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Effectiveness of Shoulder Performance Kinesio Taping Versus Sham Taping Along with Conventional Exercise on Strength, Power, and Agility of Upper Limb Among Recreational Badminton Players – A Comparative Study

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ABSTRACT

Background: Kinesio taping (KT) is widely used in sports rehabilitation to enhance functional performance, but its effectiveness in improving upper limb strength, power, and agility among badminton players remains inconclusive. This study aimed to evaluate and compare the effects of shoulder performance Kinesio taping with conventional exercises, sham taping with traditional exercises, and conventional exercises alone on upper limb performance among recreational badminton players.

Methods: Randomized controlled trial included thirty-six male participants aged 20–29 years and were randomized into three interventional groups: Group A (KT with conventional exercises), Group B (sham taping with conventional exercises), and Group C (conventional exercises only). Interventions were delivered thrice weekly for 6 weeks. Outcome measures included the push-up test (strength), Davies test (agility), and Single Arm Seated Shot-Put Test (SASSPT) for both dominant and non-dominant hands (power). Data were analyzed using repeated-measures ANOVA, with homogeneity assessed using Levene's test.

Results: KT combined with conventional exercises, demonstrated superior improvements across outcome measures compared with other groups. However, the push-up test did not show significant between-group differences ($p = 0.242$). Significant within-group effects were observed for the Davies test ($p < 0.001$), SASSPT dominant hand ($p = 0.015$), and SASSPT non-dominant hand ($p = 0.036$).

Conclusion: While significant main effects of time were observed across all performance measures, indicating overall improvement, between-group differences were non-significant. Importantly, the critical test of interest—the time \times group interaction did not reveal significant effects, suggesting that the magnitude of improvement did not differ meaningfully among CT, KT, and ST groups.

Keywords: Kinesio taping, conventional exercises, upper limb performance, agility, badminton, sports rehabilitation.

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INTRODUCTION

One of the most widely played, non-contact sports is badminton. Around 150 million people play badminton, of whom more than 2,000 play it professionally. Badminton is a game that demands stamina, power, agility, speed, and precision [1,2]. It is a technical, fast racquet sport that consists mainly of overhead shots (30%) and jump smashes [3,4]. Although it is a solo or doubles sport, the injury prevalence is 75% among recreational badminton players, with 52% in the 20-29 age group for both males and females. Around 19-32% of upper limb injuries are due to a lack of warm-up before playing, and 42.3% occur during training [5,6]. A badminton stroke can be divided into four main phases: the backswing, forward swing, contact, and follow-through. During the stroke, high acceleration forces are generated, causing the racket to bend. As the racket moves forward, it initially bends backward, then recoils and returns to its original shape just as it contacts the shuttlecock. The acceleration stage relies on the coordinated, synchronized action of multiple upper-limb muscles and on strength. During overhead shots or jump smashes, complex movement patterns are generated that quickly produce high forces on the shoulder complex [7,8]. These repetitive movements can cause overuse or strain of the muscles and joints, leading to shoulder instability or rotator cuff impingement, a major complication for overhead athletes [9].

Agility plays an important role in badminton, with sudden changes in direction, jumping smashes, and short jumps requiring various postures to hit the shuttlecock, such as half squats, lunges, and forward bends. This increases the risk of shoulder pain, scapular/shoulder instability, or muscle weakness, and sometimes non-contact injuries such as muscle or tendon strains or tears [10, 11].

Scapular taping is a beneficial technique that enhances joint stability by biomechanically realigning the scapula and glenohumeral joint during movement. K-taping, also called Kinesio-taping, follows the path of muscles and nerves. This is a method for supporting joints, muscles, and fascia. It helps reduce lymphedema, improve circulation, reduce pain, provide joint support, and enhance joint function. It offers support and stability to muscles and joints without limiting joint mobility, while also promoting the natural healing of soft tissues. KT can stretch up to 100% of its original length, with tension levels adjusted based on the application site. For joint positioning purposes, a tension of 75–100% is recommended [12, 13].

METHODOLOGY

Study approval was obtained from the Institutional Ethics Committee (IEC/IRB/DSU/MPT/2024/005). The trial was registered in Clinical Trials Registry – India (CTRI/2025/02/081271). Required permissions were obtained from various badminton centers across South Bengaluru to include recreational badminton players in the study. In the preliminary phase, a structured Google Form was developed to refine the exercise protocol. The form included sections on participant demographics, years of badminton experience, and perceptions of the proposed

exercise sets (warm-up, training exercises, and cool-down). Each exercise component was rated on a 4-point Likert scale (strongly agree, agree, neutral, disagree). Additionally, open-ended questions invited participants to suggest additions, removals, or modifications to exercises.

Feedback analysis revealed two key recommendations: (1) extending the intervention duration to a minimum of six weeks, and (2) incorporating cool-down stretches with a minimum holding time of 30 seconds. These inputs were carefully considered, and necessary modifications were integrated into the final conventional exercise program. The revised protocol thus reflects both evidence-based principles and participant-driven refinements, enhancing its ecological validity and applicability to recreational badminton players.

Participants

All participants provided written informed consent before enrolment. Eligible participants were recreational badminton players with at least one year of playing experience and an average playing frequency of at least 3 hours per week. Individuals aged 20 to 29 years who were willing to participate were included in the study. Exclusion criteria comprised individuals with a history of upper-limb musculoskeletal injuries, skin allergies to Kinesio tape, prior engagement in structured muscular strength training, or those classified as elite badminton players [14, 15]. Recruitment was conducted at a badminton training center in South Bengaluru. Before participation, all eligible individuals were clearly informed about the study objectives and procedures. Participants were then randomly allocated, using a computer-generated sequence, to three intervention groups [16].

Study design

A single-blinded, comparative study design was conducted. Participants were randomly assigned to one of three groups: Group A (Kinesio taping with conventional exercises), Group B (sham taping with conventional exercises), and Group C (conventional exercises only). (Figure 1) The sample size was determined using a significance level of 5%, an anticipated effect size of 1.0, and a projected dropout rate of 20%. Based on these parameters, the required sample size was calculated as 12 participants per group. Each intervention group received three supervised sessions per week for six weeks. In Groups A and B, taping was applied twice weekly in addition to the prescribed exercises. Outcome assessments were conducted after the first intervention session (baseline) and following the final session at the end of six weeks.

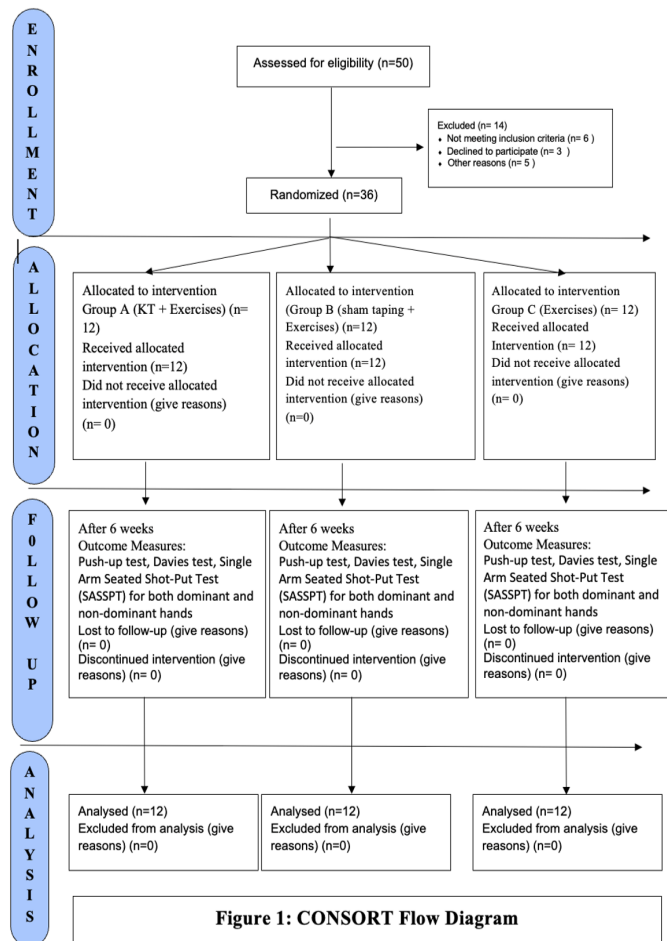


Figure 1: CONSORT Flow Diagram

Interventions:

Group A (Kinesio taping with conventional exercises):

Shoulder performance: Kinesio taping was applied to the deltoid and scapular stabilizing muscles. For the deltoid, one I-strip was placed on the middle deltoid, from the acromion process to the deltoid tuberosity, with 50% stretch, applied with the shoulder positioned at 90° abduction. An additional I-strip was applied to the anterior deltoid fibers from the lateral one-third of the clavicle to the deltoid tuberosity with the shoulder in extension. For the posterior deltoid, taping was applied from the lower lip of the scapular spine to the deltoid tuberosity with the shoulder in flexion, again with 50% stretch. For scapular stabilization, one I-strip extended from the acromioclavicular joint to the inferior angle of the scapula and another from the medial clavicle to the medial border of the scapula, both applied in retraction with 50% stretch [17,18]. Participants were permitted to engage in daily activities and play badminton, but were advised to refrain from performing any additional upper-limb exercises outside the prescribed program. Tapes were reapplied twice weekly throughout the six-week intervention.

Group B (Sham taping with conventional exercises):

The same taping procedure as in Group A was followed; however, the tape was applied without stretch to simulate a placebo effect [19].

Group C (Exercises Protocol only) [20]:

Participants in this group underwent structured exercise

sessions identical to those of the other two groups (Table 1), lasting about 45–50 minutes and including warm-up, training, and cool-down phases. A 30-second rest interval was provided between each exercise. The program primarily targeted upper limb strength, power, and agility, with progression introduced every two weeks. Warm-up: Arm swings, shoulder circles, wall angels, thoracic rotations, and wrist mobility drills. Main training: Bodyweight exercises (e.g., push-ups), free exercises (e.g., overhead throws, arm circles), and resistance band exercises (IYTWs, bent-over rows, lateral pull-downs, and seated shoulder presses). Cool-down: Static stretches (triceps stretch, cross-body shoulder stretch, wall clock stretches, child's pose), along with foam rolling of the shoulder complex.

Table 1: Exercise Programme for Recreational Badminton Players (6 weeks, 3 sessions/week)

| Phase | Week 1–2 | Week 3–4 | Week 5–6 |
|--|--|---|---|
| Warm-up (5–8 min) | <ul style="list-style-type: none"> • Arm swings (1 min) • Shoulder circles forward & backward (10 reps each side) • Wall angels (8 reps × 2 sets) • Overhead shoulder passes (2 min) • Thoracic rotations (8 reps × 2 sets) • Wrist mobility (2 min) | Same as Weeks 1–2 | Same as Weeks 1–2 |
| Training (25–30 min) | <ul style="list-style-type: none"> • Wall push-ups (10 reps × 3 sets) • IYTW's with TheraBand (yellow/red; 10 reps × 3 sets) • Overhead throws (10 throws × 3 sets) • Arm circles (small & large, forward/backward; 30 sec) • Bent-over rows with TheraBand (10 reps × 3 sets) • Lat pull-down with TheraBand (10 reps × 3 sets) • Seated shoulder press (10 reps × 3 sets) | <ul style="list-style-type: none"> • Push-ups (10 reps × 3 sets) • IYTW's with TheraBand (green; 10 reps × 3 sets) • Overhead throws (10 throws × 3 sets) • Arm circles (45 sec) • Bent-over rows with TheraBand (10 reps × 3 sets) • Lat pull-down with TheraBand (10 reps × 3 sets) • Seated shoulder press (10 reps × 3 sets) | <ul style="list-style-type: none"> • Push-ups (10 reps × 3 sets) • IYTW's with TheraBand (blue; 10 reps × 3 sets) • Overhead throws (10 throws × 3 sets) • Arm circles (1 min) • Bent-over rows with TheraBand (10 reps × 3 sets) • Lat pull-down with TheraBand (10 reps × 3 sets) • Seated shoulder press (10 reps × 3 sets) |
| Cool-down (5–10 min) | <ul style="list-style-type: none"> • Triceps stretch (30 sec hold) • Wall clock stretch (30 sec hold) • Cross-body shoulder stretch (30 sec hold) • Child's pose (30 sec hold) • Foam rolling (shoulder region) | Same as Weeks 1–2 | Same as Weeks 1–2 |
| <p>Note: min = minutes; sec = seconds; reps = repetitions; sets = number of sets performed. IYTW's = Shoulder strengthening and stabilization exercises involving four movement patterns: "I" (shoulder flexion), "Y" (scaption at 135°), "T" (horizontal abduction), and "W" (external rotation with scapular retraction) performed with TheraBand resistance. TheraBand colors indicate progressive resistance: yellow < red < green < blue. All exercises were performed under supervision, with 30 seconds of rest between sets.</p> | | | |

Outcome Measures:

Push-up test: The participant's position should be with

shoulders wide apart, back straight, head up, and toes facing the ground; for females, knees should be flexed and feet in plantar flexion. Then the participant will be asked to lower the body using the upper limbs until the chin touches the ground. Note that the stomach should not touch the ground and push up again in extension. This procedure should be performed till the maximum number of times the participant can do. ICC of 0.93. Reliability for the push-up test was 0.958 [21,22].

Single-arm seated shot-put test (SASSPT): For this, the participant sits with their back rested and their knee in a 90-degree position on the floor. A 3 kg medicine ball is placed in the hand to be tested. The participant is then asked to throw the ball as far as possible without any associated movements. Two trials are performed: in the first, the participant is asked to exert 75% of their maximum force; in the second, 100% of their maximum force. A 1 min rest period is given between the two trials. The 3 tests are performed with a 1-minute rest between tests, and the average measurement is recorded. The measurement is taken from the participant's foot to the ball. The normalized score ranges from 32.29 to 45.11 cm, with an ICC>0.93. The reliability of the dominated and nondominated single-arm seated shot-put test was 0.988 and 0.971, respectively [23, 24].

Davies test: Also known as the closed kinetic chain upper extremity stability test (CKCUEST), the distance between 2 points is measured at 36 inches. At the same time, the participant is in a push-up position, placing the hands on the marked points. The participant is instructed to touch one hand with the other and repeat the task for 15 seconds. The average count is taken after performing 2 sets and noted. If the participant scores more than 21 touches, they are ready to play sport; if not, they are prone to shoulder injuries. The sensitivity and specificity of this test are 0.83 and 0.79, respectively, and the ICC is 0.922 [25,26].

Statistical Analysis

All statistical analyses were conducted using JASP software (version 0.18, University of Amsterdam) and Microsoft Excel 2022. Descriptive statistics (mean ± standard deviation, SD) were computed for all continuous outcome measures. Assumptions of parametric testing were verified using Mauchly's Test of Sphericity for repeated measures

and Levene's Test for Equality of Variances for between-group comparisons. Where the sphericity assumption was violated, the Greenhouse–Geisser correction was applied. To evaluate the effects of the interventions over time and across groups, a Repeated Measures Analysis of Variance (RM-ANOVA) was performed, examining (i) within-subject effects (pre- to post-intervention changes), (ii) between-group differences, and (iii) time × group interaction effects. Effect sizes were reported as partial eta squared (η^2p), with values of 0.01, 0.06, and 0.14 interpreted as small, medium, and large effects, respectively. For questionnaire-based data, categorical responses were analyzed using frequency distributions and percentages to summarize patterns and trends. This allowed a comprehensive understanding of participant perceptions and experiences. All tests were two-tailed, and a significance threshold of $p < 0.05$ was adopted for inferential analyses.

RESULTS

The demographic characteristics of participants across the three intervention groups (CT, KT, ST) were assessed using Levene's test, which indicated no significant differences, confirming that the groups were statistically comparable at baseline (Figure 2). This homogeneity ensures that observed differences in outcomes can be more confidently attributed to the interventions rather than pre-existing group differences. (Table 2).

Table 2: Homogeneity of Demographic Data Across Groups

| Demographic Variable | CT (Mean ± SD) | KT (Mean ± SD) | ST (Mean ± SD) | p-value |
|-----------------------|----------------|----------------|----------------|---------|
| Age (years) | 22.33 ± 2.40 | 25.08 ± 2.50 | 25.75 ± 3.22 | > 0.05 |
| Height (meters) | 1.70 ± 0.04 | 1.70 ± 0.12 | 1.70 ± 0.06 | > 0.05 |
| Weight (kg) | 69.58 ± 6.08 | 68.58 ± 10.37 | 65.85 ± 9.04 | > 0.05 |
| Body Mass Index (BMI) | 23.65 ± 1.91 | 25.35 ± 3.70 | 22.56 ± 2.25 | > 0.05 |
| Hours Played/Week | 7.12 ± 2.37 | 5.29 ± 2.30 | 7.00 ± 2.60 | > 0.05 |

CT = Conventional Training (exercises alone), KT = Kinesio Taping + Conventional Training, ST = Sham Taping + Conventional Training, SD = Standard Deviation, Height measured in meters (m), Weight measured in kilograms (kg), BMI = Body Mass Index, calculated as weight (kg) ÷ height (m²) Hours Played/Week = Self-reported average weekly badminton play-time, $p > 0.05$ indicates no statistically significant difference across groups.

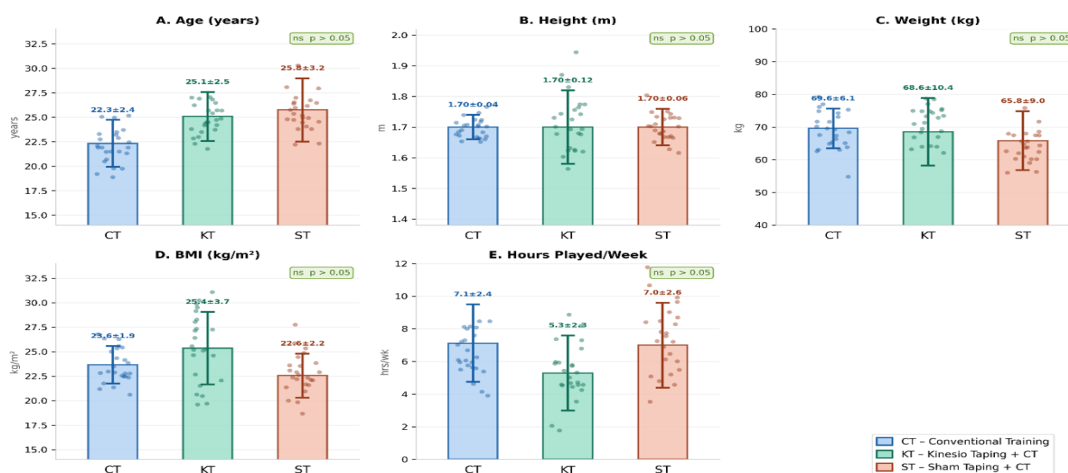


Figure 2. Baseline Demographic Characteristics by Group (Mean ± SD)

In Table 3. Repeated-measures ANOVA was employed to assess within-group and between-group changes. While significant main effects of time were observed across all performance measures, indicating overall improvement, between-group differences were non-significant. Importantly, the critical test of interest—the time × group

interaction—did not reveal significant effects, suggesting that the magnitude of improvement did not differ meaningfully among CT, KT, and ST groups. Full reporting of interaction effect sizes (η^2p) with 95% confidence intervals is recommended to aid interpretation of precision and potential small effects.

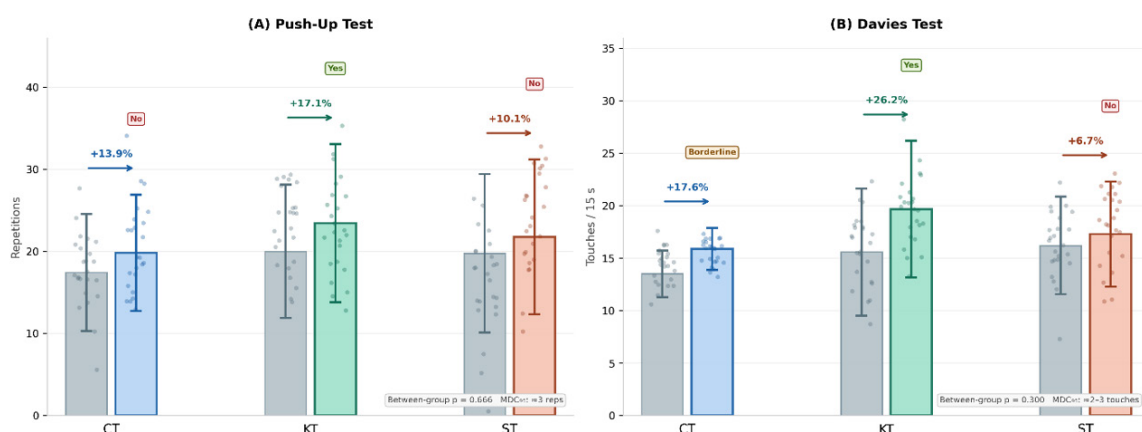
Table 3: Within-group and between-group effects for upper-extremity performance outcomes following 6-week interventions.

| Outcome Measure | Group | Pre (mean ± SD) | Post (mean ± SD) | Absolute Change | % Change | Within-Group p | Between-Group p | MDC ₉₅ | MDC ₉₅ |
|-------------------------------|-------|-----------------|------------------|-----------------|----------|----------------|-----------------|-------------------|-------------------|
| Push-Up Test (repetitions) | CT | 17.42 ± 7.13 | 19.83 ± 7.08 | 2.41 | 13.9 | 0.242 | 0.666 | ≈ 3 reps | No |
| | KT | 20.00 ± 8.12 | 23.42 ± 9.64 | 3.42 | 17.1 | — | — | ≈ 3 reps | Yes |
| | ST | 19.75 ± 9.65 | 21.75 ± 9.43 | 2 | 10.1 | — | — | ≈ 3 reps | No |
| Davies Test (touches/15 s) | CT | 13.50 ± 2.23 | 15.88 ± 2.00 | 2.38 | 17.6 | <0.001* | 0.3 | ≈ 2–3 touches | Borderline |
| | KT | 15.58 ± 6.06 | 19.67 ± 6.51 | 4.09 | 26.2 | — | — | ≈ 2–3 touches | Yes |
| | ST | 16.21 ± 4.65 | 17.29 ± 5.01 | 1.08 | 6.7 | — | — | ≈ 2–3 touches | No |
| SASSPT Dominant Hand (cm) | CT | 44.57 ± 10.98 | 47.20 ± 11.69 | 2.63 | 5.9 | 0.015* | 0.245 | ≈ 8–10 cm | No |
| | KT | 52.45 ± 16.76 | 58.65 ± 16.01 | 6.2 | 11.8 | — | — | ≈ 8–10 cm | No |
| | ST | 53.33 ± 17.90 | 56.17 ± 17.60 | 2.84 | 5.3 | — | — | ≈ 8–10 cm | No |
| SASSPT Non-Dominant Hand (cm) | CT | 41.93 ± 11.39 | 43.70 ± 12.41 | 1.77 | 4.2 | 0.036* | 0.291 | ≈ 8–10 cm | No |
| | KT | 46.77 ± 17.10 | 51.54 ± 15.90 | 4.77 | 10.2 | — | — | ≈ 8–10 cm | No |
| | ST | 51.75 ± 17.42 | 53.46 ± 16.42 | 1.71 | 3.3 | — | — | ≈ 8–10 cm | No |

CT = Conventional Training; KT = Kinesio Taping + Conventional Training; ST = Sham Taping + Conventional Training. % Change = ((Post – Pre) / Pre) × 100. Within-group p values reflect time effects from repeated-measures ANOVA; between-group p values reflect group × time interactions from mixed-model ANOVA. Dashes (—) indicate non-significant within-group effects (p > 0.05). *p < 0.05. MDC₉₅ = minimal detectable change at 95% confidence, derived from prior reliability studies (Push-Up Test ≈ 3 reps; Davies Test ≈ 2–3 touches; SASSPT ≈ 8–10 cm). “Yes” indicates change exceeding MDC₉₅; “No” indicates change within measurement error; “Borderline” indicates change near the threshold.

To evaluate the practical relevance of observed changes, absolute improvements were compared against minimal detectable change (MDC) thresholds derived from prior reliability studies. Only the KT group’s improvements in the Push-Up (+3.42 reps) and Davies Test (+4.09 touches) exceeded established MDC values, indicating these

changes likely reflect true performance enhancement rather than measurement variability. In contrast, changes in the SASSPT for both dominant and non-dominant arms remained below the 8–10 cm MDC, suggesting improvements may represent normal test–retest variation. (Figure 3)



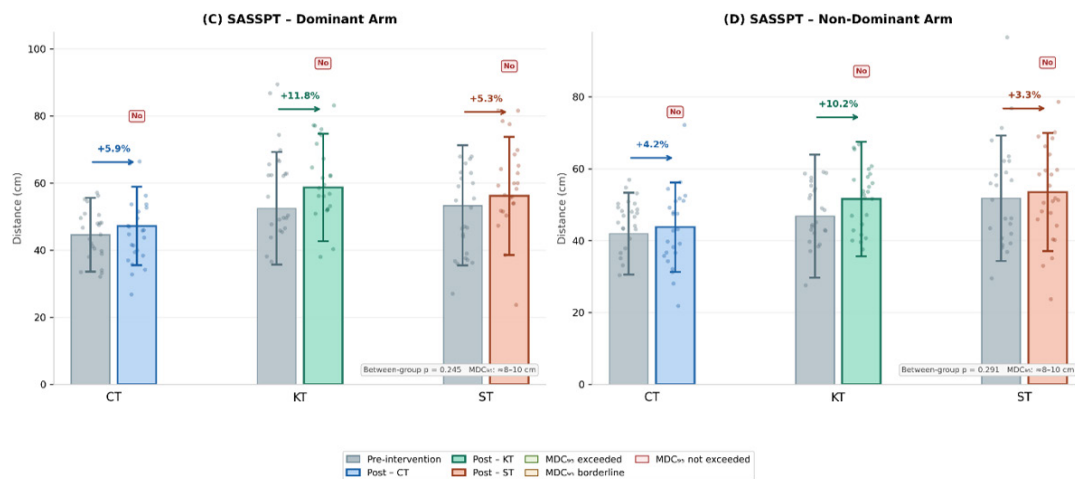


Figure 3. Pre- and Post-Intervention Performance Analysis Across Groups (CT, KT, ST). Error bars = Mean \pm SD | Arrows = direction & magnitude of change | Badges = MDC_{crit} clinical significance

DISCUSSION

This study investigated the comparative effects of conventional training (CT), kinesio taping combined with training (KT), and sham taping with training (ST) on upper-limb functional performance in badminton athletes. Although all groups demonstrated improvements following the intervention period, the absence of significant time \times group interactions indicate that the magnitude of change did not differ meaningfully between groups. This suggests that training itself, rather than the addition of KT, was the primary contributor to performance gains.

The reliability of the outcome measures strengthens the interpretation of these findings. Previous studies have established minimal detectable change (MDC) thresholds for the push-up test, Davies test, and seated shot-put test, which provide a benchmark for distinguishing true performance gains from normal measurement variability. Degot et al. (2021) reported high intra- and inter-session reliability and agreement for the Unilateral Seated Shot-Put Test in healthy male athletes [24], while Riemann and Davies (2023) demonstrated strong reliability of upper extremity functional performance tests in non-overhead athletes [25]. Supporting these findings, Barbosa et al. (2024), through a systematic review, confirmed acceptable measurement properties of upper extremity physical performance tests in athletes, and Declève et al. (2021) reported high reliability of the Modified CKCUEST in adolescent basketball and volleyball players [26,27], reinforcing their utility in both research and applied sports contexts. Additionally, Torabi et al. (2024) evaluated CKCUEST performance in elite overhead handball athletes, providing contextual benchmarks for interpreting performance variability in athletic populations [28]. The current findings fit within this reliability framework, showing that not all observed improvements exceeded MDC, which tempers the interpretation of functional relevance.

The limited additional effect of KT observed in this study aligns with a growing body of literature questioning its utility as a performance-enhancing tool in healthy athletes. Annino et al. (2022) reported that KT application did not produce acute improvements in functional performance among soccer players [29]. Similarly, Cochrane et al.

(2023), in a study on amateur soccer players, concluded that KT offers only small, transient benefits primarily in running speed and agility, which often dissipate within a short period [30]. These findings highlight that KT may have minimal impact when applied to populations without injury or pain.

However, the possibility of subtle, task-specific benefits should not be discounted. In the present study, certain improvements observed in the KT group exceeded established MDC thresholds, suggesting that KT may provide perceptual or proprioceptive cues that enhance select aspects of performance. However, these benefits were neither large enough nor consistent enough across outcome measures to translate into meaningful group-level differences. This suggests that KT's effects, when present, may be context-dependent and insufficiently robust to warrant routine application for performance enhancement in healthy athletes.

Recent research has also begun to reframe the role of KT as a recovery adjunct rather than a direct performance enhancer. For example, Li et al. (2024) and Liu S et al. (2024) demonstrated that kinesiology taping had an immediate effect on muscle strength, static balance and proprioception after eccentric muscle fatigue, suggesting that KT's utility may lie more in aiding recovery and modulating neuromuscular responses under conditions of fatigue or soreness, rather than in enhancing peak performance during competition or training [31, 32].

Overall, the present findings reinforce the consensus that KT is not a substitute for structured training in driving functional performance gains. While small, context-dependent effects cannot be ruled out—particularly regarding proprioceptive feedback or recovery—the evidence suggests that KT does not consistently confer advantages over standard or sham applications in healthy, pain-free athletes. For practitioners, this underscores the importance of prioritizing evidence-based training interventions, while recognizing that KT may have a complementary, albeit limited, role in certain scenarios.

Future research should explore KT's potential benefits in populations experiencing pain, instability, or fatigue, in which sensory feedback may play a greater role. Additionally, investigations with longer intervention

periods, sport-specific assessments, and integration with recovery modalities may help clarify whether KT's small effects can accumulate to yield outcomes of practical relevance for athletic performance.

Funding:

No funding received for this study

Institutional Review Board Statement:

The study was conducted in accordance with the requirements of the Institutional Review Board (IEC/IRB/DSU/MPT/2024/005) and was approved by the Board. The Ethics Committee approved the study protocol. All participants received the information sheet and were required to complete an informed consent form before participation. The trial was registered in Clinical Trials Registry – India (CTRI/2025/02/081271).

Informed Consent Statement:

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement:

The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

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Conflicts of Interest:

The authors declare no conflicts of interest.

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