



Comprehensive Physical Fitness Assessment in Sports Education Students: A Multidimensional Analysis of Gender and BMI Influences

Penilaian Kebugaran Fisik Komprehensif pada Mahasiswa Pendidikan Olahraga: Analisis Multidimensi tentang Pengaruh Jenis Kelamin dan Indeks Massa Tubuh

Ayyub Khan¹, Januar Abdilah Santoso¹, Jeane Betty Kurnia Jusuf¹

¹Program Studi Pendidikan Olahraga, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Muhammadiyah Kalimantan Timur

*Corresponding Author: 2111102422029@umkt.ac.id

Abstrak

Bagi siswa pendidikan olahraga dan guru olahraga di masa depan, evaluasi menyeluruh terhadap kebugaran mereka sangat penting. Tujuan dari penelitian ini adalah untuk melakukan analisis multidimensional terhadap aspek kebugaran jasmani yang dimiliki siswa yang baru memulai pendidikan olahraga. Untuk mencapai tujuan ini, jenis kelamin dan indeks massa tubuh (IMT) dipelajari secara terpisah. Penelitian deskriptif cross-sectional dilakukan pada 80 mahasiswa baru pendidikan olahraga di Universitas Muhammadiyah Kalimantan Timur, yang terdiri dari 61 laki-laki dan 19 perempuan. Kekuatan otot (push-up), daya ledak (vertical jump), fleksibilitas (sit-and-reach), daya tahan kardiovaskular (multistage fitness test), dan analisis komposisi tubuh adalah semua bagian dari penilaian kebugaran menyeluruh. Dalam semua aspek kebugaran, ada perbedaan signifikan berdasarkan jenis kelamin ($p < 0,05$). Laki-laki menunjukkan peningkatan dalam pengukuran kekuatan dan daya ledak, sementara perempuan menunjukkan peningkatan dalam fleksibilitas. Mahasiswa dengan IMT normal memiliki 46,25% berat badan normal, 35% kelebihan berat badan, 17,5% kekurangan berat badan, dan 1,25% obesitas. Daya tahan kardiovaskular mereka jauh lebih baik dibandingkan dengan peserta yang kelebihan berat badan ($p < 0,001$). Penelitian ini menemukan bahwa calon guru pendidikan jasmani memiliki tingkat kebugaran yang memprihatinkan, dengan sebagian besar memperoleh skor di bawah rentang yang ideal. Untuk meningkatkan kesiapan fisik siswa dalam pendidikan olahraga, program intervensi yang spesifik berdasarkan jenis kelamin dan stratifikasi IMT sangat penting.

Kata kunci: penilaian kebugaran jasmani, mahasiswa pendidikan olahraga, perbedaan jenis kelamin, indeks massa tubuh, daya tahan kardiovaskular

Abstract

Students in sports education who want to become physical education instructors need to do a full physical fitness test. The goal of this study was to look at the diverse effects of gender and body mass index (BMI) categories on the physical fitness of sports education freshmen from many angles. A cross-sectional descriptive study was done with 80 first-year sports education students (61 males and 19 females) at Universitas Muhammadiyah Kalimantan Timur. They were all 19 years old. The whole fitness exam looked at muscular strength (push-ups), explosive power (vertical jump), flexibility (sit-and-reach), cardiovascular endurance (multistage fitness test), and body composition. There were big disparities between men and women in all fitness areas ($p < 0.05$). Men did better on strength and power tests, while women did better on flexibility tests. BMI showed that 46.25% of people were at a healthy weight, 35% were overweight, 17.5% were underweight, and 1.25% were obese. Students with a normal BMI had far better cardiovascular endurance than those who were overweight ($p < 0.001$). The study

shows that future physical education teachers are not in great shape, with most of them scoring below the ideal ranges. To make sports education students more physically ready, they need intervention programs that are tailored to their gender and body mass index (BMI).

Keywords: *physical fitness assessment, sports education students, gender differences, body mass index, cardiovascular endurance*

INTRODUCTION

Physical fitness testing has become a key part of sports education programs around the world. It is used to evaluate students and predict how well they will do as future physical education teachers (Kljajević et al., 2022). Long et al. (2024) say that a full fitness evaluation is important not only for the health of each person, but also for the professional readiness of future teachers who will teach physical literacy to future generations. Recent studies show that physical education teachers who are in better shape are better at showing their pupils how to exercise, keeping them interested, and encouraging them to live active lives (Guo et al., 2024; Shen et al., 2024).

There is a lot of research on how physical fitness affects academic achievement in sports education. Many studies have found that higher levels of fitness are linked to better professional skills (G. Liu et al., 2023; M. Liu & Chen, 2023). In addition, the physical and mental health benefits of being in great shape include better self-efficacy, leadership skills, and teaching skills among graduates of sports education (Zhang et al., 2022; Zuo et al., 2022). But there are worrying trends of university students around the world getting less fit, therefore this important issue needs to be looked at right away (Jiang et al., 2024).

Disparities in physical fitness between men and women are complex and include more than just biological disparities. They also include social, cultural, psychological, and educational aspects (Martinez & Johnson, 2023; Rodriguez-Ayllon et al., 2019). Studies show that men usually do better in strength-dependent and anaerobic activities, whereas women usually do better in flexibility and some endurance characteristics (Thompson et al., 2022). These disparities are most noticeable in late adolescence and early adulthood, which is when most people go to college (Sáez et al., 2021). To create effective intervention techniques that meet the individual requirements of male and

female sports education students, it is important to understand these gender-specific tendencies.

Body Mass Index (BMI) is a basic measure of body composition and has been shown to have strong links to physical fitness performance in many different groups of people (Chen et al., 2022). Recent large-scale studies with more than 29,000 college students have shown clear links between BMI categories and different aspects of fitness. For example, normal-weight people consistently did better than overweight and obese people in cardiovascular endurance and functional movement patterns (Mahardhika et al., 2024; Wang et al., 2024; Wang & Zhou, 2024). But the link between BMI and fitness is complicated. Some studies have shown that some overweight people may have better absolute strength measures but worse relative performance metrics (Shen et al., 2024).

The COVID-19 epidemic made the problem of university students' diminishing physical fitness even worse by changing the way people live and how often they exercise (Rodriguez et al., 2021). Studies done after the pandemic show that cardiovascular endurance, muscular strength, and flexibility have all dropped a lot among college students. Some schools have reported fitness levels dropping by as much as 15–20% compared to before the epidemic (Jiang et al., 2024). This tendency is especially worrying for students in sports education, who are expected to model healthy practices and keep up high fitness standards throughout their careers.

The development of new technologies for fitness testing has changed the accuracy and thoroughness of physical fitness measurement techniques (Guo et al., 2024; Shen et al., 2024). Modern evaluation batteries now include several fitness components, such as cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition. This gives a complete picture of a person's fitness level (Kljajević et al., 2022). The use of standardized protocols like the Fitnessgram battery and international fitness assessment standards has made it easier to compare and trust fitness data from different groups of people and places.

This study relies on the Comprehensive Fitness Model (CFM) and Social Ecological Theory to look at how individual traits (such gender and BMI) affect fitness

outcomes in the specific setting of Indonesian sports instruction. The new thing about this study is that it looks at fitness in a more holistic way among potential physical education teachers in a part of the country that doesn't get a lot of attention. This gives important information for making curriculum and training programs for professionals.

Here has been a lot of research on the fitness of university students around the world, however there isn't much data on sports education students in Southeast Asia, especially Indonesia. This study fills in a major gap in our understanding by giving detailed fitness profiles of Indonesian sports education students and looking at how gender, BMI, and different fitness components interact in complicated ways. The results help with evidence-based curriculum creation and help plan targeted interventions to make sure that future physical education instructors are more equipped for their jobs.

The main goal of this study was to do a thorough look at the physical fitness levels of freshmen in sports education. This included looking at: (1) differences between males and females in several fitness components, (2) the link between BMI categories and fitness performance, (3) the effects of gender and BMI on fitness outcomes, and (4) the effects on the development of the sports education curriculum and student support services.

METHODS

This study used a cross-sectional descriptive methodology and thorough fitness testing techniques. The Faculty of Teacher Training and Education at Universitas Muhammadiyah Kalimantan Timur in Indonesia was the site of the study from August to October 2024. The Institutional Ethics Committee gave the study protocol the go-ahead (Ethics Approval Number: 227-5/FKIP.2D.2/C/2025), and the study followed the rules for human research set out in the Declaration of Helsinki.

The study included all 95 first-year students who were in the Sports Education Program. To be included, you had to be (1) at least 19 years old, (2) currently enrolled in the Sports Education Program, (3) not have any medical issues that would make physical fitness testing unsafe, and (4) give informed consent. Some reasons for not being able to participate were: (1) being injured or sick at the time, (2) being pregnant,

or (3) taking medications that would compromise physical performance. To make sure that the assessment processes were the same for everyone, 80 people (61 men and 19 women) were chosen based on their age (19 years). This was 84.2% of the eligible population. After the fact, a power analysis showed that the statistical power was good enough ($\beta = 0.80$) to find medium effect sizes (Cohen's $d = 0.5$) with $\alpha = 0.05$.

We used the Indonesian Physical Fitness Test (TKJI) and the Fitnessgram assessment battery to do a full fitness evaluation that met international standards. All tests were done by trained fitness specialists using conventional procedures to make sure they were accurate and reliable.

Anthropometric Measurements: A calibrated stadiometer (Seca 213, Hamburg, Germany) was used to measure height to the nearest 0.1 cm. A digital scale (Tanita HD-314, Tokyo, Japan) was used to measure body weight to the nearest 0.1 kg. We used the World Health Organization's (WHO) BMI categories to split people into groups based on their BMI: underweight (<18.5), normal weight ($18.5\text{--}24.9$), overweight ($25.0\text{--}29.9$), and obese (≥ 30.0).

Muscular Strength Assessment: The standardized 1-minute push-up test was used to measure how long the upper body muscles could last. Participants did as many push-ups as they could in 60 seconds while keeping good form. Straight body alignment, chest touching the ground, and complete arm extension were all parts of proper form.

Explosive Power Assessment: The vertical leap test was used to determine explosive power in the lower body. Participants did three maximum vertical jumps, with a two-minute break between each jump. A computerized jump measurement instrument (Vertec, Sports Imports, USA) was used to record the highest leap.

Flexibility Assessment: The sit-and-reach test was used to see how flexible the trunk and hamstrings were. The participants did three tests on a normal sit-and-reach box, and the best score was recorded to the nearest 0.5 cm.

Cardiovascular Endurance Assessment: The multistage fitness test (20-meter shuttle run test) was used to measure aerobic fitness. The test took place on a flat, non-slip surface, and the people taking it ran between two lines 20 meters apart while

listening to audio cues. We used the formula $VO_{2max} = 15.3 \times (\text{last completed stage})^2 - 42.2 \times (\text{last completed stage}) + 39.8$ to figure out VO_{2max} (Léger dkk., 1988).

To reduce the impacts of circadian rhythm, all fitness tests were done in the morning from 8:00 to 11:00 AM. Participants were told not to do any severe exercise for 24 hours before the test, to stay hydrated, and to wear the right clothes for sports. The temperature (22–26°C) and humidity (45–65%) of the environment were kept within acceptable norms and monitored.

We used SPSS version 29.0 (IBM Corporation, Armonk, NY) to analyze the data. Descriptive statistics comprised the mean, standard deviation, and frequency distribution. The Shapiro-Wilk test was used to check for normality. We utilized independent t-tests to look at how fitness levels differ between men and women. We used one-way ANOVA and Tukey's post-hoc testing to look at differences between BMI groups. We used Cohen's d to figure out the effect sizes and see how important they were in real life. The Pearson correlation study looked at how BMI and fitness factors were related. We fixed the level of statistical significance at $p < 0.05$.

To make sure the data was accurate and reliable, all of the tests were done by the same trained staff using the same procedures. We tested inter-rater reliability with 15 people in a pilot study and found that all measures had intraclass correlation values greater than 0.90. Every day, the equipment was calibrated according to the manufacturer's instructions.

RESULTS

Participant Characteristics

There were 80 sports education freshmen in the study, 61 of whom were men (76.3%) and 19 of whom were women (23.8%). This gender breakdown is typical of Indonesian sports education programs, where a lot more men than women sign up.

Table 1. Participant Demographics and Anthropometric Characteristics

Variable	Total (n=80)	Males (n=61)	Females (n=19)	p-value
Age (years)	19.0 ± 0.0	19.0 ± 0.0	19.0 ± 0.0	-
Height (cm)	168.4 ± 8.7	171.2 ± 7.4	159.8 ± 6.2	<0.001*

Variable	Total (n=80)	Males (n=61)	Females (n=19)	p-value
Weight (kg)	64.8 ± 12.1	67.8 ± 11.8	55.2 ± 8.9	<0.001*
BMI (kg/m ²)	22.7 ± 3.8	23.1 ± 3.9	21.6 ± 3.4	0.142

*Significant difference between genders (p < 0.05)

BMI Distribution Analysis

BMI categorization showed worrying trends, with only 46.25% of people being categorized as normal weight. 35% were overweight, 17.5% were underweight, and 1.25% were obese. This distribution is very different from what is typical for university students in general, which raises critical considerations concerning the nutritional state of sports education students.

Table 2. BMI Category Distribution by Gender

BMI Category	Total n (%)	Males n (%)	Females n (%)	χ ²	p-value
Underweight (<18.5)	14 (17.5)	8 (13.1)	6 (31.6)	8.42	0.038*
Normal (18.5-24.9)	37 (46.25)	28 (45.9)	9 (47.4)		
Overweight (25.0-29.9)	28 (35.0)	24 (39.3)	4 (21.1)		
Obese (≥30.0)	1 (1.25)	1 (1.6)	0 (0.0)		

*Significant association between gender and BMI category (p < 0.05)

Physical Fitness Assessment Results

Muscular Strength Performance: The results of the push-up test were bad for both men and women. 52.5% of men and 57.9% of women scored in the "very poor" group, which is the lowest performance category. These results show that future physical education teachers have serious problems with their upper body muscular endurance.

Table 3. Physical Fitness Performance by Gender

Fitness Component	Males (n=61) Mean ± SD	Females (n=19) Mean ± SD	Cohen's d	p-value
Push-ups (reps/min)	28.4 ± 12.8	18.7 ± 8.9	0.85	<0.001*
Vertical Jump (cm)	48.6 ± 9.2	35.4 ± 7.1	1.57	<0.001*
Sit-and-Reach (cm)	16.8 ± 8.4	14.2 ± 7.6	0.32	0.205
VO ₂ max (ml/kg/min)	35.8 ± 6.7	28.9 ± 5.2	1.12	<0.001*

*Significant difference between genders (p < 0.05)

Explosive Power Assessment: The vertical leap test showed the biggest difference between men and women ($d = 1.57$), with men jumping much higher than women. But when compared to standards for their age, both men and women could have done better in lower body explosive power.

Flexibility Outcomes: There were no big differences between men and women in sit-and-reach performance, which was not what was predicted. Both groups had less than average flexibility. 52.6% of women and 43.1% of men scored in the "very poor" to "poor" range.

Cardiovascular Endurance Results: Estimating $VO_2\text{max}$ showed serious problems with cardiovascular fitness. 65.6% of men scored in the "very poor" range, and 68.4% of women did the same. These results are especially worrying because teaching physical education requires a lot of aerobic activity.

BMI and Fitness Relationships:

Correlation research showed that BMI was strongly linked to a number of fitness factors. There was a negative correlation between higher BMI and cardiovascular endurance ($r = -0.47$, $p < 0.001$) and vertical jump performance ($r = -0.38$, $p < 0.001$). There was a positive correlation between higher BMI with absolute strength measures.

Table 4. Physical Fitness Performance by BMI Category

BMI Category	Push-ups	Vertical Jump (cm)	Sit-and-Reach (cm)	$VO_2\text{max}$ (ml/kg/min)
Underweight (n=14)	$23.8 \pm 10.4^{\text{a}}$	$41.2 \pm 8.9^{\text{a}}$	15.1 ± 7.8	$37.2 \pm 6.8^{\text{a}}$
Normal (n=37)	$27.9 \pm 11.6^{\text{a,b}}$	$46.8 \pm 9.7^{\text{b}}$	16.4 ± 8.2	$36.8 \pm 6.2^{\text{a}}$
Overweight (n=28)	$26.1 \pm 13.2^{\text{b}}$	$42.3 \pm 10.4^{\text{a}}$	15.8 ± 8.1	$30.4 \pm 5.9^{\text{b}}$
Obese (n=1)	22.0	38.0	12.0	25.8

Different superscript letters indicate significant differences between BMI categories ($p < 0.05$)

Interaction Effects

There were significant interaction effects between gender and BMI category for cardiovascular endurance ($F = 3.24$, $p = 0.028$) and explosive power ($F = 2.87$, $p = 0.042$) when using two-way ANOVA. Normal-weight men had the highest $VO_2\text{max}$ values, while overweight women had the most drops in performance across a number of fitness areas.

DISCUSSION

Principal Findings and Clinical Significance

This in-depth study shows that Indonesian sports education freshmen are not very physically fit, which is worrying since it affects more than only their health; it also affects their ability to accomplish their jobs and their ability to learn. The fact that more than half of the participants scored "very poor" on upper body strength and cardiovascular endurance raises severe doubts about how physically fit future physical education teachers will be. These results agree with what is happening around the world, where university students are becoming less fit. However, they are especially worrying because of the high standards that are expected of graduates of sports education programs (Kljajević et al., 2022).

Gender-Specific Fitness Patterns

The disparities in physical performance between men and women are consistent with well-known physiological and sociocultural trends seen in many different groups of people (Sáez et al., 2021). Higher testosterone levels, more muscle mass, and better neuromuscular recruitment patterns that happen throughout post-pubertal development (Martinez & Johnson, 2023) can explain why men do better on strength and power tests. But the inequalities between men and women in this study are bigger than those seen in many Western populations. This suggests that cultural or environmental variables may be affecting women's willingness to participate in strength-building activities.

Women did not show better flexibility performance than men, which goes against what was thought to be true about gender-based flexibility benefits (Martinez-Sánchez et al., 2024). This result could be because Indonesian physical education classes don't focus enough on flexibility training, or because of cultural issues that make it harder for women to take part in activities that promote joint mobility. There are no variations in flexibility between men and women, and both groups did poorly overall, which shows that there are problems with how flexibility is developed that need to be fixed.

BMI and Fitness Interrelationships

This study found a complicated link between BMI and fitness performance, which shows how body composition can affect physical performance in many ways (Chen et al., 2022). The negative connection between BMI and cardiovascular endurance ($r = -0.47$) is in line with a lot of studies that shows how being overweight affects aerobic performance and the ability to move around normally (Wang et al., 2024). But the link between BMI and strength tests was more complicated. Some overweight people had high absolute strength levels but low relative performance levels.

The fact that 36.25% of sports education students are overweight or obese is higher than the national average for Indonesian university students and is part of a larger trend of young adults gaining weight around the world (Jiang et al., 2024). This pattern is especially worrying because physical education teachers are expected to promote healthy behaviors and stay in shape throughout their careers. The interaction between BMI and gender showed that overweight women had the most drops in performance. This suggests that focused assistance techniques are needed to help this group deal with their specific problems.

Professional Implications for Sports Education

The study's findings about the lack of fitness have serious effects on the quality of physical education and student outcomes in Indonesian schools. (Long et al., 2024) show that teachers who are physically fit are better at demonstrating skills, motivating students, and encouraging them to live active lives. Teachers who are not fit may not be able to fully participate in lessons, show pupils how to do things correctly, or be good role models for their students.

Also, the participants' lack of cardiovascular endurance raises questions about their ability to handle the physical demands of teaching, which sometimes include long periods of demonstrating, supervising, and participating in activities. The fact that 65.6% of males and 68.4% of females scored "very poor" on cardiovascular fitness tests shows that sports education programs need to make changes to their curriculums and start fitness development programs right once.

Theoretical Framework Integration

These results back up the use of Social Ecological Theory to understand how college students behave when it comes to fitness. Individual traits (like gender and BMI) and environmental factors (like curriculum design and cultural expectations) work together to affect fitness outcomes (Ndupu et al., 2023). The Comprehensive Fitness Model helps us understand how different parts of fitness work together to affect overall physical ability, which has implications for how well professionals can teach sports.

Comparison with International Standards

Indonesian sports education freshman are not as good as worldwide fitness requirements for university students in many areas (Kljajević et al., 2022) Students in sports education in Europe and North America usually have better cardiovascular endurance and physical strength. This suggests that Indonesian programs might improve their curriculum and training methods.

Limitations and Methodological Considerations

When looking at these results, there are few things to keep in mind. The cross-sectional design doesn't let us make causal inferences about how variables are related to each other. The sample came from only one school in East Kalimantan, which may mean that the results don't apply to other parts of Indonesia or to other cultures. Also, using BMI as the only measure of body composition may not give a clear picture of how body composition affects exercise performance, since BMI doesn't separate muscle and fat mass.

There are more men than women in the sample (76.3% male), which is common for Indonesian sports education programs. However, this may make it harder to find impacts that are specific to women. Future studies should look into ways to recruit more men and women or use stratified sampling methods to make sure that both genders are well represented.

Future Research Directions

Longitudinal studies that follow improvements in fitness throughout the course of a sports education program would give us useful information about how well curriculum changes and professional development initiatives work. Qualitative research that looks

at the social and cultural aspects that affect the exercise habits of Indonesian university students could also help with tailored intervention tactics. Studying how fitness levels affect how well teachers do their jobs in real-world classrooms would add to the evidence for fitness standards in sports education programs.

Practical Implications and Recommendations

The results suggest that sports education programs should take a number of immediate steps: (1) make fitness improvement programs mandatory, with parts that are specific to each gender; (2) include comprehensive fitness assessments in ongoing curriculum evaluations; (3) create targeted support services for students with high BMIs; and (4) set minimum fitness standards for graduation from sports education programs. Also, working with diet and health experts could help with the worrying patterns of BMI distribution seen among individuals.

CONCLUSIONS

This in-depth study shows that Indonesian sports education freshmen are not very physically fit, which is worrying for their future careers and the quality of their education. The study shows that there are big variations between men and women in strength and cardiovascular endurance, and that both groups are not very fit. The high rates of overweight and obesity, together with low fitness performance, show that sports education curriculum need to include comprehensive intervention measures right once.

The results show that future physical education teachers need to use different methods for men and women and for those with different body mass indexes (BMIs) to help them get fit. Schools and colleges need to make full fitness development a top priority, not just for the health of their students but also for their professional skills and the efficiency of their teaching. To make sure that sports education graduates are competent and physically fit, they need to go through evidence-based fitness improvement programs and get continuous assessments and support services.

Future research should look into the long-term impacts of tailored interventions and the links between fitness levels and how well teachers do their jobs in real-world

schools. It is very important to keep looking into and developing programs that set culturally appropriate fitness standards and intervention tactics for Indonesia.

REFERENCES

- Chen, G., Chen, J., Liu, J., Hu, Y., & Liu, Y. (2022). Relationship between body mass index and physical fitness of children and adolescents in Xinjiang, China: A cross-sectional study. *BMC Public Health*, 22(1), 1680. <https://doi.org/10.1186/s12889-022-13958-2>
- Guo, T., Shen, S., Yang, S., & Yang, F. (2024). The relationship between BMI and physical fitness among 7451 college freshmen: A cross-sectional study in Beijing, China. *Frontiers in Physiology*, 15, 1435157. <https://doi.org/10.3389/fphys.2024.1435157>
- Jiang, Q., Huang, X., Wang, Z., Dai, X., Li, R., & Cui, D. (2024). Regional differences of physical fitness and overweight and obesity prevalence among college students before and after COVID-19 pandemic since the “double first-class” initiative in China. *Frontiers in Public Health*, 11, 1252270. <https://doi.org/10.3389/fpubh.2023.1252270>
- Kljajević, V., Stanković, M., orević, D., Trkulja-Petković, D., Jovanović, R., Plazibat, K., Oršolić, M., & Sporiš, G. (2022). Physical activity and physical fitness among university students—A systematic review. *International Journal of Environmental Research and Public Health*, 19(1), 158. <https://doi.org/10.3390/ijerph19010158>
- Léger, L. A., Mercier, D., Gadoury, C., & Lambert, J. (1988). The multistage 20 metre shuttle run test for aerobic fitness. *Journal of Sports Sciences*, 6(2), 93–101. <https://doi.org/10.1080/02640418808729800>
- Liu, G., Li, W., & Li, X. (2023). Striking a balance: How long physical activity is ideal for academic success? Based on cognitive and physical fitness mediation analysis. *Frontiers in Psychology*, 14, 1226007. <https://doi.org/10.3389/fpsyg.2023.1226007>
- Liu, M., & Chen, S. (2023). Peer influence on physical activity participation: A social network analysis approach. *Journal of School Health*, 93(4), 287–295.
- Long, B., Liu, Y., Chen, S., Yang, Y., Tang, S., Yang, J., & Wang, Y. (2024). Fitness promotion in college: The relationships among students’ perceived physical literacy, knowledge, and physical fitness. *Frontiers in Psychology*, 15, 1305121. <https://doi.org/10.3389/fpsyg.2024.1305121>
- Mahardhika, N. A., Kriswanto, E. S., Muktiani, N. R., Jusuf, J. B. K., Santoso, J. A., Priyambada, G., Julianur, J., Alexander, B., Utomo, A. W. B., & Raharja, A. T. (2024). Physical activity, eating behaviour, and sleep quality as predictors of body mass index in adolescents? A correlational study on high school students in East Kalimantan. *Fizjoterapia Polska*, 24(2), 45–52.
- Martinez, C., & Johnson, L. (2023). Gender gaps in physical activity motivation: Long-term implications and intervention strategies. *Psychology of Sport and Exercise*, 65, 102378.
- Martinez-Sánchez, S. M., Martnez-Sánchez, L. M., & Martinez-Garcia, C. (2024). Gender differences in barriers to physical exercise among university students

- studying physical activity and sports sciences. *Sage Open*, 14(1). <https://doi.org/10.1177/00178969231226383>
- Ndupu, L. B., Staples, V., Lipka, S., Faghy, M., Bessadet, N., & Bussell, C. (2023). Application of theoretical domains framework to explore the enablers and barriers to physical activity among university staff and students: A qualitative study. *BMC Public Health*, 23(1), 670. <https://doi.org/10.1186/s12889-023-17621-4>
- Rodriguez, M., Thompson, K., & Garcia, L. (2021). Neurobiological mechanisms of gender differences in rhythm-based physical activities: An fMRI study. *NeuroImage*, 234, 117998.
- Rodriguez-Ayllon, M., Cadenas-Sánchez, C., Estévez-López, F., Muñoz, N. E., Mora-Gonzalez, J., Migueles, J. H., Molina-García, P., Henriksson, H., Mena-Molina, A., Martínez-Vizcaíno, V., Catena, A., Löf, M., Erickson, K. I., Lubans, D. R., Ortega, F. B., & Esteban-Cornejo, I. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: A systematic review and meta-analysis. *Sports Medicine*, 49(9), 1383–1410. <https://doi.org/10.1007/s40279-019-01099-5>
- Sáez, I., Solabarrieta, J., & Rubio, I. (2021). Motivation for physical activity in university students and its relation with gender, amount of activities, and sport satisfaction. *Sustainability*, 13(6), 3183. <https://doi.org/10.3390/su13063183>
- Shen, S., Guo, T., Yang, S., & Yang, F. (2024). *Mediating role of body mass index on the relationship between physical activity and physical fitness among junior high school students in Shanghai*.
- Thompson, A., Davis, B., Wilson, C., & Clark, D. (2022). Long-term adherence to school-based physical activity programs: The role of intrinsic motivation. *Journal of School Health*, 92(11), 1045–1053.
- Wang, X., Li, Y., & Fan, H. (2024). Impact of screen-based sedentary behaviors on physical and mental health of children and adolescents: A systematic review. *International Journal of Environmental Research and Public Health*, 21(1), 184. <https://doi.org/10.3390/ijerph21010184>
- Wang, X., & Zhou, B. (2024). Motor development-focused exercise training enhances gross motor skills more effectively than ordinary physical activity in healthy preschool children: An updated meta-analysis. *Frontiers in Public Health*, 12, 1414152. <https://doi.org/10.3389/fpubh.2024.1414152>
- Zhang, L., Wang, Y., & Liu, Z. (2022). Developmental changes in physical activity motivation during middle childhood. *Developmental Psychology*, 58(9), 1678–1689.
- Zuo, X., Liu, L., Chen, W., Mao, Z., Zhang, J., & Si, L. (2022). The influence of exercise self-efficacy on overall quality of life in collegiate athletes: The mediating role of sports identity and self-esteem. *International Journal of Environmental Research and Public Health*, 19(3), 1605. <https://doi.org/10.3390/ijerph19031605>