International Journal of Physical Education, Sports and Health 2022; 9(3): 185-189

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.38
IJPESH 2022; 9(3): 185-189

www.kheljournal.com
Received: 26-03-2022
Accepted: 09-05-2022

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Effectiveness of basket-ball sports specific training program on selective fitness variables in basket-ball players

Pradeep Borkar and Dr. AN Badwe

Abstract
Background: The basketball player needs to train multiple components of fitness like agility, strength, anaerobic capacities, and endurance etc.[8] In the present study sport specific training program will be employed which will incorporate skills and movements specific to the sport, at intensities sufficient to promote aerobic and anaerobic adaptations. The purpose of the study was to evaluate the effectiveness of a basketball sports specific training on physical and physiological related variables of basket ball players
Method: After approval of institutional ethical committee and subjects were selected according to the eligibility criteria, informed consent was taken prior to the study and subjects were selected by simple random sampling method. n= 39 participants were recruited according to the selection criteria and were randomly allocated to experimental group (n=19) and control group (n=19). The experimental group underwent training for 45min, 3 times per week for 6 weeks; the control group performed conventional exercises for 6 weeks. Data was collected statistical analysis was done and result and conclusion were withdrawn.
Results: After 6 weeks training, the experimental group has demonstrated significant improvement in Anaerobic power and anaerobic capacity improved by 335.68 (95% CI 137.43 to 533.92) with a p value of < 0.05 compared with control group. While agility and vertical jump height has also shown improvement with a p value >0.05.
Conclusion: In the present Sports specific training program composed of multiple skill training components of strength, endurance, agility proprioception and flexibility has shown significant effect in improving anaerobic power and capacity and has shown beneficial effect on agility and vertical jump height. However, these sports specific circuit training can be useful for the coaches and players in developing the physical and physiological components of fitness and to improve athletes' performance.

Keywords: Basketball specific Training program, Agility, Vo2 max in basketball players

Introduction
Basketball is a sport which are characterized complicated movements such as: running, changes of direction, lateral movements, jumps, and uncontrolled landings. Therefore, a player should have a high level of cardiovascular and musculoskeletal fitness in order to perform the workload and basketball specific rapid movements. Current research has shown increase in prevalence of injuries in basketball players with high percentage of injuries in ankle/foot (39.7%), knee (14.7%), head/face/neck (13.6%), arm/hand (9.6%), and hip/thigh/upper leg (8.4%) are most commonly injured sites in basketball. The most frequent injury diagnoses are ligament sprains (44.0%), muscle/tendon strains (17.7%), contusions (8.6%), fractures (8.5%), and concussions (7.0%) [1].
The term 'sport specific training' implies that exercises should mimic as much as possible the actions of the body during participation in a given sport. Specificity should not, however, be over emphasized when selecting resistance exercises because it could lead to imbalances. Consequently, finding a balance between general and specific exercises would be appropriate in circuit training [4].
Internal changes in athlete's body are piece of the training puzzle which can be simplified with combining the training protocols with human biomechanics. Traditionally, the coaches and trainers use to plan conditioning programs by following win-loss records.

But this type of reasoning alone was not sufficient to scientifically validate their conditioning programs. Successful teams most of the time are victorious by virtue of its superior athletic and game strategies, hence, the planning of an effective athletic conditioning program can be best achieved by application of proven physiological training principles.[1]

The basketball player needs to train multiple components of fitness like agility, strength, anaerobic capacities, and endurance etc.[8] in the present study sport specific training program is given which will incorporate skills and movements specific to the sport, at intensities sufficient to promote aerobic and anaerobic adaptations.

The purpose of the study was to evaluate the effectiveness of a basketball sports specific training on physical and physiological related variables of basket ball players.

Methodology

Design

A randomized control trial was conducted in Orthopaedic physiotherapy department, Pravara Institute of Medical Sciences, with intension to treat analysis. Ethical approval was taken from the institute with ref no. PIMS/Dr/PhD/22020/COPT/108. Participants were assessed according to the eligibility criteria. Participants who were willing to participate in the study were provided with verbal and written information sheet, and were required to give the informed consent before being allocated to a group and undergoing baseline assessment. Randomization was done using the simple random sampling into 2 groups' Experimental group and control group. Outcome assessor was blinded in the study. Participants in the experimental group received 6-week sports specific circuit training and those in control group received basic exercises for 6-weeks. At day-0 demographic data and baseline assessment was done and post assessment was done at 6 week.

Participants

Participants which were eligible for the study were aged between-18-24 years, Both Male and female players qualifying PAR-Q, players practicing on regular basis with intercollegiate and above level with informed consent were selected. Exclusion criteria were history of any recent injury and any type of recent systemic illness.

Interventions

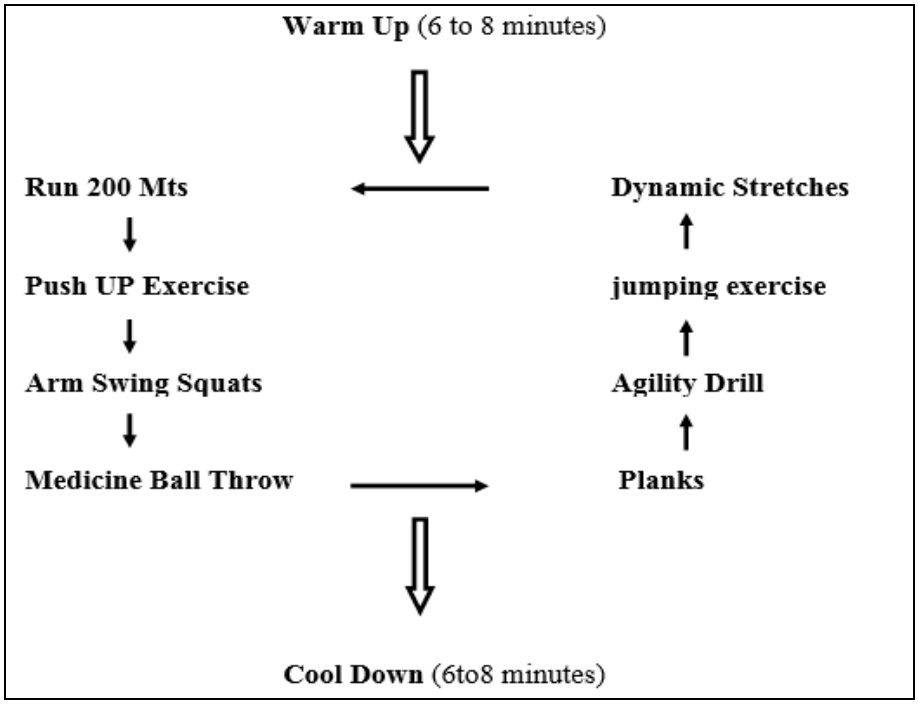
Experimental group

The intervention was performed for 6 weeks 3 times a week. Sports specific circuit training was administered which included warm-up, running exercise, strength, plyometrics and balance followed by cool down. Each exercise was progressed after 2 weeks. (Table 1)

Control group

Participants were permitted to continue with their regular exercise program and practice which involved warm-up, stretching, joint range of motion, running, squatting and dribbling exercises followed by cool down.

Sport specific training program outline



Sports specific circuit training program outline

- 1 session is 1 complete circuit
- Total sessions -3 per week
- Duration of training program-6 weeks

Fig 1: Consort chart

Results and Discussion

Flow of participants through the study

39 participants met the eligibility criteria and were randomized into 2 groups experimental (n=19) and control group (n=19). At 6-week post assessment, 18 participants in experimental group and 18 in control group were in the study. The groups were comparable at baseline as presented in (Table 2).

Effect of intervention
All group data is presented in (Table 3 and 4).

Vertical jump height within group analysis
Participants in experimental group, demonstrated no significant statistic difference $p>0.01$ in vertical jump height with mean±SD (pre-38.28±9.566 to post-38.44±9.69). While in control group $p>0.01$ with mean±SD (pre-40.44V7.93 to post-40.56±7.93)

Between group analysis
The mean between group difference in vertical jump height was 2.11(95%CI 8.107 to 3.88) with a p value of 0.475. That is, vertical jump height had no significant difference in both groups.

AGILITY - Within group analysis
Participants in experimental group, demonstrated significant statistic difference $p<0.001$ in agility with mean±SD (pre-14.62±1.39 to post-13.86±1.82). While in control group $p>0.05$ with mean±SD (pre-14.99±1.79 to post-14.98±1.79)

Between group analysis
The mean between group difference in agility was 1.13 (95%CI 2.35 to 0.09) with a p value of 0.068. That is, agility had no significant difference in both groups.

Running Based Anaerobic Sprint Test
Within group analysis
Participants in experimental group, demonstrated no significant statistic difference $p>0.05$ in anaerobic power and anaerobic capacity with mean±SD (average power-pre-319.51±148.94 to post-343.12±232.26 and anaerobic capacity-pre-9.40±12.28 to post-5.06±4.38). While in control group $p>0.05$ with mean±SD (anaerobic power-pre-359.01±184.01 to post-379.08±181.42 and anaerobic capacity pre- 9.44±13.20 to post-11.41±13.19)

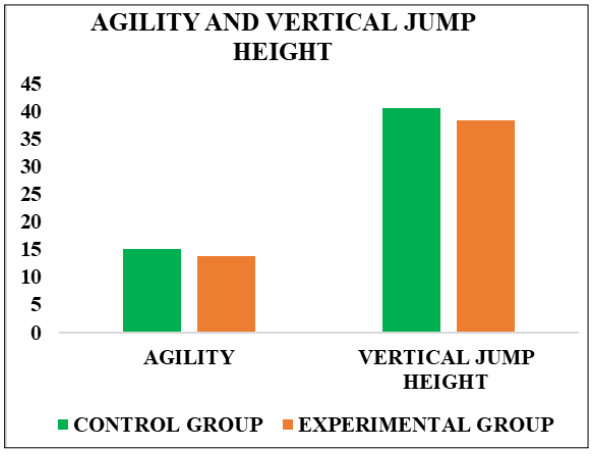
Between group analysis
The mean between group difference in RAST (average power) was 335.68 (95%CI 137.43 to 533.92) That is, although average power improved in both groups, the mean between group difference favored the experimental group by indicating 335.68 increase in average power than in control group with a p value of 0.005
The mean between group difference in RAST (fatigue index) was 5.806 (95%CI 12.46 to 0.85) That is, although fatigue index improved in both groups, the mean between group difference favored the experimental group by indicating 5.806 increase in average power than in control group with a p value of 0.001.

Table 2: Demographic data

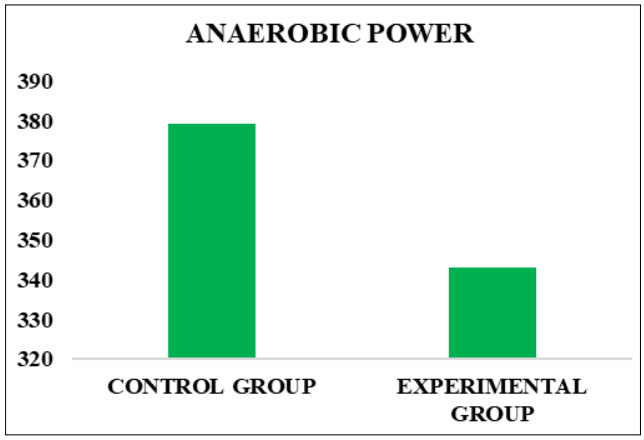
	Experimental	Control
Age years	19.83±1.24	20.33±0.90
Height cm	168.52±6.40	169.72±7.67
Weight Kg	63.66±14.13	65.33±9.06
BMI Kg/m^2	22.20±4.02	22.66±2.67
Pulse rate / min	92.83±10.26	92.66±8.91
BP-diastolic mmHg	115.22±7.48	115.27±8.52
systolic mmHg	80.88±7.91	75.88±8.77

Table 3: Mean difference and p-value of between-group differences

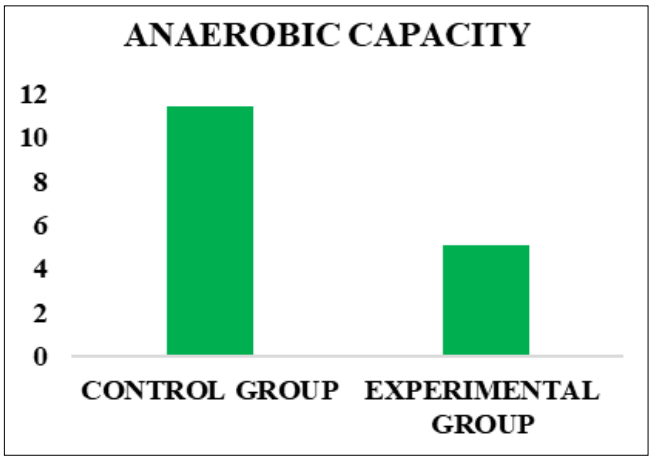
	Mean difference	P-value	Confidence interval
Agility	1.16	0.06	2.35 to 0.09
Vertical Jump Height	2.11	0.475	8.107 to 3.88
Rast-anaerobic power	335.68	0.005	137.43 to 533.92
Fatigue index	5.806	0.001	12.46 to 0.85



Graph 1: Comparison of mean of pre- and post agility and vertical jump height between experimental and control group



Graph 2: Comparison of mean of pre- and post anaerobic power between experimental and control group



Graph 3: Comparison of mean of pre- and post anaerobic capacity between experimental and control group

Adverse effect

All patients in each group who were followed up at the end of the study reported no adverse events during the intervention period.

Discussion

Sport specific circuit training is different kind of training program that is effective in preparing athletes for competition according to the need of the sports. This type of program consists of a number of ‘‘stations’’ where a given exercise is performed, usually within a specified time. Once the exercise is completed at 1 station, the subject moves rapidly to the next station, performing another exercise also within a prescribed time period. The circuit is completed once the exercises at all stations are performed [6, 7].

The objective of the study was to find out the effect of sports specific circuit training on physical and physiological variables of basketball players. The training duration was 4 weeks with a frequency of 3 days a week and analysis were done.

Explosive power, an ability to generate maximum muscle strength in the shortest possible time (Santos & Janeira, 2008) is an extremely important motor ability to play basketball (Lehnert *et al*., 2013; Aksović *et al*., 2020a; Aksović *et al*., 2021). Vertical jumps are often used to estimate the explosive power of the lower extremities. The improvements achieved were the result of enhanced neuromuscular function. The occurrence of post activation potentiation is believed to increase the rate of force development, thereby increasing speed and power production as described by Sale D *et al*. [8, 9, 10].

The post results for the vertical jump height improved for the experimental group but were not statistically significant (p>0.05). In addition, recovery interval duration was extremely short and thus may not have allowed the maintenance of strength and power production during subsequent sets (Ratamess *et al*., 2009), since substantial fatigue has the potential to affect the motor recruitment pattern (Hautier *et al*., 2000; Mendez-Villanueva *et al*., 2007, 2008; Racinais *et al*., 2007). Some cross-sectional studies have observed a reduction in the vastus lateralis and rectus femoris maximal EMG amplitude and voluntary activation (Brocherie *et al*., 2015; Mendez-Villanueva *et al*., 2008; Racinais *et al*., 2007) during and after running and repeated sprints protocols, but not all (Bishop, 2012). Taken together, these results might suggest that a progressive inhibition of motor units or decrease in motor unit firing rate or neural drive to the muscle due to eventual fatigue could result in an ineffective stimulus to improve the maximal EMG amplitude. (Bishop, 2012) [11, 12].

The post-test results for the agility performance parameters improved for both the groups but were not statistically significant (p>0.05). While in experimental group it improved from (14.82±13.62) which was statistically significant (p<0.01).

Training produces increased levels of anaerobic substrates that is ATP, PCR, free creatine and glycogen accompanied by an improvement in muscular strength. Increased quantity and activity to key enzymes that control the anaerobic phase of glucose catabolism with an increase in fiber size (fast twitch muscle fibers). It also enhances the metabolic capacity of the specifically trained muscle fibers, but it also facilitates recruitment and modulation of firing sequence of the appropriate motor units achieved in the movement [13].

In sports specific circuit training repetition of exercise causes lactate stacking which results in a higher blood lactate level than with just one bout of exhaustive effort. As with all training regimens, one must exercise the specific muscle group that require enhanced lactate-producing capacity. So, a basketball player must perform movements and direction changes similar to those required by sport [13].

There is evidence to support the concept that a six-week, multicomponent training program which included resistance, plyometric and speed training significantly enhanced strength, jumping ability and speed in female adolescent athletes as compared to a no exercising control group [14].

Along the same line, Taskin studied the effects of an eight-station circuit training session conducted three times per week for 10 weeks on speed, agility, and aerobic capacity. The results showed significant improvement for all the parameters studied. Furthermore, study of Kumar reported a significant increase in the leg muscle strength and agility of subjects participating in six station circuit training (exercise for 25 - 35 sec with 20 - 30 sec rest at each station, 2 - 4 sets with a 2 - 3 min rest period between each set for a duration of eight weeks) as shown improvement in agility [15, 16].

Anaerobic power is the peak power achieved during the test while anaerobic capacity is total work accomplished [13]. The circuit training program in this study appeared to have effect on the anaerobic power of the subjects in the experiment the group (379.08±181.42 to 343.12±232.26) (p<0.05). However, the anaerobic power of the experimental group was significantly higher than the value for the control group. Anaerobic capacity of the experiment group increased significantly from (11.41±13.19 to 5.06±4.38) (p<0.001). The experimental group showed a significantly higher anaerobic capacity than the control group.

Short term training produces higher levels of blood and muscle lactate and greater muscle glycogen depletion compared with untrained counterparts; better performances are usually associated with higher blood lactate levels supporting the belief that training for brief, all-out exercise enhances the glycolytic systems capacity to generate energy. It also enhances short-term transfer by increasing the body’s buffering capacity [13].

These results imply that the sports specific circuit training program designed which is short term training procedures in this study was responsible for an increase in an anaerobic capacity found in participants and that an increase in muscle strength be responsible for the increase in anaerobic capacity.

Conclusion

Sports specific training program composed of multiple skill training components has shown enhancing effect on Speed, Agility and Anaerobic Capacities in recreational basketball players

Limitations

Smaller sample size
Shorter duration of study

Clinical Implication

Coaches and players are therefore advised to integrate Sports specific training program minimum for 6 weeks when they are preparing for any tournament.

Acknowledgements: I wish to express my deep gratitude to my guide Dr. A.N Badve sir for his guidance and all the participants who participated in my study.

Ethical Reg No: PIMS/Dr/PhD/COPT/2020/108

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