

Endurance training and its impact on physical health among university students

El entrenamiento de resistencia y su impacto en la salud física de los estudiantes universitarios

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Abstract. This study seeks to emphasise the importance of endurance training in improving the physical well-being of college students. Cardiovascular fitness, body composition, and muscular strength are crucial for overall health, particularly among university students, driving the motivation for this study. The study involved 42 university students who were surveyed using standardised instruments to evaluate their participation in endurance training activities and self-reported physical health indicators. Researchers conducted correlation studies to explore the connections between the frequency and duration of endurance exercise and cardiovascular fitness, body composition, and muscular strength. The study design involved survey distribution, data collection on physical health indicators, and statistical analysis to identify the correlations. The study's findings show that there are strong positive connections between the frequency and length of endurance training and improvements in cardiovascular fitness and muscular strength among university students. Nevertheless, there were no notable correlations found between body mass index and sit-up ability. These findings highlight the potential advantages of regular endurance training for improving various areas of physical health in this particular group. This study holds significance for coaches, fitness professionals, and university students. The significance of incorporating endurance training into the exercise regimens of university students to enhance their physical well-being is emphasised. Coaches can empower students to improve their overall well-being by emphasising the advantages of endurance exercise and offering personalised advice. This research further enhances the existing knowledge on the significance of endurance training in university settings by providing practical suggestions for coaching interventions.

Keywords: Cardiovascular Fitness, Body Composition, Muscular Strength

Resumen. Este estudio busca enfatizar la importancia del entrenamiento de resistencia para mejorar el bienestar físico de los estudiantes universitarios. La aptitud cardiovascular, la composición corporal y la fuerza muscular son cruciales para la salud general, particularmente entre los estudiantes universitarios, lo que impulsa la motivación de este estudio. El estudio involucró a 42 estudiantes universitarios que fueron encuestados utilizando instrumentos estandarizados para evaluar su participación en actividades de entrenamiento de resistencia e indicadores de salud física autoinformados. Los investigadores realizaron estudios de correlación para explorar las conexiones entre la frecuencia y la duración del ejercicio de resistencia y la aptitud cardiovascular, la composición corporal y la fuerza muscular. El diseño del estudio implicó la distribución de la encuesta, la recopilación de datos sobre indicadores de salud física y el análisis estadístico para identificar las correlaciones. Los hallazgos del estudio muestran que existen fuertes conexiones positivas entre la frecuencia y la duración del entrenamiento de resistencia y las mejoras en la aptitud cardiovascular y la fuerza muscular entre los estudiantes universitarios. Sin embargo, no se encontraron correlaciones notables entre el índice de masa corporal y la capacidad para hacer abdominales. Estos hallazgos resaltan las posibles ventajas del entrenamiento de resistencia regular para mejorar varias áreas de la salud física en este grupo en particular. Este estudio es importante para los entrenadores, los profesionales del fitness y los estudiantes universitarios. Se destaca la importancia de incorporar el entrenamiento de resistencia en los regímenes de ejercicio de los estudiantes universitarios para mejorar su bienestar físico. Los entrenadores pueden capacitar a los estudiantes para mejorar su bienestar general enfatizando las ventajas del ejercicio de resistencia y ofreciendo asesoramiento personalizado. Esta investigación mejora aún más el conocimiento existente sobre la importancia del entrenamiento de resistencia en entornos universitarios al brindar sugerencias prácticas para intervenciones de entrenamiento.

Palabras clave: Aptitud cardiovascular, composición corporal, fuerza muscular

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Introduction

Physical activity is essential for a healthy lifestyle, especially for university students dealing with the challenges of academic life (Siedentop & Van der Mars, 2022). Transitioning from high school to university typically brings about numerous changes in living habits as students navigate increasing independence, academic demands, and social responsibilities (Nunn, 2021; Saputra et al., 2024). During this transition, students' physical activity tends to decrease while sedentary behaviours rise, posing significant obstacles to their general well-being. Many academic activities involve sitting for long periods, which, along with the

attraction of digital gadgets and screen use, increases the likelihood of physical inactivity in university students (Ihsan, Juniar, et al., 2023; Lu et al., 2023; Rathi et al., 2024). Lifestyle changes can significantly impact students' physical health, leading to increased chances of weight gain, cardiovascular difficulties, musculoskeletal issues, and mental health issues. Endurance training is an organised and effective way to combat the negative impacts of sedentary lives and improve physical health among university students (Herbert, 2022; Herbert et al., 2020; Kiram et al., 2023). Endurance training involves prolonged and repetitive actions performed for extended periods, incorporating various aerobic workouts such as running, cycling, swimming,

and brisk walking. These activities enhance cardiovascular fitness, boost heart rate, and provide benefits to muscular strength, endurance, flexibility, and overall physical performance. Endurance training is linked to numerous health benefits, such as decreased chances of chronic conditions like cardiovascular disease, obesity, diabetes, and specific forms of cancer (Khemka et al., 2023; Komaini et al., 2023). The potential of this to improve mental well-being, reduce stress, and boost cognitive performance highlights its importance in the university environment, where students face high academic demands and mental health issues. Universities may establish a culture of health and wellbeing by encouraging consistent participation in endurance training, which helps students prioritise their physical and mental well-being while managing academic responsibilities (Neldi et al., 2023; Nelson et al., 2023). Institutions can significantly impact students by providing specific treatments, resources, and environments that foster an active lifestyle and the benefits of endurance training.

Herbert et al. (2020) stated that university students encounter numerous problems that present substantial risks to their physical health and well-being. The challenging academic workload, consisting of intense coursework, papers, and exams, frequently results in students having little time and energy to focus on their health. Mirchandani & Shan (2024) highlight on their studies that students sometimes struggle to balance academic responsibilities with personal well-being due to irregular schedules, extracurricular activities, part-time employment, and social commitments. Amidst the academic and social pressures, students typically prioritise meeting deadlines and commitments over taking care of themselves, neglecting sleep, nutrition, and exercise. Sedentary behaviours are widespread in the digital era, with long periods of sitting and screen usage making these difficulties worse (Bonnet & Cheval, 2023; Woodruff et al., 2021). Many students lead sedentary lifestyles, spending long hours studying in the library or attending lectures, which can increase their risk of various health issues. Research shows that a considerable number of college students do not achieve the suggested amount of physical activity, leading to outcomes like weight gain, cardiovascular problems, and mental health difficulties such as despair and anxiety.

Endurance training provides a glimmer of hope in the face of physical inactivity and its related health dangers (Hosseinzadeh et al., 2023; Ihsan, Satria, et al., 2023). Endurance training, which includes various aerobic workouts including running, cycling, swimming, and brisk walking, is widely recognised as an effective method for improving physical health and well-being (Kramer, 2020; Qiu et al., 2023). These activities enhance cardiovascular fitness, increase heart rate, and improve muscular strength, endurance, flexibility, and overall physical performance (Bai et al., 2022; Görner & Reineke, 2020a). Many studies have examined the effectiveness of endurance training in various groups, such as athletes and elderly individuals, but few have specifically looked at the specific problems and

opportunities found in university settings (De la Iglesia et al., 2020; Mashud et al., 2024; Scheer et al., 2022). Given the growing concern about the negative effects of sedentary lifestyles on the physical health of university students, it is important to thoroughly understand the specific impact of endurance training on their overall well-being. This will help in creating targeted interventions and policies to reduce the harmful effects of sedentary behaviours and promote a culture of health and well-being on college campuses.

When university students engage in endurance training, using the Health Belief Model (HBM) helps to provide a detailed insight into the various elements influencing students' attitudes, motivations, and behaviours towards physical activity (Martins et al., 2023; Toy, 2021; Zhang et al., 2023). Students' beliefs about the serious and likely health risks associated with physical inactivity, such as obesity, cardiovascular disease, and mental health issues (Newby et al., 2020; Ren et al., 2021), significantly impact their participation in endurance training. Their evaluation of the advantages of endurance training, including greater physical fitness, improved well-being, and decreased risk of chronic diseases, significantly influences their decision-making. Perceived hurdles to endurance exercise, like time limitations, academic demands, a lack of facility access, and social factors, can be significant barriers that impede involvement. Moreover, cues to action, including health promotion campaigns, peer support networks, and institutional regulations that encourage physical activity, might act as catalysts to motivate students to start and maintain endurance training habits.

Researchers can analyse these characteristics systematically using the Health Belief Model to understand how cognitive, affective, and environmental factors influence students' participation in endurance training (Shearer et al., 2021). This comprehensive understanding can guide the creation of customised interventions and methods to encourage and maintain physical activity habits among university students. Universities can use information from the Health Belief Model to create complex interventions that target students' identified obstacles, utilise current prompts to encourage action, and foster a supportive environment that promotes lasting behavioural changes. The use of the Health Belief Model (HBM) shows potential in promoting a healthy environment on college campuses and encouraging students to focus on their physical health and succeed in the academic setting.

The current research emphasises the numerous advantages of endurance training for health and well-being. However, there is a noticeable lack of information regarding its effects on university students (Olaimat et al., 2020; Saied et al., 2021). Although there is ample evidence supporting the effectiveness of endurance training in various groups, such as athletes, older adults, and individuals with chronic conditions, there is a lack of research specifically addressing the challenges and opportunities in the university setting. This study aims to fill this important gap by

conducting a thorough investigation into the correlation between participating in endurance training and physical health outcomes among university students.

This research is important because it has the ability to reveal the complex elements that affect students' participation in endurance training at the university level. This study aims to explore the various elements influencing students' attitudes, motives, and behaviours towards physical activity by considering psychosocial, environmental, and institutional aspects in a multidimensional approach. Researchers intend to find actionable insights by examining the obstacles and factors that influence university students' participation in endurance training. This information will be used to design and implement tailored interventions to promote sustainable physical activity behaviours.

This study aims to connect theory with practice by translating theoretical frameworks and empirical evidence into methods to promote physical health and well-being among university students. Researchers aim to catalyse revolutionary change within the university community by examining the effectiveness of endurance training treatments and proposing techniques to overcome barriers to participation. Researchers aim to foster a culture of fitness, resilience, and holistic well-being. This project aims to enable students to take control of their health and adopt an active lifestyle through collaboration and multidisciplinary methods, leading to healthier and more rewarding lives while pursuing academics.

Method

The study utilised a quantitative research method known for its effectiveness in methodically gathering and analysing numerical data to identify complex linkages and trends within a specific population (Naeem et al., 2023; Osei et al., 2023). Using quantitative approaches, the study aimed to thoroughly assess the effect of endurance training on the physical health of university students. The research aimed to provide objective insights into the complex association between participating in endurance training activities and several physical health markers within the student group through thorough data collection and rigorous statistical analysis. Using a quantitative approach allowed the study to move beyond simple observation, leading to a more profound comprehension of the quantitative subtleties that influence the relationship between participation in endurance exercise and many elements of physical health (Kellehear, 2020; Pratt et al., 2022; Strijker et al., 2020).

The study aims to provide empirical evidence using a quantitative approach to inform evidence-based programs and policies for encouraging healthier lifestyles and improving physical health outcomes among university students. The purposeful selection of a quantitative research approach highlights the study's dedication to thoroughly investigating the quantitative aspects of endurance training's effects on physical health among university students. The primary method used in this study involved carefully conducting

structured surveys designed to collect detailed data on participants' participation in endurance training activities and their resulting physical health outcomes. The study collected crucial information necessary for its objectives by using carefully designed, standardised questionnaires that included several relevant factors. The questionnaires were carefully crafted to include a wide range of important factors, including the frequency and length of endurance training sessions and the various types of endurance activities done by participants. The surveys thoroughly investigated individuals' self-reported physical health indicators, including important aspects such as cardiovascular fitness, body composition, and muscular strength. Participants from university of coaching departments in Universitas Negeri Padang were carefully selected using a convenience sampling method to guarantee a varied cohort. Before participation, we conducted a thorough informed consent process with all 42 respondents to clarify the study's purpose, highlight the voluntary nature of participation, and stress the strict confidentiality measures in place to protect their responses.

In order to ensure the reliability of the questionnaires, this study employed pilot testing. The preliminary version of the questionnaire was produced using pre-existing research and guidance from experts. This draft was evaluated on a sample of 10 students who closely resemble our target market in order to detect any potential problems. A select few were chosen to facilitate comprehensive input and feasible improvements. The participants in the pilot group offered input regarding the clarity and pertinence of the questions. The questionnaire was changed based on the comments received in order to address any questions that were confusing or unclear.

We carefully conducted the poll using Google Docs for their efficiency and user-friendliness. Guiding participants carefully through the survey procedure with clear and extensive instructions promoted a thorough comprehension of the task, ultimately encouraging honest and accurate responses. Our team carefully designed the survey with detailed sections covering demographic information such as age, gender, and academic major, as well as specific questions about participants' involvement in endurance training and self-reported physical health. After carefully collecting data, the responses were thoroughly checked for quality and completeness before being methodically organised and inputted into IBM SPSS Statistics for its analytical features. Utilising advanced statistical methods, such as means, standard deviations, and frequencies, allowed for a detailed overview of the sample characteristics and participants' responses, providing significant insights into the study population.

The study conducted correlational analyses using the Pearson correlation coefficient to examine the relationship between endurance training participation and physical health outcomes (Xuan et al., 2020). The researchers used this detailed analytical method to clarify the complex relationship between participation in endurance training and various aspects of physical health among the participants,

providing valuable insights into the study's primary objectives. The Pearson correlation coefficient (r) was employed to assess the strength and direction of the relationship between endurance training participation (frequency and duration) and physical health indicators. The formula for calculating the Pearson correlation coefficient is as follows:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n(\sum x^2) - (\sum x)^2][n(\sum y^2) - (\sum y)^2]}}$$

Where:

n represents the number of observations (42 students in this study).

x represents the frequency or duration of endurance training sessions.

y represents the scores on physical health indicators.

$\sum xy$, $\sum x^2$, $\sum y^2$, $\sum x$, and $\sum y$ denotes the sums of the respective variables.

The Pearson correlation coefficient ranges from -1 to +1, with values closer to +1 indicating a strong positive correlation, values closer to -1 indicating a strong negative correlation, and values around 0 indicating no significant correlation. Statistical significance was determined using appropriate thresholds (e.g., $p < 0.05$).

Result

Prior to examining the study results, it is crucial to fully understand the demographic features of the participants, since this information is essential for evaluating the ensuing conclusions. The sample characteristics provide a detailed and subtle comprehension of the participants' profiles, including important data such as the size of the sample, the distribution among different age groups, the representation of different genders, and the distribution among various academic majors. These details are essential for evaluating the study's ability to be applied to a wider population and offer useful information about the range and variety of participants involved. Through a careful analysis of these demographic intricacies, researchers can develop a more comprehensive understanding of how different demographic factors may interact with the variables being studied, thus improving the accuracy and relevance of the study's results. Moreover, providing a clear description of the demographic characteristics of the individuals included in the study allows researchers to understand how the study findings relate to the larger social and demographic context. This helps to interpret the results in a more detailed way and understand how they may apply to different subgroups within the population. Hence, it is crucial to have a thorough comprehension of the sample characteristics in order to guarantee the strength and pertinence of the study's findings.

Comprehending the makeup of the sample population is crucial, as it reveals any patterns or trends that may arise throughout the data analysis stage. Variables such as the distribution of age and the choice of academic majors are important because they can have an impact on how engaged participants are in endurance training and the resulting physical health results. Older participants may have distinct

exercise preferences or possess differing degrees of physical fitness in comparison to younger individuals, which could potentially impact the outcomes of the study. Likewise, individuals from various academic disciplines may have different schedules or resources available to them, which can impact their capacity to participate in consistent endurance training activities. Furthermore, it is essential to note the gender distribution within the sample, since it can have an influence on attitudes towards physical exercise and health behaviours. The study's findings may be influenced by individuals' perceptions of exercise and their motivation to participate in endurance training, which can be shaped by gender-related societal norms and expectations. Researchers can improve the validity and application of their study's findings by thoroughly analysing the demographic characteristics of the sample population. This allows them to analyse how different factors interact with involvement in endurance training and physical health outcomes.

Table 1.
Sample Characteristics

Characteristic	Value
Sample Size	42
Mean Age (years)	21.5
Standard Deviation	2.3
Gender Distribution	
Male	48%
Female	52%
Academic Majors	
Engineering	29%
Humanities	23%
Sciences	20%
Business	18%
Others	10%

The study revealed a wide range of participation levels and methods in endurance training among the participants, shedding light on the complex nature of their involvement in physical exercise. Upon careful examination of the quantitative data, it was discovered that, on average, participants engaged in endurance training about three times per week. This highlights the importance of this type of exercise in their fitness routines. The moderate standard deviation of 1.2 indicates a significant level of variation among individuals, which is a result of their distinct preferences and behaviors that influence how often they participate. Moreover, the mean duration of endurance training sessions is 45 minutes, with a standard deviation of 15 minutes. This indicates that the participants have a wide variety of training routines and exercise options. The diversity of their endurance training techniques highlights the dynamic nature of their physical activities, which are customised to meet their particular demands and preferences. The analysis delved deeper into the qualitative aspects of engagement in endurance training, uncovering a diverse range of activities that participants were attracted to. This study reveals the complex interaction of several factors that influence people's exercise decisions and preferences. It offers valuable insights into many aspects of their endurance training experiences. Running was the most popular alternative, selected by 45% of the participants out of the several options given. Cycling

accounted for 30% of the reported endurance activities, indicating the popularity of this low-impact cardiovascular activity. Swimming, known for its overall health advantages and minimal risk of injury, interested 15% of the participants. Brisk walking, a diverse and easily accessible type of endurance training, was chosen by 10% of the study group. The study highlights the wide range of endurance training activities that university students engage in, showcasing different preferences, interests, and fitness objectives within the group. Running and cycling are popular due to their accessibility and variety, making them suitable for people with different fitness levels and preferences. The addition of swimming and brisk walking demonstrates the diverse aspects of endurance training, appealing to individuals interested in low-impact options or cross-training.

This investigation explores how individual preferences, societal pressures, and environmental factors interact to shape university students' exercise behaviours during endurance training. This information will help create specific interventions and programmes to encourage endurance training and improve physical health among university students, customised to meet the various needs and preferences identified in the study group. The detailed information from the sample characteristics table reveals the diverse nature of the study population. This variety includes a wide range of demographic factors, such as age groups, gender identities, and academic specialties. Further investigation into these demographic details reveals the intricate interaction of factors influencing university students' experiences and health habits. University students' diverse demographics and experiences provide a perspective to examine the complex connections between participating in endurance training and the resulting physical health consequences. The sample's age distribution could reveal age-related differences in exercise habits and physical fitness levels. The gender distribution reveals possible gender differences in exercise choices, perceptions of physical activity, and health outcomes.

The allocation of individuals across various academic majors offers valuable insights into the connections between academic interests and health behaviours. Additionally, it serves as a valuable data source for understanding the intricate relationship between educational pursuits and physical well-being. It is clear that different academic disciplines can lead to varied lifestyle patterns and sources of stress, which can have varying effects on students' likelihood to participate in endurance training and maintain their physical health at an optimal level. By exploring these contextual subtleties, researchers can acquire a comprehensive understanding of the complex elements influencing individuals' health behaviours. This forms the basis for creating customised interventions that align with the diverse needs and preferences of university students from different academic fields. Moreover, when researchers place the study findings in a wider demographic framework, they have the ability to decipher the deep mechanisms that support the observed connections, providing insight into the delicate interaction

between demographic determinants and health outcomes. This extensive understanding not only allows researchers to identify subtle patterns or trends but also provides vital insights that can guide the development and implementation of focused treatments and policy measures aimed at enhancing overall well-being among university students.

Prior to analysing the study participants' involvement in endurance training activities, it is crucial to provide a thorough foundation by explaining the specific quantitative metrics used to quantify their engagement in these exercises. These measurements are crucial indications, providing detailed information not only about the frequency and duration but also about the wide range of endurance training exercises that individuals perform. Through a careful examination of these numerical measures, researchers can identify subtle patterns, trends, and differences within the group being studied. This will lay the foundation for a deeper investigation into the complex relationship between participating in endurance training and the resulting physical health outcomes. Moreover, a thorough analysis of these numerical measurements provides a valuable understanding of the different levels of involvement and commitment to endurance training programmes among participants, allowing researchers to identify potential factors that influence individuals' participation in these activities. Analysing the measurable aspects of participants' endurance training efforts allows for a detailed investigation of their exercise routines and helps to establish a strong basis for understanding the potential effects of these activities on their overall health and wellness. These valuable observations help guide specific treatments and customised coaching methods to enhance individuals' participation in endurance training programmes, ultimately leading to better physical health outcomes among university students.

Table 2.
Endurance Training Participation

Endurance Training Metrics	Mean	Standard Deviation
Frequency per Week	3 times	1.2 times
Duration per Session (mins)	45	15
Types of Activities		
Running	45%	
Cycling	30%	
Swimming	15%	
Brisk Walking	10%	

Table 2 presents a comprehensive analysis of the endurance training participation metrics recorded in the study group, including crucial quantitative data necessary for understanding participants' exercise routines and inclinations. The average frequency of endurance training sessions per week, measured three times, indicates how regularly and consistently participants are involved in endurance training activities. A standard deviation of 1.2 indicates the extent of variation in involvement levels among individuals, revealing the different exercise habits and routines within the research group. The average duration of endurance training sessions is 45 minutes, providing information on the time component of participants' exercise routines. The 15-minute standard deviation emphasises the variation in session

lengths, showcasing the diverse character of participants' training routines. Factors such as individual fitness levels, training goals, and personal preferences may contribute to the variation in endurance training involvement among the study population.

Prior to examining the study results, it is crucial to fully understand the demographic features of the participants, since this information is essential for evaluating the ensuing conclusions. The sample characteristics provide a detailed and sophisticated comprehension of the participants' profiles, including important factors such as the size of the sample, the distribution among different age groups, the representation of different genders, and the distribution among various academic majors. These details are essential for evaluating the study's ability to be applied to a wider population and offer useful information about the range and variety of participants involved. Through a thorough analysis of these demographic intricacies, researchers can gain a more profound comprehension of how different demographic factors may intersect with the variables being studied, thus improving the accuracy and relevance of the study's results. Moreover, providing a clear description of the demographic composition of the sample population allows researchers to understand the study findings in relation to the larger socio-demographic context. This helps in interpreting the results more accurately and understanding their implications for different subgroups within the population. Hence, it is crucial to have a thorough comprehension of the sample characteristics in order to guarantee the strength and pertinence of the study's findings.

The information obtained from Table 2 provides a detailed and thorough picture of how individuals are involved in endurance training activities, revealing the complex range of exercise behaviours within the study group. Quantitative measurements can be used by researchers to identify patterns, trends, and changes in endurance training participation. This can help understand the relationship between individual preferences, environmental factors, and health effects. Comprehending the complexities of university students' involvement in endurance training is crucial for creating specific interventions to encourage physical activity and enhance overall health and well-being. By utilising the information obtained from Table 2, researchers can customise treatments to address the individual needs, interests, and preferences of participants. This will help create a friendly and inclusive environment that encourages regular exercise participation. Ultimately, these endeavours enhance the well-being and health of university students, enabling them to live active and satisfying lives during and after their academic endeavours. Before discussing the participants' physical health indicators, it is crucial to give a thorough explanation of the importance and consequences of these metrics in the overall study framework. Physical health indicators are crucial assessments that incorporate different aspects of a person's well-being, including cardiovascular fitness, body composition, and muscular strength. Researchers obtain useful insights into participants' health state and functional skills by evaluating these variables, which forms the basis for a detailed understanding of how endurance exercise affects physical well-being. Understanding the intricacies of these measurements helps researchers identify small variances and patterns in the data analysis phase, allowing for the development of focused treatments to

promote optimal health outcomes among participants. By placing these measurements in context within the study, researchers may create a strong foundation for interpreting the following results and clarifying their wider implications for the health and well-being of participants.

Table 3.
Physical Health Indicators

Physical Health Indicators	Mean Score	Standard Deviation
Cardiovascular Fitness	7.8/10	1.5
Body Mass Index (BMI)	22.5 kg/m ²	3.0
Muscular Strength (Push-ups)	25/minute	5
Muscular Strength (Sit-ups)	30/minute	6

Table 3 provides a detailed summary of the physical health indices evaluated in the study group. The indicators cover several aspects of physical fitness, such as cardiovascular health, body composition, and muscular strength. Every statistic provides valuable insights into many aspects of an individual's physical health, aiding in a comprehensive understanding of their overall well-being. Researchers found an average cardiovascular fitness score of 7.8 out of 10, with a standard deviation of 1.5. This statistic indicates individuals' self-reported cardiovascular endurance and aerobic fitness levels, offering insights into their capacity to maintain physical activity for extended durations. A higher mean score implies higher cardiovascular fitness levels in the study group, whereas the standard deviation shows the range of reported fitness levels among participants.

The participants' body mass index (BMI) was calculated to have a mean of 22.5 kg/m² and a standard deviation of 3.0. BMI is a commonly used metric for body composition, offering insight into individuals' body fat levels. The average BMI is in the healthy weight range, while the standard deviation indicates the diversity in body composition among the participants in the study. Researchers evaluated participants' muscular strength by measuring the quantity of push-ups and sit-ups completed within a one-minute timeframe. The average number of push-ups performed per minute was 25, with a standard deviation of 5. The average number of sit-ups completed per minute was 30, with a standard deviation of 6. The measurements provide information on individuals' muscle endurance and strength, offering vital insights into their physical fitness and functional capacities.

Table 3 provides a comprehensive overview of participants' physical health state, encompassing various aspects of fitness and well-being. Researchers analyse cardiovascular fitness, body composition, and muscular strength to acquire comprehensive insights into participants' physical health, offering a holistic view of their entire well-being. Understanding these physical health markers is critical for assessing the effects of endurance training on participants' health outcomes. Researchers can analyze these measurements in conjunction with individuals' involvement in endurance training to identify patterns or trends that suggest the efficacy of these interventions in enhancing physical health and well-being.

The wide range of physical health indicators evaluated in this study provides a thorough representation of people's

fitness levels and overall health conditions. It is crucial to acknowledge these differences in order to customise interventions that cater to the specific requirements and preferences of participants, thereby fostering inclusivity and fairness in health promotion efforts. Prior to exploring the correlation analyses, it is crucial to understand the reasoning behind conducting these analyses and the importance of the results within the broader context of the study. Correlation analyses are a useful method for investigating the connections between many variables, revealing possible correlations or patterns that may exist among them. This study utilised correlation analysis to investigate the complex association between participation in endurance training and other physical health indicators. Through the process of unravelling these connections, researchers gain vital knowledge on the impact of endurance training on the physical health outcomes of participants. This knowledge is then used to develop tailored interventions that aim to promote optimal well-being and fitness. These insights are crucial for developing evidence-based ways to encourage and assist individuals in their efforts to achieve better health and vitality.

Table 4.
Correlation Analysis

Correlation Analysis	Pearson's r	P-value
Frequency of Endurance Training vs. Cardiovascular Fitness	0.45	<0.05
Duration of Endurance Training vs. Muscular Strength (Push-ups)	0.38	<0.05
Frequency/Duration vs. Body Mass Index (BMI)	-0.12	>0.05
Frequency/Duration vs. Muscular Strength (Sit-ups)	0.21	>0.05

Table 4 displays the results of correlation studies investigating the relationship between endurance training participation and participants' physical health indicators. Each correlation study includes Pearson's correlation coefficient (r) and its accompanying p-values, which indicates the strength and significance of the observed associations. An initial correlation analysis investigated the connection between the frequency of endurance training sessions per week and the cardiovascular fitness levels of participants. An observed correlation coefficient of 0.45 indicates a modest positive association between the variables. A p-value of less than 0.05 indicates that the link between higher frequencies of endurance training sessions and better cardiovascular fitness among participants is statistically significant.

The second correlation study examined the connection between the length of endurance training sessions and participants' muscular strength, evaluated by the number of push-ups completed in one minute. The correlation coefficient of 0.38 indicates a modest positive link between the variables. Longer endurance training sessions are linked to higher physical strength in subjects, as indicated by a statistically significant correlation with a p-value of less than 0.05.

In the third and fourth correlation analyses, we examined the associations between the frequency and duration of endurance training sessions and two other physical health indicators: individuals' body mass index (BMI) and

muscular strength (sit-ups). Notably, the correlation coefficients for both analyses were close to zero, with p-values greater than 0.05, indicating that there were no meaningful correlations between the variables. These findings indicate that the frequency and duration of endurance training sessions do not have a significant impact on participants' BMI or sit-up performance. Although surprising, these discoveries offer vital insight into the complex nature of physical health outcomes among college students. Other factors, such as dietary habits, genetic predispositions, and engagement in other forms of physical exercise, may have a stronger impact on BMI and sit-up ability than endurance training. Future studies should further investigate these aspects to clarify their influence on body mass index (BMI) and physical strength in university students. The significance of taking into account several factors when evaluating physical health outcomes and developing specific interventions to enhance overall well-being is highlighted by these unforeseen findings.

Table 4 gives substantial insights into the link between involvement in endurance training and participants' physical health indices. The substantial positive relationships revealed between the frequency and duration of endurance training sessions and indices of cardiovascular fitness and muscular strength underline the benefits of maintaining regular and extended endurance training programmes. These findings underline the necessity of integrating endurance training into one's exercise programme to maximise cardiovascular fitness and muscular strength, ultimately contributing to overall health and well-being. The observed relationships suggest that individuals who engage in more frequent and longer-duration endurance training sessions are likely to achieve higher increases in cardiovascular fitness and muscular strength. This underscores the potential importance of endurance training as a cornerstone of physical fitness programmes aimed at generating optimal health outcomes. Moreover, these findings offer practical implications for people aiming to improve their physical well-being, underscoring the necessity of prioritising endurance training as a core component of their exercise plan. By following regular and well-maintained endurance training routines, individuals can reap the rewards of better cardiovascular fitness and muscular strength, thereby boosting their overall quality of life and promoting longevity.

The lack of significant connections between participating in endurance training and BMI/muscular strength (sit-ups) indicates that other factors may have a greater impact on these physical health markers. Additional research is needed to investigate the intricate relationship between many factors affecting BMI and muscle strength and to clarify further ways of enhancing both components of physical health in participants. The correlation analyses provide valuable insights into how endurance training may affect participants' physical health outcomes, guiding future research and interventions to promote optimal health and well-being in those involved in endurance training.

Discussion

The positive correlation between the duration of endurance training sessions and participants' muscular strength, especially in push-up performance, indicates that longer endurance training sessions may lead to greater improvements in muscular strength and endurance. Endurance training activates many muscle groups and promotes muscle growth, leading to enhancements in both muscular strength and endurance. This is consistent with previous research highlighting the mutually beneficial connection between endurance exercise and muscular strength enhancement (Görner & Reineke, 2020b; Lara-Castillo & Johnson, 2020). Incorporating endurance training into one's workout routine provides a comprehensive approach to physical fitness, improving both cardiovascular and muscular health simultaneously. Participating in endurance activities like running, cycling, swimming, and brisk walking can help individuals develop strong physical resilience, enhancing their ability to engage in prolonged physical activity and daily duties.

Effects on body mass index and muscular strength (Sit-ups)

The lack of strong correlations between the frequency and duration of endurance training sessions and participants' body mass index (BMI) or muscular strength, as measured by sit-up performance, indicates that factors other than endurance training may have a more significant impact on BMI and sit-up performance among university students. Possible reasons could include eating habits (Chen et al., 2020; Zhai et al., 2022), genetic tendencies, and participation in different types of physical activities not considered in this study. Future studies on university students should include thorough assessments that cover food analysis, genetic profiling, and evaluations of physical activity patterns to fully understand the factors influencing BMI and muscular strength. These efforts would offer a significant understanding of the complex factors involved in regulating BMI and building muscular strength, which would help in creating customised strategies to improve physical health in these areas.

Health promotion and intervention implications

This study's findings have significant implications for health promotion efforts aimed at university students. Encouraging consistent engagement in endurance exercise is a viable approach to improving cardiovascular fitness and muscular strength, ultimately enhancing overall physical well-being in this group. For interventions to be most effective in boosting endurance training involvement (Fyfe et al., 2022; Huang et al., 2022), it is crucial to take into account many elements such as accessibility, price, and individual preferences. Creating a supportive environment that encourages and enables participation in endurance training, such as group exercise classes, campus-wide challenges, and easily accessible exercise facilities, could promote a culture of physical activity and well-being in university environments. Including educational elements that explain the

various advantages of endurance training and providing students with tools to create and maintain consistent exercise habits could enhance the effectiveness of interventions, empowering individuals to actively improve their physical health and energy levels.

Constraints and prospects for future research

Although the study provided interesting insights, it is important to recognise its limits and potential areas for future research. In order to overcome these restrictions, future research should utilise longitudinal designs and objective measures of physical health markers to confirm and expand upon the observed connections. The sample size and diversity of the study cohort could calculate a representative sample of the findings, highlighting the need for bigger and more diverse samples to improve external validity. Future research should further examine several aspects that impact the physical health of university students, such as eating patterns, stress levels, sleep quality, and social support systems. Researchers can analyse many aspects to understand how they influence the physical health of university students. This can help in developing specific interventions to promote optimal health and well-being in this group.

Conclusions

In conclusion, this study suggests the potential benefits of endurance training for university students' physical health. The significant connections between endurance training frequency and duration and cardiovascular fitness and muscular strength underscore the need for regular exercise to promote heart health and muscular strength. The study highlights the diverse nature of physical health outcomes among university students, despite not finding significant connections with body mass index and sit-up ability. Promoting regular endurance exercise participation could be a beneficial technique for boosting cardiovascular fitness and muscular strength among university students, therefore fostering total physical well-being. Interventions aiming at encouraging endurance training engagement should focus on aspects such as accessibility, price, and individual preferences to increase participation rates. Despite the study's limitations, including its cross-sectional design and self-reported metrics, these findings provide useful insights into the significance of endurance training for university students' physical health. Future research should employ longitudinal designs and objective metrics to validate these connections and explore additional factors impacting physical health outcomes among university students. Overall, integrating endurance training into wellness initiatives on college campuses can empower students to lead healthier lives and enhance their long-term well-being.

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