Exploring the impact of depression, anxiety, stress, academic engagement, and dropout intention on medical students' academic performance: A prospective study

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ABSTRACT

Background: Depression, anxiety, and stress (DAS) have been linked to poor academic outcomes. This study explores the relationships among DAS, academic engagement, dropout intentions, and academic performance — measured by Grade Point Average (GPA) — in medical students. It aims to understand how these factors relate to each other and predict academic performance.
Methods: Data were collected from 351 medical students (74.9 % female) through an online survey. The average age was 20.2 years. Psychometric instruments measured DAS, academic engagement, and dropout intentions. Structural equation modeling was used to test the relationships between these variables and their prediction of GPA.
Results: DAS was negatively associated with academic engagement $(\widehat{\beta} = -0.501; p < 0.001)$ and positively associated with dropout intentions $(\widehat{\beta} = 0.340; p < 0.001)$. Academic engagement positively predicted GPA $(\widehat{\beta} = 0.298; p < 0.001)$ and negatively associated with dropout intentions $(\widehat{\beta} = -0.367; p < 0.001)$. DAS had a nonsignificant direct effect on GPA $(\widehat{\beta} = -0.008; p = 0.912)$. However, the indirect effect of DAS — via academic engagement — on GPA and dropout intention was statistically significant.
Limitations: The study's limitations include the use of a convenience sample and the collection of all variables, except GPA, at the same time point, which may affect the generalizability of the results.
Conclusions: The study supports the important role of DAS in its association with academic engagement and dropout intentions, which can predict GPA. Addressing DAS could enhance academic engagement and reduce dropout rates, leading to better academic performance.

1. Introduction

The mental health challenges faced by medical students are associated with the demanding nature of their studies. These challenges arise from rigorous academic schedules, high expectations, and intense pressure to perform (Miyazaki et al., 2024). Medical students—who exhibit higher levels of obsessive-compulsive symptoms than the general population (Torres et al., 2016) — are at an increased risk of suicidal ideation (Tyssen et al., 2001), as well as elevated levels of burnout (Dyrbye et al., 2008), anxiety (Tian-Ci Quek et al., 2019), and a diminished quality of life compared to age-matched populations (Schwenk et al., 2010). Thus, the levels of depression, anxiety, and stress (DAS) symptoms of these students represent a great concern and are addressed by numerous studies (Dyrbye et al., 2006; Hope and Henderson, 2014; Mao et al., 2019; Mirza et al., 2021; Sarkar et al., 2017).

Depression is a negative affective state characterized by a spectrum

ranging from mild unhappiness and discontent to severe sadness, pessimism, and despondency, significantly impairing daily functioning (VandenBos, 2015). Anxiety is defined as an emotion characterized by apprehension and somatic tension, where an individual anticipates impending danger, catastrophe, or misfortune (VandenBos, 2015). Clark and Watson (1991) suggested that while anxiety and depression share certain characteristics, they also possess unique symptoms. The link between depression and anxiety and other medical illness can be of two kinds: behavioral (coping strategies, adherence to medical advice and prescription, etc.) and biological (immunological, neuroendocrine, inflammatory systems) (Telles-Correia and Barbosa, 2009). A related concept is stress, frequently defined as the physiological or psychological response to internal or external stressors, involving changes that affect nearly every bodily system and influence emotions and behavior (VandenBos, 2015).

Systematic reviews have revealed high prevalence of psychological distress (29.6 %), anxiety (28 %) and of depression or depressive symptoms (27.2 %) among medical students (Hope and Henderson, 2014; Lasheras et al., 2020; Rotenstein et al., 2016). Mental issues among medical students are frequently underrecognized and underrated (Molodynski et al., 2024). DAS can be associated with the overall well-being of medical students and has positive associations with phenomena such as student burnout (Abreu Alves et al., 2022). Studies have shown that untreated emotional problems and constant mental pressure can lead to negative consequences such as impaired concentration (Dyrbye et al., 2005). DAS is also related to academic engagement. For example, Ji et al. (2021) found that depressive symptoms negatively predicted academic engagement. Ng et al. (2022) reported that anxiety can have an indirect effect on academic engagement through both sleep hygiene behaviors and sleep quality. Meanwhile, Saleem et al. (2022) demonstrated that stress can moderate the relationship between academic engagement and psychological capital, with high stress levels deteriorating the positive relationship between these two variables.

Academic engagement is defined as the intention, energy, and time students dedicate to meaningful educational activities, encompassing cognitive, emotional, and behavioral dimensions (Sinval et al., 2021). Highly engaged students are expected to actively participate in classroom discussions, seek out additional resources, collaborate with peers, and think critically about the material they are learning. From a behavioral standpoint, they pay attention in class, follow school rules, and complete their homework on time. They also actively engage in group assignments and ask questions during discussions, demonstrating a commitment to their learning environment (Marôco et al., 2016). As for their emotional state, highly engaged students feel excited about their schoolwork, enjoy being at school, and view their classrooms as interesting places to be (Sinval et al., 2021). From a cognitive perspective, they question their understanding, discuss what they have learned outside of school, and strive to integrate knowledge across subjects (Marôco et al., 2016). Higher levels of academic engagement among medical students have been shown to attenuate the positive association between burnout and dropout intentions (Abreu Alves et al., 2022) and to predict lower levels of dropout intentions (Truta et al., 2018). Recent research has further highlighted the significant positive association between burnout and dropout intentions (Sinval et al., 2024). Engaged students may find their studies meaningful, rewarding, and aligned with their personal and professional goals. This sense of purpose and satisfaction can mitigate some psychological complaints that are commonly associated with dropout intentions (Abreu Alves et al., 2022).

Dropout intention refers to a student's perceived likelihood of academic failure (Bean, 1985). It includes the intention to consider either changing majors or withdrawing from college, serving as an early warning sign of potential dropout (Véliz Palomino and Ortega, 2023). The relationship between dropout intentions and Grade Point Average (GPA) can be reciprocal (Respondek et al., 2017). Lower academic performance, as indicated by a declining GPA, can reinforce or exacerbate dropout intentions (Robbins et al., 2004). Students struggling

academically may feel overwhelmed, demoralized, or perceive their efforts as futile, leading to an increased likelihood of considering dropout as a viable option (Martín-Arbós et al., 2024; Scheunemann et al., 2022). This cycle can create a feedback loop where initial dropout intentions result in lower GPA, which, in turn, strengthens the dropout intentions, further deteriorating academic performance (Respondek et al., 2017). Higher DAS levels have been associated with reduced academic engagement (Mou et al., 2022), increased dropout intentions (Peng et al., 2023, 2022), and lower academic performance (Mihäilescu et al., 2016; Moreira de Sousa et al., 2018). Additional factors, including lack of sleep, limited social interactions, and the emotional burden of patient care, exacerbate these conditions (Dyrbye et al., 2011) highlighting the urgent need for awareness and better mental health resources tailored specifically for medical students (Edwin et al., 2024). These mental health issues can be the precursors of long-term professional repercussions, including burnout and decreased quality of patient care, further emphasizing the importance of addressing DAS among medical students early and effectively (Dahlin and Runeson, 2007; Sen et al., 2010).

1.1. Hypotheses

This study aims to analyze the relationships between DAS, academic engagement, dropout intention, and academic performance — quantified by GPA — among medical students. By testing a structural model (Fig. 1), this paper explores the direct, indirect, and total effects of these variables, seeking to provide a comprehensive understanding of how DAS relates to both academic outcomes and dropout intentions.

It is hypothesized that DAS is related to academic engagement (H_1). Higher levels of DAS are anticipated to be associated with lower levels of engagement due to the emotional and cognitive burdens these psychological states impose on students.

It is proposed that DAS is related to dropout intentions (H_2). Increased levels of DAS are expected to be associated with a higher likelihood of students considering leaving their educational programs prematurely.

It is hypothesized that DAS predicts GPA (H_3). Increased levels of DAS are anticipated to be correlated with poorer academic performance, reflecting the detrimental impact of psychological distress on students' ability to perform academically.

It is posited that academic engagement is associated with dropout intentions (H_4). Higher levels of engagement are expected to reduce the likelihood of students considering dropping out, as engaged students are more likely to feel connected and satisfied with their studies.

It is hypothesized that academic engagement predicts GPA (H_5). Increased engagement is expected to correlate with higher academic performance, as engaged students typically exhibit better study habits and greater time management skills.

It is proposed that dropout intentions negatively predict future GPA (H_6). Students who consider dropping out are expected to show decreased motivation and commitment to their studies, leading to poorer academic performance.

Through the exploration of these hypotheses, insights into the relationships between DAS, academic engagement, dropout intentions, and performance among medical students are expected to be gained. Understanding these associations provides a potential basis for developing targeted interventions aimed at reducing DAS and enhancing student retention and success in medical education.

2. Method

2.1. Sampling

A non-probability convenience sampling method was used by inviting first- and second-year undergraduate medical students from a public university in Portugal to participate in the study. There were no
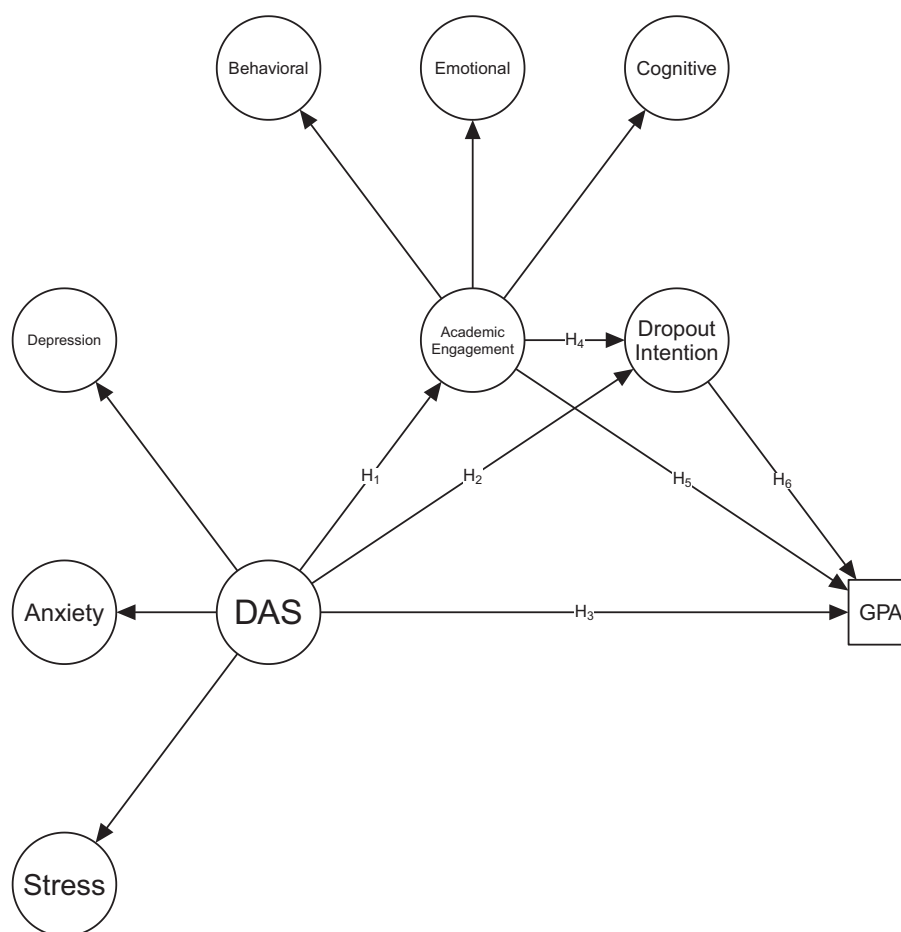
Fig. 1. Hypothesized model.

exclusion criteria. The minimum sample size for the originally proposed model ($df = 668$) was calculated under the assumption that the population root mean square error of approximation (*RMSEA*) should not exceed $\varepsilon_0 = 0.06$ (H_0: $\varepsilon \geq 0.06$). This assumption is based on the premise that rejecting this hypothesis would indicate a model fit that is better than 0.06, a cutoff recommended by Hu and Bentler (1999). The true population RMSEA was set at $\varepsilon = 0.05$. With $\alpha = 0.05$ and $\beta = 0.20$ (i.e., $\pi = 0.80$), the required minimum sample size for the structural model was determined to be $n = 165$ (Kelley and Lai, 2018).

2.2. Procedure

All first- and second-year medical students of the integrated master's in medicine from a major public university in Lisbon were invited to participate in the study through email. Data collection began midway through the first semester of the 2023/2024 academic year and lasted for two weeks. An online survey, including psychometric instruments, sociodemographic, and academic questions, was administered via *LimeSurvey* software (LimeSurvey GmbH, 2024). Students were first presented with an electronic informed consent form (Stevens, 2013), which they needed to accept to proceed, and were informed of their right to withdraw at any time. To increase the participation rate, an automatically generated report summarizing each participant's responses compared to the overall sample was provided at the end of the survey. The students' first-semester GPA was obtained from the academic services of the institution following the completion of the first semester exams. The study was approved by the Ethics Committee of CHLN-HSM and the Faculty of Medicine at the University of Lisbon (FMUL) (Ref. No. 210/20).

2.3. Measures

All measures were presented to participants using the appropriate Portuguese version.

2.3.1. Demographic and academic data

Students also answered questions pertaining to their sex, age, relocation status, number of higher education enrollments, prior undergraduate studies in other disciplines, and grant holder status. The students' first-semester GPA, which ranges from 0 to 20, was calculated as the weighted arithmetic mean of the course grades, with weights assigned according to the number of credits for each course. If a student has a grade of <10 (rounded to the unit), the student will have to repeat the course. This GPA was obtained from the academic services of the institution following the completion of the first semester exams.

2.3.2. Depression, Anxiety and Stress Scale (DASS-21)

The Portuguese version of the DASS-21 (Pais-Ribeiro et al., 2004) was used to measure students' levels of depression, anxiety and stress (first-order dimensions). The self-report psychometric instrument consists of 21 items, rated from 0 — 'Did not apply to me at all' to 3 — 'Applied to me very much, or most of the time.' The three dimensions were nested under a second-order factor. The DASS-21 showed good validity evidence in previous studies with Portuguese university students (Abreu Alves et al., 2022).

2.3.3. University Student Engagement Inventory (USEI)

The Portuguese version of the USEI was used to measure students' academic engagement; a second-order factor comprising three first-

order dimensions: emotional, cognitive, and behavioral (Marôco et al., 2016). The psychometric instrument is composed of 15 items rated from 1 — 'Never' to 5 — 'Always.' USEI presented good psychometric properties in previous research with university students from Portugal (Sinval et al., 2021).

2.3.4. Screening instrument for students at-risk of dropping out

Dropout intentions were assessed using the Screening Instrument for Students At-Risk of Dropping Out, a self-report instrument developed by Casanova et al. (2021) with a sample of students from a Portuguese university. The psychometric instrument has three dimensions — dropout intention, satisfaction with education and academic exhaustion — each measured by four items. For the current study, only the items measuring dropout intention were used. The response scale ranges from 1 — 'Strongly disagree' to 5 — 'Strongly agree.'

2.4. Data analysis

Statistical analyses were conducted using the *R* program (R Core Team, 2024) via the integrated development environment *RStudio* (Posit Team, 2024) using a significance level of $\alpha = 0.05$. Confirmatory Factor Analysis was performed to investigate the proposed dimensionality of the measurement model while full structural equation modeling (SEM) was used to test the hypothesized structural model. The goodness-of-fit indices included the scaled versions of *NFI, TLI, CFI, RMSEA, SRMR*, and χ^2. Acceptable fit values for *NFI, TLI,* and *CFI* are >0.95 (Hu and Bentler, 1999) and *RMSEA* and *SRMR* <0.08 (Browne and Cudeck, 1993; Hu and Bentler, 1999). The minimum recommended sample size for the tested models was obtained using the *MBESS* package (Kelley, 2023) according to the guidelines by Kelley and Lai (2018). Both CFA and full SEM models were tested using the *lavaan* package (Rosseel, 2012) using the Weighted Least Squares Mean and Variance adjusted (WLSMV) estimator (Muthén, 1983) with listwise deletion of missing data. The direct, indirect, and total effects for the hypothesized serial mediation model were estimated as recommended in Lemardelet and Caron (2022). The diagrams were created using the *semPlot* package (Epskamp, 2015) and the *semptools* package (Cheung and Lai, 2023).

The reliability of the first-order factors was estimated using ω (McDonald, 1999), which accounts for the ordinal nature of the indicators. For second-order factors, the internal consistency estimators included the following: $\omega_{partial\ L1}$ (the proportion of variance explained by the second-order factor after accounting for the uniqueness of the first-order factor), ω_{L1} (the proportion of the total score accounted for by the second-order factor), and ω_{L2} (the proportion of variance in the first-order factors explained by the second-order factor). All internal consistency estimates were calculated using the *semTools* package (Jorgensen et al., 2023).

3. Results

3.1. Sample characterization

The study sample (Table 1) consisted of 351 medical students, predominantly female (74.9 %) with an average age *of* approximately 20.2 years (*SD* = 3.99). About 59.5 % of students remained in their city of origin for studies. Academically, the average GPA was 15.0 on a scale of 20 points, with male students slightly outperforming their female counterparts. Most students entered medical school directly after secondary education, as indicated by an average of 1.86 prior enrollments in higher education before their current program. Only 12 % had previously pursued undergraduate courses in disciplines other than medicine, and 14.2 % received financial grants. This demographic and academic snapshot highlights the typical educational paths and characteristics within the cohort.

Table 1
Demographic and academic characteristics of the sample.

	Female	Male	Overall
	n = 263	*n* = 88	*N* = 351
Age (years)			
M (*SD*)	20.2 (4.2)	20.3 (3.4)	20.2 (4.0)
Mdn [*Min, Max*]	19.0 [17.0, 49.0]	19.0 [17.0, 34.0]	19.0 [17.0, 49.0]
Moved from the city of origin			
Yes	108 (41.1 %)	34 (38.6 %)	142 (40.5 %)
No	155 (58.9 %)	54 (61.4 %)	209 (59.5 %)
GPA (1st semester 2023/2024)			
M (*SD*)	15.0 (1.0)	15.2 (1.4)	15.0 (1.1)
Mdn [*Min, Max*]	14.9 [11.9, 18.3]	15.3 [10.0, 18.0]	15.0 [10.0, 18.3]
Number of prior enrollments in higher education before their current program			
M (*SD*)	1.80 (1.5)	2.02 (2.1)	1.86 (1.7)
Mdn [*Min, Max*]	1.00 [1.00, 13.0]	1.00 [1.00, 14.0]	1.00 [1.00, 14.0]
Previously pursued undergraduate course (other than medicine)			
Yes	30 (11.4 %)	12 (13.6 %)	42 (12.0 %)
No	233 (88.6 %)	76 (86.4 %)	309 (88.0 %)
Grant holder			
Yes	38 (14.4 %)	12 (13.6 %)	50 (14.2 %)
No	225 (85.6 %)	76 (86.4 %)	301 (85.8 %)

3.2. Measurement model

The original measurement model presented an acceptable fit to the data; however, the disturbance of the emotional engagement first-order factor was negative (−0.004). Thus, a constraint was imposed on the model, fixing the emotional engagement disturbance to 0.01. The modified model showed an acceptable fit to the data ($n = 319$; $\chi^2_{(769)} = 1511.942$; $p < 0.001$; *CFI* = 0.939; *NFI* = 0.883; *TLI* = 0.935; *SRMR* = 0.081; *RMSEA* = 0.055; $P_{[RMSEA \leq 0.05]} < 0.021$; CI 90 % (0.051; 0.059)).

The internal consistency estimates provided satisfactory to very good evidence ($\omega_{Depression} = 0.90$; $\omega_{Anxiety} = 0.87$; $\omega_{Stress} = 0.87$; $\omega_{Behavioral\ Engagement} = 0.73$; $\omega_{Emotional\ Engagement} = 0.84$; $\omega_{Cognitive\ Engagement} = 0.77$; $\omega_{Dropout\ Intention} = 0.90$). Regarding the second-order internal consistency estimates, the results demonstrated good to very good evidence (DAS: $\omega_{partial\ L1} = 0.96$; $\omega_{L1} = 0.89$; $\omega_{L2} = 0.93$; Academic Engagement: $\omega_{partial\ L1} = 0.91$; $\omega_{L1} = 0.80$; $\omega_{L2} = 0.88$).

As shown in Table 2, all correlations between the latent variables and GPA were statistically significant ($p < 0.001$). GPA exhibited a negative correlation with DAS ($r = -0.18$) and dropout intention ($r = -0.22$), and a positive correlation with academic engagement ($r = 0.33$).

3.3. Structural model

Building upon the modified measurement model, the hypothesized model was tested by replacing some of the covariance paths with regression paths. The structural model (Fig. 2) presented an acceptable fit to the data ($n = 319$; $\chi^2_{(769)} = 1511.942$; $p < 0.001$; *CFI* = 0.939; *NFI* = 0.883; *TLI* = 0.935; *SRMR* = 0.081; *RMSEA* = 0.055; $P_{[RMSEA \leq 0.05]} <$

Table 2
Correlations between latent variables and GPA, mean and SD of the raw scores.

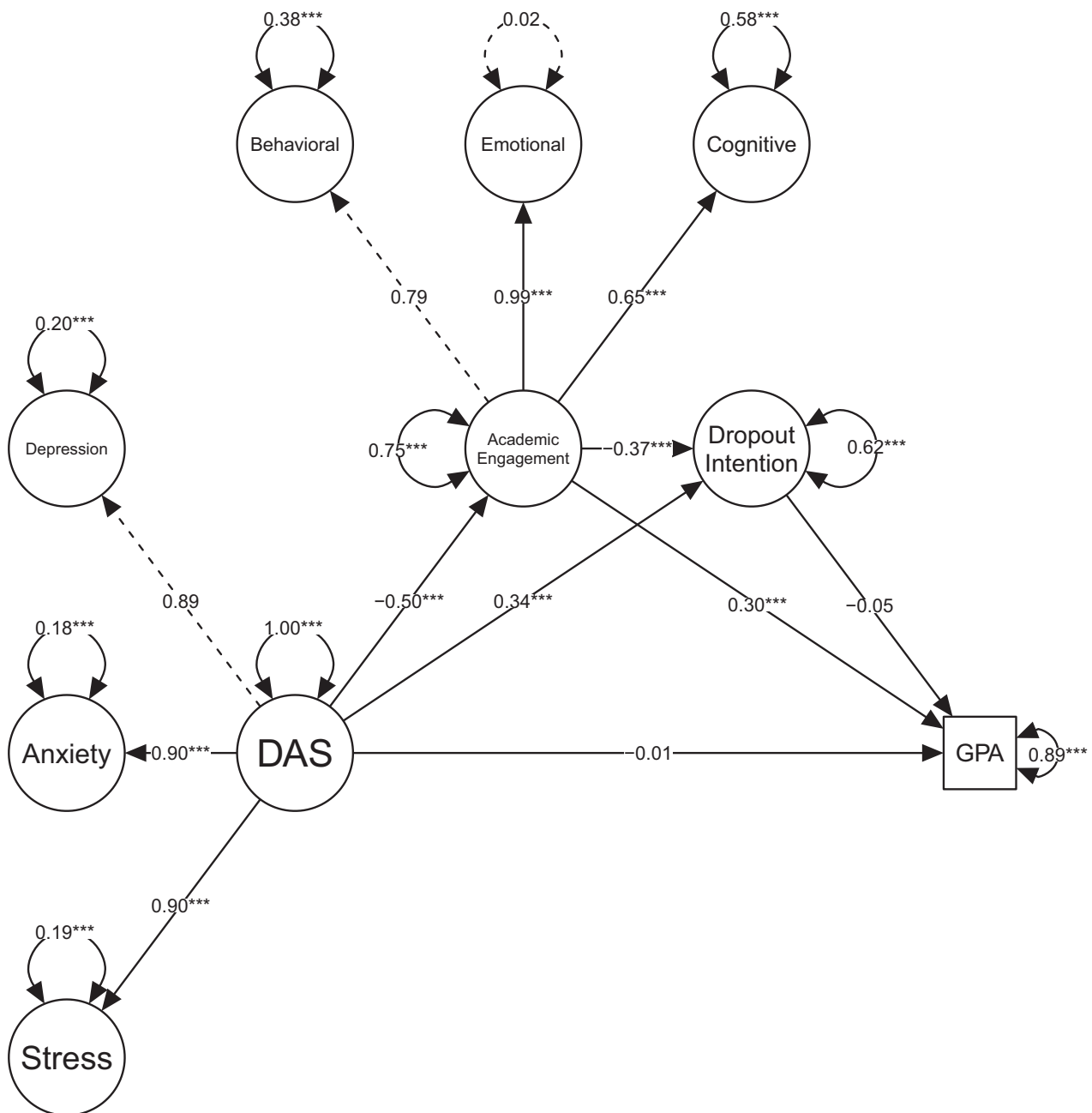| Variable	*M*	*SD*	1	2	3
DAS (1)	0.98	0.61			
Academic engagement (2)	3.81	0.52	−0.50***		
Dropout intention (3)	1.45	0.69	0.52***	−0.54***	
GPA (4)	15.04	1.12	−0.18***	0.33***	−0.22***

*** — $p < 0.001$.

Fig. 2. Structural model diagram.
Note. *** — $p < 0.001$. Dotted lines indicate fixed parameters.

0.021; CI 90 % (0.051; 0.059)). In fact, the fit of the structural model is exactly the same as that of the modified measurement model because the number of degrees of freedom remained unchanged.

The structural model's regression coefficients (Table 3) revealed that three of the direct, indirect, and total effects were not statistically significant. DAS had a statistically significant negative direct effect on Academic Engagement ($\widehat{\beta} = -0.501; p < 0.001$) and a statistically significant positive effect on Dropout Intention ($\widehat{\beta} = 0.340; p < 0.001$). Academic engagement exhibited a significant negative direct effect on dropout intention ($\widehat{\beta} = -0.367; p < 0.001$) and directly predicted GPA ($\widehat{\beta} = 0.298; p < 0.001$). DAS did not have a statistically significant direct effect on GPA ($\widehat{\beta} = -0.008; p = 0.912$), nor did dropout intention ($\widehat{\beta} = -0.053; p = 0.440$).

Among the indirect effects, DAS presented a statistically significant

indirect effect on GPA via academic engagement ($\widehat{\beta} = -0.149; p < 0.001$). DAS also revealed a statistically significant indirect effect on dropout intention via academic engagement ($\widehat{\beta} = 0.184; p < 0.001$). The total indirect effect of DAS on GPA was statistically significant ($\widehat{\beta} = -0.177; p < 0.001$). However, no serial mediation effect of DAS on GPA via academic engagement and dropout intention was found ($\widehat{\beta} = -0.010; p = 0.444$).

DAS exhibited a negative and statistically significant total effect on GPA ($\widehat{\beta} = -0.185; p < 0.001$) and a positive and statistically significant total effect on dropout intention ($\widehat{\beta} = 0.524; p < 0.001$). Academic engagement had a positive and statistically significant total effect on GPA ($\widehat{\beta} = 0.318; p < 0.001$). The explained variance for the endogenous latent variables of interest (Fig. 2) ranged from moderate to substantial (Cohen, 1988): $r^2_{Academic\ Engagement} = 0.25; r^2_{Dropout\ Intention} = 0.38; r^2_{GPA} = 0.11$.

Table 3
Structural model's regression coefficients.

Path	$\hat{b}$	se	z	$\hat{\beta}$	p	95 %CI
Direct effects						
AcE ← DAS	−0.381	0.047	−8.143	−0.501	<0.001	(−0.473; −0.290)
DrI ← DAS	0.371	0.080	4.634	0.340	<0.001	(0.214; 0.527)
DrI ← AcE	−0.524	0.096	−5.464	−0.367	<0.001	(−0.712; −0.336)
GPA ← DAS	−0.011	0.102	−0.111	−0.008	0.912	(−0.211; 0.188)
GPA ← AcE	0.580	0.131	4.435	0.298	<0.001	(0.324; 0.836)
GPA ← DrI	−0.072	0.093	−0.773	−0.053	0.440	(−0.254; 0.110)
Indirect effects						
IndE1: GPA ← AcE ← DAS	−0.221	0.050	−4.402	−0.149	<0.001	(−0.320; −0.123)
IndE2: GPA ← DrI ← DAS	−0.027	0.035	−0.768	−0.018	0.442	(−0.094; 0.041)
IndE3: GPA ← DrI ← AcE	0.038	0.049	0.769	0.019	0.442	(−0.058; 0.133)
IndE4: DrI ← AcE ← DAS	0.200	0.039	5.156	0.184	<0.001	(0.124; 0.276)
IndE5: GPA ← DrI ← AcE ← DAS	−0.014	0.019	−0.765	−0.010	0.444	(−0.051; 0.022)
IndE Total (GPA ← DAS): IndE1 + IndE2 + IndE5	−0.262	0.059	−4.462	−0.177	<0.001	(−0.377; −0.147)
Total effects						
GPA ← AcE + (GPA ← DrI ← AcE)	0.618	0.121	5.116	0.318	<0.001	(0.381; 0.854)
DrI ← DAS + (DrI ← AcE ← DAS)	0.570	0.067	8.531	0.524	<0.001	(0.439; 0.702)
GPA ← DAS + IndE Total (GPA ← DAS)	−0.273	0.079	−3.455	−0.185	<0.001	(−0.428; −0.118)

Note. AcE — Academic Engagement; DAS — Depression, Anxiety, and Stress; DrI — Dropout Intention; GPA — Grade Point Average; IndE — Indirect Effect.

4. Discussion

The findings of this study enhance the understanding of the relationships between DAS, academic engagement, dropout intentions, and GPA among medical students. The results indicate that DAS significantly impacts academic engagement and dropout intentions, confirming the detrimental effects of DAS on students' academic lives. Although DAS does not directly predict GPA, its indirect effects through academic engagement are particularly noteworthy, suggesting that mental health issues can permeate various aspects of academic performance. Additionally, academic engagement emerges as a relevant factor, not only in potentially enhancing GPA but also in negatively associating with dropout intentions, highlighting its protective role in the academic environment (Abreu Alves et al., 2022).

The results supported H_1, as DAS was found to have a meaningful negative direct effect on academic engagement. This finding aligns with previous research suggesting that higher levels of DAS impair students' ability to engage academically because of the emotional and cognitive burdens associated with these psychological states (Moreira de Sousa et al., 2018). The negative relationship between DAS and academic engagement highlights the critical need for mental health interventions focused on reducing symptoms of DAS (Selvaraj and John, 2021), which, in turn, could enhance students' academic engagement and overall academic experience (Maftei et al., 2024).

The second hypothesis (H_2) was also supported by the findings, showing a statistically significant positive direct effect of DAS on dropout intentions. This indicates that students experiencing higher levels of DAS are more likely to consider leaving their educational programs, consistent with prior studies that highlight the adverse impact of psychological distress on students' commitment to their education (Peng et al., 2023, 2022). The positive relationship between DAS and dropout intentions emphasizes the importance of early identification and support for students who experience high levels of stress, anxiety, and depression (Selvaraj and John, 2021).

Regarding H_3, the results did not support this hypothesis. Although a statistically significant latent correlation was observed between the two variables in the measurement model, with an effect size consistent with findings from previous research (Ahmed and Julius, 2015), DAS did not have a statistically significant direct effect on GPA. Awadalla et al. (2020) reported similar statistically significant correlations between anxiety and GPA, as well as between depressive symptoms and GPA. The authors found that neither anxiety nor depressive symptoms predicted

GPA at baseline. However, they observed that only depressive symptoms measured at baseline predicted GPA at the 6-month follow-up. It is noteworthy that this statistically significant relationship was suppressed when baseline GPA was added to the model. This suggests that while DAS impacts various aspects of academic life, its direct influence on academic performance, as measured by GPA, might be limited. Students experiencing high DAS levels often struggle to maintain consistent academic performance, leading to lower grades and academic dissatisfaction (Mihăilescu et al., 2016). However, it is important to note that in the present study, DAS had an indirect effect on GPA through academic engagement, indicating that DAS can still negatively impact academic performance through its influence on engagement. This indirect relationship suggests that interventions aimed at reducing DAS could improve academic outcomes indirectly by enhancing students' engagement with their studies. In the current study, DAS is operationalized as a second-order construct (Szabó, 2010), allowing for an analysis of its collective relationship with other variables (Abreu Alves et al., 2022). This approach differs from previous studies that examine the individual associations of depressive symptoms, anxiety, and stress with GPA (Jehi et al., 2024; Yaghmour et al., 2023). Although the dimensions of DAS are often highly correlated (Crawford and Henry, 2003; Oei et al., 2013), analyzing them separately allows for verification of whether the three dimensions exhibit identical relationships with academic performance.

The fourth hypothesis (H_4) was supported by the findings, with academic engagement showing a meaningful negative direct effect on dropout intentions. This result underscores the protective role of academic engagement against dropout intentions, suggesting that engaged students are less likely to contemplate leaving their programs (Honey and Mudge, 2022). The negative relationship between academic engagement and dropout intentions highlights the importance of fostering a supportive and engaging academic environment to reduce the likelihood of student attrition (Passeggia et al., 2023).

The data supported H_5, revealing a significant positive direct effect of academic engagement on GPA. This seems to suggest that higher levels of academic engagement are associated with better academic performance, consistent with existing literature highlighting the benefits of engagement on students' academic outcomes (Casanova et al., 2024; Martínez et al., 2019). The positive relationship between academic engagement and GPA emphasizes the need for educational strategies that promote student involvement and active participation in learning activities to enhance academic success (Kassab et al., 2022).

Finally, H_6 was not supported, as dropout intentions did not have a

statistically significant effect on GPA. This finding suggests that the direct impact of contemplating dropout on academic performance might be less pronounced than anticipated. Students who contemplate dropping out are generally less focused on their academic responsibilities, which can detract from their performance (Peng et al., 2022). However, it is possible that other mediating factors not captured in this study could influence this relationship (Scheunemann et al., 2022). The lack of a significant relationship between dropout intentions and GPA indicates that, while dropout considerations are concerning, they may not directly lead to immediate declines in academic performance, suggesting the need for a broader approach to understand and address the factors influencing both dropout intentions and academic success. Previous research has shown that lower academic performance can predict higher dropout intentions; however, this study analyzed the effect of dropout intentions on subsequent performance.

4.1. Implications for practice

These results emphasize the importance of addressing DAS and promoting academic engagement to improve academic outcomes and retention among medical students (Beshr et al., 2024; Casanova et al., 2024; Moreira de Sousa et al., 2018; Rolland et al., 2022). Some recommendations to reduce medical student distress include promoting well-being through mindfulness, exercise, and social connections (Dyrbye et al., 2005). Providing priority access to counseling and mental health services ensures students have the support they need (Selvaraj and John, 2021). However, it is known that not all depressed students utilized mental health counseling services. The main reasons for this included lack of time, concerns about confidentiality, stigma associated with seeking support, cost, fear of documentation on academic records, and fear of unwanted intervention (Givens and Tjia, 2002).

Other recommendations include fostering a positive, non-competitive learning environment, and encouraging a healthy study-life balance, both of which help students manage stress more effectively (Dyrbye et al., 2005). Instructional methods can increase medical student engagement by targeting key drivers such as positive student-peer relationships, positive student-faculty relationships, an enhanced sense of competence, a sense of agency and empowerment, and the perceived relevance of meaningful learning activities (Kassab et al., 2022).

4.2. Strengths and limitations

A key strength of this study is its comprehensive analysis of how DAS relate to academic engagement, dropout intentions, and GPA among medical students. The findings confirm that DAS significantly reduces academic engagement and increases dropout intentions, highlighting the need for mental health interventions. Although DAS did not directly predict GPA, the indirect impact of DAS through academic engagement suggests that reducing DAS can enhance academic outcomes.

Unlike prior research that predominantly focused on the behavioral dimension, our study examines the multidimensional nature of academic engagement and its relationship with key academic outcomes, such as GPA and dropout intention (Kassab et al., 2022). By integrating mental health factors, a refined perspective on how DAS is associated with academic performance and retention is provided, highlighting the importance of interventions to enhance student well-being and engagement.

The current study contributes to the understanding of dropout intention among medical students; however, the etiology of dropout is complex and multifactorial, with mental health being just one of many contributing factors (Wainipitapong and Chiddaycha, 2022). The tested model did not include — for example — medical students' sociodemographic variables that are known to be associated with attrition (Nguyen et al., 2022). The current study design is strengthened by the use of a prospective approach to measure later performance at the end of the first semester with a more quantifiable measure of performance (i.e., GPA).

The complexity of diagnosing and treating mental health disorders such as depression and anxiety among medical students is compounded by the limitations of current psychiatric classification systems (Maes and Stoyanov, 2022). The evolving definitions of mental disorders that address various ethical, legal, and financial issues, further complicate the diagnostic landscape (Telles-Correia et al., 2018). Incorporating advanced methodologies, such as data-driven machine learning models, may offer more accurate and individualized diagnostic and therapeutic strategies (Maes and Stoyanov, 2022). Additionally, there is a need for further investigation into how the improved diagnostic frameworks can be integrated into mental health resources specifically designed for medical students.

The current study used GPA as a measure of success. However, scholars have long advocated for a more comprehensive definition of success beyond GPA and retention rates. While it is challenging to measure, future studies should consider using alternative success indicators that could be crucial for better aligning students with programs (Mould and DeLoach, 2017).

Another limitation of this study is the use of non-probability convenience sampling, as data were collected solely from first- and second-year medical students at the Faculty of Medicine of a public university in Lisbon, Portugal. This approach does not mitigate selection bias, which restricts the generalizability of our findings and may not adequately represent the broader population of medical students. Additionally, the current study did not control for factors such as medication use, diagnosed medical conditions, or ongoing medical or psychological treatment among the participants. Future research should aim to include participants from various regions of Portugal, as well as those from private universities and different course years, while also controlling for medication use, diagnosed medical conditions, and ongoing treatment.

5. Conclusion

The results provide valuable insights into the complex dynamics between DAS, academic engagement, dropout intentions, and GPA among medical students. While some hypotheses were fully supported, others revealed nuanced relationships that warrant further exploration. These findings highlight the importance of addressing DAS and fostering academic engagement to enhance student retention and performance in medical education. Understanding these relationships can inform the development of targeted interventions and policies, aimed at improving the mental health and academic outcomes of medical students, ultimately contributing to a more supportive and effective educational environment.

CRediT authorship contribution statement

Jorge Sinval: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Pedro Oliveira:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Conceptualization. **Filipa Novais:** Conceptualization. **Carla**

Maria Almeida: Conceptualization. **Diogo Telles-Correia:** Writing – review & editing, Supervision, Project administration, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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