

Non-pharmacological approach based on physical exercise in the campus environment as a strategy to prevent sedentary lifestyle among university students

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Abstract

Background and Study Aim Sedentary behavior among university students has become a pressing public health issue that requires innovative and context-specific interventions within the campus setting. One strategic approach to addressing this issue is the implementation of structured, non-pharmacological, exercise-based programs. Therefore, this study aimed to design and evaluate a campus-based, non-pharmacological exercise intervention to prevent sedentary lifestyles among university students.

Material and Methods A total of 58 university students (26 females and 32 males), aged 18–20 years, participated in this study. All participants completed a 4-week intervention combining aerobic exercise (jogging and power walking) with bodyweight resistance training. Four key indicators, namely physical activity level (PA level), sedentary duration (sitting or lying time), cardiorespiratory fitness (VO₂max), and resting heart rate (resting HR), were measured at baseline (pretest) and after the 4-week intervention (posttest) in both male and female groups. Statistical analysis was conducted using a paired-sample t-test with a significance level of 5%.

Results Physical activity levels significantly increased between the pretest and posttest by 2,022.75 METs (114.17%) in males and 1,769.08 METs (114.65%) in females. Sedentary duration significantly decreased by 109.22 minutes (–22.65%) in males and 131.58 minutes (–17.73%) in females. VO₂max showed a significant improvement, increasing by 10.09 mL/kg/min (27.43%) in males and 7.81 mL/kg/min (27.50%) in females. Resting heart rate also decreased significantly by 7.32 bpm (–11.32%) in males and 7.26 bpm (–10.29%) in females.

Conclusions This study demonstrates that a 4-week, non-pharmacological, exercise-based intervention is effective in reducing sedentary behavior and improving key health indicators among university students.

Keywords: healthy campus environment, healthy lifestyle, physical exercise, university students

Introduction

The global prevalence of sedentary lifestyles, along with associated health risks such as cardiovascular, metabolic, and mental health disorders, has emerged as a major public health concern, particularly among university students [1]. According to data from the World Health Organization [2], 31 percent of adults and 80 percent of adolescents fail to meet the recommended levels of physical activity. Sedentary behavior is defined as any waking activity involving energy expenditure

of 1.5 metabolic equivalents (METs) or less, such as sleeping, sitting, lying down, watching television, or engaging in other screen-based entertainment [3, 4]. Most university students do not meet the WHO physical activity guidelines, with fewer than 10 percent considered active and approximately 40.5 percent classified as highly inactive [5]. As a population undergoing the transition to adulthood [6], students are particularly vulnerable to adopting inactive lifestyles, often driven by academic stress [7, 8], lifestyle changes, and the ease of access to technologies that encourage prolonged sitting [9]. The college years represent a critical period for shaping long-term behavioral patterns that significantly influence the risk of developing chronic diseases later in life [10, 11, 12, 13]. Therefore,

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sedentary behavior among university students should be treated as a serious health issue requiring innovative and context-specific approaches within the campus environment.

Recently, physical inactivity has been widely recognized as a leading risk factor for premature mortality and chronic conditions such as type 2 diabetes, metabolic syndrome, and cardiovascular disease. Additionally, growing evidence suggests that high levels of sedentary behavior negatively impact mental health, increasing the risk of anxiety and depression [14, 15, 16, 17, 18, 19]. Although various studies have confirmed the harmful effects of sedentary behavior [10], most existing preventive interventions remain generalized, lack specificity for student populations, and rarely adopt structured, exercise-based approaches within campus settings [11]. Furthermore, many existing programs focus heavily on pharmacological treatment or theoretical education, without integrating practical physical activities into students' daily routines [12]. These gaps highlight the need for innovative preventive strategies that are physically engaging, contextually relevant, and tailored to meet the specific needs of students, while promoting long-term behavioral change toward an active lifestyle [13].

One strategic approach to addressing sedentary behavior among university students is the implementation of non-pharmacological, exercise-based interventions within the campus environment [20]. Such interventions emphasize the promotion of daily physical activity through simple yet consistent exercise programs that can be seamlessly integrated into academic life [21]. The primary goal of these interventions is to reduce prolonged sitting time, enhance cardiorespiratory capacity, improve body composition, and support mental health through beneficial neurobiological activation [22, 23]. Additionally, the social engagement that emerges from group-based exercise programs has the potential to boost students' intrinsic motivation to maintain an active lifestyle [24]. Several studies have shown that exercise-based interventions are effective in increasing physical activity levels, reducing sedentary time, and producing positive psychosocial outcomes among university students [25, 26, 27].

Analysis of the reviewed studies has shown that structured, non-pharmacological interventions based on physical activity can effectively reduce sedentary behavior and improve key health indicators among university students. The authors emphasize that such interventions are most effective when they are context-specific, seamlessly integrated into academic routines, and promote both individual engagement and social interaction. At the same time, there remains a clear need for further research to explore the long-term sustainability, adaptability, and psychological impact of these

interventions in diverse student populations and educational settings.

Therefore, this study aimed to design and evaluate a campus-based, non-pharmacological exercise intervention to prevent sedentary lifestyles among university students.

Materials and Methods

Participants

This study employed a two-group pre-experimental design using pretest and posttest assessments. A total of 58 participants (32 males and 26 females) were recruited from the Department of Sport Coaching Education, Faculty of Sport and Health Science, Universitas Negeri Surabaya (Indonesia). All participants were recruited using consecutive sampling. All eligible individuals who met the inclusion criteria and volunteered during the data collection period were enrolled in the study. Inclusion criteria included age between 18 and 20 years, body mass index (BMI) between 18.5 and 24.9 kg/m², and absence of any cardiovascular or metabolic diseases. Participants also had no history of smoking or alcohol consumption in the past five years and had not taken any medication in the last three months. All procedures complied with the principles of the Declaration of Helsinki.

Study Design

Both male and female participants underwent a 4-week combined exercise intervention involving aerobic exercise (jogging and power walking) and bodyweight resistance training. Four outcome variables were observed: resting heart rate (resting HR), cardiorespiratory fitness (VO₂max), physical activity level, and sedentary time (sitting or lying duration).

Exercise programs for male and female

The exercise intervention was conducted under the supervision of certified coaches from the Department of Sports Coaching Education to ensure the correct and safe performance of each movement. Participants followed a structured combined exercise program, consisting of aerobic exercise (jogging and power walking) and bodyweight resistance training, four times per week for four consecutive weeks. Sessions were conducted from 06:00 to 07:30 AM at the Universitas Negeri Surabaya Athletic Field. To ensure progressive physiological adaptation, the training program was designed based on the principle of progressive overload. In this approach, the intensity and duration of both aerobic and resistance components were gradually increased each week. This method is widely supported in exercise science as it allows the body to continuously adapt to increasing physical demands. As a result, it enhances cardiorespiratory fitness, muscular strength, and endurance. The

incremental adjustments, which were reflected in training time, repetition schemes, and target heart rates, were structured to avoid plateau and to optimize performance gains throughout the intervention period. Details of the intervention are presented in Table 1.

Data collection methods

Resting heart rate (resting HR) was assessed using the Polar H10 heart rate sensor (Polar Electric, Inc., Bethpage, NY, USA) [28]. Cardiorespiratory fitness (VO₂max) was measured using the 20-meter Multi-Stage Shuttle Run Test [29]. Physical activity

Table 1. Details of the exercise program

Group	Frequency	Intensity	Time	Type	Warm-up	Cooldown
Male and Female	Week 1	85% HRmax	3 sets (15 seconds training and 15 seconds rest) for each movement	Strength training (jumping jacks, plank jacks, burpees, jumping squats, mountain climb)	Dynamic stretching for 5 min	Static stretching for 5 min
		Jogging: 75% HRmax	30 min	Aerobic exercise (5 minutes jogging and 5 minutes power walking) 3 repetitions		
	Week 2	90% HRmax			3 sets (20 seconds training and 20 seconds rest) for each movement	Strength training (jumping jacks, plank jacks, burpees, jumping squats, mountain climbs)
		Jogging: 75% HRmax	40 min	Aerobic exercise (5 minutes jogging and 5 minutes power walking) 4 repetitions		
	Week 3	90% HRmax			3 sets (25 seconds training and 25 seconds rest) for each movement	Strength training (jumping jacks, plank jacks, burpees, jumping squats, mountain climbs)
		Jogging: 75% HRmax	50 min	Aerobic exercise (5 minutes jogging and 5 minutes power walking) 5 repetitions		
	Week 4	95% HRmax			3 sets (30 seconds training and 30 seconds rest) for each movement	Strength training (jumping jacks, plank jacks, burpees, jumping squats, mountain climb)
		Jogging: 75% HRmax	60 min	Aerobic exercise (5 minutes jogging and 5 minutes power walking) 6 repetitions		
	Power walking: 60% HRmax					

level and sedentary behavior (sitting or lying time) were assessed using the Global Physical Activity Questionnaire (GPAQ) from the World Health Organization [30]. All variables were measured at baseline (pretest) and after the intervention period of four weeks in both male and female participants.

Statistical analysis

Descriptive statistics were used to calculate means, standard deviations, and the distribution of the data. The Kolmogorov–Smirnov test was used to assess normality, and Levene’s test was used to assess homogeneity of variance. For normally distributed data, paired sample t-tests were used to evaluate changes between pretest and posttest values. Effect sizes were calculated using Cohen’s d, with values interpreted as small ($d = 0.2$), medium ($d = 0.5$), and large ($d \geq 0.8$). All statistical analyses were conducted using SPSS version 21 (SPSS Inc., Chicago, IL, USA), and the significance level was set at $p < 0.05$. Sample size calculations were performed using G*Power software (Düsseldorf, Germany).

Results

A total of 26 female and 32 male participants voluntarily provided written informed consent and completed the four-week intervention program. The demographic characteristics of the participants

are presented in Table 2. The observed changes in resting heart rate (resting HR), cardiorespiratory fitness (VO_2max), physical activity level, and sedentary time (sitting or lying duration) between pretest and posttest for both sexes are illustrated in Figure 1.

Table 2. Demographic characteristics of study participants

Characteristics	Female (n = 26)	Male (n = 32)
Age (years)	19.00 ± 0.40	19.03 ± 0.31
Height (m)	1.59 ± 0.05	1.70 ± 0.05
Weight (kg)	55.91 ± 6.71	65.34 ± 7.14
Body Mass Index (kg/m ²)	22.02 ± 2.06	22.58 ± 2.08

Note. Data are presented as mean ± standard deviation (SD).

Based on the results of the normality test (Kolmogorov–Smirnov) and homogeneity test (Levene’s), the data showed a normal distribution and homogeneous variance. Therefore, the parametric test could be applied.

As shown in Figure 1, the results of the paired sample t-test indicated a significant reduction in resting heart rate (resting HR) between pretest and posttest in both males (64.63 ± 5.35 vs. 59.75 ± 3.96

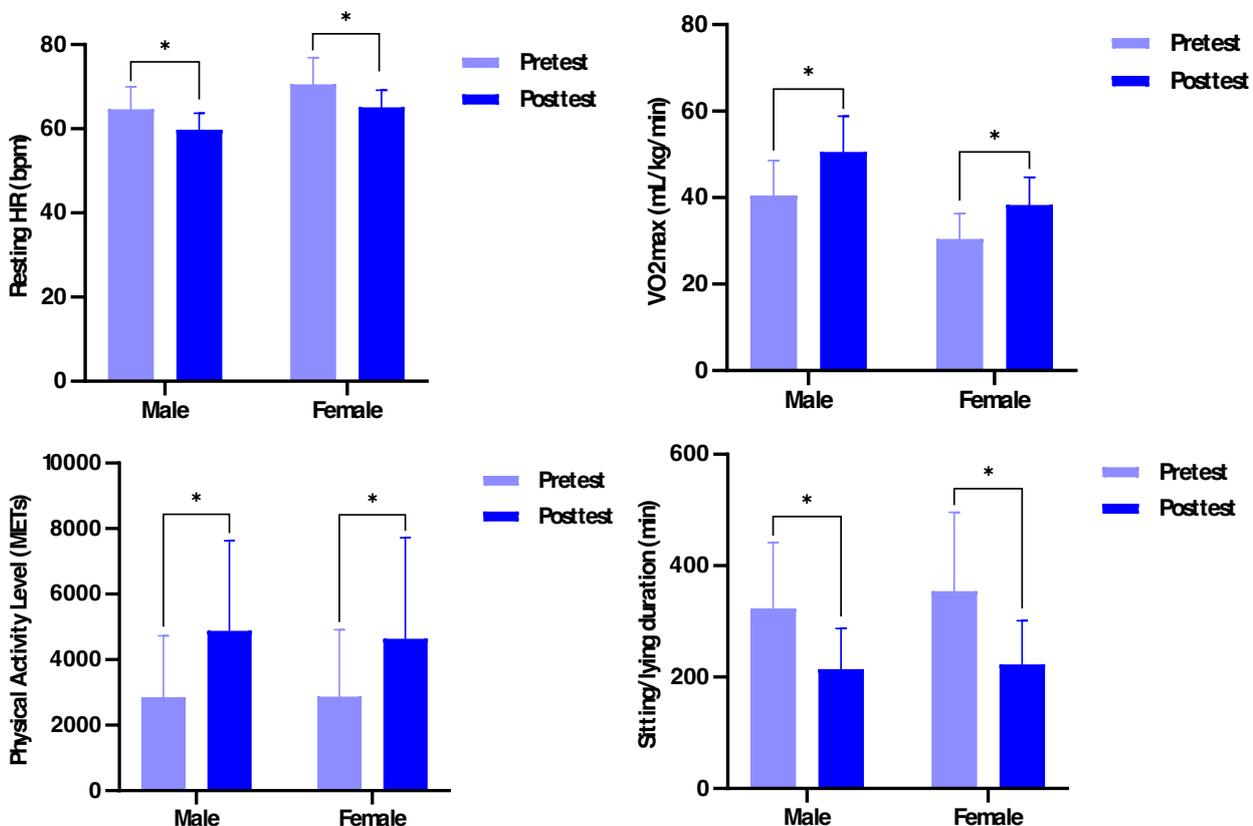


Figure 1. Assessment of Resting HR, VO_2max , Physical Activity Level, and Sitting/Lying Duration Between Pretest and Posttest in Both Sexes. *Significantly different from pretest ($p < 0.001$). p-values were obtained using paired sample t-tests. Data presented as mean ± standard deviation. Effect size calculated using Cohen’s d.

bpm; $p = 0.001$; effect size [ES] = 1.037; 95% CI: 3.64, 6.12) and females (70.54 ± 6.34 vs. 65.12 ± 4.03 bpm; $p = 0.001$; ES = 1.022; 95% CI: 3.43, 7.42). This corresponds to a decrease of 7.32 bpm (a reduction of 11.32 percent) in males and 7.26 bpm (a reduction of 10.29 percent) in females.

Cardiorespiratory fitness, as measured by VO_{2max} , showed a statistically significant improvement between pretest and posttest for both males (40.49 ± 8.09 vs. 50.58 ± 8.23 mL/kg/min; $p = 0.001$; ES = 1.237; 95% CI: 7.43, 12.75) and females (30.46 ± 5.84 vs. 38.27 ± 6.42 mL/kg/min; $p = 0.001$; ES = 1.272; 95% CI: 5.67, 9.95). VO_{2max} increased by 10.09 mL/kg/min (an increase of 27.43 percent) in males and 7.81 mL/kg/min (an increase of 27.50 percent) in females.

Significant increases in physical activity levels were also recorded. Male participants showed an increase from 2855.75 ± 1870.84 to 4878.50 ± 2753.76 METs ($p = 0.001$; ES = 0.859; 95% CI: 1394.92, 2650.58). Female participants increased from 2870.46 ± 2040.55 to 4639.54 ± 3081.11 METs ($p = 0.001$; ES = 0.677; 95% CI: 1038.14, 2500.01). This corresponds to an increase of 2022.75 METs (an increase of 114.17 percent) in males and 1769.08 METs (an increase of 114.65 percent) in females.

Additionally, sedentary time (measured as sitting or lying duration) significantly decreased in both groups. Males reduced from 323.44 ± 117.93 to 214.21 ± 72.92 minutes ($p = 0.001$; ES = 1.114; 95% CI: 64.27, 154.17). Females reduced from 354.08 ± 141.5 to 222.50 ± 78.71 minutes ($p = 0.001$; ES = 1.149; 95% CI: 63.19, 199.96). This represents a reduction of 109.22 minutes (a decrease of 22.65 percent) in males and 131.58 minutes (a decrease of 17.73 percent) in females.

Discussion

This study aimed to design and evaluate a campus-based, non-pharmacological exercise intervention to prevent sedentary lifestyles among university students. The findings demonstrate that a combination of aerobic exercise (jogging and power walking) and bodyweight-based resistance training has a significant impact. It improves cardiorespiratory fitness (VO_{2max}), lowers resting heart rate, increases daily physical activity, and reduces sedentary time among university students. These results support the effectiveness of non-pharmacological, physical activity-based interventions in the context of a healthy, non-clinical population. This study addresses gaps in the literature, which has predominantly examined aerobic and resistance training separately. In addition, most existing research has focused on clinical populations or individuals with high metabolic risk [31, 32, 33, 34, 35, 36]. By integrating both training modalities into a single protocol and applying it to a student population, this study offers

a more comprehensive experimental approach. It is tailored to the preventive active lifestyle needs of university students. Although combined aerobic and resistance training is not a novel concept, this study distinguishes itself by applying a minimal-equipment protocol within an open-campus setting. It targets healthy students in a real-world university environment.

The significant increase in VO_{2max} , particularly in the aerobic group, indicates physiological adaptations such as increased stroke volume, muscle perfusion, and oxygenation efficiency [37, 38]. VO_{2max} is a key parameter in assessing cardiorespiratory capacity and has been linked to long-term cardiovascular risk and mortality [39]. Interestingly, the resistance training group also exhibited VO_{2max} improvements, although to a lesser degree. This finding is consistent with earlier studies suggesting that bodyweight-based resistance exercises can induce sufficient metabolic and neuromuscular stimuli to enhance aerobic capacity, particularly in untrained individuals [40, 41, 42]. The reduction in resting heart rate further reflects increased cardiac efficiency. This is likely due to improved parasympathetic tone, indicating autonomic adaptation to the training program [43, 44].

In addition to physiological responses, the increase in METs scores indicates positive behavioral changes among participants in enhancing daily physical activity. The exercise program designed in this study combines moderate to high intensity with a practical structure. This enables students to engage in activity beyond formal training sessions. Aerobic exercise provides a rhythmic and familiar format that is easy to adopt. Resistance training involves simple but intense movements that target functional strength and muscle capacity [45, 46]. The significant reduction in sedentary time also reflects a shift toward a more active lifestyle among students. This finding supports the meta-analysis by Ekelund et al. [47], which showed that moderate to vigorous physical activity, even in short bouts, can reduce mortality risk associated with prolonged sitting behavior.

The improvements in physical activity levels and reductions in sedentary time observed in this study may be partially interpreted through established behavioral frameworks, although no psychological constructs were directly measured. Self-determination theory (SDT) suggests that when individuals experience autonomy, competence, and relatedness, they are more likely to develop intrinsic motivation for sustained physical activity [48]. The format of the intervention, which was simple, required no equipment, and was conducted in open campus settings, may have supported these needs. It may have done so by fostering a sense of choice, perceived capability, and social engagement.

Similar findings by Li et al. [49] highlight how such motivational contexts can enhance adherence and even cardiorespiratory fitness among college students, although our study did not assess these mediators directly.

In addition, the Theory of Planned Behavior (TPB) provides a complementary perspective. TPB posits that attitudes, perceived norms, and behavioral control predict intentions and subsequent behaviors [50]. While we did not collect data on these specific constructs, the structure of the intervention, with its regular scheduling and group participation, may have influenced students' perceived feasibility and social acceptability of engaging in physical activity. Wang and Kang [51] also emphasize the role of behavioral triggers, such as routine scheduling and peer support, which were embedded in our intervention and may have contributed to beneficial behavioral changes.

The university campus provides a distinct and practical setting for implementing physical activity interventions, particularly for young adults navigating academic and lifestyle transitions. As emphasized by García-Álvarez and Faubel [52], interventions that incorporate social engagement and participatory elements are more likely to encourage sustainable health habits among students. This study followed similar approaches by offering open-space sessions on campus that reduced structural and financial barriers.

Yin et al. [53] also noted the importance of contextual relevance and perceived enjoyment in university HIIT programs. These factors were present in the current intervention through its informal, flexible, and socially supportive design.

In line with broader trends in digital health promotion, the present study, although not incorporating technology directly, reflected essential principles of digital-social models. As demonstrated by Bi et al. [54], interventions that include peer interaction and behavioral cues through digital platforms improve student engagement and physical outcomes. Group-based outdoor sessions in this study may have reproduced some of these motivational effects through visible participation and shared routines.

Social reinforcement and perceived relatedness, as described in both SDT and TPB frameworks, likely contributed to adherence. In addition to behavioral improvements, emerging research highlights the mental and cognitive benefits of combining exercise modalities. Dhahbi et al. [55] reported that aerobic and resistance training support cognitive resilience. Wang et al. [56] found that regular combined training in supportive environments may help reduce depressive symptoms.

Taken together, these insights support the potential of integrated and socially embedded physical activity interventions to promote multiple

benefits for young adult populations in non-clinical academic settings. Such program characteristics may be especially relevant in the post-pandemic academic environment, where promoting physical activity must address increased screen exposure, digital fatigue, and limited social interaction.

From a practical standpoint, the design of this intervention offers flexibility and broad applicability. Activities such as jogging, power walking, and bodyweight resistance training can be performed with minimal infrastructure. This makes the program particularly suitable for institutions with limited resources. The ACSM's position statement affirms that moderate-intensity aerobic and resistance training are sufficient to improve cardiorespiratory, neuromuscular, and functional health in healthy adults [45]. Steele et al. [46] also support the integration of effort-based resistance models in public health programming. These recommendations align with the structure of our intervention and support its relevance, even in resource-limited educational settings. From a methodological perspective, the use of a pre-post experimental design allowed for direct observation of behavioral and physiological change. Furthermore, targeting a healthy young adult population adds a distinct contribution, as most combination training studies have focused on clinical or at-risk groups. This focus provides useful insight into preventive strategies for wider, non-clinical populations within higher education.

Study Limitations

Despite its promising findings, this study has several limitations that should be acknowledged. The absence of a control group limits the ability to attribute the observed changes solely to the intervention, as other external influences may have contributed to the outcomes. Furthermore, the relatively small and demographically homogeneous sample (in terms of age, baseline activity level, and health status) reduces the generalizability of the findings to broader student populations. The short intervention duration of four weeks may also be insufficient to capture long-term physiological adaptations. This is especially relevant for parameters such as $VO_2\max$ and resting heart rate, which usually require extended exposure to demonstrate sustained improvement. In addition, uncontrolled external variables such as diet, sleep patterns, academic stress, and individual motivation could have introduced variability in participant responses. Another limitation lies in the use of self-reported instruments, including the Global Physical Activity Questionnaire (GPAQ), to assess physical activity and sedentary time. Although GPAQ is a widely validated tool, it remains subject to potential recall bias and social desirability effects, which may have led participants to overreport or underreport their actual behaviors.

Future studies would benefit from incorporating objective measures such as accelerometers to improve data accuracy and reliability. To address current limitations, future research should consider including randomized control groups, extending intervention durations, and recruiting more diverse populations across different institutions and activity backgrounds. Further research is also needed to evaluate the long-term sustainability of such interventions and their adaptability across varied demographic and institutional contexts. This should involve the use of randomized controlled designs and extended follow-up periods. In addition, future applications may include integrating structured exercise programs into student health services, academic curricula, or campus wellness policies. Applying mixed-methods approaches may enhance understanding of psychosocial determinants of physical activity. These include habit formation, fatigue perception, and environmental barriers, particularly among university students [57, 58]. Such approaches may help explore the dynamics of student motivation in maintaining participation after the formal intervention period.

Conclusions

This study demonstrates that a short-term,

structured physical activity intervention can lead to measurable improvements in cardiorespiratory fitness and reductions in sedentary behavior among healthy university students aged 18 to 20. While these findings are specific to a relatively homogeneous, non-clinical student population, they suggest that simple and low-cost exercise strategies, when implemented within the campus environment, can be both feasible and effective. Instead of aiming for broad generalization, these results support the development of targeted interventions within educational institutions, particularly in contexts with limited access to fitness infrastructure.

Conflict of Interest

The authors declare that they have no conflicts of interest.

AI Tools Usage

During the preparation of this manuscript, the authors utilized the AI-based tool ChatGPT (OpenAI) to assist in language editing and initial phrasing of certain background sections. The content was subsequently reviewed and revised by the authors to ensure accuracy and originality. No data analysis or interpretation was performed using AI tools. The authors take full responsibility for all content.

References

- Guerriero MA, Dipace A, Monda A, De Maria A, Polito R, Messina G, et al. Relationship Between Sedentary Lifestyle, Physical Activity and Stress in University Students and Their Life Habits: A Scoping Review with PRISMA Checklist (PRISMA-ScR). *Brain Sci.* 2025;15(1):78. <https://doi.org/10.3390/brainsci15010078>
- World Health Organization (WHO). *Physical activity* [Internet]. 2020 [updated 2024 Jun; cited 2024 Sep 28]. Available from: <https://www.who.int/news-room/fact-sheets/detail/physical-activity>
- Huang Z, Liu Y, Zhou Y. Sedentary Behaviors and Health Outcomes among Young Adults: A Systematic Review of Longitudinal Studies. *Healthcare (Basel)*, 2022;10(8):1480. <https://doi.org/10.3390/healthcare10081480>
- Pate RR, O'Neill JR, Lobelo F. The evolving definition of "sedentary". *Exerc Sport Sci Rev.* 2008;36(4):173-178. <https://doi.org/10.1097/JES.0b013e3181877d1a>
- García-Lorenzo E, Visos-Varela I, Pintos-Rodríguez S, Salgado-Barreira A, Corral-Varela M, Figueiras-Guzmán A, et al. Physical activity and sedentarism among university students: an approach using a real-life survey. *Eur J Public Health.* 2024;34(Suppl 3):ckae144.1297. <https://doi.org/10.1093/eurpub/ckae144.1297>
- Chen L. Research on the Psychological and Social Development of College Students in the New Era. *Academic Journal of Humanities & Social Sciences*, 2023;6(22):121–126. <https://doi.org/10.25236/AJHSS.2023.062221>
- Olson N, Oberhoffer-Fritz R, Reiner B, Schulz T. Stress, student burnout and study engagement - a cross-sectional comparison of university students of different academic subjects. *BMC Psychol.* 2025;13(1):293. <https://doi.org/10.1186/s40359-025-02602-6>
- Edelmann D, Pfirrmann D, Heller S, Dietz P, Reichel JL, Werner AM, et al. Physical Activity and Sedentary Behavior in University Students-The Role of Gender, Age, Field of Study, Targeted Degree, and Study Semester. *Front Public Health.* 2022;10:821703. <https://doi.org/10.3389/fpubh.2022.821703>
- Zhang L, Zhao S, Zhao S, Ke Y, Yang W, Lei M. Association Between the Time of Exposure to Electronic Screen and Anxiety and Depression After Controlling Demographics, Exercises, and Lifestyles Among University Students. *Neuropsychiatr Dis Treat.* 2025;21:885–902. <https://doi.org/10.2147/ndt.s510287>
- Vainshelboim B, Brennan GM, LoRusso S, Fitzgerald P, Wisniewski KS. Sedentary behavior and physiological health determinants in male and female college students. *Physiol Behav.* 2019;204:277–282. <https://doi.org/10.1016/j.physbeh.2019.02.041>
- Castro O, Bennie J, Vergeer I, Bosselut G, Biddle SJH. Correlates of sedentary behaviour in university students: A systematic review. *Prev Med.* 2018;116:194–202. <https://doi.org/10.1016/j.ypmed.2018.09.016>

12. Park MJ, Scott JT, Adams SH, Brindis CD, Irwin CE Jr. Adolescent and young adult health in the United States in the past decade: little improvement and young adults remain worse off than adolescents. *J Adolesc Health*. 2014;55(1):3–16. <https://doi.org/10.1016/j.jadohealth.2014.04.003>
13. Bonnie RJ, Stroud C, Breiner H. *Committee on Improving the Health, Safety, and Well-Being of Young Adults; Board on Children, Youth, and Families; Institute of Medicine; Investing in the Health and Well-Being of Young Adults*. Washington (DC): National Academies Press (US); 2015.
14. Castro O, Bennie J, Vergeer I, Bosselut G, Biddle SJH. How Sedentary Are University Students? A Systematic Review and Meta-Analysis. *Prev Sci*. 2020;21(3):332–343. <https://doi.org/10.1007/s11121-020-01093-8>
15. Patterson R, McNamara E, Tainio M, de Sá TH, Smith AD, Sharp SJ, et al. Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis. *Eur J Epidemiol*. 2018;33(9):811–829. <https://doi.org/10.1007/s10654-018-0380-1>
16. Biswas A, Oh PI, Faulkner GE, Bajaj RR, Silver MA, Mitchell MS, et al. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Ann Intern Med*. 2015;162(2):123–32. <https://doi.org/10.7326/M14-1651>
17. Wilmot EG, Edwardson CL, Achana FA, Davies MJ, Gorely T, Gray LJ, Khunti K, Yates T, Biddle SJ. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia*, 2013;56(4):942–3. <https://doi.org/10.1007/s00125-012-2677-z>
18. Teychenne M, Costigan SA, Parker K. The association between sedentary behaviour and risk of anxiety: a systematic review. *BMC Public Health*, 2015;15:513. <https://doi.org/10.1186/s12889-015-1843-x>
19. Zhai L, Zhang Y, Zhang D. Sedentary behaviour and the risk of depression: a meta-analysis. *Br J Sports Med*. 2015;49(11):705–709. <https://doi.org/10.1136/bjsports-2014-093613>
20. Vella CA, Nelson MC. Patterns and correlates of sedentary behavior among university students. *J Am Coll Health*. 2024;72(9):3772–3780. <https://doi.org/10.1080/07448481.2023.2198020>
21. Maselli M, Ward PB, Gobbi E, Carraro A. Promoting Physical Activity Among University Students: A Systematic Review of Controlled Trials. *Am J Health Promot*. 2018;32(7):1602–1612. <https://doi.org/10.1177/0890117117753798>
22. Blom V, Drake E, Kallings LV, Ekblom MM, Nooijen CFJ. The effects on self-efficacy, motivation and perceived barriers of an intervention targeting physical activity and sedentary behaviours in office workers: a cluster randomized control trial. *BMC Public Health*, 2021;21(1):1048. <https://doi.org/10.1186/s12889-021-11083-2>
23. Feter N, Ligeza TS, Bashir N, Shanmugam RJ, Montero Herrera B, Aldabbagh T, et al. Effects of reducing sedentary behaviour by increasing physical activity, on cognitive function, brain function and structure across the lifespan: a systematic review and meta-analysis. *Br J Sports Med*. 2024;58(21):1295–1306. <https://doi.org/10.1136/bjsports-2024-108444>
24. Han X, Li H, Niu L. How does physical education influence university students' psychological health? An analysis from the dual perspectives of social support and exercise behavior. *Front Psychol*. 2025;16:1457165. <https://doi.org/10.3389/fpsyg.2025.1457165>
25. Contardo Ayala AM, Parker K, Mazzoli E, Lander N, Ridgers ND, Timperio A, et al. Effectiveness of Intervention Strategies to Increase Adolescents' Physical Activity and Reduce Sedentary Time in Secondary School Settings, Including Factors Related to Implementation: A Systematic Review and Meta-Analysis. *Sports Med Open*. 2024;10(1):25. <https://doi.org/10.1186/s40798-024-00688-7>
26. Harding S, Richardson A, Glynn A, Hodgson L. Influencing factors of sedentary behaviour in people with chronic obstructive pulmonary disease: a systematic review. *BMJ Open Respir Res*. 2024;11(1):e002261. <https://doi.org/10.1080/15412555.2025.2482710>
27. Cao L, Yu Q, Feng X, Wang L, Lang J. The influence of physical exercise on achievement motivation among college students: the mediating roles of self-efficacy and life satisfaction. *Front Psychol*. 2025;16:1529829. <https://doi.org/10.3389/fpsyg.2025.1529829>
28. Pranoto A, Putera SHP, Yudhistira D, Ristiawan B, Al Adha Nikmah R, Bimantoro AP, et al. Long-term Endurance Training as a Modulator for Preventing Cardiovascular Disease Risk in Obese Individuals. *Physical Education Theory and Methodology*, 2025;25(2):221–227. <https://doi.org/10.17309/tmfv.2025.2.01>
29. Puspodari P, Wiriawan O, Setijono H, Arfanda PE, Himawanto W, Koestanto SH, et al. Effectiveness of Zumba Exercise on Maximum Oxygen Volume, Agility, and Muscle Power in Female Students. *Physical Education Theory and Methodology*, 2022;22(4):478–484. <https://doi.org/10.17309/tmfv.2022.4.04>
30. World Health Organization (WHO). *Global physical activity questionnaire (GPAQ)* [Internet]. Geneva: WHO Press. 2021 [updated 2024 Jun; cited 2024 Sep 28]. Available from: <https://www.who.int/publications/m/item/global-physical-activity-questionnaire>
31. García-Hermoso A, Ramírez-Vélez R, Ramírez-Campillo R, Peterson MD, Martínez-Vizcaíno V. Concurrent aerobic plus resistance exercise versus aerobic exercise alone to improve health outcomes in paediatric obesity: a systematic review and meta-analysis. *Br J Sports Med*. 2018;52(3):161–166. <https://doi.org/10.1136/bjsports-2016-096605>
32. Ramos-Campo DJ, Andreu Caravaca L, Martínez-Rodríguez A, Rubio-Arias JÁ. Effects of Resistance Circuit-Based Training on Body Composition, Strength and Cardiorespiratory Fitness: A Systematic Review and Meta-Analysis. *Biology (Basel)*. 2021;10(5):377. <https://doi.org/10.3390/biology10050377>

33. Weston KS, Wisløff U, Coombes JS. High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis. *Br J Sports Med.* 2014;48(16):1227–1234. <https://doi.org/10.1136/bjsports-2013-092576>
34. Zhang J, Tam WWS, Hounsri K, Kusuyama J, Wu VX. Effectiveness of Combined Aerobic and Resistance Exercise on Cognition, Metabolic Health, Physical Function, and Health-related Quality of Life in Middle-aged and Older Adults With Type 2 Diabetes Mellitus: A Systematic Review and Meta-analysis. *Arch Phys Med Rehabil.* 2024;105(8):1585–1599. <https://doi.org/10.1016/j.apmr.2023.10.005>
35. Valenti VE, Chagas ADS, Chedraui P, de Souza IS, Porto AA, Sorpreso ICE, Soares Júnior JM, Zangirolami-Raimundo J, Garner DM, Raimundo RD. Effect of combined aerobic exercise and resistance training on postmenopausal women with type 2 diabetes: a systematic review and meta-analysis. *Gynecol Endocrinol.* 2025;41(1):2450338. <https://doi.org/10.1080/09513590.2025.2450338>
36. Mengistu FA, Lake YA, Andualem ME, Miherete YD, Zewdie SA. Impact of aerobic, resistance, and combined training on cardiometabolic health-related indicators in inactive middle-aged men with excess body weight and obesity. *Front Physiol.* 2025;16:1519180. <https://doi.org/10.3389/fphys.2025.1519180>
37. Gormley SE, Swain DP, High R, Spina RJ, Dowling EA, Kotipalli US, et al. Effect of intensity of aerobic training on VO₂max. *Med Sci Sports Exerc.* 2008;40(7):1336–43. <https://doi.org/10.1249/MSS.0b013e31816c4839>
38. Gao Z, Li Y, Zhang J, Li L, Wang T, Wang X, Wang H. Effects of aerobic training with blood flow restriction on aerobic capacity, muscle strength, and hypertrophy in young adults: a systematic review and meta-analysis. *Front Physiol.* 2025;15:1506386. <https://doi.org/10.3389/fphys.2024.1506386>
39. Joyner MJ, Coyle EF. Endurance exercise performance: the physiology of champions. *J Physiol.* 2008;586(1):35–44. <https://doi.org/10.1113/jphysiol.2007.143834>
40. Ozaki H, Loenneke JP, Thiebaud RS, Abe T. Resistance training induced increase in VO₂max in young and older subjects. *Eur Rev Aging Phys Act.* 2013;10(2):107–116. <https://doi.org/10.1007/s11556-013-0120-1>
41. Shaw BS, Shaw I. Effect of resistance training on cardiorespiratory endurance and coronary artery disease risk. *Cardiovasc J S Afr.* 2005;16(5):256–259.
42. Kumari A, Gujral T, Sidiq M, Kashoo F, Hanif H, Rai RH. Effect of combined aerobic and resistance training exercise on Vo₂ max and BMI in overweight collegiate population a randomized controlled trial. *J Bodyw Mov Ther.* 2025;42:221–226. <https://doi.org/10.1016/j.jbmt.2024.12.023>
43. Reimers AK, Knapp G, Reimers CD. Effects of Exercise on the Resting Heart Rate: A Systematic Review and Meta-Analysis of Interventional Studies. *J Clin Med.* 2018;7(12):503. <https://doi.org/10.3390/jcm7120503>
44. Bharwani M, Peregrin-Alvarez JM. Consistent reduction of heart rate through regular aerobic exercise. *JCMPHR.* 2021;2(8):1–3. <https://doi.org/10.38207/JCMPHR/2021/0208135>
45. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, et al. American College of Sports Medicine. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Med Sci Sports Exerc.* 2011;43(7):1334–59. <https://doi.org/10.1249/mss.0b013e318213f3fb>
46. Steele J, Fisher J, Skivington M, Dunn C, Arnold J, Tew G, et al. A higher effort-based paradigm in physical activity and exercise for public health: making the case for a greater emphasis on resistance training. *BMC Public Health.* 2017;17(1):300. <https://doi.org/10.1186/s12889-017-4209-8>
47. Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, et al. Lancet Physical Activity Series 2 Executive Committee; Lancet Sedentary Behaviour Working Group. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *Lancet.* 2016;388(10051):1302–10. [https://doi.org/10.1016/S0140-6736\(16\)30370-1](https://doi.org/10.1016/S0140-6736(16)30370-1)
48. Teixeira PJ, Carraça EV, Markland D, Silva MN, Ryan RM. Exercise, physical activity, and self-determination theory: a systematic review. *Int J Behav Nutr Phys Act.* 2012;9:78. <https://doi.org/10.1186/1479-5868-9-78>
49. Li B, Han S, Meng S, Lee J, Cheng J, Liu Y. Promoting exercise behavior and cardiorespiratory fitness among college students based on the motivation theory. *BMC Public Health.* 2022;22(1):738. <https://doi.org/10.1186/s12889-022-13159-z>
50. Thompson NR, Asare M, Millan C, Umstattd Meyer MR. Theory of Planned Behavior and Perceived Role Model as Predictors of Nutrition and Physical Activity Behaviors Among College Students in Health-Related Disciplines. *J Community Health.* 2020;45(5):965–972. <https://doi.org/10.1007/s10900-020-00814-y>
51. Wang Y, Kang HK. The Role of Triggers in Physical Activity among College Students: An Extended Model of the Theory of Planned Behavior. *Behav Sci (Basel).* 2024;14(4):328. <https://doi.org/10.3390/bs14040328>
52. García-Álvarez D, Faubel R. Strategies and Measurement Tools in Physical Activity Promotion Interventions in the University Setting: A Systematic Review. *Int J Environ Res Public Health.* 2020;17(18):6526. <https://doi.org/10.3390/ijerph17186526>
53. Yin H, Zhang J, Lian M, Zhang Y. A systematic review and meta-analysis of the effectiveness of high-intensity interval training for physical fitness in university students. *BMC Public Health.* 2025;25(1):1601. <https://doi.org/10.1186/s12889-025-22829-7>
54. Bi S, Yuan J, Wang Y, et al. Effectiveness of Digital Health Interventions in Promoting Physical Activity

- Among College Students: Systematic Review and Meta-Analysis. *J Med Internet Res.* 2024;26:e51714. <https://doi.org/10.2196/51714>
55. Dhahbi W, Briki W, Heissel A, et al. Physical Activity to Counter Age-Related Cognitive Decline: Benefits of Aerobic, Resistance, and Combined Training-A Narrative Review. *Sports Med Open.* 2025;11(1):56. <https://doi.org/10.1186/s40798-025-00857-2>
56. Wang H, Liu Q, Pan Y. Impact of combiner aerobic and resistance training on depression: a systematic review and meta-analysis of randomized controlled trials. *BMC Sports Sci Med Rehabil.* 2025;17(1):10. <https://doi.org/10.1186/s13102-025-01058-w>
57. Brown CEB, Richardson K, Halil-Pizzirani B, Atkins L, Yücel M, Segrave RA. Key influences on university students' physical activity: a systematic review using the Theoretical Domains Framework and the COM-B model of human behaviour. *BMC Public Health.* 2024;24(1):418. <https://doi.org/10.1186/s12889-023-17621-4>
58. Feil K, Allion S, Weyland S, Jekauc D. A Systematic Review Examining the Relationship Between Habit and Physical Activity Behavior in Longitudinal Studies. *Front Psychol.* 2021;12:626750. <https://doi.org/10.3389/fpsyg.2021.626750>

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