Procrastination in medical students: a systematic review

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Abstract

Background: The purpose of this systematic review was to understand the implications of procrastination on medical students' lives and well-being by examining its conceptualization in the medical education literature, the contexts in which it has been studied, and with which variables it has been associated. These areas were investigated to propose practical solutions to reduce medical students' procrastination tendencies.

Methods: This systematic review was completed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and the guidelines of the Association for Medical Education in Europe. We searched the PubMed, ERIC (ProQuest), and PsycINFO (OVID) databases. A total of 243 articles were identified and screened independently by two authors.

Results: Based on a set of inclusion criteria, 26 articles were kept and analyzed in the review. We found that medical students' procrastination was most often conceptualized as the voluntary delay of a given task. Medical students' procrastination was examined in two different contexts: academic procrastination and bedtime procrastination. Procrastination was negatively related to variables such as academic achievement, metacognition, and self-esteem, and positively related to other variables such as stress, anxiety, and mobile phone addictions.

Conclusions: Medical students' procrastination is most frequently described as the intentional or voluntary postponement of a given task with the expectation of negative consequences and is most often evaluated in academic settings alongside mental health and affective variables. Future research should focus on promoting students' awareness of their procrastination and emotional states through targeted and goal-oriented interventions.

Résumé

Résumé français à venir.

Introduction

Medical school is a high-stress, competitive environment, where students report elevated levels of stress, burnout, depression, and anxiety.[1-6] Examples of such stressors include, but are not limited to, adjusting to the medical environment, ethical struggles, inadequate preparation for death and human suffering, personal and health concerns, financial issues, excessive workloads, difficulties with studying, and poor time management skills.[7,8] One key variable associated with medical students' academic stress is procrastination.[9] Many students report being unable to manage their time efficiently and up to 50% of medical students procrastinate their academic tasks because they feel overwhelmed and/or do not have enough energy to complete their work.[10]

Procrastination is commonly defined as the voluntary and needless delay of an intended action, despite possible negative consequences.[11] When students procrastinate, they needlessly put off what they should be doing (i.e., their responsibilities), such as completing their homework to do other tasks (e.g., watching television). Multiple studies have shown procrastination to lead to negative consequences in students' personal and academic lives, such as frequent visits to health care professionals,[12] experiencing negative emotions (e.g., anxiety),[13] and diminished academic performance.[14]

We chose to focus specifically on medical students for two reasons. First, while students at different levels of medical education (e.g., medical students, residents) experience stress and burnout during their medical training,[15,16] medical students are more frequently tasked with gaining large amounts of knowledge with short deadlines (e.g., writing papers, preparing for exams). Second, in an effort to mitigate medical students' stress and burnout and support their well-being, the purpose of this review is to further examine one of the key variables related to students' stress: procrastination (i.e., students procrastinate academic tasks when they are overwhelmed and their procrastination can also cause stress) at the start of their medical education journey.[9,10] To provide guidelines regarding how to promote students' well-being, it is important to understand how procrastination is conceptualized and measured within the realms of medical education.

The present systematic review sought to answer the following questions:

1. How is procrastination conceptualized in medical education literature?

2. What are the contexts in which medical students' procrastination has been empirically examined?

3. Which variables are most often measured alongside medical students' procrastination?

The first question explores how procrastination is conceptualized within the medical education literature. There is one definition of procrastination (defined as the voluntary and needless delay of an intended action, despite possible negative consequences[11]) that has been prominently used among adults and students, however, we do not know if this definition is also relevant for medical students. The second question explores the settings that medical students' procrastination has been examined. Procrastination can occur in a variety of contexts, such as in one's personal life (e.g., procrastinating doing or completing taxes, doing exercise, eating healthy foods) and in academia (e.g., procrastinating on specific academic tasks such as watching pre-recorded lectures or preparing for exams). This review aimed to better understand the full range of activities in which medical students' procrastination takes place. Lastly, the third question examines the variables that are most often measured alongside procrastination and the way that procrastination functions in relation to such variables. Previous research has shown procrastination to negatively associate with adaptive variables (e.g., metacognition) and positively associate with maladaptive variables (e.g., negative emotions, worrying).[11] Therefore, identifying which variables are related to medical students' procrastination specifically, and in which way (positively or negatively), is an important step toward understanding the implications of procrastination on medical students' lives and well-being. Another aim of the present systematic review was to offer practical recommendations that could reduce students' procrastination.

Methods

This systematic review was reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)[17] guidelines and the guidelines of the Association for Medical Education in Europe (AMEE).[18]

Search strategy

The first author (SR) conducted an initial pilot search to examine the breadth of articles on medical students' procrastination. The first author (SR) researched procrastination among university students and initially anticipated procrastination to relate positively with maladaptive variables. To minimize the potential biases based on prior knowledge of the results, the search strategy was developed by two authors (SR, TC) through an iterative process where they met several times to refine the search terms. For instance, after several searches, they discovered that the word "student" was not descriptive enough, thus they added the word "learner" to their search terms. After the search terms were finalized, the authors (SR, SYL) independently searched the PubMed, ERIC (ProQuest), and PsycINFO (OVID) databases from the inception of the database until November 2024. The authors decided to focus on medical students because the courses/structure of other health programs may significantly differ from those found in medical school. Using the Boolean operators "AND" and "OR" the above-mentioned authors searched: "*procrastinat**" AND "*medic**" AND "*student** OR *learn.**" This search produced 243 articles. Articles were imported into the Mendeley Reference Manager software (version 2.61.1, Mendeley Ltd., Elsevier) by the first author (SR). Duplicates were screened using Excel (version 16.93.1, Microsoft) which resulted in the removal of 37 articles, bringing the total to 206.

Selection process

The titles and abstracts of the 206 articles were screened independently by the first and third authors (SR, SYL) to see if they met the following inclusion criteria: (1) the research sample had to be medical students and not students enrolled in other health professions (e.g., physiotherapy students), (2) studies had to include procrastination as either a correlate, antecedent, mediator, moderator, or outcome, (3) studies had to be written in (not translated to) English, and (4) all publication types were considered with the exception of dissertations (they are considered grey literature and non-peer reviewed).

Articles were first screened based on their titles and abstracts. When the title or abstracts did not enclose adequate information to determine inclusion or exclusion (e.g., article indicates that students were in the medical field, but not specifically indicating that they were medical students), the full article was downloaded and read. The citations of all articles were imported into Microsoft Excel and each article was coded based on if the article was kept or removed and why. Two authors (SR, SYL) met to discuss their coding and the level of agreement between the authors was 99%. Any disagreements were resolved through discussions until consensus was obtained.

Quality assessment

The Medical Education Research Study Quality Instrument (MERSQI)[19,20] was used to assess the methodological quality of quantitative studies based on six domains: study design, sampling, type of data, validity of evaluation instrument, data analysis, and outcomes. By checking the research quality, this also served to assess certainty of evidence for results. Items in each domain were scored on a scale from 1-3 with possible scores on the MERSQI ranging from 5-18. Note that one paper[9] included both quantitative and qualitative analyses, but only the quantitative results were scored using the MERSQI. Two additional qualitative papers that met the inclusion criteria[21,22] were not scored. Two authors (SR, SYL) independently assessed all remaining articles, and any disagreements were resolved through discussions until consensus was reached.

Results

Figure 1 presents an overview of the study selection process. Inclusion criteria were applied in the same order as outlined above. In total, 180 articles were excluded because they did not meet the criteria, of which 154 articles did not involve medical students specifically (e.g., dental students), 21 articles did not include procrastination as either a correlate, antecedent, mediator, moderator, or outcome (e.g., papers on Attention Deficit Hyperactivity Disorder), four articles were not written in English (e.g., Chinese, Farsi), and one article was a dissertation. We included 26 articles in the review. Results from the MERSQI scoring showed that the majority of selected articles employed single group, cross-sectional designs ($n = 23$).[9,10,21-33,35-39,41-43] Overall, possible scores ranged from 8.5 to 14.5, demonstrating a relatively average research quality score according to the MERSQI scoring scheme.
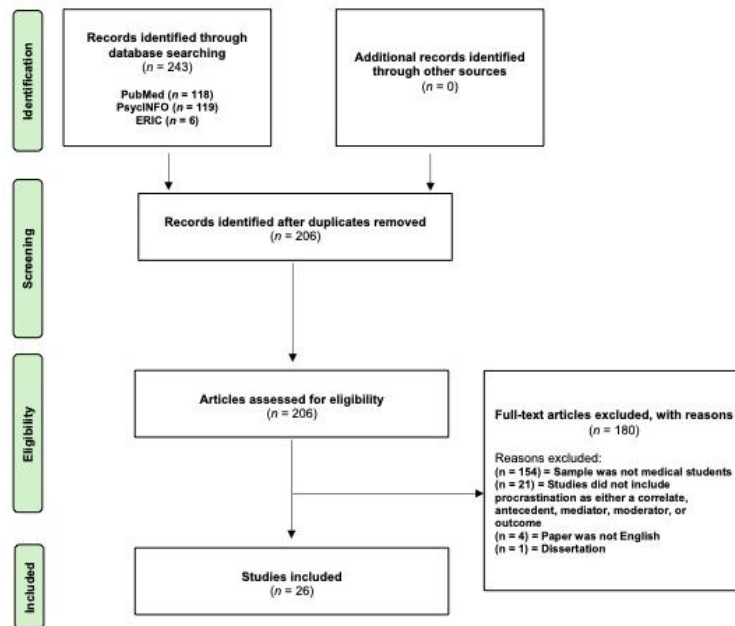
Figure 1. Search selection process

Summary of findings

SR extracted the relevant information (articles' purpose, definition of procrastination, sample, country, and main results) which SYL verified (Appendix A, Table 1). All articles were published from 2011 – 2024, with most (*n* = 19) articles published in more recent years (2020-present) in English. The 26 studies were conducted in China (*n* = 7), Iran (*n* = 4), United States (*n* = 3), Germany (*n* = 2), Pakistan (*n* = 2), Aruba (*n* = 1), Hungary (*n* = 1), India (*n* = 1), India/Malaysia (*n* = 1), Ireland (*n* = 1), Lebanon (*n* = 1), Romania (*n* = 1), and South Korea (*n* = 1). The results of the review are outlined below in line with each research question.

How is procrastination conceptualized in the medical education literature?

Six articles did not conceptualize or define procrastination at all.[9,21,22,26,37,40] In the remaining 21 articles, the most often cited definition of procrastination was by Steel[11] who conceptualizes procrastination as (1) voluntary, (2) a delay, and (3) resulting in negative consequences. All three components of this definition were observed in the medical education literature and six articles directly referenced Steel.[33,34,36,38,42,44] First, procrastination was defined as a voluntary or intentional behaviour and is described in terms of the intention-action gap where students know that they are supposed to do something yet fail to act upon this intention.[23,24,30,31,33-36,38,39,42,43] Second, many articles (*n* = 19), referred to delay or postponement.[10,23-25,28-36,38,39,41-44] Third, seven articles explicitly defined procrastination in terms of the potential negative consequences that follow

from delaying.[24,25,29,33,34,36,38] Procrastination was also described using negative words such as pernicious,[27] unreasonable,[32] and irrational[44] and one article conceptualized procrastination more generally as a form of self-regulation failure.[27]

What are the contexts in which medical students' procrastination has been empirically examined?

Medical students' procrastination is examined in two different contexts: academic and bedtime (Appendix A, Table 2). In almost all of the articles (*n* = 24), procrastination was specifically discussed within academic settings.[9,10,21-27,29,31-44] Among these articles, four[21,38,40,43] examined procrastination when learning online. Academic procrastination was most often measured using the Procrastination Assessment Scale–Students.[10,24,29,32,34,39] Three articles[28,30,31] examined medical students' bedtime procrastination (e.g., "Going to bed later than intended").

Which variables are most often measured alongside medical students' procrastination?

Procrastination was most often measured alongside variables that were categorized into two groups: Internal and External (Appendix A, Table 2). Internal variables consist of variables that are nested within students (e.g., academic and learning behaviors, mental health, emotions and personality traits, physical health and self-perceptions) and external variables are outside of students (e.g., learning environments and home environments). Under the umbrella of internal variables, academic procrastination was positively associated with avoidance of

help seeking,[23] freedom to watch lectures at one's own pace,[21] bedtime procrastination,[31] and academic failure.[22]

Procrastination was negatively related to other academic and learning behaviors such as poor academic achievement and career aspirations,[10,23,29,35,42] metacognition,[23,37] field interest,[29] time management,[41] career calling,[43] and visualization techniques of previous procrastination.[44] Academic procrastination was positively associated with several mental health, emotion and personality variables such as openness to experience,[24] impulsivity,[31] emotion regulation difficulties and negative emotional experiences,[9,26-28,30,33,34,36-38] fear of failure[25] and self-handicapping,[33] smartphone and internet addiction,[31,32,42] as well as fatigue, sleep insufficiency, and cognitive capacity decrease.[31] On the other hand, personality traits[24,25] emotional intelligence,[24] self-control,[28] hardiness,[33] self-regulation and proactive coping,[27] and positive emotions[10,38] were negatively associated with procrastination. Procrastination was also related to physical health and self-perceptions such as positively related to positive expectations about medication,[26] and negatively related to self-regulation, dentist health,[27] self-esteem (perceptions of one's value/worth)[29,] and patient care self-efficacy.[37] Under the umbrella of external variables, procrastination had a negative relationship with mastery goal structures,[23] online vs. in-person learning burdens,[40] peer pressure,[43] and conducive and positive learning environments.[32,41,43] In addition, positive parenting styles (e.g., warmth) from students' parents were negatively related to procrastination while negative (e.g., rejecting) parenting styles from students' parents were positively related to procrastination,[34] and married students were more likely to procrastinate than single students.[10]

Discussion

The overall purpose of this systematic review was to better understand how medical students' procrastination is conceptualized, the contexts in which it is most evident, and the variables with which it has been associated. Also, this review aimed to propose practical solutions to improve medical students' procrastination. Our review revealed that research on medical students' procrastination is scarce, as indicated by the mere 26 articles representing the core of this review. Although several studies used cross-sectional designs, the complexity of analyses went beyond descriptive analyses. No study used objective measurements of procrastination, such as timed assignments, and most studies focused on attitudes and perceptions as study outcomes. Future research is

encouraged that goes beyond correlation designs to more rigorously examine the causal relationships between procrastination and other variables. We found that medical students' procrastination was conceptualized as the voluntary delay of a given task, mainly examined in academic contexts, and most often measured alongside mental and physical health variables such as anxiety.

Conceptualizing and contextualizing medical students' procrastination

Procrastination was most often defined in the literature as the voluntary delay of a given task. Procrastination involves failing to act upon a previously set intention. The definitions used in the articles from this review were directly comparable to the most common definition of procrastination[11] underscoring a potential universal understanding of the term procrastination among medical education researchers and learners.

Medical students' procrastination was most often measured in academic settings, an expected finding since the literature search was on *students* who are typically measured in academic contexts. Many articles outside of the medical field also examine procrastination with student populations in academic settings.[11,12,14] However, research on students in non-medical fields has found procrastination to occur across several areas of life, thus future research is needed to better understand medical students' procrastination outside of academia to discern if their procrastination is a contextual issue or a habitual problem. Also, the COVID-19 pandemic has significantly impacted medical student's lives,[45] yet only four articles[21,38,40,43] examined medical students' mental health before, during and/or after the "new normal." During the pandemic, many students shifted rapidly to online learning, and this may continue in the coming years as other hybrid learning modalities become more popular, therefore, we recommend future research on medical students' procrastination in e-learning platforms. This is especially important given that procrastination is linked with internet addiction[32] and students may be prone to excessive procrastination when learning online as indicated by the findings[21] showing students procrastinated when given the opportunity to watch lectures at their own pace.

Relationships between procrastination and other variables

Medical students' procrastination hindered their academic performance (e.g., lower clinical points and GPA), a finding that is consistent with the research on procrastination with non-medical students, implying that students who delay their academic tasks may be more likely to perform inadequately on them.[14] Overall, findings from this review

produced similar outcomes to research among students in non-academic fields in which procrastination is negatively associated with adaptive variables (e.g., metacognition, awareness of one's thoughts, self-regulation[46]) and positively associated with maladaptive variables (e.g., avoidance behaviours).[11] Negative emotional experiences (depression, anxiety, stress) and a lack of positive emotional experiences (e.g., positive feelings, positive academic emotions) were frequently reported by students and/or studied by researchers. This finding is analogous to other research with medical students who report higher levels of anxiety than their peers in other programs, [5] and research with non-medical students where procrastination is negatively related to positive emotions such as hope, pride, and enjoyment, and positively related to negative emotions such as anxiety, shame, and anger.[47]

Self-perceptions, mainly self-esteem and self-efficacy, were also negatively related to students' procrastination.[29,37] This supports the theoretical framework that procrastination includes different components, such as cognitive (e.g., irrational beliefs), behavioural (e.g., delay behaviours), and affective elements.[11] External variables included learning and home environments, highlighting the role that teachers and parents play in students' learning and well-being.

Implications and practical solutions

Medical students frequently experience depression, anxiety, and burnout.[1] Our findings highlight the close positive relations that exist between medical students' negative emotional experiences and procrastination. From a practical perspective, these findings shed light on the importance of promoting adaptive emotional regulation strategies for students (e.g., emotion regulation interventions, one-on-one or group counselling, wellness programs such as Medical Student Wellness Program at Vanderbilt School of Medicine,[48] peer support groups, and other university student's services), and encouraging medical school faculty to have an awareness of students' procrastination behaviours so they can implement some supportive resources in classroom settings. One technique[44] that can be used to combat medical students' procrastination is visualization. When students are presented a line chart which displayed the course and extent of students' self-reported procrastination, they were less likely to engage in procrastination in the future due to raised awareness of previous procrastination. This insight can be potentially used to create interventions in which mindfulness of procrastination behaviours may prevent or reduce future procrastination. Other initiatives targeting medical students' well-being include wellness programs such as Medical Student Wellness Program at Vanderbilt School of Medicine,[48] peer support groups, and other university student services.

Limitations

This systematic review had several limitations. First, during the screening process, four articles were removed because they were not written in English, and it is also possible that non-English papers did not even appear in our initial search, thus limiting our understanding of procrastination to specific countries and regions of the world. Second, the way procrastination was defined or described in the medical education literature could have limited the number of articles selected for this review (e.g., discussing study habits vs. explicitly using the term *procrastination*). Third, given that articles were collected from different medical schools around the world; it was quite difficult to discern if these medical programs were comparable given the differences in curriculums and programs offered by each school. Finally, depending on the country and university, slight variations may have existed in the learning materials, the age students began the program, and the number of years needed before getting a medical license. For instance, the most common country that papers from our review originated from was China and one paper specifically[34] explained that students attended medical school for five years after high school, while in North America the duration is different.

Conclusions

The present systematic review paper sought to explore the implications of procrastination on medical students' lives and well-being. Findings revealed that medical students' procrastination is most frequently described as the intentional or voluntary postponement of a given task with the expectation of negative consequences and is most often evaluated in academic settings alongside mental health and emotion variables. We also discovered that medical students do indeed engage in procrastination and this procrastination is positively related to their stress. Therefore, future research should focus on promoting students' awareness of their procrastination and emotional states through targeted interventions.

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Appendix A.

Table 1. Overview of selected articles, including study purpose, conceptualization and assessment of procrastination, main findings, and study quality (MERSQI score)

Author (year)	Purpose	Conceptualization	Sample and Country	Assessment of Procrastination	Type of Analysis and Relevant Main Findings	Study Quality. MERSQI score
Artino et al. (2012)[23]	The purpose of this study was to examine how medical students' perceptions of their learning environments are associated with their self-regulated learning behaviors. In addition, how such perceptions and behaviors are related to performance and change across students' medical studies were also examined.	"Procrastination can be defined as knowing that one is supposed to complete a task but failing to do so within the expected or desired time frame." Wolters (2003)	304 medical students at various phases of medical school training USA	Four-item Academic Procrastination Assessment (Wolters, 2003)	Correlations (1) Students' perceptions of their learning environments (mastery goal structures) were negatively correlated with academic procrastination, (2) Students' learning behaviors (metacognitive control strategies; metacognition) were negatively correlated with academic procrastination, (3) Students' avoidance of help-seeking was positively correlated with academic procrastination and, (4) Clinical points were negatively correlated with procrastination.	13/18
Awad et al. (2023)[24]	The purpose of this study was to examine the relationship between procrastination and personality traits, as well as the mediating role of emotional intelligence (EI) in medical students.	"Procrastination is the act of unnecessarily avoiding or deferring the accomplishment of a certain task despite feelings of discomfort and awareness of its adverse consequences" Engberding (2017)	296 general medicine students from 7 national schools of medicine Lebanon	12-item Procrastination Assessment Scale – Students (PASS) (Solomon & Rothblum, 1984)	Correlations and Mediation Analysis (1) Students' academic procrastination was negatively correlated with extraversion, conscientiousness, neuroticism, and EI, whereas it was positively correlated with openness to experience, (2) Student's EI mediated the association between neuroticism and academic procrastination, students' neuroticism and EI were also directly negatively associated with academic procrastination, (3) Students' EI mediated the association between openness to experience and academic procrastination, openness to experience was directly positively associated with higher academic procrastination, students' EI was negatively associated with academic procrastination, and (4) 44.3% of medical students were procrastinators.	11/18
Barche et al. (2022)[21]	The purpose of this study was to examine medical students' perceptions towards online learning during the COVID-19 pandemic restrictions.	Not defined	18 undergraduate medical students India	Qualitative focus group questions not mentioned	Thematic Analysis (1) Students procrastinated watching recorded lectures when given the opportunity to watch them at their own pace.	Not applicable, qualitative research
Cho et al. (2022)[25]	The purpose of this study was to examine the mediating role of fear of failure (FF) in the relationship between self-oriented perfectionism (SOP) and academic procrastination (AP) in medical students.	"Academic procrastination (AP) is a common behavioral tendency to unnecessarily delay starting or finishing required academic tasks with a fixed deadline, despite knowing that such delay will result in negative consequences" Sirois et al. (2017), Jadidi et al. (2011), and Seo (2008).	156 undergraduate medical students South Korea	19-item Aitken Procrastination Inventory (Aitken, 1982)	Correlations, Regression Analysis, Mediation Analysis (1) Students' SOP was negatively correlated with and negatively predicted their AP, (2) Students' FF was positively correlated with and positively predicted their AP, and (3) Students' FF partially mediated the relationship between their SOP and AP, with SOP being negatively and directly associated with AP, and FF being positively and directly associated with AP.	11/18
De Bruyn et al. (2022)[26]	The purpose of this study was to examine the Theory of Triadic Influence (TTI) as a framework for understanding the risk factors of stimulant misuse among medical students.	Not defined	2740 pre-med and medical students USA	Three-items from the Tuckman Procrastination Scale (Tuckman, 1991)	Structural Equation Modeling (1) Students' academic stress was positively associated with students' procrastination and, (2) Students' positive expectancies about medication were positively associated with procrastination.	10/18

Dumitrescu et al. (2011)[27]	The purpose of this study was to examine the relationships between self-regulation, proactive coping, proactive attitudes, procrastination, perceived oral health and self-reported oral-health behaviours among medical students.	"Procrastination is a prevalent and pernicious form of self-regulatory failure."	198 first year medical students Romania	Ten-item Procrastination Scale (PS) (Schwarzer's et al., 2000)	Correlations, T-tests and Analysis of Variance (ANOVA) (1) Students' self-regulation, proactive coping, and proactive attitudes were all negatively correlated with procrastination, (2) Students who procrastinated reported often experiencing anxiety and stress in everyday life, (3) Students who rated their gingival condition as very good/excellent vs. lower had lower levels of procrastination and, (4) Significant differences in procrastination levels were observed between students who never visited the dentist and those who do.	12/18
Feng et al. (2022)[28]	The purpose of this study was to examine the relationships between bedtime procrastination (BP), self-control, and depressive symptoms in medical students (based on the perspective of sex differences).	"Bedtime procrastination (BP), a behavior related to sleep insufficiency due to bedtime delay without external reasons." No citation	364 students from a medical school of a public university China	Nine-item Bedtime Procrastination Scale (Kroese et al., 2014)	Correlations, Regression, Two-way Anova, Binary Logistic Regression, Structural Equation Modeling (1) Students' BP was negatively correlated with their self-control among males in both the non-depressed and depressed groups, (2) Students' BP was positively correlated with students' depressive symptoms, and negatively correlated with self-control only in non-depressed women, (3) Students' BP was an independent predictor of depressive symptoms in women and (3) Students' BP mediated the relationship between self-control and depressive symptoms exclusively in the non-depressed female group.	11/18
Ghasempour et al. (2024)[29]	The purpose of this study was to examine the relationships between academic procrastination, self-esteem, and moral intelligence.	"Academic procrastination…this particular type of postponement refers to learners' dominant and constant tendency to postpone academic tasks such that it affects their anticipated performance" Bytamar et al. (2020)	205 medical sciences students Iran	27-item Procrastination Assessment Scale – Students (PASS) (Solomon & Rothblum, 1984)	Backward Multivariable Linear Regression (1) 96.1% of the students experienced moderate to severe levels of academic procrastination and (2) Students' academic procrastination was negatively predicted by to their self-esteem, GPA, and field interest.	9/18
Guo et al. (2020)[30]	The purpose of this study was to examine the impact of bedtime procrastination on depression symptoms among medical students.	"People with bedtime procrastination often go to bed later than intended without external resistance" Kroese et al. (2014)	401 pre-clinical sophomores and junior medical students China	Nine-item Bedtime Procrastination Scale (Kroese et al., 2014)	Analysis of Variance (ANOVA) and Binary Logistic Regression Analysis (1) Bedtime procrastination scores were higher among depressed students vs. non-depressed students and, (2) Bedtime procrastination was an independent contributor of depression symptoms.	14/18
Hamvai et al. (2023)[31]	The purpose of this study was to investigate the possible mediators between medical students' impulsivity and sleep outcomes (including bedtime procrastination)	"Bedtime procrastination, a situation when people fail to go to sleep at the intended time, with nothing hindering them from doing so" Kroese et al. (2014) "Academic procrastination means mainly academic task delays, such as writing term papers, reading weekly assignments, or studying for exams" Schouwenburg et al. (1995)	211 medical students Hungary	Nine-item Bedtime Procrastination Scale (Kroese et al., 2014) Five-item Academic Procrastination Scale-Short Form (Yockey, 2016)	Correlations and Path Analysis (1) Students' bedtime procrastination was positively correlated with attentional impulsivity, motor impulsivity, non-planning impulsivity, smartphone addiction, academic procrastination, fatigue, sleep insufficiency, and cognitive capacity decrease, (2) Students' academic procrastination was positively correlated with attentional impulsivity, motor impulsivity, non-planning impulsivity, smartphone addiction, sleep insufficiency, and cognitive capacity decrease, (3) Students' attentional impulsivity and non-planning impulsivity positively predicted academic procrastination, which in turn positively predicted bedtime procrastination and,	9/11

					(4) Students' academic procrastination and smartphone addiction mediated the relationship between attentional impulsivity and bedtime procrastination.	
Hayat et al. (2020)[32]	The purpose of this study was to examine the relationship between internet addiction and academic procrastination among medical students.	"Academic procrastination … is an unreasonable trend through which the person delays starting or finishing the academic tasks or other assignments" Senécal et al. (2003)	233 medical students from different periods of the medical program Iran	18-item Procrastination Assessment Scale – Students (PASS) (Solomon & Rothblum, 1984)	Frequencies, Correlations, and T-tests (1) 28.85% of students reported high levels of academic procrastination, (2) 33.5% of students believed that their procrastination in academic duties was problematic for them, (3) Students' internet addiction was positively correlated with academic procrastination and, (4) Students who lived at home had lower procrastination scores than students who lived in a dormitory.	10.5/18
Jia et al. (2021)[33]	The purpose of this study was to examine the relationship between academic anxiety and self-handicapping of medical students, assessing the mediating and moderating role that procrastination and hardiness play in such relations.	"Procrastination could be defined as the voluntary delay behavior of students in academic tasks though it was expected the consequences might be negative" Steel (2007)	320 medical students China	20-item General Procrastination Scale (GPS) (Lay, 1986; Chinese version: Chu et al., 2010)	Correlations and Moderated Mediation Model (1) Students' self-handicapping and academic anxiety were positively correlated with procrastination, (2) Student's hardiness was negatively correlated with procrastination, (3) Student's procrastination partially mediated the relationship between students' academic anxiety and students' self-handicapping and, (4) Hardiness moderated the mediating effect of procrastination.	11/18
Khalid et al. (2019)[34]	The purpose of this study was to examine the relationships between procrastination, perceived stress, sAA (saliva as an indicator of stress), and parenting styles of medical students (students' mothers and fathers)	"Procrastination [is]… defined as a voluntary behavior in which the negative consequences are expected to outweigh the positive consequences of delays" Steel (2007); Nordbly et al. (2017)	140 medical students who were in their first year of medical school China	44-item Procrastination Assessment Scale – Students (PASS) (Solomon & Rothblum, 1984)	Repeated and One-way Analysis of Variance (ANOVA), One-way Analysis of Variance (ANOVA), and Correlations (1) Students perceived and objective stress were positively associated with procrastination, (2) Positive parenting styles (e.g., warm, affectionate mother or father) were negatively associated with students' procrastination and, (3) Negative parenting styles (e.g., rejecting mother or father) were positively associated with students' procrastination.	14.5/18
Kumari et al. (2024)[35]	The purpose of this study was to examine factors that impede medical students' academic and career aspirations and compare the perspectives of medical students with medical school teaching faculty.	"Academic procrastination, the voluntary delay of an intended course of study-related action" Not citation	250 first- and second-year medical students India and Malaysia	The authors developed and validated a questionnaire containing 25 at-risk factors to understand the participant's perceptions of factors influencing academic success	One-way ANOVA, Independent T-tests (1) Students reported that procrastination was one of the factors impeding their academic and career aspirations, and (2) Faculty believed that procrastination was more influential in impeding students' academic success than students did.	10/18
Lane et al. (2020)[9]	The purpose of this research was to examine final-year medical students' stress using objective and subjective measures of stress and study medical students' perspectives on the factors that impact their well-being and stress.	Not defined	161 medical students Ireland	Qualitative Questions 1. What things in your life make you feel stressed (triggers)? 2. How do you feel when you are stressed/how do you react (effects)? Quantitative and Qualitative (Qualitative relevant to review)	Thematic Analysis (1) Students' identified exams at the largest contributor to their stress due to feeling overwhelmed and procrastination.	8.5/18
Mortavazi et al. (2015)[10]	The purpose of this study was to validate the PASS in Farsi with medical students.	"Academic procrastination [is] defined [as] postponing academic assignments and tasks" Milgram et al. (1999)	423 medical students Iran	44-item Procrastination Assessment Scale – Students (PASS) (Solomon & Rothblum, 1984)	Frequencies, Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), Correlations, and T-tests (1) Students reported procrastination in 6 academic domains (34.8% writing a term paper; 37.1% studying for	10/18

					an exam; 49.9% keeping up with weekly reading assignments; 13.8% performing administrative tasks; 27.6% attending meetings; and 44.4% performing academic tasks in general), (2) Students who were married procrastinated less than those who were married, (3) Students' positive feelings and academic scores were negatively correlated with academic procrastination and, (4) Students' average academic scores from the previous semester were negatively correlated with procrastination.	
Mohammadi Bytamar et al. (2020)[36]	The purpose of this study was to examine the role of emotion regulation difficulties in academic procrastination.	"Procrastination is defined as to voluntarily delay an intended course of action despite expecting to be worse off for the delay" Steel (2010)	210 medical sciences students Iran	16-items from the Tuckman Procrastination Scale (Tuckman, 1991)	Correlations, Regression Analysis, ANOVA/MANOVA, ANCOVA/MANCOVA (1) Students' academic procrastination was significantly and positively correlated with emotion regulation difficulties (except the awareness dimension) and this association remained significant even after controlling for students' anxiety and depression in regression analyses, (2) Students' emotional regulation strategies positively predicted their academic procrastination, and (3) Students with high levels of academic procrastination reported higher emotional regulation difficulty scores compared to those with lower levels of academic procrastination.	11/18
Phillips et al. (2015)[37]	The purpose of this study was to develop a self-report measure of task value beliefs, particularly task importance and anxiety.	Not defined	368 medical school students USA	Four-item Academic Procrastination Assessment (Wolters, 2003)	Correlations (1) Students' interpersonal skills anxiety and health knowledge anxiety were positively correlated with academic procrastination and, (2) Students' patient care self-efficacy and metacognition were negatively correlated with academic procrastination.	10/18
Qu et al. (2022)[38]	The purpose of this study was to examine the mediating role of academic emotions in procrastination and burnout with Chinese medical students during the COVID-19 pandemic.	"The voluntary delay of an intended and necessary and/or [personally] important activity, despite expecting potential negative consequences that outweigh the positive consequences of the delay." Klingsieck et al. (2013) Steel (2007)	995 undergraduate medical students China	19-item Aitken Procrastination Inventory (Aitken, 1982)	T-test, One-way ANOVA, Binary Logistic Regression, Mediation (1) Students' procrastination was positively correlated with burnout as well as both activating and deactivating negative academic emotions, (2) Students' procrastination was negatively correlated with both positive activating and deactivating academic emotions, (3) A similar pattern of results was found in the regression analyses, where procrastination was positively associated with negative emotions, and negatively associated with positive emotions and, (4) Students' academic emotions mediated the relationship between procrastination and burnout.	11/18
Rashid et al. (2022)[22]	The purpose of this study was to examine the factors that predict academic failure before students' first major assessment.	Not defined	8 medical college students Pakistan	Qualitative assessment	Thematic Analysis (1) Students perceive that their procrastination is a factor that predicts academic failure.	Not applicable, qualitative research
Shankar et al. (2017)[39]	The purpose of this study was to study procrastination with basic science undergraduate medical students.	"A purposive, habitual, intentional and needless delay in beginning or completing tasks, which prevents individuals from reaching their goals" Lay (1986)	107 undergraduate basic science medical students Aruba	44-item Procrastination Assessment Scale – Students (PASS) (Solomon & Rothblum, 1984)	Frequencies (1) Students reported that procrastination was as a problem specifically when they were studying for exams, completing reading assignments, and preparing for problem-based learning sessions and, (2) 42% of students were interested in going to a program to overcome their procrastination.	9/18

Schindler et al. (2021)[40]	The purpose of this study was to examine first-year German medical students' mental health before and during the "new normal" caused by the COVID-19 pandemic.	Not defined	63 medical students Germany	Four-items asked students about their study related burdens (one was about procrastination)	Repeated Measures Analysis of Variance (ANOVA) (1) Students were less likely to report 'procrastination of learning online-learning material' as a burden in December 2020 vs. June 2020.	10.5/18
Tahir et al. (2022)[41]	The purpose of this study was to examine the level of procrastination and to explore the coping strategies adopted by low procrastinators to overcome their procrastination.	"Procrastination means an act or habit of putting off or delaying something, especially something that demands prompt attention." No citation	255 undergraduate medical students completed APS; 18 students interviewed Pakistan	25-item Academic Procrastination Scale (used to identify low procrastinators) No citation	Interviews (1) From interviews, 10 coping strategies by low procrastinators were identified: time management, self-regulation, establishment of priorities, self-reward, goal-setting, conducive learning environment, self-reminders, task management, self-evaluation and self- monitoring.	9/18
Tian et al. (2021)[42]	The purpose of this study was to examine the relationships between medical students' mobile phone addiction, academic procrastination, and academic achievement.	"Academic procrastination is a type of situational procrastination and is defined as an initiative delay in the learning process and intended course." Steel (2007) Karimi Moonaghi and Baloochi Beydokhti (2017)	3511 medical students China	Five-item The Academic Procrastination Scale–Short (APS-S) (Yockey, 2016)	Multiple Linear Hierarchical Regression Analysis (1) Students' academic achievement was negatively associated with academic procrastination and, (2) Students' mobile phone addiction was positively associated with academic procrastination.	12/18
Wang et al. (2023)[43]	The purpose of this study was to examine Chinese medical students' academic procrastination during the COVID-19 pandemic and the relationships between career calling, peer pressure, positive learning environments, and academic procrastination.	"Academic procrastination is a type of procrastination in which students voluntarily delay their academic activities until the last minute" Vilca (2022)	3614 medical students China	Five-item Procrastination scale made by the research team	Correlations, T-test and One-way ANOVA, Hierarchical Regression Analysis (1) Students' procrastination was negatively correlated with career calling and positively correlated with peer pressure and positive learning environments and, (2) The interaction between students' career calling and peer pressure influenced students' procrastination, such that higher levels of peer pressure amplified the relationship between career calling and academic procrastination.	11.5/18
Waschle et al. (2014)[44]	The purpose of the research was to examine if visual feedback (line chart visualizing students' previous procrastination) was effective in reducing students' future procrastination and self-regulated learning.	"Procrastination...is defined as the irrational postponing of important tasks." Steel (2007)	Study 1: 18 medical students Study 2: 49 medical students Germany	Four-item Procrastination assessment (Lay & Silverman, 1996)	Repeated Measures Analysis of Variance (ANOVA) Hierarchical Linear modeling (HLM) (1) Students' visualization (line chart) of previous self-reported procrastination led to statistically significant decreases in their future procrastination (in two studies), (2) Students who were shown this visualization set more specific learning goals to combat their procrastination vs. the control condition (Study 1) and, (3) Students with real visual feedback reduced their procrastination most effectively, followed by students with random visual feedback and no visual feedback (Study 2).	11/18

Table 2. Contexts in which procrastination takes place and variables measured alongside procrastination

Context			Internal Variables							External Variables		
Citation	Educational	Personal	Academic and Learning Behaviors (+)	(-)	Mental Health, Emotions, and Personality Traits (+)	(-)	Physical Health (+)	(-)	Self-perceptions (-)	Learning Environments (-)	Home Environments (+)	(-)
Artino et al. (2012)[23]	X		- avoidance of help-seeking (+)	- clinical points (-) - metacognition (-)						- mastery goal structure (-)		
Awad et al. (2023)[24]	X				- openness to experience (+)	- extraversion (-) - conscientiousness (-) - neuroticism (-) - emotional intelligence (-)						
Barche et al. (2020)[21]	X (online, COVID)		- freedom to watch lectures at own pace (+)									
Cho et al. (2022)[25]	X				- fear of failure (+)	- self-oriented perfectionism (-)						
De Bruyn et al. (2022)[26]	X				- academic stress (+)		- positive expectancies about medication (+)					
Dumitrescu et al. (2011)[27]	X				- anxiety and stress (+)	- self-regulation (-) - proactive coping (-) - proactive attitudes (-)		- dental health (-)				
Feng et al. (2022)[28]		X (Bedtime)			- depressive symptoms (+)	- self-control (-)						
Ghasempour et al. (2024)[29]	X			- GPA (-) - field interest (-)					-self-esteem (-)			
Guo et al. (2020)[30]		X (Bedtime)			- depression (+)							
Hamvai et al. (2023)[31]	X	X (Bedtime)	- academic procrastination (+) with bedtime procrastination		- impulsivity (+) - smartphone addiction (+) - fatigue, only academic proc. and not bedtime proc. (+) - sleep insufficiency (+) - cognitive capacity decrease (+)							
Hayat et al. (2020)[32]	X				- internet addiction (+)					- less proc. at home vs. dorm		
Jia et al. (2021)[33]	X				- self-handicapping (+) - academic anxiety (+)	- hardiness (-)						

Study	Context					External (left)	External (right)
Khalid et al. (2019)[34]	X		- perceived stress and objective stress (+)			- negative parenting styles (+)	- positive parenting styles (-)
Kumari et al. (2024)[35]	X	- academic and career aspirations (-)					
Lane et al. (2020)[9]	X		- overwhelmed (+) - stress (+)				
Mortavazi et al. (2015)[10]	X	- academic scores (-)		- positive feelings (-)			- less procrastination when single than married
Mohammadi Bytamar et al. (2020)[36]	X		- emotional regulation difficulties, specifically strategies (+)				
Phillips et al. (2015)[37]	X	- metacognition (-)	- interpersonal skills anxiety (+) - health-knowledge anxiety (+)		- patient care self-efficacy (-)		
Qu et al. (2022)[38]	X (online, COVID)		- burnout (+) - negative academic emotions (+)	- positive academic emotions (-)			
Rashid et al. (2022)[22]	X	- academic failure (+)					
Shankar et al. (2017)[39]	X						
Schindler et al. (2021)[40]	X (online, COVID)					- proc. burden of online learning (-)	
Tahir et al. (2022)[41]	X	- personal coping skills/strategies such as time management (-)				- conducive learning environment (-)	
Tian et al. (2021)[42]	X	- academic achievement (-)	- mobile phone addiction (+)				
Wang et al. (2023)[43]	X (online, COVID)	- career calling (-)				- peer pressure (-) - positive learning environments (-)	
Waschle et al. (2014)[44]	X	- visualization (-)					

Note. Context refers to the areas in which procrastination can occur. Internal variables are nested within students, while external variables are outside of students.

Legend: + = positively associated with procrastination, - = negative associated with procrastination.

Please note that Shankar et al. (2017) was not included in the right side of Table 2 because their paper discussed frequencies of procrastination, and not what variables specifically related to procrastination.