International Journal of Yogic, Human Movement and Sports Sciences 2024: 9(1): 75-79

ISSN: 2456-4419
Impact Factor: (RJIF): 5.18
Yoga 2024; 9(1): 75-79

www.theyogicjournal.com
Received: 01-11-2023
Accepted: 05-12-2023

Pramod Ravi
Research Scholar, Alagappa University, Karaikudi, Tamil Nadu, India

Dr. Divya K
Assistant Professor, Alagappa University, Karaikudi, Tamil Nadu, India

Corresponding Author:
Pramod Ravi
Research Scholar, Alagappa University, Karaikudi, Tamil Nadu, India

Improving athletic abilities: The role of circuit training in student populations

Pramod Ravi and Dr. Divya K

DOI: https://doi.org/10.22271/yogic.2024.v9.i1b.1522

Abstract
This study investigates the impact of circuit training on sprint agility and explosive power, with a focus on motion and action velocity. The research explores the interplay between strength and speed training, particularly in male subjects, aiming to discern the effects of intrasession sequencing on speed, explosive strength, and power development. The study involves 30 boys aged 14 to 17, utilizing circuit training (CT) with an experimental group and a control group. The results demonstrate significant improvements in the experimental group's 50m dash and explosive power, highlighting the efficacy of CT in enhancing sprinting capabilities and explosiveness. The findings contribute valuable insights into the nuanced correlation between intrasession sequencing and physiological adaptations in concurrent strength and speed training for males. The study emphasizes the potential benefits of incorporating CT into fitness and training programs to enhance speed and explosive power.

Keywords: Circuit training, sprint agility, anaerobic endurance, explosive strength, power development, physiological adaptations, concurrent training, speed enhancement

Introduction

The key characteristic of circuit training is the successive performance of many anaerobic exercises usually with little or no rest in between aiming at producing cardiovascular training effects [1, 2]. It is widely embraced due to its time efficiency and use of lighter loads in the program [3]. Commonly, the settings of the group exercise embrace the free-weight circuit weight training classes, designating an increase in aerobic capacity, body composition, as well as muscular strength and endurance [4, 5]. The speed, flexibility, skill, endurance, and strength are all among the basic elements of fitness in any sport [6]. For the elite athletes, development for each component interrelates as part of the competition preparation [7]. In athletics especially, in the field sports reliant on the short distance running speed, speed and acceleration are pivotal qualities [8, 9]. Maximal speed actions classifies into maximal speed, acceleration or sprint-agility [10]. Agility - defined as the ability of fast change in direction and to begin and stop quickly assumes his significance in the context [11]. More specifically, there can be muscle fatigue resulting from repeated exposure to movements during any given match and hence the need for muscular endurance exercises as an additive within the strength training program of a player [12, 13]. The stride frequency, stride length, speed endurance, and movement efficiency were some of the physical components that determined running speed [14, 15]. Traditional methods in increasing sprint performance were general, velocity-specific, and movement-specific strength training [16].

The repetition number is a crucial variable, impacting the number of repetitions achievable at a given intensity [17]. This variable is intrinsic to the repetition continuum wherein magnitude and loading dictates the spectrum of repetitions, hence this dictates the associated outcomes on strength development [18]. In this context, the present study aims to delve into how much sprint-agility and anaerobic endurance can be improved through motion and action velocity-focused circuit training [19]. Other than this, a notable purpose of the paper is to explore how variation in velocity while exercising in a resistance training bout under accepted loading conditions can affect repetition range especially when speed is largely decreased for exercise.

More recently, concurrent strength and endurance training have been the subject of much focus in literature [13, 20]. Such research areas have thrown up questions on whether benefits usually derived from isolated resistance training are compromised with when both the strength and endurance exercises are performed concurrently [21]. For instance, investigations have focused on the sequencing of and order given to concurrent training regimens in question because of the phenomenon of interference, which essentially means that concurrent training may interfere with previously achieved gains [13, 22]. Several studies that sequenced or ordered such combinations of strength and endurance training in one study introduced endurance training prior to the commencement of strength training [14], placing strength training ahead of the endurance training [23, 24] or use of dual appointment of training on the same and alternate days. However, two studies investigated the particular influence of intrasession sequencing in the same training session on strength and endurance adaptations [10]. In particular, in such studies carried out among sedentary female subjects, the order of sequencing was found to have a minimal effect on strength with respect to those within a session [25]. Of more concern, however, is the fact that no research has been done to date among males to determine the effect of intrasession sequencing on strength and endurance training.

Previous studies, which have examined intrasession sequencing and order effects, often used continuous submaximal endurance protocols and traditional weight training [26]. Nonetheless, those studies have never included high-intensity interval training for endurance or resistance-type circuit training to improve strength [27]. With the well-established effectiveness related to high-intensity interval training for endurance [28] and circuit as such, as a mechanism to improve both strength and cardiovascular performance at the same time, it becomes not more than necessary to understand an optimal interaction between these two when simultaneously executed in the course of a single session. The current study hence targeted delving into the intricate details of how in intrasession sequencing concurrent strength and endurance training specifically concerning whether strength training precedes endurance training or otherwise affects [20] strength, explosive strength as well as power development in the male subjects. Based on such findings, therefore, the hypothesis was that maximal strength, strength endurance, and explosive strength and power were expected to increase in all the groups under consideration. Secondly, there was an expectation relating to the aspect that the two integrated training groups would record relatively lesser improvements in strength and power than their exclusive resistance-type training counterpart [10]. This exhaustive investigation intended to contribute nuanced insights into the intricate correlation amid intrasession sequencing and physiological adaptations related to concurrent strength and endurance training in males.

Methodology

The methodology employed consisted of a sample of 30 boys aged between 14 to 17 years, all of whom were students of the School in Doha, Qatar. Despite being of Indian nationality. The pre-tests were conducted for all the students, assessing the standing broad jump (SBJ) for Explosive Power (EP) and the 50M sprint for Anaerobic Performance (AP), facilitating the essential criterion to measure the impact of Circuit Training (CT). The students were later randomly assigned in two groups that is the Experimental Group (EG) of 15 students and the same number in the Control Group (CG). The EG underwent CT three times a week during 12 weeks whereas each session consisted of 10 stations and each exercise lasted for 60 seconds with the following 60-second rest interval. They undertook the following exercises during training: High Knee, Medicine Ball Throw, Hopping, Sit-ups, Box Jumping, Push-ups, Hurdle Jump, Shuttle Run, Bounding and Skipping.

In the subsequent 12-week intervention phase, while the CG subjects acted as the control group, they were kept active by their regular school activities through active rest. After CT intervention, a post-test was conducted yet again for both groups to analyze if any change took place regarding EP and AP. The entire data was then analyzed systematically using the 't' ratio with the level of statistical significance set at P< 0.01 for all tests.

Summary, the study design involved a comprehensive approach including choosing a targeted age group from the population, using relevant pre-tests, and conducting a properly defined CT protocol. Another important factor that enhanced the ability of the research to contribute any observations made with the CT intervention was the fact that the study used an active control group. The utilization of statistical analysis that uses a pre-set level of significance further facilitated the evaluative process and affirmed the credibility of the results.

Analysis of results

Table 1: Descriptive Statistics and ‘t’ Ratio for Speed and Explosive Power of Experimental and Control Groups

Exp. Group	Pre- test	8.15 ± 0.81	0.87	0.05	12.62*	.000
	Post-test	7.29 ± 0.65				
Con. Group	Pre- test	8.04 ± 0.82	-0.05	0.04	-0.305	.673
	Post-test	8.09 ± 0.61				
SBJ Exp. Group	Pre- test	1.87 ± 0.27	-0.32	0.02	-13.87*	.04
	Post-test	2.19 ± 0.17				
Con. Group	Pre- test	1.88 ± 0.31	0.01	0.05	0.78	.373
	Post-test	1.87 ± 0.40				

The mean performance of the 50 m Dash in Experimental Group (EG), which was induced under moderate-intensity circuit training (CT), is analyzed using a pre and post-test. The findings revealed that significantly improved performance, and this is because the pre-test mean of 8.15 and the post-test mean reduced to 7.29. The 't' value calculated for the 50 m Dash in the EG was 12.62, thus representing statistical significance at the 0.01 confidence level. This meant that the score for the 50 m dash of the subjects significantly improved after circuit training at moderate intensity. Average-wise, there was no appreciable alteration in the performance of the Control Group (CG) in the same period. The calculated 't' value for the 50 m Dash in the CG was -0.305, which was insignificant at a confidence level of 0.05. This, thus, implies that the control group to whom moderate-type circuit training was not given shows no statistically significant increase in their 50-m dash performance. The comparison between the EG and CG results depicts with greater particularity the specific impact of moderate-intensity circuit training regarding the improved performance in 50 m Dash. The final findings gained in this research study reinforce the effectiveness of circuit training as a mechanism to promote or enhance short-distance sprinting like 50 m. In sum, the improvement in the Experimental Group which was statistically significant, and no significant change in the Control Group results provide strong hints as to potential benefits for individuals aiming at improvements in their sprinting capabilities who would incorporate this training regimen.

Mean scores of Standing Broad Jump (SBJ) for experimental group (EG) participants and control group (CG) were calculated for pre and post-test. The findings in this regard showed an important increase in the SBJ scores of the experimental group participants. More specifically, the mean score of SBJ in EG increased from before the test. The computed 't' value for SBJ in the experimental group comes out to be -13.87 showing statistical significance at 0.01 level of confidence. This signifies that the circuit training (CT) applied to the experimental group had a positive and highly significant effect according to the 0.01 level of confidence based on the flexibility of the subjects by the SBJ test. Consistently, the SBJ scores for the control group demonstrated to be decreasing. The calculated 't' value for SBJ in the control group was 0.78 which proved to be statistically not significant at a level of confidence of 0.05. This means that the control group did not increase its SBJ scores significantly enough after the period of intervention, thus confirming that the positive effect observed in this case was most likely caused by the circuit training that took place in the other group. The overall results of the research study indicated that there was a remarkable increase in the SBJ scores among the experimental group, who were administered with circuit training as compared to the control group. These findings further highlight the prospective efficacy of CT protocol for flexibility as measured through SBJ. As a result, these outcomes further increase the potential value of using CT in fitness and training programs that intend to enhance flexibility

Discussion

Circuit training is a popular and effective method of exercise that involves performing a series of exercises in a sequence, with minimal rest between each exercise [1]. This type of training has been associated with improvements in both speed and explosive power, making it a valuable tool for athletes and fitness enthusiasts [3, 29]. Let's delve into some research and discussions on how circuit training methods can contribute to the enhancement of speed and explosive power. Research has shown that circuit training induces neuromuscular adaptations, leading to improvements in muscle coordination and recruitment patterns. This is crucial for activities requiring explosive power and rapid muscle contractions, such as sprinting or jumping [30] this finding is supported the current research, how the development of speed and explosive power. A study published in the "Journal of Strength and Conditioning Research" found that circuit resistance training significantly improved power output in athletes [22]. The combination of resistance exercises and minimal rest periods may contribute to enhanced power development over traditional training methods.

Circuit training often involves high-intensity, short-duration exercises that target the anaerobic energy system. The current research was conducted under the moderate intensity training and the results are shown and supported by existing research. This type of training has been associated with improvements in anaerobic capacity, which is essential for explosive efforts like sprinting and rapid changes in direction [31, 32]. Circuit training incorporates a variety of exercises targeting different muscle groups. The repetitive nature of these exercises helps improve muscular endurance, allowing athletes to sustain power output over extended periods [33]. This can be particularly beneficial for sports that require repeated explosive efforts. The metabolic demands of circuit training contribute to increased calorie expenditure and improvements in cardiovascular fitness [34]. Enhanced metabolic adaptations can positively impact an athlete's ability to sustain high-intensity efforts, contributing to better performance in explosive activities.

Circuit training can be tailored to mimic the specific demands of a sport or activity. This specificity allows athletes to focus on movements and energy systems relevant to their sport, resulting in more targeted improvements in speed and explosive power [14, 35]. Circuit training is known for its time-efficient nature. Athletes can achieve a high volume of work in a relatively short time, making it a practical choice for those with busy schedules. Consistent training over time can lead to significant improvements in speed and explosive power [36]. The variety of exercises in circuit training prevents the body from adapting too quickly to a specific stimulus. This variability can lead to continuous improvements in strength, power, and speed as the body is constantly challenged in different ways [14]. While circuit training can be effective, it's important to note that individual responses may vary. Proper program design, including exercise selection, intensity, and progression, is crucial for optimizing the benefits of circuit training for speed and explosive power development. Additionally, athletes should consider incorporating adequate rest and recovery to prevent overtraining and reduce the risk of injuries.

Funding

The exploration into " Improving Athletic Abilities: The Role of Circuit Training in Student Populations" was independently conducted without any financial support from external funding organizations. This manuscript constituted a chapter within the Doctor of Philosophy project undertaken by Research Scholar Mr. Pramod R, under the guidance of Dr. K Divya, Assistant Professor at Alagappa University, Karaikudi, Tamil Nadu, India.

Ethical Declarations

Ethical clearance and participant consent were obtained from the Alagappa University College of Physical Education, Karaikudi, Tamil Nadu, India, for the project titled " Improving Athletic Abilities: The Role of Circuit Training in Student Populations" on December 15, 2018. The development of this paper adhered to the WMA Declaration of Helsinki - Ethical Guidelines for Medical Research Involving Human Subjects. Written consent was acquired from all individuals involved in the research, and all procedures strictly followed relevant regulations and guidelines.

Acknowledgement

The researchers extend their gratitude to the students who participated in this study. Additionally, the authors wish to acknowledge the support received from various individuals and organizations during the research. This study was conducted as a part of a research project at the Alagappa university college of physical education, under the supervision and guidance of Dr. K. Divya, Assistant Professor at Alagappa University, Karaikudi, Tamil Nadu. The authors affirm that there are no conflicts of interest to disclose.

Reference

1. Adamson GT, Morgan RE. Circuit training. J Phys Educ. London; c1956.
2. Sonchan W, Moungmee P, Sootmongkol A. The Effects of a Circuit Training Program on Muscle Strength Agility Anaerobic Performance and Cardiovascular Endurance. Int J Sport Heal Sci. 2017;11(4):176-179. [Online]. Available: https://www.researchgate.net/publication/334535073
3. Ravi P. Potential role of circuit training and ladder training in the development of anaerobic power and explosive. 2023;14(02):1783-1793. doi: 10.47750/pnr.2023.14.02.223.
4. Klika B, Jordan C. High-Intensity Circuit Training Using Body Weight. ACSMs Health Fit J. 2013;17(3):8-13. doi: 10.1249/fit.0b013e31828cb1e8.
5. Naikoo KA, Bhat ZA, Bhat JA. Effect of circuit training and resistance training on strength endurance of young male college football players. Int J Physiol Nutr Phys Educ. 2017;2(2):580-582.
6. Ambroży T, *et al*. Influence of experimental training with external resistance in a form of ‘kettlebell’ on selected components of women’s physical fitness. Balt J Heal Phys Act. 2017;9(1):28-36. Doi: 10.29359/bjhpa.09.1.03.
7. Rathi Meena M, Parimalarani G. The International journal of analytical and experimental modal analysis ISSN NO: 0886-9367. Int J Anal Exp modal Anal. 2019;XI(VIII):629-636.
8. Strelnikowa IV, Polevoy GG. The influence of circuit training on the development of strength and speed-power abilities in basketball players of 18-19 years old. Phys Educ students. 2018;23(2):89-92. doi: 10.15561/20755279.2019.0206.
9. Marx JO, *et al*. Low-volume circuit versus high-volume periodized resistance training in women. Med Sci Sports Exerc. 2001;33(4):635-643.
10. McBride JM, Triplett-McBride T, Davie A, Newton RU. The effect of heavy- vs. light-load jump squats on the development of strength, power, and speed. J Strength Cond Res. 2002;16(1):75-82. doi: 10.1519/1533-4287(2002)016<0075:TEOHVL>2.0.CO;2.
11. Jovanovic M, Sporis G, Omrcen D, Fiorentini F. Effects of speed, agility, quickness training method on power performance in elite soccer players. J Strength Cond Res. 2011;25(5):1285-1292. doi: 10.1519/JSC.0b013e3181d67c65.
12. Schnitzler C, Heck G, Chatard JC, Ernwein V. A simple field test to assess endurance in inexperienced runners. J Strength Cond Res. 2010;24(8):2026-2031. doi: 10.1519/JSC.0b013e3181d2c48d.
13. Doma K, *et al*. Mickelson-AnaerobicThreshold-EliteRowers(MSSE1982).pdf. Int J Sports Med. 2013;47(1):488-494. [Online]. Available: http://journals.lww.com/nsca-jscr/Abstract/2013/09000/Concurrent_Training_in_Elite_Male_Runners___The.10.aspx%5Cnhttp://www.ncbi.nlm.nih.gov/pubmed/23287831%0Ahttp://dx.doi.org/10.1016/j.jesf.2013.12.001%0Ahttp://aut.researchgateway.ac.nz/handle/10292/459
14. Branet C, Grigoroiu C, Netolitzchi M, Wesselly T. The Effect of Plyometric Training on Lower Body Strength in Preadolescent Athletes. Brain. Broad Res Artif Intell Neurosci. 2020;11(4Sup1):13-29. doi: 10.18662/brain/11.4sup1/153.
15. Gopinathan P. Effect of circuit training on speed, agility and explosive power among inter collegiate handball players. Int J Yogic, Hum Mov Sport Sci. 2019;4(1):1294-1296.
16. Manolopoulos E, Papadopoulos C, Kellis E. Effects of combined strength and kick coordination training on soccer kick biomechanics in amateur players. Scand J Med Sci Sport. 2006;16(2):102-110. doi: 10.1111/j.1600-0838.2005.00447.x.
17. Park WB, Cho HS, Lee MG. Effects of 12 weeks of high intensity circuit training on abdominal fat, physical fitness, blood lipids, and insulin resistance in middle-aged obese women. Korean J Sport Sci. 2019;30(2):236-250.
18. Jovanovic M, Sporis G, Omrcen D, Fiorentini F. Effects of speed, agility, quickness training method on power performance in elite soccer players. J Strength Cond Res. 2011;25(5):1285-1292.
19. Meng HC, Low J, Lee F. Effects of Agility Ladder Drills on Dynamic Balance of Children. J Sains Sukan Pendidik. Jasm. 2014;3(1):68-74. doi: 10.1088/1742-6596/1529/3/032038.
20. Tabacchi G, *et al*. Field-based tests for the assessment of physical fitness in children and adolescents practicing sport: A systematic review within the ESA program. Sustain. 2019. doi: 10.3390/su11247187.
21. Mayorga-Vega D, Viciana J, Cocca A. Effects of a circuit training program on muscular and cardiovascular endurance and their maintenance in schoolchildren. J Hum Kinet. 2013;37(1):153-160. Doi: 10.2478/hukin-2013-0036.
22. Chtara C, *et al*. Effect of concurrent endurance and circuit resistance training sequence on muscular strength and power development. J Strength Cond Res. 2008;22(4):1037-1045.
23. Rimmer E, Sleivert G. Effects of a Plyometrics Intervention Program on Sprint Performance. J Strength Cond Res. 2000;14(3):295-301. doi: 10.1519/00124278-200008000-00009.
24. Divya PR, Karthik K, & Karthik. A Study of Selected Anthropometric and Physical Fitness Components Empowers on Playing Ability among Sudan and Indian Children Aged between 6 and 10 Years in Qatar. 2019;19(4):4-10.
25. Osterberg KL, Melby CL. Effect of acute resistance exercise on postexercise oxygen consumption and resting metabolic rate in young women. International Journal of Sport Nutrition. 2000;10(1):71-81. doi: 10.1123/ijsnem.10.1.71.
26. Rodríguez-Rosell D, Torres-Torrelo J, Franco-Márquez F, González-Suárez JM, González-Badillo JJ. Effects of light-load maximal lifting velocity weight training vs. combined weight training and plyometrics on sprint, vertical jump and strength performance in adult soccer players. J Sci Med Sport. 2017;20(7):695-699. doi: 10.1016/j.jsams.2016.11.010.
27. Buchheit M, Abbiss CR, Peiffer JJ, Laursen PB. Performance and physiological responses during a sprint interval training session: Relationships with muscle oxygenation and pulmonary oxygen uptake kinetics. Eur J Appl Physiol. 2012;112(2):767-779. doi: 10.1007/s00421-011-2021-1.
28. Sobrero G, *et al*. A Comparison of High Intensity Functional Training and Circuit Training on Health and Performance Variables in Women: A Pilot Study. Women Sport Phys Act J. 2017;25(1):1-10. doi:

10.1123/wspaj.2015-0035.
29. Maniazhagu D, Kannadasan, Malar S. Effects of Explosive Strength and Strength Endurance Based Circuit Training on Speed Performance. Int J Res - GRANTHAALAYAH. 2017;5(8(SE)):76-82. doi: 10.29121/granthaalayah.v5.i8(se).2017.2251.
30. Yuliandra R, Nugroho RA, Gumantan A. The Effect of Circuit Train-ing Method on Leg Muscle Explosive Power. J Phys Educ. 2020;9(3):157-161. [Online]. Available: http://journal.unnes.ac.id/sju/index.php/peshr
31. Markovic G, Jukic I, Milanovic D, Metikos D. Effects of sprint and plyometric training on muscle function and athletic performance. J Strength Cond Res. 2007;21(2):543-549. doi: 10.1519/R-19535.1.
32. Milanović Z, Sporiš G, Trajković N, James N, Šamija K. Effects of a 12 week SAQ training programme on agility with and without the ball among young soccer players. J Sport Sci Med. 2013;12(1):97-103.
33. Mohanta N, Kalra S, Pawaria S. A Comparative Study of Circuit Training and Plyometric Training on Strength, Speed and Agility in State Level Lawn Tennis Players. J Clin Diagnostic Res. 2019:5-10. doi: 10.7860/jcdr/2019/42431.13348.
34. Peltzer K, *et al*. Prevalence of overweight/obesity and its associated factors among university students from 22 countries. Int J Environ Res Public Health. 2014;11(7):7425-7441. doi: 10.3390/ijerph110707425.
35. Pradana RA, Maulang I, Gondo AA. Effect of ladder drill training toward agility level among basketball players. J Phys Conf Ser. 2020;1529(3). doi: 10.1088/1742-6596/1529/3/032038.
36. Paavolainen L, Häkkinen K, Hämäläinen I, Nummela A, Rusko H. Explosive-strength training improves 5-km running time by improving running economy and muscle power. J Appl Physiol. 1999;86(5):1527-1533. doi: 10.1152/jappl.1999.86.5.1527