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Identifying academic motivation profiles and their association with mental health in medical school

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ABSTRACT

Introduction: Academic motivation (AM), motivation in relation to formal studies that as a construct of the self-determination theory (SDT), is frequently assessed by the Academic Motivation Scale (AMS). However, the scoring of AMS in itself is not fully consistent with the SDT theory as only scores of the subscales can be calculated resulting in seven different score means instead of positioning the individual on the self-determination continuum. There have been few attempts at a person-centered approach to AMS scoring, especially among medical students. Our study aimed to find distinct academic motivation profiles and demonstrate their concurrent criterion validity with mental health variables (psychological distress, life satisfaction) among medical students.

Methods: The AMS-28 college version, the General Health Questionnaire (GHQ-12), and the Single-Item Measure of Life Satisfaction were administered among medical freshmen. Academic motivation profiles were generated by two methods: 1) two-step cluster analysis, and 2) quantile analysis.

Results: The sample consisted of 189 participants (mean age = 19.38 ± 2.03 years, 72% females). The cluster analyses revealed three fairly distinct profiles of self-determination: 'High' ($n = 59$; mean im = 5.48 ± 0.60; mean em = 6.07 ± 0.41; mean am = 1.57 ± 0.95), 'Moderate' ($n = 111$; mean im = 4.5 ± 1.06; mean em = 4.41 ± 0.87; mean am = 1.25 ± 0.36), and 'Low' ($n = 19$; mean im = 4.22 ± 1.02; mean em = 4.03 ± 1.16; mean am = 3.07 ± 1.30). The creation of deciles allowed the identification of those who were most intrinsically ($n = 14$, 7.4%), extrinsically ($n = 10$, 5.3%), and least motivated (amotivated) ($n = 18$, 9.5%). 'Low' self-determination/amotivation was associated with increased psychological distress and decreased life satisfaction.

Conclusion: Our results provide means to position medical students on the SDT continuum based on 'Low', 'Moderate', or 'High' levels of self-determination toward their studies. These AM profiles predict the mental health of medical freshmen, which supports the validity of the outcomes and highlight the risks of amotivation for psychological morbidity. The limitations and implications are discussed.

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self-determination theory; academic motivation scale (AMS); medical students; cluster analysis; quantile analysis

Introduction

Motivation research is concerned with investigating why individuals behave the way they do, what 'moves' them to start, maintain, and stop their actions. The self-determination theory (SDT) of Deci and Ryan – the leading theory of human motivation – provides a broad theory of human motivation with an emphasis on the inherent need of humans for autonomy, competence, and relatedness from which natural tendencies for growth, learning and connection with others follow [1]. The theory conceptualizes self-determination as a continuum within which three main types of motivation can be distinguished based on the degree of self-determination. Intrinsic motivation (im) pertains to engagement in an activity for its inherent satisfaction. Extrinsic motivation (em) is instrumental, that is, it explains activities carried out for specifiable external or internal reasons which can be allocated into one of four subtypes: external regulation, introjected regulation, identified regulation and integrated regulation. The first two types (external and introjected regulation) of extrinsic motivation are collectively referred to as controlled motivation because the control is external, beyond the individual's agency. Conversely, identified and integrated regulation fall under autonomous motivation along with intrinsic motivation where individuals feel a sense of control over their actions. Amotivation (am) refers to reduced intention towards goal-directed behaviour, reflecting the absence of intrinsic and extrinsic motivation to engage in an activity [2].

Self-determination theory applied to the educational sector can be used to understand and promote a desire to learn and increase students' achievements. As it was shown by several authors, intrinsic motivation leads to

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high-quality learning, in-depth understanding, better academic performance [3–5], more efficient psychological adjustment [6]and decreased drop-out rate [7].

The motivation to learn in school based on the SDT has been most widely assessed by the Academic Motivation Scale (AMS) created by Vallerand et al. in [8]1989 originally designed for high-school students [8] but later an adapted version for college students was also created [9]. Vallerand et al. interpreted intrinsic motivation as a multidimensional construct and differentiated it into three subtypes: intrinsic motivation to know, to accomplish, and to experience stimulation. Intrinsic motivation to know refers to the pleasure of learning new things. Intrinsic motivation to accomplish is about the drive to achieve or create something new. Intrinsic motivation to experience stimulation is the motivation to seek sensory stimulation during an activity [10]. They reduced the number of extrinsic motivation subtypes into three (instead of four defined by Ryan and Deci) by removing the subtype of integrated regulation due to psychometric reasons. Thus, they created the AMS with 28 items answerable on a 7-point Likert-type scale (1=doesn't correspond at all; 7=corresponds exactly). The items are arranged into seven subscales (4 item per each): im: intrinsic motivation (1) to accomplish, (2) to know, and (3) to stimulate; em: (4) external regulation, (5) introjection, (6) identification; and (7) am (amotivation). Scores of the subscales can be obtained by calculating means using the relevant item scores but no overall score is calculated.

Evidence on the validity and reliability of both the high school and college versions of AMS have been established in several studies. The seven-factor structure defined by Vallerand et al. in the original theoretical model was confirmed by subsequent confirmatory analyses and showed good internal consistency [8,10]. The psychometric properties of AMS have been demonstrated in several studies both at the secondary level [10–13] as well as in colleges and universities [14–20] in various languages. These studies provided evidence for the reliability and factorial construct and concurrent validity of the scale.

The traditional approach to evaluate AMS-28 results in scores for the seven subtypes (seven different continuous outcomes) that provides simple and time-efficient means for examining trends, averages or aggregated data at group level [21]. However, the seven scores cannot be collapsed into 3 types of motivation. That is, this approach does not help the allocation of respondents into motivational types (intrinsically, or extrinsically motivated or amotivated), or a person-centered approach although the SDT clearly delineates these 3 types on the continuum of self-determination. The traditional approach makes the descriptive interpretation of the AMS-28 difficult which leaves individual differences in motivational types hidden. Therefore, a person-centered approach of the AMS scores would be needed to identify motivational profiles to bring the scoring system in line with the SDT theory that would also allow the recognition of individual differences within groups. Parsing out individual features of motivation would allow for the exploration of complex relationships between variables within subgroups and can reveal subtle patterns or interactions that might be missed by traditional, group-level analyses [22].

There have been studies which tested the AMS subdomains for distinct motivation profiles. Some were carried out in high school samples [23–26], others in college populations [23,25,27]. Only a handful of studies were conducted among medical students [28–30].

Of the latter, the first study was conducted in 2004 with 294 Brazilian medical students and used a somewhat re-interpreted factor structure of the AMS, combining intrinsic motivation subscales with identified extrinsic motivation, then external regulation with introjected regulation, and treated amotivation separately. They identified four motivation profiles with no clear alignment with the types specified by SDT [30]. In a sample of 844 Dutch students [28] the authors 'configurated' the AMS scale for intrinsic motivation and controlled (external and introjected extrinsic regulation) factors while subscales of extrinsic identified regulation and amotivation were omitted. They pre-determined four motivational profiles and classified students into those: High Intrinsic High Controlled (HIHC), High Intrinsic Low Controlled (HILC), Low Intrinsic High Controlled (LIHC), and Low Intrinsic Low Controlled (LILC). The same analytical approach was taken by Shrestha & Pant [29] in a Nepalese sample of medical students.

In light of these freely re-interpreted analyses of the AMS-28, our aim was to identify distinct academic motivation types among Hungarian medical students taking a person-centered approach with the AMS-28 scale. We aimed at creating motivational profiles by cluster analysis as well as quartile analysis the latter of which we found no precedent for in the literature. We tested concurrent criterion validity of the results through correlation with mental health variables, such as psychological distress and life satisfaction. Several studies found a positive relationship between independent or intrinsic motivation and indicators of mental health while controlled or extrinsic motivation had been shown to be negatively correlated with indicators of mental health such as positive mood, vitality, personal growth, positive coping strategies, and self-development [31–35]. Studies on life satisfaction and academic motivation tend to find that students with more autonomous motivation

experience higher levels of life satisfaction [36,37]. Intrinsic motivation is positively associated with well-being and life satisfaction [32,38,39]. Academic engagement driven by controlled motivation is not effective in satisfying autonomy, competence, and relatedness needs [40] leading to lower life satisfaction [41] so as amotivation/disengagement [42].

While the association between academic motivation and mental health has been established in the literature, the evidence mainly emerged from high school samples or non-medical undergraduates taking the traditional approach of evaluating motivation.

In terms of the traditional, variable-centered approach in academic motivation among medical students it was found that motivation for lifelong learning proved to be an important mediating factor between information literacy and creative skills [43]. Part of the AMS was used to confirm the mediating role of self-efficacy and learning engagement between motivation and performance among Chinese medical students [44]. Using the search words of 'academic motivation', 'mental health', and 'medical students', only one relevant publication was found in PubMed (along with two non-relevant studies not observing academic motivation) (PubMed search, accessed 13 June 2023) that investigated academic motivation by the AMS-28 scale among Thai medical students. In addition, the relationship between motivation, mental health problems and other psychological factors was uncovered by path analysis revealing that each subtype of motivation had specific sets of determinants with intrinsic and extrinsic motivation being more related to personal choice than amotivation, and the latter also predicted symptoms of depression [45]. The reference list of this paper contained two more studies which assessed academic motivation and mental health in medical students.

Park et al. [46] investigating 160 South-Korean medical students carried out a path analysis examining the sequential relationship between motivation, stress, depression, and personality traits, forming a feedback loop. This model suggested that stress and motivation may be linked and that motivation indirectly influences stress through academic performance. Students with higher amotivation scores in a highly competitive environment may find it difficult to maintain good academic performance which may lead to increased stress levels. On the other hand, students who score high on the externally identified regulation subscale, a type of extrinsic motivation similar to intrinsic motivation, may be strongly influenced by both intrinsic and extrinsic factors. This suggests that the pressure to achieve good grades may influence both motivation and stress levels. A longitudinal study carried out by Del-Ben et al. [47] measured increased anxiety, decreased academic motivation, and disturbances in leisure and social life during the academic year among 85 Brazilian first-year medical students.

Considering the scarcity of research in this topic, our second aim was to investigate the association of the person-centered approach to academic motivation to mental health among medical students.

Methods

Sampling and data collection

The cross-sectional study was designed and conducted in 2021. All first-year medical students at the University of Debrecen, Hungary ($N = 632$) were invited by e-mail to participate in the study (one invitation and two reminders). The invitation included a link to the online anonymous survey hosted on the questionnaire management platform of the University. The questionnaire was available between 14 and 31 December 2021 (Ethical approval statement number: DE RKEB/IKEB: 5923–2021).

Measures

The questionnaire consisted of standard items on sociodemographic characteristics (gender, age, race), the 28-item college version of the Academic Motivation Scale (AMS-C 28), the General Health Questionnaire (GHQ-12) and the Single-Item Measure of Life Satisfaction.

Academic motivation scale – college version (AMS-C 28)

The scale assesses 7 constructs of motivation towards college studies. Twelve items of the 3 constructs of intrinsic motivation (Cronbach's alpha = 0.91), 12 items of 3 constructs of extrinsic motivation (Cronbach's alpha = 0.86), and 4 items of amotivation (Cronbach's alpha = 0.83) can be estimated on a 1 [does not correspond at all] to 7 [corresponds exactly] Likert scale [9]. Means of the responses for the 7 subscales were calculated and used for cluster analysis. The sum total of all items belonging to each factor was also calculated (minimum-maximum values for intrinsic motivation: 12–84, extrinsic motivation: 19–84, amotivation: 4–28) and used for creating binary variables of motivational types. International students answered the English version of the questionnaire, Hungarian students received the Hungarian version of the AMS [48] adapted to medical students by changing relevant words.

General Health Questionnaire (GHQ)

The 12-item version of the General Health Questionnaire (GHQ-12) was used to detect notable psychological distress in which questions are answered on a 1–4-point Likert scale [49,50].

Notably stressed cases were detected by assigning each symptom a score of 1, while its absence is scored 0 yielding a total score ranging between 0 and 12 (Cronbach's alpha = 0.89). Total scores were transformed into a binary variable by defining scores above 4 reflecting pathological distress as determined in the Hungarian National Health Interview Survey [51].

Single-item measure of life satisfaction (LS)

Participants responded on a scale from 0 ('not at all') to 10 ('totally') as to how satisfied they were in their lives these days [52].

Statistical analysis

Statistical analysis was conducted in SPSS v. 23.0 (IBM, Armonk, NY, USA) and Stata-16.1 (StataCorp LLC, College Station, TX). The level of significance was set at a two tailed p-value less than 0.05 ($p < 0.05$). Categorical variables were described by proportion and were compared using Pearson's chi-squared test (for a 2×2 contingency table of risk for psychological morbidity for male and female Fisher's exact test was used). Continuous variables were described by mean and standard deviation or median and interquartile range. Distribution of normality was tested by Kolmogorov–Smirnov test. Between gender differences of AMS subscales, GHQ-12 score (level of psychological distress) and life satisfaction was examined using Mann–Whitney U-test test. Bivariate correlations were performed by calculating Pearson correlation coefficients. The internal consistency of items was tested by Cronbach's alpha. Academic motivation (AM) profiles were generated by the following two methods:

(1) Two-step cluster-analysis. To reduce the number of scale dimensions for the cluster analysis, we examined the intercorrelations between the three intrinsic motivation subscales and the three extrinsic motivation subscales separately in advance. The intrinsic motivation subscales ($r = 0.66$-0.70; $p < 0.001$) and the extrinsic motivation subscales ($r = 0.40$-0.42; $p < 0.001$) showed consistently significant moderate correlations; hence, we applied a three-factor solution and all the subscales demonstrated good internal consistencies (intrinsic motivation: $\alpha = 0.91$, extrinsic motivation: $\alpha = 0.86$; amotivation: $\alpha = 0.93$). Between-group differences of AM profiles with continuous variables of motivation factors and life satisfaction were analysed using one-way ANOVA with Tukey's post-hoc test. Within group differences of motivation factors were tested by one-sample t-test.

(2) Creation of binary variables. In order to find a method for unequivocally differentiating between intrinsically motivated, extrinsically motivated, and amotivated students, binary variables were constructed using the summary scores of the 3 factors of motivation. First, quantiles (tertiles and deciles) were created from the summary scores. Next, those in the top quantiles versus those below were cross-tabulated as follows: 3rd tertile vs tertiles 1–2; 9–10th decile versus 1–8th decile, 10th decile versus 1–9th deciles.

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Results

Description of the sample

The sample consisted of 189 (response rate 29.9%) first-year medical students (mean age = 19.38 ± 2.03 years, 72% females, d(age) = 0.21, p = 0.528). 59.3% of the students were Caucasian, 22.2% Asian, and 18.5% African. The descriptive statistics and comparisons by gender of academic motivation and mental health variables are presented in Table 1. In the sample the intrinsic and amotivation subscales and the life satisfaction scale did not follow normal distribution, while the extrinsic motivation subscale did. None of the variables showed significant differences across gender groups in the sample.

Table 1. Academic motivation (AM) and mental health characteristics of the sample overall and by gender.

	Total (n=189)	Male (n=53)	Female (n=136)	Test statistic	p-value
AMS subscales Mdn (Q25-Q75)					
Intrinsic motivation	4.83 (3.83–5.58)	5.00 (4.25–5.63)	4.67 (3.68–5.58)	U=3197.00	0.228[a]
Extrinsic motivation	5.00 (4.13–5.83)	5.08 (4.08–6.04)	4.92 (4.17–5.58)	U=3233.50	0.273[a]
Amotivation	1.00 (1.00–1.75)	1.00 (1.00–1.75)	1.00 (1.00–1.75)	U=3519.50	0.787[a]
Psychological distress Mdn (Q25-Q75)	6.00 (3.00–9.00)	5.00 (3.00–8.50)	7.00 (3.00–9.75)	U=3000.00	0.073[a]
Psychological distress n (%)					
High risk	118 (62.4)	28 (52.8)	90 (66.2)	-	0.101[b]
Low risk	71 (37.6)	25 (47.2)	46 (33.8)		
Life satisfaction Mdn (Q25-Q75)	7.00 (5.00–8.00)	7.00 (5.00–8.00)	6.50 (5.00–8.00)	U=3294.50	0.355[a]

[a]Indicates the application of Mann-Whitney U test for gender differences.
[b]Indicates the application of Fischer's exact test for for gender differences.
AMS = Academic Motivation Scale.

Academic motivation profiles by cluster analysis

Two-step clustering was performed to reveal academic motivation profiles based on the three factors. As a result, we found three cluster profiles (Figure 1). The average Silhouette coefficient of 0.4 indicated fairly distinct clusters. In Cluster 1 ('High' self-determination, n = 59) the mean of extrinsic motivation was the highest (M = 6.07, SD = 0.41), followed by high level of intrinsic motivation (M = 5.48, SD = 0.60) and low level of amotivation (M = 1.57, SD = 0.95). For the members of Cluster 2 ('Moderate' self-determination, n = 111) the mean of intrinsic (M = 4.50, SD = 1.06) and extrinsic motivation (M = 4.41, SD = 0.87) showed a similar and moderate level, while the level of amotivation was low (M = 1.25, SD = 0.36). Cluster 3 ('Low' self-determination, n = 19) consisted of those with moderate level of amotivation (M = 4.22, SD = 1.02) as the highest factor mean, followed by moderate level of extrinsic motivation (M = 4.03, SD = 1.16) and reduced intrinsic motivation (M = 3.07, SD = 1.30). Table 2 demonstrates that no significant differences emerged in AM cluster profile distribution by gender (Pearson's Chi-squared test, $\chi^2 = 3.72$; p = 0.156).

We used one-sample t-tests to compare factors means within clusters using higher values as reference values. All factor means were significantly different within all the three clusters, excluding two pairs of factors. The levels of intrinsic ($M = 4.5$, SD = 1.06) and extrinsic motivation ($M = 4.41$, SD = 0.87) did not differ significantly (t[110] = 0.964; $p = 0.337$) in the 'Moderate' self-determination cluster; similarly, the means of extrinsic motivation ($M = 4.03$ SD = 1.16) and amotivation ($M = 4.22$, SD = 1.02) were no different (t[18] = 0.726, $p = 0.477$) in the 'Low' self-determination cluster. To clarify these results, we examined the subscales of extrinsic motivation (Table 3). We found that the extrinsic motivation factor in the 'High' and 'Moderate' self-determination profiles was significantly dominated

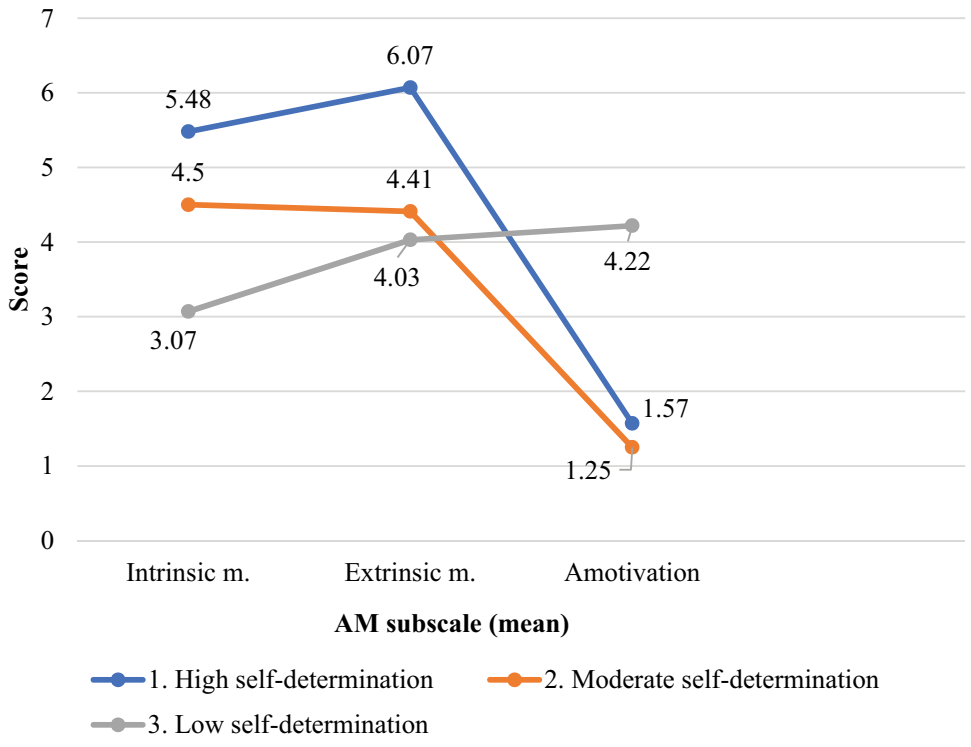

Figure 1. AM cluster profile centroids by mean scores for the three subscales of motivation.
AM = academic motivation

Table 2. Distribution of AM cluster profiles in the sample overall and by gender.

	AM profiles by cluster analysis n (%)				
	"High"self-determination self-determination	"Moderate" self-determination	Low"self-determination self-determination	Test statistic	p-value
Total (*n*=189)	59 (31.2)	111 (58.7)	19 (1.1)	χ^2=3.72	0.156[a]
Male (*n*=53)	22 (37.3)	27 (24.3)	4 (21.1)		
Female (*n*=136)	37 (62.7)	84 (75.7)	15 (78.9)		

[a]Indicates the application of Pearson's Chi-squared test for gender differences.
AM = academic motivation.

Table 3. Means of the extrinsic motivation subscale by AM cluster profiles.

	Extrinsic motivation subscales mean (SD)		
	Identified regulation	Introjected regulation	External regulation
"High" self-determination	6.37 (0.50)	6.01 (0.74)	5.80 (0.90)
	ref.	t(58)=5.86**	t(58)=8.96**
"Moderate" self-determination	5.13 (1.14)	4.07 (1.20)	4.03 (1.48)
	ref.	t(110)=9.73**	t(110)=10.10**
"Low" self -determination	4.07 (1.52)	3.73 (1.48)	4.28 (1.46)
	t(18)=0.62	t(18)=1.63	ref.

ref. = reference value (set as the highest value for within group comparisons) (one-sample t-test), **$p<0.001$.
AM = academic motivation.

by the 'identified regulation' subscale which is the closest extrinsic motivation subtype towards intrinsic motivation on the SDT continuum. The extrinsic motivation subscales in the 'Low' self-determination profile show a similarly moderate level with the non-significant dominance of the external regulation subscale which is the closest extrinsic motivation subtype towards amotivation.

In terms of between-group differences, all factor means were significantly different across the three clusters except for the level of extrinsic motivation between the 'Low' (M = 4.03 SD = 1.16) and 'Moderate' self-determination clusters (M = 4.41, SD = 0.87) (ANOVA, F[2;186] = 96.27; Tukey post hoc test p = 0.132).

Types of academic motivation using quantiles

The creation of quantiles to differentiate between categories of motivation produced the following results. Using tertiles, the 3-way cross-tabulation of students in tertile 3 compared to tertiles 1 and 2 resulted in 4.7% of the students belonging both to tertile 3 of amotivation and tertile 3 of intrinsic motivation proving undifferentiating. Based on deciles, the top 2 categories (deciles 9 and 10) compared to all others (deciles 1–8) resulted in three (1,59%) students being classified both as amotivated and intrinsically motivated, and 24.3% of them were extrinsically and intrinsically motivated. However, when comparing those in decile 10 to deciles 1–9, none of the most amotivated students (those in decile 10 of amotivation) were classified as also being allocated to the most intrinsically motivated (those in decile 10 of intrinsic motivation), and 14.3% of the students were allocated into those being extrinsically and intrinsically motivated as well (Table 4).

According to the less stringent calculation (I.), 13.7% of the students can be considered amotivated, whereas 9.5% of them are so when the more stringent assessment (II.) is used. There was no gender difference in either factor of motivation when the binary evaluation (comparing the 10th decile to the rest) was used (intrinsic: $p = 0.639$, extrinsic: $p = 0.300$, amotivation: $p = 0.748$).

The association of AM profiles with mental health indicators

First, Pearson's chi-squared test of AM profiles with psychological distress was used to test the concurrent criterion validity of the outcomes (Table 5). While the proportion of those with high risk for psychological morbidity (GHQ score > 4) was similar: 57.6% and 59.5% respectively, in the 'High' and 'Moderate' self-determination clusters, it was much higher, 94.7% in the 'Low' self-determination cluster. The test indicated a significant association between AM cluster profiles and low/high risk group membership for psychological morbidity (Pearson's Chi-squared test, $\chi^2(2) = 9.45$, $p = 0.009$).

Table 4. Percent of students classified by comparing the top quantiles to all students.

Classification based on	Most intrinsically motivated	Most extrinsically motivated	Most amotivated	Not uniquely classifiable
I. Deciles 9–10 vs deciles 1–8	11.1% (21)	11.6% (22)	13.7% (26)	63.5% (120)
II. Decile 10 vs deciles 1–9	7.4% (14)	5.3% (10)	9.5% (18)	77.7% (147)

Table 5. The distribution of high/low risk groups for psychological morbidity and life satisfaction mean scores by AM cluster profiles.

	AM profiles by cluster analysis n (%)				
	"High" self-determination (n=59)	"Moderate" self-determination (n=111)	Low" self-determination (n=19)	Test statistic	p-value
Psychological distress n (%)					
High risk	34 (57.6)	66 (59.5)	18 (94.7)	$\chi^2(2)=9.45$	0.009[a]
Low risk	25 (42.4)	45 (40.5)	1 (5.3)		
Life satisfaction M (SD)	6.8 (1.83)	6.46 (2.26)	3.53 (2.29)	F[2,186]=17.92	<0.001[b]

[a]Indicates the application of Pearson's Chi-squared test.
[b]Indicates the application of one-way ANOVA with Tukey's post-hoc test.
AM = academic motivation.

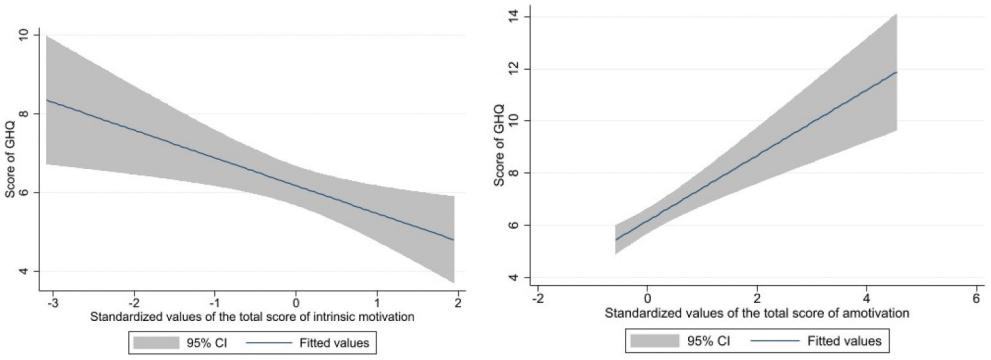

Figure 2. Linear fit with confidence intervals of psychological distress on the standardized total scores of intrinsic motivation (left) and amotivation (right).

The median of the total score of psychological distress was also much higher in the 'Low' self-determination cluster (Mdn = 9.00, Q25-Q75: 8.00–11.00) in comparison with the 'High' (Mdn = 6.00, Q25-Q75: 6.00–9.00; Mann-Whitney U = 252.50; p < 0.001) and 'Moderate' self-determination (Mdn = 6.00, Q25-Q75: 3.00–9.00; Mann-Whitney U = 511.00, p < 0.001) clusters (figure not shown). We observed no significant difference in the level of psychological distress between the 'High' and the 'Moderate' self-determination profiles (Mann–Whitney U = 3223.50, p = 0.867).

Concurrent criterion validity was further examined by checking the differences in the level of life satisfaction across AM cluster profiles (Table 5). Having a 'Low' self-determination profile was significantly associated with lower level of life satisfaction ($M = 3.53$, SD = 2.29) compared to having 'High' ($M = 6.80$, SD = 1.83; ANOVA, F[2,186] = 17.92; $p < 0.001$; Tukey post-hoc test $p < 0.001$) or 'Moderate' self-determination ($M = 6.46$, SD = 2.26; ANOVA, F[2,186] = 17.92; $p < 0.001$; Tukey post-hoc test $p < 0.001$) profile.

The association of mental health indicators with motivational types as quantile-based variables were also tested. Fisher's test was used to check the difference in the proportion of pathologically distressed among those in the 10th decile versus deciles 1–9 in each group of the motivational factors. Compared to those in deciles 1–9, the proportion of overly distressed students was not significantly higher among those in decile 10 of intrinsically (11.02%, $p = 0.175$) and decile 10 of extrinsically (6.78%, $p = 0.776$) motivated students, the proportion of students at high risk of pathological distress was significantly higher among those in decile 10 of amotivation compared to those in deciles 1–9 (13.56%, $p = 0.011$). There was significant difference in the median of life satisfaction by motivational type established by quantiles. Specifically, those of the intrinsic (median: 7; IQR:6;9.5) or extrinsic type (median: 8; IQR:7;9) showed no difference in life satisfaction but the amotivated reported significantly lower life satisfaction (median: 4.5; IQR:4;6; $p < 0.001$ for the model). Kruskal–Wallis test was used to check differences in life satisfaction scores between those in the highest deciles of the 3 motivational factors as opposed to the rest. There was no significant difference between those in the 10th decile vs the rest in terms of intrinsic ($p = 0.629$) or extrinsic ($p = 0.321$) motivation, but those in the highest decile of amotivation reported significantly lower life satisfaction compared to those in deciles 1–9 ($p < 0.001$).

Finally, total scores of psychological distress were fitted onto the standardized summary scores of each of the three factors of academic motivation. Significant negative correlation between the standardized total scores of intrinsic motivation and psychological stress ($p = 0.006$) revealed that higher level of intrinsic motivation was related to lower level of stress; whereas the opposite, strongly significant positive association was found between the total scores of amotivation and levels of pathological stress ($p < 0.001$) (Figure 2a.). There was no association between the total score of extrinsic motivation and stress ($p = 0.758$, figure not shown).

Next, the scores of life satisfaction were fitted onto the standardized summary scores of the 3 subscales of academic motivation (Figure 2b). Significant positive correlation was found between the standardized total score of intrinsic motivation and LS ($p < 0.001$).

The opposite, significant negative correlation was seen between the standardized total score of amotivation and LS ($p < 0.001$). Correlation was not found between the standardized total score of extrinsic motivation and LS ($p = 0.080$, figure not shown).

Discussion

The present study was designed to test two new methods for a person-centered approach in scoring the Academic Motivation Scale and to provide distinct profiles of motivation while demonstrating the concurrent validity of the outcomes. First, based on

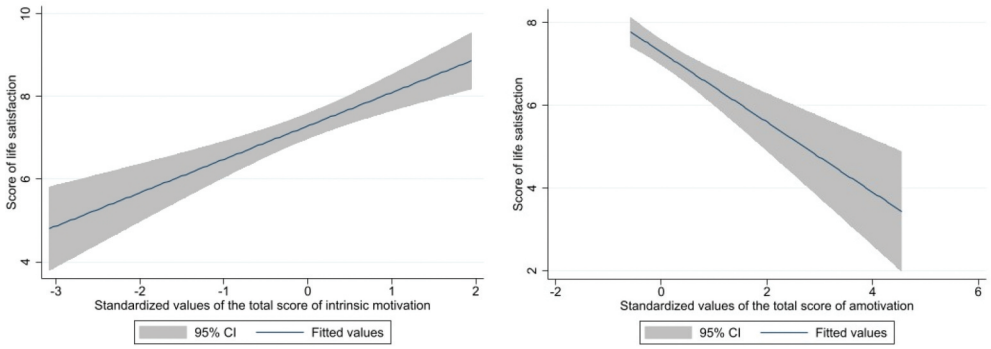

Figure 2. Linear fit with confidence intervals of life satisfaction on the standardized total scores of intrinsic motivation (left) and amotivation (right).

the three main domains (intrinsic motivation, extrinsic motivation, amotivation), two-step cluster analysis was developed that revealed three AM profiles. The 'High' self-determination profile indicates high level of intrinsic and extrinsic motivation and low level of amotivation. The 'Moderate' self-determination profile includes moderate levels of intrinsic and extrinsic motivation along with low amotivation. The major hallmarks of the 'Low' self-determination profile are moderate level of amotivation which nevertheless exceeds that of detected in the other two clusters and decreased intrinsic motivation. Although this latter profile incorporates moderate levels of all the three subtypes of extrinsic motivation, the other two profiles entail higher levels of identified motivation, the most self-determinant form of extrinsic motivation. In addition, while identified motivation was the dominant extrinsic subscale in the other two clusters, the level of this subscale in the 'Low' self-determination cluster does not exceed the level of the introjected and the external regulation subscales. We consider the three motivational profiles revealed by cluster analysis well distinguished that allows the positioning of a respondent on the SDT continuum with 'Low', 'Moderate' or 'High' level of self-determination in terms of academic motivation. 10.1% of medical students in our sample fell into the 'Low' self-determination cluster demonstrating notable level of amotivation; more than half (58.7%) showed 'Moderate' self-determination; and approximately every third student (31.2%) could be allocated into the 'High' category of self-determination. The method using quantiles resulted in finding 7.4% of the respondents strongly intrinsically motivated, 5.3% purely extrinsically motivated and 9.5% clearly amotivated.

The comparability of our results with others is limited due to methodological differences. Kusurkar et al. [28] in Utrecht of the Netherlands, and [29]in Nepal used four predefined clusters, combinations of high/low – intrinsic/controlled (extrinsic) motivation and successfully grouped individuals accordingly. In contrast, we left the number of possible categories open and thus obtained three distinct profiles, consistent with SDT theory. Comparing the distribution of motivational profiles, the Utrecht sample [28] showed somewhat similar results to our findings, with the highest proportion of those who are both intrinsically and extrinsically motivated (25.2%), followed by those who are driven by extrinsic factors (31.8%), then those who are mainly only intrinsically motivated (26.1%), and finally those with low academic motivation (16.9%).

Contrary to our results, the second highest proportion of students in the Nepalese sample [29]demonstrated low motivation (23.8%) following those who were both intrinsically and extrinsically motivated (36.1%).

Regarding the relationship between mental health and motivation in medical students, we are aware of one study that used the GHQ but that measured achievement motivation and not exactly academic motivation. Significant relationship was found between achievement motivation assessed by Herman's Achievement Motivation Test and psychological distress, so that less distressed students were more motivated to achieve their study goals [53]. Results of other studies presented in the Introduction are also consistent with our findings, namely, that 'Low' self-determination or amotivation is associated with greater risk for psychological morbidity [31–33,35,36,38,39,42] and lower life satisfaction [36,37].

Our study is also limited by the relatively low response rate that was probably related to data collection being conducted during the first two weeks of the examination period that affected the free time and mental health of respondents. Further research outside of the examination period in larger and more diverse student populations is needed to generalize the results. Voluntary participation may also bias the sample and suggests that more motivated students were more willing to participate in a motivation survey in the first place which further limits the

extrapolation of the findings. Mental health and its association with motivation under excessive stress would also warrant further investigation.

Though the AMS has been widely used since its publication in French [8] and English [10]; and has been validated in a sample of Greek high school students [15], among Argentinian students in Spanish [20], in Hungarian high schoolers [54], among Polish university students [14]; the norm is to describe the factorial validity, reliability, internal consistency, and statistics (means and standard deviation) of the 7 motivational subtypes. Our new methods to describe academic motivation also heed the clarion call of Howard et al. who – finding evidence for the continuum-like structure of motivation based on data from 486 samples using 13 different validated motivation scales in over 205,000 participants – had seen the need for the development of better motivation scoring methods [55]. Howard et al. recommended Latent Profile Analysis (LPA) for classifying individuals into motivationally homogenous subgroups. However, LPA assumes that the observed indicator variables from which latent subgroups are inferred are distributed normally. This was not the case for intrinsic motivation and amotivation in our sample, therefore cluster analysis – not requiring the assumption of normality – was our choice of identifying subgroups of motivation.

Identifying motivational profiles is particularly beneficial because academic motivation, especially its more autonomous forms have been shown to be positively related to various academic outcomes [56]. They predict not only psychological adjustment, but self-efficacy [57] and objective measures like academic achievement [58–61], attrition and dropout rates [15]. Academic motivation both mediates and moderates the relationship between self-efficacy and procrastination [62].

In practice, identifying academic motivation profiles of students can be useful for supporting career choices at entry, for predicting individual risk and even for talent management programmes. In conclusion, the presented methods for allocating respondents into different motivational categories in accordance with the self-determination theory allow more extensive use of the AMS for descriptive research, developmental studies, evaluation of interventions, and for screening academic motivation.

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Author contributions

Conceptualization, K.K.; data curation, B.O.; methodology, B.O., M.A., K.K.; formal analysis, B.O., M.A., K.K.; funding acquisition, B.O., K.K.; investigation, K.K.; supervision, K.K.; visualization, B.O., K.K.; writing – original draft preparation, B.O.; writing – review and editing, K.K. All authors consent to the publication of this paper. All authors have read and agreed to the published version of the manuscript.

Institutional review board statement

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Informed consent statement

Informed consent was obtained from all subjects involved in the study.

Data availability statement

The data that support the findings of this study are available from the corresponding author, BO, upon reasonable request.

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