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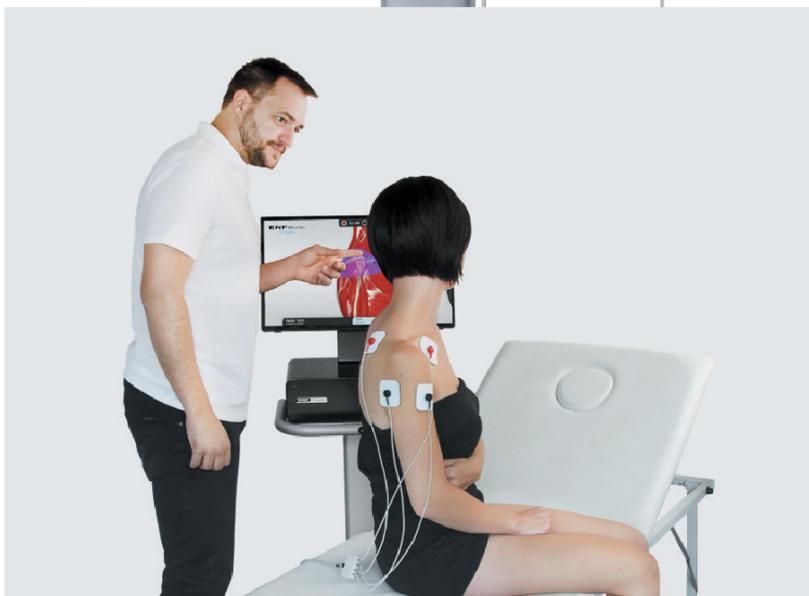

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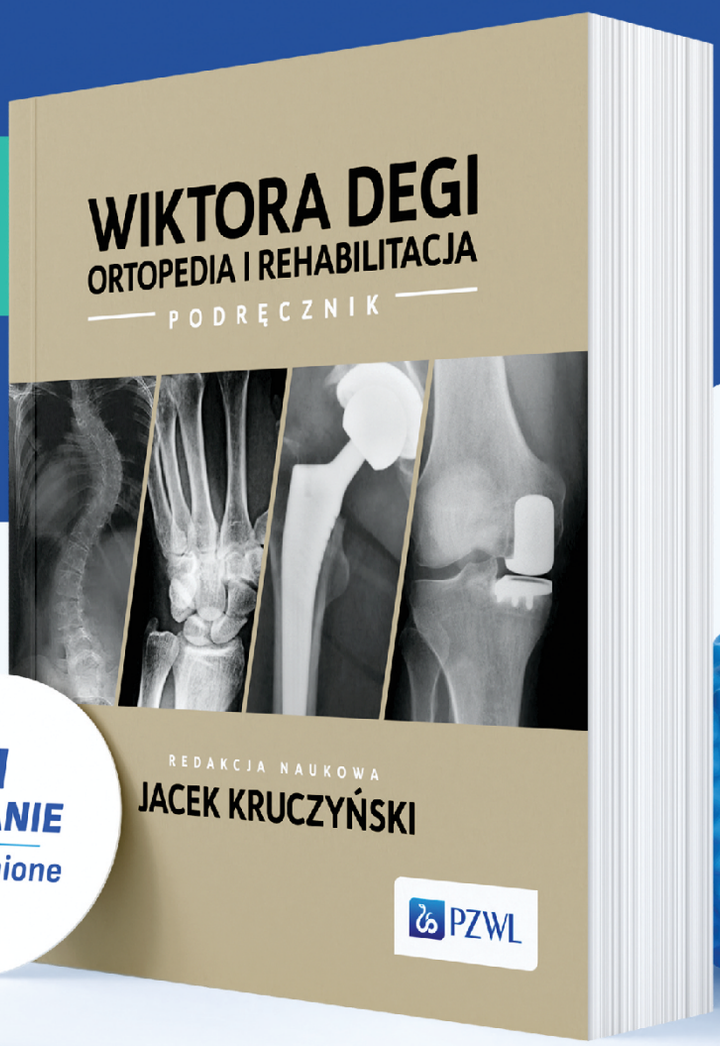

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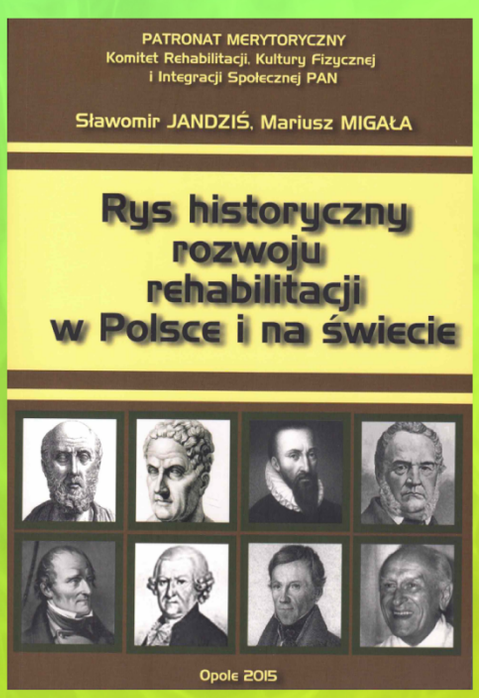

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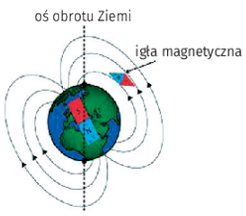

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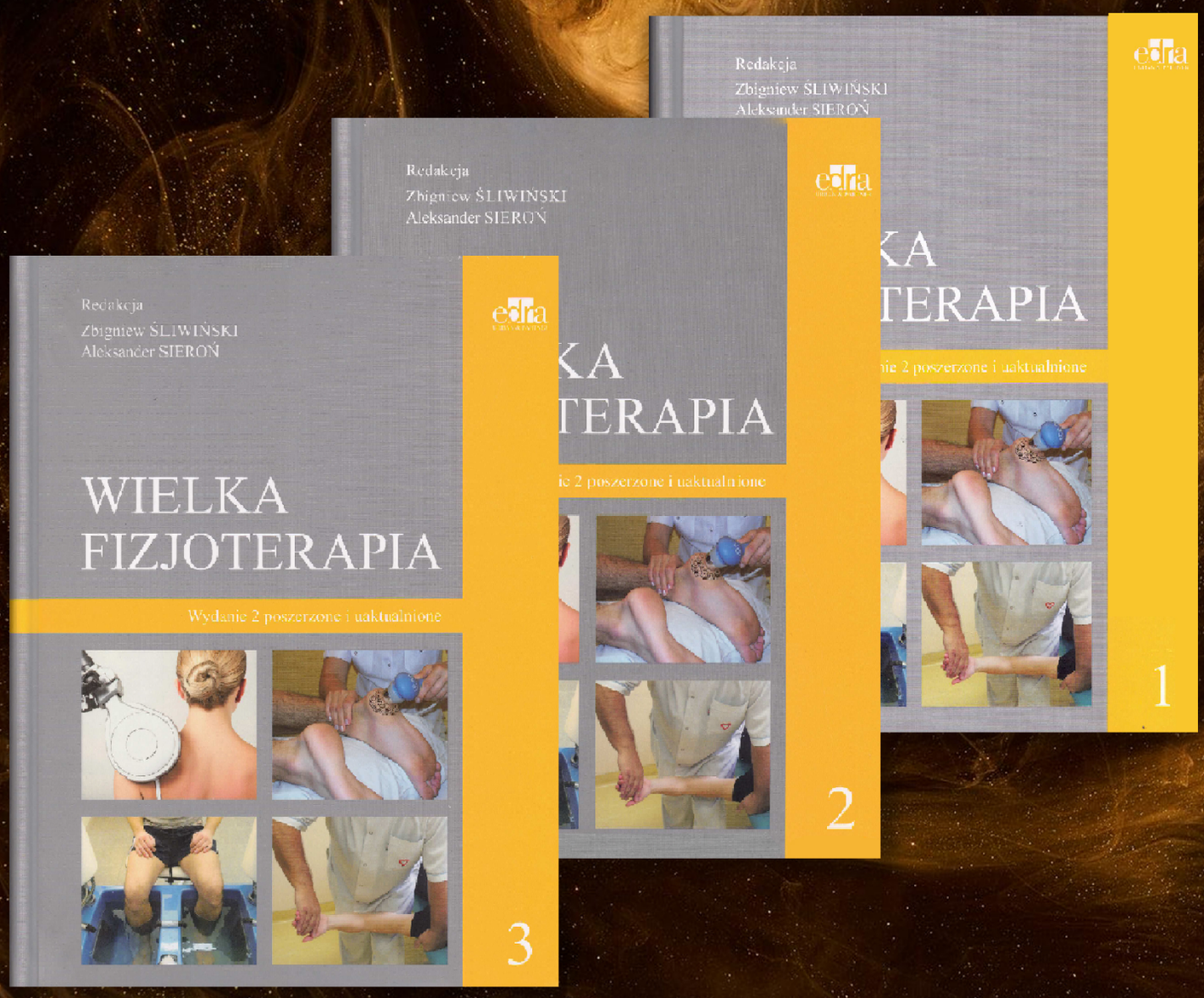

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The effect of the circuit bodyweight training method on increasing muscle strength, muscle endurance, and balance of wrestling athlete

Wpływ metody treningu obwodowego z wykorzystaniem masy ciała na zwiększenie siły mięśniowej, wytrzymałości mięśniowej i równowagi zapaśników

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Abstract

This study aims to find out: (1) the effect of the circuit bodyweight training method on increasing muscle strength, muscle endurance, and balance of wrestling athletes, (2) the difference in the effect of the circuit bodyweight training method between the treatment group and the control group on increasing strength, muscle endurance, and balance of wrestling athletes. This type of research is quasi-experimental with a pre-test design and post-test control group design. The sample in this study amounted to 77 people taken using random sampling techniques. The subjects were divided into 2 groups, namely the group given the treatment of as many as 36 people and the control group with as many as 31 people. Instruments used to measure hand muscle strength are using a hand grip dynamometer, arm muscle endurance using a push-ap, abdominal muscle endurance using a sit-ap, Leg muscle strength using a wall sit test, and balance test using a standing stork test. The data analysis technique used is an independent sample t-test followed by a paired sample t-test. The results showed that: 1) There was a significant effect of the circuit bodyweight training method on increasing muscle strength, muscle endurance, and balance in wrestling athletes, in the treatment group evidenced by data on hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance obtained a significance value smaller than 0.05 ($p < 0.05$). 2) There is a significant difference in influence between the treatment group and the control group on increasing muscle strength, muscle endurance, and balance in wrestling athletes, as evidenced by the average value of hand muscle strength, hand muscle endurance, abdominal muscle endurance, Leg muscle strength, and balance in the treatment group was 60.46 while the average value of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance in the control group was 48.54 with an average post-test difference of 11.92. So this study concluded that there was a significant increase in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance before and after treatment, and there was no significant improvement in the control group. The treated group had better hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance compared to the untreated control group.

Keywords

circuit bodyweight training, muscle strength, muscular endurance, balance

Streszczenie

To badanie ma na celu ustalenie: (1) Wpływu metody treningu obwodowego z wykorzystaniem masy ciała na zwiększenie siły mięśni, wytrzymałości mięśniowej i równowagi zapaśników. (20) Różnicy w efekcie metody treningu obwodowego z wykorzystaniem masy ciała między grupą badaną a grupą kontrolną w zakresie wzrostu siły, wytrzymałości mięśniowej i równowagi zapaśników.

Rodzaj badania to badanie kwazieksperymentalne z projektowaniem przedtestowym i projektowaniem grupy kontrolnej po testach. Próba w tym badaniu wyniosła 77 osób, wybranych za pomocą technik losowego doboru próby. Badani zostali podzieleni na 2 grupy: grupę otrzymującą terapię (36 osób) oraz grupę kontrolną (31 osób).

Do pomiaru siły mięśni dłoni użyto dynamometru chwytu dłoni, wytrzymałość mięśni ramion była mierzona testem push-up, wytrzymałość mięśni brzucha za pomocą testu sit-up, siła mięśni nóg przez test ściany, a równowaga przez test stojącego bociana. Analiza danych opierała się na niezależnych testach t dla próbek, a następnie sparowane testy t dla próbek.

Wyniki wskazują, że (1) istnieje znaczący wpływ metody treningu obwodowego z wykorzystaniem masy ciała na wzrost siły mięśniowej, wytrzymałości mięśniowej i równowagi u zapaśników w grupie badanej. Wszystkie pomiary wykazały wartości istotności mniejsze niż 0,05 ($p < 0,05$); istnieje znacząca różnica wpływu między grupą badaną a grupą kontrolną na wzrost siły mięśni, wytrzymałości mięśniowej i równowagi u zapaśników. Średnia wartość dla grupy badanej wynosiła 60,46, podczas gdy dla grupy kontrolnej 48,54, co daje różnicę 11,92 w teście po. Zatem, badanie wykazało, że nastąpił znaczący wzrost siły mięśni dłoni, wytrzymałości mięśni dłoni, wytrzymałości mięśni brzucha, siły mięśni nóg i równowagi przed i po terapii w grupie badanej. W grupie kontrolnej nie odnotowano znaczącej poprawy. Grupa badana miała lepsze wyniki w zakresie siły mięśni dłoni, wytrzymałości mięśni dłoni, wytrzymałości mięśni brzucha, siły mięśni nóg i równowagi niż grupa kontrolna.

Słowa kluczowe

trening obwodowy z wykorzystaniem ciężaru własnego ciała, siła mięśniowa, siła mięśniowa, siła mięśniowa

doi.org/10.56984/8ZG143BD3

Introduction

Physical training is pivotal for athletes, as it systemically enhances their physical quality, ultimately boosting sports performance. Athletes with superior physical conditions significantly increase their chances of becoming champions [1, 2]. This superior physicality not only aids in various activities but is also integral to achieving sports excellence [3, 4]. The objective of enhancing an athlete's physical condition is to prime their physical abilities to support their sporting endeavors. Every training regimen requires a precise exercise program tailored to both physical and technical skills. The human condition is ever-evolving, thus making it essential for the exercise program to be aptly designed [5]. The ultimate goal of any training is progress, including improvements in the physical and functional capacities of the body, as well as mental strength. Athletic accomplishments are transient, and training demands continuous adaptation to achieve enduring results. Generating potential champions necessitates a long and dedicated training period. However, the length of the training doesn't guarantee success without the right training regimen [6].

Wrestling, a sport demanding optimal physical prowess, encompasses a mix of pulling, pushing, lifting, and spinning maneuvers. The primary emphasis lies on slamming, rolling, and lock-in techniques aimed at destabilizing the opponent and intensifying offensive movements [7, 8]. Muscular endurance, muscle strength, and balance are the dominant physical components in wrestling [9]. Previous studies have highlighted the crucial roles of muscle endurance and strength in mastering wrestling slam techniques [10, 11].

Accurate and systematic physical training can hone slamming skills in wrestling [12, 13]. Mastering the slam technique increases a wrestler's scoring potential. A subpar slam might yield 2 points, while an optimal slam can earn 5, significantly enhancing victory chances. During offensive moves in wrestling matches, many athletes still lack sufficient hand and leg muscle strength, often evidenced by their inability to effectively capture opponents. Deficiencies also arise in lockdown techniques, with wrestlers unable to maintain a grip due to inadequate muscular endurance.

Nikooie et al. (2015) emphasized the need for wrestlers to possess optimal muscle strength and endurance, both for defensive and offensive moves [15]. These elements, along with balance, are integral to achieving success in wrestling. This notion is supported by literature that underlines the importance of muscle strength, endurance, and balance in attack techniques [16, 17].

However, in reality, many wrestlers still fall short in these physical components. A study conducted on February 1, 2023, at the Indonesian wrestling training facility revealed suboptimal attacking, slamming, and locking abilities among wrestlers. This can be attributed to inefficient training programs focusing predominantly on cardiovascular and agility drills, thus neglecting muscle endurance, strength, and balance.

Previous research has proposed various physical training methodologies to boost muscle endurance, strength, and balance. Notably, an innovative training method, the bodyweight training circuit, has emerged as a promising regimen [19]. Circuit bodyweight training fuses aerobic and endurance exercises using one's body weight. It's versatile, allowing training in diverse settings [20–22]. This system aims to holistically enhance endurance, strength, flexibility, power, agility, speed, and balance. In light of these findings, this study aims to ascertain the efficacy of the circuit bodyweight training method in augmenting muscle endurance, strength, and balance among wrestlers.

Method

Research design

This quasi-experimental study employs a pre-test and post-test design for control and treatment groups.

Research procedure

Data collection encompassed tests and measurements. The instruments used include a hand grip dynamometer for hand strength, push-ap for arm muscle endurance, sit-ap for abdominal muscle endurance, wall sit test for leg strength, and the standing stork test for balance. The study consisted of 16 sessions, conducted thrice a week, concluding with a post-test evaluation.

Research participants

The study's population comprised Indonesian wrestlers. Random sampling produced a sample size of 77 participants, split into two groups: 36 in the treatment group and 31 in the control group. All participants provided consent and adhered to the research code of ethics.

Data analysis

Using SPSS 22, data analysis employed an independent sample t-test, followed by a paired sample t-test. Preliminary tests checked for normality and homogeneity.

The subsequent section details the internal weight circuit training program.

Table.1 Training program session 1-8 circuit weight training

No.	Exercise	Goal	Set	Reps	Breaks between posts	Breaks between sets
1	Shoulder Tapping Push Up	Chest	2	12	20 second	
2	Inchworm to Side Plank	Core	2	12	20 second	
3	Reclining Circle	Stomach	2	12	20 second	
4	Reclining Triceps Press	Arm	2	12	20 second	
5	Lateral Plyo Squat	Leg	2	12	20 second	
6	Slide Out	Back	2	12	20 second	120 second
7	Floor Inverted Shoulder Press	Shoulder	2	12	20 second	
8	Plank with Leg Lift	Core	2	12	20 second	
9	Reverse Crunch	Stomach	2	12	20 second	
10	Single Leg Dip	Arm	2	12	20 second	
11	Split Jacks	Leg	2	12	20 second	
12	Back Extension with Opposite Arm and Leg Reach	Back	2	12	20 second	

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Table 2. Training program session 9-16 circuit weight training

No.	Exercise	Goal	Set	Reps	Breaks between posts	Breaks between sets
1	Shoulder Tapping Push Up	Chest	3	15	20 second	
2	Inchworm to Side Plank	Core	3	15	20 second	
3	Reclining Circle	Stomach	3	15	20 second	
4	Reclining Triceps Press	Arm	3	15	20 second	
5	Lateral Plyo Squat	Leg	3	15	20 second	
6	Slide Out	Back	3	15	20 second	120 second
7	Floor Inverted Shoulder Press	Shoulder	3	15	20 second	
8	Plank with Leg Lift	Core	3	15	20 second	
9	Reverse Crunch	Stomach	3	15	20 second	
10	Single Leg Dip	Arm	3	15	20 second	
11	Split Jacks	Leg	3	15	20 second	
12	Back Extension with Opposite Arm and Leg Reach	Back	3	15	20 second	

Result

Normality test

The normality test was conducted to determine if the data follows a normal distribution. This was assessed using the Shapiro-Wilk test. The outcomes of this test are presented in the subsequent tables.

Treatment group

Statistical analysis of the normality tests conducted using the Shapiro-Wilk test revealed that all pre-test and post-test data for the treatment group showed a significance value of $p > 0.05$. This indicates a normal data distribution. Hence, it is concluded that all the data in the treatment group, both pre-test and post-test, are normally distributed.

Table 3. Pre-test and post-test results of pre-test and post-test data treatment group

Data	Significance P	Information	
Pre-test hand muscle strength	0.05	0.832	Usual
Post-hand muscle strength test	0.05	0.342	Usual
Pre-test hand muscle endurance	0.05	0.426	Usual
Post-hand muscle endurance test	0.05	0.743	Usual
Pre-abdominal muscle endurance test	0.05	0.568	Usual
Post-abdominal muscle endurance test	0.05	0.360	Usual
Pre-test leg muscle strength	0.05	0.183	Usual
Post-leg muscle strength test	0.05	0.213	Usual
Pre balance test	0.05	0.164	Usual
Post balance test	0.05	0.070	Usual

Control Group

Similar to the treatment group, the Shapiro-Wilk test for the control group demonstrated that all the pre-test and post-test data have a significance value of $p > 0.05$, confirming a normal distribution. Therefore, all the data in the control group, for both pre-test and post-test, are declared normal.

Table 4. Pre-test and post-test results of pre-test and post-test data control group

Data	Significance P	Information	
Pre-test hand muscle strength	0.05	0.319	Usual
Post-hand muscle strength test	0.05	0.920	Usual
Pre-test hand muscle endurance	0.05	0.882	Usual
Post-hand muscle endurance test	0.05	0.519	Usual
Pre-abdominal muscle endurance test	0.05	0.443	Usual
Post-abdominal muscle endurance test	0.05	0.165	Usual
Pre-test leg muscle strength	0.05	0.090	Usual
Post-leg muscle strength test	0.05	0.068	Usual
Pre balance test	0.05	0.173	Usual
Post balance test	0.05	0.060	Usual

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Homogeneity test

The homogeneity test is used to test the similarity of variance between the compared data. The results of the homogeneity test of pre-test and post-test data between the treatment group and the control group of this study are in the Table 5.

Results of homogeneity test to test the similarity of variance of pre-test post-test data between the treatment group and the control group. Since the significance value is greater than 0.05 ($p > 0.05$), it can be stated that the pre-test and post-test data between the treatment group and the control group are homogeneous.

Table 5. Test results of homogeneity of pre-test and post-test data

Data	Group	F_{count}	p	Information
Pre-test hand muscle strength	Treatment Control	3.749	0.057	Homogeneous
Post-hand muscle strength test	Treatment Control	3.662	0.060	Homogeneous
Pre-test hand muscle endurance	Treatment Control	0.139	0.710	Homogeneous
Post-hand muscle endurance test	Treatment Control	1.497	0.225	Homogeneous
Pre-abdominal muscle endurance test	Treatment Control	0.174	0.678	Homogeneous
Post-abdominal muscle endurance test	Treatment Control	0.527	0.471	Homogeneous
Pret leg muscle strength test	Treatment Control	2.945	0.091	Homogeneous
Post-leg muscle strength test	Treatment Control	2.945	0.091	Homogeneous
Pre balance test	Treatment Control	0.252	0.617	Homogeneous
Post balance test	Treatment Control	0.502	0.481	Homogeneous

Test Effectiveness

Independent sample t-test results

Pre test

The results of the independent sample t-test on the pre-test data compared between the treatment group and the control group are as follows.

Table 6. Results of independent sample t-test data pre test

Data	Group	Mean	t_{count}	p	Information
Hand muscle strength	Treatment Control	40.90 39.79	0.420	0.676	Significant
Hand muscle endurance	Treatment Control	19.16 32.19	1.287	0.203	Significant
Endurance of the abdominal muscles	Treatment Control	24.44 25.83	0.751	0.455	Significant
Leg muscle strength	Treatment Control	76.38 77.22	0.901	0.935	Significant
Balance	Treatment Control	68.13 61.03	0.590	0.557	Significant
The average number of grades	Treatment Control	47.21 45.80			

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Based on the results of the Independent Sample t-test analysis obtained a value (p) greater than 0.05 ($p > 0.05$), it can be concluded that there is no significant difference in the components of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance between the treatment group and the control group at the time of the pre-test. This means that both groups had the same hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance before being treated in the treatment group.
Based on the results of the analysis, the average value of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance in the treatment group was 47.21 while the average value of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, balance in the control group was 45.80. This means that the treatment group had an average of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and better balance compared to the control group that did not get treatment.

Post Test
The results of the independent sample t-test on the post-test data compared between the treatment group and the control group are as follows.

Table 7. Results of independent sample t-test data post test

Data	Group	Mean	t_{count}	p	Information
Hand muscle strength	Treatment Control	53.76 40.75	6.589	0.000	Significant
Hand muscle endurance	Treatment Control	38.52 33.03	2.521	0.014	Significant
Endurance of the abdominal muscles	Treatment Control	28.66 25.35	2.338	0.022	Significant
Leg muscle strength	Treatment Control	94.44 78.93	2.315	0.024	Significant
Balance	Treatment Control	86.94 64.67	2.429	0.018	Significant
The average number of grades	Treatment Control	60.46 48.54			

Based on the results of the Independent Sample t-test analysis obtained a significance value smaller than 0.05 ($p < 0.05$), it can be concluded that there is a significant difference in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, the balance between the treatment group and the controversy group.
Based on the results of the analysis, the average value of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance in the treatment group was 60.46 while the average value of hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance in the control group was 48.54. This means that the treatment group had better hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance compared to the control group that did not receive treatment.

Paired sample t-test results
Treatment Group

Table 8. Results of paired sample t-test treatment group

Data	Group	Mean	t_{count}	p	Information
Hand muscle strength	Treatment Control	40.90 53.76	8.782	0.000	Significant
Hand muscle endurance	Treatment Control	29.16 38.52	6.799	0.000	Significant
Endurance of the abdominal muscles	Treatment Control	24.44 28.66	4.122	0.000	Significant
Leg muscle strength	Treatment Control	76.38 94.44	4.003	0.000	Significant
Balance	Treatment Control	68.13 86.94	3.950	0.000	Significant

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Based on the results of the Paired Sample t-test data on hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance obtained a significance value smaller than 0.05 ($p < 0.05$), it can be concluded that there are significant differences in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance during the pre-test and post-test in the treatment group. This means that there is a significant increase in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance before and after treatment.

Control group

Based on the results of the Paired Sample t-test data on hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance obtained a significance value greater than 0.05 ($p > 0.05$), it can be concluded that there is no significant difference in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance during pre-test and post-test in the control group. This means that there was no significant increase in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance in the control group.

Table 9. Results of paired sample t-test control group

Data	Group	Mean	t_{count}	p	Information
Hand muscle strength	Treatment Control	39.79 40.75	0.749	0.460	Significant
Hand muscle endurance	Treatment Control	32.19 33.03	1.351	0.187	Significant
Endurance of the abdominal muscles	Treatment Control	25.83 25.35	1.060	0.298	Significant
Leg muscle strength	Treatment Control	77.22 78.93	0.711	0.483	Significant
Balance	Treatment Control	61.03 64.67	1.642	0.111	Significant

Discussion

The discussion of the results of this study provides a further interpretation of the results of the data analysis that has been presented. The discussion of the results of the analysis can be further described as follows.

Effect of the circuit bodyweight training method on enhancing muscle strength, muscle endurance, and balance of wrestling athletes

The hypothesis testing reveals the impact of the circuit bodyweight training method on augmenting muscle strength, endurance, and balance in wrestling athletes. Circuit weight training has proven to be an effective regimen to enhance physical fitness parameters like hand muscle strength, leg muscle strength, arm muscle endurance, and abdominal muscle endurance. This assertion is buttressed by various studies. For instance, research [24] found that high-intensity circuit training could significantly enhance muscle endurance in a moderately fit population. Similarly, evidence from another study [21] highlights that a six-week circuit weight training regime effectively develops fitness parameters like leg strength, explosive leg power, and abdominal strength endurance. The observed improvement in muscle strength and abdominal muscle endurance can be attributed to specific exercises included in both the training and cool-down sessions. The boost in leg strength and endurance is likely influenced by the training intensity, circuit weight, movement speed, and explosive power. Current findings align with the hypothesis that circuit weight training can enhance physical conditions, especially the endurance component of muscle strength [25]. Circuit training is a potent regimen to enhance strength and functional fitness [23], improving mobility, strength, and stamina. The system comprises 6 to 8 strength exercises performed sequentially, each for a specific number of repetitions or a set duration. Short breaks intersperse the exercises, while longer rest intervals separate different circuits. The overall number of circuits in a training session can range between two to six, contingent on the training level, phase (preparation or competition), and training objective. Circuit training can influence various physical and fitness components, necessitating balance due to its rapid movements, thereby engaging the knee and ankle balancing muscles to maintain equilibrium during exercise. Strong muscle contractions, a response to dynamic load or rapid muscle stretching, are induced by circuit weight training [6]. Muscle hypertrophy effects enhance muscle strength and endurance. This is further supported by another study [26], suggesting that increased muscle strength arises from a growth in the number of contractile proteins, actin filaments, and myosin, as well as enhanced connective tissue and ligament strength. Engaging in exercises that maximally contract muscles thrice weekly over a span of 6-8 weeks can boost muscle strength by up to 30%. Hence, this research followed a thrice-weekly regimen with an escalating training load over six weeks to enhance physical fitness, especially muscle strength, endurance, and balance.

Effect of variances in circuit bodyweight training methods between treatment and control groups on muscle strength, endurance, and balance in wrestling athletes

Analysis indicates a significant disparity in effects between the treatment and control groups concerning enhancing the

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strength, muscular endurance, and balance of wrestling athletes. Athletes subjected to the circuit weight training method outperformed their counterparts in the control group. This is corroborated by previous research [27], suggesting that an experimental group exhibited substantial differences in chosen physical fitness metrics like leg muscle strength, explosive muscle power, and abdominal muscle endurance compared to a control group. Hence, six weeks of circuit weight training can substantially enhance an athlete's physical fitness variables.

Conclusions

Drawing from the Independent Sample t-test results and the subsequent Paired Sample t-test, the following conclusions emerge:

1.There was a significant improvement in hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance post-treatment, with no noticeable enhancement in the control group.

2. The group subjected to the Circuit Body Weight Training method displayed superior hand muscle strength, hand muscle endurance, abdominal muscle endurance, leg muscle strength, and balance compared to the untreated control group.

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