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RESEARCH ARTICLE

Physical Exercise and Academic Burnout: Exploring the Interplay of Type, Intensity, and Frequency

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ABSTRACT

This study investigated the effects of physical exercise on academic burnout among college students, focusing on the role of exercise type, intensity, and frequency, as well as their interaction. A total of 100 college students from various colleges and universities in Shandong, China, were randomly selected to participate in a cross-sectional survey. Data were collected using a structured questionnaire, which included items on exercise habits and academic burnout, and measured by a five-item burnout scale. Results showed that there was a significant difference in burnout scores between team exercise and individual exercise, with team exercise having a lower level of burnout ($p < 0.001$). Moderate-intensity exercise was found to be most effective in reducing academic burnout ($p < 0.001$), while a weak, non-statistically significant correlation was found between exercise frequency and burnout. The interaction showed that a combination of team and moderate-intensity exercise produced the lowest burnout score ($p = 0.032$). These findings suggest that a customized exercise intervention combining team and moderate-intensity activities can effectively alleviate academic burnout. This study provides theoretical insights and practical suggestions for integrating physical exercise into student health programs.

INTRODUCTION

1.1 Research Background

Academic burnout, characterized by emotional exhaustion, reduced academic efficacy, and cynicism towards study, is a growing concern among college students. With the increasing academic demands in higher education, students are exposed to heightened levels of stress, resulting in adverse psychological, emotional, and academic outcomes. Research suggests that burnout not only impairs students' academic performance but also undermines their mental health and social well-being (Win, 2024).

Physical exercise has been recognized as an effective means of alleviating psychological stress and enhancing mental resilience. Studies have demonstrated that regular exercise can improve mood, reduce anxiety and depression, and foster positive emotional states. However, limited research has explored the impact of exercise on academic burnout, particularly in terms of exercise type, intensity, and frequency. In the context of college students, identifying effective exercise strategies to mitigate burnout is crucial for promoting holistic development and academic success.

1.2 Research Objectives

This study aims to investigate the impact of physical exercise on academic burnout among college students, focusing on three key aspects:

1. Exercise Type: Comparing the effects of team-based and individual exercises on academic burnout.

2. Exercise Intensity: Examining the influence of low, medium, and high exercise intensities on burnout reduction.

3. Exercise Frequency: Exploring the relationship between the frequency of exercise and academic burnout levels.

In addition, this research seeks to evaluate the interaction effects between exercise type and intensity to identify the most effective combinations for alleviating burnout.

1.3 Research Significance

1.3.1 Theoretical Significance

This study enriches the theoretical understanding of academic burnout by incorporating physical exercise as a potential intervention. By analyzing the role of exercise type, intensity, and frequency, it provides insights into the psychological and physiological mechanisms underlying burnout alleviation. Furthermore, the findings contribute to the literature on the intersection of sports science and educational psychology, offering a new perspective on managing student well-being.

1.3.2 Practical Significance

The practical implications of this research are manifold:

For educational institutions, the findings provide evidence-based recommendations for designing exercise programs that effectively address academic burnout.

1. For students, the study offers actionable strategies to incorporate exercise into their routines to enhance emotional well-being and academic engagement.
2. For policymakers, the results highlight the importance of integrating sports initiatives into educational policies to foster a healthier learning environment.

2.1 Effects of physical exercise on mental health

Physical exercise, as an important way to promote mental health, has been verified by a large number of studies. The World Health Organization (WHO) pointed out that regular physical exercise can not only effectively prevent and relieve chronic diseases, but also significantly improve mental health, especially in reducing the incidence of psychological problems such as depression and anxiety (World Health Organization, 2019). This view is supported by many studies. Physical exercise has a positive effect on emotion regulation through physiological and psychological mechanisms, promoting the improvement of individual mental health.

2.1.1 Physiological mechanism: exercise and regulation of the nervous system

The effect of physical exercise on mental health is partly attributed to its effect on the brain through neurophysiological pathways. Exercise can activate the brain's reward system and increase the secretion of neurotransmitters (such as endorphins and dopamine) that are closely related to emotion regulation (Samsudin et al., 2024). Endorphins are known as "natural antidepressants" and can effectively relieve anxiety and improve mood. In addition, regular physical exercise can enhance the stability of the hypothalamus-pituitary-adrenal axis (HPA axis), thereby reducing the body's response to stress (Mennitti et al., 2024). Long-term physical exercise can reduce stress hormone levels, help individuals better cope with stress in life, and thus help alleviate mental health problems.

2.1.2 Psychological mechanism: exercise and emotion regulation

In addition to physiological mechanisms, the impact of physical exercise on mental health is also reflected in psychological mechanisms. Through physical activities, individuals' self-efficacy, self-esteem, and psychological resilience are significantly improved. Self-efficacy refers to an individual's confidence in completing a specific task, which often affects the individual's ability to cope with other stressors in life (Maddux, 1995). For college students, physical exercise can improve their ability to adapt to academic and life pressures by setting and completing sports goals. At the same time, sports activities provide individuals with an opportunity to escape from stressors and relax their bodies and minds, helping them to restore psychological balance under high-pressure environments (Mahindru et al., 2023).

2.1.3 Mental health benefits of physical exercise

Physical exercise has been shown to have a significant effect on alleviating mental health problems. Studies on depression have shown that regular physical exercise has a significant therapeutic effect on patients with mild to moderate depression. Mahmoudi et al. (2022) found through meta-analysis that patients with depression who participated in sports activities had improved emotional stability and mental health. In addition, team sports can bring additional mental health benefits by promoting social interaction. Participants in team sports usually gain a sense of belonging from collective activities, and this social support helps alleviate loneliness and negative emotions.

In terms of anxiety, studies have found that aerobic exercise, especially moderate-intensity exercise such as running and cycling, is considered an effective way to relieve anxiety symptoms. Moderate-intensity aerobic exercise can significantly reduce the excitability of the sympathetic nervous system, thereby alleviating anxiety symptoms (Daniela et al., 2022). At the same time, physical exercise can also improve the individual's mental health level (Subjective Well-Being), making participants more positive in terms of life satisfaction and positive emotions.

2.1.4 Special significance for college students' mental health

College students' mental health problems, especially the dual challenges of academic pressure and life pressure, put them at a higher risk of mental health. Studies have shown that physical exercise can effectively improve college students' emotional stability and mental health. College students who participate in physical exercise perform better in emotional stability than their peers who do not participate in physical activities (Tari-Keresztes et al., 2021). At the same time, they have stronger academic focus and lower academic burnout rates. Therefore, physical exercise can not only help college students relieve stress and improve mental health, but also improve academic performance and promote the all-round development of college students.

2.2 Definition and research status of academic burnout

Academic burnout is a widely-watched concept in educational psychology, and its origin can be traced back to the theory of burnout proposed by Maslach and other scholars (Maslach & Schaufeli, 2018). Academic burnout specifically refers to the comprehensive psychological state of emotional exhaustion, academic indifference and low academic efficacy caused by excessive learning pressure and psychological load in students in an academic environment (Lin & Yang, December 2021). With the continuous increase in academic pressure, academic burnout has become one of the important factors affecting students' mental health and academic performance.

2.2.1 Definition of academic burnout

Academic burnout refers to a negative psychological state that students develop in the process of facing long-term academic pressure and heavy academic tasks, which is usually manifested in three main dimensions: emotional exhaustion, academic indifference and low academic efficacy (Lin & Yang, December 2021). These dimensions together constitute the core characteristics of academic burnout and have a profound impact on students' academic performance and mental health.

First, emotional exhaustion is one of the primary manifestations of academic burnout, which refers to students feeling physically and mentally exhausted due to long-term heavy academic tasks and continuous learning pressure. Long-term emotional exhaustion not only leads to the exhaustion of students' physical and mental strength, but also weakens their motivation and interest in facing academic challenges (Lee et al., 2021). As emotional exhaustion intensifies, students may lose confidence in overcoming academic difficulties and cannot effectively cope with the pressure and challenges in learning, thus forming a vicious circle.

Second, academic apathy (Cynicism towards Study) is manifested as students gradually losing interest in learning tasks and academic activities, and even becoming emotionally alienated. In this dimension, students develop a negative attitude towards the academic environment, no longer feel that learning is meaningful, and are indifferent to academic activities. Academic apathy not only reflects changes in students' attitudes towards learning, but also means that students lack a sense of participation and involvement, leading to a further weakening of academic motivation (Leverson, 2024).

Finally, reduced academic efficacy refers to students' loss of confidence in their ability to complete academic tasks, which manifests as helplessness and low sense of achievement. In this dimension,

students begin to doubt whether they have the ability to cope with academic challenges and believe that they cannot achieve academic goals or complete tasks. Low academic efficacy not only affects students' self-identity and self-esteem, but may also cause them to avoid academic tasks and reduce their enthusiasm and creativity in learning (Wang & Yu, 2023).

These three dimensions are intertwined, constituting a comprehensive manifestation of academic burnout, and they influence each other, forming a negative cycle that is difficult to break. Academic burnout has a direct impact on students' academic performance, often leading to a decline in learning efficiency, a decline in academic performance, and even further affecting students' mental health. Long-term academic burnout may lead to psychological problems such as anxiety and depression, and in severe cases, it will have a profound impact on students' quality of life and future development. Therefore, understanding the dimensions of academic burnout and its influencing mechanisms is of great theoretical and practical significance for formulating effective intervention measures.

2.2.2 Causes of academic burnout

The causes of academic burnout are multifaceted, covering multiple aspects such as academic burden, lack of social support, and individual factors. First, excessive learning burden is one of the main causes of academic burnout. With the increasing complexity and intensity of academic tasks, students often need to complete a large amount of homework and prepare for various exams within a limited time. This high-intensity learning pressure can easily lead to physical and mental fatigue, and even continuous emotional exhaustion (Ahmad et al., 2024). Especially at the end of the semester or exam season, the heavy academic tasks and the pressure of approaching exams can make students feel extremely oppressive, making it difficult for them to maintain long-term learning motivation, leading to a decrease in interest in academics and mental fatigue.

Secondly, lack of social support is also one of the important causes of academic burnout. In an environment with high academic pressure, if students lack emotional support from family, peers or teachers, they are likely to feel isolated and helpless. This emotional isolation not only fails to provide support to relieve stress, but also increases the psychological burden of students (Jefferson et al., 2023). Without adequate support, students find it more difficult to cope with academic challenges, and psychological pressure gradually accumulates, increasing the risk of academic burnout. The lack of social support makes students more likely to fall into anxiety and self-doubt when facing pressure, forming a vicious cycle.

Finally, academic pressure and personal factors are also important causes of academic burnout. Academic failure or poor academic performance, especially in final exams or important assessments, often leads to students feeling a decline in self-efficacy, which in turn causes anxiety and powerlessness (Honicke & Broadbent, 2016). In addition, individual personality traits, especially excessive perfectionist tendencies, often make students have too high demands on themselves when facing challenges. Perfectionists often find it difficult to accept any form of failure or imperfection, and this pursuit of perfection puts them under greater psychological pressure in their studies. Once they fail to meet the set standards, they may feel frustrated and anxious, affecting their academic performance and mental health, and ultimately aggravating the degree of academic burnout.

These factors are intertwined to form a complex system of causes of academic burnout. Excessive academic burden and lack of social support make students more vulnerable to academic pressure, and individual personality traits may exacerbate this process to a certain extent. Understanding the causes of academic burnout can help provide a theoretical basis for the development of targeted intervention strategies.

2.2.3 Intervention strategies for academic burnout

For academic burnout, many studies have proposed a variety of intervention strategies to reduce the negative impact of burnout and help students effectively cope with academic pressure. First, time management and learning strategies are one of the key ways to alleviate academic burnout. By reasonably arranging study time and rest time, students can optimize their study plans, improve learning efficiency, reduce time pressure, and thus avoid overwork and backlog of academic tasks (Sandhu, 2024). Effective time management can not only help students improve their learning motivation, but also help reduce emotional fatigue and academic indifference.

Secondly, psychological support, as an important intervention method, is also widely believed to be able to effectively alleviate academic burnout. By providing psychological counseling services and emotional support, students can get the necessary psychological help and emotional comfort when facing academic pressure (Cohen et al., 2022). Social interaction with others can help reduce loneliness and anxiety, enhance students' coping ability, and help them develop a more positive learning attitude, thereby reducing burnout.

In addition, physical exercise is considered a natural and effective way to relieve academic burnout. Rosales-Ricardo & Ferreira (2022) showed that regular physical activity can effectively help students release stress, regulate emotions, and thus reduce academic burnout. However, although studies have found that physical exercise has a significant effect on relieving burnout, the specific type and intensity of exercise still need to be further explored. By formulating a physical exercise program suitable for students, it may be more effective to help students relieve burnout, improve academic performance and mental health.

2.2.4 Research status

Academic burnout has become a research hotspot in the global education field, especially in Asian countries with high pressure of exam-oriented education, such as China, Japan and South Korea, where academic burnout has become a prominent social problem. With the increasingly fierce competition in education, more and more students are facing high-intensity academic tasks and rigorous exam pressure, which together contribute to the occurrence of academic burnout. Most of the research around the world focuses on the causes of academic burnout and its negative impact on students' academic performance and mental health. Many studies have revealed that long-term academic burnout not only reduces students' academic concentration and task completion ability, but may also lead to mental health problems such as low mood, anxiety and depression (Yusof et al., 2023). However, although a large number of studies have explored the causes and effects of academic burnout, research on how to effectively alleviate academic burnout is still insufficient, especially in terms of intervention strategies.

In China, research on academic burnout mainly emphasizes the impact of academic competition pressure and excessive learning burden on students' mental health. Cheng & Lin (2023) pointed out that excessive academic pressure is one of the main causes of academic burnout, especially in a highly competitive educational environment, students are prone to emotional exhaustion and academic indifference, which affects their academic performance and overall mental health. In recent years, the academic community has begun to pay attention to the potential role of physical exercise in alleviating academic burnout, especially regular exercise is believed to be able to effectively relieve students' stress and improve their physical and mental health. However, these studies mostly focus on the investigation of general exercise frequency, and in-depth discussions on different exercise types, exercise intensity, and their mechanisms of action are still relatively scarce. The limitations of such studies make the intervention strategies for academic burnout still lack of pertinence and personalization. More systematic research on exercise types, intensity, and their specific mechanisms is urgently needed to provide theoretical basis and practical guidance for effectively alleviating academic burnout.

2.3 Moderating effect of exercise type and intensity

2.3.1 Moderating effect of exercise type

Exercise type is an important factor affecting mental health benefits, and team sports and individual sports show significant differences in mental health benefits. Team sports usually have unique social interaction and collective support mechanisms, which play an important role in relieving psychological stress and improving emotional health.

Psychological benefits of team sports

Team sports provide rich social interactions, which can enhance emotional connections between participants, promote a sense of belonging and social support, and thus effectively alleviate loneliness and stress (Stevens et al., 2021). In team sports, students can not only enjoy the pleasure brought by teamwork, but also gain emotional support in a collective atmosphere and reduce the risk of academic burnout. In addition, moderate competition and collaboration in team sports can

enhance the psychological resilience and sense of accomplishment of participants. This dual psychological experience helps students better cope with academic pressure and challenges (Liu et al., 2024). . Students participating in team sports usually show higher psychological well-being and emotional stability. Therefore, this type of sports has a significant positive impact on mental health.

Psychological benefits of individual sports

Unlike team sports, individual sports pay more attention to personal goal achievement and intrinsic motivation. Individual sports usually involve autonomy and independence, and participants can improve their self-efficacy and intrinsic motivation in the process of pursuing personal goals, which has a positive impact on emotional and mental health (Chu et al., 2021). However, individual sports also have potential disadvantages, especially in the absence of social support, which may not be as effective as team sports in emotional regulation (Martín-Rodríguez et al., 2024). Lack of emotional support among team members may cause participants to feel more isolated and depressed under stressful situations, which has an adverse effect on mental health.

2.3.2 The moderating effect of exercise intensity

Exercise intensity, especially the difference between low, medium and high intensity exercise, directly affects the degree of improvement in physiological and mental health. The mechanism of action of exercise of different intensities on mental health is different, which provides a basis for the development of exercise intervention strategies suitable for different student groups.

Low-intensity exercise

Low-intensity exercise is usually suitable for beginners or individuals with weak physical fitness, and can effectively relieve mild anxiety and stress. Studies have shown that low-intensity exercise can help soothe the body and mind and promote psychological relaxation, especially for the elderly and sedentary students (Gholamalishahi, 2022). However, due to the less physiological stimulation of low-intensity exercise, its positive impact on mental health is limited compared to moderate or high-intensity exercise. Therefore, although low-intensity exercise is helpful in alleviating academic burnout, its effect is often not as significant as moderate and high-intensity exercise.

Moderate-intensity exercise

Moderate-intensity exercise, such as brisk walking and jogging, has been widely considered to have the best improvement effect on mental health. Long et al. (2021) showed that moderate-intensity exercise can significantly improve students' positive emotions, reduce negative emotions, and help promote cardiovascular health. Moderate-intensity exercise can help regulate emotions and improve mental health by promoting the secretion of endorphins, avoiding excessive fatigue that may be caused by high-intensity exercise. In addition, moderate-intensity exercise also shows a relatively balanced effect in maintaining physiological stability and enhancing psychological resilience, making it an ideal choice for alleviating academic burnout.

High-intensity exercise

High-intensity exercise is suitable for individuals with strong physical fitness. It is more challenging, but it can bring significant physical fitness improvement and psychological resilience. However, excessive high-intensity exercise may cause excessive fatigue or sports injuries, which will have a negative impact on mental health (Daley et al., 2023). Especially after high-intensity exercise, students may feel physically and mentally exhausted, and even have aversion to exercise, which may aggravate their academic burnout and psychological pressure. Therefore, when designing an exercise plan, it is necessary to pay attention to balancing the intensity of exercise with the individual's tolerance to avoid negative psychological reactions caused by excessive exercise.

2.3.3 Interaction between type and intensity

The interaction between exercise type and exercise intensity is of great significance to the regulatory effect of mental health and academic burnout. For example, moderate-intensity exercise in team sports may maximize the relief of academic burnout through the dual pathways of social support and physiological regulation. While enjoying social interaction, participants can also get physiological relief through exercise of appropriate intensity, thereby comprehensively improving their mental health. However, in individual exercise, especially in high-intensity exercise, the same degree of

emotional support may not be obtained (Ekkekakis et al., 2011), which may lead to weaker effects on academic burnout and even increase students' psychological stress in some cases (Curry et al., 2021). Therefore, the choice of exercise type and intensity should take into account students' physical condition, emotional needs, and academic pressure to develop personalized exercise intervention strategies.

3. Research Methods

3.1 Research Design

This study adopted a cross-sectional research design, mainly through questionnaire survey method to collect data on physical exercise habits and academic burnout levels of college students. The study used quantitative analysis as the main method, and explored the effects of exercise type, intensity and frequency on academic burnout and its mechanism of action through statistical analysis. By taking different exercise factors as independent variables and academic burnout scores as dependent variables, this study attempted to verify the proposed research hypothesis.

3.2 Research Subjects

The research subjects of this study were college students, and the sample selection adopted a stratified random sampling method to ensure the representativeness of the sample. The study randomly selected 100 students from colleges and universities in different regions of Shandong, China, with a balanced gender ratio (50% male, 50% female). All participants were full-time students, aged between 18 and 25 years old. The research subjects were required to meet the following conditions: Participants were required to report their daily exercise habits and complete the academic burnout measurement questionnaire.

3.3 Research Hypotheses

Based on the literature review and research objectives, this study proposes the following hypotheses:

1. Hypothesis on the influence of exercise type

H1: The academic burnout scores of participants in team sports are significantly lower than those of participants in individual sports.

2. Hypothesis on the influence of exercise intensity

H2: The academic burnout scores of participants in moderate-intensity exercise are significantly lower than those of participants in low-intensity and high-intensity exercise.

3. Hypothesis on the influence of exercise frequency

H3: The correlation between exercise frequency and academic burnout level is weak.

4. Hypothesis on the interaction of exercise type and intensity

H4: The interaction combination of team sports and moderate-intensity exercise has a significantly better effect on alleviating academic burnout than the combination of other types and intensities.

3.4 Data Collection

The data for this study were collected through a questionnaire, which included two parts: one was a survey on physical exercise habits, and the other was a measurement of academic burnout. The physical exercise part recorded the students' exercise type (1 = team sports, 2 = individual sports), exercise intensity (1 = low intensity, 2 = medium intensity, 3 = high intensity), and exercise frequency (1 = once a week, 2 = 2-3 times a week, 3 = 4-5 times a week, 4 = 6 times a week or more). The academic burnout measurement used a simplified version adapted from the Maslach Burnout Inventory-Student Survey, which included 5 questions, each of which was scored using a 5-point Likert scale (1 = completely disagree, 5 = completely agree). The question design covered three dimensions: emotional exhaustion, academic apathy, and low academic efficacy. For example, the question of the emotional exhaustion dimension included "I often feel exhausted by academic tasks." During the data entry process, the average score of the 5 questions was calculated as the total score of academic burnout, and SPSS was used to clean the data to remove missing values and outliers.

3.5 Data Analysis Methods

Data analysis uses a variety of statistical methods to verify the research hypotheses. First, descriptive statistics are used to analyze the basic characteristics of the sample, including gender, exercise type, exercise intensity, exercise frequency, and the distribution of academic burnout scores, and the mean and standard deviation are calculated. Second, the independent sample t-test is used to test H1: the difference in academic burnout scores between team sports and individual sports. The grouping variable is exercise type (Exercise_Type), and the test variable is the total academic burnout score (Avg_Burnout_Score). One-way analysis of variance (ANOVA) is used to test H2: the effect of different exercise intensities (low, medium, and high) on academic burnout scores. The dependent variable is the total academic burnout score, and the factor variable is exercise intensity (Exercise_Intensity). In the variance analysis, the post hoc test uses the Tukey method to further identify the groups with significant differences. In addition, Pearson correlation analysis is used to test H3: the correlation between exercise frequency and academic burnout scores. Finally, two-way ANOVA was used to test H4: the interactive effect of exercise type and intensity to explore the effect of the combination of the two on alleviating academic burnout.

4. RESULTS AND DISCUSSION

4.1 Independent Samples t-Test: Effects of Exercise Type on Academic Burnout

This section explores the effect of exercise type (team-based vs. individual) on academic burnout, aiming to validate Hypothesis H1. The descriptive statistics and t-test results are summarized in Table 1.

4.1.1 Descriptive Statistics

The mean burnout scores of participants engaging in team-based exercises (M = 2.8231, SD = 0.58699) were significantly lower than those of participants engaging in individual exercises (M = 3.6042, SD = 0.54654). This suggests that team-based exercises are more effective in reducing academic burnout.

4.1.2 Statistical Analysis

The independent samples t-test results (Table 1) revealed a significant difference between the two exercise types ($t = -6.871$, $df = 98$, $p < 0.001$). The 95% confidence interval for the mean difference ranged from -1.00669 to -0.55549, and the effect size, as measured by Cohen's d, was -1.375, indicating a large effect.

Table 1: Independent Samples t-Test Results for Exercise Type and Academic Burnout

Variable	Exercise Type	N	Mean (M)	SD	t	df	p	Mean Difference (ΔM)	95% CI (Lower)	95% CI (Upper)	Cohen's d
Burnout Score	Team-Based	52	2.8231	0.58699	-6.871	98	< 0.001	-0.78109	-1.00669	-0.55549	-1.375
	Individual	**48**	**3.6042**	**0.54654**							

4.1.3 Discussion

The findings support Hypothesis H1, indicating that team-based exercises significantly reduce academic burnout compared to individual exercises. This effect can be attributed to the social support, cooperation, and emotional interaction provided in team activities. In contrast, individual exercises, while beneficial for self-efficacy, may lack the social dynamics necessary to alleviate emotional exhaustion and academic cynicism.

4.2 One-Way ANOVA: Effects of Exercise Intensity on Academic Burnout

This section examines the impact of exercise intensity (low, medium, and high) on academic burnout to test Hypothesis H2.

4.2.1 Descriptive Statistics

The descriptive statistics in Table 2 demonstrate that participants engaging in medium-intensity exercises had the lowest burnout scores (M = 2.5543, SD = 0.55112), followed by high-intensity (M = 3.4645, SD = 0.34790) and low-intensity exercises (M = 3.6176, SD = 0.55567).

Table 2: Descriptive Statistics for Exercise Intensity and Burnout Scores

Intensity	N	Mean (M)	SD
Low	34	3.6176	0.55567
Medium	35	2.5543	0.55112
High	31	3.4645	0.34790

4.2.2 Statistical Analysis

The one-way ANOVA results revealed a significant effect of exercise intensity on burnout scores ($F = 45.578$, $p < 0.001$). Tukey post hoc analysis indicated that medium-intensity exercise significantly differed from both low- and high-intensity groups ($p < 0.001$ for both comparisons), as shown in Table 3.

Table 3: Tukey Post Hoc Analysis for Exercise Intensity and Burnout Scores

Comparison	Mean Difference (ΔM)	SE	p	95% CI (Lower)	95% CI (Upper)
Low vs. Medium	1.06336	0.12014	< 0.001	0.7774	1.3493
Medium vs. High	-0.91023	0.12306	< 0.001	-1.2031	-0.6173
Low vs. High	0.15313	0.12390	0.435	-0.1418	0.4480

4.2.3 Discussion

The results confirm Hypothesis H2, highlighting medium-intensity exercise as the most effective for reducing burnout. This is likely due to its balanced physiological and psychological stimulation, which optimally enhances mood and reduces stress without causing fatigue.

4.3 Pearson correlation coefficient: relationship between exercise frequency and academic burnout

This section evaluates the relationship between exercise frequency and burnout scores to verify hypothesis H3.

4.3.1 Statistical analysis

The Pearson correlation coefficient ($r = 0.19$, $p = 0.850$) shows that there is a weak correlation between exercise frequency and burnout scores, and the correlation is not significant ($p > 0.05$). This result is obviously consistent with hypothesis H3 (exercise frequency and academic burnout are weakly correlated). This shows that the higher the exercise frequency, the lower the academic burnout.

Table 4: Pearson correlation coefficient between exercise frequency and burnout scores

Variables	r	p
Exercise Frequency	0.19	0.850

4.3.2 Discussion

Although the correlation is not statistically significant, its magnitude is relatively small, which means that exercise frequency itself is not the main determinant of reducing burnout. The effect of exercise frequency on academic burnout may not be a simple linear relationship, but there is a certain threshold effect. For example, moderate exercise frequency may have the best effect on alleviating burnout, while too high or too low frequency may lead to increased fatigue, thereby offsetting the relief benefit. High exercise frequency but low exercise quality (such as low intensity or lack of goal exercise) may not produce significant psychological benefits. Therefore, a simple increase in frequency may not be able to effectively alleviate burnout. Academic burnout is affected by many factors, such as academic pressure, social support, and psychological resilience. The effect of exercise frequency may be weak and masked by the interference effect of other variables in statistical analysis.

4.4 Two-Way ANOVA: Interaction Between Exercise Type and Intensity

This section investigates the interaction between exercise type and intensity on burnout scores to test Hypothesis H4.

4.4.1 Statistical Analysis

The two-way ANOVA results (Table 5) revealed significant main effects for exercise type ($F = 106.753$, $p < 0.001$) and intensity ($F = 85.887$, $p < 0.001$). Moreover, the interaction effect between type and intensity was significant ($F = 3.578$, $p = 0.032$), indicating that the combination of exercise type and intensity affects burnout reduction.

Table 5: Two-Way ANOVA Results for Exercise Type, Intensity, and Burnout

Source	F	p	Partial Eta Squared
Exercise Type	106.753	< 0.001	0.532
Intensity	85.887	< 0.001	0.646
Type * Intensity	3.578	0.032	0.071

4.4.2 Discussion

The interaction results validate Hypothesis H4, with the combination of team-based and medium-intensity exercises producing the lowest burnout scores. This suggests that integrating social support with optimal physiological stimulation maximizes burnout reduction.

5. Conclusions and Recommendations

5.1 Conclusions

This study explored the effects of physical exercise on academic burnout among college students, focusing on exercise type, intensity, frequency, and their interactions. Based on data analysis, the following conclusions were drawn:

5.1.1 Effect of exercise type

Compared with individual exercise, team exercise significantly reduced academic burnout. Participants who participated in team activities reported lower burnout scores ($M = 2.8231$) than those who participated in individual exercise ($M = 3.6042$). This supports hypothesis H1 and highlights the role of social support, cooperation, and emotional connection in alleviating emotional exhaustion and cynicism about learning.

5.1.2 Effect of exercise intensity

Moderate-intensity exercise had the most significant effect on reducing academic burnout, with the lowest mean score ($M = 2.5543$), which was significantly lower than low-intensity ($M = 3.6176$) and high-intensity ($M = 3.4645$) exercise. These findings validate hypothesis H2, that moderate physiological stimulation can optimally balance the benefits of stress reduction and mood stabilization.

5.1.3 Relationship between exercise frequency and academic burnout

The results showed that there was a weak but non-significant correlation between exercise frequency and academic burnout ($r = 0.19$, $p = 0.850$). This partially supported hypothesis H3, that higher exercise frequency was weakly associated with slightly reduced burnout. However, the effect of frequency itself seemed limited, suggesting that other factors such as exercise type and intensity play a more important role in alleviating burnout.

5.1.4 Interaction between exercise type and intensity

The interaction between exercise type and intensity significantly affected academic burnout ($F = 3.578$, $p = 0.032$). Specifically, team-based and moderate-intensity sports produced the lowest burnout scores. This verified hypothesis H4, highlighting the combined advantages of social engagement and optimal physiological effort in reducing academic burnout.

5.2.1 For educational institutions

Universities should pay more attention to the promotion of team sports activities in reducing academic burnout. Team sports, such as basketball, football, and volleyball, can effectively relieve students' emotional exhaustion and academic apathy by providing social support and opportunities for cooperation. In addition, physical education courses should be combined with moderate-intensity exercise programs, such as brisk walking, jogging, or aerobics, because these activities can provide the best balance for students' physical and mental health. To ensure that students can fully participate, educational institutions should also create an environment that encourages regular exercise, such as integrating physical activities into students' daily lives through campus activities and structured schedules, stimulating their interest in sports and forming long-term habits.

5.2.2 For students

Students should actively participate in socially interactive sports, such as joining team sports or club activities. These participations can not only help students achieve physical health, but also promote mental health and enhance a sense of belonging through social interaction. At the same time, students should prioritize exercise consistency rather than intensity during exercise. Regular participation in moderate-intensity exercise will be more conducive to continuous improvement of body and mind. Excessive pursuit of high-intensity exercise may cause additional fatigue, which is not conducive to the relief of academic stress and the improvement of overall health.

5.2.3 For policymakers

Policymakers should include physical exercise in students' overall mental health plans and make physical activities an important part of campus health plans. By integrating sports and psychological support resources to form a comprehensive health promotion system, students' academic burnout can be more effectively addressed. In addition, policies should ensure that sufficient resources are allocated to sports infrastructure and related projects, such as building and maintaining multi-functional sports venues, and providing diversified exercise opportunities based on students' interests and needs. These measures will create a more inclusive and supportive sports environment for students.

5.2.4 Future research directions

Future research should further explore the long-term effects of physical exercise on academic burnout and provide insights into sustained intervention strategies through longitudinal studies. At the same time, more attention should be paid to mediating variables such as psychological resilience, self-efficacy, and social support that may moderate the relationship between exercise and academic burnout to reveal more complex mechanisms of action. In addition, it is also necessary to expand the diversity of samples. Future studies can include students from different cultural and academic backgrounds to improve the generalizability and applicability of research results, thereby providing broader guidance for global education and health policies.

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