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Submission date: 12-Jun-2024 09:24PM (UTC+0700)

Submission ID: 2373177607

File name: 8_JSA_2024_Agustus_OKE_Yeliz_Kahraman_230_238.docx (192.31K)

Word count: 3467

Character count: 21191

Circuit resistance training strategy on maximal strength, rate of force development, and power: A random model meta-analysis

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Received 13 January 2024; Accepted 05 May 2024; Published 13 June 2024
Ed 2024; 9(2): 246-254

ABSTRACT

Background Problems: Circuit resistance training is a type of strength and power training mode according to short-term strength, rate of force development, and power strategy; however, priority maximises performance outcomes and is not used on trained and untrained resistance populations. **Research Objectives:** Increased performance on developing high-intensity resistance sessions and short time intervals was investigated with systematic review and meta-analysis methodology. This meta-analysis methodologic approach aimed to report popular circuit resistance training on maximal strength, rate of force development, and power able to short-time interval set-up micro-periodization. **Methods:** By following this way, a high-intensity resistance combination short-time interval strategy was provided between 2008 and 2023. A study using keywords of circuit resistance training, dynamic strength, explosive power, and rate of force development was conducted to explore SportDiscus, PubMed, and the and the Web of Science databases investigated in a random model meta-analysis. **Findings and Results:** Exploration of circuit resistance training contributed to clarifying maximise strength and power performance under probable report outcomes detected to analysis of metadologic quality risk of bias, effect size, and mean difference. **Conclusion:** In conclusion, circuit resistance training strategy resulted in maximising strength and power regimes, but sufficient research has not yet been carried out as a proper periodic session adapted to detect rate of force development and power combination in the literature. In addition, circuit resistance training strategic approach may be re-performed to plan strength and power.

Keywords: Circuit resistance training; dynamic strength; explosive power; rate of force development



[https://doi.org/10.25299/sportarea.2024.vol9\(2\).15885](https://doi.org/10.25299/sportarea.2024.vol9(2).15885)

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How to Cite: Hocalar, A., & Kahraman, Y. (2024). Circuit resistance training strategy on maximal strength, rate of force development and power: A random model meta-analysis. *Journal Sport Area*, 9(2), 246-254. [https://doi.org/10.25299/sportarea.2024.vol9\(2\).15885](https://doi.org/10.25299/sportarea.2024.vol9(2).15885)

Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

An example of resistance mode is circuit resistance training that is able to maximise performance by performing high-intensity sessions and high-volume periods of professional resistance. The resistance population used circuit model training to enhance maximal strength in multiple set configurations (Kahraman & Varol, 2023). Over the last decade, this traditional resistance approach has generally been used to maximise performance by conducting high-intensity combined short-time intervals (Alcaraz et al., 2008, 2011;

Hermassi et al., 2019). In literature examined to high performance out of influence circuit resistance training explained on maximal strength, rate of force development, and power, indeed high strength effort may be observed circuit upper and lower compartment muscle reactivity (Freitas et al., 2016; Ramos-Campo et al., 2021; Kahraman & Varol, 2023).

The current approach to circuit resistance training included rapid force with a short time interval to determine maximal exercise workload and arrange maximal strength provided work to rate of force development to independent movement speed (Turner et al., 2020; Kahraman & Varol, 2023). Under the condition of circuit resistance, strategies are performed on maximal and rapid strength, which is one form of session-based time interval exercises section-based constant time strength evaluation to develop power. For example, non-professional men perform high-load exercises by all region compartment muscle groups, thereby showing power performance (Alcaraz et al., 2008, 2011; Hermassi et al., 2020). Additionally, advanced power is pronounced on the professional and non-professional population in relation to maximal strength-related peak force development (Alcaraz et al., 2008; Freitas et al., 2016). Whereas, the early peak rate of force development via a short time interval remains unchanged on maximal and explosive exercise tasks (Ramos-Campo et al., 2021).

Strength increase explained by early peak rate of force development is constant explosive power; therefore, circuit resistance training periodization has been worked continually concentric peak force (Freitas et al., 2016; Ramos-Campo et al., 2021; Kahraman & Varol, 2023). For this reason, high load circuit resistance performance is one of exercise capacity to evaluate strength and power activation and enable strength and power output during resistance training periodization, whereas moderate load circuit resistance is specific development to upper and lower compartment constant strength effort (Alcaraz et al., 2008; Hermassi et al., 2019; Ramos-Campo et al., 2021). Non-periodic high-volume set-up to maximise performance, whereas traditional circuit resistance produces strength and power; indeed, combination circuit exercise tasks increase peak rate of force development and power to reflect load time change with a short time interval, whereas low-load circuit resistance training of power players provides technical region power performance (Alcaraz et al., 2008, 2011; Freitas et al., 2016).

Thus, this probable report's base target is that circuit resistance training periodization changes promote different model strengths, power, and rate of force development gains, and in correction, circuit resistance training strategies may provide a constant performance level. However, circuit resistance training has been limited to maximal strength, rate of force development, and power; therefore, a probable report aimed to include circuit resistance training, including strength and power strategy, at the centre of research attention (Hu et al., 2024). This knowledge gap underscores the urgent need for research to delve deeper into the intricate strategies within circuit resistance training (Alcaraz et al., 2008; Hermassi et al., 2019; Ramos-Campo et al., 2021). By elucidating the distinct changes in performance elicited by different training protocols, we can refine and optimise circuit resistance training methodologies for consistent performance enhancement (Freitas et al., 2016; Ramos-Campo et al., 2021; Kahraman & Varol, 2023). Moreover, by exploring the interaction between strength and power activation throughout the training process, we can unlock new insights into maximising athletic potential (Kahraman & Varol, 2023).

Hence, this study endeavours to comprehensively investigate the varying modalities of circuit resistance training periodization and their differential impacts on strength, power, and rate of force development gains (Ramos-Campo et al., 2021). Through rigorous empirical analysis, we seek to elucidate the underlying mechanisms driving performance enhancements within circuit resistance training protocols (Ramos-Campo et al., 2021). By bridging this knowledge gap, we aim to propel circuit resistance training to the forefront of strength and power development research, revolutionising athletic performance enhancement strategies for the future (Vadivel & Maniazhagu, 2022). The exploration of circuit resistance training's efficacy extends beyond mere performance enhancement to encompass broader implications for injury prevention and rehabilitation (Buch et al., 2017; Hu et al., 2024). By understanding how circuit resistance training influences neuromuscular adaptations, we can develop targeted interventions to mitigate injury risks and expedite recovery processes (Moraru et al., 2019). Moreover, given the versatility of circuit resistance training in accommodating various

fitness levels and goals, its widespread adoption can foster inclusivity and accessibility in athletic training programmes (Hermassi et al., 2020).

As the sporting landscape continues to evolve, the demand for evidence-based training methodologies intensifies. Circuit resistance training, with its emphasis on functional movements and dynamic muscle activation patterns, holds immense promise for meeting these evolving demands. By conducting robust research into the intricacies of circuit resistance training, we can equip athletes, coaches, and fitness professionals with the knowledge and tools necessary to unleash their full potential in the pursuit of athletic excellence.

METHOD

The research was a probable report detected on circuit resistance training quality and risk of bias by a critical standard systematic literature database review. The study inclusion criteria provided to the methodologic approach used the obtaining of relevant circuit resistance training research and were selected between 2008 and 2023. There are no accepted reviews and meta-analyses of research taken from PubMed, Sportdiscus, or the or the Web of Science database. Currently, all of the research determined on the risk of bias assessment, but there is research on proper random allocation concealment, blinding of outcomes, incomplete outcome data, selective outcome reporting, other sources of bias, and overall risk of bias using quality risk of bias to determine 2 low, 3 medium, and 4 high risks of bias. Keywords of studies determined "circuit resistance" OR "circuit resistance training" AND "dynamic strength" AND "maximal strength" AND "rapid force reaction" OR "rate of force development" AND "explosive power OR "anaerobic power." This random model meta-analysis approach was provided in accordance with the guidelines of the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) (Fig. 1).

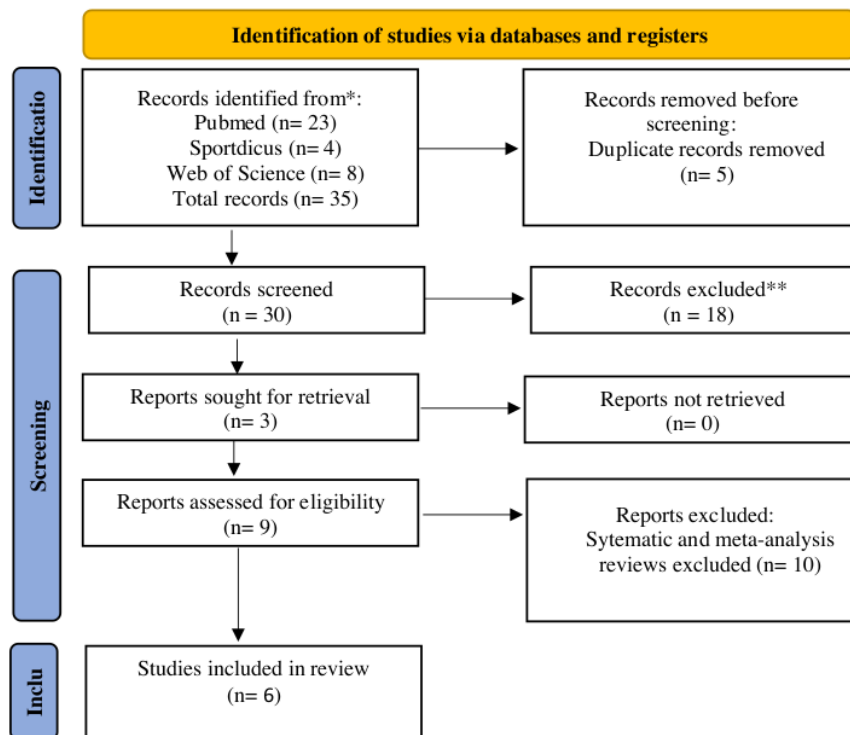


Figure 1. PRISMA Flow Chart of the Search Process

Statistical analysis

SPSS.22 was used to examine the means, standard deviations, and p values to obtain the mean difference and determine the effect size (Schwaederle et al., 2015). To explore strength and power strategy, the mean difference and effect size were calculated on the descriptors: $0.00 < 0.20$ very weak, $0.20 < 0.50$ weak, $0.50 < 0.80$ moderate, $0.80 < 1.20$ strong, $1.20 < 2.00$ very strong, and 2 or > 2 concluded as extremely strong effect size (Sawilowsky, 2009).

RESULTS AND DISCUSSION

The initial search revealed 35 studies of potential relevance to this report. After the removal of duplicates, we screened 30 records, of which 9 were considered for eligibility. To date, methodologic resolution detected circuit resistance training produced a common approach to strength and power strategic outcomes. This report's outcome is based on micro-periodization of circuit resistance training to resolve the risk of bias, mean difference, and descriptor effect size. Totally of the researchers reported acute effects ($n = 4$) and chronic effects ($n = 3$), lower compartments ($n = 1$) and full bodies ($n = 6$), linear periodization ($n = 4$), and non-periodized periodization ($n = 3$). Current report detected to risk of bias has been noted high risk of bias ($n = 3$) and medium risk of bias ($n = 1$), and other researches were low risk of bias (Table 1). The dynamic strength of circuit resistance training was reported to have a to have a strong range effect size (Kahraman & Varol, 2023), a moderate and strong range effect size (Hermassi et al., 2020), a very weak range effect size (Hermassi et al., 2019) and a weak range effect size (Ramos-Campo et al., 2021). The rate of force development in circuit resistance training noted a weak range effect size (Ramos-Campo et al., 2017). The explosive power of circuit resistance training was found to be very strong range effect size (Hermassi et al., 2020), strong range effect size (Hermassi et al., 2019), moderate range effect size (Alcaraz et al., 2011) and very weak and weak range effect size (Kahraman & Varol, 2023) (Table 2).

Table 1. Risk of Bias Quality

Authors	Randomize Range	Allocation Concealment	Blind Participation	Incomplete Outcomes Data	Selective Outcomes Reporting	Other Sources of Bias	Overall Risk of Bias
Kahraman and Varol, (2023)	L	L	H	L	L	L	L
Ramos-Campo et Al., (2021)	L	L	L	L	L	L	L
Hermassi et al., (2019)	L	L	L	L	L	L	L
Freitas et al., (2016)	L	L	H	L	L	L	L
Alcaraz et al., (2011)	L	L	L	M	L	L	L
1 Icaraz et al., (2008)	L	L	L	L	L	L	L

Blue: Low risk of bias 2; Pink: Medium risk of bias 3; Red: High risk of bias 4

Table 2. Circuit Strength and Power Strategies

Authors	Population	Design	Exercise	Protocol	Mean Difference	ES
Kahraman and Varol, (2023)	International wrestling women athletes: 17 y (n=10)	Acute; 6RM – 85%* 4 set – 10RM 35 s interval	Hip flexion Ankle inversion Squat	IRM	0.16 0.15 0.26 0.19 0.21 0.18	1.53 1.41 0.82 1.19 1.00 1.38
Ramos-Campo et Al., (2021)	Healthy men: 24.6 y (n=28)	8 week; 6RM -100%* 3 set – 6RM 35 s interval	Bench press Leg extension Front latpull down Deadlift Preacher curl Seated calf raise	MVC	0.17	0.34
Hermassi et al., (2019)	Outfield men handball players: 19-20 y (n=22)	10 week; 6-8RM - 70-80%* 3 set – 6-8RM For each 2 set 3 min interval	Bench press Leg half squat	PRFD CMJ SJ IRM	327.25 0.03 0.03 1.14 0.13	0.21 1.95 1.93 0.56 0.14
				CMJ SJ	0.02 0.03	1.10 1.03

Authors	Population	Design	Exercise	Protocol	Mean Difference	ES
Freitas et al., (2016)	Semi-professional men basketball players: 21.44 y (n=9)	Acute: 6RM – 50%* 3 set – 10RM 40 s interval	Squat			
			Bench press	Bench press (W)	0.18	0.87
			Ankle extension	CMJ	1.02	0.93
Alcaraz et al., (2011)	Healthy men: 22.7 y (n=15)	8 week; 6RM – 80-90%* 3 set, 35 s interval	Latpull down	CMJ (W)	0.09	1.56
			Knee flexion			
			Elbow extension			
			Knee flexion			
Alcaraz et al., (2008)	Men: 26 y (n=10)	Acute: 6RM – 85%* 5 set, 35 s interval	Bench press	Bench press (W)	0.19	0.51
			Ankle extension			
			Latpull down			
			Squat elbow flexion			
			Bench press	Bench press (W)	0.22	1.31
	Leg extension					
	Ankle extension					

The results of circuit resistance training were determined by the population mean difference and effect size on acute and chronic designs. Acute effect of circuit resistance training showed on maximal strength outcomes of international wrestling women athletes and semi-professional men basketball players on maximal strength constant set non-periodized periodization to show high rapid force (Freitas et al., 2016; Kahraman & Varol, 2023). In this conclusion, high-intensity short-time interval linear set-ups to develop the upper and lower compartment muscle maximal strength were reported to result in large power formation (Alcaraz et al., 2008, 2011). Contrastly, non-periodized circuit resistance training periodization provided high explosive power strategic development (Chtara et al., 2008).

One of the maximal strength combinations is circuit resistance microperiod, which performs explosive power gain to rapid force due to a short time interval on constant high-strength exercise set efforts (Kahraman & Varol, 2023). A report noted that high loading intensity popularities applied to long-term resistance training during short intervals developed high explosive jump height compared to short-term circuit resistance training periodization (Hermassi et al., 2020; Kahraman & Varol, 2023). For this reason, short-set high-intensity circuit training with linear periodization compared to acute-effect similar short-time interval set-ups enhances maximal strength and explosive power (Hermassi et al., 2020). Some researchers reported that high-intensity loading strength training unexplained microperiodization in athletic modalities and competitive seasonal strength and power strategies (Alcaraz et al., 2008, 2011; Freitas et al., 2016). In this case, the current effect may be advanced peak force and explosive power reaching working principles to produce strength on sport-specific tasks; additionally, proper periodization can be formed to form maximal strength repeat (Strelnikowa & Polevoy, 2018; Kahraman & Varol, 2023). Furthermore, circuit resistance training regimes have been considered one of the seasonal training programmes to prefer enhanced performance and neuromuscular potential gain (Naikoo et al., 2017).

Current high-intensity condition complexes and upper and lower compartment combination training sessions are suitable for developing rate of force development indicators (Ramos-Campo et al., 2021). This controversial force time performance may be a reason for neuromuscular fatigue at the rate of force development; however, a force rapid reaction is performed on every high-intensity repetition (Ramos-Campo et al., 2021). Rapid strength loading and unfatigue gradually increase maximal strength and explosive power during long-term moderate circuit periodization compared to high-intensity constant non-periodized model circuit resistance training (Hermassi et al., 2019, 2020). Thus, linear and non-linear periodized acute and chronic training regimes via circuit resistance training produce high-effective performance outcomes (Freitas et al., 2016; Hermassi et al., 2020).

CONCLUSION

Circuit resistance training is not common in the current literature to perform maximal strength, rate of force development, and power outcomes. The research reported up-to-date results from verifiable data. Circuit resistance training performance results are unexplained by linear and non-linear resistance training periodization; therefore, continued research is essential to exaggerate current performance improvements. This research supports the current contribution of resistance training, which promotes high and low load performance enhancement in both professional and non-professional resistance training populations. The research is limited, as included in the provable report on circuit resistance training strategies. Circuit resistance training is limited to maximal strength, rate of force development, and power strategy to enhance strength and power performance levels in both professional and non-professional resistance training populations. This limitation provided that circuit resistance training with low load and high load periodizations had similar gains in performance levels with acute and chronic effect periodizations. In the future, the direction of general performance development and muscular adaptation may be circuit resistance training periodization.

ACKNOWLEDGEMENTS

The probable report is dependent on circuit resistance training, maximal strength, rate of force development, and power strategies. Specifically, acknowledgement to the current report explained strength and power strategy to produce resistance training microperiods by using high intensity and a short time interval is

effective. Our proposed report aimed to conduct circuit resistance training using high-volume sessions, tests, and training plans.

CONFLICT OF INTEREST

The authors stated there was no conflict of interest.

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