

Review

Physical activity as a protective factor against burnout in university students

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Citation: Muntean A., Kiss M., Kollos C., David S., Popovici C. - Physical activity as a protective factor against burnout in university students

Balneo and PRM Research Journal
2026, 17(3): 1071

Academic Editor(s):
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Production Officer:
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Received: 28.07.2026
Published: 30.09.2026

Reviewers:
Himena Zippenfening
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Publisher's Note:

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Abstract: Physical activity (PA) is a potential neuroprotective factor that may alleviate academic fatigue among university students through the modulation of stress hormones and mental protection. This study aims to analyze the recent evidence regarding the impact of physical activity on academic burnout among university students and to identify essential elements for effective interventions. Three reviewers performed a review according to PRISMA guidelines standards on three databases (Web of Science, Scopus, Pubmed) of research published during the last ten years. The results show that the mental health of students is greatly enhanced by regular physical activity, which brings about the urge of thinking about physical activity as a vital approach in the prevention of academic burnout. The findings highlight the significant role of physical activity in the prevention, study and reduction of academic burnout in university students. Regular physical exercise appears to have beneficial physiological and psychological effects such as improving cardiovascular function, increasing tissue oxygenation and stimulating neurochemical pathways associated with well-being including higher secretion of serotonin and endorphins.

Keywords: burnout, physical activity, university students

1. Introduction

Physical activity (PA) is any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above the basal level. PA can be classified by type, intensity, frequency, duration and purpose. Depending on the type of movement it can be classified as isometric (same length) or static and isotonic (same tension) or dynamic. PA by metabolic classification can be aerobic (oxygen available) or anaerobic (oxygen unavailable) processes [1-2]. PA is a significant determinant of general health and has been linked to improved mood, psychological well-being, stress regulation, and cognitive functioning, as well as better academic performance and social adjustment [3–5].

From a mental health perspective, regular PA may be involved in reducing psychological distress and perceived stress, while facilitating emotional regulation and psychological recovery. These effects might be particularly relevant to individuals facing ongoing academic pressures, where chronic stress could increase susceptibility to burnout. However, given that a substantial portion of the available literature relies on observational designs, these findings primarily reflect significant associations rather than established direct causal relationships.

On the other hand, prolonged occupational, academic and personal stress may contribute to the development of burnout, a multidimensional condition generally

characterized by emotional exhaustion, a detached or cynical attitude and a diminished sense of personal accomplishment [6-10]. Burnout may have a considerable negative impact on quality of life, and may affect academic performance, psychological and physical well-being [11], motivation, engagement and the ability to cope with personal and professional responsibilities [12-13]. Chronic fatigue, anxiety, thoughts of dropping out of medical school and suicidal ideation have been associated with burnout in students, especially in medical education [11-13].

Burnout was first described in the context of the human services profession, particularly among those working in settings with long-term emotional demands and the care of vulnerable populations [14]. Although originally conceptualized in occupational contexts, the construct has since been extended to academic environments, where students are exposed to sustained cognitive, emotional and performance-related demands

Medical education is an extraordinarily challenging academic environment. Students are expected to learn a great deal of complex knowledge, to develop practical and professional skills, to meet high academic standards, and to cope with multiple responsibilities often with limited time and energy resources. These persistent demands, along with academic competition and the pressure of future professional responsibilities, may have a detrimental effect on students physical and psychological health and increase their susceptibility to stress and burnout [15].

Academic activities can be viewed as a type of work that includes activities such as attending classes, studying for tests, completing academic tasks, and other educational duties [11]. Students experiencing chronic stress may show reduced motivation to study, lower commitment and a reduced sense of competence [16]. Conceptually, academic burnout is a sub-type of the wider construct of occupational burnout and is commonly conceptualized as a state of fatigue or exhaustion resulting from prolonged academic demands and characterized by a cynical or detached attitude toward academic work and a reduced sense of academic efficacy or competence [17-18].

Academic burnout is a complex psychological condition with emotional exhaustion, maladaptive attitudes/behaviors and reduced sense of achievement due to persistent academic stress and/or reduced interest in academic activities [19]. In keeping with the multidimensional conceptualization of burnout, academic burnout is typically defined by three dimensions: emotional exhaustion, cynicism or disengagement, and reduced academic efficacy. Emotional exhaustion is associated with chronic fatigue and the depletion of emotional and cognitive resources [20].

Cynicism manifests in indifference, reduced interest in learning, and psychological distance from academic activities, including the classroom, teachers, and academic work [21]. Reduced academic efficacy is characterized by a decreased perception of one's abilities and competences, which may foster avoidant behaviors and decreased academic engagement [22].

Academic burnout occurs through the complex interactions of individual, academic, environmental, social, technological, and institutional factors. Heavy academic workload and high expectations, lack of autonomy, lack of social support, and limited institutional resources are the most frequently reported factors in the literature [23-28, 29-40]. However, efficient time management, reasonable goal setting, self-care activities, scheduled breaks and sufficient social and institutional support may be potential protective factors against burnout [23-28, 41-45].

The conventional approach to measuring burnout has been the Maslach Burnout Inventory (MBI), which initially defined the syndrome as emotional exhaustion, depersonalization, and reduced personal accomplishment [17]. The instrument was later adapted for different occupational and non-occupational populations, such as the MBI-General Survey (MBI-GS) which assesses more general dimensions of exhaustion, cynicism and professional efficacy and is not exclusively focused on interpersonal relationships that are characteristic of human service occupations [22, 44]. In addition, an

instrument has been developed for academic populations, specific for students, reflecting the characteristics of the academic environment.

Physical exercise may be a relevant behavioral factor for the prevention and management of chronic stress, psychological distress and burnout due to their established association. The available evidence indicates that regular PA is associated with less psychological distress, anxiety and symptoms of depression, factors that may be related to the development and maintenance of academic burnout.

Magro et al. [43] found associations between PA and lower levels of psychological difficulties, while Chen et al. [44-45] found a relationship between PA and academic stress with psychically active students reporting lower levels of academic strain. Additionally, regular PA may improve emotional health, aid psychological and physical rehabilitation, and potentially lessen the experience of fatigue and perceived academic stress [46-49].

Some students looked at the relation between PA and burnout directly. Gerber et al. [48] described a relationship between moderate to vigorous PA and fewer burnout symptoms, while Elliot et al. [49] reported a specific relationship with lower levels of burnout and vigorous-intensity PA. A study among Brazilian university students also found a significant negative correlation between burnout symptoms and PA levels [48-49].

This consistent evidence suggests that PA and academic burnout should be studied further, particularly in demanding academic institutions like medical school. Understanding this association may help design better techniques to improve students' mental health, academic performance, and long-term health.

The aim of this review is to evaluate the existing evidence on the association between PA and academic burnout among university students. The findings may contribute to a better understanding of the protective role of PA and support development of effective strategies for burnout prevention and student well-being.

2. Materials and Methods

2.1. The protocol

This systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [50]. We employed the PICO framework to delineate the qualifying criteria, assuring conformity with the subsequent guidelines: Does physical activity, in contrast to a sedentary lifestyle, alleviate stress and mitigate academic burnout?

P—population - university students;

I—intervention - physical activity/regular exercise/aerobic training/sports;

C—comparison - sedentary lifestyle/no structured physical activity/passive study breaks;

O—outcome - reduced stress, lower academic burnout, improved mental resilience.

The primary objective of this review was to map and synthesize the literature regarding the types of physical activity and exercise behaviors associated with mitigating academic burnout among university students.

2.2. Search processing

To maximize reproducibility and systematic rigor, database-specific syntax, controlled vocabularies, and precise field restrictions were custom-tailored for each electronic index. The search was restricted to articles published between January 1, 2016, and May 1, 2026. The comprehensive, fully expanded search strings implemented are detailed in **Table 1**.

Table 1. Database search indicators

Database	Exact Search String / Syntax	Filters & Restrictions	Initial records
PubMed / MEDLINE	((("Burnout, Psychological"[Mesh] OR "burnout"[Title/Abstract] OR "academic burnout"[Title/Abstract] OR "school burnout"[Title/Abstract] OR "learning burnout"[Title/Abstract])) AND ((("Exercise"[Mesh] OR "Physical Activity"[Mesh] OR "physical activity"[Title/Abstract] OR "exercise"[Title/Abstract] OR "sports"[Title/Abstract] OR "aerobic training"[Title/Abstract])) AND ((("Students"[Mesh] OR "university students"[Title/Abstract] OR "college students"[Title/Abstract] OR "medical students"[Title/Abstract]))	Timespan: 2016–2026 Language: English Text: Peer-reviewed	1.187
	(TITLE-ABS-KEY (burnout OR "academic burnout" OR "school burnout" OR "learning burnout")) AND (TITLE-ABS-KEY ("physical activity" OR exercise OR sports OR "aerobic training")) AND (TITLE-ABS-KEY ("university students" OR "college students" OR "medical students")) AND (LIMIT-TO (LANGUAGE , "English"))	Timespan: 2016–2026 Language: English Document: Article	1836
Scopus	TS=(burnout OR "academic burnout" OR "school burnout" OR "learning burnout") AND TS=("physical activity" OR exercise OR sports OR "aerobic training") AND TS=("university students" OR "college students" OR "medical students")	Timespan: 2016–2026 Language: English Document: Article	1329
Web of Science (Core Collection)	TS=(burnout OR "academic burnout" OR "school burnout" OR "learning burnout") AND TS=("physical activity" OR exercise OR sports OR "aerobic training") AND TS=("university students" OR "college students" OR "medical students")	Timespan: 2016–2026 Language: English Document: Article	
Total	Combined records across all checked sub-databases prior to duplicate removal		4.352

2.3. Eligibility Criteria and Study Selection

The selection process followed a structured two-stage screening protocol conducted independently by three reviewers (P.C., A.M., and K.M.) to minimize selection bias. In the first stage, the titles and abstracts of all electronically retrieved records were screened against the core inclusion criteria: (1) original, primary research; (2) peer-reviewed publications available in full-text; (3) studies published in the English language between January 2016 and May 2026; and (4) research explicitly evaluating university student populations.

Dissertations, conference abstracts, book chapters, expert opinions, and systematic reviews or meta-analyses were excluded during this initial phase. In the second stage, the full-text articles of all potentially eligible studies were retrieved and comprehensive assessments were performed. The specific reasons for the exclusion of full-text articles (e.g., lack of a validated academic burnout endpoint, non-student populations, or secondary data designs) were systematically recorded.

2.4. Data processing

According to the selection criteria, three reviewers (P.C., A.M. and K.M.) independently accessed the databases to gather the research and provide a quality rating. During the screening procedure, publications that did not align with the analyzed themes may have been eliminated due to discrepancies. Upon confirming that the publications satisfied the established inclusion criteria, the complete text of each was reviewed.

2.5. Methodological Quality and Risk of Bias Assessment

To evaluate the methodological quality and risk of bias of the included evidence, two reviewers (P.C. and A.M.) independently appraised each study using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies.[50]. This standardized 8-item tool evaluates essential parameters, including core inclusion criteria definition, study subjects and setting description, exposure measurement validity, confounding factors identification, strategies to deal with confounding, outcomes measurement reliability, and appropriate statistical analysis. Each item was

scored as "Yes", "No", "Unclear", and a final quality score was calculated as the percentage of "Yes" responses. Studies scoring $\geq 75\%$ were categorized as high quality (low risk of bias), 50–74% as moderate quality, and $< 50\%$ as low quality (high risk of bias). Discrepancies in scoring were resolved through discussion and consensus with a third reviewer (K.M.).

3. Results

3.1. Selection and Characteristics of Study

A total of 4352 publications were found using the electronic database search (Web of Science = 1329, PubMed = 1187, and Scopus = 1836).

Prior to the screening phase, 555 duplicate records were identified and removed (due to the overlapping coverage of the selected electronic databases). An additional 362 records were excluded through automated database filters as they fell outside the targeted 10-year publication timespan (2016–2026). This left a total of 3,435 records to be screened based on title and abstract. During the title and abstract screening phase, 2,895 records were excluded because they did not meet the predefined population or intervention criteria (e.g., occupational burnout rather than academic burnout, or non-exercise lifestyle variables). A total of 540 remained. Upon comprehensive full-text review of these 540 documents, 518 articles were excluded. The primary reasons for exclusion were secondary or review methodologies without original dataset generation ($n = 5$), and studies where academic burnout was not evaluated as a direct primary or secondary outcome ($n = 513$). At the conclusion of the curation process, 22 primary papers satisfied all eligibility criteria and were included in the final qualitative synthesis. (Figure 1).

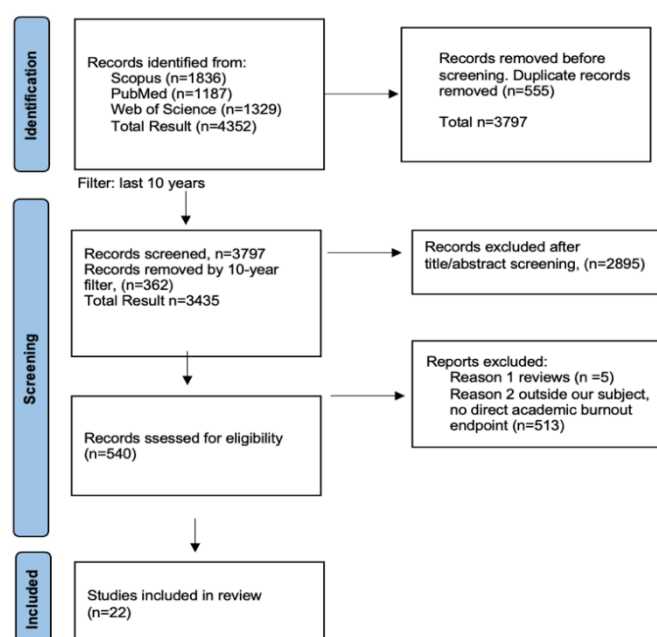


Figure 1. Prisma flow diagram [51]

3.2. Synthesis of the results

The search results are displayed in Table 2, based on the many characteristics of exercise performance related to burnout examined in the included studies. The first group comprises studies providing direct academic burnout evidence ($n=17$), which explicitly evaluated burnout as primary or secondary outcome using validated instruments. Conversely, the second group consists of studies providing indirect or contextual lifestyle evidence. ($n = 5$).

Table 2. Data analyses of the included studies

Nr. Crt.	Authors/Year	Country	Participant characteristics	Physical activity measure	Scales used/Outcome classification	Study design and follow up	Key finds/results	Total score (% YES)/ JBI-Risk of bias
1.	Lee et al. (2020), [52]	Hong Kong	n=731, medical students; mean age was 20.5 (S.D.=2.07); male= (44.2%); female= (55.8%);	PA Measure: Godin-Shephard Leisure-Time PA (GSLTPA)	Maslach Burnout Inventory (MBI); Alcohol Use Disorder Identification Test (AUDIT-C); Pittsburgh Sleep Quality Index (PSQI); GSLTPA; Direct evidence, validated burnout endpoint;	Cross-sectional not applicable (N/A)	Clear protective effect: Regular/ frequent exercise significantly decreases burnout prevalence compared to rare exercise (13.7%) vs. (31.7%); (p<0.001).	8/8; 100% Low Risk (High Quality)
2.	Rosales-Ricardo (2020), [53]	Ecuador	university students: n=26 (aerobic); n=25 (strength);	PA Measure: Structured 30–50 min aerobic vs. anaerobic/strength sessions	MBI; Heart Rate Variability (HRV); Direct evidence, validated burnout endpoint;	Experimental (Short-term)	Dimension-specific impacts: Aerobic Group: Highest reduction in emotional exhaustion (↓ 26%). -Strength Group: Highest reduction in cynicism (↓ 27%).	6/8; 75% Low Risk (High Quality)
3.	de Souza (2021), [54]	Brazil	n=3,578 university students:	PA Measure: 7-day recall (Cardio/Strength frequency; 5x30m mod or 3x20m vig) activity) as well as muscle-strengthening exercise.	Maslach Burnout Inventory—Student Survey—MBI-SS; Health Behavior; Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Sedentary lifestyle risks: Complete absence of cardio training increases burnout risk by 61% (OR=1.61); absence of strength training increases it by 62% (OR=1.62)	8/8; 100% Low Risk (High Quality)
4.	Salgado & Au-Yong-Oliveira (2021), [55]	Portugal	n=207, students from Portuguese universities, 31% male and 69% female	PA Measure: Structured athletic participation and frequency scores	MBI-SS Questionnaire on burnout and taking medication; Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Significant score drops: Active sports participants display significantly lower burnout baselines (M=2.42) vs. completely sedentary peers (M=2.70); (p=0.021).	7/8; 87.5% Low Risk (High Quality)
5.	Khosravi (2021), [56]	Iran	n=400, medical students, 39% male and 61% female	PA Measure: Baecke PA Questionnaire (Work, sports, leisure domains)	The Baecke PAQ; Temperament and Character Inventory; Bresó's Academic Burnout Questionnaire; Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Statistical moderation: PA effectively moderates the "novelty seeking-burnout" ($\beta = -0.47$, $p=0.044$) and "cooperativeness-burnout" ($\beta = -0.89$, $p=0.001$) pathways.	8/8; 100% Low Risk (High Quality)
6.	Rosales-Ricardo & Ferreira (2022), [57]	Ecuador	n=81, technical university students; mean age, 23.13 (SD=3.77); in aerobic exercise group 22.74	PA Measure: 16-week regimen (1h sessions, 3x/week on alternating days)	MBI-SS; Direct evidence, validated burnout endpoint;	Controlled trial- 16 weeks	16-week intervention trends: Aerobic: (↓ 31%) exhaustion, (↓ 21.1%) cynicism. Strength: (↓ 27.4%) cynicism,	6/8; 75% Low Risk (High Quality)

			(SD=3.05), and in strength-training group 22.97 (SD=3.31)				(↓ 21.7%) inefficacy. Control Group: (↑10.1%) exhaustion	
7.	Chen et al. (2022), [58]	China	n=1270 students from different universities	PA Measure: Revised PA Rating Scale (PARS-3; intensity, duration, frequency).	PARS-3; Learning Burnout Scale for College Students; General Self-Efficacy Scale (GSES); Connor-Davidson Resilience Scale (CD-RISC); Direct evidence, validated burnout endpoint;	Mediation analysis (N/A)	Dual-pathway benefits: PA exhibits a strong direct negative effect on burnout ($\beta = -0.1104$) alongside vital indirect paths mediated via self-efficacy and resilience ($\beta = -0.0802$).	8/8; 100% Low Risk (High Quality)
8.	Dhachpramuk et al. (2024), [59]	Thailand	n=404, medical students, average age was 21.06 ± 1.8 . male=49.5%, female=50.5%;	PA Measure: Godin-Shephard Leisure-Time PAQ (GSLTPAQ-9Q scores)	GSLTPAQ- 9Q; Thai version MBI; Thai general health question 28 (Thai GHQ-28); Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Insufficient exercise risks: Low PA strongly increases odds of moderate-to-severe depression (OR=2.89), anxiety/insomnia (OR=1.56), and social dysfunction (OR=2.51).	8/8; 100% Low Risk (High Quality)
9.	Morgan et al. (2024), [60]	Canada	n=129, medical students; the average age (M = 24.91; male=55 (42.6); female= 73 (56.6.)	PA Measure: Godin Leisure Time Exercise Q (Light, mod, vig minutes, sitting hours)	The Godin Leisure Time Exercise Questionnaire; The 2-item Maslach Burnout Inventory (MBI); Direct evidence, validated burnout endpoint;	Observational (N/A)	Light exertion value: Light physical activity ($\beta = -.191$, $p=.039$) and lower sedentary behavior ($\beta = -.230$, $p=.013$) are independently linked with reduced burnout indices.	8/8; 100% Low Risk (High Quality)
10.	Ye et al. (2024), [61]	China	n=305 male students from different colleges, mean age of 18.54;	PA Measure: Godin-Shephard Leisure-Time PA (LTPA; light, mod, high)	MBI-SS; Chinese version of the Patient Health Questionnaire-9(PHQ-9); LTPA; Direct evidence, validated burnout endpoint;	Lagged mediation-longitudinal	A reduction in physical activity over time directly drives sequential increases in school burnout ($r= -0.298$, $p<0.001$) and clinical depression.	8/8; 100% Low Risk (High Quality)
11.	Gulanes A. (2025), [62]	Philippines	n=152, students in rural area from various subjects;	PA Measure: International PA Questionnaire Short Form (IPAQ-SF)	IPAQ-SF; Assessment Tool (BAT-Student); Direct evidence, validated burnout endpoint;	Rural survey (N/A)	Exhaustion shielding: Significant inverse linear correlation found ($r= -0.244$, $p=0.002$); higher active thresholds correspond with lower exhaustion and mental distress.	5/8; 62.5% Moderate risk
12.	Caravaca et al. (2025), [63]	Spain	n=789, students (20.5% men; 79.5% women); the average age m= 24.33;	PA Measure: Regular physical exercise and/or sports status (67.9% active)	MBI-SS Emotional Exhaustion Scale; Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Males scored higher on academic burnout while females scored higher on emotional exhaustion	7/8; 87.5% Low Risk (High Quality)

(p < 0.05).							
13.	Peng Xu (2025), [64]	China	n=942, students from different universities;	PA Measure: 3-dimensional Likert scale (PA intensity, duration, frequency)	Structural Equation Modeling (SEM)' The Learning Burnout Scale; The social support scale; The self-regulation ability scale; Direct evidence, validated burnout endpoint;	Structural model (N/A)	Outdoor sports benefit: Strongly linked to lower learning burnout (r= -0.452, p<0.001). Positively driven by enhanced social support (r=0.499) and self-regulation (r=0.473). 8/8; 100% Low Risk (High Quality)
14.	Xiang & Jiang (2025), [65]	China	n=858, students from different universities;	PA Measure: Physical Activity Rating Scale-3 (PARS-3)	PARS-3; Learning Burnout Scale; Multidimensional Scale of Perceived Social Support (MSPSS); PsyCap Questionnaire (PCQ); Direct evidence, validated burnout endpoint;	Mediation model (N/A)	Chain mediation pathways: Inverse relationship confirmed. Social support (mediating 14.5%) and psychological capital (mediating 10.1%) operate in an integrated sequential chain (23.2%). 8/8; 100% Low Risk (High Quality)
15.	Pereira et al. (2025), [66]	Portugal	n=274, psychology students, with a mean age of 22.05 (SD = 5.82); male= (10.6); female = (89.4);	PA Measure: PARS-3 and IPAQ-Short version classification	Sociodemographic and Clinical Questionnaire; MBI-SS; Psychological General Well-Being Index (QGBEP); Depression, Anxiety, and Stress Scale (DASS21); Difficulties in Emotion Regulation Scale (DERS); IPAQ. PSQI; Food Frequency Questionnaire (QFA); Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Non-significant direct path: No uniform standalone baseline correlation. However, the high burnout risk profile cluster shares traits of low PA, poor sleep, and a pro-inflammatory diet. 8/8; 100% Low Risk (High Quality)
16.	Gao et al. (2025), [67]	China	n=1267 university students;	PA Measure: Physical Activity Rating Scale (PARS-3)	The Adolescent Academic Burnout Scale; Social Support Scale; PARS-3; Direct evidence, validated burnout endpoint;	Cross-sectional (N/A)	Direct negative prediction: Sports participation negatively predicts academic burnout indices (β = -0.201, p<0.05) while boosting beneficial social support channels (β =0.231). 8/8; 100% Low Risk (High Quality)
17.	Holm et al. (2026), [68]	Finland	n=3639, university students; mean age of the students was 24.65 (SD=3.60) years, and 1,990 (54.7%) were female;	PA Measure: Volume thresholds (Mod aerobic $\geq$ 2h30m/wk, or vig $\geq$ 1h15m/wk + 2x strength)	The School Burnout Inventory (SBI-9); Alcohol Use Disorder Identification Test (AUDIT-C; Compulsive Internet Use Scale (CIUS-5;	Cross-sectional (N/A)	Lifestyle risk clustering: The specific profile defined as "physically inactive with problematic Internet use" (29% of sample) is significant. 8/8; 100% Low Risk (High Quality)

					Direct evidence, validated burnout endpoint;		cantly more vulnerable to severe academic burnout.	
18.	Yorks et al. (2017), [69]	USA	n=69, medical students; fitness group=25; health-enhancement=29; control group=15.	PA Measure: 12-week structured 30-min CXWORX group classes vs. solo running/weights	Perceived Stress Scale survey; Quality of Life (QOL); Indirect/contextual, No direct burnout scale used;	Cohort study- 12 weeks	Group exercise value: Group fitness yields significant drops in perceived stress (p=0.038) and profound spikes across physical (p=0.007), mental (p=0.046), and emotional QOL tiers.	6/8; 75% Low Risk (High Quality)
19.	Boyd et al. (2022), [70]	USA	n=238, medical students; mean age=26.01; female=121 (59.3%), men=83 (40.7%)	PA Measure: Godin-Shephard Leisure-Time PA (LTPA tracking over a typical week)	PSQI; LTPA; Grit Scale, Perceived Stress Scale (PSS) REAP Healthy Eating Index (HEI); Indirect/contextual, No direct burnout scale used;	Longitudinal - 1 year tracking	Stress prediction models: Longitudinal improvements in physical activity ΔLTPA, (p=0.012) combined with sleep shifts (ΔPSQI, (p<0.0001) serve as primary predictors of lowered stress.	8/8; 100% Low Risk (High Quality)
20.	Panton et al. (2023), [71]	USA	n=1182, medical students, average age was 21.06 60.9% female; while 39.1% male;	PA Measure: Formal educational training evaluation (classroom or hands-on clinical settings)	Health Survey; Indirect/contextual, No direct burnout scale used;	Survey study (N/A)	Curricular deficit exposed: Only 8% of students received formal instruction on PA counseling; the vast majority (85%) demand lifestyle education be integrated as a graduation baseline.	5/8; 62.5% Moderate risk
21.	Neuman et al. (2024), [72]	USA	n=141, medical students; mean age=25.62; female=84 (60%); male=54 (38%);	PA Measure: Simple Lifestyle Indicator Questionnaire (SLIQ; light, mod, heavy types)	The Simple Lifestyle Indicator Questionnaire (SLIQ); Indirect/contextual, No direct burnout scale used;	Cross-sectional (N/A)	Academic achievement links: Strong positive cross-sectional correlation isolates high PA thresholds (p=0.012) and dietary metrics (p=0.043) as core drivers within high-achieving GPA cohorts.	7/8; 87.5% Low Risk (High Quality)
22.	Deisz et al. (2024), [73]	USA	n=393, medical students;	PA Measure: Medical Wellness Survey tracking exercise type, intensity, and hours/week	Wellness Survey; Indirect/contextual, No direct burnout scale used;	Cross-sectional (N/A)	Wellness correlations: Number of weekly training hours directly correlates with satisfaction regarding academic performance (r=0.213), social life (r=0.212), and relationship stability.	7/8; 87.5% Low Risk (High Quality)

The JBI appraisal process was conducted systematically, and the complete evaluation of each study across all eight criteria is shown also in Table 3. Utilizing this standardized approach allows for a highly visual, comprehensive comparison of study quality, reinforcing the overall transparency and methodological integrity of this review. (table 3)

Regarding the methodological quality synthesis, the overall risk of bias across the included literature was remarkably low, with no studies categorized as low quality. A substantial majority, comprising 19 studies, demonstrated high methodological quality, securing JBI appraisal scores of 75% or higher. Conversely, only three studies—namely those by Panton, Gulanes, and Rosales—exhibited moderate methodological quality.

3.3. Classification of Evidence Outcomes: Direct vs. Contextual Data

To address the clinical heterogeneity of the compiled literature, the 22 included studies were stratified into two distinct analytical tiers based on the directness of their primary endpoints:

- **Direct Academic Burnout Evidence (n = 17 studies).** Most of the selected papers evaluated academic burnout as a direct primary or secondary outcome using validated psychometric instruments. Among these, the MBI-SS or its adapted variants represented the predominant measurement standard (n = 12 studies: Lee et al.; Rosales-Ricardo; de Souza; Salgado & Au-Yong; Rosales-Ricardo & Ferreira; Dhachpramuk et al.; Morgan et al.; Ye et al.; Caravaca et al.; Pereira et al.; Gao et al.; Holm et al.). Other validated frameworks targeted to student populations included the Learning Burnout Scale (n = 3 studies: Chen et al.; Peng Xu; Xiang & Jiang), the Adolescent Academic Burnout Scale (n = 1 study: Gao et al.), and the Burnout Assessment Tool for students (BAT-Student) (n = 1 study: Gulanes A.);
- **Indirect or Contextual Lifestyle Evidence (n = 5 studies).** A subgroup of five studies did not measure burnout through a designated, validated burnout scale but provided critical contextual data regarding key behavioral, lifestyle, and psychological precursors. Specifically, Yorks et al. tracked shifts in the Perceived Stress Scale (PSS) and Quality of Life (QOL) surveys following exercise interventions. Khosravi evaluated personality dimensions utilizing Bresó's Academic Burnout Questionnaire parameters mixed with general character tracking. Boyd et al. isolated physical activity changes as predictors of the Perceived Stress Scale (PSS) scores. Neuman et al. analyzed cross-sectional variations tracking physical activity alongside nutrition indices against cumulative Grade Point Average (GPA) records, and Deisz et al. monitored general satisfaction trends via a Wellness Survey framework. These data are integrated into the synthesis strictly as supportive lifestyle context.

4. Discussion

The findings synthesized in our review imply that physical activity plays a significant role in the prevention and management of burnout among university students. Physical activity, whether it be aerobic activity (cardiovascular exercise) or anaerobic training (strength-based exercise), has shown a significant beneficial impact on minimizing burnout symptoms and enhancing overall wellbeing. The evidence indicates that physical activity is one of the most effective means to fight burnout. Its favorable effects are also connected to other crucial characteristics of a healthy lifestyle, such as a proper diet, psychological well-being and mental health aid.

In addition, Lee et al. [52] highlighted that the prevalence of burnout among medical students ranges from approximately 25% to over 70%, according to recent systematic reviews. Their study further emphasized that burnout was strongly associated with poorer academic performance and insufficient social support. These findings underline the significant psychological burden experienced by medical students and reinforce the importance of preventive strategies focused on mental health support, social connectedness, and lifestyle interventions.

Potential Mechanisms Associated With Physical Activity And Burnout Indices

The compiled datasets suggest that the inverse relationship between physical activity and reduced burnout may be explained by interconnected physiological, psychological, and psychosocial mechanisms. Rosales-Ricardo et al. [57] proposed that physical exercise might contribute to improved mood, reduced depressive symptoms, and enhanced physical and mental resilience, while Xiang & Jiang [65] highlighted the potential role of social support and psychological capital in mediating the relationship between physical activity habits and academic burnout scores. Taken together, these findings indicate that the protective effects of physical activity may extend beyond psychological adaptations alone, encompassing psychological and social resources that may help university students manage academic demands more effectively. Similarly, Morgan et al. [60] reported that physical activity may reduce burnout, supporting these present findings.

Contradictions between Studies

The statistical associations between physical activity and academic burnout outcomes are not entirely uniform across the reviewed literature. While some research has identified a protective association between physical activity and burnout, other studies have failed to demonstrate a statistically independent correlation. De Souza et al. [54] and Gulanes et al. [67] noted that did not remain significantly associated with primary burnout outcomes once comprehensive demographic, environmental, and baseline psychological confounding factors were integrated into multivariate regression models. Similarly, Pereira et al. [66] emphasized the multifactorial nature of academic distress, suggesting that its relationship with physical activity may be influenced by a broader range of psychological, behavioral, and environmental factors.

In contrast, Chen et al. [58] reported a distinct inverse association between physical exercise scores and primary academic burnout dimensions, noting that self-efficacy and individual resilience metrics could act as significant intermediate variables. These divergent findings demonstrate that the association between physical activity and burnout scales may not be uniform across student population. Rather, its potential protective effect may depend on the interaction between physical activity and other individual and contextual factors, such as psychological resources, social and academic environments, and the characteristics of the physical activity itself. Therefore, physical activity is conceptualized as one potentially modifiable factor within a complex multifactorial framework of student mental health, rather than as an isolated, independent determinant of burnout prevention.

Burnout, Academic Performance and the Stress Response

The relationship between physical activity and burnout may also be understood through its potential effects on academic performance and stress regulation. Neuman et al. [72] reported a positive cross-sectional association between higher levels of physical activity and academic achievement, with students engaging in more frequent and vigorous exercise demonstrating better academic outcomes. These findings suggest that physical activity may support academic functioning through mechanisms related to cognitive performance, although the cross-sectional nature of the evidence does not allow causal conclusions to be drawn.

Additionally, an inverse association was observed by Gao et al. [67] between organized sports participation and academic burnout indices, suggesting that active students reported lower subjective exhaustion, irrespective of minor gender variations.

The potential relevance of physical activity for behavioral coping models is further supported by findings regarding stress and psychological well-being. Regular physical activity is conceptually linked to lower emotional exhaustion scores, thereby correlating with better general well-being. Cuevas-Caravaca et al. [63] and Deisz et al.

[73] highlighted the pronounced academic stress levels reported by medical students. **They identified** regular exercise and structured sleep hygiene as key protective lifestyle indicators. Because chronic stress and anxiety are established correlates of burnout, these models suggest that exercise may support students indirectly by acting as a tool for physiological recovery and distress management. Similarly, Salgado et al. [55] observed that active students exhibited lower attrition intentions, suggesting a potential role for physical activity in student retention strategies.

This interpretation is consistent with the coping reservoir model discussed by Khosravi et al. [56] according to which burnout develops when psychological and environmental demands outweigh available protective and replenishing resources over time. Within this framework, physical activity may represent an important replenishing factor by contributing to stress reduction, emotional regulation, resilience, and psychological recovery. Therefore, the relationship between physical exercise and academic adjustment appears multidimensional, serving as a supportive behavioral asset to help students manage the cumulative workload of higher education.

Burnout and Variations in Physical Activity Characteristics

The available evidence indicates that the relationship between physical activity and academic burnout is influenced by the type, intensity, and context of exercise. Morgan et al. [60] reported that even light physical activity was associated with a lower risk of burnout among medical students, while Rosales-Ricardo et al. [53] demonstrated that both aerobic and resistance training regimens correlate inversely with burnout scales, though they appear to map to different dimensions of the syndrome. In their study, aerobic protocols showed closer associations with lower emotional exhaustion, while resistance training mapped more strongly to improvements in academic efficacy and lower cynicism scores. Likewise, Dhachpramuk et al. [59] found that regular physical activity, particularly running, was associated with lower burnout levels and superior mental health scores among medical students.

The context in which physical activity occurs also appears to be important. Xu, P. [64] demonstrated that participation in outdoor sports correlated with lower academic burnout, with social support and self-regulation mediating part of this relationship. Similarly, Yorks et al. [69] reported that participation in group fitness classes reduced perceived stress and improved quality of life, suggesting that the psychological benefits of exercise may be enhanced through social interaction. In contrast, Pereira et al. [66] noted that students classified within high burnout risk profiles concurrently exhibited significantly lower physical activity levels, poorer sleep quality, and highly pro-inflammatory dietary indicators.

Beyond exercise itself, several studies emphasize the importance of healthy lifestyle behaviors in preventing academic burnout. Holm et al. [68] highlighted physical activity as a key component of a healthy lifestyle associated with lower burnout risk, while Boyd et al. [70] demonstrated that inadequate sleep and low physical activity were associated with higher perceived stress among medical students. Furthermore, Xiang & Jiang [65] confirmed that physical exercise correlates with lower subjective stress metrics, whereas Ye, Z. [61] suggested that burnout indicators may act as an intermediate bridge linking declining physical activity levels to subsequent increases in depressive symptom scores.

Overall, the findings support the integration of accessible and varied physical activity opportunities into university environments, particularly within medical education, as emphasized by Panton et al. [71]. Rather than evidence promoting a single exercise modality, the evidence suggests that universities should encourage regular participation in diverse forms of physical activity alongside other healthy lifestyle behaviors, including adequate sleep, as part of comprehensive strategies to reduce academic burnout and promote student well-being.

Strengths and Limitations

This review has several strengths, including the use of PRISMA framework and the inclusion of a substantial body of literature specifically focused on university students, particularly medical students. However, the population-specific inclusion criteria limit the generalizability of the findings on non-university population and other age groups. In addition, the restriction to studies published between 2016 and 2026 may have excluded relevant evidence published outside this period. Despite these limitations, the focused population and systematic methodology provide a structured synthesis of the available evidence on the relationship between physical activity and burnout among university students.

5. Conclusions

This systematic synthesis provides valuable observational evidence supporting a consistent and statistically significant relationship between regular physical activity and a reduction in academic burnout levels among university students. However, due to the cross-sectional nature of the analyzed literature, these findings reflect correlational trends rather than a definitive causal impact. Consequently, a precise dose-response relationship—such as the exact number or optimal frequency of weekly exercise sessions required to maximize burnout mitigation—cannot be established under current research constraints, and formal prescriptive guidelines should not be inferred.

The literature also indicates that academic burnout negatively affects students' academic performance, cognitive functioning and learning outcomes. Hence, physical activity may indirectly improve academic performance through a reduction in feelings of burnout and an increase in mental well-being, which may in turn lead to an increase in the ability to concentrate and healthier lifestyle behaviors.

In addition to their physiological benefits, physical activity provides important opportunities for social interaction and peer involvement that have been shown to be protective against burnout and supportive of academic adjustment.

Furthermore, while the existing literature frequently references physiological mechanisms such as enhanced tissue oxygenation, optimized serotonin regulation, and increased endorphin secretion, these biochemical adjustments must be classified strictly as mechanistically plausible hypotheses. Because the reviewed studies relied primarily on self-reported burnout outcomes and did not directly evaluate biological markers, these pathways remain unproven frameworks rather than direct evidence. Future research utilizing longitudinal designs, rigorous meta-analyses, and biomarker-based experimental methodologies is required to formally bridge the gap between these mechanistic hypotheses and direct evidence, ultimately enabling the development of validated, dose-specific guidelines for burnout prevention.

Thus, adding physical activity to the university curriculum and student support programs could be a sustainable and effective means of reducing the prevalence of burnout, improving academic performance, and promoting long-term physical and psychological health among university students.

Supplementary Materials: “Not applicable.”

Author Contributions: “Conceptualization, P.C., A.M.; methodology, A.M.; software, P.C.; validation, K.M., K.C. and A.M.; formal analysis, P.C.; investigation, K.M.; resources, A.M.; data curation, A.M.; writing—original draft preparation, P.C.; writing—review and editing, A.M.; P.C.; visualization, P.C.; supervision, A.M.; project administration, P.C.; funding acquisition, D.S. All authors have read and agreed to the published version of the manuscript.”

Funding: Please add: “This research received no external funding”.

Institutional Review Board Statement: “Not applicable”

Informed Consent Statement: “Not applicable.”

Data Availability Statement: “Not applicable”

Acknowledgments: In this section, you can acknowledge any support given which is not covered by the author contribution or funding sections. This may include administrative and technical support, or donations in kind (e.g., materials used for experiments).

Conflicts of Interest: “The authors declare no conflict of interest.

References

1. Caspersen, C.J.; Powell, K.E.; Christenson, G.M. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*, 1985, 100(2):126–131, PMID: 3920711.
2. U.S. Department of Health and Human Services, Physical Activity and Health - A Report of the Surgeon, Chapter 1: Introduction, Summary, and chapter conclusions, Pittsburgh, 1996:1-8.
3. Pan, Y.; Lv, M.; Shi, Y.; Ji, Y. The effect of peer support on physical exercise behavior among university students in a Bei-jing university. *Chin J Health Educ*, 2021, 37:825–828. Doi: 10.16168/j.cnki.issn.1002-9982.2021.09.012.
4. Sani, S.H.; Fathirezaie, Z.; Brand, S.; Pühse, U.; Holsboer-Trachsler, E.; Gerber, M.; et al. Physical activity and self-esteem: testing direct and indirect relationships associated with psychological and physical mechanisms. *Neuropsychiatr Dis Treat*, 2016, 12:2617–2625. doi: 10.2147/NDT.S116811
5. Ji, H.; Zheng, C. The influence of physical exercise on college students’ mental health and social adaptability from the cognitive perspective. *IOS Press*, 2021, 69, 1–12. doi: 10.3233/WOR-213506
6. Maslach, C., Jackson, S.E.; Leiter, M.P.; Schaufeli, W.B.; Schwab, R.L. *Maslach Burnout Inventory*. Evaluating Stress: A Book of Resources, 3rd ed.; Rowman & Littlefield Publishers Inc. 1997.
7. Ball, S.; Bax, A. Self-care in medical education. Effectiveness of health habits intervention for first year medical students. *Acad Med*, 2002, 77(9):911–917. DOI: 10.1097/00001888-20020000-00023.
8. Mitchell, R.E.; Matthews J.R.; Grandy, T.G.; Lupo, J.V. The question of stress among first-year medical students. *J Med Educ*, 1983, 58(5):367–72. DOI: 10.1097/00001888-198305000-00001.
9. Aach, R.D.; Thomas, G.C.; Donald, E.G.; Grob, D. Stress and impairment during residency training: Strategies for reduction, identification and management. *Ann Intern Med*, 1988, 109(2):154–161, DOI:10.7326/0003-4819-109-2-154.
10. Rotbart, H.A.; Nelson, W.L.; Krantz, J.; Doughty, R.A. The developmental process of residency education. Issues of stress and happiness. *Am J Dis Child*, 1985, 139:762–765. DOI: 10.1001/archpedi.1985.02140100024018.
11. Shin, H.; Puig, A.; Lee, J.; Lee, J. H.; Lee, S. M. Cultural validation of the Maslach Burnout inventory for Korean students. *Asia Pac Educ Rev*, 2011, 12(4):633–639, DOI:10.1007/s12564-011-9164-y.
12. Salanova, M.; Schaufeli, W.; Martinez, I.; Breso, E. How obstacles and facilitators predict academic performance: the mediating role of study burnout and engagement. *Anxiety Stress Coping*, 2010, 1:53–70. DOI: 10.1080/10615800802609965.
13. Maslach, C.; Leiter, M.P. Understanding the burnout experience: Recent research and its implications for psychiatry. *World Psychiatry*, 2016, 15(2), 103–111, PMID: 27265691, doi: 10.1002/wps.20311.
14. Freudenberger, H.J. Staff burn-out. *J Soc Issues*, 1974, 30 (1):159–165, Doi: 10.1111/j.1540-4560. 1974.tb00706.x
15. Batista, J.; Carlotto, M.; Coutinho, A.; Augusto, L. Prevalence of Burnout Syndrome and sociodemographic and work factors of elementary education teachers of the City of João Pessoa. *Rev Bras Epidemiol*, 2010, 13:502–512. DOI: 10.1590/s1415-790x2010000300013.
16. Maslach, C. What have we learned about burnout and health? *Psychol & Health*, 2001, 16(5), 607–611. DOI: 10.1080/08870440108405530.
17. Maslach, C.; Jackson, S.E. The measurement of experienced burnout, *J Organ Behav*, 1981, 2(2):99 –113, DOI:10.1002/job.4030020205.
18. Zhang, Y.; Gan, Y.; Cham, H. Perfectionism, academic burnout and engagement among Chinese college students: a structural equation modeling analysis. *Pers Individ Differ*, 2007, 43(6):1529–1540, DOI: 10.1016/j.paid.2007.04.010.
19. Turhan, D.; Schnettler, T.; Scheunemann, A.; Gadosey, C.K.; Kegel, L.S.; Bülke, L.; et al. University students’ profiles of burnout symptoms amid the COVID-19 pandemic in Germany and their relation to concurrent study behavior and experiences. *Int J Educ Res*, 2022, 116:102081. doi: 10.1016/j.ijer.2022.102081.
20. Caballero, C.C.; Esteve, E.B.; Gutiérrez, O. G. Burnout in university students. *Psicología Desde El Caribe*, 2015, 32(3): 424–441, DOI:10.14482/psdc.32.3.6217.
21. Madigan, D.J.; Curran, T. Does burnout affect academic achievement? A meta-analysis of over 100,000 students. *Educ Psychol Rev*, 2021 33(2), 387–405, DOI:10.1007/s10648-020-09533-1.
22. Schaufeli, W.; & Salanova, M. Efficacy or inefficacy, that’s the question: Burnout and work engagement, and their relationships with efficacy beliefs. *Anxiety, Stress and Coping*, 2007, 20(2), 177–197, PMID: 17999223, DOI: 10.1080/10615800701217878.
23. Deci, E. L.; Ryan, R. M. *Intrinsic Motivation and Self-Determination in Human Behavior*, 1st ed.; Springer New York, NY, 1985; DOI:https://doi.org/10.1007/978-1-4899-2271-7.
24. Bakker, A.B.; Demerouti, E. The job demands-resources model: State of the art. *J Manag Psychol*, 2007, 22(3):309–328, DOI:10.1108/02683940710733115.

25. Macan, T.H.; Shahani, C.; Dipboye, R.L.; Phillips, A. P. College students' time management: Correlations with academic performance and stress. *J Educ Psychol*, 1990, 82(4):760-768, <https://doi.org/10.1037/0022-0663.82.4.760>.
26. Britton, B. K.; Tesser, A. Effects of time-management practices on college grades. *J Educ Psychol*, 1991, 83(3):405-410, DOI:10.1037/0022-0663.83.3.405.
27. Cohen, S.; Wills, T. A. Stress, social support, and the buffering hypothesis. *Psychol Bulletin* 1985, 98(2):310-357, PMID: 3901065.
28. Schaufeli, W. B.; Bakker, A. B. Job Demands, Job Resources, and Their Relationship with Burnout and Engagement: A Multi-Sample Study. *J Org Behav*, 2004, 25(3):293-315, DOI: 10.1002/job.248.
29. Frost, R.O.; Marten, P.; Lahart, C.; Rosenblate, R. The dimensions of perfectionism. *Cognit Ther Res*, 1990, 14(5), volume 14:449-468.
30. American College Health Association (2018). American College Health Association-National College Health Assessment II: Reference Group Executive Summary Fall, Silver Spring, ,2018.
31. Hershner, S.; Chervin, R. Causes and consequences of sleepiness among college students. *Nat Sci Sleep*, 2014, 6:73-84. DOI: 10.2147/NSS.S62907.
32. Folkman, S.; Moskowitz, J. T. Coping: Pitfalls and promise. *Annu Rev of Psychol*, 2004, 55:745-774. DOI: 10.1146/annurev.psych.55.090902.141456.
33. Chang, E.C. Perfectionism and dimensions of psychological well-being in a college student sample: A test of stress-mediation model. *J Soc Clin Psychol*, 2006, 25(9):1001-1022. doi:10.1521/jscp.2006.25.9.1001.
34. Beck, A.T., Steer, R.A.; Brown, G. K. Manual for the Beck Depression Inventory-II, TX: The Psychological Corporation, San Antonio, 1996.
35. Benton, S.A.; Robertson, J.M.; Tseng, W.C.; Newton, F.B.; Benton, S.L. Changes in counseling center client problems across 13 years. *Prof Psychol: Res Pract*, 2003, 34(1):66-72, DOI:10.1037/0735-7028.34.1.66.
36. Eisenberg, D.; Golberstein, E.; Gollust, S. E. Help-seeking and access to mental health care in a university student population. *Med Care*, 2007, 45(7):594-60. DOI: 10.1097/MLR.0b013e31803bb4c1.
37. Demirci, K.; Akgönül, M.; Akpınar, A. Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *J Behav Addict*, 2015, 4(2):85-92. DOI: 10.1556/2006.4.2015.010.
38. Tosevski, D.L.; Milovancevic, M.P.; Gajic, S. D. Personality and psychopathology of university students. *Curr Opin Psychiatry*, 2010, 23(1):48-52. DOI: 10.1097/YCO.0b013e328333d625.
39. Locke, E.A.; Latham, G.P. Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *Am Psychol*, 2002, 57(9):705-717. DOI: 10.1037//0003-066x.57.9.705.
40. Schunk, D.H. Goal setting and self-efficacy during self-regulated learning. *Educ Psychol*, 1990, [Published online: 08 Jun 2010], 25(1):71-86, https://doi.org/10.1207/s15326985ep2501_6.
41. Khawaja, N.G.; Duncanson, K. Using the university student depression inventory to investigate the effect of demographic variables on students' depression. *Aust J Guid Couns*, 2008, 18(2):195-209, DOI:10.1375/ajgc.18.2.195.
42. Schaufeli, W.B., Leiter M.P., Maslach, C.; Jackson, S.E. Maslach Burnout Inventory-General Survey', in C. Maslach, S.E. Jackson and M.P. Leiter (eds.), *The Maslach Burnout Inventory-Test Manual* (3rd ed.), Consulting Psychologists Press, Pa-lo Alto, California, 1996.
43. Magro, G.; Esenarro L.; Huayllani, L.; Mejia, C.R. Physical exercise and cognitive-psychology health in COVID-19 recovered-patients. *Nutr Clinica Dietet Hosp*, 2023, 43:53-60. doi: 10.12873/432magro.
44. Chen, K.; Liu, F.; Mou, L.; Zhao, P.; Guo, L. How physical exercise impacts academic burnout in college students: The mediating effects of self-efficacy and resilience. *Front Psychol*, 2022, 13:964169. DOI: 10.3389/fpsyg.2022.964169.
45. Chen X.; Zhang H. Soccer player's physical training for physical function improvement. *Rev Bras Med Esporte*, 2022, 28(5):577-580. doi: 10.1590/1517-8692202228052022_0091.
46. Prontenko, K.; Bondarenko, V.; Bezpalii, S.; Kyslenko, D.; Lisnichenko, Y.; Ollo V., et al. Physical training as the basis of professional activities of patrol policemen. *Balt J of Health Phys Act*, 2020, 12(1):41-53, DOI:10.29359/BJHPA.12.1.05.
47. Zhang, L. Physical strength training methods in badminton teaching and training. *Rev Bras Med Esporte*, 2023, 29(6):1-4, DOI:10.1590/1517-8692202329012022_0253.
48. Gerber, M.; Lang, C.; Feldmeth, A.K.; Elliot, C.A.; Brand, S.; Holsboer-Trachsler, E.; et al. Burnout and mental health in Swiss vocational students: The moderating role of physical activity. *J Res Adolesc*, 2015;25(1):63-74. doi:10.1111/jora.12097.
49. Elliot, C.A.; Lang, C.; Brand S.; Holsboer-Trachsler, E.; Pühse, U.; Gerber, M. The relationship between meeting vigorous physical activity recommendations and burnout symptoms among adolescents: an exploratory study with vocational students. *J Sport Exercise Psy*, 2015, 37(2):180-192, <https://doi.org/10.1123/jsep.2014-0199>.
50. Moola, S.; Munn, Z.; Tufanaru, C.; Aromataris, E.; Sears, K.; Sfetio, R., et al. Chapter 7: Systematic Reviews of Etiology and Risk. In: Aromataris. *JBIR Reviewer's Manual*, JBI, 2019:219-271. <https://doi.org/10.46658/jbirm-17-06>
51. Hutton, B.; Salanti, G.; Caldwell, D.M.; Chaimani, A.; Schmid, C.H.; Cameron, C.; Ioannidis, J.P.; Straus, S.; Thorlund, K.; Jansen, J.P.; Mulrow, C.; Catalá-López, F.; Gøtzsche, P.C.; Dickersin, K.; Boutron, I.; Altman, D.G.; Moher, D. The

- PRISMA extension statement for reporting of systematic reviews incorporating network meta-analyses of health care interven-tions: checklist and explanations. *Ann Intern Med*, 2015, 2;162(11):777-84. DOI: 10.7326/M14-2385.
52. Lee, K.P.; Yeung, N.; Wong, C.; Yip, B.; Luk, L.H.F.; Wong, S. Prevalence of medical students' burnout and its associated de-mographics and lifestyle factors in Hong Kong. *PLoS One*, 2020, 10;15(7):e0235154. doi: 10.1371/journal.pone.0235154.
 53. Rosales-Ricardo, Y.; Montoro-Bombú, R.; Ferreira, J.P. The most effective physical exercise to reduce burnout syndrome in university students. *J Hum Sport and Exerc*, 2020, 15(3proc), S518-S530. doi:https://doi.org/10.14198/jhse.2020.15.Proc3.05
 54. de Souza, R.O.; Ricardo Guilherme, F.; Elias, R.G.M.; dos Reis, L.L.; Garbin de Souza, O.A.; Robert Ferrer, M. dos Santos, S.L.C.; Osiecki, R. Associated Determinants Between Evidence of Burnout, Physical Activity, and Health Behaviors of University Students. *Front Sports Act Living*, 2021, 3:733309. doi: 10.3389/fspor.2021.733309
 55. Salgado, S.; Au-Yong-Oliveira, M. Student Burnout: A Case Study about a Portuguese Public University. *Educ Sci*, 2021, 11(1), 31. https://doi.org/10.3390/educsci11010031
 56. Khosravi, M. Burnout among Iranian medical students: Prevalence and its relationship to personality dimensions and physical activity. *Eur J Transl Myol*, 2021, 26;31(1):9411. doi: 10.4081/ejtm.2021.9411.
 57. Rosales-Ricardo, Y.; Ferreira, J.P. Effects of Physical Exercise on Burnout Syndrome in University Students. *MEDICC Rev*, 2022, 24(1):36-39. doi: 10.37757/MR2022.V24.N1.7.
 58. Chen, K.; Liu, F.; Mou, L.; Zhao, P.; Guo, L. How physical exercise impacts academic burnout in college students: The mediating effects of self-efficacy and resilience. *Front Psychol*, 2022, 13:964169. doi: 10.3389/fpsyg.2022.964169
 59. Dhachpramuk, D.; Sonjaipanich, S.; Theppiban, S.; In-Iw, S. Exercise, mental well-being and burnout in Thai medical stu-dents in 2020-2021: an online cross-sectional survey. *BMC Med Educ*, 2024, ;24(1):837. doi: 10.1186/s12909-024-05843-y.
 60. Morgan, T.L.; McFadden, T.; Fortier, M.S.; Sweet, S.N.; Tomasone, J.R. Do physical activity intensity and sedentary be-havior relate to burnout among medical students? Insight from two Canadian medical schools. *Can Med Educ J*, 2024, 15(5):54-63. doi: 10.36834/cmej.79169.
 61. Ye, Z.; Peng, Y.; Rao, W.; Zhang, T. The effect of physical activity on depression: a lagged mediation study of school burnout. *BMC Public Health*, 2024, (1):3491. doi: 10.1186/s12889-024-21003-9.
 62. Gulanes, A. A. Investigación sobre la actividad física como protección contra el agotamiento académico en la academia rural. *Sportis. SPORTIS*, 2025, 11(4), 1-25. https://doi.org/10.17979/sportis.2025.11.4.12018
 63. Cuevas Caravaca, E.; Garcés de los Fayos Ruiz, E.J.; Sánchez Romero, E.I.; López Morales, J. L. Academic burnout and emotional exhaustion among university students: The role of physical exercise. *SPORT TK*, 2025, 14, 99. https://doi.org/10.6018/sportk.583751
 64. Xu, P. Effects of outdoor sports on college students' learning burnout: a multiple mediation model of social support and self-regulation. *Front Psychol*, 2025, 16:1629986. doi: 10.3389/fpsyg.2025.1629986
 65. Xiang, J.; Jiang, Y. The impact of physical activity on academic burnout in Chinese college students: a moderated chain mediation model. *Front Psychol*, 2025, 16:1681455. doi: 10.3389/fpsyg.2025.1681455
 66. Pereira, M. G.; Santos, M.; Magalhães, R.; Rodrigues, C.; Araújo, O.; Durães, D. Burnout Risk Profiles in Psychology Stu-dents: An Exploratory Study with Machine Learning. *Behav Sci*, 2025, 15(4), 505. https://doi.org/10.3390/bs15040505
 67. Gao, J.; Tian, X.; Wu, H. Exploring the mediating role of social support in sports participation and academic burnout among adolescent students in China. *Front Psychol*, 2025, 16:1591460. doi: 10.3389/fpsyg.2025.1591460.
 68. Holm, M.E.; Lahti, J.; Pohjola, V.; Parikka, S. Identifying vulnerable groups in academic burnout among higher educa-tion students: lifestyle and sociodemographic characteristic. *BMC Public Health*, 2026, 26(1):826. doi: 10.1186/s12889-026-26486-2.
 69. Yorks, D.M.; Frothingham, C.A.; Schuenke M.D. Effects of Group Fitness Classes on Stress and Quality of Life of Medical Students. *J Am Osteopath Assoc*. 2017,1;117(11):e17-e25. doi: 10.7556/jaoa.2017.140. PMID: 29084328.
 70. Boyd, A.; Mealand, K.; Briggs Early, K.; Oestreich, E. Perceived Stress, Grit, and Self-Care Behaviors in First-Year Medi-cal Students. *Am J Lifestyle Med*, 2022, 17(6):803-812. doi: 10.1177/15598276221124576.
 71. Panton, Z.A.; Smith, S.; Duggan, M.; Kodali, A.; Donaghue, J.F.; Riew, G.J.; Seward, M.; Briggs, L.G. The Significance of Physical Activity Education: A Survey of Medical Students. *Am J Lifestyle Med*, 2023, 18(6):832-842. doi: 10.1177/15598276231187838.
 72. Neuman, J.; Ina, E.A.; Huq, S.O.; Blanca, A.; Petrosky, S.N. Cross-Sectional Analysis of the Effect of Physical Activity, Nu-trition, and Lifestyle Factors on Medical Students' Academic Achievement. *Cureus*, 2024, 16(3):e56343. doi: 10.7759/cureus.56343.
 73. Deisz, M.; Papproth, C.; Ambler, E.; Glick, M.; Eno, C. Correlates and Barriers of Exercise, Stress, and Wellness in Medi-cal Students. *Med Sci Educ*, 2024, 34(6):1433-1444. doi: 10.1007/s40670-024-02134-5.