EFFECT OF COMPLEX TRAINING ON BIO-MOTOR ABILITIES OF TEAM GAME PLAYERS

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Abstract

The study investigates the impact of complex training on bio-motor variables, precisely speed and agility, in team game players. A total of 24 participants, consisting of 6 handball players and 6 volleyball players (12 in the experimental group and 12 in the control group), were selected from various master's degree programs at the Central University of Punjab, Bathinda. The participants, aged between 21 and 26 years, were divided into two groups: the experimental group underwent complex training, while the control group did not. Before and after the 8-weeks training, both groups were tested on speed and agility using standardized assessments. ANOVA was applied to analyze the data to determine any significant differences between the pre-test and post-test results for both bio-motor variables. The results revealed that complex training significantly improved the speed and agility performance of the team game (handball and volleyball) players.

Keywords*: Complex Training, Bio-motor, Speed, Agility.*

INTRODUCTION

Sports training is a specialized, comprehensive approach to physical conditioning aimed at optimizing performance in sports. It encompasses various elements such as structured training regimens, competitive participation, tailored nutrition plans, advanced rehabilitation strategies, performance assessments, and psychological conditioning. Conducted over an extended period, sports training follows a systematic, evidence-based approach rooted in scientific principles and proven methodologies. It serves as a foundational process for preparing athletes (Uppal, 2018).

Complex training, a periodized training method, alternates between strength-focused exercises and explosive, skill-based movements. This approach has garnered attention for its ability to enhance athletic performance by combining plyometric and weight training to develop power. Specifically, complex training pairs biomechanically similar high-load resistance exercises with plyometric exercises within the same session, performed sequentially set for set. For instance, a complex training routine might involve completing a set of squats followed by a set of jump squats (Ebben, 2002). Incorporating ballistic exercises into traditional resistance training within a

complex training framework has been shown to yield greater improvements in sprint performance over 5 m and 20 m distances, change-of-direction speed (CODS), and countermovement jump (CMJ) height compared to resistance training alone.

Both unloaded plyometric training (PLT) and complex training (CT) demonstrate similar improvements in 1-repetition maximum (1RM) squats, indicating their efficacy in enhancing maximal strength (Rohit K. Thapa, 2024). These methods significantly impact explosive performance—such as jump and sprint abilities—over the short term (within 10 weeks). However, loaded PLT proves to be more effective for explosive performance, while CT shows a pronounced advantage in improving maximum strength. Based on these findings, it is recommended to use unloaded or lightly loaded PLT for short-term explosive training and CT for longer training cycles. Additionally, training programs extending beyond 10 weeks are likely to yield greater improvements in power (Xiaolin Wang, 2023).

While complex training has been extensively researched in individual sports, there is a notable lack of studies exploring its effects on bio-motor variables in team sport athletes, particularly in handball and volleyball. This study seeks to fill that gap by examining the impact of complex training on the speed and agility of handball and volleyball players. Despite the well-documented benefits of speed-strength training, the specific area of running training has received limited attention, highlighting a deficiency in current methodologies for team sports athletes (Yuriy, 2022).

Research has demonstrated the benefits of complex training for adolescent basketball players, showing significant improvements in aerobic endurance, speed, power, and agility following a structured 24-session program (Dewangga Y. S., 2024). Similarly, complex agility training programs have proven effective in enhancing agility among amateur male soccer players, with targeted sprinting, agility, and plyometric sessions contributing to better overall performance Furthermore, integrating cognitive training strategies with complex exercises has been shown to positively impact skill acquisition in football, emphasizing the value of such methods in teaching and training settings.

The present study aims to explore whether complex training can lead to significant enhancements in key bio-motor variables such as speed, agility, and power, ultimately improving the performance of athletes in team sports.Bio-motor abilities are the fundamental physical qualities that contribute to an athlete's overall sports performance. These abilities represent the various physiological attributes that underpin motor skills and movement patterns, playing a crucial role in an athlete’s functional capacity to perform specific tasks during training and competition. In team sports like handball and volleyball, bio-motor abilities like speed, agility, strength, endurance,

coordination, and flexibility are essential for high performance. Bio motor abilities (motor qualities), namely strength, speed, endurance, flexibility, agility, and coordinative abilities (Uppal, 2009). Speed is used in sports for such muscle reactions (Motor movements) characterized by maximally quick alternation of contraction and relaxation of muscles (Uppal, 2009).

Speed is the ability to move the entire body quickly and repeatedly in successive directions, sometimes without significant positional or direction changes. Agility is "a rapid whole-body movement with change of speed or direction in response to a stimulus (Sheppard, 2006). This definition is based on a model that separates agility into two components: the change of direction speed and perceptual and decision-making processes. The importance of this study lies in its potential to provide valuable insights into how complex training can enhance critical bio-motor abilities, precisely speed and agility, for athletes involved in handball and volleyball. There is expected to be a significant improvement in the speed and agility of athletes who undergo complex training, compared to those in the control group after the intervention period.

METHODS

The study aims to examine the effects of complex training on bio-motor variables, specifically speed and agility, in team sport players. The research involved 24 participants, including 6 handball players and 6 volleyball players, drawn from master's degree programs at the Central University of Punjab, Bathinda. The participants, aged between 21 and 26 years, were evenly divided into two groups: an experimental group (n=12), which underwent complex training, and a control group (n=12), which did not participate in any specialized training intervention.

Standardized assessments were conducted to measure speed and agility before and after the training period. The experimental group participated in a structured complex training program, while the control group maintained their regular activities without additional training interventions. The data collected from pre-test and post-test assessments were analyzed using paired 't' test and Analysis of Variance (ANOVA) to identify any statistically significant differences in the bio-motor variables within and between the groups and across time points. This approach allowed the researchers to evaluate the effectiveness of complex training in enhancing speed and agility in team sport athletes.

TRAINING PROTOCOL

The experimental group participated in a structured training program thrice a week for 8 weeks. Each session lasted approximately 45 minutes, including warm-up and cool-down periods. In contrast, the control group did not engage in any specific training regimen or strenuous physical activities outside their usual routines. Training schedules are as follows.

Complex Training Schedule

Training	Weeks	Exercises	Rep. x Sets	Intensity	Rest between	
					Exc.	sets
Weight Training	I	Bulgarian split squat, Standing calf raise, Incline bench press, Pull-ups, Shoulder press, Dead lift.	10 x 3	50%1RM	1:1	1:3
	II		10 x 2	551RM	1:1	1:3
	III		9 x 2	601RM	1:1	1:3
	IV		8 x 2	651RM	1:1	1:3
Plyometric Training 20 cm Height for Jumps	V	Skipping, Single leg hopping, Medicine ball overhead throw (2kg), Box jump, Push-ups, split jump	8 x 2	90 Foot Contact	1:1	1:3
	VI		9 x 2	100 Foot Contact	1:1	1:3
	VII		10 x 2	110 Foot Contact	1:1	1:3
	VIII		11 x 2	120 Foot Contact	1:1	1:3

EXPERIMENTAL DESIGN AND STATISTICAL ANALYSIS

The study employed a randomized group design with pre-test and post-test assessments to investigate the effects of complex training on bio-motor variables. A total of 24 subjects, randomly selected from the handball and volleyball teams at the Central University of Punjab, participated in the study. These participants were divided into two groups: the Control Group and the Experimental Group.

At the start of the study, all participants underwent pre-test evaluations to measure their bio-motor variables. Following this, the experimental group engaged in a structured 8-week complex training program, while the control group continued their usual activities without any additional training intervention. After the training period, a post-test was conducted to assess changes in the dependent variables.

The data collected from both the pre-test and post-test were analyzed using paired ‘t’ test and Analysis of Variance (ANOVA). In all cases the level of statistical significance was set at $P<0.05$.This statistical approach was used to determine whether the 8-week complex training program had a significant impact on the bio-motor variables, comparing the outcomes between the control and experimental groups.

RESULTS

The experimental and control group’s pre and post data on speed and agility was analyzed for significant difference within groups by using paired ‘t’ test. The results thus obtained are given in Table -1.

Table 1 Results of Paired 't' Test and Percentage of Improvement (%) on Speed and Agility of Experimental & Control Groups

Variable	Group	Test	N	Mean	SD	DM	%	't' - ratio	P value
Speed	Complex Training	Pre	12	7.1933	.30515	0.6650	10.19%	19.907	.000
		Post		6.5283	.30939				
	Control	Pre	12	7.2508	.20020	0.0383	0.53%	2.028	.067
		Post		7.2125	.21516				
Agility	Complex Training	Pre	12	9.9808	.08262	0.5366	5.38%	28.182	.000
		Post		9.4442	.12428				
	Control	Pre	12	10.0000	.09135	0.0858	0.86%.	7.100	.000
		Post		9.9142	.09793				

The complex training group's pre and post test means on speed (7.1733 & 6.5283) and agility(9.9808 & 9.4442) vary noticeably because the obtained paired 't' test values(19.907 & 28.182) aregreater. The findings of the study indicate that, complex training considerably increases the chosen biomotor abilities such as speed ($t = 19.907$, $p < 0.05$) and agility ($t = 28.182$, $p < 0.05$) of team game players (Table-1). Subsequent to 8 weeks of complex training (CT) 10.19% and 5.38% of changes in speed and agilityof team game playerswas observed. No significant differences were noted in the pre and post test means ofcontrol groupon speed (7.2508&7.2125) and agility(10.000 & 9.9142).

The ANCOVA statistics was applied to further investigate the difference between the two groups, as shown in Table 3.

Table 2 ANCOVA Results on Speed and Agility

Variable	Adjusted post test means of		SoV	Sum of Squares	df	Mean Squares	'F' Ratio	P value
	Complex Training Group	Control Group						
Speed	6.5283	7.2125	B	2.339	1	2.339	254.704	.001
			W	0.193	23	.009		
Agility	9.4442	9.9142	B	1.191	1	1.191	387.162	.001
			W	0.065	21	.003		

The complex training and control group's adjusted post test means on speed (6.5283 & 7.2125) and agility (9.4442 & 9.9142) differ significantly because obtained paired 'F' ratio values (254.704 & 387.162) are higher. The finding indicates that, complex training program influence positively the chosen biomotor

abilities such as speed (F = 254.704, p < 0.05) and agility (F = 387.162, p < 0.05) of team game players (Table-2).

Figure 1 On Speed

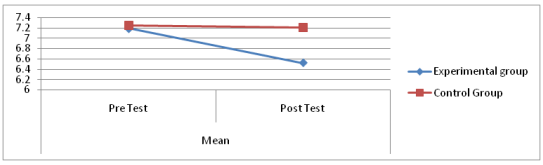
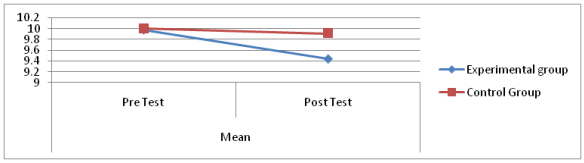


Figure 2 On Agility



DISCUSSION

This study investigated the effect of an 8-week complex training program on speed and agility among athletes from the handball and volleyball teams at the Central University of Punjab. The primary aim was to determine whether complex training could significantly improve these bio-motor variables compared to a control group. The results demonstrated that complex training had a significant positive impact on both speed and agility in the experimental group, whereas no significant changes were observed in the control group. Analysis of pre-test and post-test data using ANOVA revealed substantial differences between the groups for speed (F = 254.704) and agility (F = 387.162) following the intervention.

Specifically, the mean speed of the experimental group improved from 7.19 seconds before training to 6.52 seconds post-training due to complex training indicating enhanced performance (Dewangga, 2024). A study on adolescent basketball players found that complex training significantly improved speed, with average sprint test times decreasing from 3.20 seconds in the first test to 2.97 seconds after 24 training sessions, reflecting enhanced running speed (Thomas, 2021). Among elite academy soccer players, no significant improvement in 10- and 40-meter sprint times was observed after a 10-week training program, indicating that certain population groups may not respond similarly to complex training (Rohit, 2021). Complex training significantly enhanced sprint performance in soccer players, with standardized mean differences (SMD) ranging from 0.92 to 1.91. Greater benefits were observed in players under 18 years of age and in interventions lasting 8 weeks or more (Sebstien, 2022). In professional ice hockey players, complex training improved skating speed, particularly when the training was performed 8 hours before testing compared to 4 hours before, demonstrating the importance of timing in performance gains.(Jenita, 2024) Over seven weeks, complex training improved 5-meter sprint times and linear sprint performance (10 to 30 meters) compared to traditional resistance training, highlighting superior neuromuscular adaptations.

These findings collectively support the conclusion that complex training is a highly effective method for enhancing speed and agility in athletes. Variations in results across studies may be attributed to differences in participant demographics,

training duration, and sport-specific demands, underscoring the importance of tailored training programs. Compared to the control group, the experimental groups' agility performance improved with complex training. Before training, the experimental group's mean agility was 9.98s; following training, the mean agility decreased to 9.44s. This study is supported by the studies listed below. The study found that a complex training program significantly improved agility in amateur male soccer players, with notable differences observed between baseline and the 6th week ($p = 0.03$), indicating its effectiveness for enhancing agility related to soccer performance (Pattarapol, 2022). The study found that a six-week plyometric training program significantly improved athletes' agility compared to a control group that did not undergo any plyometric training. The results indicated that the plyometric training group achieved quicker post-test times in the T-test and Illinois Agility Test (Michael, 2006). The study revealed that implementing complex training significantly enhanced the agility of adolescent basketball players. The average scores for agility tests showed a marked improvement over the training sessions, indicating that the players became more adept at changing direction quickly and efficiently.

Specifically, the results demonstrated a progression in agility performance, with the final test reflecting a notable decrease in time taken to complete the agility tasks (Dewangga Y. S., Implementing Complex Training Method: Its Effects on Endurance, Speed, Power, and Agility of Adolescent Basketball Players., 2024). Another study investigated the effectiveness of a complex agility training program on amateur male soccer players, revealing significant findings regarding agility improvement. After a 6-week training period, the results indicated that the complex training group (CTG) showed a statistically significant improvement in agility when comparing their performance from the baseline to the 6th week, with a p-value of 0.03. However, there were no significant differences in agility improvements when comparing the CTG to the control group (CG), which followed a general football training program. This suggests that the complex training program can enhance agility in amateur male soccer players (Pattarapol, 2022). The study revealed that the agility-focused training program significantly improved players' agility metrics, as evidenced by enhanced scores in agility tests that measured their ability to change direction quickly and effectively during gameplay. Using game-specific drills allowed players to apply their agility skills in realistic match scenarios, increasing confidence in their field movements (Ian, 2017).

The findings of this study provide valuable insights into the impact of the experimental intervention on the speed and agility of CUPB handball and volleyball players. For future implementation, It can be used to enhance decision-making and movement efficiency, especially in fast-paced sports like handball and volleyball. It could improve players' ability to change

direction quickly and efficiently, a critical skill for sports that require rapid lateral movements, such as volleyball and handball. Integrating these interventions consistently into weekly training schedules could yield long-term benefits in player performance.

CONCLUSIONS

In conclusion, this study provides strong evidence that complex training can significantly improve the speed and agility performances of the experiment group. The statistical significance of the results, combined with the consistency with existing literature, highlights the effectiveness of this complex training approachdespite the limitations; these findings underscore the potential benefits of complex training for enhancing key bio-motor (speed and agility) variables and contribute to the growing body of research supporting its use in sports training programs. Further studies can be conducted during the training program and with elite sportspeople.

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