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The Effect of Circuit Training on Leg Muscle Power During the Crouch Start in the 60-Meter Dash

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Abstract

This study was motivated by the observation that most students are still unable to complete tasks quickly. This study employs a quantitative approach using a quasi-experimental design. The study population consisted of 30 students participating in the 60-meter sprint track and field extracurricular program at MI Miftahunnajah Pakikiran. The students participating in the track and field program were from grades III, IV, and V. Sampling was conducted using purposive sampling, resulting in a sample of 10 students. The results of this study indicate that the circuit training method has an effect on the 60-meter sprint performance of students in the track and field extracurricular program at MI Miftahunnajah Pakikiran. This can be demonstrated through a T-test hypothesis test. Since the significance value is 0.000 < 0.05, H0 is rejected and H1 is accepted. The mean score on the pretest was 6.486, while on the posttest it was 5.656 (an increase of 0.829), resulting in a 1.658% increase. Based on the conclusions reached, the most appropriate recommendation is: (1) The need for a fundamental and comprehensive exploration of sprint training methods so that the exercises can be properly applied and tailored to the athletes' needs: (2) The need for new innovations in the form of resources that can motivate students in the track and field training program at MI Miftahunnajah Pakikiran.

Introduction

Physical Education (PE) is a means of achieving educational goals through physical activities that engage various parts of the body, the nervous and muscular systems, cognitive abilities, interaction with others, cultural understanding, emotional well-being, and the development of ethical attitudes (Saril et al., 2023). Through academic and extracurricular sports activities, students can enhance their physical potential. Extracurricular sports activities at school not only improve students' physical health but also have a positive impact on their social skills and their enthusiasm for regular exercise (Prasetyo & Azhari, 2024). As one of the fundamental sports, track and field particularly running events is typically introduced in physical education classes at the elementary school level because track and field can help improve fitness components such as speed, explosive power, and movement coordination, which are essential aspects of students' physical activity (Utami, 2024). The 60-meter sprint is a sprint event that requires full speed over a short period to cover a distance of 60 meters (Yuliawan & Septriasa, 2023).

To achieve optimal results in the 60-meter sprint, mastery of starting techniques particularly the crouch start is essential. Supporting physical conditions, such as leg muscle strength and explosive power, significantly influence sprint performance because the muscles' ability to generate force and react quickly is directly related to running speed (Febrianti et al., 2025). Lower-body muscle explosive power plays a crucial role in generating strong force during the start phase particularly in the crouch start technique thereby affecting initial acceleration and overall running speed.

Lower-body muscle explosiveness is the ability of the lower-body muscles to generate force rapidly over a short period (Dinata & Priyambada, 2024). It plays a vital role in the start and acceleration phases of running, particularly in generating a strong initial push-off and accelerating the increase in speed. Research indicates a significant correlation between lower-body muscle explosiveness and 60-meter sprint performance, where higher explosiveness correlates with better running speed (Hasanuddin, 2022).

Therefore, lower-body muscle explosiveness is one of the primary factors determining success in short-distance sprints. In practical application, training tends to be dominated by technical or fundamental activities such as running, without being balanced by more specific physical exercises. Other research indicates that in

extracurricular activities, coaches focus more on technical and tactical training, while physical aspects such as strength and explosive power still receive insufficient attention (SarmadanFittaqi & Winarno, 2024).

This section explains the methodology used in the research, which is considered necessary to strengthen the published manuscript. The importance of proper training methods in sprinting cannot be overlooked, as effective training must be systematically planned, varied, and tailored to the physical demands of the sport. Systematic training programs have been proven to optimally and sustainably improve physical fitness components such as strength, speed, and lower-body explosive power (Susanti et al., 2022).

Training designed based on the principle of periodization yields greater physical adaptation compared to unstructured training. This is because periodization is a scientific method for designing training programs that systematically and progressively regulate training volume, intensity, and variety (Evans, 2019). Circuit training is a form of exercise that involves various exercise stations performed sequentially within a specific time frame or number of repetitions to train multiple aspects of fitness simultaneously (Mirpana & Mahfud, 2024). The variety and rotation in this type of training make circuit training ideal for comprehensively developing fitness elements, making this method highly suitable for improving students' lower-body explosive strength and sprint performance. Circuit training is characterized by a number of distinct exercise stations, movement variations at each station, and a system that allows participants to rotate through the exercises in sequence (Wilk et al., 2020).

Circuit training is beneficial for improving various elements of physical fitness because participants perform a series of exercises with varied movements in succession (Lase et al., n.d.). Through circuit training, explosive power and muscular speed can be optimally enhanced, directly contributing to students' sprint performance. The selection of circuit training techniques in this study was based on their suitability for the physical demands of sprinting, specifically the 60-meter sprint. Activities included in circuit training such as jumping, sprinting, and lower-body strength exercises are directly related to the physical components required for sprinting, particularly lower-body explosive power and acceleration ability. Training that structurally combines strength and speed can improve the explosive movement

capabilities required in sprinting (Nasution & Tarigan, 2025).

Circuit training has great potential to improve lower-body muscle explosiveness because it involves explosive and repetitive exercises in a single training sequence (Herlambang, n.d.). Combining various types of exercises in circuit training can provide maximum stimulation to the muscles, thereby significantly improving power capacity. Therefore, circuit training is considered appropriate for enhancing lower-body muscle power in students participating in the 60-meter sprint extracurricular activity.

Methods

Research methodology is the foundation and the first step in conducting research, providing a framework for systematically collecting and analyzing data. According to Sugiyono (2017), "research methodology is essentially a scientific approach to obtaining data for specific purposes and applications." This study employs a quantitative approach using an experimental method.

According to Arikunto (2013:265), data collection methods are the means researchers use to gather research data. Thus, obtaining the desired data in accordance with the researcher's objectives as part of the data collection process is a challenging step, because incorrect data will lead to erroneous conclusions. In this study, the researcher conducted tests and measurements using a survey method with a one-group pretest-posttest design, which involves administering a pretest, followed by the treatment, and concluding with a posttest. The purpose of using this design was to determine the effect of circuit training on the improvement of lower-body muscle power in students participating in the 60-meter sprint track and field extracurricular program.

The instrument used to measure lower-body muscle power was the Standing Broad Jump test (Gunawan, 2014). The following norms were established for elementary school students aged 10–12 years and were differentiated by gender.

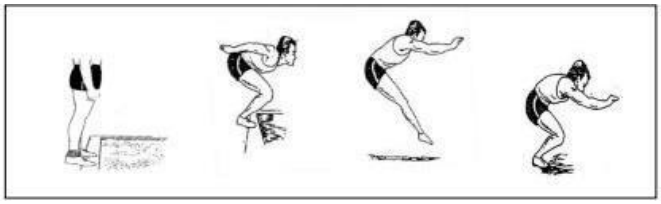

Figure 1. Standing Broad Jump

Source: (Gunawan, 2014: 27)

Table 1. Assessment Standards for Boys

Age	Excellent	Good	Fair	Poor	Very Poor
10 Age	>170 cm	150-169 cm	130-149 cm	110-129 cm	< 110 cm
11 Age	>180 cm	160-179 cm	140-159 cm	120-139 cm	< 120 cm
12 Age	> 190 cm	170-189 cm	150-169 cm	130-149 cm	< 130 cm

Source: (Gunawan, 2014)

Tabel 2. Assessment Standards for Girls

Age	Excellent	Good	Fair	Poor	Very Poor
10 Age	>160 cm	140-159 cm	120-139 cm	100-119 cm	< 100 cm
11 Age	>170 cm	150-169 cm	130-149 cm	110-129 cm	< 110 cm
12 Age	> 180 cm	160-179 cm	140-159 cm	120-139 cm	< 120 cm

Source: (Gunawan, 2014)

Therefore, the researcher used SPSS to determine whether the data followed a normal distribution, conducted a homogeneity test, and performed a paired t-test to determine whether there was an effect on the implementation of the exercise program.

Results

The treatment in this experiment was administered over 16 sessions, as this was deemed sufficient to produce changes; therefore, the researcher administered the final test after 12 training sessions, in accordance with the minimum weekly training requirement. The training program to improve the athletes' performance was conducted three times a week using a circuit training regimen. The final test was conducted after the participants completed the training program over 10 sessions, plus 2 days for the pretest and posttest. In the posttest, the children were retested using the same procedure as the initial pretest; the difference was that in this posttest, the children had already undergone the circuit training program. The researcher re-administered the lower-body muscle strength test, beginning by measuring the children's lower-body muscle strength first. The researcher measured the children's lower-body muscle strength by having them perform a standing board jump using a board that had been specifically designed and provided for this purpose, and then recorded the results of the standing board jump test for the children.

The study titled "The Effect of Circuit Training on Lower-Body Muscle Power During the Crouch Start in the 60-Meter Run in the Track and Field Extracurricular Program at MI Miftahunnajah Pakikiran" can be analyzed and described as follows:

Table 3. Pretest and Posttest Results

No	Category	*Pretest*		*Post-test*	
		Frequency	Percentage	Frequency	Percentage
1	**Excellent**	0	0%	4	43%

2	**Good**	4	47%	6	57%
3	**Fair**	5	49%	0	0%
4	**Poor**	1	4%	0	0%
5	**Very Poor**	0	0%	0	0%
	Total	10	100%	10	100%

When presented in a graph, the results can be seen in the figure below: Based on Table 3, it can be seen that the pretest results for the experimental group of male students showed 0 students (0%) in the “very good” category, 4 students (47%) in the “good” category, 5 students (49%) in the “average” category, 1 student (4%) in the “below average” category, and 0 students (0%) in the “very below average” category. Meanwhile, the post-test results for the experimental group of students showed that 4 students (43%) were in the “very good” category, 6 students (57%) were in the “good” category, 0 students (0%) were in the “average” category, 0 students (0%) were in the “poor” category, and 0 students (0%) were in the “very poor” category.

Table 4. Descriptive Analysis *Pretest* dan *Post-test*

	Pretest	***Post-test***	**Difference**
Average	6,48651	5,65698	0,82953
Standard Deviation	0,36459	0,31647	0,04812
Minimum	5,79	5,31	0,48
Maximum	7,83	6,41	1,42

Based on Table 4, it can be seen that the descriptive analysis of the pretest for the experimental group yielded a mean score of 6.487651, a standard deviation of 0.36459, a minimum score of 5.79, and a maximum score of 7.83. Meanwhile, the posttest for the experimental group yielded a mean score of 5.65698, a standard deviation of 0.31647, a minimum score of 5.31, and a maximum score of 6.41.

Table 5. Results of the Normality Test for the Pretest and Posttest

	Tests of					
	Kolmogorov-Smirnov[a]			*Shapiro-Wilk*		
	Statistic	Df	*Sig.*	*Statistic*	Df	*Sig.*
Pretest	,096	10	,200*	,656	10	,074
Posttest	,101	10	,200*	,656	10	,271

**. This is a lower bound of the true significance.*

a. Lilliefors Significance Correction

Based on Table 5, it can be seen that the results of the normality test for the pretest of the experimental group showed a significance value of 0.200 for the

Kolmogorov-Smirnov test and 0.074 for the Shapiro-Wilk test, while the normality test for the posttest showed a significance value of 0.200 for the Kolmogorov-Smirnov test and 0.271 for the Shapiro-Wilk test. This indicates that the data are normally distributed; since the significance levels for both the pretest and posttest Kolmogorov-Smirnov and Shapiro-Wilk tests are > 0.05, H0 is accepted and H1 is rejected. Therefore, it can be concluded that the pretest results are normally distributed.

Table 6. Results of the Homogeneity Tests for the Pretest and Posttest

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	*Sig.*
Based on Mean Pretest	,217	1	52	,642
Based on Median Pretest	,267	1	52	,606
Based on Mean Posttest	1,188	1	52	,278
Based on Median Posttest	1,154	1	52	,285

Based on Table 6, it can be seen that the significance value for the pretest homogeneity test (Based on Mean) is 0.642. This indicates that the data have homogeneous variance; since the significance value for the pretest (Based on Mean) is 0.642 > 0.05, H0 is accepted and H1 is rejected. Therefore, it can be concluded that the pretest results have homogeneous variance. The p-value for the posttest homogeneity test based on the mean is 0.278. This indicates that the data have homogeneous variance; since the p-value for the posttest based on the mean is 0.278 > 0.05, H0 is accepted and H1 is rejected. Therefore, it can be concluded that the posttest results have homogeneous variance.

Table 7. Results of the Posttest Hypothesis Test

Independent Samples Test									
	Levene's Test for Equality of Variances		*t-test for Equality of Means*						
	F	*Sig*	T	Df	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*95% Confidence Interval of the Difference*	
								Lower	*Upper*
Equal variances assumed	1,065	,232	4,128	10	,000	,37546	,07412	,54923	,2538

Based on Table 7, it can be seen that the results of the post-test hypothesis test, assuming equal variances, yielded a significance level (two-tailed) of 0.000. This indicates that there is a significant effect. Therefore, it can be concluded that circuit training has an effect on lower-body muscle power during the crouch start of the 60-meter sprint in the track and field extracurricular program at MI Miftahunnajah Pakikiran.

Discussion

This study was conducted by analyzing the difference between the pretest and posttest results to determine the improvement in students' ability to perform the 60-meter sprint. The first step taken by the researcher was to administer a pretest to students participating in the track and field sprint extracurricular program, followed by an intervention using circuit training. After the students completed the intervention, a second test the posttest was administered to assess changes or improvements in their ability to perform the 60-meter sprint.

From the results of the t-test comparing the initial and final test scores for the 60-meter sprint in the MI Miftahunnajah Pakikiran track and field extracurricular program, a t-calculated value of 4.128 was obtained. Meanwhile, the t-table value is 2.228. Since the t-calculated value is greater than the t-table value, the null hypothesis is rejected. Thus, it can be concluded that after 10 sessions of intervention, there is a significant difference between the final and initial test results for the 60-meter run in the MI Miftahunnajah Pakikiran Athletics Extracurricular Program, as the mean score in the final test was higher than that in the initial test; thus, it can be concluded that there was an improvement in the 60-meter run performance in the MI Miftahunnajah Pakikiran Athletics Extracurricular Program.

These research findings are understandable, as optimal performance in the 60-meter run must be supported by specific physical components related to the running motion in this case, lower-body muscle power. Furthermore, lower-body muscle power is a supporting factor in every sport, particularly those involving the use of the legs. Furthermore, lower-body muscle explosiveness will lead to an improvement in an individual's ability to run the 60-meter dash. This is because lower-body muscle explosiveness is a component of overall explosiveness, which is a key factor in achieving athletic performance, particularly in sports that require movement from one place to another or that involve the lower-body muscles.

The 60-meter sprint involves transferring explosive power from the lower body to the upper body to perform various movements in sports. Furthermore, by possessing maximum strength, an athlete will be able to improve their physical abilities, which can directly support the mastery of techniques during game situations, such as when running. In the 60-meter sprint, the physical component specifically the explosive power of the lower-body muscles is the primary factor in

achieving a high-quality run. From this definition, it is clear that performing a Standing Broad Jump requires lower-body explosive power, as we need fast and powerful movements while running. Therefore, based on the results of previous research, it can be concluded that 60-meter sprint speed is determined by lower-body explosive power; thus, the better an individual's lower-body explosive power, the faster their 60-meter sprint time will be.

In the process of training for the 60-meter sprint using the circuit training method, the specific exercises selected influence the training process. Some examples of circuit training exercises include squat thrusts, step-ups, and 10-meter sprints. Based on these results, it can be concluded that circuit training is an effective method for improving an athlete's physical condition. Circuit training is defined as "a form of exercise conducted across several stations, each with distinct exercises and functions." It is very easy to perform and consists of a structured sequence of physical exercises carried out in a specific order. The physical attributes enhanced through circuit training include endurance, muscular power, strength, speed, flexibility, and agility. The intensity of the physical training can be determined by the number of sets and the duration at each station. Through circuit training, students' running technique and speed will improve and become even better. According to Kusuma, L. S. W., & Jamaludin, J. (2022), champions are not born but must be shaped and developed, even though talent is a dominant factor. Talent can be identified through an athlete's internal factors, which are innate from birth.

Training must be conducted continuously with progressively increasing and measurable loads to bring about changes; training can be defined as an activity to improve skills or as athletic proficiency achieved by using various equipment according to the needs and goals of the sport. Therefore, the group that underwent circuit training was assessed for its performance in the 60-meter sprint. Thus, the hypothesis states that there is an effect of circuit training on lower-body explosive power during the crouch start of the 60-meter sprint in the track and field extracurricular program at MI Miftahunnajah Pakikiran.

This training provides engaging and enjoyable activities for athletes, thereby increasing their enthusiasm and motivation to master the techniques taught. Training is a systematic process aimed at improving an athlete's performance

quality in terms of fitness, skills, and energy capacity. Training is a planned physical exercise program designed to help athletes learn skills, improve physical fitness, and most importantly prepare them for major competitions. It is a conscious process of refining an athlete's qualities to achieve maximum performance through regular, targeted, gradual, progressive, and repetitive physical and mental challenges (Atiq, 2018: 5–6). Through training, students' physical condition improves.

Many factors on the field influence students' development; one of these is their enthusiasm for participating in training. Additionally, their discipline significantly impacts their performance. Students' active engagement on the field and their enthusiasm for participating in activities have a very positive impact on their development. This makes a significant contribution to their overall improvement. Based on the success of these training sessions, this can certainly serve as a driving factor in achieving the training objectives. Students will be able to maximize their potential in improving their performance whether in academic achievement or athletic performance both at school and outside of school. Furthermore, this motivation can foster students' personal development in cognitive, affective, and psychomotor domains.

Conclusion

Based on the research data obtained and the data calculations, the calculated t-test value is 4.128, while the critical t-value (t-table) is 2.228; therefore, the alternative hypothesis (Ha) is accepted and the null hypothesis (Ho) is rejected. This means that the circuit training method has an effect on the 60-meter run results in the MI Miftahunnajah Pakikiran Athletics Extracurricular Program; the average 60-meter run score in the program was 6.486 on the pretest and 5.656 on the posttest (an increase of 0.829) representing an increase of 1.658%. Based on the discussion and conclusions reached, the most appropriate recommendations are: (1) The need for sprint training to be explored thoroughly and comprehensively so that exercises can be applied effectively and in accordance with the athletes' needs; (2) The need for new innovations in the form of resources that can motivate students to participate in the track and field program at MI Miftahunnajah Pakikiran.

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