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Original Article

Physiotherapy Section

Effectiveness of Dynamic Taping Combined with Resistance Band Training on Dynamic Balance, Jumping Performance, Agility, Sprint Speed and Lower Limb Strength among Young Male Football Players: A Pilot Study

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ABSTRACT

Introduction: Football, a high-intensity sport, requires abilities such as dynamic balance, agility, jumping performance, sprint speed, and lower limb strength. These demands place repetitive stress on the hips, knees, and ankles of young individuals, making them susceptible to lower limb injuries such as hamstring strains, ankle sprains, Anterior Cruciate Ligament (ACL) tears, meniscus injuries, Patellofemoral Pain Syndrome (PFPS), and shin splints. Dynamic taping is an advanced intervention in sports physiotherapy that differs from classic kinesiology taping in its biomechanical properties and uses. Dynamic taping provides additional features, including multidirectional joint support, enhanced joint stability, and proprioceptive feedback, without limiting joint movement. Its unique elasticity allows for greater force absorption and enhanced neuromuscular control. The combination of dynamic taping with Resistance Band Training (RBT) may suggest a coactive strategy to improve athletic performance and reduce injury risk. However, the evidence to support this vital combination remains limited.

Aim: To investigate the effectiveness of dynamic taping combined with RBT on key performance factors in young football athletes.

Materials and Methods: This pilot study was conducted at the Growing Star Sports Club in Delhi, India, from December 2024 to January 2025 with a total sample size of 12 participants who were selected and allocated to either the experimental group, which engaged in dynamic taping combined with resistance band exercises, or the control group, which performed only resistance band exercises, using simple random sampling. Double blinding was used during assessments to minimise bias. Vertical jump, sprint speed, Y-balance test (YBT), t-test agility, and lower limb strength were evaluated before and after the 4-week intervention (3 sessions per week). The analysis was performed using descriptive statistics and paired-samples t-tests.

Results: The baseline characteristics of participants in the control (n=6) and experimental (n=6) groups were comparable in terms of age (15.67±1.03 vs. 15.83±0.75 years) and Body Mass Index (BMI) (20.21±1.22 vs. 19.54±0.94). Post-intervention, the experimental group showed greater improvements in vertical jump, lower limb strength, agility, balance, and sprint speed, with significant effect sizes (Cohen's d: vertical jump d=4.73, agility d=2.48). Strong correlations were found between improvements in lower limb strength (r=0.88) and balance (r=0.86) ($p<0.05$).

Conclusion: The findings of the study suggest that dynamic taping combined with RBT can significantly enhance key athletic performance measures in football players.

Keywords: Athletic performance, Biomechanics, Neuromuscular adaptation

INTRODUCTION

One of the most popular and physically demanding games in the world is football, which challenges players to sprint quickly, change momentum rapidly, jump high, and exert their lower limbs strongly [1]. The lower extremities experience severe strain due to these frequent, vigorous motions, particularly among adolescents who are still developing their strength and coordination [2]. Due to their extreme training schedules, exposure to competitions, and biomechanical demands, young male football players are specifically at risk of lower limb injuries. Their period of physical development makes them an ideal group to evaluate the potential for improved performance and preventive measures [3,4].

Commonly seen injuries include muscle strains, ligament sprains, contusions, and repetitive stress syndromes [5]. Ankle sprains, hamstring strains, and knee-related ailments—including meniscal tears, Anterior Cruciate Ligament (ACL) injuries, and patellofemoral pain syndrome—are particularly prevalent among these athletes [6,7]. Football players frequently sustain these injuries through sudden acceleration and deceleration, cutting motions, jumping, and direct contact. Young male athletes are especially prone to anterior knee pain, which is frequently associated with muscle imbalances and poor neuromuscular control [8].

Football players often complain of anterior knee soreness, especially younger players [9]. Research indicates that between 15% and 30% of teenage and collegiate players experience this condition. Contributing factors include inadequate core stability, tight quadriceps or hamstrings, weak hip abductors, and poor lower limb alignment, all of which can lead to altered load distribution over the knee [10]. Moreover, playing on uneven or hard surfaces and wearing inappropriate footwear can increase stress on the anterior knee region. The susceptibility of football players to anterior knee discomfort is heightened by the sport's high physical demands, constant training routines, and short recovery periods [11]. If untreated, anterior knee discomfort may lead to reduced performance, compensatory movement patterns, and an increased risk of more serious injuries.

Dynamic taping is a recently developed and innovative taping method designed to provide joints and muscles with multidirectional elastic support during functional and athletic movements [12]. Dynamic tape is made from a highly elastic material that can stretch in all directions, unlike typical rigid tape or kinesiology taping, without reducing the range of motion. This feature enables it to absorb load, aid in movement, and lessen mechanical stress on tissues [13,14]. Dynamic taping has unique biomechanical characteristics that help improve muscle efficiency and kinetic chain alignment, potentially reducing the chances of injuries and enhancing performance. Football players can benefit from this effective technique if they wish to improve lower limb function while maintaining their maximum dynamic potential on the field [15].

Additionally, dynamic taping enhances proprioceptive feedback, joint stability, and muscle activation during dynamic movements. These benefits are critical for performance outcomes such as agility, sprint speed, jumping, and balance, along with its non-invasive, performance-friendly characteristics [16].

Resistance Band Training (RBT) has become known as one of the most effective training methods for improving an athlete's performance in various sports, thanks to its multipurpose usage, portable nature, and ability to provide variable resistance throughout movement. RBT is an effective and efficient method for developing muscular strength, power, and sport-specific movements, becoming an irreplaceable tool for professionals in various sports [17,18]. Furthermore, resistance bands not only provide strength training but also allow for resistance training, making them excellent for muscle activation in both the concentric and eccentric phases. Workouts involving resistance bands have been shown to increase the proprioception of the lower limb and improve movement control, which is crucial for preventing injuries and enhancing performance [19]. As these benefits are recognised, more trainers are incorporating RBT into their regular strength training programs [20].

Despite the potential demonstrated by each technique individually, the combined effect of dynamic taping and RBT on performance measures such as dynamic balance, lower limb strength, agility, jump performance, and sprint speed is not well understood. Thus, the purpose of this study is to close this research gap and assess the effectiveness of combining dynamic taping with RBT on key performance factors in young football athletes.

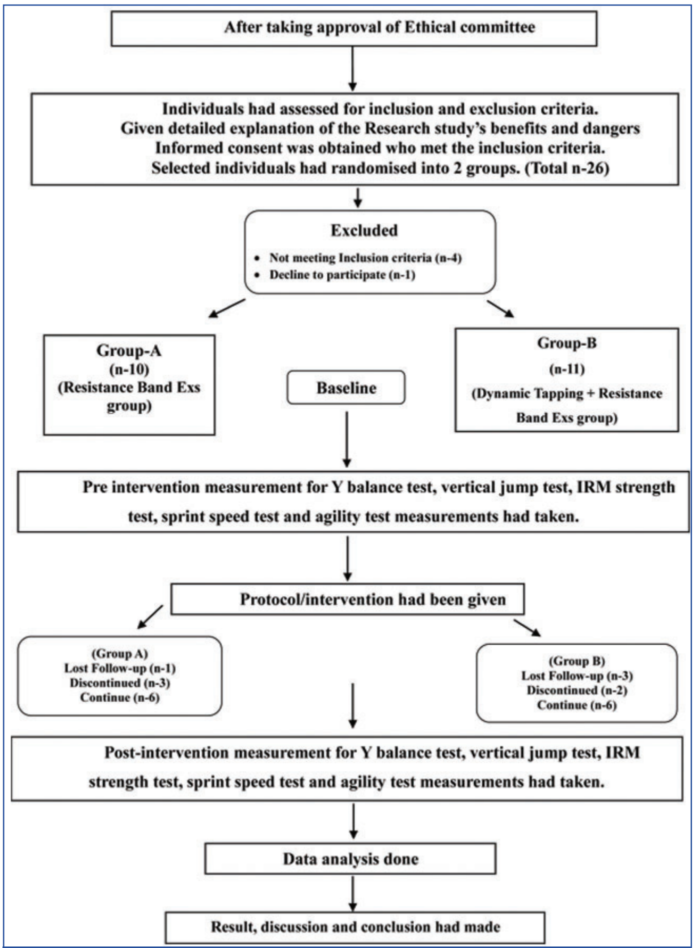
MATERIALS AND METHODS

This pilot study was conducted at the Growing Star Sports Club in Delhi, India, from December 2024 to January 2025. The study protocol followed the SPIRIT and TiDER guidelines and received approval from the Institutional Review Board of Galgotias University (Ethical Approval No. SEC/SAHS/PHD/24/05). The study was conducted according to the Declaration of Helsinki, and consent was obtained from each participant before their involvement. The study involved young male football players aged between 14 and 18 years, with a BMI ranging from 18.5 to 24.9 kg/m^2 [21]. Double blinding was employed during assessments to minimise bias.

Inclusion criteria: The inclusion criteria included participants with no prior history of musculoskeletal injuries in their lower limbs (e.g., hamstring strains, ankle sprains, ACL tears, meniscus injuries, PFPS, or shin splints) or any neurological and cardiopulmonary problems in the last six months. Participants were required to have played football for more than a year and to comply with the protocol after providing consent.

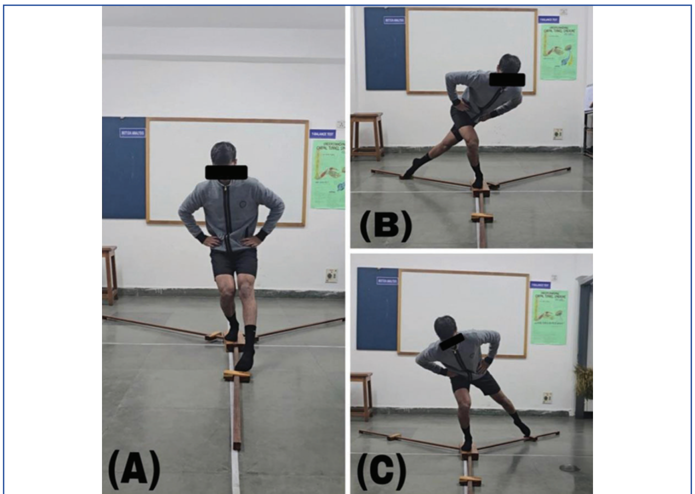
Exclusion criteria: The exclusion criteria included participants with a history of any surgeries (such as ACL reconstruction, meniscus repair, meniscectomy, ankle ligament repair, or hamstring tendon repair) in the past six months; those receiving medications (such as central nervous system depressants, anticonvulsants, antihistamines, muscle relaxants, and antidepressants) that could hinder muscle function or recovery; and those lacking sufficient training experience. Other exclusion points included players currently competing in the season, individuals allergic to taping materials, or participants exhibiting any discomfort with tape application, such as skin irritation, constriction, or reduced range of motion. These criteria helped enhance the efficiency of the study by minimising extraneous factors that could affect outcomes.

Sample size calculation: A convenience sample of 12 participants was selected in accordance with the guidelines of the pilot project [22]. With α=0.05, a post-hoc power analysis verified an 80% power. In this study, Group A served as the control group (only resistance band exercises), while Group B was the experimental group (dynamic taping and resistance band exercises). Both groups participated in three sessions per week for a four-week protocol [Table/Fig-1].

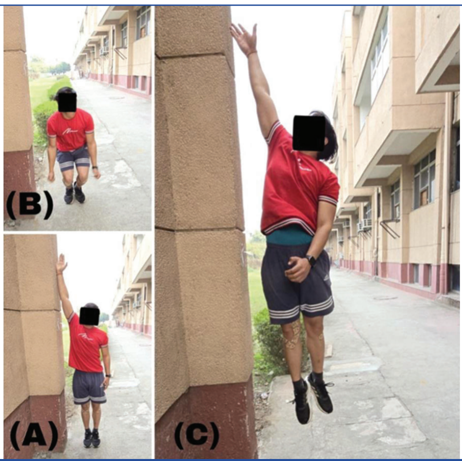


[Table/Fig-1]: Flow chart elaborating the procedure of the study.

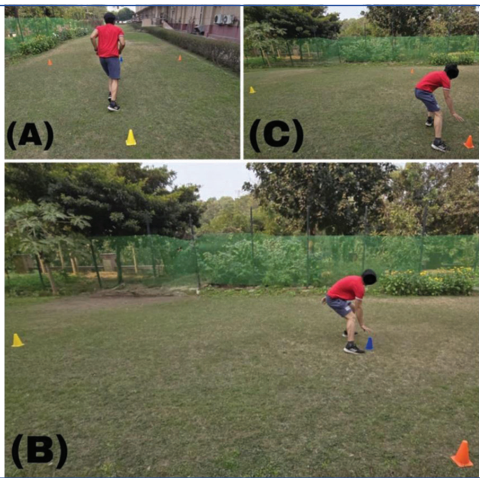
One of the outcome measures used to assess dynamic balance was the Y-Balance Test (YBT), which evaluated reach distances in the anterior, posterolateral, and posteromedial directions. Agility was assessed using the t-test, while sprint speed was measured with the 40-meter maximum sprint speed test. Lower limb strength was evaluated using the one-Repetition Maximum (1RM) strength test, and jump performance was measured through the vertical jump test. To reduce bias, all measurements were performed by blinded assessors both before and after the intervention [Table/Fig-2-6].



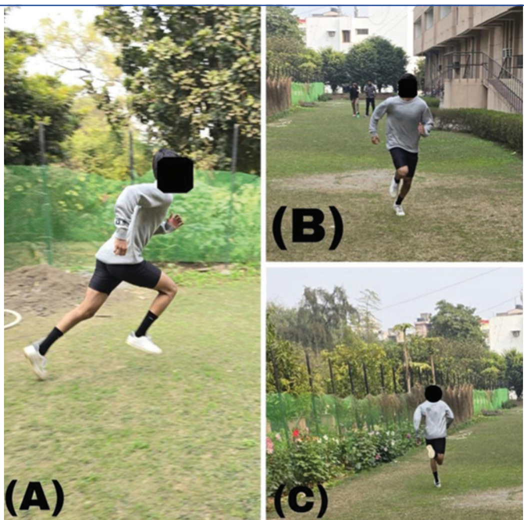
[Table/Fig-2]: Y-Balance Test.



[Table/Fig-3]: Vertical jump test.



[Table/Fig-4]: T-test.



[Table/Fig-5]: 40-M Sprint Speed Test.

[Table/Fig-6]: 1 RM Test.

Study Procedure

The study flow chart diagram elaborates on the procedure of the study, detailing the steps: participant recruitment, baseline assessments, intervention application (e.g., dynamic taping or resistance band exercises), scheduled follow-ups, and final evaluations. Pre and post-data for the outcome measures were recorded [Table/Fig-1].

Intervention Protocols:

- Group A (Control Group): Resistance band strengthening exercises only.
- Group B (Experimental Group): Received dynamic taping in combination with resistance band strengthening exercises, along with percussion on the muscle group of the knee joint.

Dynamic Taping Technique (DT): Utilising visco-elastic nylon Lycra tape with 200% multidirectional stretch for dynamic taping provides mechanical support by reducing movement, absorbing load, and inducing motion [23]. Its aims are to minimise pain, improve muscle endurance, control fatigue, and maximise biomechanical efficiency [24]. Applied three times weekly for four weeks, a 7.5 cm spiral double-layered tape was placed bilaterally on the hip joint complex at angles of 40 degrees of abduction, 20 degrees of extension, and full external rotation to resist the following movements: adduction, flexion, and internal rotation [23].

Resistance training with power bands: Resistance training increases muscular strength and power by inducing hypertrophy and maximising neural drive. Power band training, when combined with elastic resistance and free weights, has known biomechanical benefits, including increased peak power, improved force generation, and enhanced eccentric contraction velocity, which facilitate advanced movement velocities and prolonged muscular exertion over the range of motion without interruption. Such training may preferentially recruit type II muscle fibers and promote greater neuromuscular adaptations, leading to improved athletic performance [25].

Exercise protocols [Table/Fig-7-12]: Hip abduction/external rotation progressing from non-weight-bearing to weight-bearing; resistance band exercises initiated with a yellow band, selecting the appropriate resistance band based on the Rating of Perceived Exertion (RPE) scale [26]; Vastus Medialis Obliquus (VMO) activation; resistance band deadlifts for the functional retraining of hip extensors and external rotators using dynamic loading; power band squats with bands placed above the knees to target hip flexors and knee extensors while maintaining pelvic neutrality; and clamshells/reverse clamshells for hip stability and gluteal activation, performed with controlled pelvic alignment (20 reps per side) [25].


[Table/Fig-7]: Resistance band hip abduction-adduction exercise.

[Table/Fig-8]: Resistance band single leg deadlift exercise.

[Table/Fig-9]: Resistance band deadlift exercise.

[Table/Fig-10]: Resistance band hip squatting exercise.

[Table/Fig-11]: Resistance band clam and reverse clam exercise.

S. No.	Exercise	Sets	Reps	Rest (minutes)	Reference
1	Hip abduction-adduction	3	20	5	[Table/Fig-7]
2	Single leg deadlift	3	20	5	[Table/Fig-8]
3	Deadlift	3	20	5	[Table/Fig-9]
4	Hip squatting	3	20	5	[Table/Fig-10]
5	Clam and reverse clam	3	20	5	[Table/Fig-11]

[Table/Fig-12]: Example of prescribed weekly intervention training.

The YBT assesses dynamic balance by requiring the individual to maintain a single-leg stance while reaching the free leg in the anterior, posteromedial, and posterolateral directions. The test measures the maximum reach distance in these three directions from a single-leg stance, with a reliability ranging from 0.79 to 0.86 [27]. The vertical jump test is used to evaluate power by measuring the height an individual can jump from a standstill [28,29]. The t-test is a standardised method to assess agility, measuring an individual's ability to change direction rapidly. It involves forward sprinting, lateral shuffling, and backpedaling, with a reliability score of 0.98 [30]. The 40-meter sprint test gauges linear sprinting speed over a 40-meter distance, with time recorded using timing gates or a stopwatch and a reliability score of 0.90 to 0.96 [31]. The 1RM test determines the maximal load an individual can lift once with proper form, with a reliability score exceeding 0.90 [32].

STATISTICAL ANALYSIS

Statistical Package for the Social Sciences (SPSS) version 21 was used to analyse the data. Descriptive analyses were performed by calculating the mean and standard deviation. To compare between the groups, a paired t-test was used with an alpha value of 0.05.

RESULTS

The baseline characteristics of Group A and Group B showed no statistically significant differences in age, weight, height, or BMI (p>0.05 for all variables) [Table/Fig-13]. Pre-test comparisons revealed that Group A was not significantly different from Group B on all measures of performance (p>0.05). The results of the post-test showed a significant difference in the vertical jump, with Group B performing better than Group A (p=0.001). Other variables, such as sprint speed, YBT, t-test, and lower extremity strength, improved but did not reach significance between the two groups [Table/Fig-14].

Variable	Group A Mean±SD	Group B Mean±SD	p-value
Age (years)	15.67±1.03	15.83±0.75	1.000
Weight (kg)	53.33±3.93	55.83±1.94	0.180
Height (m)	1.63±0.08	1.69±0.05	0.190
BMI (kg/m^2)	20.21±1.22	19.54±0.94	0.463

[Table/Fig-13]: Baseline characteristics of participants (Group A and B).

Variables	Time	Group A (Mean±SD)	Group B (Mean±SD)	t value	p-value
Vertical jump (cm)	Pretest	31.5±2.66	32.2±1.72	0.515	0.618
	Post-test	39.0±1.26	45.8±3.66	4.327	0.001
Sprint speed (sec)	Pretest	8.2±0.98	7.5±0.55	-1.451	0.177
	Post-test	6.3±0.82	5.8±0.98	-0.958	0.360
YBT	Pretest	30.1±1.02	30.5±0.95	0.631	0.542
	Post-test	34.7±1.91	37.1±2.59	1.773	0.107
t-test (sec)	Pretest	12.0±1.67	12.3±1.21	0.395	0.701
	Post-test	10.7±1.63	9.5±1.05	-1.472	0.172
Lower limb strength (kg)	Pretest	95.8±11.58	91.7±6.05	-0.781	0.453
	Post-test	98.3±12.52	100.0±5.48	0.299	0.771

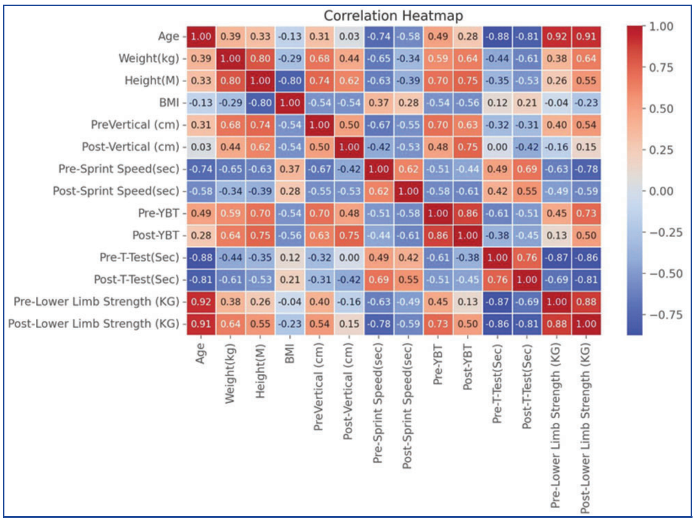
[Table/Fig-14]: Independent t-test results for between the groups comparisons for pre and post intervention.
YBT: Y-balance test; M: Mean; SD: Standard deviation. A was a control, B was an experimental Group

The results of the within-group analysis from pre- to post-test indicated that all the measured variables in Group A and Group B were significant after the intervention (p<0.05). Effect sizes (Cohen's d) were classified as very large to large for all variables, with mostly higher values in Group B, reflecting substantial improvements, particularly in lower limb strength (d=4.73) and upper limb strength (d=2.34) [Table/Fig-15].

Variables	Group	t(5)	p-value	Cohen's d
Vertical jump (cm)	A	12.10	<0.001	3.42
	B	14.90	<0.001	4.73
Sprint speed (sec)	A	-4.41	0.003	1.76
	B	-3.98	0.005	1.63
YBT	A	8.92	<0.001	2.86
	B	9.45	<0.001	3.06
t-test (sec)	A	-3.67	0.007	1.46
	B	-6.12	<0.001	2.48
Lower limb strength (kg)	A	3.02	0.016	1.21
	B	5.76	<0.001	2.34

[Table/Fig-15]: Paired-samples t-test results for pre- and post-intervention comparisons.
Degrees of freedom (df)=5 for all tests. Cohen's d=effect size. A was a control, B was an experimental Group

The correlation analysis exhibits relationships between physical features and performance metrics. Pre- and post-training lower limb strength had a statistically strong positive correlation, with r=0.88 (p<0.001). Pre- and post-YBT balance scores also demonstrated a statistically strong positive correlation, with r=0.86 (p<0.001). Pre- and post-sprint speed showed a moderate positive correlation, with r=0.62 (p=0.001), while pre- and post-vertical jump performance had a moderate positive correlation at r=0.50 (p=0.05). Sprint speed negatively correlated with weight, with r=-0.65 (p=0.01). BMI and sprint speed had a weaker positive correlation, with r=0.37 (p=0.05). Interestingly, agility (t-test) and sprint speed were moderately positively correlated, with r=0.49 (p=0.05). However, BMI and lower limb strength showed a very weak negative correlation, with r=-0.04 (p=0.05) [Table/Fig-16].



[Table/Fig-16]: Correlation heat map.

DISCUSSION

This study investigated the effectiveness of integrating dynamic taping with resistance band training (RBT) on dynamic balance, jumping competence, agility, sprint speed, and lower limb strength among young football players. The results demonstrate that the experimental group showed significant improvements in the vertical jump test compared with the control group, whereas the other outcome variables did not show significant results. In the within-group analysis, all outcomes pre- and post-intervention showed significant changes. Thus, it supports the notion that dynamic taping, when combined with resistance band exercises, positively affects dynamic balance, agility, sprint speed, lower limb strength, and jumping performance among young football players.

The vertical jump test showed an improvement of 13.66 cm in the experimental group, which is twice that of the control group (7.50 cm). Similarly, lower limb strength was significantly enhanced in the experimental group. These results are consistent with a study conducted by Alexander CM et al., which reported that dynamic taping is effective in enhancing neuromuscular control and proprioceptive feedback, contributing to improvements in power and strength during dynamic movements and augmenting the benefits of training [33].

Dynamic balance also saw greater improvements in the experimental group. A possible reason could be the enhancement of proprioception, which leads to improved neuromuscular control—a crucial factor for balance during dynamic exercises [34]. These results are similar to those of a study conducted by Han J et al., which investigated the effects of dynamic tape on balance control in individuals with Chronic Ankle Instability (CAI). The study found that applying dynamic tape over the gastrocnemius muscle significantly reduced sway velocity and path length during single-limb stance tests, particularly under eyes-closed conditions [35].

Agility is a major Key Performance Indicator (KPI) in football that requires quick acceleration, braking, and changes in direction. The experimental group also showed good results in this regard. The improvement is, to some extent, related to better joint stability and neuromuscular efficiency resulting from the tape's mechanical assistance and sensorimotor feedback. Supporting this, Kim JH et al., (2020) concluded that there is an immediate effect of double-taped Kinesio taping on functional performance and pain caused by muscle fatigue after exercise. This suggests that dynamic taping may enhance neuromuscular coordination and movement efficiency, leading to improved agility performance [36].

A negative correlation was observed between body weight and sprint speed. This relationship is supported by the literature from Sogut M et al., which states that excess mass can increase energy demand and reduce acceleration during high-speed movements. He concluded in his study that there is a negative correlation between BMI and sprint performance in young male soccer players [37].

Dynamic training is a main factor that helps athletes boost KPIs by increasing strength, speed, agility, balance, and coordination within the nervous system. It employs functional, sport-specific movements that energise several muscle groups and joints simultaneously, thus improving overall movement efficiency. Resistance Band Training (RBT), one form of dynamic training, provides variable resistance, leading to improvements in muscular strength and power, particularly in the lower limbs, which are essential for sprinting and jumping activities, as explained by Andersen LL et al., (2010) [38].

In addition, dynamic movements enhance the stimulation of proprioceptors and improve neuromuscular control, resulting in better balance and coordination—two of the most important factors for injury prevention and performance stability, as suggested by Lephart SM et al., [39]. Agility-focused dynamic exercises, such as cone or ladder drills, improve reaction time and facilitate the ability to change direction quickly, making them crucial elements in sports like football and basketball. In summary, the use of dynamic training in athletic conditioning programs aids in the acquisition of sport-specific skills and enables athletes to achieve a higher performance level through enhanced neuromuscular and biomechanical function.

The research demonstrates that dynamic taping functions as both a supportive treatment and a preventive measure for injuries. The external support from dynamic taping stabilises joints by replicating natural movement patterns while preserving a full range of motion. This external support helps decrease the chances of joint misalignment and overuse injuries, which commonly affect high-demand athletic activities. Dynamic taping activates the cutaneous mechanoreceptors, which may improve proprioception and enhance awareness of joint position and movement. Improved proprioception leads to quicker reflexes and better muscle coordination, both of which are vital for enhancing stability and preventing injuries such as sprains or strains. The research shows that dynamic taping holds value as a preventive and rehabilitative tool for sports and physical therapy practices [40].

Limitation(s)

There are limitations that need to be considered in the current study, which may provide only low statistical power due to the small sample size and restrict the representational ability of the findings. Secondly, the follow-up time was only four weeks, and whether there will be a long-term effect is unknown. Furthermore, female athletes were not included, which affects the generalisability of the findings for both sexes. Expanding the research in this manner could provide a more comprehensive understanding of the intervention's effectiveness and its broader application in athletic populations.

CONCLUSION(S)

The research concluded that the integration of dynamic taping with resistance band exercises is a beneficial approach for enhancing dynamic balance, jump performance, agility, sprinting speed, and lower limb strength in young male football athletes. The vertical jump was significantly better with dynamic taping combined with resistance band exercises compared to resistance band exercises alone. Although both groups showed significant improvement in all the outcome measures, the effect size was larger in the group receiving dynamic taping with resistance band exercises, reflecting substantial improvements.

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