

Received: June 2025

Accepted: December 2025

DOI: 10.7862/rz.2025.mmr.21

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THE ROLE OF PHYSICAL ACTIVITY IN STRESS MANAGEMENT AMONG UNIVERSITY STUDENTS

This article examines the role of physical activity in stress management among university students. A survey conducted in 2024 among 101 students at Rzeszów University of Technology investigated the relationship between regular engagement in physical activity and the occurrence of stress-related symptoms. The data were analyzed using descriptive statistics and Pearson's chi-square tests ($\alpha = 0.05$).

The results demonstrated a statistically significant association between regular physical activity and a reduction in stress-related symptoms, particularly muscle tension and insomnia. Male students were more likely than female students to report improvements in physical performance. Furthermore, forms of physical activity perceived as enjoyable and relaxing, such as martial arts or fitness training, were associated with better physical condition and higher energy levels.

The findings indicate that regular physical activity constitutes an effective, non-pharmacological strategy for stress reduction, especially when aligned with individual preferences. The study supports the implementation of personalized physical activity programs in academic settings as a means of promoting students' psychological and physical health.

Keywords: physical activity, stress, students, physical activity as intervention, physical fitness, stress management strategies.

1. INTRODUCTION

The contemporary lifestyle, marked by dynamic changes and increasing demands, contributes to elevated levels of stress. This physiological and psychological response is an inherent aspect of human life, the intensity and consequences of which may be modulated by a range of factors, including life circumstances, as well as professional and academic environments. The pressure associated with educational responsibilities and examinations presents a significant challenge for higher education institutions, which are expected to provide students with adequate tools for coping with stress – an issue of key importance for both their psychological and physical health and academic performance.

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In response to these challenges, growing attention has been directed toward non-pharmacological stress management strategies, among which physical activity occupies a central role. The use of sport as a method for stress reduction is based on the premise that regular physical exercise has a positive impact on well-being and fosters the development of supportive interpersonal relationships. Essential to this process are psychosocial factors such as motivation to engage in physical activity, access to resources (including time, equipment, and infrastructure), and support from one's environment – family, friends, and coaches. The integration of these elements promotes regularity in physical activity and enhances the effectiveness of the applied intervention strategies.

The aim of this article is to identify the role of physical activity in stress management and to evaluate the effectiveness of different forms of sport in stress management strategies among university students. To this end, the following research questions were posed:

Does regular participation in sports activities contribute to a reduction of stress-related symptoms such as muscle tension and insomnia?

Are there differences between male and female students in the effects of sports participation on general physical performance?

Does the selection of an appropriate form of physical activity – key to effective stress management – contribute to improved physical fitness and energy levels?

The subject of analysis includes the results of a study conducted in 2024 among a group of university students, aimed at expanding the current knowledge on the role of physical activity as a supportive tool in stress management. The findings may serve as a basis for formulating recommendations for academic institutions and organizations seeking to implement non-pharmacological methods to improve psychological and physical health.

2. LITERATURE REVIEW

The literature review provides the theoretical foundation for this study, which aims to assess the role of physical activity in stress management. The scholarly literature identifies several key thematic areas that connect the concepts of stress, physical activity, and their effects on mental health and interpersonal relationships.

2.1. Definition of stress and its implication

Stress is defined as the body's response to challenges or threats that disturb its homeostasis (Grygorczuk, 2008). It is a dynamic process in which the individual undertakes adaptive actions to restore psychological and physical equilibrium. Depending on its intensity and duration, stress can have both positive and negative consequences for human health and functioning (Lazarus, 1984).

Recent studies have indicated that high levels of stress – particularly in academic environments – negatively affect emotional resilience (Ansari et al., 2024). Prolonged psychological tension may impair cognitive performance, concentration, and learning efficiency, often leading to reduced motivation and academic burnout (Maslach et al., 2001). Moreover, chronic stress has been correlated with an increased risk of mental health disorders, such as depression and anxiety (McEwen, 2004). Elevated stress levels can also manifest in physical symptoms, such as muscle tension, insomnia, and mood disturbances, making the search for effective stress-reduction strategies a high-priority topic in contemporary scientific discourse.

One of the central concepts in this context is stress management, defined as a set of strategies and techniques aimed at minimizing the negative effects of stress while

enhancing the individual's adaptive capacities (Quick et al., 1997). Among the most commonly applied stress management methods are relaxation techniques, meditation, cognitive-behavioral therapy, and physical activity – which has been shown to be particularly effective in regulating emotions and supporting the neurobiological balance of the body (Varvogli, Darviri, 2011; Basso, Suzuki, 2017).

2.2. Physical activity as a tool for coping with stress

Academic literature focused on the pertinent subjects emphasizes that regular physical activity plays a significant role in alleviating symptoms of stress. Empirical studies demonstrate that physical exercise has beneficial effects on both biological and psychological dimensions. On a biological level, physical activity increases the secretion of endorphins and modulates cortisol levels, thereby contributing to improved well-being (Mennitti et al., 2024; Enayatjazi et al., 2015). Psychological mechanisms, in turn, include mood enhancement, increased self-esteem, and the development of positive social relationships (Gracz et al., 2007; Kwilecki, 2012). Moreover, numerous studies have shown that physical activity positively influences brain neuroplasticity, which translates into improved cognitive functions such as memory, concentration, and learning ability. Regular physical exertion promotes an increase in hippocampal volume and the activity of brain-derived neurotrophic factor (BDNF), which may strengthen psychological resilience and facilitate adaptation to stressful situations (Hillman, Erickson, Kramer, 2008; Mandolesi et al., 2018).

Research indicates that sport can serve as an effective intervention in the context of stress reduction, as evidenced by numerous comparative analyses. Morga et al. (2015) observe that individuals who engage in regular sports activities report lower levels of stress and fewer associated symptoms, such as anxiety and depression. Furthermore, Dyrła-Mularczyk et al. (2019) and Kazimierzczak et al. (2015) highlight that an active lifestyle has a positive impact on cognitive and social functioning, which may contribute to more effective stress management. Importantly, physical activity not only serves a preventive function but may also support therapeutic interventions. Intervention studies have shown that regular aerobic exercise – such as running, swimming, or cycling – effectively reduces symptoms of anxiety and depression, with efficacy comparable to pharmacological treatment in mild cases (Craft, Perna, 2004; Mikkelsen et al., 2017).

2.3. The impact of physical activity on interpersonal relationships

Another aspect frequently discussed in the scholarly literature is the influence of physical activity on the development of social relationships. Participation in sports activities fosters the establishment of interpersonal connections and strengthens the sense of belonging to a group. A systematic review conducted by Eime et al. (2013) demonstrated that sport has a significant impact on the formation of social bonds, which is particularly relevant in academic environments, where stress and pressure can negatively affect interpersonal interactions. Bailey et al. (2013) emphasize that sport not only enhances physical fitness but also serves as an important integrative factor, increasing levels of social support and satisfaction with interpersonal relationships.

In the context of interpersonal relationship development, physical activity undertaken in a team-based format appears especially beneficial, as it promotes cooperation, communication, and mutual trust. As noted by Eather et al. (2023), participation in sports – especially team sports – is associated with improved psychological well-being, including higher self-esteem and greater life satisfaction.

2.4. Synthesis of existing research findings

A review of the literature indicates that physical activity exerts a multidimensional influence on individual health. Both biological and psychological mechanisms support the hypothesis that regular participation in sports activities can effectively reduce symptoms of stress and enhance social functioning. Empirical findings (Mennitti et al., 2024; Enayatjazi et al., 2015; Morga et al., 2015; Kwilecki, 2012) confirm that sport plays a key role in stress-coping strategies, which is also reflected in studies examining its impact on interpersonal relationships (Eime et al., 2013; Bailey et al., 2013). Moreover, there is growing interest in incorporating physical activity as a supportive element in mental health promotion programs, particularly in high-stress environments such as academic, medical, or corporate settings. Analyses of intervention studies (Craft, Perna, 2004; Mikkelsen et al., 2017) show that exercise-based interventions are effective both in the prevention and treatment of mild anxiety and depressive disorders, as well as in improving psychological functioning. It is worth noting that the form and intensity of physical activity can be tailored to individual needs and capabilities, thereby increasing the accessibility of this type of intervention across various age and social groups.

In summary, the existing body of research provides a robust theoretical foundation for the present article, which explores the role of physical activity in coping with stress and fostering healthy social relationships within academic settings. Based on current findings, it can be assumed that physical activity serves not only a preventive but also a therapeutic function. Its significance in the context of mental and social health highlights the need for further research aimed at elucidating the specific mechanisms underlying these associations.

3. METHODOLOGY OF THE AUTHOR'S RESEARCH

The research conducted within the framework of this article aimed to assess the impact of physical activity on stress reduction among students at Rzeszów University of Technology. The sample was selected using purposive sampling, as the study targeted students participating in sports classes offered at Rzeszów University of Technology. The research was carried out in 2024 on a group of 101 students. Within the analyzed group, males constituted a slight majority (56%), while females accounted for 44% of the respondents. In terms of age, most participants fell within the 19–25 age range, with only a small proportion being older (above 25 years).

Inclusion and exclusion criteria. Inclusion criteria required being an active student of Rzeszów University of Technology and participation in university sports classes. Exclusion criteria included incomplete questionnaires and failure to confirm voluntary participation.

Data collection window and response rate. The survey was conducted between **April – June 2024**. A total of **101** invitations were distributed, and **101** valid responses were obtained, resulting in a response rate of **100%**. Participation in university sports classes during the time of the study was **elective**.

Ethical considerations. The study complied with institutional ethical standards. Participation was voluntary and anonymous. According to institutional guidelines, this non-interventional, anonymous online survey was **exempt from formal ethics committee approval**.

The research method employed was an online survey, developed and distributed via the platform www.surveymonkey.com. A proprietary questionnaire was designed specifically for the purposes of this study. It consisted of 17 questions divided into two main sections:

- Section on sports participation – the questions aimed to determine the frequency, duration, and preferred type of physical activity;
- Section on stress-coping strategies – the questions assessed participants' subjective perception of the impact of physical activity on the reduction of stress symptoms, such as muscle tension or insomnia, as well as on overall well-being and energy levels.

Respondents were able to select one or more response options and were also provided with the opportunity to submit their own suggestions. The questionnaire was preceded by a detailed instruction informing participants about the purpose of the study, the procedure for completing the survey, and the assurance of full anonymity of the collected data.

The questionnaire was made available to students in electronic form. Participants completed it independently, selecting the response options that best reflected their views and experiences. Prior to completing the survey, they were informed about the anonymous nature of the study, which aimed to enhance the reliability and honesty of their responses.

The collected data were subjected to statistical analysis using both descriptive and inferential statistics. For the purposes of this research, frequency and percentage analyses were used to present the distribution of responses across categories. To test the research hypotheses, Pearson's chi-square test of independence was applied, with a significance level set at $\alpha = 0.05$. This allowed for the assessment of relationships between regular participation in sports activities and the reduction of stress symptoms, as well as for the identification of potential differences in the perceived impact of physical activity between male and female respondents.

Given the nature of the study, which involved collecting data on the subjective experiences of students, particular attention was paid to adhering to ethical research principles. The questionnaire was anonymous, and no personal data were collected, ensuring confidentiality and the protection of participants' privacy.

4. RESULTS OF THE AUTHOR'S RESEARCH

4.1. Descriptive findings

The analysis revealed that 64% of respondents reported engaging in physical activity several times a week, 28% once a week, 6% daily, and only 2% less than once a week. The largest proportion of participants (34%) reported practicing sports for more than three years, 27% for six months to one year, 25% for one to three years, 13% for less than six months, and 2% selected the "other" category. An analysis of preferences showed that the most dominant form of physical activity was martial arts (68%), followed by fitness (42%), running (35%), and team sports such as football, basketball, or volleyball (30%). The least popular activities were dance and tennis, each indicated by 2% of respondents. Other forms of physical activity mentioned included golf, calisthenics, street workout, rugby, and skiing.

Respondents evaluated the regularity with which they engaged in specific types of physical activity (e.g., running, fitness, cycling, winter sports, team games, martial arts, hiking, swimming) using three categories: regularly, irregularly, or not at all. In terms of participation style, 51% of respondents reported exercising individually, 19% with

a partner, and 30% in a group setting. With regard to the subjective assessment of the impact of sport on stress-coping abilities, 44% of participants stated that engaging in sports activities significantly improved their ability to manage stress, 37% reported moderate improvement, 12% observed no change, and 8% were uncertain. Respondents identified a range of benefits, including increased productivity (32%), improved concentration and problem-solving ability (27%), enhanced interpersonal relationships (13%), and greater resilience to stress (26%). In addition, individual responses referred to improved mood and the perception of physical effort as a form of relaxation. According to participants, 56% believed that sports activities significantly improve overall physical condition, 40% noted moderate improvement, 3% reported no improvement, and 2% were uncertain. Regarding the reduction of stress symptoms, 40% of respondents indicated that sports activities significantly reduced symptoms such as muscle tension or insomnia, 49% reported partial reduction, 8% observed no improvement, and 4% were uncertain.

The analysis further showed that 66% of respondents believed that participation in sports activities significantly improved their overall mood and energy levels, 30% reported moderate improvement, while only 2% noticed no change and another 2% were uncertain. In this study, 73% of participants emphasized that choosing an enjoyable and relaxing form of activity is crucial, whereas 21% believed that any form of physical activity can be beneficial for stress reduction. Only 6% had no opinion on this matter.

A substantial majority (85%) of respondents indicated that participation in sports activities should be recommended for individuals experiencing stress, while 12% were undecided and 3% pointed to alternative methods. Furthermore, 84% of participants declared being aware of other stress-coping strategies. In total, 97% of respondents stated that sports activities can contribute to the development of healthy relationships with others. In the open-ended section, 74% of participants did not submit additional comments or questions regarding the impact of sports activities on stress management. The remaining 26% shared observations related to improvements in sleep quality, relaxation, and stress-coping effectiveness. Demographic analysis showed that 56% of respondents were male and 44% female. The vast majority (97%) fell within the age range of 19–25 years.

4.2. Inferential results

To verify the research hypotheses, inferential analyses were conducted using Pearson's chi-square test at a significance level of $\alpha = 0.05$. The results are presented in descriptive, tabular, and graphical formats (Figures 1–3).

4.3. Impact of regular physical activity on the reduction of stress-related symptoms

The chi-square test revealed a statistically significant association between regular physical activity and the reduction of stress-related symptoms ($\chi^2 = 31.31$, $df = 9$, $p < 0.001$, Cramér's $V = 0.56$). Effect size for this table ($df = 9$) was assessed using Cramér's V , which is recommended for contingency tables larger than 2×2 . The value of Cramér's V (0.56) indicates a strong association between the examined variables (Table 1, Figure 1). Respondents who regularly participated in sports activities more frequently reported either a significant or partial reduction in stress symptoms. Percentages may not sum to 100 due to rounding and because respondents were allowed to select multiple responses.

Table 1. Results of Pearson’s chi-square test of independence: Regular participation in physical activity and reduction of stress-related symptoms

	Statistic	df	p-value
Pearson’s χ^2	31.31	df=9	p<0.001
Cramér’s V	0.56		

Source: Author’s own study.

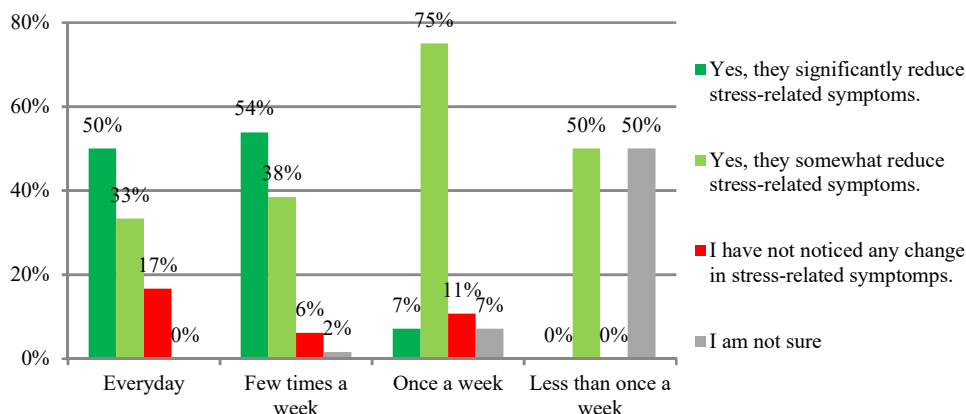


Figure 1. Regular participation in sports activities and the reduction of stress-related symptoms such as muscle tension and insomnia

Source: Author’s own study.

4.4. Gender differences in the perceived impact of physical activity on physical fitness

The analysis revealed significant differences between men and women in their assessment of the impact of sports activities on physical fitness ($\chi^2 = 7.64$, $df = 1$, $p = 0.005$). These findings suggest that men are more likely to perceive sports activity as beneficial for physical performance, which is further supported by the statistical indicators (contingency coefficient = 0.26) (Table 2, Figure 2).

Table 2. Results of Pearson’s chi-square test of independence: Gender and perceived impact of physical activity on physical fitness

	Chi-square	df	p
Pearson’s χ^2	7.64	df=1	p=0.005
Contingency coefficient	0.26		

Source: Author’s own study.

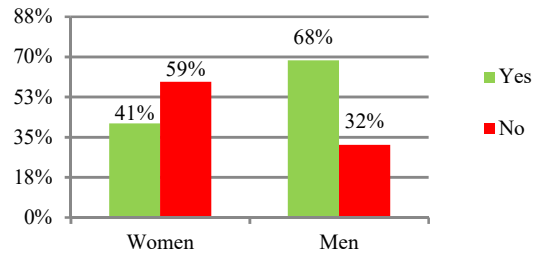


Figure 2. Assessment of the Impact of Sports Activities on Overall Physical Fitness by Gender

Source: Author's own study.

4.5. The impact of choosing sports activities on physical fitness and energy levels

The conducted analysis indicates that selecting appropriate sports activities – specifically those perceived as enjoyable and relaxing – is significantly associated with improvements in physical fitness and energy levels ($p < 0.001$). Within this group, 77% of respondents reported that engaging in such activities had a substantial positive effect on their well-being and energy.

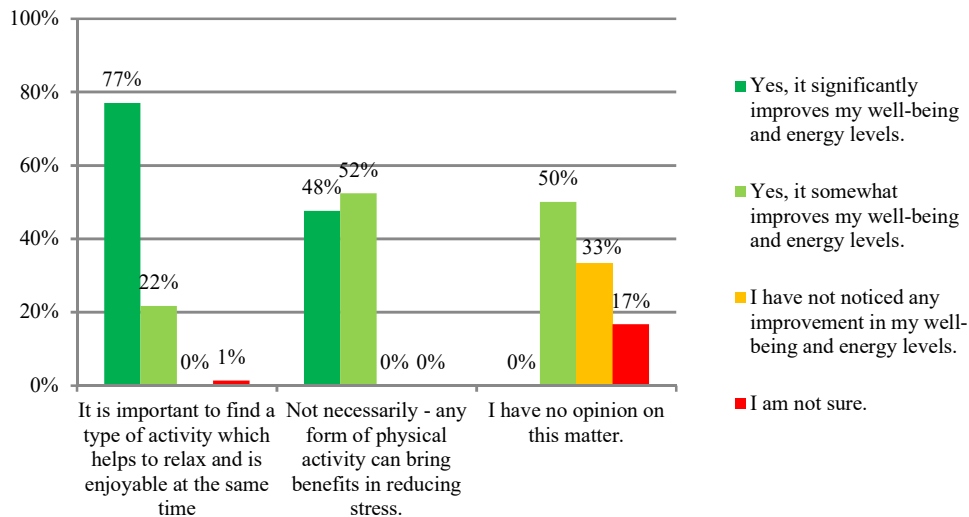


Figure 3. Selection of appropriate sports activities as a determinant of effective stress management, improved physical fitness, and increased energy levels

Source: Author's own study.

Furthermore, research indicates that activities perceived as enjoyable are more likely to be maintained over time, leading to sustained benefits in physical fitness and energy. This underscores the importance of personal preference in selecting physical activities to promote long-term adherence and health benefits.

5. DISCUSSION

The contemporary academic environment presents numerous challenges for students, often leading to elevated stress levels. Consequently, identifying effective stress-reduction methods is of paramount importance. The findings of this study corroborate existing literature, indicating that regular participation in sports activities plays a significant role in stress management.

In the present study, more than half of the respondents reported engaging in sports activities several times a week, with a substantial proportion participating consistently for periods ranging from six months to over three years. These results suggest a propensity among students for maintaining regular physical activity, aligning with the observations of Guerriero et al. (2025) and Yoon et al. (2023), who emphasize the association between regular exercise and reduced stress levels. Furthermore, Hassmén et al. (2000) found that individuals exercising at least twice weekly experience lower levels of depression, anger, cynical distrust, and stress, underscoring the positive impact of physical activity on mental health.

An analysis of physical activity preferences indicated a predilection among students for dynamic forms such as martial arts, fitness, and running, while activities requiring lower energy expenditure, like tennis or yoga, were less favored. This preference suggests that intensive physical exertion characteristic of the aforementioned activities may effectively alleviate tension and enhance mood. Literature associates prolonged martial arts training with increased self-confidence and reduced aggression, contributing to improved stress coping mechanisms (Vertonghen et al., 2010; Fabio et al., 2017; Blomqvist Mickelsson, 2020). Similarly, running has been identified as having therapeutic effects on mental health (Oswald et al., 2020). Regarding modes of participation in sports activities, the study found a majority of respondents prefer individual exercises, potentially reflecting a desire for complete control over training schedules and personal stress management strategies. Conversely, a smaller group engages in sports with partners or groups, possibly indicating a need for external motivation or challenges in finding suitable training partners. Research by Žižek et al. (2013) suggests that individual forms of activity can be effective stress-coping strategies, while Andersen et al. (2019) highlight the social benefits and positive psychological impacts of team sports.

Subjective assessments of stress reduction revealed that 44% of respondents believe sports significantly enhance their stress-coping abilities, with 8% uncertain. Reported benefits include increased productivity, improved concentration, enhanced problem-solving skills, and greater stress resilience. These findings align with Hillman et al. (2008), who documented the positive effects of physical activity on executive brain functions, including attention, planning, and decision-making. Additionally, Ratey et al. (2010) describe the phenomenon of exercise-induced brain stimulation, highlighting its role in promoting mental health and protecting against psychiatric disorders and dementia. Moreover, 56% of respondents reported significant improvements in physical fitness due to sports participation, corroborating literature that links regular physical activity with enhanced cardiovascular endurance, increased muscular strength, and improved body flexibility (Warburton et al., 2006; Kenney et al., 2022). Adaptive mechanisms resulting from consistent training lead to beneficial changes in muscle structure and circulatory function, consistent with the findings of this study.

Analysis of subjective stress reduction assessments indicated that 40% of respondents experienced substantial alleviation of stress symptoms, while 49% reported partial relief.

These outcomes may be associated with neurobiological mechanisms wherein physical activity plays a crucial role in hormonal regulation and increased endorphin levels, natural mood enhancers. Saeed et al. (2023) demonstrated that exercises of varying intensities modulate serotonin levels, including beta-endorphin secretion in the bloodstream. Furthermore, Hoosain et al. (2024) emphasize that physical training exhibits antidepressant effects and aids in regulating circadian rhythms, thereby improving sleep quality, mood, and vitality. In this study, 66% of respondents acknowledged that participation in sports activities significantly enhances well-being and energy levels, with only 2% noting no changes. Additionally, 73% emphasized the importance of selecting activities that provide enjoyment and relaxation, suggesting that personal preferences may significantly influence the effectiveness of sports interventions in mental health contexts. Scientific literature supports these observations; Basso and Suzuki (2017) found that short-term exercise sessions induce changes in neurotransmitter levels, such as norepinephrine, serotonin, and dopamine, directly improving mood and energy. Similarly, a meta-analysis by Rebar et al. (2015) concluded that regular physical activity enhances well-being by regulating the body's stress response, leading to reduced depressive symptoms and anxiety.

The finding that 85% of respondents believe sports activities should be recommended for individuals experiencing stress underscores the role of physical activity in stress management strategies. This is supported by studies from Xie et al. (2021) and Ross et al. (2023), which highlight the efficacy of exercise in reducing depressive symptoms and improving cognitive functions. Conversely, only 3% of respondents considered alternative stress management methods superior, suggesting that interventions like relaxation techniques may be less popular among the studied population, as indicated by Sabu and Kisan (2023). The accessibility of physical activity and its tangible benefits reinforce its preferential status, consistent with findings by Buecker et al. (2021).

Finally, the study revealed that 97% of respondents perceive a positive impact of sports activities on building healthy interpersonal relationships. Engagement in sports requiring cooperation and communication fosters social connections and strengthens group belonging, particularly vital in academic settings. These observations align with systematic reviews by Eime et al. (2013) and studies by Bailey et al. (2013), which emphasize the role of sports in developing social support networks and enhancing psychological well-being.

6. CONCLUSIONS

The aim of this study was to examine the role of physical activity in stress management among university students and to assess the effectiveness of different forms of physical activity as non-pharmacological stress management strategies. The conclusions are presented in direct correspondence with the three research questions formulated in the Introduction.

6.1. Does regular participation in physical activity contribute to a reduction of stress-related symptoms such as muscle tension and insomnia?

The results clearly indicate that regular participation in physical activity is significantly associated with a reduction in stress-related symptoms, including muscle tension and insomnia. The statistical analysis revealed a strong relationship between the examined variables ($\chi^2 = 31.31$, $df = 9$, $p < 0.001$; Cramér's $V = 0.56$). Students who engaged in physical activity on a regular basis more frequently reported both significant and partial reductions in stress symptoms. These findings confirm that regular physical activity

constitutes an effective, non-pharmacological strategy for alleviating stress-related physiological symptoms in academic populations.

6.2. Are there differences between male and female students in the perceived effects of physical activity on overall physical performance?

The study identified statistically significant gender differences in the perception of the impact of physical activity on overall physical fitness ($\chi^2 = 7.64$, $df = 1$, $p = 0.005$; contingency coefficient = 0.26). Male students were more likely than female students to report improvements in physical performance resulting from participation in physical activity. This result suggests that gender may influence the perceived benefits of physical activity and highlights the potential need for gender-sensitive approaches when designing physical activity programs for stress management in university settings.

6.3. Does the selection of an appropriate form of physical activity contribute to improved physical fitness and energy levels?

The findings demonstrate that selecting forms of physical activity perceived as enjoyable and relaxing is significantly associated with improvements in physical fitness and energy levels ($p < 0.001$). A substantial proportion of respondents (77%) reported a strong positive impact of such activities on their well-being and vitality. This underscores the importance of individual preferences in the choice of physical activity and indicates that enjoyment and personal satisfaction play a key role in maximizing the stress-reducing and health-promoting effects of physical activity.

Overall Conclusions and Practical Implications. In summary, the study confirms that regular physical activity contributes to the reduction of stress-related symptoms and supports psychological and physical health among university students. Gender differences in perceived benefits suggest the value of tailored interventions, while the strong association between enjoyable forms of activity and positive outcomes emphasizes the importance of personalization. From a practical perspective, academic institutions should promote diverse and flexible physical activity programs that accommodate individual preferences, thereby enhancing participation, long-term adherence, and the effectiveness of stress management strategies.

Limitations of the study include several important considerations. First, the research was conducted on a relatively small sample, which may affect the overall representativeness and generalizability of the results to a wider population. Second, the sample consisted solely of students from Rzeszów University of Technology, which limits the ability to extend the findings to other academic institutions or demographic groups. Additionally, the respondents were all individuals actively engaged in sports, which may have influenced the positive assessments of the impact of physical activity on stress management, thereby limiting comparisons with groups less involved in physical activity.

Acknowledgements

Declaration of AI: The author declares that AI-assisted tools were used during the preparation of this manuscript exclusively for language checking, stylistic refinement, and minor editorial improvements. The use of AI-assisted tools was limited to enhancing clarity and readability of the text and did not involve data collection, data analysis, statistical calculations, interpretation of results, or the formulation of scientific conclusions. The author confirms that the use of AI-assisted tools complies with the ethical standards of their institution and the journal *Modern Management Review*. The author has reviewed and

edited all AI-assisted content and takes full responsibility for the final content and conclusions presented in this manuscript.

Author Contributions: Conceptualization, methodology, data collection, data analysis, writing – original draft preparation, writing – review and editing, conclusions, and references: D. K.

Funding: The author declares that this research received no external funding.

Data Availability Statement: The data presented in this study are available from the author upon reasonable request.

Conflicts of Interest: The author declares no conflict of interest.

The author has read and agreed to the published version of the manuscript.

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