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Literature Review

Effectiveness of kinesiology tape on sports performance abilities in athletes: A systematic review

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ABSTRACT:

Objective: Establish the effectiveness of kinesiology tape (KT) on sports performance abilities compared to that of other tapes or no tape with consideration to the application methodology, timeframe, and outcome measurement.
Methods: PubMed, Embase, and PEDro databases were systematically searched. The following inclusion criteria were applied: 1) participants were healthy athletes, 2) compared any brand of dynamic KT to other types of tape (sham or therapeutic) and/or no tape, 3) measured some construct of functional sports performance, 4) involved randomization. The PEDro scale was used to grade the risk of bias.
Results: Fifteen studies met the inclusion criteria with PEDro scores ranging from 3 to 8 of 10 points. The sports performance abilities included: ball skills; power squats; cycling; dynamic balance; jumping (vertical and horizontal); agility; sprint speed; and distance running with 193 comparisons between KT and other tapes or no tape at a variety of timeframes after application. In total, eleven comparisons demonstrated significant effects: 2 in favor of KT, 8 in favor of Mulligan's tape, and one in favor of no tape.
Conclusion: There is a lack of compelling evidence to support the use of KT to enhance the sports performance abilities based on this review.
Level of evidence: 1a-.

Contents

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1. Introduction

Sports-specific training is physically rigorous and requires the completion of endurance activities, repetitive movements, and a variety of other demands on the musculoskeletal system. Performance in competitive games or trials generally occurs concurrently with maintaining this intense sport-specific training, which further stresses the body. Many of the options to legally enhance sports performance focus on diet or dietary supplements (Beck, Thomson, Swift, & von Hurst, 2015; Mason, Morrison, McConell, & Wadley, 2016; Pasiakos, McLellan, & Lieberman, 2015), psychological interventions (Brown & Fletcher, 2016; McCormick, Meijen, & Marcora, 2015), and external muscular supportive garments or elements (MacRae, Cotter, & Laing, 2011; Murray & Cardinale, 2015). One type of external support that athletes and coaches routinely use in an effort to enhance sports performance abilities is dynamic kinesiology tape (KT).

The originally developed dynamic KT, Kinesiotape®, gained international interest among athletes in the 2008 summer Olympics when participants from all over the world wore it during televised sporting events (Beutel & Cardone, 2014). Since the development of Kinesiotape®, there have been many similarly developed dynamic elastic adhesive tapes, collectively known as kinesiology tape. Kinesiology tapes are used for a range of reasons including to: improve blood flow (Woodward, Unnithan, & Hopkins, 2015), reduce pain (Lee, Yi, & Lee, 2016), prevent injuries (Woodward et al., 2015), facilitate recovery (Woodward et al., 2015), expand range of motion or flexibility (Farquharson & Greig, 2015; Lee et al., 2016), increase strength, add stability (Kim, Lee, Kim, & Lee, 2015) and enhance several other measures of athletic performance (Kinesio University, 2016; Ward et al., 2014). Despite the widespread publicity and use by athletes, there is limited research evidence to support the use of KT for these reasons (Nunes et al., 2015). Most of the validation for the use of KT is through endorsements and testimonials found on the internet (Beutel & Cardone, 2014).

A variety of clinician specialists who routinely work with athletes, are eligible to participate in continuing education training, achieve competency, and to be endorsed as a Certified Kinesio Taping Practitioner. Kinesio University is the organization that manages this certification and is overseen by Dr. Kinzo Kase, who developed the original Kinesiotape® and taping method (Kinesio University, 2016). Dr. Kase's taping methodology is frequently utilized with many different brands of KT. The correct application of KT according to the taping method is believed to be related to its effectiveness and therefore, any research protocols investigating it should include the experience of the practitioner to ensure the correct application of the tape (Lee, 2015). Secondarily, the measurement of the outcome in relationship to the duration of tape application is also of interest, as KT is often worn for multiple days before removal.

There are many previously published systematic reviews completed on a range of uses for KT in a variety of patient populations. Most of these reviews have been done on a specific pathology or cause of pain (Montalvo, Cara, & Myer, 2014; Morris, Jones, Ryan, & Ryan, 2013). Only two published systematic reviews have focused on a healthy population (Csapo & Alegre, 2015; Williams, Whatman, Hume, & Sheerin, 2012). Despite the number and range of reviews on KT, to our knowledge, there has been no systematic review to focus on the effectiveness of KT on sports performance abilities. Therefore, the aims of this systematic review are to: 1) assess the strengths and weaknesses of individual studies, and 2) establish effect sizes for KT compared to any other tape or no tape conditions. This will be done with attention to the application methodology of the tape and the timeframe from tape application to the outcome measurement.

2. Methods

The 2009 preferred guidelines for systematic reviews and meta-analyses (PRISMA) were used in the reporting of this systematic review. This guideline consists of a 27-item checklist that includes items regarded essential for manuscript development and transparent reporting (Moher, Altman, Liberati, & Tetzlaff, 2011).

2.1. Eligibility criteria

Articles were included based on the following criteria: 1) participants were identified as healthy non-injured competitive athletes or recreationally active subjects, 2) the study design compared any variant of KT to any other type of tape and/or a no tape group, 3) the outcome was a construct of sports performance, and 4) involved randomization in any form (randomized crossover designs where participants serve as their own control were also accepted). Articles were excluded if they were not available in English or in full text (e.g. published abstracts from conference proceedings were not included).

Given that this is a systematic review on the effectiveness of KT, which refers to its performance under 'real-world' conditions (Revicki & Frank, 1999), the measurement of sports performance outcomes had to have been completed during any functional component of a sport activity. Measurements of outcomes obtained while the subject was completing a non-functional activity (e.g. sitting on a Cybex machine) were not included in this review as a "sports performance ability" because these types of measurements

do not necessarily translate into meaningful sports abilities (Moradi, Movahedi, & Salehi, 2014; Wolpert & Flanagan, 2010).

2.2. Information sources/search

Two online databases, PubMed and Embase were searched in August 2016. The following search query was used in both databases ((kinesiology tape* OR kinesiology taping* OR kinesiotape* OR kinesiotaping OR tape OR taping) AND (sport performance OR sports performance OR sporting performance OR athletic performance)). No limits were placed on this search. A third electronic search was performed in the PEDro database using a similar strategy. Finally, the included manuscript's references were reviewed to ensure that all relevant studies were identified. The computerized searches were completed with the assistance of a health university librarian.

2.3. Study selection

A stepwise process was used to identify articles to be selected for inclusion in this review. Two authors independently screened titles, followed by abstracts, and then full text. Where discrepancies arose, the third author served as a tie-breaker at each stage of the process.

2.4. Data collection process/data items

The following items were extracted from each included study; the sex and description of the athlete (i.e. soccer player, runner, etc.) and level of participation; the intervention with KT, including the tape brand, location and method of tape application; the time between tape application and performance testing; and the clinician type and experience with KT; the comparator condition(s) including type of tape, location and method of tape application; the no tape condition and timeframe between testing conditions; any attempts to blind subjects; the functional sports-performance abilities measured; and the measurement used for obtaining the outcome.

Since we were interested in the effectiveness of KT, all comparator tape conditions were included. Sham tape was regarded as any non-therapeutic taping procedure with any type of tape, including ineffective application of KT (as described by the original research). Other taping strategies that were used as a second intervention were also included in our other tape designation and were indicated as a second taping intervention. No tape conditions included measurements of the outcomes where no adhesive tape was applied to the body.

2.5. Risk of bias in individual studies

Each full-text article was assessed by two independent reviewers and scored using the PEDro scale. Any discrepancies were resolved by discussion and consensus. One article (Nunes, de Noronha, Cunha, Ruschel, & Borges, 2013) was archived in the PEDro database so these scores were used in lieu of the authors scoring. The PEDro scale was developed to measure methodological quality and internal validity of randomized studies (de Morton, 2009). Each of the 10 items is scored as either present (Mason et al., 2016) or absent (0) and a score is then calculated out of 10 with a larger number indicating better quality (de Morton, 2009). The categories that were used to define overall quality of each article are as follows: $\leq$4 (poor), 5–6 (moderate) and $\geq$7 (high quality) (Fernandez et al., 2016).

2.6. Summary measures

Cohen's *d* effect sizes with 95% confidence intervals were calculated using a downloaded Excel spreadsheet to establish the size of the difference in the performance outcome between testing conditions (Centre for Evaluation and Monitoring Durham, 2017). Separately, calculations were made for each included study between KT and other tape and between KT and no tape. For studies reporting pre and post values for within group change, only post value scores were used to calculate between groups effect size. An effect size was considered significant if the calculated 95% confidence interval for the point estimate did not cross zero. Negative effect sizes reflect that the performance being measured resulted in a better outcome during the comparator condition whereas positive effect sizes reflect better performance during the KT condition.

3. Results

3.1. Study selection

The database searches resulted in a total of 260 articles, after duplicates were removed. With review of titles, 122 remained, and after review of abstracts, 53 full-text articles were reviewed for eligibility. After full-text review, a total of 11 articles fit the inclusion criteria (see Fig. 1). The search of the references of the selected manuscripts yielded 4 additional articles for an overall total of 15 studies for this review.

3.2. Study characteristics

The description of the participants, interventions with KT, interventions with other tape, and no tape conditions, and the time between tape application and testing as described in the selected studies can be found in Table 1. Seven articles compared the effectiveness of KT to other tape, including six as a sham tape (or ineffective KT tape application) (Cheung et al., 2016; Lins, Neto, & Amorim, 2013; Nunes et al., 2013; Strutzenberger, Moore, Griffiths, Schwameder, & Irwin, 2016; Vercelli et al., 2012; Wilson et al., 2016), and one as a second intervention with Mulligan's Tape (Howe, Campbell, Ng, Hall, & Hopper, 2015) and one as a second intervention with inhibitory KT (Vercelli et al., 2012). Thirteen articles compared the effectiveness of KT to a no tape condition (Chaney, Hirayama, Mendoza, Schmitt, & Janini, 2015; Cheung et al., 2016; Csapo, Herceg, Alegre, Crevenna, & Pieber, 2012; Harmanci et al., 2016; Howe et al., 2015; Lins et al., 2013; Miller et al., 2015; Mostaghim, Koushkie Jahromi, Rojhani, & Salesi, 2016; Muller & Brandes, 2015; Schiffer, Mollinger, Sperlich, & Memmert, 2015; Strutzenberger et al., 2016; Vercelli et al., 2012; de Hoyo, Alvarez-Mesa, Sanudo, Carrasco, & Dominguez, 2013). The time between tape application and testing varied across studies but in general, all studies tested subjects within 1 h of KT application. In addition, 1 study completed testing immediately after application of tape and again after a fatigue inducing protocol (exact time not reported) (Strutzenberger et al., 2016). Two additional studies tested immediately after tape application and 24 h later (Mostaghim et al., 2016; Wilson et al., 2016) and 72 and 120 h after application (Wilson et al., 2016). Nine studies specify that the KT tape was applied according to Kase's recommendations (Chaney et al., 2015; Csapo et al., 2012; Harmanci et al., 2016; Lins et al., 2013; Mostaghim et al., 2016; Nunes et al., 2013; Schiffer et al., 2015; Strutzenberger et al., 2016; de Hoyo et al., 2013). Five do not specifically state that they used Kase's method but they describe the amount of tension applied to the tape during application and the specific location of the body where the tape was applied (Cheung et al., 2016; Howe et al., 2015; Muller & Brandes,

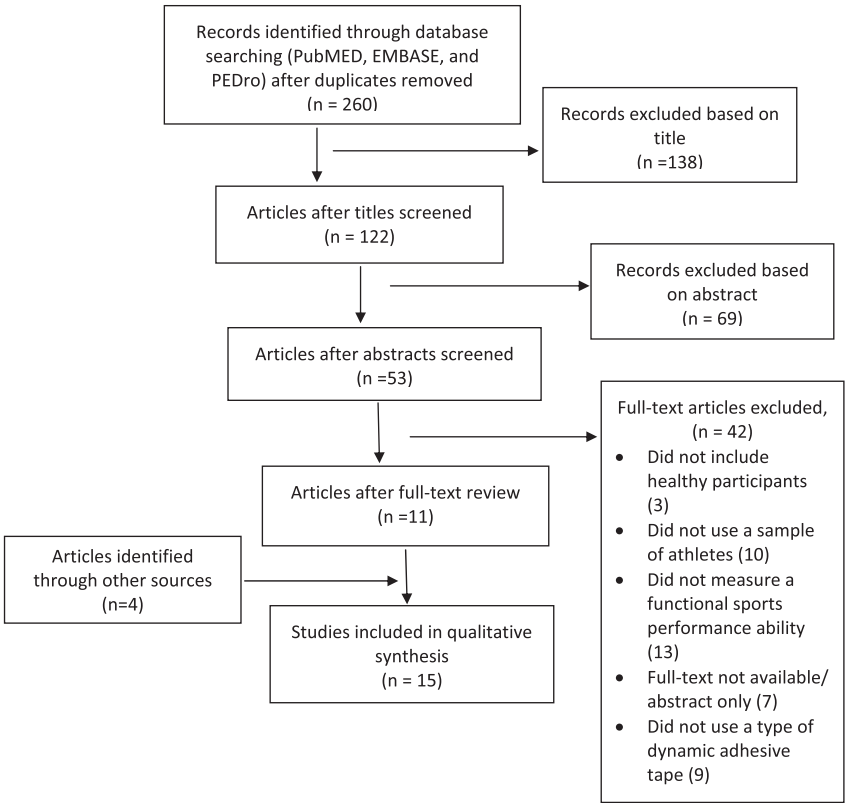

Fig. 1. PRISMA flow chart.

2015; Vercelli et al., 2012; Wilson et al., 2016). One does not describe the tension with which the KT was applied (Miller et al., 2015).

Information regarding the clinician type and experience with KT, the test and units used to measure the sports performance ability, and the manner and attempts to blind participants is presented in Table 2. Ten of the studies describe KT in the intervention was applied by a clinician with experience and/or certification in application of KT (Cheung et al., 2016; Csapo et al., 2012; Miller et al., 2015; Muller & Brandes, 2015; Nunes et al., 2013; Schiffer et al., 2015; Strutzenberger et al., 2016; Vercelli et al., 2012; Wilson et al., 2016; de Hoyo et al., 2013). Two studies describe the clinician type and/or level of expertise in sport physical therapy but do not describe specific expertise with KT (Chaney et al., 2015; Mostaghim et al., 2016). Three studies did not provide information on the clinician type or expertise of the person applying the tape (Harmanci et al., 2016; Howe et al., 2015; Lins et al., 2013). None of the studies were able to blind the therapists who administered the therapy (i.e. applied the tape). Three of the studies describe procedures to blind the subjects (Cheung et al., 2016; Nunes et al., 2013; Wilson et al., 2016) and four studies described procedures to blind the assessors of the key outcomes (Cheung et al., 2016; Nunes et al., 2013; Vercelli et al., 2012; Wilson et al., 2016).

3.3. Risk of bias within studies

Scores on the PEDro scale ranged from 3 to 8 for the selected articles (Table 3). Five studies demonstrated poor quality (Csapo et al., 2012; Harmanci et al., 2016; Mostaghim et al., 2016; Strutzenberger et al., 2016; de Hoyo et al., 2013); four were of moderate quality (Howe et al., 2015; Miller et al., 2015; Schiffer et al., 2015; Wilson et al., 2016); and six studies scored at a level on the PEDro indicating high quality (Chaney et al., 2015; Cheung et al., 2016; Lins et al., 2013; Muller & Brandes, 2015; Nunes et al., 2013; Vercelli et al., 2012).

3.4. Results of individual studies

For ease of interpretation and comparison across results, studies were arranged in tabular format by the sports ability that was measured (Table 4). Outcomes measured at different times were reported at each time.

3.4.1. Ball skills – handball and soccer

Within the single study looking at ball skills (Muller & Brandes, 2015), there were no comparisons of KT to other tape and 4 comparisons of KT to no tape. This study was of high quality (7 points) on the PEDro scale. There were two comparisons for the outcome of ball velocity and two comparisons for ball accuracy. Neither outcome of ball velocity was significant. Both measures of ball accuracy found a statistically significant difference. Kinesiology tape was superior to no tape for a soccer goal kick, distance from the target ($d = 0.67$; 95%CI: 0.11,1.22) and no tape was superior to KT for a handball goal throw distance from the target (−0.53; 95% CI: −0.03,-1.02).

3.4.2. Squat performance

Within the single study looking at muscular power (de Hoyo et al., 2013), there were no comparisons of KT to other tape and two comparisons of KT to no tape for power output during a concentric return to stance from a half-squat with 30 kg and 50 kg. This study was of poor quality (3 points) according to the PEDro scale. The results were only reported in percent change between conditions, which were positive in favor of KT but were not

Table 1
Description of included studies.

Study	Participant characteristics – total number, sex, and type of athlete; study design	Intervention with KT – number of participants, type of tape and location of application	Intervention with placebo or other tape – number of participants, type of tape and location of application	Control Condition – number of participants, when was control condition measured in relationship to the intervention with KT	Time between taping and testing
Chaney et al., 2015	34 male and female high school basketball players; Randomized controlled trial, cross-over design	33 participants - KT applied to the gastroc-soleus complex bilaterally according to Kase's recommendations		34 participants completed on same day and time as intervention group	Taping followed by testing immediately
Cheung et al., 2016	44 male and female volleyball players; Randomized controlled trial, cross-over design	44 participants 1st trial - KT (KINTAPE) applied to rectus femoris, vastus medialis, and gastroc bilaterally with appropriate tension to provide muscle facilitation 38 participants 2nd trial (1 week after 1st trial) KINTAPE applied to rectus femoris, vastus medialis, and gastroc bilaterally with appropriate tension to provide muscle facilitation	44 participants 1st trial- sham KINTAPE applied to rectus femoris, to vastus medialis, and gastroc bilaterally with no tension 38 participants 2nd trial (1 week after 1st trial) sham KINTAPE applied to rectus femoris, vastus medialis, and gastroc bilaterally with no tension	30 participants 3rd trial (2 weeks after 1st trial) control group testing	Taping followed by 5 min static stretching of quads, hamstrings, and gastrocs bilaterally before testing
Csapo et al., 2012	12 male and 12 female physically active sports students or physically active physical therapists; Randomized controlled trial, cross-over design	24 participants with ktape (biviax GmbH, Dortmund, Germany) applied to gastroc and soleus bilaterally with no tension according to Kase's recommendations; on 2 separate days, with a minimum of 48 h between each day of testing carried out at the same of day		24 participants randomly assigned to control group first or intervention group first, then switched on subsequent day	Taping followed by 5 min treadmill run warm-up, then testing
de Hoyo et al., 2013	18 elite soccer players; Randomized controlled trial, cross-over design	18 participants, Cure Tape (FysioTape BV, Enschede, The Netherlands) tape applied to rectus femoris of dominant limb according to Kase's recommendations		18 participants randomly assigned to control group or intervention group on the 1st day of testing; all tests were performed on Monday, Wednesday, and Friday; and repeated one week later with the group assignment switched	Taping followed by assessment of muscle contractile properties of the vastus lateralis and vastus medialis using tensiomyographic response (TMG), then a 5 min warm-up on a cycle ergometer at 60 rpm (C3 Advanced, Life Fitness, EEUU) followed by testing
Harmanci et al., 2016	31 healthy male athletes; Randomized controlled trial	16 participants, KT applied to quadriceps bilaterally according to Kase's recommendations		15 participants randomly assigned to control group or intervention group; same day and time as intervention group	Aerobic cycling: Taping followed by a 5 min warm up on cycle at 60–70 rpms followed by 5 min passive recovery time then testing Vertical jump: Taping followed by a 10 min fixed warm-up protocol, then testing
Howe et al., 2015	29 female recreational runners; Randomization of limb and order of testing for each participant in all three conditions	29 participants, KT cut into "Y", placed on VMO with 25–50% stretch and applied to the patella with 75–100% stretch. With 0% stretch, KT placed on inferior and medial border of patella	29 participants, Mulligan's tape (2 layers of rigid tape) applied according to Mulligan in a spiral from the fibula neck across the tibia with internal tibial rotation force; posterior & inferior to the medial knee then centrally over the posterior knee joint. Tape ended on the lateral lower aspect of the thigh	29 participants same day and time as intervention and Mulligan's tape group	Series of "run throughs" at selected jogging pace with feedback from researchers on speed, ten taping, then testing
Lins et al., 2013	60 recreationally active female University level students; Randomized clinical trial	20 participants, KT (kinesio tex gold) applied to rectus femoris, vastus lateralis and medialis of dominant limb with 50% tension according to Kase's recommendations	20 participants with sham non-elastic adhesive tape applied to rectus femoris, vastus lateralis and medialis of the dominant limb	20 participants same day and time as intervention groups	Initial assessment followed by 5 min warm-up on stationary bicycle, then taping, then testing
Miller et al., 2015	18 competitive cyclists (16 male and 2 female);	18 participants, Rocktape applied to anterior arms,		18 participants; randomly assigned to order of testing,	Taping, then 2 min rest phase, then 10 min warm-

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Table 1 (*continued*)

Study	Participant characteristics – total number, sex, and type of athlete; study design	Intervention with KT – number of participants, type of tape and location of application	Intervention with placebo or other tape – number of participants, type of tape and location of application	Control Condition – number of participants, when was control condition measured in relationship to the intervention with KT	Time between taping and testing
	Randomized controlled trial, cross-over design	anterior legs, posterior back, and posterior neck bilaterally		4 episodes separated by at least 48 h and completed within 3 weeks of initial episode	up (30% of peak), then testing
Mostaghim et al., 2016	23 male and 21 female collegiate athletes (soccer, futsal, volleyball, track and field); Randomized controlled trial, cross-over design	44 participants, KT (red Kinesio Tex tape) applied to anterior thigh and knee of dominant limb with 15% –25% stretch according to Kase's recommendations		44 participants; randomly assigned to control group or intervention group, and then switched to other group on 2nd episode one week later; order of tests the same for each episode	Taping followed by 10 min warm-up- jogging and stretching of lower extremities directed by therapist, then testing. Second test done 24 h after KT application
Muller et al., 2015	58 skilled male athletes in mid-level German amateur leagues (Soccer and Handball); Randomized controlled trial, cross-over design	58 participants, KT applied to tibialis anterior, quads, and iliopsoas (for soccer kick) or subscapularis and pectoralis major (for handball throw). Tape applied 20–30% of its original length.		58 participants; randomly assigned to intervention or no tape first and then switched. 60 min between trials	10 min of the player's typical warm up was permitted before each trial.
Nunes et al., 2013	20 college athletes (9 male and 11 female) (track and field, volleyball, handball, and soccer); Randomized clinical trial, cross-over design	20 participants, KT applied to gastrocnemius with 50% tension according to Kase's recommendations	20 participants; sham kinesotape applied to gastrocnemius with no tension; randomly assigned before or after kinesiotaping with 48 h between sessions		5 min warm up period prior to testing
Schiffer et al., 2015	18 female track and field athletes; Randomized controlled trial, cross-over design	18 participants; Athlete's lower extremity randomly selected to receive KT on the gastrocnemius, rectus femoris and iliopsoas without traction according to Kase's recommendations		18 participants; Athlete's lower extremity that was selected to receive tape was used as a control with no tape during the single limb jump test. The athlete would perform 2 single limb jumps without tape, then with tape, and then without tape. 15 min break between testing conditions.	30 min warm to prior to testing in each condition
Strutzenberger et al., 2016	10 Male university rugby players; Randomized clinical trial, cross-over design	10 participants; KT was applied to gluteus maximus with tension ranging from 50 to 100% according to Kase's recommendations	10 participants; sham KT applied from greater trochanter to posterior superior iliac spine with no tension	10 participants Each testing condition completed 7 days or 14 days after the previous condition	7 -14 days between the 3 sessions. Each session consisted of a 20 min warm up. For the fatigue testing, time was not reported
Vercelli et al., 2012	36 healthy individuals(17 male and 19 female) that participated in nonprofessional sport activities; Randomized cross-over design	34 Participants; KT (Cure Tape; Aneid Italia, Rome, Italy) applied to dominant anterior thigh taped in a facilitation pattern. The tape was applied with 0- to 50% tension	34 Participants; KT (Cure Tape; Aneid Italia, Rome, Italy) applied to dominant thigh in an inhibitory pattern with light tension (15–25%) 34 participants; sham piece of tape was applied horizontally across the dominant anterior thigh; 1 week interval between each session.		In each session there was a 10 min warm up and 10 min rest before each trial. 2 trials per session
Wilson et al., 2016	17 healthy subjects (9 male and 8 female) that participated in moderate exercise; Randomized controlled trial	8 participants. KT applied to dominant gastrocnemius with 50% tension	9 Participants; sham KT applied to dominant gastrocnemius with no tension; randomly assigned to before or after intervention group		No exact time between taping and testing. Participants were measured 4 times over a 120 h period

The phrase "according to Kase's recommendations," refers to Kenzo Kase, the creator of Kinesio Tape. KT = kinesiology tape.

significantly greater than the no tape condition (per the original manuscript). Effect sizes were unable to be calculated.

3.4.3. Cycling

Two studies measured aspects of performance during cycling. The first study looked at endurance (Harmanci et al., 2016). Within this study there were no comparisons of KT to other tape and 5 comparisons of KT to no tape. This study demonstrated poor quality (3 points) according to the PEDro scale. There were two comparisons for the outcome of Windgate anaerobic power (absolute and relative) and two comparisons for anaerobic capacity (absolute and relative). Of these, relative Windgate anaerobic capacity demonstrated a significant effect in favor of KT compared to no tape (d = 0.77; 95%CI: 0.02,1.48), while the other three comparisons did

Table 2
Clinician type and experience and means of blinding.

Study	Clinician Type/Experience with KT	Test and units used to measure the sports performance ability	Manner/Attempts to blind participants
Chaney et al., 2015	2 experienced physical therapists with more than 1 year of clinical experience	3 Vertical jumps with 2 min recovery between trials; average height 3- 20 m indoor sprints on a gym floor with 1 min recovery between trials- 2 timers with standard stop watches	No blinding
Cheung et al., 2016	1 experienced researcher with ≥7 years of taping using KINTAPE	3 Countermovement jumps (specific volleyball jump) with 1 min rest between trials; 3 sessions 7 days apart; mean maximal jump height and peak jump power- Smartjump tool (Fusion Sport, Queensland, Australia)	Blinding of participants by blindfolding participants during taping and then lower extremity covered with loose elastic bandage to cover tape (blinding participants and assessors)
Csapo et al., 2012	2 specialists in Physical Medicine and Rehabilitation experienced in the use of KT (ktape)	3 × 3 reactive jumps- drop heights 20, 40, and 60 cm; ground reaction forces by a force plate embedded in the ground determined at initial contact, take-off, and landing; flight times and ground contact times; jump heights; reactive strength indices	No blinding
de Hoyo et al., 2013	1 experienced physical therapist with application of KT	90° knee flexion half-squat to full extension-power output measured on a Multipower (Smith Machine, Life Fitness, EEUU) using 2 different loads (both 30 and 50 kg are the most common loads used in daily training) with 90 s rest between the 2 repetitions Mean of 2 countermovement jumps going down to 90° and then immediately jumping up as high as possible with a 90 s rest between jumps; height in meters and flight time in seconds measured by infrared-ray platform built into the Opto Jump System (Opto Jump, Microgate, Italy) Mean time of two 10 m sprint using a dual beam electronic timing gates (Ergo Timer, Globus, Italy) with a 2 min rest between sprints	No blinding
Harmanci et al., 2016	No indication of level of expertise	Wingate anaerobic cycling test performed on first day for all participants and then again after taping or no taping-(After the 1 and 2 days later of the second visit) 30 s Wingate anaerobic test-cycling at fastest speed against resistance equivalent to 7.5% of body mass and pedal speed of 150 revolutions/minute (Monark 894 E Peak Bike, Sweden) Repetitive vertical jumps performed on 2nd test day (next day after 1st test day) and again after taping or no taping- (After the 1 and 2 days later of the second visit) 30 s continuous repetitive jumps measured on force platform (Newtest Powertimer, Finland) according to Bosco method	No blinding
Howe et al., 2015	No indication of level of expertise but taping for each participant in both taping episodes was performed by the same researcher	Mean of 3 running trials of 10 m at 5 m/s for hip and knee peak angles, angular velocities, forces and moments between ground contact with force plate and toe off	No blinding
Lins et al., 2013	No indication of level of expertise	2 episodes of single and triple hop tests on dominant leg; best distance recorded with metric tape for single and triple hop episodes	No blinding
Miller et al., 2015	1 investigator with training from Rocktape certified technician (all investigators trained) (all tape applied bilaterally by the same investigator)	Cycling efficiency: Peak VO2 at 60% and 80% intensity for 5 min after reaching steady state; heart rate and rate of perceived exertion (overall, arm, leg, and chest) measured every 2 min	No blinding
Mostaghim et al., 2016	1 expert sport physical therapist	3 Sargent vertical jumps; best height recorded; 10 min between each test 3 trials Shuttle run agility test; fastest time to the nearest tenth of a second recorded; 10 min between each test	

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Table 2 (*continued*)

Study	Clinician Type/Experience with KT	Test and units used to measure the sports performance ability	Manner/Attempts to blind participants
		2 trials 30 yard dash; fastest time to the nearest 2 decimals recorded; 10 min between each test	
Muller et al., 2015	KT experienced physiotherapist and sports scientist	Kicking a soccer ball – velocity and accuracy Throwing a handball – velocity and accuracy	No blinding
Nunes et al., 2013	1 clinician experienced in the use of KT	Vertical jump height, distance of horizontal jump, and dynamic balance assessed by Star Excursion Balance Test.	Both assessor and participant were blinded. The participant wore a sock over the tape so that the assessor did not know what type of type had been applied. The therapist taping would cut the tape in a different room and then cover the tape/leg with a sock to blind the participant.
Schiffer et al., 2015	Physiotherapists experienced in the use of KT	Distance between starting point and landing point of a single limb jump	No blinding
Strutzenberger et al., 2016	1 physiotherapist experienced in the use of KT	Sprinting was measured by time. Vertical jump was measured by jump height, maximal vertical ground reaction force	No blinding
Vercelli et al., 2012	Physiotherapist certified in KT application	Isokinetic peak torque test measured strength and single limb triple hop for distance	No blinding of participants. Investigator did not participate in outcome assessment
Wilson et al., 2016	Practitioner certified in KT application	Balance System SD used to measure dynamic balance and 4 hop test used single limb hop for distance, triple hop for distance, 6-m timed hop, and cross over hop	Participants and assessors were blinded (details not provided)

KT – KinesiologyThree Tape; m/s = meters per second; Kg = kilogram; VO2 max = Maximum velocity of oxygen consumption.

not demonstrate significant effects of KT compared to no tape.

The second study that explored cycling performance completed 5 comparisons of KT to no tape for efficiency and rate of perceived exertion (RPE) (Miller et al., 2015). This study scored 5 points on the PEDro scale (moderate quality). According to the calculated effects for chest and overall RPE, neither resulted in a significant effect between KT and no tape conditions. Comparisons of RPE for the legs, arms and cycling efficiency were reported by the authors only according to the results of an ANOVA with a p-value. Per the results of ANOVA, none of these were significant (p-values between 0.09 and 0.64). Effect sizes were unable to be calculated.

3.4.4. Dynamic balance

Two studies explored the outcome of dynamic balance. One was of high quality (8 points) according to the PEDro and compared KT to sham tape with three comparisons using the Star Excursion Balance Test (Nunes et al., 2013), and one was of moderate quality (6 points) and compared KT to no tape with four comparisons using Dynamic Stability Index measurements at 4 time points (Wilson et al., 2016). None of the comparisons produced a statistically significant effect in any of the measures between KT and sham tape or no tape conditions.

3.4.5. Jumping – horizontal and vertical

Six studies compared KT to sham tape for the outcome of jumping, with 50 comparisons reported (Cheung et al., 2016; Lins et al., 2013; Nunes et al., 2013; Strutzenberger et al., 2016; Vercelli et al., 2012; Wilson et al., 2016) and one study compared

Table 3
PEDro scale scores.

PEDro Criteria	1	2	3	4	5	6	7	8	9	10	Total
Chaney et al., 2015	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
Cheung et al., 2016	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	7
Csapo et al., 2012	Yes	No	Yes	No	No	No	No	No	Yes	Yes	4
de Hoyo et al., 2013	Yes	No	No	No	No	No	No	No	Yes	Yes	3
Harmanci et al., 2016	Yes	No	Yes	No	No	No	No	No	No	Yes	3
Howe et al., 2015	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
Lins et al., 2013	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
Miller et al., 2015	Yes	No	Yes	No	No	No	No	Yes	Yes	Yes	5
Mostaghim et al., 2016	Yes	No	No	No	No	No	No	No	Yes	Yes	3
Muller et al., 2015	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	7
Nunes et al., 2013	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	8
Schiffer et al., 2015	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6
Strutzenberger et al., 2016	Yes	No	Yes	No	No	No	No	No	Yes	Yes	4
Vercelli et al., 2012	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	8
Wilson et al., 2016	Yes	No	Yes	Yes	No	Yes	No	No	Yes	Yes	6

Criteria: 1) Subjects randomly allocated to groups; 2) Allocation was concealed; 3) Groups similar at baseline regarding most important prognostic indicators; 4) Blinding of all subjects; 5) Blinding of all therapists who administered therapy; 6) Blinding of all assessors who measured at least one key outcome; 7) Measures of at least one key outcome were obtained from more than 85% of the subjects; 8) All subjects for whom outcome measures were available received the treatment; 9) The results of between-group statistical comparisons are reported for at least one key outcome; 10) The study provides both point measures and measures of variability for at least one key outcome.

facilitation KT to inhibition KT (Vercelli et al., 2012) with one outcome. Within these studies, 4 scored 7 or 8 points on the PEDro (high quality) (Cheung et al., 2016; Lins et al., 2013; Nunes et al., 2013; Vercelli et al., 2012), one was of moderate quality (6 points on the PEDro) (Wilson et al., 2016), and one was of poor quality (4 points on the PEDro) (Strutzenberger et al., 2016). The jumping outcomes included: six on vertical jump height, 20 on horizontal jump distances, one on flight time during a vertical jump, one on jump power during a vertical jump, two on the Reactive Strength Index during a drop jump, 4 on ground reaction forces with a countermovement jump or a drop jump, and 16 on work (total work and individually within the 3 major joints of the lower extremity in a fatigued and a non-fatigued state) during a drop jump and a countermovement jump. There were no significant effects between KT and any of the other taping conditions in any of the comparisons reported.

Ten studies compared KT to no tape for the outcome of jumping, with 37 comparisons reported (Chaney et al., 2015; Cheung et al., 2016; Csapo et al., 2012; Harmanci et al., 2016; Lins et al., 2013; Mostaghim et al., 2016; Schiffer et al., 2015; Strutzenberger et al., 2016; de Hoyo et al., 2013). Within these studies, 3 scored 7 points on the PEDro and were of good quality (Chaney et al., 2015; Cheung et al., 2016; Lins et al., 2013), one was of moderate quality (6 points) (Schiffer et al., 2015), and 5 were of poor quality (3 or 4 points on the PEDro) (Csapo et al., 2012; Harmanci et al., 2016; Mostaghim et al., 2016; Strutzenberger et al., 2016; de Hoyo et al., 2013). The jumping outcomes included 10 on vertical jump height, four on horizontal jump distances, one on jump power during a vertical jump, three on the Reactive Strength Index during a drop jump, 4 on ground reaction forces with a countermovement jump or drop, and 16 on work (total work and within the 3 major joints of the lower extremity) during a drop jump and a countermovement jump. There were no significant effects between KT and no tape in any of these comparisons.

3.4.6. Agility

One study looked at agility (Mostaghim et al., 2016), with no comparisons of KT to other tape and two comparisons of KT to no tape for speed of the Shuttle Run Test immediately after tape was applied and 24 h after tape application. This study was rated as having poor quality (3 points) by the PEDro scale. Of the comparisons, there were no significant effects between KT and no tape.

3.4.7. Sprint speed

There was one study comparing KT to sham tape for the outcome of sprint speed with overall low quality on the PEDro scale (Strutzenberger et al., 2016). This study reported 2 comparisons for speed of a 20 m sprint immediately after tape was applied and 24 h after tape application. There were no significant effects at either time-point between KT and sham tape.

Four studies compared KT to no tape with 6 total comparisons made. One demonstrated high quality (Chaney et al., 2015) and 3 were of low quality according to the PEDro scale (Mostaghim et al., 2016; Strutzenberger et al., 2016; de Hoyo et al., 2013). One measured speed during a 10 m distance; one measured speed during a 30 yard distance (immediately after and 24 h tape application); and 2 measured speed during a 20 m distance with one in a fatigued and a non-fatigued state. There were no significant effects in the outcome of speed between KT and no tape conditions.

3.4.8. Distance running

Within the single study looking at distance running, there were 36 comparisons of KT to Mulligan's Tape as a second intervention, and 36 comparisons of KT to no tape for hip and knee kinematics and hip and knee kinetics (Howe et al., 2015). This study demonstrated moderate quality (6 points) on the PEDro scale. There were 8 significant effects in favor of Mulligan's Tape over KT. Mulligan's Tape resulted in reduced peak knee flexion angular velocity (d = −0.91; 95%CI:-1.43,-0.36), peak hip internal rotation angular velocity (d = −0.6; 95%CI:-1.12,-0.07), peak hip external rotation angular velocity (d = −0.7; 95%CI:-1.25,-0.18), peak hip anterior forces (d = −0.95; 95%CI:-1.48,-0.39), peak hip posterior forces (d = −0.88; 95%CI:-1.40,-0.33), peak knee extension moment (d = −0.72; 95%CI:-1.24,-0.18), peak knee flexion moment (d = −0.98; 95%CI:-1.51,-0.42), and peak hip extension moment (d = −1.22; 95%CI:-1.76,-0.65). There were no significant effects for any of the comparisons between KT and no tape conditions.

4. Discussion

Across the functional sports performance abilities in the 15 included studies, of the 193 comparisons reported there were 11 significant findings: 2 in favor of KT, one where the soccer ball was closer to the target for the KT condition than the no tape condition (Muller & Brandes, 2015) and one for the relative Windgate anaerobic capacity compared to no tape (Harmanci et al., 2016); one in favor of no tape, where the handball was closer to the target for those with no tape than for those with KT (Muller & Brandes, 2015); and 8 effects favored Mulligan's Tape for measures of kinematics and kinetics at the hip and knee during running over KT (Howe et al., 2015).

The significant effect of KT over no tape on muscular endurance was produced by a study with poor methodological quality. As such these results should be accepted with caution. The study by Muller and Brandes (2015) produced two of the other significant effects in this review. This study was rated as demonstrating high quality. Interestingly, one of the significant effects was large in favor of KT (d = 0.67; 95%CI:0.11,1.22) and the other was moderate in favor of no tape (d = −0.53; 95%CI:-1.02,-0.03). Given that these effects are completely opposite and were obtained for a similar construct (soccer goal kick distance from the target and handball goal throw distance from the target, respectively) it is difficult to draw any meaningful inferences as to the superiority of one condition over another. In addition, for both of these studies, none of the PEDro criteria for blinding were affirmatively met, introducing the potential for different forms of bias (expectation of the subjects and measurement of the assessors) which could have contributed to the results.

The final study that produced eight significant effects favoring Mulligan's Tape over KT for kinetic and kinematic measures at the knee during running demonstrated high quality overall but lacked blinding. It is possible that participant expectation influenced the results but this is somewhat unlikely given the outcomes are biomechanical and not effort based. In addition, it is also unlikely that participants would have had an anticipation of benefit for either taping mechanism over the other because both techniques are commonly used in runners (Howe et al., 2015). As such, these results may be interpreted as meaningful and demonstrate the effectiveness of Mulligan's tape but not KT for reducing stress at the knee. It should be emphasized in this study that Mulligan's Tape was utilized as a second intervention, not a sham. A subsequent review on the effectiveness of Mulligan's Tape for sport performance may be warranted to further explore this finding, as further discussion is beyond the scope of this review.

Two additional elements were explored within this review, the clinician experience along with the method of tape application and the time of tape application related to the outcome measure. All of the research articles included sufficient details describing the qualifications and technique used to apply the KT. Although not all of the articles describe specific KT expertise of the person applying

Table 4
Sports performance activity with effect sizes comparing Kinesiology Tape (KT) to Other Tape (OT) and No Tape (NT) conditions.

	Outcome Measured	Measured Value			Effect Size	
		KT Group Mean (SD)	OT Group Mean (SD)	NT Group Mean (SD)	KT compared to PT	KT compared to NT
Ball Skills (Handball and Soccer)						
Muller et al., 2015	Soccer goal kick speed (Km/h)	79.40 (7.60)		78.00 (6.90)		0.19 (−0.35, 0.73)
	Handball goal throw speed (Km/h)	77.00 (6.90)		75.90 (7.70)		0.15 (−0.34, 0.64)
	Soccer goal kick distance from target (cm)	57.10 (9.40)		64.00 (11.00)		**0.67 (0.11, 1.22)**
	Handball goal throw distance from target (cm)	31.50 (7.60)		28.00 (5.40)		**−0.53 (-1.02, -0.03)**
Squat						
De Hoyo et al., 2013 (Size of effect reported in percent increase between NT and KT conditions)	30 kg Power Output during concentric return to stance from half-squat (% change)	NR		NR		0.45% (1.43%)*
	50 kg Power Output during concentric return to stance from half-squat (% change)	NR		NR		0.74% (2.29%)*
Cycling						
Harmanci et al., 2016	Absolute Windgate Anaerobic Power (W)	856.29 (114.90)		917.10 (121.11)		−0.52 (−1.22, 0.21)
	Relative Windgate Anaerobic Power (W/kg)	11.20 (0.95)		10.79 (1.10)		0.40 (−0.32, 1.10)
	Absolute Windgate Anaerobic Capacity (W)	616.64 (89.19)		632.52 (60.84)		−0.21 (−0.91, 0.50)
	Relative Windgate Anaerobic Capacity (W/kg)	8.05 (0.59)		7.48 (0.89)		**0.76 (0.01, 1.47)**
Miller et al., 2015	Rating of perceived exertion – overall	13.12 (2.54)		13.95 (1.78)		0.38 (−0.29, 1.03)
	Rating of perceived exertion – chest	11.20 (2.72)		11.85 (3.01)		0.23 (−0.43, 0.88)
	Rating of perceived exertion – legs	NR		NR		NC ($p = 0.64$)**
	Rating of perceived exertion – arms	NR		NR		NC ($p = 0.09$)**
	Cycling efficiency	NR		NR		NC ($p = 0.61$)**
Dynamic Balance						
Nunes et al., 2013	Star Excursion Balance Test – anterior (normalized %)	90.00 (6.70)	89.50 (7.50)		0.07 (−0.55, 0.69)	
	Star Excursion Balance Test- posterolateral (normalized %)	92.50 (7.50)	93.20 (5.80)		−0.10 (−0.72, 0.52)	
	Star Excursion Balance Test posteromedial (normalized %)	98.30 (6.70)	98.70 (7.40)		−0.06 (−0.67, 0.56)	
Wilson et al., 2016	Dynamic stability Index	1.56 (0.64)		1.56 (0.54)		0.00 (−0.95, 0.95)
	Dynamic stability Index – 24 h after tape application	1.34 (0.44)		1.59 (0.81)		−0.38 (−1.32, 0.60)
	Dynamic stability Index – 72 h after tape application	1.49 (0.50)		1.47 (0.58)		0.04 (−0.92, 0.99)
	Dynamic stability Index – 120 h after tape application	1.39 (0.39)		1.49 (0.66)		−0.18 (−1.13, 0.78)
Jumping (Horizontal and Vertical)						
Chaney et al., 2015	Vertical Jump (in)	18.40 (5.60)		18.58 (5.67)		−0.03 (−0.51, 0.44)
Cheung et al., 2016	Vertical countermovement jump (cm)	33.50 (8.42)	32.79 (8.46)	33.21 (8.05)	0.08 (−0.33, 0.50)	0.04 (−0.38, 0.45)
	Vertical countermovement peak jump power (W)	173.65 (27.78)	171.43 (27.60)	173.14 (27.56)	0.08 (−0.34, 0.50)	0.02 (−0.40, 0.44)
Csapo et al., 2012	Vertical drop jump (cm)	28.40 (6.50)		28.70 (6.60)		−0.05 (−0.84, 0.76)
	Vertical drop jump reactive strength index (cm/s)	1.45 (0.45)		1.42 (0.45)		0.07 (−0.74, 0.86)
de Hoyo et al., 2013 (Size of effect reported in percent increase between NT and KT conditions)	Vertical countermovement jump (% change)	NR		NR		1.97% (1.57%)*
Lins et al., 2013	Horizontal single hop (normalized %)	80.20 (0.40)	79.40 (9.20)	80.00 (14.20)	0.12 (−0.05, 0.74)	0.02 (−0.60, 0.64)
	Horizontal triple hop (normalized %)	231.00 (38.00)	228.70 (31.20)	230.00 (47.40)	0.07 (−0.56, 0.68)	0.02 (−0.60, 0.64)
Harmanci et al., 2016		2623.39 (498.98)		2909.02 (637.11)		−0.50 (−1.20, 0.23)

Table 4 (*continued*)

	Outcome Measured	Measured Value			Effect Size	
		KT Group Mean (SD)	OT Group Mean (SD)	NT Group Mean (SD)	KT compared to PT	KT compared to NT
	30-s Repeated Jump Power (W)					
Mostaghim et al., 2016	Vertical jump (cm) (measured immediately after tape applied)	47.38 (8.59)		46.43 (8.31)		0.11 (−0.31, 0.53)
	Vertical jump (cm) (measured 24 h after tape applied)	48.08 (8.90)		46.53 (8.26)		0.18 (−0.24, 0.60)
Nunes et al., 2013	Vertical countermovement jump (m)	0.18 (0.06)	0.17 (0.06)		0.17 (−0.46, 0.78)	
	Vertical countermovement jump flight time (s)	0.38 (0.07)	0.37 (0.06)		0.15 (−0.47, 0.77)	
	Horizontal single-leg jump (m)	1.48 (0.30)	1.47 (0.30)		0.03 (−0.59, 0.65)	
Schiffer et al., 2015	Horizontal double one-legged jump test (m)	4.13 (0.17)		4.08 (0.21)		0.26 (−0.40, 0.91)
Strutzenberger et al., 2016	Vertical countermovement jump (m)	0.32 (0.05)	0.33 (0.06)	0.33 (0.06)	−0.18 (−1.05, 0.70)	−0.18 (−1.05, 0.70)
	Vertical countermovement jump (m) after fatigue	0.27 (0.06)	0.29 (0.07)	0.28 (0.07)	−0.31 (−1.18, 0.59)	−0.15 (−1.02, 0.73)
	Vertical countermovement jump ground reaction force (N/kg)	11.17 (1.34)	11.64 (1.57)	11.13 (1.36)	−0.32 (−1.19, 0.57)	0.03 (−0.85, 0.90)
	Vertical countermovement jump ground reaction force (N/kg) after fatigue	10.86 (1.14)	11.36 (1.33)	11.02 (1.22)	−0.40 (−1.27, 0.50)	−0.14 (−1.01, 0.75)
	Total work with vertical countermovement jump (J/kg)	1.90 (0.49)	2.06 (0.59)	1.95 (0.51)	−0.30 (−1.16, 0.60)	−0.10 (−0.97, 0.78)
	Total work with vertical countermovement jump (J/Kg) after fatigue	1.71 (0.48)	1.86 (0.58)	1.78 (0.55)	−0.28 (−1.15, 0.61)	−0.14 (−1.01, 0.75)
	Hip work with vertical countermovement jump (J/kg)	0.57 (0.28)	0.61 (0.34)	0.60 (0.38)	−0.13 (−1.00, 0.75)	−0.12 (−0.99, 0.76)
	Hip work with vertical countermovement jump (J/Kg) after fatigue	0.48 (0.20)	0.49 (0.24)	0.52 (0.32)	−0.05 (−0.92, 0.83)	−0.15 (−1.02, 0.73)
	Knee work with vertical countermovement jump (J/kg)	0.53 (0.24)	0.64 (0.22)	0.59 (0.27)	−0.48 (−1.35, 0.43)	−0.53 (−1.40, 0.39)
	Knee work with vertical countermovement jump (J/Kg) after fatigue	0.46 (0.26)	0.58 (0.19)	0.51 (0.24)	−0.20 (−1.07, 0.69)	−0.13 (−1.00, 0.75)
	Ankle work with vertical countermovement jump (J/kg)	0.88 (0.13)	0.90 (0.17)	0.90 (0.16)	−0.13 (−1.00, 0.75)	−0.14 (−1.01, 0.75)
	Ankle work with vertical countermovement jump (J/Kg) after fatigue	0.82 (0.12)	0.83 (0.18)	0.86 (0.16)	−0.07 (−0.94, 0.81)	−0.28 (−1.15, 0.61)
	Vertical drop jump (m)	0.21 (0.06)	0.21 (0.05)	0.22 (0.05)	0.00 (−0.88, 0.88)	−0.20 (−1.07, 0.69)
	Vertical drop jump (m) after fatigue	0.19 (0.05)	0.18 (0.06)	0.19 (0.05)	0.18 (−0.70, 1.05)	0.00 (−0.88, 0.88)
	Vertical drop jump ground reaction force (N/kg)	28.64 (7.54)	29.35 (6.82)	30.31 (7.92)	−0.10 (−0.97, 0.78)	−0.22 (−1.09, 0.67)
	Vertical drop jump ground reaction force (N/kg) after fatigue	28.38 (6.82)	28.55 (6.53)	29.21 (7.54)	−0.03 (−0.90, 0.85)	−0.12 (−0.99, 0.77)
	Total work with vertical drop jump (J/kg)	0.63 (0.47)	0.63 (0.22)	0.61 (0.44)	0.00 (−0.88, 0.88)	0.04 (−0.83, 0.92)
	Total work with vertical drop jump (J/Kg) after fatigue	0.40 (0.29)	0.34 (0.36)	0.43 (0.34)	0.18 (−0.70, 1.05)	−0.09 (−0.97, 0.79)
	Hip work with vertical drop jump (J/kg)	−0.10 (0.14)	−0.13 (0.11)	−0.14 (0.07)	0.24 (−0.65, 1.11)	0.36 (−0.54, 1.23)
	Hip work with vertical drop jump (J/Kg) after fatigue	−0.04 (0.19)	−0.08 (0.12)	−0.09 (0.08)	0.25 (−0.64, 1.12)	0.34 (−0.55, 1.21)
	Knee work with vertical drop jump (J/kg)	0.33 (0.27)	0.29 (0.14)	0.24 (0.23)	0.19 (−0.70, 1.06)	0.36 (−0.54, 1.23)
		0.04 (0.30)	0.05 (0.24)	0.08 (0.20)	−0.04 (−0.91, 0.84)	−0.16 (−1.03, 0.73)

(*continued on next page*)

Table 4 (*continued*)

	Outcome Measured	Measured Value			Effect Size	
		KT Group Mean (SD)	OT Group Mean (SD)	NT Group Mean (SD)	KT compared to PT	KT compared to NT
	Knee work with vertical drop jump (J/Kg) after fatigue					
	Ankle work with vertical drop jump (J/kg)	0.41 (0.26)	0.46 (0.14)	0.51 (0.21)	−0.24 (−1.11, 0.65)	−0.42 (−1.29, 0.48)
	Ankle work with vertical drop jump (J/Kg) after fatigue	0.40 (0.15)	0.38 (0.16)	0.47 (0.14)	0.13 (−0.75, 1.00)	−0.48 (−1.35, 0.43)
	Drop jump Reactive Strength Index (m/s)	58.09 (8.38)	55.08 (7.16)	59.43 (9.51)	0.39 (−0.51, 1.25)	−0.15 (−1.02, 0.73)
	Drop jump reactive Strength Index (m/s) after fatigue	60.01 (11.66)	57.40 (9.46)	60.49 (10.84)	0.25 (−0.64, 1.11)	−0.04 (−0.92, 0.84)
Vercelli et al., 2012 2 OT conditions (I= Inhibitory and S= Sham)	Horizontal single-leg triple hop test (cm)	538.0 (98.0)	532.0 (94.0) (I)		0.06 (−0.40, 0.52)	
			532.0 (94.0) (s)		0.06 (−0.40, 0.52)	
Wilson et al., 2016	Horizontal crossover hop (cm)	409.17 (95.89)	387.63 (115.85)		0.20 (−0.76, 1.15)	
	Horizontal crossover hop (cm) − 24 h after tape application	403.77 (85.68)	397.79 (100.46)		0.06 (−0.89, 1.01)	
	Horizontal crossover hop (cm) − 72 h after tape application	408.20 (86.50)	403.38 (93.31)		0.05 (−0.90, 1.00)	
	Horizontal crossover hop (cm) − 120 h after tape application	347.14 (149.45)	353.85 (175.95)		−0.04 (−0.99, 0.91)	
	Horizontal triple hop (cm)	425.41 (105.20)	427.80 (124.01)		−0.02 (−0.97, 0.93)	
	Horizontal triple hop (cm) − 24 h after tape application	438.56 (99.77)	446.94 (105.68)		−0.08 (−1.03, 0.88)	
	Horizontal triple hop (cm) − 72 h after tape application	440.28 (97.13)	446.55 (109.48)		−0.06 (−1.01, 0.90)	
	Horizontal triple hop (cm) − 120 h after tape application	371.77 (161.29)	363.43 (182.96)		0.05 (−0.91, 1.00)	
	6-m hop (s)	2.00 (0.45)	2.09 (0.52)		0.18 (−0.78, 1.13)	
	6-m hop (s)− 24 h after tape application	2.15 (0.37)	2.17 (0.47)		0.05 (−0.91, 1.00)	
	6-m hop (s) − 72 h after tape application	1.87 (0.50)	1.89 (0.39)		0.04 (−0.91, 1.00)	
	6-m hop (s)− 120 h after tape application	2.03 (0.93)	1.88 (0.85)		−0.17 (−1.11, 0.79)	
	Horizontal single hop (cm)	136.12 (29.64)	133.05 (38.20)		0.09 (−0.87, 1.04)	
	Horizontal single hop (cm) − 24 h after tape application	138.56 (27.68)	133.91 (35.51)		0.14 (−0.82, 1.09)	
	Horizontal single hop (cm) − 72 h after tape application	135.83 (28.71)	138.81 (34.02)		−0.09 (−1.04, 0.86)	
	Horizontal single hop (cm) − 120 h after tape application	111.42 (47.72)	109.29 (56.94)		0.04 (−0.91, 0.99)	
Agility						
Mostaghim et al., 2016	Shuttle Run Test (s) (measured immediately after tape applied)	10.49 (0.77)		10.49 (0.73)	0.00 (−0.42, 0.42)	
	Shuttle Run Test (s) (measured 24 h after tape applied)	10.32 (0.71)		10.47 (0.71)	0.21 (−0.21, 0.63)	
Sprinting						
Chaney et al., 2015	20-m sprint speed (s)	3.81 (0.38)		3.83 (0.39)		0.05 (−0.42, 0.53)
de Hoyo et al., 2013 (Size of effect reported in percent increase between NT and KT conditions)	10-m sprint test (%)	NR		NR		0.10% (0.66%)*
Mostaghim et al., 2016		4.91 (0.58)		5.03 (0.67)		0.19 (−0.23, 0.61)

Table 4 (*continued*)

	Outcome Measured	Measured Value			Effect Size	
		KT Group Mean (SD)	OT Group Mean (SD)	NT Group Mean (SD)	KT compared to PT	KT compared to NT
	30-yard dash test (s) (measured immediately after tape applied)					
	30-yard dash test (s) (measured 24 h after tape applied)	4.85 (0.65)		5.07 (0.43)		0.40 (−0.03, 0.82)
Strutzenberger et al., 2016	20-m sprint speed (s)	3.09 (0.10)	3.10 (0.15)	3.09 (0.13)	0.08 (−0.80, 0.95)	0.00 (−0.88, 0.88)
	20-m sprint (s) after fatigue	3.18 (0.24)	3.16 (0.18)	3.21 (0.24)	−0.09 (−0.96, 0.79)	0.12 (−0.76, 1.00)
Distance Running						
Howe et al., 2015	Peak knee flexion (◦)	54.60 (17.70)	55.70 (21.70)	55.20 (18.30)	−0.06 (−0.57, 0.46)	−0.03 (−0.55, 0.48)
	Peak knee extension (◦)	8.80 (5.90)	11.40 (5.00)	7.80 (5.20)	−0.48 (−0.99, 0.05)	0.18 (−0.34, 0.69)
	Peak hip flexion (◦)	48.90 (8.70)	48.20 (8.60)	48.90 (8.90)	0.08 (−0.44, 0.59)	0.00 (−0.51, 0.51)
	Peak hip abduction (◦)	15.00 (4.00)	14.60 (4.20)	15.20 (4.00)	0.10 (−0.42, 0.61)	−0.05 (−0.56, 0.47)
	Peak hip internal rotation (◦)	18.50 (12.60)	18.20 (12.30)	18.20 (13.00)	0.02 (−0.49, 0.54)	0.02 (−0.49, 0.54)
	Peak hip extension (◦)	−7.64 (5.10)	−6.10 (5.10)	−8.00 (5.50)	−0.30 (−0.82, 0.22)	0.07 (−0.45, 0.58)
	Peak hip adduction (◦)	−8.70 (3.90)	−10.10 (3.60)	−8.80 (3.80)	0.37 (−0.15, 0.89)	0.03 (−0.49, 0.54)
	Peak hip external rotation (◦)	−10.60 (11.80)	−14.80 (13.50)	−10.00 (11.70)	0.33 (−0.19, 0.84)	−0.05 (−0.57, 0.46)
	Peak knee flexion angular velocity (◦/s)	870.80 (197.50)	712.20 (148.70)	857.50 (193.00)	**−0.91(-1.43, -0.36)**	−0.07 (−0.58, 0.45)
	Peak knee extension angular velocity (◦/s)	−524.20 (148.90)	−474.80 (159.80)	−535.40 (159.10)	−0.32 (−0.83, 0.20)	0.07 (−0.44, 0.59)
	Peak hip flexion angular velocity (◦/s)	280.50 (175.80)	220.60 (182.40)	280.70 (172.90)	−0.33 (−0.85, 0.19)	0.00 (−0.51, 0.51)
	Peak hip abduction angular velocity (◦/s)	247.90 (90.00)	227.50 (82.60)	240.30 (78.50)	−0.24 (−0.75, 0.28)	−0.09 (−0.60, 0.43)
	Peak hip internal rotation angular velocity (◦/s)	819.00 (205.80)	682.90 (241.40)	804.30 (239.00)	**−0.61(-1.12, -0.07)**	−0.07 (−0.58, 045)
	Peak hip extension angular velocity (◦/s)	−446.8 (91.40)	−412.90 (90.90)	−455.40 (93.60)	−0.37 (−0.89, 0.15)	0.09 (−0.42, 0.61)
	Peak hip adduction angular velocity (◦/s)	−240.60 (57.00)	−245.60 (53.30)	−242.10 (56.70)	0.09 (−0.43, 0.60)	0.03 (−0.49, 0.54)
	Peak hip external rotation angular velocity (◦/s)	−818.70 (258.50)	−635.80 (246.30)	−773.30 (249.10)	**−0.72(-1.25, -0.18)**	−0.18 (−0.69, 0.34)
	Peak knee anterior forces (N/kg)	11.20 (3.30)	10.00 (3.10)	11.20 (3.00)	−0.37 (−0.89, 0.15)	0.00 (−0.51, 0.51)
	Peak knee medial forces (N/kg)	2.20 (2.30)	2.10 (2.30)	3.00 (2.20)	−0.04 (−0.56, 0.47)	0.36 (−0.17, 0.87)
	Peak knee compression forces (N/kg)	1.40 (0.80)	1.30 (0.70)	1.40 (0.80)	−0.13 (−0.65, 0.38)	0.00 (−0.51, 0.51)
	Peak knee posterior forces (N/kg)	−2.50 (0.80)	−2.10 (0.70)	−2.70 (1.00)	−0.53 (−1.05, 0.00)	0.22 (−0.30, 0.73)
	Peak knee lateral forces (N/kg)	−5.70 (4.10)	−5.40 (3.90)	−5.50 (3.90)	−0.07 (−0.59, 0.44)	−0.05 (−0.56, 0.47)
	Peak knee distraction forces (N/kg)	−19.70 (5.50)	−19.10 (5.80)	−19.80 (5.70)	−0.11 (−0.62, 0.41)	0.02 (−0.50, 0.53)
	Peak hip anterior forces (N/kg)	5.80 (2.60)	3.60 (2.00)	6.00 (2.50)	**−0.95(-1.48, -0.39)**	0.08 (−0.44, 0.59)
	Peak hip medial forces (N/kg)	2.80 (1.80)	2.20 (1.30)	2.50 (1.50)	−0.38 (−0.90, 0.14)	−0.18 (−0.69, 0.34)
	Peak hip compression forces (N/kg)	2.30 (1.50)	2.20 (1.50)	2.30 (1.40)	−0.07 (−0.58, 0.45)	0.00 (−0.51, 0.51)
	Peak hip posterior forces (N/kg)	−15.9 (5.20)	−11.60 (4.60)	−15.90 (4.60)	**−0.88(-1.40, -0.33)**	0.00 (−0.51, 0.51)
	Peak hip lateral forces (N/kg)	−3.00 (2.10)	−2.10 (1.30)	−2.90 (1.90)	−0.52 (−1.03, 0.01)	−0.05 (−0.56, 0.47)
	Peak hip distraction forces (N/kg)	−20.00 (6.00)	−19.70 (5.90)	−20.2 (0.20)	−0.05 (−0.56, 0.47)	0.05 (−0.47, 0.56)
	Peak knee flexion moment (Nm/kg)	2523.80 (777.10)	2280.80 (745.80)	2508.70 (734.40)	−0.32 (−0.83, 0.20)	−0.02 (−0.53, 0.50)
	Peak knee extension moment (Nm/kg)	−799.20 (213.10)	−664.90 (153.40)	−821.20 (174.70)	**−0.72(-1.24, -0.18)**	0.11 (−0.40, 0.63)
	Peak hip flexion moment (Nm/kg)	3691.90 (1250.70)	2607.80 (948.10)	3733.50 (1163.80)	**−0.98(-1.51, -0.42)**	0.03 (−0.48, 0.55)
	Peak hip abduction moment (Nm/kg)	2052.00 (748.90)	1676.50 (659.00)	2074.20 (715.70)	−0.53 (−1.05, 0.00)	0.03 (−0.48, 0.54)
	Peak hip internal rotation moment (Nm/kg)	129.90 (101.10)	92.20 (105.50)	132.30 (93.10)	−0.36 (−0.88, 0.16)	0.02 (−0.49, 0.54)
		−2994.90 (1052.00)	−1818.60(865.80)	−3084.20 (1057.70)	**−1.22(-1.76, -0.65)**	0.08 (−0.43, 0.60)

(*continued on next page*)

Table 4 (*continued*)

	Outcome Measured	Measured Value			Effect Size	
		KT Group Mean (SD)	OT Group Mean (SD)	NT Group Mean (SD)	KT compared to PT	KT compared to NT
	Peak hip extension moment (Nm/kg)					
	Peak hip adduction moment (Nm/kg)	−763.00 (320.80)	−742.80 (258.90)	−737.50 (257.00)	−0.07 (−0.58, 0.45)	−0.09 (−0.60, 0.43)
	Peak hip external rotation moment (Nm/kg)	−605.50 (305.10)	−473.50 (259.50)	−592.40 (275.20)	−0.47 (−0.98, 0.06)	−0.05 (−0.56, 0.47)

KT=Kinesiology Tape; OT = other tape/alternative tape method; NT = no tape; SD=Standard deviation; NR = not reported; CI= Confidence Interval. * An effect size was unable to be computed based on the data presented by the source; percent difference between groups as reported by the source article is reported. ** An effect size was unable to be computed based on the data presented by the source; the p-value of the statistical test utilized in the source article is reported. Positive effects reflect outcome in favor of KT, negative effects reflect outcome in favor of comparator. Bold indicates effect size with significant confidence interval. Units of measurement: Km/h = Kilometer per hour; cm = centimeters; in = inch; W= Watts; Kg = kilogram; s = seconds; m = meters; N=Newton; J-Jewels; ◦ = degrees; Nm = Newton-meters.

the tape, the taping methodology was written with enough detail to demonstrate the similarity of application across participants within each study. Despite the information provided in each individual study, it is possible that differences in opinion exist as to the exact taping techniques and locations that should be utilized to produce the desired effect (Lee, 2015; Nunes et al., 2015). Any discrepancies in the exact taping methodology between practitioners with training and clinical expertise in KT should not completely negate a true physiological effect or by definition, the tape lacks effectiveness. Therefore, we conclude that the technique of tape application was unlikely to be the cause of its ineffectiveness in a high majority of the comparisons made.

Secondarily, the time of tape application does not appear to have a substantial impact on its effectiveness in relation to the performance of the sports ability. Of the three studies that measured outcomes at different times after tape application or after an athlete wore the tape through activity to become fatigued, there were no significant effects for any of the constructs of sports performance represented.

The findings of this review demonstrate a lack of evidence to support the use of KT to enhance the sports performance abilities. These results are similar to the findings of other systematic reviews on KT that describe a lack of evidence to support its use in clinical practice (Morris et al., 2013); for muscular strength in healthy adults (Csapo & Alegre, 2015); or for pain in individuals with musculoskeletal injuries (Montalvo et al., 2014).

Despite the results presented here, there is still potential for KT to enhance sport performance if the athlete believes in the benefits of its use. This may be through several mechanisms, including a psychological benefit if the athlete had a previous positive performance experience while wearing KT (Vercelli, Ferriero, Bravini & Sartorio 2013). None of the studies included in this review specifically explored the participants' beliefs on the effectiveness of KT and the effects these beliefs may have on performance while wearing KT. A recent meta-analysis on the placebo effect in sport performance revealed small to moderate effects with placebo treatments but suggested that larger effects may be demonstrated with athletes who are considered placebo-responders (i.e. individuals with personal and situational factors who produce enhanced performance in response to a placebo) (Berdi, Köteles, Szabo, & Bardos 2011). Such may be the case for KT. Future research on the effectiveness of KT on sport performance in athletes who believe in its benefit would be helpful to further elucidate this phenomenon.

4.1. Limitations

This review was limited to studies published in English and as such, studies with relevant findings may have been omitted. The electronic search for this review was complicated in that "kinesiology tape" is not a MESH term, Because of this, the hand search resulted in identification of 4 additional studies. As such, we cannot be certain that we were able to identify all potentially relevant articles. In addition, although several published conference abstracts were identified through the electronic search, these do not exist in manuscript form and were unable for be included. Because necessary details to be included in this review were not present in the abstracts, it is not known if these additional unpublished studies could have contributed additional findings within this review. The authors of these abstracts were not contacted, as the extent of written detail required to determine eligibility would have likely required a full completion of methods and results by the original author, which was not seen as a reasonable request. Lastly, all sports performance abilities and constructs within the performance of sports were not represented in the original research included in this review. Therefore, these results cannot be generalized to all sports performance abilities.

5. Conclusions

This review is the first of its kind to explore the effectiveness of KT on sports performance abilities in healthy athletes. Across 193 comparisons made, only two significant effects were demonstrated in favor of KT to a no tape condition. The lack of blinding for the participants and the assessors cannot be negated when interpreting these results. There were no significant effects in favor of KT when compared to other tapes (sham or a second intervention). Based on these results, there is no convincing evidence for the effectiveness of KT on any construct within the sports performance abilities included.

Ethical statement

This manuscript was conducted and was written with adherence to strict ethical standards.

Ethical approval

No approval was required for this review article.

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Conflict of interest

None declared.

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