotherapy students. Further research is warranted to explore interventions to address these outcomes in randomised controlled trials.

Keywords: students; mindfulness; psychological distress; academic performance

Introduction

University students face challenges during their studies that can negatively impact their mental health and wellbeing (Hernández-Torrano et al., 2020). University students report higher levels of stress, anxiety and depression compared to age-matched peers in the general community (Larcombe et al., 2015), and the problem displays a worsening trajectory (Auerbach et al., 2018). The health and wellbeing of health professional students faces further challenges from rigorous academic and clinical placement requirements (Jacob et al., 2013), for both medical (Dyrbye et al., 2006) and allied health students in training (Gallagher et al., 2014).

Stress, in particular, is the biggest predictor of psychological distress and low life satisfaction among allied health students (Harris et al., 2006). Stress refers to the reactions a person has to daily pressures in life (Hathaisaard et al., 2022). Stress can adversely affect student wellbeing (McEwan, 2004) and can influence the onset and maintenance of anxiety and depression (Capsi et al., 2003). Furthermore, stress, depression and burnout in healthcare professionals have been shown to reduce patient safety and treatment satisfaction (Panagioti et al., 2018). For example, research indicates that doctors who are depressed are more than six times as likely to make medication errors (Fahrenkopf et al., 2008).

Student mental health and wellbeing can also impact academic performance. High levels of stress can negatively impact working memory, learning and executive functioning of students (Beilock & Carr, 2005) and is associated with impaired academic performance (Hassed & Chambers, 2014; Pritchard & Wilson, 2003) and a higher risk of non-completion of their degree (Vaez & Laflamme, 2008). Higher levels of depression (Hysenbegasi et al., 2005) and anxiety (Gallasch et al., 2021) have also been shown to correlate with poorer academic grades in university students. Evidence suggests that patterns of stress and poor coping commonly continue into clinical life after graduation (Lindsay et al., 2008).

Engagement with work or study is another important factor of relevance to university students. Work or study engagement refers to a positive, fulfilling, work-related state of mind (Schaufeli et al., 2002). The opposite of burnout (Malasch & Leiter, 2008), engagement is commonly considered to be comprised of three components: vigour, dedication and absorption (Schaufeli et al., 2006). Vigour is characterised by mental resilience and high energy levels while working and one's willingness to put effort into

their work (Schaufeli et al., 2006). Dedication is characterised by a sense of involvement, significance, inspiration, challenge, enthusiasm and pride (Schaufeli et al., 2006). Absorption is characterised by high concentration and becoming engrossed in work (Schaufeli et al., 2002). Low levels of engagement in students are associated with poorer mental health (Hakanen et al., 2008) and inferior academic performance (Schaufeli et al., 2002).

Given the impacts of mental health, wellbeing and study engagement on university students, early identification and intervention for students at risk of poor academic performance or the development of stress, anxiety or depression are warranted (Hernández-Torrano et al., 2020). Mindfulness training for university students is a potential management option that may positively influence these factors. Mindfulness has been defined as "the awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally to the unfolding experience moment by moment" (Kabat Zinn, 2003, p. 145). Mindfulness is experienced by everyone at times but can be enhanced through training (Kakoschke et al., 2021). Mindfulness training has been shown to reduce stress, anxiety and depression in medical and other health professional students (Hassed et al., 2009; Hathaisaard et al., 2022; Kakoschke et al., 2021; Spinelli et al., 2019). Mindfulness training may also improve study engagement (Kakoschke et al., 2021) and academic performance (Klingbeil et al., 2017).

Unlike the significant volume of research involving medical students, there has been little research into the factors that impact the wellbeing and academic performance of physiotherapy students. One recent study of physiotherapy students showed an association between higher levels of self-reported stress on a visual analogue scale and poorer performance on clinical placements (Gallasch et al., 2022), but other elements of wellbeing, and their effect on academic performance, were not explored. Physiotherapy students face a number of unique stressors as they transition into clinical placements and then clinical practice. These include the expectation that new graduate physiotherapists can manage a caseload independently, leading to high expectations from clinical supervisors and physiotherapy students themselves regarding their performance, which results in high levels of stress (Stoikov et al., 2022). The aim of this study is to determine predictors of future stress, anxiety, depression, study engagement and academic performance in physiotherapy students, including a subgroup who undertook a mindfulness training program.

Methods

A prospective cohort study with a focus on predictors of outcome was undertaken involving physiotherapy students at La Trobe University, Australia. As part of the study, students could self-select to participate in a 6-week mindfulness program. Students volunteering for mindfulness training were randomly allocated to receive one of two variations of the mindfulness training (mindful stress reduction or mindful movement).

The study was initially designed as a nested randomised controlled trial within the prospective cohort study, but the sample size was insufficient for the two mindfulness groups to be analysed separately. The current prospective cohort study, therefore, pooled data from all groups to explore predictors of future academic performance, depression, anxiety, stress and study engagement. The La Trobe University Human Ethics Committee approved the study (FHEC1413), and all participants signed informed consent forms.

Participants and recruitment

Physiotherapy students were invited to participate at the commencement of their penultimate year of the physiotherapy course in which they were enrolled. This comprised students in the third year of a 4-year bachelor's degree as well as students in the first year of a 2-year graduate-entry master's program who had previously completed another bachelor's degree. These cohorts were deemed comparable, as students from both programs study the same curriculum in shared classes. Students were advised not to volunteer for the mindfulness training if they had significant physical or mental health conditions that may have inhibited their ability to complete meditation or mindful movement, although no specific screening was completed. Eighty-three of the approximately 123 students invited consented to participate. Seventeen of these students agreed to attend a mindfulness training program during Semester 1, while 66 agreed to complete outcome measures without mindfulness training. Students were not asked why they preferred not to complete the mindfulness training program or partake in the study.

Mindfulness training

Mindfulness training offered students six 1-hour sessions outside of their normal classes, timetabled over the first 6 weeks of the semester (March–April 2015). One group of 8 students attended the mindful stress reduction sessions with an emphasis on meditation, while another group of 9 students attended mindful movement sessions with a focus on mindful movement. Sessions in both mindfulness training groups comprised mindfulness practices (sitting mindfulness meditation or mindful movement), reflections on the home practice assignments from the previous week, theoretical concepts of mindfulness and an exploration of how the mindfulness strategies presented could be applied in the students' personal and academic lives to enhance psychological wellbeing and academic performance. The mindfulness programs were based on the generic principles of existing, empirically validated mindfulness programs, such as mindfulness-based stress reduction (Kabat-Zinn, 1990) but adapted to meet the specific needs of physiotherapy students in a tertiary environment (Hassed, 2007). All sessions were conducted by a registered clinical psychologist (author RC) who has developed and run mindfulness programs for 10 years at Monash University, Australia (See Appendix 1 for focus of each session and weekly "at-home" practice). Students were advised to complete daily practice at home for 10–30 minutes, but no practice diaries were checked to monitor compliance. Participants

attended a mean (*SD*) of 5.0 (0.8) of the six mindfulness sessions, with all participants attending at least four sessions. Full details of the mindfulness training have been described previously (McConville et al., 2019).

Predictor variables

Potential predictor variables were obtained from all study participants at the start of Semester 1.

Demographics

Basic demographics (age, gender, course enrolment—combined bachelor–master's degree or master's degree) were collected at baseline.

Mindfulness

Trait mindfulness was measured with the Freiburg Mindfulness Inventory-14 (FMI-14) (Walach et al., 2006). The FMI-14 is a reliable and valid (α = .86) tool for measuring mindfulness (Walach et al., 2006) and has 14 items, covering all aspects of mindfulness over the previous 7 days, which are rated on a 4-point scale ranging from 1 (*rarely*) to 4 (*almost always*). Items include statements such as "*I am open to the experience of the present moment*".

Study engagement

The student version of the Utrecht Work Engagement Scale (UWES-S) was used to measure study engagement (Schaufeli & Bakker, 2003). It generates a total score as well as three elements of study engagement in students: vigour, dedication and absorption. Fourteen items are rated on a 6-point scale ranging from 1 (*almost never/a few times a week*) to 6 (*always/every day*). Items include statements such as "*When studying, I feel bursting with energy*" (vigour), "*Studying inspires me*" (dedication) and "*I get carried away when I am studying*" (absorption). Satisfactory internal consistency has been demonstrated with α = .74 for vigour, α = .87 for dedication and α = .84 for absorption (Casuso-Holgado et al., 2013).

Depression, anxiety and stress

Symptoms of depression, anxiety and stress were measured using the Depression Anxiety and Stress Subscales (DASS-21) (Lovibond & Lovibond, 1995). Respondents indicated how much each statement applied to them over the previous week using a 4-point scale ranging from 0 (*not at all*) to 3 (*very much/most of the time*). Items include statements such as "*I couldn't seem to experience any positive feeling at all*." The scale has good construct validity (Henry & Crawford, 2005) and reliability (Sinclair et al., 2012).

Mindfulness training

Each student's choice at the start of Semester 1 to either undergo the mindfulness training during the semester or to receive no mindfulness training was also modelled as a predictor variable.

Outcome variables

The baseline predictor variables of study engagement, depression, anxiety and stress were measured again at the end of Semester 1 to serve as outcome variables. It would have been challenging to obtain wellbeing outcomes over a longer period as students dispersed to clinical placements at the end of Semester 1. In addition, academic performance (represented by grade point average) was obtained from official student records as an outcome measure. The two time periods for measuring grade point average were throughout Semester 1 (March–June 2015) and, again, over the final 18 months of the course (July 2015–December 2016) to evaluate predictive ability of variables on longer-term academic outcomes. Academic data were extracted by an administrator not involved in the study, who was blinded to the students' scores on the predictor variables.

Data analysis

Data were analysed using SPSS (V21). Descriptive data were analysed to determine the extent of psychological symptoms among students at the beginning of the semester and, again, at the end of the semester (just prior to exams). To determine predictors of stress, anxiety, depression and study engagement at the end of the semester and predictors of academic performance at the end of the semester and, subsequently, over the final 18 months of the course, two-stage multiple linear regression models were used (one model for each outcome). In Stage 1, univariate analysis was conducted using Pearson correlation coefficients to determine the association between all potential predictors and each outcome. In Stage 2, predictors with a p-value < 0.1 from the univariate analysis were included in a multiple linear regression model using Wald backwards deletion. This involves the removal of non-significant ($p > .05$) predictors from each model one at a time (starting with the predictor with the lowest predictive value) until it contains only predictors that contribute significantly to the prediction of the outcome variable after adjusting for the influence of the other variables in the model. This enabled the strongest predictors of outcome to be identified after controlling for other variables in each multivariate model.

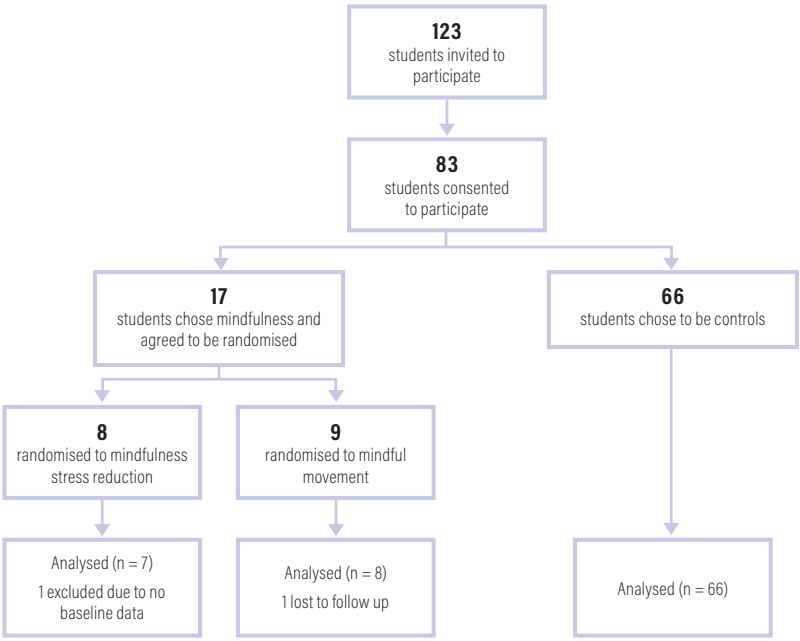
No fixed sample size was set as all students in the target year level were invited to participate, however based on our planned analysis of 12 potential predictor variables, we required 60–120 participants to satisfy the guideline of 5–10 subjects per variable suggested for regression analysis (Katz, 2006). It eventuated that a maximum of five variables were entered into any of the multivariate models, meaning that over 15 subjects per variable were available for each analysis.

Results

The flow of participants through the originally designed study is presented in Figure 1.

Figure 1

Flow of Participants Through the Study



Descriptive data

The characteristics of participants are shown in Table 1. There were 54 females (66.6%) and 27 males (33.3%). Five (6.2%) students were enrolled in the 2-year graduate-entry master's program and 76 (93.8%) were enrolled in the 4-year bachelor's program. Descriptive statistics showed that the students who elected to undertake mindfulness training had significantly higher age and UWES dedication scores at the commencement of the study relative to those who declined the training ($p < .05$). Students across both groups combined reported significantly ($p < 0.05$) increased symptoms of stress, anxiety and depression; reduced mindfulness; and increased study engagement between the start and end of the semester (Table 1). No students reported any adverse events associated with the study.

Table 1

Descriptive Statistics of Participants[1]

	Full Sample (n = 81)		Mindfulness Training (n = 17)		No Mindfulness Training (n = 66)	
Variable	Baseline mean (*SD*)	Follow-up mean (*SD*)	Baseline mean (*SD*)	Follow-up mean (*SD*)	Baseline mean (*SD*)	Follow-up mean (*SD*)
Age	23.3 (4.7)		24.8 (5.0)*		22.9 (4.6)	
DASS: stress	5.0 (3.6)	8.1 (4.2)**	5.1 (2.5)	7.6 (3.4)	5.0 (3.8)	8.3 (4.4)
DASS: anxiety	2.4 (3.1)	4.1 (3.5)**	2.1 (1.4)	3.1 (2.7)	2.5 (3.3)	4.4 (3.7)
DASS: depression	2.5 (2.7)	5.4 (4.7)**	2.0 (1.5)	3.1 (2.2)	2.6 (3.0)	6.0 (5.0)
FMI: mindfulness	35.2 (6.8)	33.1 (6.9)**	38.0 (6.9)	34.8 (6.0)	34.6 (6.6)	32.7 (7.1)
UWES: total	56.7 (11.1)	62.3 (15.3)**	60.7 (12.4)	67.8 (14.1)	55.8 (10.7)	61.0 (15.4)
UWES: vigour	18.5 (4.2)	20.8 (5.9)**	19.3 (4.4)	23.3 (4.6)	18.3 (4.2)	20.1 (6.0)
UWES: dedication	19.1 (3.4)	19.6 (4.3)	20.9 (3.4)*	20.6 (4.4)	18.7 (3.3)	19.3 (4.3)
UWES: absorption	19.1 (4.7)	21.7 (6.1)**	20.7 (5.8)	23.8 (5.9)	18.8 (4.4)	21.2 (6.1)

Abbreviations: DASS = Depression Anxiety and Stress Sub-scales; FMI = Freiburg Mindfulness Inventory; UWES = Utrecht Work Engagement Scale (student version), *SD* = standard deviation

[1] whole sample, split into mindfulness training and no mindfulness training groups

* significantly higher baseline score in the mindfulness training group relative to the no mindfulness training group

** significant change between baseline and follow-up in the full sample ($p < .05$)

As shown in Table 2, a significant proportion of students transitioned from "normal" to higher severity categories on all subscales of the DASS between the baseline and follow-up measures (depression: $X^2 = 24.1$, $df = 4$, $p < .001$; stress: $X^2 = 16.0$, $df = 4$, $p = .003$; anxiety: $X^2 = 19.6$, $df = 4$, $p < .001$).

Student grade point average across all subjects (out of 100) was 69.4 ($SD = 6.2$) for the semester of observation and 75.6 ($SD = 5.7$) over the subsequent 18 months of the course.

Predictors of stress, anxiety, depression, study engagement and academic performance

Table 3 shows the results of the univariate analysis for predictors of stress, anxiety, depression, study engagement and academic performance. Being a member of the mindfulness training group and higher study engagement scores at baseline (total score and all subcategories) were significant univariate predictors of better academic performance at both the end of Semester 1 and over the final 18 months of the course, while female gender and lower depression scores at baseline predicted better academic performance at the end of the semester. Higher follow-up study engagement was predicted by being enrolled in the master's program, older age, higher mindfulness scores and

higher UWES (absorption) (Table 3 shows prediction of total UWES scores, while the subscales are presented in Appendix 2). There was only one predictor of depression at the end of semester (being a member of the mindfulness intervention group was associated with lower depression scores). We found no predictors of stress or anxiety at the end of semester.

Table 2

Number of Students Fitting Each Severity Category of the DASS Subscales

	Baseline		Follow-up	
	N	%	N	%
Stress				
Normal (0–7)	64	79.0%	41	50.6%
Mild (8–9)	6	7.4%	13	16.0%
Moderate (10–12)	8	9.9%	14	17.3%
Severe (13–16)	3	3.7%	10	12.3%
Extremely severe (17–21)	0	0.0%	3	3.7%
Anxiety				
Normal (0–3)	65	80.2%	44	54.3%
Mild (4–5)	9	11.1%	8	9.9%
Moderate (6–7)	1	1.2%	15	18.5%
Severe (8–9)	2	2.5%	4	4.9%
Extremely severe (10–21)	4	4.9%	10	12.3%
Depression				
Normal (0–4)	69	85.2%	36	49.3%
Mild (5–6)	4	4.9%	16	21.9%
Moderate (7–10)	6	7.4%	11	15.1%
Severe (11–13)	1	1.2%	4	5.5%
Extremely severe (14–21)	1	1.2%	6	8.2%

Table 3

Univariate Predictors of Depression, Anxiety, Stress and Academic Performance

		Depression: End of Semester	Anxiety: End of Semester	Stress: End of Semester	Study Engagement (UWES Total): End of Semester	Academic Performance: End of Semester	Academic Performance: Final 18 Months
Predictor variables							
Master's course enrolment (vs bachelor's course)	Pearson *R*	-0.047	0.090	-0.081	-.203*	0.001	-0.093
	Sig. (2-tailed)	0.693	0.422	0.471	.037	0.995	0.467
	N	74	82	82	81	80	63
Mindfulness group (vs control)	Pearson *R*	-.256*	-0.140	-0.067	.176	.262*	.331*
	Sig. (2-tailed)	0.028	0.210	0.547	.115	0.019	0.008
	N	74	82	82	81	80	63
Age	Pearson *R*	0.035	-0.068	0.007	0.349*	-0.027	-0.057
	Sig. (2-tailed)	0.771	0.548	0.950	.002	0.810	0.657
	N	73	80	80	81	80	63
Female gender (vs male)	Pearson *R*	0.114	-0.027	0.091	.022	.317*	0.128
	Sig. (2-tailed)	0.335	0.807	0.417	0.846	0.004	0.316
	N	74	82	82	79	80	63
Depression (start of semester)	Pearson *R*	0.116	0.178	0.129	-0.109	-.239*	-0.229
	Sig. (2-tailed)	0.328	0.113	0.250	0.335	0.034	0.074
	N	73	81	81	80	79	62
Stress (start of semester)	Pearson *R*	0.099	0.017	0.132	-0.209	0.171	0.033
	Sig. (2-tailed)	0.404	0.877	0.239	0.063	0.132	0.801
	N	73	81	81	80	79	62

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		Depression: End of Semester	Anxiety: End of Semester	Stress: End of Semester	Study Engagement (UWES Total): End of Semester	Academic Performance: End of Semester	Academic Performance: Final 18 Months
Anxiety (start of semester)	Pearson *R*	0.015	0.028	-0.021	-0.126	-0.144	-0.185
	Sig. (2-tailed)	0.898	0.801	0.852	0.264	0.206	0.151
	N	73	81	81	80	79	62
Mindfulness: FMI (start of semester)	Pearson *R*	0.014	-0.065	-0.007	0.344*	0.101	-0.039
	Sig. (2-tailed)	0.908	0.568	0.951	0.002	0.379	0.767
	N	72	80	80	79	78	61
UWES: total (start of semester)	Pearson *R*	0.049	-0.126	-0.011	0.213	.400*	.359*
	Sig. (2-tailed)	0.686	0.268	0.924	0.061	0.000	0.005
	N	71	79	79	78	77	60
UWES: vigour (start of semester)	Pearson *R*	0.058	-0.126	-0.064	0.165	.319*	.319*
	Sig. (2-tailed)	0.634	0.269	0.575	0.148	0.005	0.013
	N	71	79	79	78	77	60
UWES: dedication (start of semester)	Pearson *R*	0.035	-0.087	0.029	0.116	.368*	.345*
	Sig. (2-tailed)	0.770	0.448	0.799	0.311	0.001	0.007
	N	71	79	79	78	77	60
UWES: absorption (start of semester)	Pearson *R*	0.038	-0.122	0.011	0.270*	.394*	.312*
	Sig. (2-tailed)	0.753	0.283	0.925	0.017	0.000	0.015
	N	71	79	79	78	77	60

* statistically significant association between predictor and outcome variable ($p < .05$).

Abbreviations: FMI = Freiburg Mindfulness Inventory; UWES = Utrecht Work Engagement Scale (student version)

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Outcomes that were predicted by two or more variables progressed to multivariate analysis. Table 4 shows final multivariate models for prediction of academic performance during the semester that the study operated and across the final 18 months of the course as well as for predicting study engagement (UWES) total score. The final multivariate models for predicting academic performance over the current semester and over the final 18 months of the course accounted for 26.3% and 18.6% of the variance in academic scores, respectively, while the model for predicting study engagement accounted for 25.6% of the variance in study engagement (total score).

Table 4

*Final Multivariate Models for Predicting Academic Performance**

Model		Unstandardised Coefficients		Standardised Coefficients	
		Beta	Std. Error	Beta	Sig.
Predicting current semester academic performance	(Constant)	51.680	3.517		0.000
	Mindfulness group (vs control group)	4.018	1.615	0.255	0.015
	Female gender (vs male)	3.428	1.410	0.258	0.018
	UWES: absorption	0.371	0.142	0.279	0.011
Predicting final 18 months of the course academic performance	(Constant)	64.042	3.363		0.000
	Mindfulness group (vs control group)	3.920	1.607	0.293	0.018
	UWES: vigour	0.370	0.157	0.284	0.022
Study engagement (UWES: total score)	(Constant)	8.778	10.932		0.425
	Age	1.083	0.327	0.337	0.001
	Mindfulness	0.819	0.231	0.362	0.001

Abbreviations: UWES = Utrecht Work Engagement Scale (student version)

* over the current semester and over the final 18 months of the course and for predicting study engagement

Discussion

This study explored predictors of future stress, anxiety, depression, study engagement and academic performance in physiotherapy students, a subgroup of whom completed a mindfulness training program. Mindfulness training was significantly associated with better academic performance and lower depression scores at the end of the semester. Female gender, lower depression scores and higher study engagement also predicted better academic performance. Older age, higher baseline trait mindfulness and higher study

engagement (absorption) predicted higher levels of study engagement (total score) at the end of the semester.

Physiotherapy students involved in this study reported similar levels of stress, anxiety and depression symptoms on the DASS-21 to other normative non-clinical samples (Henry & Crawford, 2005). However, by the end of the semester, a significant proportion of students moved from normal to higher severity categories in the subscales of the DASS for stress, anxiety and depression. As we did not conduct long-term follow-up evaluation of psychological symptoms, it is unclear whether these increases were transient (just during the exam period) or persistent. Other studies have shown that psychological distress amongst university students compared to community (non-clinical) samples increases during the semester (Dyrbye et al., 2006; Larcombe et al., 2016; Walsh et al., 2010).

The ability of depression, anxiety and stress to predict future student wellbeing and academic performance was only partially supported in the current study with physiotherapy students. Lower depression scores on the DASS were associated with better academic performance during the semester, consistent with other literature supporting the negative impact of depression on grade point average in tertiary students (Eisenberg et al., 2009; Hysenbegasi et al., 2005). However, in our study neither stress nor anxiety were found to predict academic performance, which is contrary to previous research showing a connection between higher levels of stress or anxiety and poorer academic performance (Hassed & Chambers, 2014; Pritchard & Wilson, 2003). A previous study involving physiotherapy students found that higher levels of self-rated stress or anxiety on a visual analogue scale predicted poorer performance on clinical placement (Gallasch et al., 2022). However, unlike our study, Gallasch et al. (2022) did not measure other predictors of academic performance, such as depression, and the performance assessment was limited to clinical placement marks rather than all subjects. Further research is warranted to clarify whether stress and anxiety negatively impact general academic performance in physiotherapy students.

Participating in the mindfulness training program was associated with lower depression scores at the end of the semester and better academic performance at the end of the semester and at the end of the course (Table 3). No causal effect from the mindfulness training can be concluded given the cohort study design, where students self-selected to complete mindfulness training. Baseline characteristics revealed that the students who self-selected mindfulness training had higher levels of study engagement at the start of the semester prior to completing the mindfulness training, although these differences were sufficiently accounted for by the multivariate analysis that adjusted for these baseline factors. The associations found in this study are consistent with previous research showing improved levels of depression (McConville et al., 2017) and better academic performance (Leland, 2015; Mrazek et al., 2013; Zeidan et al., 2010) in students completing mindfulness training programs. Randomised controlled trials have shown benefits of mindfulness-based interventions in decreasing stress and anxiety in health professional

students (Spinelli et al., 2019), but there was no association between mindfulness training and either stress or anxiety in our prospective cohort study. Irrespective of mindfulness training, higher trait mindfulness at the start of the semester was also significantly associated with study engagement at the end of the semester in our study, consistent with other research (Bailey et al., 2019). These relationships suggest that targeting mindfulness as an intervention is worthy of further investigation in physiotherapy students via randomised controlled trials.

Older age and being enrolled in the master's course (n = 5 students) were both associated with higher levels of study engagement, although only older age remained in the multivariate analysis, suggesting that the master's course variable was only reflecting the older age in that cohort. Females achieved better academic performance at the end of the semester, consistent with other research on physiotherapy students (Edgar, 2015; Hammond, 2009). Higher levels of study engagement (total score and all subscales) were also predictive of better academic performance, in support of previous findings (Schaufeli et al., 2002). Work engagement (closely linked to study engagement) is of particular interest to employers because it links personal wellbeing factors to work performance (Burton et al., 2017), with engaged workers more productive and likely to put in effort to achieve desired workplace outcomes (Bakker, 2011).

Limitations and future research

A limitation of our study is the relatively small number of factors evaluated from a larger list that could conceivably predict student wellbeing and academic performance, although the multivariate model employed in our study is an advantage over many other studies in the field that analyse predictors individually. It is also possible that the amount of mindfulness training deployed in the study (6 hours) was insufficient to generate significant changes in some student wellbeing variables, such as stress and anxiety, especially during an intensive examination period. Adherence with home practice was also not recorded, so it is likely that some students did not incorporate their mindfulness techniques into their daily routine. There were also two types of mindfulness used, which could plausibly have differing effects. Finally, only a small proportion of students in the study (20%) volunteered to undertake the mindfulness intervention. Although the reasons for declining the mindfulness program were not explored in this study, other literature has found that lack of time and awareness of mindfulness are key barriers (Sanchez-Campos et al., 2020). Incorporating mindfulness into the curriculum for all students may be one way to improve participation rates beyond those seen in our study, where the opportunity was presented as completely voluntary.

The findings of the current study with physiotherapy students, combined with previous research completed predominately with medical students, appears to make a case for pursuing randomised controlled trials investigating the effectiveness of including mindfulness-based training into physiotherapy and other health professional education

programs. In addition, further research that helps to clarify the interconnections between student wellbeing, mental health, study engagement, mindfulness and academic performance would help to clarify the relationship between these and other variables. Such questions would be best answered with large samples subjected to multivariate modelling, such as multiple regression or Bayesian network models (Nagarajan et al., 2018).

Conclusion

Potentially modifiable factors (study engagement, depression and mindfulness training) were associated with future wellbeing and academic success in physiotherapy students. When combined with the findings from other research in this field, randomised controlled trials evaluating the effect of mindfulness training on physiotherapy student wellbeing and academic performance appear warranted.

Conflicts of interest and funding

The authors declare no conflicts of interest or funding was obtained for this study.

References

Auerbach, R. P., Mortier, P., Bruffaerts, R., Alonso, J., Benjet, C., Cuijpers, P., Demyttenaere, K., Ebert, D. D, Green, J. G., Hasking, P., Murray, E., Nock, M. K., Pinder-Amaker, S., Sampson, N. A., Stein, D. J., Vilagut, G., Zaslavsky, A. M., & Kessler, R. C. (2018). WHO world mental health surveys international college student project: Prevalence and distribution of mental disorders. *Journal of Abnormal Psychology*, *127*(7), 623–638. https://doi.org/10.1037/abn0000362

Bailey, N., Opie, J. L., Hassed, C. S., & Chambers, R. (2019). Meditation practice, dispositional mindfulness, personality and program outcomes in mindfulness training for medical students. *Focus on Health Professional Education*, *20*(1), 50–68. https://doi.org/10.11157/fohpe.v20i1.311

Bakker, A. B. (2011). An evidence-based model of work engagement. *Current Directions in Psychological Science*, *20*(4), 265–269. https://doi.org/10.1177/0963721411414534

Beilock, S. L., & Carr, T. H. (2005). When high-powered people fail: Working memory and "choking under pressure" in math. *Psychological Science*, *16*(2), 101–105. https://doi.org/10.1111/j.0956-7976.2005.00789.x

Burton, W. N., Chen, C. Y., Li, X., & Schultz, A. B. (2017). The association of employee engagement at work with health risks and presenteeism. *Journal of Occupational and Environmental Medicine*, *59*(10), 988–992. https://doi.org/10.1097/jom.0000000000001108

Caspi, A., Sugden, K., Moffitt, T. E., Taylor, A., Craig, I. W., Harrington, H., McClay, J., Mill, J., Martin, J., Braithwaite, A., & Poulton, R. (2003). Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. *Science*, *301*(5631), 386–389. https://doi.org/10.1126/science.1083968

Casuso-Holgado, M. J., Cuesta-Vargas, A. I., Moreno-Morales, N., Labajos-Manzanares, M. T., Barón-López, F. J., & Vega-Cuesta, M. (2013). The association between academic engagement and achievement in health sciences students. *BMC Medical Education*, *13*, Article 33. https://doi.org/10.1186/1472-6920-13-33

Dyrbye, L. N., Thomas, M. R., & Shanafelt, T. D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among US and Canadian medical students. *Academic Medicine*, *81*(4), 354–373. https://doi.org/10.1097/00001888-200604000-00009

Edgar, S. (2015). Identifying the influence of gender on motivation and engagement levels in student physiotherapists. *Medical Teacher*, *37*(4), 348–353. https://doi.org/10.3109/0142159x.2014.948829

Eisenberg, D., Golberstein, E., & Hunt, J. B. (2009). Mental health and academic success in college. *The BE Journal of Economic Analysis & Policy*, *9*(1), Article 40. http://doi.org/10.2202/1935-1682.2191

Fahrenkopf, A. M., Sectish, T. C., Barger, L. K., Sharek, P. J., Lewin, D., Chiang, V. W., Edwards, S., Wiedermann, B., & Landrigan, C. P. (2008). Rates of medication errors among depressed and burnt out residents: Prospective cohort study. *British Medical Journal*, *336*(7642), 488–491. https://doi.org/10.1136/bmj.39469.763218.be

Gallagher, C. T., Mehta, A. N., Selvan, R., Mirza, I. B., Radia, P., Bharadia, N. S., & Hitch, G. (2014). Perceived stress levels among undergraduate pharmacy students in the UK. *Currents in Pharmacy Teaching and Learning*, *6*(3), 437–441. https://doi.org/10.1016/j.cptl.2014.02.004

Gallasch, D., Conlon-Leard, A., Hardy, M., Phillips, A., Van Kessel, G., & Stiller, K. (2022). Variable levels of stress and anxiety reported by physiotherapy students during clinical placements: A cohort study. *Physiotherapy*, *114*, 38–46. https://doi.org/10.1016/j.physio.2021.12.002

Hakanen, J. J., Schaufeli, W. B., & Ahola, K. (2008). The job demands–resources model: A three-year cross-lagged study of burnout, depression, commitment, and work engagement. *Work and Stress*, *22*(3), 224–241. https://doi.org/10.1080/02678370802379432

Hammond, J. A. (2009). Assessment of clinical components of physiotherapy undergraduate education: Are there any issues with gender? *Physiotherapy*, *95*(4), 266–272. https://doi.org/10.1016/j.physio.2009.06.003

Harris, L. M., Cumming, S. R., & Campbell, A. J. (2006). Stress and psychological well-being among allied health professionals. *Journal of Allied Health, 35*(4), 198–207.

Hassed, C. (2007). "Healer know thyself": Mindfulness in the training of health professionals. *Psychotherapy in Australia*, *13*(4), 58.

Hassed, C., & Chambers, R. (2014). *Mindful learning: Reduce stress and improve brain performance for effective learning*. Exisle Publishing.

Hassed, C., De Lisle, S., Sullivan, G., & Pier, C. (2009). Enhancing the health of medical students: Outcomes of an integrated mindfulness and lifestyle program. *Advances in Health Sciences Education*, *14*(3), 387–398. https://doi.org/10.1007/s10459-008-9125-3

Hathaisaard, C., Wannarit, K., & Pattanaseri, K. (2022). Mindfulness-based interventions reducing and preventing stress and burnout in medical students: A systematic review and meta-analysis. *Asian Journal of Psychiatry*, *69*, Article 102997. https://doi.org/10.1016/j.ajp.2021.102997

Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *44*(2), 227–239. https://doi.org/10.1348/0144665505x29657

Hernández-Torrano, D., Ibrayeva, L., Sparks, J., Lim, N., Clementi, A., Almukhambetova, A., Nurtayev, Y., & Muratkyzy, A. (2020). Mental health and well-being of university students: A bibliometric mapping of the literature. *Frontiers in Psychology*, *11*, Article 1226. https://doi.org/10.3389/fpsyg.2020.01226

Hysenbegasi, A., Hass, S. L., & Rowland, C. R. (2005). The impact of depression on the academic productivity of university students. *Journal of Mental Health Policy and Economics*, *8*(3), 145–151.

Jacob, T., Itzchak, E. B., & Raz, O. (2013). Stress among healthcare students: A cross disciplinary perspective. *Physiotherapy Theory and Practice*, *29*(5), 401–412. https://doi.org/10.3109/09593985.2012.734011

Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. Delacorte Press.

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*(2), 144–156. http://doi.org/10.1093/clipsy.bpg016

Kakoschke, N., Hassed, C., Chambers, R., & Lee, K. (2021). The importance of formal versus informal mindfulness practice for enhancing psychological wellbeing and study engagement in a medical student cohort with a 5-week mindfulness-based lifestyle program. *PLoS One*, *16*(10), Article e0258999. https://doi.org/10.1371/journal.pone.0258999

Katz, M. (2006). *Study design and statistical analysis: A practical guide for clinicians*. Cambridge University Press. https://doi.org/10.1017/CBO9780511616761

Klingbeil, D., Fischer, A., Renshaw, T., Bloomfield, B., Polakoff, B., Willenbrink, J., Copek, R., & Chan, K. (2017). Effects of mindfulness-based interventions on disruptive behavior: A meta-analysis of single-case research. *Psychology in the Schools*, *54*(1), 70–87. https://doi.org/10.1002/pits.21982

Larcombe, W., Finch, S., & Sore, R. (2015). Who's distressed? Not only law students: Psychological distress levels in university students across diverse fields of study. *Sydney Law Review*, *37*(2), 243–273.

Larcombe, W., Finch, S., Sore, R., Murray, C. M., Kentish, S., Mulder, R. A., Lee-Stecum, P., Baik, C., Tokatlidis, O., & Williams, D. A. (2016). Prevalence and socio-demographic correlates of psychological distress among students at an Australian university. *Studies in Higher Education*, *41*(6), 1074–1091. https://doi.org/10.1080/03075079.2014.966072

Leland, M. (2015). Mindfulness and student success. *Journal of Adult Education*, *44*(1), 19–24.

Lindsay, R., Hanson, L., Taylor, M., & McBurney, H. (2008). Workplace stressors experienced by physiotherapists working in regional public hospitals. *Australian Journal of Rural Health*, *16*(4), 194–200. https://doi.org/10.1111/j.1440-1584.2008.00980.x

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, *33*(3), 335–343. https://doi.org/10.1016/0005-7967(94)00075-u

Maslach, C., & Leiter, M. P. (2008). *The truth about burnout: How organizations cause personal stress and what to do about it*. John Wiley & Sons.

McConville, J., Lewis, D., Chambers, R., & Hassed, C. (2019). Physiotherapy student experience of a mindful movement and mindful stress-reduction intervention: A qualitative study. *New Zealand Journal of Physiotherapy*, *47*(3), 172–182. http://doi.org/10.15619/NZJP/47.3.05

McConville, J., McAleer, R., & Hahne, A. (2017). Mindfulness training for health profession students—the effect of mindfulness training on psychological well-being, learning and clinical performance of health professional students: A systematic review of randomized and non-randomized controlled trials. *Explore*, *13*(1), 26–45. http://doi.org/10.1016/j.explore.2016.10.002

McEwen, B. S. (2004). Protection and damage from acute and chronic stress: Allostasis and allostatic overload and relevance to the pathophysiology of psychiatric disorders. *Annals of the New York Academy of Sciences*, *1032*(1), 1–7. https://doi.org/10.1196/annals.1314.001

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science*, *24*(5), 776–781. https://doi.org/10.1177/0956797612459659

Nagarajan, R., Scutari, M., & Lèbre, S. (2013). *Bayesian networks in R: With applications in systems biology*. Springer. https://doi.org/10.1007/978-1-4614-6446-4

Panagioti, M., Geraghty, K., Johnson, J., Zhou, A., Panagopoulou, E., Chew-Graham, C., Peters, D., Hodkinson, A., Riley, R., & Esmail, A. (2018). Association between physician burnout and patient safety, professionalism, and patient satisfaction: A systematic review and meta-analysis. *JAMA Internal Medicine*, *178*(10), 1317–1331. https://doi.org/10.1001/jamainternmed.2018.3713

Pritchard, M. E., & Wilson, G. S. (2003). Using emotional and social factors to predict student success. *Journal of College Student Development*, *44*(1), 18–28. https://doi.org/10.1353/csd.2003.0008

Sanchez-Campos, M., Archibald, D., MacLean, H., Koszycki, D., & Gosalves, C. (2020). Mindfulness in medical education: Students' perceptions and four recommendations for implementation of a mindfulness intervention. *International Journal of Whole Person Care*, *7*(2), 3. https://doi.org/10.26443/ijwpc.v7i2.248

Schaufeli, W. B., & Bakker, A. B. (2003). *UWES–Utrecht work engagement scale: Test manual*. Department of Social and Organisational Psychology, Utrecht.

Schaufeli, W. B., Bakker, A. B., & Salanova, M. (2006). The measurement of work engagement with a short questionnaire: A cross-national study. *Educational and Psychological Measurement*, *66*(4), 701–716. https://doi.org/10.1177/0013164405282471

Schaufeli, W. B., Martinez, I. M., Pinto, A. M., Salanova, M., & Bakker, A. B. (2002). Burnout and engagement in university students: A cross-national study. *Journal of Cross-Cultural Psychology*, *33*(5), 464–481. https://doi.org/10.1177/0022022102033005003

Sinclair, S. J., Siefert, C. J., Slavin-Mulford, J. M., Stein, M. B., Renna, M., & Blais, M. A. (2012). Psychometric evaluation and normative data for the depression, anxiety, and stress scales-21 (DASS-21) in a nonclinical sample of US adults. *Evaluation and the Health Professions*, *35*(3), 259–279. https://doi.org/10.1177/0163278711424282

Spinelli, C., Wisener, M., & Khoury, B. (2019). Mindfulness training for healthcare professionals and trainees: A meta-analysis of randomized controlled trials. *Journal of Psychosomatic Research*, *120*, 29–38. https://doi.org/10.1016/j.jpsychores.2019.03.003

Stoikov, S., Maxwell, L., Butler, J., Shardlow, K., Gooding, M., & Kuys, S. (2022). The transition from physiotherapy student to new graduate: Are they prepared? *Physiotherapy Theory & Practice*, *38*(1), 101–111. https://doi.org/10.1080/09593985.2020.1744206

Vaez, M., & Laflamme, L. (2008). Experienced stress, psychological symptoms, self-rated health and academic achievement: A longitudinal study of Swedish university students. *Social Behavior and Personality: An International Journal*, *36*(2), 183–196. https://doi.org/10.2224/sbp.2008.36.2.183

Walach, H., Buchheld, N., Buttenmüller, V., Kleinknecht, N., & Schmidt, S. (2006). Measuring mindfulness: The Freiburg mindfulness inventory (FMI). *Personality and Individual Differences*, *40*(8), 1543–1555. https://doi.org/10.1016/j.paid.2005.11.025

Walsh, J. M., Feeney, C., Hussey, J., & Donnellan, C. (2010). Sources of stress and psychological morbidity among undergraduate physiotherapy students. *Physiotherapy*, *96*(3), 206–212. https://doi.org/10.1016/j.physio.2010.01.005

Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulness meditation improves cognition: Evidence of brief mental training. *Consciousness and Cognition*, *19*(2), 597–605. https://doi.org/10.1016/j.concog.2010.03.014

Appendix 1

Focus of Each Session and Weekly "At-Home" Practices

Week	Mindful Stress Reduction	Mindful Movement
1	Introducing mindfulness • Body-scan 5 mins twice a day • Notice how much (1) paying attention and (2) in "default mode" (distracted/daydreaming) and effect of each	Introducing mindfulness • Body-scan 5 mins twice a day • Notice how much (1) paying attention and (2) in "default mode" (distracted/daydreaming) and effect of each
2	Reducing stress • Breath meditation 5 mins twice a day • Noticing when fight/flight (stress) response triggered and using mindfulness to disconnect it	Releasing tension • Tensing & relaxing 5 mins twice a day • Noticing & releasing physical/mental tension throughout day
3	Compassion • Mindful listening meditation 10 mins twice a day • Recognising self-criticism and practising self-compassion	Moving mindfully • Mindful walking 10 mins twice a day • Moving/commuting mindfully
4	Acceptance/letting go • Mindfulness of thoughts 10 mins twice a day • Noticing conflict/tension and letting go	Efficient/compassionate movement • Compassionate body-scan/mindful yoga 10 mins twice a day • Using minimal effort throughout daily activities
5	Improving productivity • Choiceless awareness 15 mins twice a day • Unitasking (instead of multitasking)	Joyful movement • Free movement/dance 15 mins twice a day • Awareness of joyful movement throughout day
6	Course review & maintaining the practice	Review & maintaining the practice

Appendix 2

Univariate and Analysis for Predicting Scores on the Subscales of the UWES (Study Engagement)

Univariate Predictors

		Study Engagement (UWES: Total)	Study Engagement (UWES: Vigour)	Study Engagement (UWES: Dedication)	Study Engagement (UWES: Absorption)
Master's course enrolment (vs bachelor's course)	Pearson *R*	-.232*	-0.212	-.222*	-.228*
	Sig. (2-tailed)	0.037	0.056	0.045	0.040
	N	81	82	82	82
Mindfulness group (vs control)	Pearson *R*	0.176	0.215	0.119	0.168
	Sig. (2-tailed)	0.115	0.052	0.289	0.131
	N	81	82	82	82
Age	Pearson *R*	.349**	.361**	.282*	.349**
	Sig. (2-tailed)	0.002	0.001	0.011	0.002
	N	79	80	80	80
Female gender (vs male)	Pearson *R*	0.022	0.020	0.101	0.025
	Sig. (2-tailed)	0.846	0.861	0.366	0.827
	N	81	82	82	82
Depression (start of semester)	Pearson *R*	-0.109	-0.107	-0.090	-0.097
	Sig. (2-tailed)	0.335	0.340	0.426	0.387
	N	80	81	81	81
Stress (start of semester)	Pearson *R*	-0.209	-0.205	-0.157	-0.186
	Sig. (2-tailed)	0.063	0.067	0.161	0.096
	N	80	81	81	81
Anxiety (start of semester)	Pearson *R*	-0.126	-0.150	-0.104	-0.104
	Sig. (2-tailed)	0.264	0.180	0.354	0.357
	N	80	81	81	81
Mindfulness (FMI: start of semester)	Pearson *R*	.344**	.277*	.308**	.336**
	Sig. (2-tailed)	0.002	0.013	0.005	0.002
	N	79	80	80	80

UWES: total (start of semester)	Pearson *R*	0.213	0.205	0.205	.234*
	Sig. (2-tailed)	0.061	0.070	0.069	0.038
	N	78	79	79	79
UWES: vigour (start of semester)	Pearson *R*	0.165	0.172	0.172	0.178
	Sig. (2-tailed)	0.148	0.131	0.129	0.117
	N	78	79	79	79
UWES: dedication (start of semester)	Pearson *R*	0.116	0.117	0.098	0.147
	Sig. (2-tailed)	0.311	0.303	0.390	0.198
	N	78	79	79	79
UWES: absorption (start of semester)	Pearson *R*	.270*	.246*	.260*	.288*
	Sig. (2-tailed)	0.017	0.029	0.021	0.010
	N	78	79	79	79

* Correlation is significant at the 0.05 level (2-tailed).

Abbreviations: N = number in analysis; UWES = Utrecht Work Engagement Scale (student version)