OPEN ACCESS

Scholars International Journal of Anatomy and Physiology

Abbreviated Key Title: Sch Int J Anat Physiol
ISSN 2616-8618 (Print) | ISSN 2617-345X (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Impact of Diverse Handball Training Interventions on Dribbling Ability and Skill Performance in Male College Handball Players

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DOI: https://doi.org/10.36348/sijap.2026.v09i04.004 | **Received:** 27.06.2026 | **Accepted:** 19.08.2026 | **Published:** 22.08.2026

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Abstract

The present study was designed to examine the effects of three differentiated handball training interventions on dribbling ability and skill performance among male collegiate handball players. Sixty male college handball players aged 18–24 years were assigned to four groups: Fitness Handball Training (FHT), Technical Handball Training (THT), Integral Handball Training (IHT) and Control Group (CG), with 15 participants in each group. The experimental programmes were structured to emphasize physical conditioning, technical execution or an integrated combination of physical and handball-specific skills. The intervention was planned for eight weeks, with three training sessions per week, each lasting 60 minutes. Dribbling ability was evaluated using a standardized handball dribbling obstacle-course test, in which lower completion time represented superior performance. Pre-test and post-test measurements were obtained before and after the intervention. The statistical plan consisted of descriptive statistics, paired-samples *t*-tests, analysis of covariance (ANCOVA) and Scheffe's post-hoc comparisons, with statistical significance established at the 0.05 level. The intervention framework was informed by evidence indicating that handball performance depends on repeated acceleration, sprinting, changes of direction, technical execution and rapid transitions between physical and skill demands [1–8]. Previous intervention research has also shown beneficial effects of small-sided games, high-intensity training, plyometric training, resistance training and integrated handball-specific conditioning on selected performance characteristics [9–18]. The proposed study therefore examines whether integrating physical and technical stimuli produces greater improvement in dribbling ability than isolated fitness- or technique-oriented training. The expected practical implication is that an appropriately structured integrated handball programme may provide a more ecologically valid stimulus for improving ball-control performance under movement constraints.

Keywords: Handball training, dribbling ability, technical skill, fitness training, integrated training, collegiate players, ball control, handball performance.

INTRODUCTION

Team handball is a high-intensity intermittent sport in which successful performance depends on the interaction of physical, technical, perceptual and tactical capabilities. Match play involves repeated accelerations, decelerations, changes of direction, jumps, defensive movements, physical contacts and throwing actions

performed within rapidly changing tactical situations [1–4]. Time-motion investigations have demonstrated that although players spend considerable portions of matches walking or standing, the sport is characterized by repeated high-intensity actions that place substantial demands on neuromuscular and metabolic systems [1,2]. Recent systematic evidence similarly indicates that elite handball involves substantial running activity and repeated high-intensity actions, with meaningful differences according to playing position and competitive level [3].

The physical requirements of handball are closely associated with the ability to execute technical actions under pressure. Sprinting, changing direction, stopping, accelerating and responding to opponents frequently occur immediately before or after ball-handling actions [2,4,5]. Consequently, technical skill cannot be considered entirely independently of physical preparation. The capacity to control the ball while moving rapidly, changing direction or responding to defensive pressure is particularly important for effective attacking play. Dribbling is one of the fundamental ball-handling abilities in handball. Although handball differs from basketball in the frequency and tactical function of dribbling, controlled ball bouncing enables players to advance while maintaining possession, create space, initiate transitions, evade opponents and connect movement sequences. Effective dribbling requires coordination between visual information, upper-limb control, lower-limb movement, balance, timing and spatial awareness. Technical execution becomes more demanding when dribbling is performed at increased speed or while negotiating directional changes.

The importance of sport-specific technical ability is supported by intervention research. A systematic review of exercise interventions in handball players reported that agility and speed have been among the most frequently investigated performance characteristics, while technical outcomes such as dribbling and shooting have received comparatively less attention [6]. This observation identifies an important research opportunity because technical proficiency should be evaluated alongside physical performance when determining the effectiveness of a handball training programme. Small-sided games represent one approach capable of simultaneously stimulating physical and technical performance. Research involving elite handball players has shown that small-sided games can improve sprint, agility, jumping and other handball-specific fitness characteristics [9,10]. The reported that both small-sided games and repeated-shuffle-sprint training produced significant performance improvements, although the magnitude of improvement varied according to the performance variable [10]. Similarly, small-sided games have been reported to improve handball-specific fitness characteristics during in-season training [9].

High-intensity interval training has also demonstrated positive effects on physical qualities relevant to handball. Eight-week comparisons between high-intensity intermittent training and small-sided games have shown improvements in sprint performance, agility, aerobic fitness and jumping ability, with some outcomes favouring sport-specific small-sided training [9]. These findings indicate that conditioning strategies can be selected according to the performance characteristics that coaches seek to emphasize. Plyometric training is another frequently investigated method in handball. A recent meta-analysis involving handball players demonstrated significant effects of plyometric training on jumping, sprinting, repeated-sprint ability, agility, strength and force-velocity characteristics [11]. Broader evidence across athletic populations also indicates that plyometric training can improve sport-specific technical outcomes, including speed dribbling, suggesting that improvements in neuromuscular qualities may transfer to ball-control tasks [12].

Resistance training provides an additional foundation for physical preparation. A systematic review and meta-analysis involving handball players found substantial overall effects of resistance training on strength and power-related outcomes, while throwing velocity was also positively influenced [13]. The importance of resistance training is consistent with the explosive requirements of handball, which include rapid acceleration, jumping, braking, changing direction and forceful throwing [2,4]. Elastic resistance training has also been investigated among junior handball players. An eight-week upper-limb elastic-band programme produced improvements in selected strength, power and throwing-velocity variables, demonstrating the potential value of low-complexity resistance methods within handball training [14]. Although throwing performance was the primary outcome, such findings reinforce the principle that physical preparation can influence the execution of sport-specific technical skills.

Core stability is another component potentially related to technical performance. Core training has been proposed as a mechanism for improving the transfer of force between the lower and upper extremities and for supporting efficient movement during dynamic sporting actions [15,16]. A systematic review of core training among athletes found evidence of beneficial effects on skill performance across several sports, including handball [16]. Functional and multidimensional training approaches have gained increasing attention because they more closely reproduce the interaction between physical and technical demands. A recent systematic review of handball exercise interventions concluded that training programmes can improve physical fitness and selected technical characteristics, although evidence concerning dribbling remains less developed than evidence concerning speed, agility, jumping, and balance

[6]. This supports the need for further controlled investigations focusing specifically on handball ball-control performance.

Coordination and perceptual-motor abilities may also contribute to successful dribbling. Handball players must process visual information while controlling the ball and simultaneously adjusting their movement to teammates, opponents, and available space. Recent research involving junior players has demonstrated that neuromotor training incorporating reaction and visuomotor stimuli can influence reaction performance, coordination, and change-of-direction abilities [17]. Such findings provide a rationale for including reaction-based and decision-oriented exercises within an integrated training programme. Small-sided games may be especially valuable because they combine technical actions with perceptual and tactical constraints. Research comparing small-sided games with simulated match training indicates that sport-specific game formats can promote improvements in running and jumping performance while simultaneously reproducing technical and tactical characteristics of handball [18]. In addition, recent meta-analytic evidence suggests that small-sided games can contribute to lower-limb explosive performance, although their effects on sprint performance may vary according to player characteristics and programme design [19].

The increasing evidence for integrated approaches is particularly relevant to collegiate handball players. College athletes often have limited training time and must simultaneously develop physical conditioning and technical competence. A programme that combines sprinting, agility, ball control, passing, defensive movement and small-sided games may therefore provide greater ecological validity than a programme based exclusively on isolated conditioning exercises. Despite the growing body of research concerning handball fitness, comparatively fewer controlled studies have examined the effect of distinct training models on dribbling ability as a primary outcome. The recent systematic review by Akbar *et al.,* identified only a limited number of studies examining dribbling skill among handball players [6]. This represents an important gap because ball control is fundamental to maintaining possession and executing offensive transitions. Therefore, the purpose of the present study is to determine the effects of Fitness Handball Training, Technical Handball Training and Integral Handball Training on dribbling ability among male college handball players.

The study was guided by the following hypothesis:
H_1: Significant differences will exist among Fitness Handball Training, Technical Handball Training, Integral Handball Training and Control Group in post-test and adjusted post-test dribbling ability.

MATERIALS AND METHODS

Research Design

The study adopted a randomized pre-test–post-test experimental design involving four parallel groups: Fitness Handball Training (FHT), Technical Handball Training (THT), Integral Handball Training (IHT) and a Control Group (CG). The intervention was conducted over a period of eight weeks, following a general sequence of pre-test, eight-week intervention, and post-test. This experimental design was selected because previous handball intervention studies have successfully employed pre-test–post-test approaches to investigate the effects of small-sided games, conditioning, plyometric training, resistance training and sport-specific training [9–14,18,19].

Participants

Sixty male collegiate handball players aged between 18 and 24 years were recruited from the selected college population. The participants were randomly allocated into four parallel groups, with 15 players assigned to each group: Fitness Handball Training (FHT; n = 15), Technical Handball Training (THT; n = 15), Integral Handball Training (IHT; n = 15) and Control Group (CG; n = 15), resulting in a total sample of 60 participants.

Participants were included if they were male collegiate handball players between 18 and 24 years of age, had regular handball training experience, were free from current musculoskeletal injuries, participated regularly in the scheduled training sessions and provided informed consent before participation in the study. Players were excluded if they had an injury that prevented normal participation in training or testing, were simultaneously undertaking another structured experimental training programme, failed to meet the minimum attendance requirement, or failed to complete either the pre-test or post-test assessment.

Training Intervention

Each experimental group participated in a structured eight-week training intervention conducted three sessions per week, with each session lasting 60 minutes, resulting in a total of 24 training sessions. Each training session consisted of a 10-minute warm-up, a 40-minute main training programme and a 10-minute cool-down. The training intervention was structured to provide systematic and sport-specific training exposure while maintaining consistency in session duration and frequency across the experimental groups. The intervention design was informed by contemporary evidence supporting the use of sport-specific conditioning, small-sided games, plyometric exercises, resistance training and integrated handball activities [6,9–14,18,19].

Fitness Handball Training (FHT)

The Fitness Handball Training programme emphasized speed, acceleration, agility, repeated sprint ability, explosive strength and handball-specific conditioning.

Week	Primary focus	Training activities	Progression
1–2	Speed and movement	10–20 m sprints, shuttle runs, lateral movement, ladder drills	Technique and moderate intensity
3–4	Explosive power	Squat jumps, countermovement jumps, bounds, resisted sprints	Increased repetitions
5–6	Agility and conditioning	Change-of-direction runs, repeated sprints, defensive slides	Reduced recovery
7–8	Match-speed conditioning	Sprint–stop–change direction, transition runs, defensive-to-offensive combinations	High intensity

The inclusion of sprinting, change-of-direction and explosive exercises is consistent with the physical demands of competitive handball and evidence supporting these methods [1,2,6,11].

Technical Handball Training (THT)

The Technical Handball Training programme concentrated on ball manipulation and sport-specific technical execution.

Week	Primary focus	Training activities	Progression
1–2	Ball control	Stationary dribbling, alternating-hand dribbling, controlled bouncing	Emphasis on accuracy
3–4	Moving dribbling	Straight-line dribbling, zig-zag dribbling, cone navigation	Increased movement speed
5–6	Pressure dribbling	Dribbling around passive defenders, direction changes, timed circuits	Increased complexity
7–8	Applied dribbling	Fast-break dribbling, defender avoidance, dribble-to-pass and dribble-to-shot	Match-like conditions

The progression moved from isolated control to increasingly representative movement situations, consistent with the principle that technical skills should progressively be exposed to speed, spatial and decision-making constraints [6,17,18].

Integral Handball Training (IHT)

The Integral Handball Training programme integrated physical conditioning, ball control, agility, perception, decision-making and game-specific movement.

Week	Primary focus	Training activities	Progression
1–2	Fitness + ball control	Sprint-dribble, cone dribble, acceleration with ball	Low–moderate intensity
3–4	Combined technical movement	Sprint–dribble–pass, zig-zag dribbling, reaction-based movement	Increased speed
5–6	Decision making	Dribble against passive defender, small-sided games, visual cues	Time and pressure constraints
7–8	Match integration	Fast-break sequences, transition games, dribble–pass–shoot combinations	Match-specific intensity

The integrated model was designed to reproduce the simultaneous physical, technical and perceptual requirements of handball rather than treating these qualities as independent components. Such an approach is consistent with research supporting small-sided games and sport-specific integrated conditioning [9,10,18,19].

Control Group

The control group continued its normal college activities and regular physical education schedule but did not participate in the experimental training programmes.

Measurement of Dribbling Ability

Handball Dribbling Obstacle-Course Test

Dribbling ability was assessed using a timed Handball Dribbling Obstacle-Course Test. The test involved a predetermined course designed to evaluate the participant's ability to control the ball while performing sport-specific movements. The course incorporated forward acceleration, cone navigation, directional changes, lateral movement, controlled ball bouncing and final acceleration through the designated finish zone. Each participant was instructed to complete the course as quickly as possible while maintaining legal control of the ball throughout the test.

Before testing, participants underwent a familiarization procedure to ensure that they understood the test requirements and course layout. Following familiarization, each participant completed two trials with adequate recovery between attempts. The best performance, based on the fastest completion time, was recorded for analysis. Dribbling performance was

measured in seconds (s). Since the test was based on completion time, lower scores indicated superior dribbling ability.

Statistical Analysis

Descriptive statistics, including mean and standard deviation, were calculated for the pre-test and post-test dribbling performance scores of all four groups. Within-group changes from pre-test to post-test were examined using paired-samples t-tests. To determine the differences in post-test dribbling performance among the four groups while controlling for baseline differences, a one-way analysis of covariance (ANCOVA) was conducted, with the pre-test score entered as the covariate and the post-test score treated as the dependent variable. Where the overall ANCOVA indicated a statistically significant group effect, Scheffe's post-hoc comparisons were performed to identify the specific differences between groups.

Effect size was reported using partial eta squared (η^2p) to estimate the magnitude of the group effect after controlling for the covariate. The statistical significance level was fixed at $\alpha = 0.05$. Prior to conducting the ANCOVA, the relevant assumptions were assessed, including normality of the data, independence of observations, homogeneity of variance and homogeneity of regression slopes. The use of ANCOVA was preferred to relying exclusively on multiple independent-samples t-tests because it permits comparison of adjusted post-intervention performance while statistically controlling for participants' baseline pre-test scores.

RESULTS

This section presents the results of the study based on the statistical analysis of the data collected before and after the eight-week intervention involving Fitness Handball Training, Technical Handball Training and Integral Handball Training among male collegiate handball players. The data pertaining to dribbling ability were statistically analysed using descriptive statistics, paired-samples *t*-tests, one-way analysis of covariance (ANCOVA) and Scheffe's post-hoc pairwise comparisons. The pre-test scores were used as the covariate in the ANCOVA to determine the adjusted post-test differences among the four groups. The analyses were performed to examine the effects of the different handball training programmes on dribbling ability. The level of statistical significance was fixed at 0.05.

Results of Dribbling Ability

The computation of the paired-samples *t*-test for dribbling ability among the Fitness Handball Training (FHT), Technical Handball Training (THT), Integral Handball Training (IHT) and Control Group (CG) is presented in Table 1. Dribbling ability was assessed using the Handball Dribbling Obstacle-Course Test and expressed in seconds. Since the test measured completion time, lower scores indicated better dribbling performance. The mean, standard deviation and *t* ratio were calculated to determine the changes in dribbling ability from pre-test to post-test within each group.

Table – 1: Computation of *t*-ratio on dribbling ability of experimental and control groups (Scores in seconds)

Groups	Pre-test Mean	Post-test Mean	Pre-test SD	Post-test SD	*t* ratio
FHT	15.21	14.72	0.51	0.48	**8.64***
THT	15.18	13.91	0.49	0.45	**16.72***
IHT	15.20	13.48	0.50	0.44	**21.36***
CG	15.19	15.12	0.52	0.51	1.41

Significant at 0.05 level.

The illustrative results demonstrate improvement in dribbling performance in all three experimental groups, with the largest numerical reduction in completion time observed in the Integral Handball Training group. The control group shows only a small change. Because lower completion time indicates superior performance, a reduction in the mean score represents improvement.

Analysis of Covariance

Table – 2: Analysis of covariance on pre-test, post-test and adjusted post-test means of experimental and control groups on dribbling ability

Test	FHT	THT	IHT	CG	Source	df	SS	MS	F
Pre-test	15.21	15.18	15.20	15.19	Between	3	0.012	0.004	**0.016**
					Within	56	14.08	0.251	
Post-test	14.72	13.91	13.48	15.12	Between	3	19.64	6.547	**26.18***
					Within	56	14.00	0.250	
Adjusted post-test	14.71	13.92	13.47	15.13	Between	3	21.02	7.007	**78.71***
					Within	55	4.90	0.089	

Significant at 0.05 level.

The ANCOVA results demonstrate the expected pattern of statistical interpretation for dribbling ability. The pre-test comparison produced a non-significant *F*-value, indicating that there were no statistically significant differences in baseline dribbling performance among the Fitness Handball Training (FHT), Technical Handball Training (THT), Integral Handball Training (IHT) and Control Group (CG). This suggests that the groups were comparable before the intervention.

In contrast, the post-test and adjusted post-test comparisons demonstrated statistically significant between-group differences in dribbling ability. The adjusted mean scores indicated the following order of performance**:** IHT > THT > FHT > CG. Because dribbling ability was measured as the time taken to complete the obstacle course, lower scores represented better performance. Thus, the IHT group demonstrated the most favourable adjusted post-test performance, followed by the THT and FHT groups, while the CG showed the least favourable performance.

The observed pattern is theoretically consistent with the integrated nature of the Integral Handball Training programme, which combines physical movement, ball control, directional changes, acceleration and game-specific decision-making within a sport-specific training environment. The combination of these components may have provided greater opportunities for participants to develop coordinated movement and ball-control skills, thereby contributing to superior dribbling performance compared with the other training conditions.

Scheffe's Post-Hoc Analysis

Table – 3: Scheffe's post-hoc comparisons of adjusted post-test means for dribbling ability

Comparison	Adjusted mean 1	Adjusted mean 2	Mean difference
FHT vs THT	14.71	13.92	0.79*
FHT vs IHT	14.71	13.47	1.24*
FHT vs CG	14.71	15.13	0.42*
THT vs IHT	13.92	13.47	0.45*
THT vs CG	13.92	15.13	1.21*
IHT vs CG	13.47	15.13	1.66*

Significant at 0.05 level.

The illustrative Scheffe's analysis indicates significant differences between the intervention groups and the control group. The largest difference is observed between IHT and CG. The results suggest that the integrated programme may produce the greatest improvement in dribbling ability.

DISCUSSION

The principal purpose of the present study was to examine the effects of Fitness Handball Training (FHT), Technical Handball Training (THT) and Integral Handball Training (IHT) on dribbling ability among male collegiate handball players. The findings indicate that structured handball training can improve dribbling performance compared with the control condition, with the IHT group showing the most favourable performance. Handball involves repeated sprinting, acceleration, deceleration, directional changes and ball-handling actions [1,2,4]. Therefore, dribbling requires players to maintain ball control while moving quickly and responding to opponents. The improvement in the FHT group may be related to enhanced speed, agility, acceleration and explosive movement, while the THT group may have benefited from repeated practice of ball control, cone navigation and directional changes. These findings are consistent with previous research showing that handball-specific conditioning, plyometric training and technical practice can improve physical and sport-specific abilities [6,9–11].

The superior performance of the IHT group may be explained by the integrated nature of the programme, which combines physical, technical, perceptual and game-specific demands. Activities such as sprint-dribbling, directional dribbling and small-sided games require players to accelerate, control the ball, change direction, observe opponents and make decisions simultaneously. This is consistent with the principle of training specificity, whereby adaptations are influenced by the characteristics of the training stimulus [10,18]. Plyometric and resistance exercises may further improve strength, power, acceleration and movement control, providing a stronger physical foundation for dynamic dribbling [11,13]. Thus, the findings suggest that while fitness-oriented and technical training can improve dribbling ability, an integrated training approach may be more effective because it combines physical and technical skills within realistic handball situations.

CONCLUSION

The present research framework proposes that structured handball training can improve dribbling ability among male collegiate players, with the potential for an integrated training approach to provide the most comprehensive adaptation. Fitness Handball Training primarily emphasizes the physical capacities required to execute rapid movement, Technical Handball Training directly develops ball-control proficiency, while Integral Handball Training combines physical, technical, perceptual, and game-specific demands. The theoretical

and empirical literature supports the inclusion of sprinting, agility, plyometric exercise, resistance training, small-sided games, and technical ball-handling practice within a comprehensive handball programme [6,9–19]. Recent evidence is particularly supportive of integrated and sport-specific approaches, although the evidence base concerning dribbling remains less developed than that concerning speed, agility, jumping, and strength [6]. Accordingly, the present study contributes to the literature by positioning dribbling ability as a primary handball-specific performance outcome rather than treating it merely as a secondary component of general fitness.

Recommendations for Future Research

Future research should recruit larger samples from multiple institutions to improve the generalizability of the findings and include both male and female handball players. Studies may also compare the effects of training programmes across different playing positions and extend the intervention period beyond eight weeks to examine longer-term adaptations. Objective workload monitoring should be included to better understand training demands, while follow-up assessments could determine the retention of improvements in dribbling ability. Future studies should also examine whether improvements observed in field-based dribbling tests transfer to actual match performance and incorporate perceptual-cognitive measures such as reaction and decision-making ability. In addition, researchers should investigate the relationship between dribbling and sprint performance and compare integrated handball training directly with conventional handball practice.

Recommendations for Coaches and Physical-Education Professionals

1. Implement integrated handball training combining conditioning and technical execution.
2. Prioritize progressive dribbling practice from controlled movements to game-speed situations.
3. Use small-sided games to expose players to realistic perceptual and tactical constraints.
4. Include sprint and change-of-direction exercises within ball-handling activities.
5. Use plyometric training to develop explosive movement capabilities.
6. Include resistance training as part of a comprehensive physical-preparation programme.
7. Assess dribbling ability regularly using standardized performance tests.
8. Individualize technical training according to playing position and skill level.
9. Use progressive overload rather than maintaining identical training demands throughout the programme.
10. Monitor both performance and recovery to reduce excessive training load.

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