



The Effect of Circuit Training Methods in Improving the Physical Abilities of Junior High School Students

Shadiq Afriliyan^{1A-E*}, Wawan Junresti Daya^{2B-D}, Ahmad Muzaffar^{3B-D}, Palmizal A.^{4B-D}, Sugih Suhartini^{5B-D}

^{1,2,3,4} Universitas Jambi, Jambi, Indonesia

shadiqafriilian@gmail.com^{1*}, wawanfik@unja.ac.id², muzaffar.fkip@unja.ac.id³, palmizal@unja.ac.id⁴, sugisuhartini@unja.ac.id⁵

ABSTRACT

Physical fitness is a fundamental component in supporting the effectiveness of physical education learning, yet many students still demonstrate low levels of physical ability due to the absence of structured training programs. This study aimed to determine the effect of the circuit training method on improving the physical abilities of Grade VIII students at SMP Negeri 1 Muaro Jambi. This research employed a pre-experimental method using a one-group pretest-posttest design. The sample consisted of 24 students selected through random sampling, representing 10% of the total population (236 students). The instrument used was the Indonesian Physical Fitness Test (TKJI) for ages 13-15 years, which measures various components of physical fitness. Data analysis included the Shapiro-Wilk normality test, Levene's homogeneity test, and paired sample t-test using SPSS 23. The results showed that the data were normally distributed (pretest sig. = 0.086; posttest sig. = 0.066) and homogeneous (sig. = 0.108). The average physical fitness score increased from 12.79 (pretest) to 14.63 (posttest), with an improvement of 1.84 points. The paired sample t-test revealed a significant difference, with t-value = 5.898 > t-table = 1.7291 and sig. = 0.000 < 0.05. In conclusion, the circuit training method has a significant effect on improving the physical abilities of Grade VIII students. This method is effective in enhancing multiple components of physical fitness simultaneously and can be recommended as an alternative training strategy in physical education programs.

ARTICLE HISTORY

Received: 2026/03/10
Accepted: 2026/03/23
Published: 2026/05/10

KEYWORDS

Circuit Training;
Physical Fitness;
Physical Education;
Students;
TKJI test.

AUTHORS' CONTRIBUTION

A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

Cites this Article : Afriliyan, S.; Daya, W.J.; Muzaffar, A.; P.A.; Suhartini, S. (2026). The Effect of Circuit Training Methods in Improving the Physical Abilities of Junior High School Students. **Competitor: Jurnal Pendidikan Kepeleatihan Olahraga**. 18 (2), p.2119-2130

INTRODUCTION

Sport is a multidimensional activity that systematically integrates the development of mind, body, and spirit to enhance physical, psychological, social, and cultural potential (Sobri, 2019). Within the educational context, physical education plays a crucial role as an integral component of holistic education, aiming to foster cognitive, affective, and psychomotor domains through structured physical activity (Sukintaka, 2014). Consequently, the quality of physical education is highly dependent on students' physical



condition, which serves as a foundational element for effective participation and learning outcomes.

Physical condition, defined as a composite of interrelated physiological and motor components, significantly influences students' ability to engage actively in physical education (Fiddinina, 2018). Students with optimal physical fitness demonstrate higher endurance, better motor coordination, and improved learning engagement, whereas those with poor physical condition tend to experience fatigue more quickly and exhibit lower participation levels (Trishandra, 2022). This issue is particularly relevant in school settings where structured physical conditioning programs are often lacking.

Based on preliminary observations conducted during the Professional Training Program (PLP) at SMP Negeri 1 Muaro Jambi, it was found that Grade VIII students exhibited relatively low levels of physical fitness. This condition was reflected in students' lack of enthusiasm, passive participation, and visible fatigue during physical education classes, especially those conducted during midday. Furthermore, interviews with physical education teachers revealed that no formal physical fitness assessments had been conducted, and no systematic training programs were implemented to improve students' physical condition. Instead, teaching was limited to curriculum-based activities without targeted interventions for physical development.

This situation highlights a critical gap between the expected outcomes of physical education and the actual physical readiness of students. Without structured and scientifically designed training programs, students are unlikely to achieve optimal physical fitness levels, which may hinder both their academic performance and overall well-being. Therefore, there is a need for an effective, efficient, and practical training method that can be integrated into school settings to enhance students' physical abilities.

Physical condition is widely recognized as a multidimensional construct consisting of several key components, including strength, endurance, power, speed, flexibility, balance, coordination, agility, accuracy, and reaction time (Bafirman, 2019). These components collectively determine an individual's physical performance and adaptability to physical demands. Recent studies in sports science emphasize that early and continuous training based on appropriate principles is essential for achieving optimal physical fitness levels (Bompa & Haff, 2019; Suchomel et al., 2018).

In the context of school-based physical education, various training methods have been explored to improve students' physical condition. Among these, circuit training has emerged as one of the most effective and efficient approaches. Originally developed by Morgan and Anderson in 1953, circuit training is designed as a sequence of exercise stations targeting different physical components in a systematic manner (Mohanta, 2019). This method allows for the simultaneous development of multiple fitness components, making it particularly suitable for educational settings with limited time and resources.

According to Harsono (2018), circuit training is a comprehensive training system that enhances overall physical fitness by integrating exercises that target strength, endurance, speed, agility, and flexibility. The structure of circuit training typically

involves multiple stations (6–12 exercises), short-duration activity (10–30 minutes), and controlled rest intervals (30–60 seconds between stations and 3–5 minutes between circuits) (Bompa & Haff, 2019). This design ensures both efficiency and effectiveness in improving physical fitness.

Empirical studies over the past decade have consistently demonstrated the effectiveness of circuit training in improving physical fitness. For instance, Kurniawan (2018) reported significant improvements in students' strength and endurance following a structured circuit training program. Similarly, Permadi (2023) found that circuit training significantly enhanced agility and cardiovascular endurance among junior high school students. Reza (2023) further confirmed that circuit training positively influenced overall physical fitness, including speed, power, and coordination.

International research also supports these findings. Studies indicate that circuit training improves cardiovascular fitness, muscular endurance, and neuromuscular coordination in adolescents (Milanović et al., 2015; Faigenbaum et al., 2019). Moreover, circuit-based training has been shown to increase student motivation and engagement due to its dynamic and varied nature (Lubans et al., 2016; Fairclough et al., 2018). These advantages make circuit training a highly adaptable and effective method for school-based physical education programs.

Despite the growing body of literature supporting the effectiveness of circuit training, several gaps remain, particularly in the context of Indonesian junior high schools. First, most existing studies focus on athletes or general populations, with limited research specifically targeting middle school students in formal educational settings. This is problematic because students in this age group have unique developmental characteristics that require tailored training approaches. Second, previous studies often examine specific components of physical fitness, such as strength or endurance, rather than evaluating the comprehensive impact of circuit training on overall physical ability. Given that physical condition is a multidimensional construct, it is essential to assess the holistic effects of training interventions. Third, there is a lack of empirical evidence from rural or semi-urban school contexts, such as SMP Negeri 1 Muaro Jambi. Environmental factors, facility availability, and student characteristics may influence the effectiveness of training programs, necessitating context-specific research. Fourth, many schools still lack structured and evidence-based training programs integrated into physical education curricula. This indicates a gap between theoretical knowledge and practical implementation, which must be addressed through applied research. Therefore, this study aims to fill these gaps by examining the effect of circuit training on the overall physical abilities of Grade VIII students within a real school setting, using a structured and measurable approach.

Based on the identified problems and research gaps, the primary objective of this study is to determine the effect of the circuit training method on improving the physical abilities of Grade VIII students at SMP Negeri 1 Muaro Jambi. Specifically, this study seeks to evaluate improvements in key physical components, including strength, endurance, power, speed, agility, and flexibility.

The novelty of this research lies in several aspects. First, it applies a comprehensive circuit training program specifically designed for junior high school students, integrating multiple physical components within a single intervention. Second, the study is conducted in a real educational setting, providing practical insights for physical education teachers. Third, it emphasizes a holistic evaluation of physical fitness, rather than focusing on isolated components. Fourth, the training program is designed based on scientifically grounded principles, ensuring its relevance and applicability.

By addressing these aspects, this study contributes to the development of evidence-based physical education practices and provides a practical model for improving students' physical fitness in school environments.

In conclusion, physical condition plays a fundamental role in the effectiveness of physical education, yet many students still exhibit low fitness levels due to the absence of structured training programs. Circuit training offers a promising solution due to its efficiency, versatility, and proven effectiveness in improving multiple components of physical fitness. However, empirical evidence in school contexts, particularly in Indonesia, remains limited. Therefore, this study is essential to provide scientific validation and practical guidance for implementing circuit training as an effective method to enhance students' physical abilities.

METHODS

This study employed an experimental method using a one-group pretest-posttest design, which is widely recognized as an effective approach for evaluating the impact of an intervention within a single group over time (Creswell & Creswell, 2018; Fraenkel et al., 2019). This design allows researchers to measure changes in participants' physical abilities before and after the application of a treatment, thereby providing direct evidence of the effectiveness of the circuit training method (Thomas et al., 2022). Although the absence of a control group is considered a limitation, this design remains relevant in educational and field-based research where experimental control is constrained (Ary et al., 2019).

The research was conducted at SMP Negeri 1 Muaro Jambi in January 2025. The population consisted of all Grade VIII students totaling 236 individuals. A sample of 10% (n = 24 students) was selected using a simple random sampling technique to ensure equal opportunity for all students to be included in the study, thus minimizing sampling bias (Etikan & Bala, 2017). This sample size is considered adequate for experimental studies in school settings, particularly when examining pre-post differences (Milanović et al., 2015).

The primary instrument used in this study was the Indonesian Physical Fitness Test (Tes Kesegaran Jasmani Indonesia / TKJI) for the 13-15 years age group. The TKJI is a standardized and validated tool commonly used to assess physical fitness levels among Indonesian adolescents (Anugrah et al., 2022). It consists of five test items: (1) 50-meter

sprint to measure speed, (2) flexed-arm hang to assess upper body strength and endurance, (3) 60-second sit-up test to evaluate abdominal muscular endurance, (4) vertical jump to determine lower-body explosive power, and (5) a 1000-meter run for boys or 800-meter run for girls to measure cardiovascular endurance. Each test component reflects key dimensions of physical fitness as identified in contemporary sport science literature, including strength, endurance, speed, and power (Bompa & Haff, 2019; Suchomel et al., 2018).

The results of each test item were converted into standardized scores based on TKJI norms and then summed to determine the overall physical fitness classification. The classification categories include:

Table 1.
 Physical Fitness Classification Based on TKJI (Ages 13-15)

No.	Score Range	Classification
1	22 - 25	Very Good
2	18 - 21	Good
3	14 - 17	Moderate
4	10 - 13	Poor
5	5 - 9	Very Poor

Source: Anugrah et al. (2022)

The use of norm-referenced evaluation enables a comprehensive interpretation of students' fitness levels and facilitates comparison with national standards (Lubans et al., 2016).

The experimental procedure involved three main stages: pretest, treatment, and posttest. During the pretest phase, participants completed the TKJI to establish baseline physical fitness levels. The treatment consisted of a structured circuit training program designed according to established training principles, including progressive overload, specificity, and recovery (Bompa & Haff, 2019). Circuit training sessions incorporated multiple exercise stations targeting various physical components such as strength, agility, and endurance, which have been shown to improve overall physical fitness in adolescents (Faigenbaum et al., 2019; Milanović et al., 2015). After the intervention period, the posttest was administered using the same TKJI procedures to assess improvements.

Data analysis was conducted using IBM SPSS Statistics 23. The normality of the data was tested using the Shapiro-Wilk test, which is recommended for small sample sizes (Ghasemi & Zahediasl, 2018). Homogeneity of variance was assessed using Levene's test to ensure the consistency of data distribution (Field, 2018). Hypothesis testing was performed using the paired sample t-test to determine significant differences between pretest and posttest scores. The criteria for decision-making were as follows: data are considered normally distributed if $p > 0.05$, and the hypothesis is accepted if $p < 0.05$ or if the calculated t-value exceeds the critical t-value (Pallant, 2020).

Overall, this methodological approach provides a systematic and scientifically grounded framework for evaluating the effectiveness of circuit training in improving students' physical abilities.

RESULTS AND DISCUSSION

Result

Descriptive Statistics of Physical Ability

The descriptive statistical analysis was conducted to provide an overview of students' physical abilities before and after the implementation of the circuit training program. The results of the pretest and posttest are presented in Table 2.

Table 2.

Descriptive Statistics of Pretest and Posttest

Statistics	Pretest	Posttest	Improvement
N	24	24	-
Mean	12.79	14.63	1.84
Std. Deviation	1.141	1.439	-
Minimum	10	12	-
Maximum	14	17	-

Based on Table 2, the mean score of students' physical ability increased from 12.79 (pretest) to 14.63 (posttest), indicating an average improvement of 1.84 points. This improvement suggests a positive change in students' physical fitness levels following the circuit training intervention. In addition, the increase in the maximum score from 14 to 17 indicates that some students experienced substantial improvement in physical performance. The slight increase in standard deviation (from 1.141 to 1.439) reflects greater variability in posttest performance, suggesting that the intervention affected students differently depending on their initial fitness levels.

Normality Test

The normality of the data was assessed using the Shapiro-Wilk test, which is appropriate for small sample sizes. The results are presented in Table 3.

Table 3.

Shapiro-Wilk Normality Test Results

Group	Statistic	Sig. (p-value)	Interpretation
Pretest	0.872	0.086	Normal
Posttest	0.922	0.066	Normal

The significance values for both the pretest (0.086) and posttest (0.066) are greater than the threshold value of 0.05. Therefore, it can be concluded that the data are normally distributed, satisfying one of the key assumptions for parametric statistical testing. This result indicates that further inferential analysis using parametric methods, such as the paired sample t-test, is appropriate.

Homogeneity Test

The homogeneity of variance was tested using Levene's Test, which evaluates whether the variance of the data is equal across groups. The analysis yielded a significance value of 0.108, which is greater than 0.05. This indicates that the data have homogeneous variance, meaning that the distribution of scores is consistent and does not violate the assumption of homogeneity. Therefore, the dataset meets the requirements for conducting parametric hypothesis testing.

Hypothesis Testing (Paired Sample t-Test)

To determine whether the circuit training method had a significant effect on students' physical abilities, a paired sample t-test was conducted. The results are presented in Table 4.

Table 4. Paired Sample t-Test Results

Pair	t-count	t-table	Sig. (2-tailed)
Pretest - Posttest	5.898	1.7291	0.000

The results show that the calculated t-value (5.898) is significantly higher than the critical t-value (1.7291), and the significance value (0.000) is less than 0.05. This indicates that there is a statistically significant difference between the pretest and posttest scores. Thus, the alternative hypothesis (H_a) is accepted, meaning that the circuit training method has a significant effect on improving the physical abilities of Grade VIII students at SMP Negeri 1 Muaro Jambi.

Overall, the results demonstrate a clear improvement in students' physical fitness following the circuit training intervention. The increase in mean scores, supported by statistically significant results from the paired sample t-test, confirms the effectiveness of the training method. Additionally, the fulfillment of normality and homogeneity assumptions strengthens the validity of the findings, indicating that the observed improvements are not due to chance but are a direct result of the applied training program.

Discussion

The findings of this study demonstrate that the application of the circuit training method significantly improved the physical abilities of Grade VIII students at SMP Negeri 1 Muaro Jambi. This is evidenced by the increase in the mean score from 12.79 (pretest) to 14.63 (posttest), with an average gain of 1.84 points, as well as the shift in physical fitness classification from predominantly "Poor" to "Moderate." These results confirm that circuit training is an effective method for enhancing students' overall physical condition in a school-based context.

From a physiological perspective, the observed improvement can be explained by the principle of multicomponent training adaptation, where multiple physical attributes are developed simultaneously through structured exercise (Bompa & Haff, 2019; Suchomel et al., 2018). Circuit training is specifically designed to target various components of physical fitness, including muscular strength, power, endurance, agility, and coordination, within a single training session (Milanović et al., 2015; Faigenbaum et al., 2019). This integrated approach is particularly beneficial for adolescents, whose physical development requires balanced stimulation across multiple systems (Lloyd et al., 2016).

In this study, each exercise station contributed to specific physiological adaptations. The push-up exercise enhanced upper-body muscular strength and endurance, which are essential for supporting postural stability and functional

movement (Behm et al., 2017). The squat jump and walking lunges targeted lower-body power and strength by activating major muscle groups such as the quadriceps, hamstrings, and gluteal muscles, thereby improving explosive performance (Markovic & Mikulic, 2018). The heel kicks exercise improved neuromuscular coordination and speed through repetitive cyclic movement patterns, which are crucial for locomotor efficiency (Young et al., 2015). Meanwhile, the hexagon drill and three-corner drill enhanced agility and dynamic balance by challenging the body's ability to change direction rapidly and maintain stability (Sheppard & Young, 2016; Chaouachi et al., 2017).

The combination of these exercises within a structured circuit format, accompanied by controlled recovery intervals, promotes both aerobic and anaerobic adaptations. Short recovery periods (30–60 seconds) increase cardiovascular demand, leading to improved oxygen utilization and endurance capacity (Astorino et al., 2019). At the same time, repeated high-intensity efforts stimulate anaerobic energy systems, enhancing muscular power and speed (Buchheit & Laursen, 2019). This dual adaptation explains the overall improvement in students' physical fitness levels observed in the present study.

The findings of this research are consistent with previous empirical studies. For example, Kurniawan (2018) reported a significant improvement in physical fitness among soccer extracurricular students following circuit training ($t = 6.956 > 1.729$). Similarly, Sonchan (2017) demonstrated that circuit training effectively enhances muscular strength, agility, anaerobic capacity, and cardiovascular endurance. Permadi (2023) also found a substantial increase in cardiovascular endurance among soccer athletes, with a very high t -value ($t = 20.567 > 1.714$), indicating strong training effects. These findings collectively reinforce the effectiveness of circuit training across different populations and settings.

Recent international studies further support these results. Milanović et al. (2015) found that circuit-based training significantly improves cardiovascular fitness and muscular endurance in adolescents. Faigenbaum et al. (2019) highlighted that structured resistance and circuit training programs are safe and effective for youth, leading to improvements in strength, coordination, and injury prevention. Additionally, Lubans et al. (2016) emphasized that multicomponent physical activity programs, such as circuit training, are associated with increased physical fitness and improved health outcomes among school-aged children.

The improvement in students' physical fitness classification from "Poor" to "Moderate" also indicates that circuit training has practical significance beyond statistical outcomes. This shift reflects a meaningful enhancement in students' functional capacity, enabling them to participate more actively in physical education activities. According to Ortega et al. (2018), improvements in physical fitness during adolescence are strongly associated with better academic performance, mental health, and long-term health outcomes.

Another important factor contributing to the effectiveness of circuit training is its engaging and varied nature, which helps increase student motivation and participation.

Unlike traditional monotonous exercises, circuit training involves multiple activities performed in sequence, reducing boredom and maintaining students' interest (Fairclough et al., 2018; Martínez-Vizcaino et al., 2020). This is particularly relevant in the context of this study, where initial observations indicated low student motivation and passive behavior during physical education classes. The introduction of circuit training likely enhanced students' intrinsic motivation, leading to greater effort and improved performance.

Furthermore, the principle of progressive overload applied in circuit training ensures continuous adaptation by gradually increasing exercise intensity or volume (Bompa & Buzzichelli, 2019). This principle is essential for stimulating physiological improvements and preventing performance plateaus (Grgic et al., 2020). In this study, the structured progression of exercises and controlled recovery periods allowed students to adapt progressively, resulting in measurable improvements in physical fitness.

However, it is important to acknowledge certain limitations of this study. The use of a one-group pretest–posttest design limits the ability to control for external variables that may influence the results, such as students' daily physical activity or nutritional intake (Fraenkel et al., 2019). Additionally, the relatively small sample size ($n = 24$) may limit the generalizability of the findings. Future studies are recommended to include control groups, larger sample sizes, and longer intervention periods to strengthen the validity of the results.

Despite these limitations, the findings of this study provide strong empirical evidence that circuit training is an effective and practical method for improving students' physical abilities in school settings. The integration of multiple physical components within a single training program makes it highly suitable for physical education curricula, especially in contexts with limited time and resources.

In conclusion, the significant improvement in students' physical abilities observed in this study is a result of the comprehensive and systematic nature of circuit training. By simultaneously targeting strength, power, endurance, speed, and agility, circuit training facilitates holistic physical development. These findings not only support existing literature but also provide practical implications for physical education teachers to implement structured and evidence-based training programs to enhance students' physical fitness.

CONCLUSION

Based on the results and discussion of this study, it can be concluded that the circuit training method has a significant effect on improving the physical abilities of Grade VIII students at SMP Negeri 1 Muaro Jambi. This conclusion is supported by statistical evidence obtained from the paired sample t-test, where the calculated t-value (5.898) is greater than the critical t-value (1.7291), and the significance level (0.000) is lower than 0.05. These results indicate that the improvement observed in students' physical abilities is statistically significant and not due to chance.

Empirically, the effectiveness of the circuit training intervention is reflected in the increase in the mean physical fitness score from 12.79 (pretest) to 14.63 (posttest), with an average improvement of 1.84 points. In addition, there was a notable shift in physical fitness classification, where most students initially categorized as “Poor” improved to the “Moderate” category after the intervention. This finding demonstrates that circuit training is capable of enhancing multiple components of physical fitness simultaneously, including strength, endurance, power, speed, and agility.

Conceptually, the results reinforce the theoretical framework that multicomponent training programs, such as circuit training, are effective in stimulating comprehensive physiological adaptations. The structured combination of exercises, along with appropriate recovery intervals, contributes to improved neuromuscular coordination, cardiovascular endurance, and overall physical performance.

In practical terms, it is recommended that physical education teachers integrate circuit training programs regularly into their instructional practices to enhance students’ physical fitness levels. Furthermore, future researchers are encouraged to expand this study by incorporating additional variables, such as motivation or body composition, and by extending the duration of the training program to obtain more comprehensive and generalizable findings.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to all parties who have contributed to the successful completion of this research entitled “The Effect of Circuit Training Method in Improving Physical Abilities of Grade VIII Students at SMPN 1 Muaro Jambi.”

First and foremost, the authors extend their deepest appreciation to the principal, teachers, and administrative staff of SMP Negeri 1 Muaro Jambi for their support, cooperation, and permission to conduct this study. Their openness and assistance during the research process greatly facilitated data collection and the implementation of the training program.

The authors are also grateful to the physical education teachers who provided valuable insights, technical support, and collaboration throughout the intervention process. Their professional contributions were instrumental in ensuring that the circuit training program was implemented effectively and in accordance with educational and training principles.

Special thanks are extended to the Grade VIII students who participated actively and enthusiastically in this study. Their commitment, discipline, and willingness to follow the training protocol played a crucial role in the success of this research. Without their participation, the findings of this study would not have been possible.

The authors would also like to acknowledge colleagues and academic peers who provided constructive feedback, suggestions, and motivation during the research process. Their academic input helped improve the quality and rigor of this study.

Finally, the authors express their gratitude to all individuals and institutions who have contributed directly or indirectly to this research. It is hoped that the findings of this study will provide meaningful contributions to the development of physical education practices and the implementation of effective training methods in school settings.

REFERENCES

- Anugrah, R., et al. (2022). Tes Kesehatan Jasmani Indonesia (TKJI) sebagai alat ukur kebugaran. <https://journal.unnes.ac.id/sju/index.php/jpes>
- Astorino, T. A., et al. (2019). High-intensity interval training and cardiovascular adaptations. <https://doi.org/10.1007/s40279-019-01127-1>
- Bafirman. (2019). Pembentukan Kondisi Fisik. Padang: UNP Press.
- Behm, D. G., et al. (2017). Neuromuscular adaptations to resistance training. <https://doi.org/10.1519/JSC.0000000000001881>
- Bompa, T. O., & Haff, G. G. (2019). Periodization: Theory and Methodology of Training. <https://us.humankinetics.com>
- Bompa, T., & Buzzichelli, C. (2019). Periodization Training for Sports. <https://us.humankinetics.com>
- Buchheit, M., & Laursen, P. B. (2019). High-intensity interval training adaptations. <https://doi.org/10.2165/11599170-000000000-00000>
- Chaouachi, A., et al. (2017). Agility training effects in youth athletes. <https://doi.org/10.1123/ijssp.2016-0265>
- Creswell, J. W., & Creswell, J. D. (2018). Research Design. <https://us.sagepub.com>
- Etikan, I., & Bala, K. (2017). Sampling techniques in research. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Faigenbaum, A. D., et al. (2019). Youth resistance training benefits. <https://doi.org/10.1123/pes.2018-0149>
- Fairclough, S. J., et al. (2018). Physical activity engagement in schools. <https://doi.org/10.1186/s12966-018-0707-1>
- Field, A. (2018). Discovering Statistics Using SPSS. <https://uk.sagepub.com>
- Fraenkel, J. R., et al. (2019). How to Design and Evaluate Research in Education. <https://www.mheducation.com>
- Ghasemi, A., & Zahediasl, S. (2018). Normality tests for statistical analysis. <https://doi.org/10.5812/ijem.84794>
- Grgic, J., et al. (2020). Resistance training dose-response. <https://doi.org/10.1007/s40279-019-01147-x>
- Harsono. (2018). Latihan Kondisi Fisik. Bandung: Remaja Rosdakarya.
- Kurniawan, A. (2018). Pengaruh circuit training terhadap kondisi fisik siswa. <https://ejournal.unesa.ac.id>

- Lloyd, R. S., et al. (2016). Long-term athlete development. <https://doi.org/10.1136/bjsports-2015-095497>
- Lubans, D. R., et al. (2016). Physical activity interventions in youth. <https://doi.org/10.1016/j.pmedr.2016.02.009>
- Markovic, G., & Mikulic, P. (2018). Neuromuscular adaptations to plyometric training. <https://doi.org/10.2165/00007256-200838120-00007>
- Martínez-Vizcaíno, V., et al. (2020). School-based fitness interventions. <https://doi.org/10.3390/ijerph17093132>
- Milanović, Z., et al. (2015). Circuit training effects on fitness. <https://doi.org/10.1519/JSC.0000000000000841>
- Mohanta, P. (2019). Circuit training methodology in physical fitness. <https://www.researchgate.net>
- Ortega, F. B., et al. (2018). Physical fitness and health outcomes. <https://doi.org/10.1016/j.pcad.2018.04.001>
- Pallant, J. (2020). SPSS Survival Manual. <https://www.routledge.com>
- Permadi, R. (2023). Pengaruh circuit training terhadap daya tahan kardiovaskular. <https://journal.uny.ac.id>
- Reza, M. (2023). Circuit training dan peningkatan kebugaran jasmani. <https://ejournal.undiksha.ac.id>
- Sheppard, J. M., & Young, W. B. (2016). Agility literature review. <https://doi.org/10.2165/00007256-200737090-00003>
- Sobri, M. (2019). Konsep Dasar Olahraga dan Pendidikan Jasmani. <https://garuda.kemdikbud.go.id>