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"Effect of Sports Specific Training Program on Skill Performance of Basketball Players – A Randomized Trial"

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Abbreviated title: **Basketball specific training program for amateur basketball players**
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ABSTRACT

Objectives: To evaluate effectiveness of basketball-specific training program on Skill performance of amateur basketball players. **Methods:** Randomized controlled trial using hidden allocation, accessor blinding, and analysis under the intention to treat standard. Participants: Regular basketball practices were attended by 56 amateur basketball players. Intervention: For a period of 12 weeks, the experimental group participated in a sports-specific training program that involved three 60-minute sessions each week. The standard conditioning program was carried out by the control group. Results were measured by Johnson Basket ball test for number of successful baskets made and dribble score by dribbling Test at weeks 0 and 12. **Results**: Randomization allocated 29 participants in each group. Three participants from the experimental group and two from the control group did not complete the study. After 12 weeks the mean between-group difference for the performance of accurate basket was 2.56 to 3.57 and Dribbling Score was 7.68 to 11.24 at (95% CI).

Conclusion: Basketball sports-specific training program that incorporates basketball-specific exercises have shown improvement in the level of skill performance-related variables in amateur basketball players. The effect appears to be more significant when the program is implemented for 12 weeks.
Trial registration Number: CTRI/2020/02/023553.

INTRODUCTION

Basketball was once thought to be a non-contact sport, but recent body contact trends indicate that it has changed into a semi-contact sport. [1]. One of the most important aspects of sports performance is the creation of effective conditioning

regimens based on the unique physiological demands of each discipline.[1] Inherent risk factors for injuries in sports include a lack of necessary abilities, functional limitation, muscle imbalance, etc.
A sport-specific training program was used in the current study to create physical, aerobic, and anaerobic adaptations for the sport's unique skills and motions. Although they are focused on short-term effects—4 or 6 weeks—previous research have been found with characteristics similar to these ones. Therefore, it is yet to be determined whether chronic benefits may be achieved over a longer training period with sports-specific training programs.
The notion that combination training offers larger neuromuscular adaptations, leading to greater transfer across a wide range of performance indicators, served as our starting point. We predicted that an amateur basketball player's performance would improve with a sports-specific training regimen that combined sprinting, strength, endurance, jumping, flexibility, and agility. The aim of the study was to investigate the impact of 12-week sports-specific training programs on amateur basketball players' skill performance capacities.

METHOD

Design
A randomized controlled trial was conducted from January 2021 to October 2022 at the Basketball Court of Pravara Institute of Medical Sciences. Potential participants were assessed according to eligibility criteria. Eligible participants who are willing to participate in the study were provided with verbal information about the study and a written information sheet and were required to give informed consent before undergoing baseline assessment and being allocated to a group. Randomization was performed using simple random sampling into two groups: The experimental group and the controlled to conceal the upcoming random allocation, the randomized allocations were concealed in envelopes. The new participant was required to contact the researcher who had no other involvement in the study with the new participant's enrollment details before receiving random allocations whenever they enroll. Before the intervention period, the demographic data and baseline assessment of the study outcome measures were recorded. Participants in the experimental group had undergone 12 weeks of sports specific training exercise program (Fig.1) and those in the control group had undergone 12 weeks of conventional routine exercises (Fig.2). To limit the impact of knowing whether they were in the experimental group or controlled group, participants were advised that the study was to compare two exercise regimens and they received no information about the exercise intervention to which they were not allocated. The same researchers reassessed the outcome measures after the completion of 12 weeks of the intervention period. Outcome assessors were blinded to the group to which each participant was allocated. The data was analyzed with an intention to treat approach.

Participants
56 basketball players fulfilling the eligibility criteria from different areas of Maharashtra state took part in the present study. Participants attended practice sessions regularly. They were aged between 18-24 years, of all genders and qualified PAR-Q. Exclusion criteria were players having any recent injury, any systemic illness and players involved in any other type of personal training methods. No Exclusion was made due to gender or Weight.

Intervention

Experimental group:
Basketball sports-specific training programs were administered which include speed, strength, and endurance training along with core exercises; proprioception and agility drills for 12 weeks (Fig. 1). Exercises were progressed after every 4 weeks with alteration in frequency and intensity. The intervention was performed for 60 min/per session and 3 sessions per week for 12 weeks. (Table 1)

***Control group*:**
Control group intervention continued with the usual conditioning program (Table 2) which include warm-up, running, stretching and cool-down for 12 weeks.

Outcome measures
The number of baskets and calculating the dribbling score, basketball players' abilities were evaluated on the Johnson basketball test. Using the stopwatch and measuring tape, each parameter was measured, scored, and added for the overall score. For better performance, the best of the three trials was taken into account.

Data analysis

The sample size calculation used mean differences on open EPI software and was based on the information from the

preceding two investigations. The analysis was done with the aid of paid software. The Shapiro-Wilk test was used to determine whether the data was normal. The analysis of variance (ANOVA) was performed to compare the mean values at various time intervals within the control and experimental groups, and the post hoc test was utilized for multiple comparisons. The mean (SD) of quantitative variables was presented. Unpaired data were used to generate the mean group difference between the experimental and control groups, which was then published along with a 95% confidence interval.

RESULTS

Deviations from the study protocol:
Apart from two participants who could not complete the study due to losing their interest in participation. There was no deviation from the study protocol. The registered study questions were assessed, all participants were prescribed their randomly allocated interventions and both registered outcomes were measured at the scheduled time points.

Flow of participants throughout the study:
Among the 79 participants who were screened for the study, 58 met the eligibility criteria and were randomized into two groups -29 in the experimental group and 29 in the controlled group (Fig.1)

The groups were comparable at baseline as presented in table-3. Two participants were lost to follow-up, one from the experimental group and one from the control group (Fig.1). After 12 weeks of assessment 28 participants in the experimental group and 28 participants in the control group were available for assessment and all were measured. Compliance with the prescribed resume was not assessed.

Effect of intervention:
Performance variables: Both groups showed improvement in number of baskets and dribble score at end of the training period. Sports-specific training programs are estimated to be more effective than conventional training methods for several skill performance levels.
After 12 weeks the mean between-group difference for the performance of accurate basket was 2.56 to 3.57 and Dribbling Score was 7.68 to 11.24 at (95% CI).
Exercise training in both groups was well tolerated and there were no adverse events. Individual participant data for all outcomes is presented in (Table-4)

DISCUSSION

This study estimated that a sports-specific training program that combines various training methods like strength, speed, agility, balance, etc was more beneficial than conventional training for several outcomes of skill performance in amateur basketball players.

Performance:
The players in the experimental group showed significant improvement in their basketball performance when assessed on the Johnson basketball test. The parameters of dribbling scores and the number of baskets were significantly increased in the training group with a mean of 28.79 mt when compared with the control group's mean of 25.68 mt. The SSTP comprised a dynamic task including strength, agility, speed and endurance drills specifically targeting the requirements of a competitive basketball game. It is inclusive of the moderate and sub-maximal level of running and dribbling practice, acceleration-deceleration activities and shooting accuracy practice. These activities will cause neuromuscular changes like an increase in the recruitment of additional motor units, and an increase in the activation of synergistic muscles to assist force production for strength, power speed and hypertrophy.
Neural pathways linking to the target muscle become more efficient in transmitting the stimulus. The timing of contractions of muscles becomes more co-ordinate especially with power, speed and strength training to meet the required force generation.[6, 17]
The ability to summate (fire a lot of impulse in target muscle all at once) is improved with this type of training load. Enhance neural facilitation largely accounts for rapid and significant increase in strength which often occurs during early training without an actual increase in muscle size and cross-sectional area. The neural adaptations with the training are greater efficiency in neural recruitment patterns, increased central nervous system activation improved motor unit synchronization, and lowering of neural inhibitory reflex.
Effective integration of multiple body segments to create explosive movements or lift heavy loads requires a more neuromuscular environment than any other training. Hence, the strength, power, and speed training along with sports-specific drills performed specifically for the game is all-inclusive consideration to improve coordination, motor learning and neuromuscular system resistance to fatigue. [14]

Table- 1: Content and progression of the experimental group intervention

Exercise Category	**Exercises**	**Level I Week 1-4**		**Level II Week 5-8**		**Level III Week 9-12**		**Frequency *(Sessions/week)***
Warm up (7 min)	ROM for all joints , Spot marching, small distance jogging (1- 12 weeks)							
		Reps.	Sets	Reps.	Sets	Reps.	Sets	
Speed	200m Run	2	1	2	1	3	1	3
Strength	Push Up	8-10	2	10-12	2	10-12	3	3
	Arm Swing Squat	8-10	2	10-12	2	10-12	3	
Endurance	Medicine Ball Throw	8-10	2	10-12	2	12-15	2	3
	Kettle Bell Swing	8-10	2	10-12	2	12-15	2	
Core Strengthening	Planks							3
Agility Drill	Cone Drills	8-10	2	8-10	2	8-10	3	3
Proprioception Drills	Depth Jump	8	2	10	2	12	2	3
	Split Jump	8	2	10	2	12	2	
	Squat Jump	8	2	10	2	12	2	
	Reactive Double Leg Bounding	8	2	10	2	12	2	
Flexibility	Lunge with a twist	8-10	3	10-12	3	10-12	3	3
	Knee to chest	8-10	3	10-12	3	10-12	3	
	High Kicks	8-10	3	10-12	3	10-12	3	
Cool down (5 min)	Stretching of Major group of muscles, gentle walk for 3 min.(1- 12 weeks)							

*Three sessions per week were prescribed to occur on Tuesday, Thursday, and Saturday. Min=Minutes, Reps=Repetitions

Table- 2: Content and progression of the control group intervention

Exercise Category	**Exercise**	**Volume**		**Frequency *(Sessions/week)***
Warm Up	ROM, Spot marching, small distance jogging (1- 12 weeks)			
		Reps	Sets	
Strength Training	Pull Ups	15	2	3
	Squats	15	2	
Aerobic group exercise Session	Running 100m	2	1	3
	Curl Ups	15	2	
	Medicine ball Throw	15	2	
Cool Down	Stretching of Major group of muscles, gentle walk for 3 minutes.(1- 12 weeks)			

*Three sessions per week were prescribed to occur on Tuesday, Thursday, and Saturday
Min=Minutes, Reps=Repetitions

Table 3: Characteristics of participants at baseline (n=56)

Characteristics of participants	**Experimental Group (n=28)**	**Controlled Group (n=28)**
Age (yr.), mean (SD)	20.07(1.24)	19.71(1.24)
Gender male, n (%) Female, n (%)	17(61%) 11(39%)	18(64%) 10(36%)
Height (cm), mean (SD)	166.9(7.04)	167.6(11.83)
Weight (Kg), mean (SD)	63.3(13.6)	60.5(12.7)
BMI (kg/m^2), mean (SD)	22.58(3.9)	21.48(3.85)

*Con= control group, Exp = experimental group,

Table 4 Mean (SD) of Groups, Mean (SD) Difference within groups and mean (95% CI) difference between groups

Outcome Measures		Groups				Within group difference		Between group difference
		Week 0		Week 12		Week12 minus Week0		Week12 minus Week0
		Exp(n=25)	Con(n=26)	Exp(n=25)	Con(n=26)	Exp(n=25)	Con(n=26)	Exp minus Con
Performance Variables	No. of basket	5.82(1.02)	5.79(1.10)	8.86(0.76)	7.96(1)	3.04(1.10)	2.17(0.98)	3.07(2.56-3.57)
	Dribbling Score	21.71(2)	19.32(3.03)	28.79(3.58)	25.68(2.63)	7.08(3.2)	6.32(2.3)	9.46(7.68-11.24)

*Con= control group, Exp = experimental group

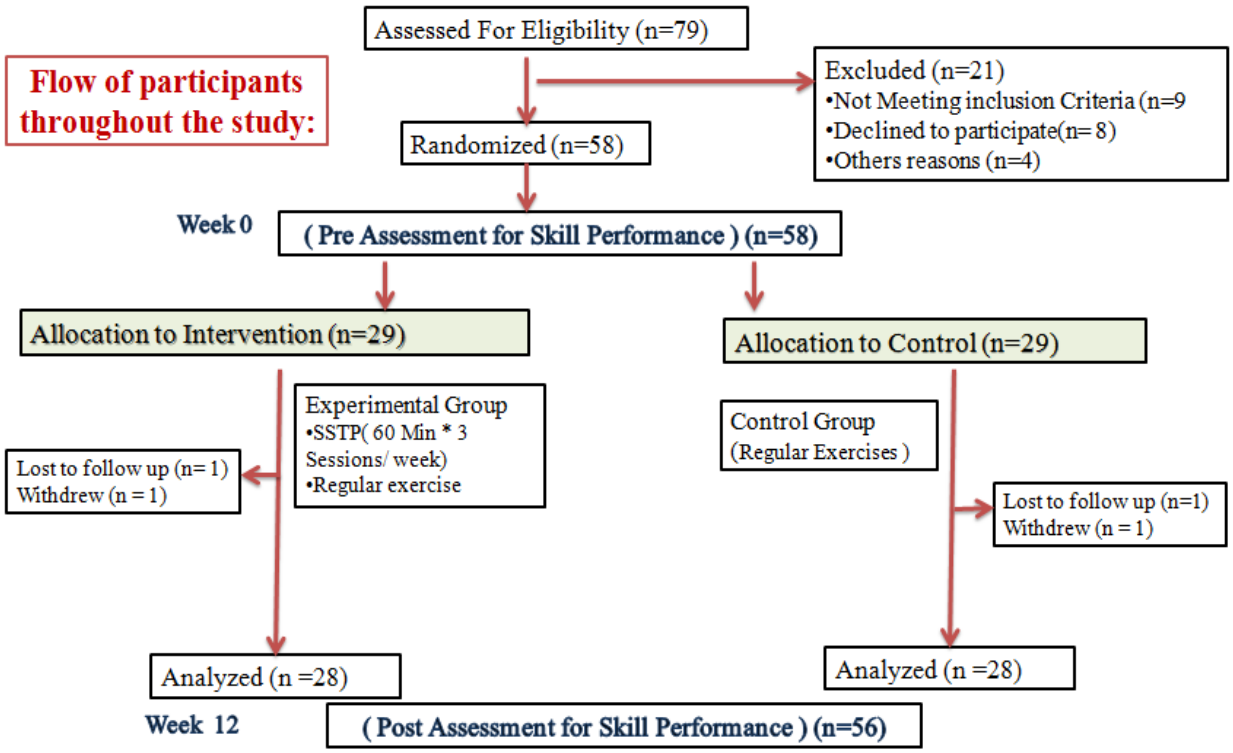

Figure 1. Design and flow of participants through the trail

Footnotes: *IBM SPSS20 Software Windows V.28.0.10 version (Statistical package for social science), SPSS*
Ethics approval: The Institutional Ethics Committee(s) approved this study. (PIMS/DR/PhD/2020/COPT/108) All participants gave written informed consent before data collection began.
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