Addressing Medical Student Burnout through Informal Peer-Assisted Learning: Analysis of a Cross-Sectional Study

Paola Campillo  
Universidad Central del Caribe

Frances Ramírez-Arellano  
Universidad Central del Caribe

Natalia Jiménez  
University of Puerto Rico (RP)

Isabel C. Gómez  
University of Puerto Rico (RP)

Joan Boada-Grau  
Universitat Rovira i Virgili

Legier V. Rojas  
Universidad Central del Caribe

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Abstract

Background

Despite the recognized advantages of Peer-Assisted Learning (PAL) in academic settings, there is a notable absence of research analyzing its effects on students’ Academic Burnout. This study aims to cover this gap by assessing the underlying effectiveness of Informal Peer-Assisted Learning as a cooperative learning method, focusing on its potential to mitigate academic burnout among medical students.

Methods

In 2022, a cross-sectional study was conducted at the School of Medicine, Universidad Central del Caribe, in Puerto Rico. The research team gathered data from 151 participants, being 49.19% of the total student body. This cohort included 76 female students, 71 male students, and 4 individuals saying other. The School Burnout Inventory questionnaire (SBI-9) was employed to assess Academic Burnout, along with an added query about self-reported Informal Peer-Assisted Learning. The School Burnout Inventory questionnaire underwent validation, and from correlated with the Informal Peer-Assisted Learning.

Results

The validation process of the questionnaire affirmed its alignment with an eight-item inventory, encapsulating two principal factors that elucidate academic burnout. The first factor pertains to exhaustion, while the second encompasses the combined subscales of cynicism and inadequacy.

The questionnaire shows high reliability (Cronbach’s alpha = 0.829) and good fit indices (CFI= 0.934; TLI= 0.902; SRMR= 0.0495; RMSEA= 0.09791; p-value < 0.001). The factors proven in the selected model were used to evaluate the correlation between the Academic Burnout and the Informal Peer-Assisted Learning. Students engaged in Informal Peer-Assisted Learning showed significantly lower academic burnout prevalence (p-value < 0.01) compared to those who never taken part in such practices. Furthermore, this group of students displayed lower cynicism/inadequacy compared to its exhaustion with an p-value < 0.001.

Conclusions

The results of this study underscore a notable issue of academic burnout among medical students within the surveyed cohort. The investigation presents a robust link between Academic Burnout and Informal Peer-Assisted Learning (IPAL), affirming the hypothesis that Informal Peer-Assisted Learning contributes to mitigating Academic Burnout. This correlation suggests that incorporating IPAL strategies may be beneficial in addressing burnout in medical education settings.

Background

Burnout, characterized by overwhelming mental and physical exhaustion, presents a critical concern within the medical student (MS) community. This phenomenon is strongly associated with reduced feelings of achievement and depersonalization, potentially leading to adverse student outcomes, such as poor academic performance, compromised mental health, increased dropout rates, and even suicidal ideation [1] [2].

The School Burnout Inventory (SBI-9) questionnaire supplies a standardized tool for assessing academic burnout (ABO), encompassing three key sub-scales: exhaustion (EX), cynicism (CY), and inadequacy (IN) [3]. These metrics, along with others, have been instrumental in shaping our understanding of burnout as a psychological syndrome (4) and have contributed to the International Classification of Diseases-11 definition, characterizing burnout as an occupational phenomenon resulting from chronic workplace stress that has not been effectively managed [5].

Evidence suggests a rising prevalence of ABO among MS over the past decade, with a 6% increase in burnout levels in the United States from 2008 to 2014 [6]. Studies estimate that half of all MS worldwide experience ABO even before entering residency [7]. Preliminary research conducted at the Universidad Central de Caribe (UCC) also showed elevated levels of ABO among its MS [8].

Despite various support systems implemented by medical schools [9] [10] [11], effective strategies to mitigate ABO are still lacking. Recognizing that students and healthcare professionals experiencing burnout are more susceptible to unprofessional behavior, it is imperative to promote and supply effective support mechanisms to mitigate ABO [12] [13].

Recent research shows that the learning environment significantly influences ABO rates among MS, with lower learning environment scores correlating with higher burnout rates [14]. One approach to address ABO and enhance the student wellness is through formal peer teaching (FPT), particularly peer learning [9]. Peer teaching (PT) plays a crucial role in developing problem-solving skills, critical thinking, effective communication, and student wellness [9] [15] [16]. Additionally, it enhances students’ self-efficacy, coping skills, and social support networks, all essential for academic success [17]. Research shows that peer learning (PL), particularly when helped by near-peer teachers, improves students’ comprehension of the subject matter, and boosts their confidence in their roles [18].

Peer Teaching (PT), often referred to as Near Peer Teaching (NPT), is not a recent innovation. It involves a trainee who is one or more years senior to another trainee within the same tier of medical education [18]. This practice has been embraced to streamline the learning process during medical residencies and has also been applied in academic settings to enhance student learning [19].

Formal Near Peer Teaching (FNPT) consists of structured sessions with faculty input and may be integrated into medical curricula. In contrast, Informal Peer-Assisted Learning (IPAL) characterizes situations in which a near-peer, without faculty involvement, imparts knowledge to a less-experienced student [20].
Considerable attention has been directed toward Peer Assisted Learning (PAL), recognizing it as a supplementary and indispensable mechanism in the education of future healthcare professionals [21] [22] [23] [24] [25]. However, despite the acknowledged merits of PAL in academia, there is a lack of analysis of its impact on students’ ABO outcomes. To address this gap, our aim is to investigate whether PAL, particularly IPAL, plays a role in lessening ABO levels among MS. By exploring the connection between IPAL and ABO, we aim to contribute to the existing literature on this critical issue in medical education. Partial results from this study were presented at the December 2022 conference of the Medical Association of Puerto Rico [26].

Methods

Survey: Measurement Tools

The cross-sectional survey SBI-9 [3] was administered online. Participants self-reported their gender, age range, and current academic standing. The Institutional Review Board (IRB) of the UCC (054-2022-25-06-IRB) approved the method and corresponding protocols.

The SBI-9, chosen for its strong psychometric properties and effectiveness in university settings, includes three sub-scales for assessing ABO: EX, CY, and IN, each with four, three, and two items, respectively. Additionally, we included a self-reported item on IPAL, where participants showed if they explained concepts to their peers during their study process.

We used both the original English version of the SBI-9 [3] and a Spanish-adapted version [27] to meet the bilingual needs of our university context (refer to Supplementary Material 1). The translation procedure followed established standards for adapting assessment instruments [28].

Rating Scale

Participants used a Likert scale, ranging from 1 (complete disagreement), 2 (disagree), 3 (neutral), 4 (agree) to 5 (complete agreement), to rate each SBI-9 query. Additionally, we included a behavior of IPAL, expressed as “Although I study alone, I usually explain concepts to my colleagues,” where participants showed the frequency with which they explained concepts to peers during their study process, with response options including values ‘never’ (NE) = 0, ‘occasionally’ (O) = 3, and ‘frequently’ (F) = 5. In this instance, the intention was to restrict the capacity to capture subtle nuances in students’ opinions, opting instead for a concise representation on the five-value scale.

Study Sample

In January 2022, we conducted a cross-sectional study involving 151 participants, 49.19% (N = 307) of the MS population at the UCC in Puerto Rico. The participants included 76 females, 71 males, and 4 individuals who did not specify their gender. These participants were medical students in their 1st to 4th year, aged 21 or older. Comprehensive details regarding demographic aspects, encompassing age, gender, and language preferences, along with their corresponding levels of Academic Burnout (ABO), are presented in Supplementary Material 2.

ABO Calculations

The overall ABO calculation was carried out using SBI-8 [29]. We defined high ABO as an average above 50%. For graphical analyses, data from respondents all population were considered and both responses in English and Spanish were merged, and Likert scale values of each responder were converted into percentages and then averaged and statistically processed.

Statistical Analysis

The process of setting up the factors acting on the ABO involved several key steps. Initially, we found the main components using Principal Component Analysis (PCA), which was further explored through Factor Analysis and assessed using the Gaussian Graphical Model (see Supplementary Material 3) [30]. The last step was to validate the model via Confirmatory Factor Analysis (CFA).

For the School Burnout Inventory validation in the MS population, we followed the guidelines set by [31]. This included the use of several fit indices like the Comparative Fit Index (CFI), Root Mean Squared Error of Approximation (RMSEA), Tucker-Lewis Index (TLI), and Standardized Root Mean Squared Residual (SRMR). The CFI and RMSEA are particularly important, rated on a scale from 0 to 1. A higher CFI, closer to 1, shows a better alignment of the data with our model, while a lower RMSEA, closer to 0, shows a strong fit.

To visually present our findings of ABO, we used GraphPad Prism v.9. Additionally, we performed more analyses, including Pearson coefficient and Ordinary One-way ANOVA. For showing the Exploratory and Confirmatory Factor Analysis, as well as Multiple Correlation Comparisons and Path Model Mediation, we used Jamovi v2.3 with R subroutines (The Jamovi Project, 2022, https://www.jamovi.org).

Results

Student Burnout Inventory Validation

We initially get the items correlation matrix and the Chronbach’s α reliability of 0.913 and using the through Principal Component Analysis (PCA) found the most proper model using Oblimin rotation, an eigenvalue >1 and a factor loading of 0.3. The results revealed two loaded components: one represented by of EX items excluding EX3 and other, corresponding to the accumulation of items of CY with IN (abbreviated CYIN). The significance of Bartlett’s Test of sphericity ($\chi^2 =430, p<0.001$) and an overall Kaiser-Meyer-Olkin (KMO) of 0.825 (ranged 0.788-0.855) validated the robustness of our findings.
The exclusion of the EX3 item and the fission of CY with IN creating the Fc2 was further confirmed by the Gaussian Graphical Model (GGM) [30] (see Supplementary Material 3). The correlation analyses (Table 1) showed minimal or no correlation with item EX3 from the EX sub-scale of ABO.

**TABLE 1: NEAR HERE and**

In all instances, our results align with the model (refer to Table 2), where EX3 demonstrated elevated uniqueness (0.94; CI 0.91-0.97). Thus, we went ahead to analyze the results with the Puerto Rican version of the SBI-9, now referred to as SBI-8, with EX3 excluded from the EX-subscale.

The Student Burnout Inventory underwent thorough validation through Confirmatory Factor Analysis (CFA), corroborated a misalignment of EX3 with the construct's defining characteristics. Operating under this premise, and to confirm the finding we evaluated five models of the SBI-8, as delineated in Table 2, standing for the Academic Burnout (ABO) within the medical student population under study. This process aimed to find the model that most accurately aligns with our observed results.

**TABLE 2: NEAR HERE**

The five models presented various configurations, as displayed in Table 2, with Model M2 from the SBI-8 appearing as the most suitable. In Model M2, CY and IN items were combined as one factor (Fc2), while EX items formed another (Fc1). The analysis showed that ABO, as measured by the SBI-8 (with the item EX3 excluded) in Model M2, proved the most robust statistical consistency. The CFA and reliability analysis yielded a Cronbach's $\alpha$ of 0.927, signifying excellent internal consistency. The high KMO (measure of sample adequacy) value for Model M2 (>0.82) confirmed excellent sample adequacy for all eight items. Model M2's $\chi^2$, TLI, CFI, RMSEA, and SMRS, with a $p$-value < 0.001, showed a good fit to the data (see Table 2).

**Academic Burnout in Medical Students**

The data collected from our survey, analyzed under the two-factor Model M2 derived from the SBI-8 (as depicted in Table 2), allows for precise categorization of ABO percentages among participants by academic year. Interestingly, the analysis revealed no statistically significant variation in ABO values across academic years, spanning from the MS1 to MS4 (see Figure 1).

**FIG. 1: NEAR HERE**

From figure 1 the mean ABO percentages, standard deviation (in parenthesis), and the number of respondents and their percentage (in parenthesis) for each academic year respectively were as follows: MS1, 41.34 (±23.19) for 38 (25%); MS2, 50.50 (±17.44) for 56(37%); MS3, 51.75 (±20.98) for 27(18%) and MS4 39.54 (±23.06) for 30(20%), from the total N=151.

The percentage of students with ABO values above 50% in each year is as follows: MS1, 26.32%, (10 out of 38 respondents); MS2, 51.79% (29 out of 56 respondents); MS3, 51.85% (14 respondents out of 27); and for MS4, 33.33% (10 out of 30 respondents).

In the gender-based ABO analysis, no statistically significant difference was found between females and males. ABO percentages standard deviation (in parenthesis), and the number of respondents and their percentage (in parenthesis), were 44.76 (±19.16) for 71 (47%) male respondents and 48.68 (±23.45) for 76 (53%) female respondents. More details can be found in Supplementary Material 2. Four students who chose not to write down their gender were excluded from this analysis, with an average ABO percentage of 60.42 (±11.42) for 4 (3%) of the respondents that were not analyzed into the gender analysis due to the small number of respondents. No statistically significant differences in the ABO were found by the analysis of participants' ages (see Supplementary Material 2).

**Analysis of Factors Contributing to Academic Burnout in Medical Students**

Reliability analysis, assessed with Cronbach's $\alpha$-coefficient for the SBI-8, showed an elevated level of internal consistency ($\alpha$=0.829). It was seen that global CYIN factor -Fc2- consistently showed lower values than global EX factor -Fc1- (empties circle and square respectively). This difference was statistically significant ($p$-value<0.01), as illustrated in Fig. 2 (left). A detailed breakdown of EX and CYIN percentages across MS years, see Figure 2 (right), revealed no difference between these two factors: Fc1 and Fc2.

**FIGURE 2: NEAR HERE**

**Diminished Academic Burnout in Medical Students Engaged in Informal Peer Assisted Learning**

Our study revealed that MS engaged in IPAL demonstrated lower levels of ABO compared to those who reported no involvement in tutoring their peers. As depicted in Figures 3A, which shows the ABO score obtained from each student, shows that the ABO score for MS who reported occasional or frequently IPAL (O/F), was 44.75% (SD 18.50) for 126 (83% of the respondents), in contrast to MS who reported never tutoring their peers (NE), who had a score of 54.89% (SD 23.71) for 25 (17% of the respondents). A statistically significant difference between these two student groups was seen, with a $p$-value of 0.0133.

Examining model M2 in MS who were engaged in IPAL (see Fig 3B), the factor CYIN (Fc2) was found to be significantly lower compared to factor EX (Fc1) ($p$-value<0.001).
Discussion

Our study showed the two-factor model M2 (employing the SBI-8) as the most proper (Table 2), consistent with findings in other studies using the SBI-9 and SBI-8 [32][33]. The validated SBI-8 model highlights the interconnectedness of CY and IN, suggesting shared underlying issues, such as a lack of support or resources at school, or a mismatch between students’ skills and the demands of their academic pursuits. This model has implications for interventions aimed at reducing burnout, as addressing one factor may help alleviate the other. For example, interventions that aim to improve students’ skills and resources, or to better match students with their academic jobs, could potentially alleviate both CY and feelings of IN. Noticeably, this two-factor model supplies a simplified and potentially more actionable framework for understanding and addressing burnout among MS. However, further research is needed to fully understand ABO and find the most effective interventions for alleviating it.

The ABO in our school of medicine mirrors levels reported in medical schools across the United States [1][34]. Despite our medical school’s abundance of support resources and emphasis on the availability of help, the results of this study underscore a notable issue of academic burnout among medical students within the surveyed cohort. This pattern is not unique to our institution but reflects a broader challenge faced by many educational institutions [9][35][36].

However, our study introduces a unique perspective by delving into the impact of IPAL on the experiences of ABO among our MS, offering valuable insights into this critical issue. The pivotal finding is that there is a statistically significant (p-value < 0.01) decrease in ABO levels among MS who engage in IPAL, compared to those who do not (Fig. 3A). This finding underscores the potential importance of engaging in IPAL as a mitigating factor for ABO in our academic environment. Moreover, MS involved in IPAL correlates with lower cumulative levels of O/F-CYIN, compared to O/F-EX (Fig. 3B), resulting in a statistically significant (p < 0.001) reduction in ABO among students engaged in IPAL (O/F IPAL) compared to those who never do (NE - IPAL).

Notably, we found that the two factors Fc2: CYIN and Fc1: EX seem to contribute to heightened ABO levels in students who reported never (NE) taking part in IPAL (Fig. 3B). While this study does not explore the mechanisms underlying this correlation, it is plausible that MS with lower ABO levels be more inclined to engage in IPAL. Conversely, although less likely, MS with higher ABO levels might also be motivated to engage in IPAL if sufficiently motivated. Given the significance of this finding, further detailed studies are called for to understand the causality behind these dynamics.

The subsequent study, aimed at ascertaining the mediating role of Informal Peer-Assisted Learning (IPAL) on Factor 2 (Fc2) in relation to Academic Burnout (ABO), revealed that while the mediation effect of IPAL was negligible, as detailed in the supplementary data (see Supplementary Material 3 for reference). Intriguingly, these findings indicate that IPAL’s direct influence is predominantly concentrated on Fc2, which encompasses cynicism/inadequacy (Cy/IN), while its impact on Fc1, representing exhaustion (EX), is non-existent. This result confirms that IPAL does not mediate the relationship between these factors and ABO.

We believe that our approach contributes additional insights into potential strategies to mitigate ABO levels in MS. Further research and targeted interventions are needed to gain a comprehensive understanding of ABO and to set up proactive strategies to mitigate its adverse effects [1][7]. While many studies have shed light on factors that mitigate ABO, none has specifically discussed the impact of peer learning or peer-assisted learning on ABO.

Our results show that O/F students have significantly lower CYIN levels compared to EX, suggesting an approach to address the issue. Earlier studies have highlighted the dynamic nature of peer learning, suggesting that students’ enthusiasm and engagement in this approach can fluctuate over time [23][37][38][39]. Through regular IPAL assessments, it could be possible to proactively show and address potential shifts in these activities, implementing the right targeted interventions to sustain their benefits. Moreover, research shows peer learning’s effectiveness is influenced by factors such as prior knowledge, motivation, and confidence levels [21][22][23][24][25][40][41][42]. Our results suggest that IPAL appears directly as a key factor to consider in the implementation of strategies to reduce ABO and that its action seems to be a direct one and not by a mediation mechanism.

Conclusions

The findings of our research highlight a significant concern about academic burnout among medical students in our study population. The levels of academic burnout seen are alarmingly high and comparable to those reported in other medical schools across the continental United States. This situation underscores the urgent need for effective strategies to mitigate these stress levels.

Our study reveals a strong correlation between Academic Burnout (ABO) and Informal Peer-Assisted Learning (IPAL). Interestingly this informal yet impactful practice plays a crucial role in alleviating the effects of ABO.

Limitations

Our study encompasses several limitations. Firstly, its cross-sectional nature means it lacks a control group, which restricts our ability to make temporal comparisons regarding ABO rates and other aspects of well-being among medical students (MS) throughout their careers. Future research would benefit from incorporating such a design to facilitate more effective comparisons of ABO rates among MS over different years. Additionally, our study encountered limited
student participation, evidenced by a response rate of 49.19% (151 respondents out of a total of 307), which introduces the potential for response rate bias. This bias could manifest as MS who are more "distressed" might be less motivated to participate, or conversely, they might be more inclined to do so due to the topic's relevance, although this was not observed in our case. Moreover, our study was conducted in only one medical school, which limits the generalizability of our findings to the broader medical student population in Puerto Rico. Lastly, the nature of our questionnaire limited our ability to collect comprehensive psychological and personal data from the students, further constraining the breadth of our study. Future studies should aim to explore a broader range of factors, such as studying conditions, to gain a more holistic understanding of the ABO experiences among medical students.

**Abbreviations**

ABO: Academic Burnout

CFA: Confirmatory Factor Analysis

CY: Cynicism

CYIN: Cynicism/Inadequacy

EFA: Exploratory Factor Analysis

EX: Exhaustion

Fc1, Fc2: Factor 1, Factor 2

FNPT: Formal Near Peers Teaching

GGM: Gaussian Graphical Model

IN: Inadequacy

INPL: Informal Near Peers Learning

INPT: Informal Near Peers Teaching

IPAL: Informal Peer Assisted Learning

MS: Medical Students

MS1, MS2, MS3, MS4: Medical students' year 1, 2, 3 and 4, respectively

NE: Never

NPT: Near Peer Teaching

O/F: Occasionally / Frequently

PCA: Principal Component Analysis

PT: Peers Teaching

SBI-8: School Burnout Inventory -8 items

SBI-9: School Burnout Inventory -9 items

UCC: Universidad Central del Caribe

**Declarations**

Data Availability

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

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Conflict of interest statement

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

Authors Information

Authors and Affiliations

School of Medicine, Universidad Central del Caribe. Bayamón, Puerto Rico, USA.

Paola Campillo and Frances Ramirez de Arellano

Interdisciplinary Sciences Dept. University of Puerto Rico (RP), San Juan, Puerto Rico, USA.

Natalia Jiménez

Cellular-Molecular Biology Dept. University of Puerto Rico (RP), San Juan, Puerto Rico, USA.

Isabel C. Gómez

Education Sciences and Psychology Dept. Universitat Rovira i Virgili, Spain

Joan Boada-Grau

Physiology Dept, School of Medicine, Universidad Central del Caribe, Bayamón, Puerto Rico, USA.

Legier V. Rojas

Author Contribution

Project Conceptualization: PC, FR, LVR; Intervention Design: PC, FR, LVR.


All authors agree to be accountable for all aspects of the work. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work. PC and FR share first authorship in this work. All authors approved the last version and agreed to be accountable for all aspects of the final product.

Corresponding author

Correspondence to legier.rojas@uccaribe.edu

Ethics Declarations

The methodology and corresponding protocols received approval from the Institutional Review Board (IRB) of the UCC (054-2022-25-06-IRB). Each participant was completely informed about the study protocol and supplied a written and informed consent form before taking part in the study.

Consent for publication

Not applicable.

Competing interests

All authors declare no further competing interests.

References


### Tables

#### TABLE 1

Correlation Matrix of the SBI-9 and the overall Reliability of the SBI-8 and per Items (excep EX3).

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<thead>
<tr>
<th></th>
<th>EX1</th>
<th>CY1</th>
<th>IN1</th>
<th>EX2</th>
<th>CY2</th>
<th>CY3</th>
<th>EX3</th>
<th>IN2</th>
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<td>0.34233 ***</td>
<td>0.37281 ***</td>
<td>0.31982 ***</td>
<td>0.31982 ***</td>
<td>0.25428 ***</td>
<td>0.25428 ***</td>
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<td>CY1</td>
<td>0.34233 ***</td>
<td>0.57814 ***</td>
<td>0.25650 ** 0.24792 **</td>
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<td>EX3</td>
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<td>EX4</td>
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**Note.** * p < .05, ** p < .01, *** p < .001

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<th>Scale Reliability Statistics (SBI-8) no EX3</th>
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<tbody>
<tr>
<td>mean</td>
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</tbody>
</table>

**Table 1.** Items Correlation Matrix and Reliability statistics. Data derived from Jamovi v2.2.2. Asterisks in the correlation matrix highlight statistically significant values as detailed in the table's footnote. EX3 subfactor has larger no significant correlation among sub-parameters. Two scales of global reliability are presented Cronbach’s α and McDonald’s ω. The sub-parameters item’s reliability is presented in Cronbach’s α values only.

### Table 2

Bivariate Correlation Models and the statistics under the Confirmatory Factor Analysis

<table>
<thead>
<tr>
<th>MODEL</th>
<th>RMSEA 90% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ESTIMATED</td>
</tr>
<tr>
<td>-------</td>
<td>-----------</td>
</tr>
<tr>
<td>M1e</td>
<td>1F(CYINEX)</td>
</tr>
<tr>
<td>M2e</td>
<td>2F-a (CYIN-EX)</td>
</tr>
<tr>
<td>M3e</td>
<td>3F (CY-IN-EX)</td>
</tr>
<tr>
<td>M4e</td>
<td>2F-b (EXIN-CY)</td>
</tr>
<tr>
<td>M5e</td>
<td>2F-c (CY-EX)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FINALS</th>
<th>Models (SBI-8)</th>
<th>CFI</th>
<th>TLI</th>
<th>SRMR</th>
<th>RMSEA</th>
<th>Lower</th>
<th>Upper</th>
<th>AIC</th>
<th>BIC</th>
<th>χ²</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>1F(CYINEX)</td>
<td>0.904</td>
<td>0.866</td>
<td>0.0589</td>
<td>0.1150</td>
<td>0.0820</td>
<td>0.149</td>
<td>3637</td>
<td>3709</td>
<td>60</td>
<td>20</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>M2</td>
<td>2F-a (CYIN-EX)</td>
<td>0.934</td>
<td>0.902</td>
<td>0.0495</td>
<td>0.0979</td>
<td>0.0625</td>
<td>0.134</td>
<td>3626</td>
<td>3701</td>
<td>47</td>
<td>19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>M3</td>
<td>3F (CY-IN-EX)</td>
<td>0.951</td>
<td>0.920</td>
<td>0.0416</td>
<td>0.0888</td>
<td>0.0497</td>
<td>0.128</td>
<td>3620</td>
<td>3702</td>
<td>37</td>
<td>17</td>
<td>&lt;0.003</td>
</tr>
<tr>
<td>M4</td>
<td>2F-b (EXIN-CY)</td>
<td>0.932</td>
<td>0.899</td>
<td>0.0505</td>
<td>0.0995</td>
<td>0.0643</td>
<td>0.135</td>
<td>3627</td>
<td>3702</td>
<td>47</td>
<td>19</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>M5</td>
<td>2F-c (CY-EX)</td>
<td>1.000</td>
<td>1.030</td>
<td>0.0898</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.044</td>
<td>4419</td>
<td>4476</td>
<td>4</td>
<td>8</td>
<td>0.891</td>
</tr>
</tbody>
</table>

**Table 2.** Statistical values of the Confirmatory Factor Analysis (CFA) and model fit. M1 one factor model in which all subscales (CY, EX, and IN) are grouped into one factor. Three (3) two models’ factors (M2, M4 and M5). In M2, CY and IN subscale are grouped into one factor, EX maintain as second factor. In M4, EX and IN are grouped in one factor, CY maintains as second factor and in M5, where CY and EX represent the factors. The M3 represents the three factors model in which CY, EX and IN are factors.

Note. χ² = chi-square; df = degrees of freedom; CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; $p = p$-value.

### Figures
The Academic Burnout per academic year of medical students.

The ABO values for both MS1 and MS4 were lower compared to MS2 and MS3. Furthermore, the proportion of students with ABO scores above 50% in each year was as follows: 10/38 (26.32%), 29/56 (51.79%), 14/27 (51.85%), and 10/30 (33.33%) for MS1, MS2, MS3 and MS4, respectively. The ABO scores across four different medical student (MS) years, specifically from the 1st year (MS1) to the 4th year (MS4), along with their corresponding 95% confidence intervals (CI). The calculated ABO percentages, represented as mean percentage (standard deviation) and sample size, for each year were as follows: MS1, 41.34 (23.19) 38; MS2, 50.50 (17.44) 56; MS3, 51.75 (20.98) 27; and MS4, 39.54 (23.06) 30.
Figure 2

Factors contributing to Academic Burnout (ABO). The figure shows average percentages, and 95% confidence intervals (CI) for the two factors. On the far left and with clear symbols are the overall percentages, standard deviation, and number of students. The percentage, standard deviation, and number of values were obtained after excluding the EX3 item based on the final M2 model: Fc1 (EX) represented by circle 53.26 (22.40) N=151, Fc2 (CYIN), represented by square 43.88 (24.68) N=151. The global percentage between these two factors is statistically significant. On the right are represented with mean symbols half-full the percentages of the Fc1, EX for each year of study: triangle MS1, 51.75 (26.16) N=38; rhombus MS2, 59.08 (9.22) N=56; circle MS3, 52.65 (19.48) N=22; and square MS4, 42.82 (23.44) N=29. Following in that order are the percentages of the Fc2, CYIN factor with fully filled symbols for each year of study: MS1, 42.60 (28.28) N=38; triangle, MS2, 46.21 (20.61) N=56; rhombus, MS3, 48.01 (28.15) N=22; circle and MS4 square 38.24 (26.83) N=28.
A. The academic burnout percent value of each medical student (MS) in the population's offering peer-teaching (O/F) and those never do that (NE). The figure shows cumulative probability of the percentages of academic burnout (ABO) within the medical student population, specifically those who indicated that they never taught their peers - NE (Fill circles) and those who reported doing so frequently or occasionally - O/F do informal peer learning (clear circles). Results presented excluding the EX3 item based on the findings of the CFA (model M2). The O/F student group is shifted to the left, indicating a lower average ABO value. The mean percentage values, standard deviations (SD), and sample sizes for the O/F population were 44.75 (18.50) N=126, while for the NE population they were 54.89 (23.71) N=25. The O/F population had a statistically significant lower proportion of academic burnout compared to the NE population (p<0.0133).

B. Factors (EX and CYIN) involved in academic burnout. In the left part the figure shows the relationship of students who do informal peer learning (IPAL) to their peers (O/F) and those students who did not do informal peer learning their peers (NE).

When analyzing the students who do IPAL, the percentage of Fc2 is statistically lower p=0.001 compared to the Fc1: 41.98 (23.41) vs 52.25 (22.42) N=126. On the other hand, in students who do not take IPAL, there is no significant difference in the percentages of Fc2: 56.33 (30.65) vs Fc1: 58.33 (22.05) N=25. Values represent, the mean percentage values, standard deviations (SD), and sample sizes.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryMaterialABOIPAL231120.docx