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THE SHORT-TERM EFFECT OF KINESIO TAPE APPLICATION ON RUNNING SPEED, AGILITY AND PLYOMETRIC PERFORMANCE IN AMATEUR SOCCER PLAYERS

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ABSTRACT

Soccer is a physically demanding team sport requiring players to run fast, perform multiple changes in direction and jump, among other skills. Soccer players with optimal running speed, agility and plyometric abilities are more likely to be selected for team participation, as they will have enhanced on-the-field performance. Various exercise and rehabilitation protocols exist to ensure optimal player performance, but none focus on the immediate effect of Kinesio tape (Kinesio Holding Corporation, Albuquerque, NM, USA) on the stabilising muscles of the lower limb to influence important basic soccer skills. A one-group pre-test–post-test quasi-experimental design was used. Thirty-three male university-level soccer players aged 18–35 years with no history of lower limb surgery were included. Baseline testing was performed using the vertical jump test, Modified Illinois Change of Direction test and a timed 50-metre sprint. After a rest period of 1–4 days, the participants were strapped with Kinesio tape and the post-test, using the same objective measures, was conducted. Pre- and post-test analysis was performed using paired student t-test. Improvement was observed for running speed ($p \leq 0.001$, SD: 0.685), agility ($p \leq 0.001$; SD: 2.312) and plyometrics ($p \leq 0.001$; SD: 2.451). The application of Kinesio tape on the stabiliser muscles of the lower limbs significantly improved running speed, agility and plyometrics in amateur soccer players immediately after application.

Key words: Performance enhancement; Sport rehabilitation; Strapping/taping.

INTRODUCTION

Soccer requires high-intensity, long-lasting intermittent physica l activity that is physica lly (cognitively and emotionally) very demanding on the players (Requena *et al.* 2009). To perform optima lly, soccer pla yers a re required to run, change direction multiple times during a match and jump (Requena *et al.*, 2009; Mendez-Villa nueva *et al.*, 2011; de Hoyo *et al.*, 2015). High-speed running actions such as sprinting have the potential to affect the outcome of a soccer match and a re therefore a prerequisite for soccer pla yers at any level of competition (Gissis *et al.*, 2006; Mendez-Villa nueva *et al.*, 2011). A soccer pla yer's agility is equa lly importa nt to ensure optimal on-field performance (Jullien *et al.*, 2008). Little and Williams (2005) studied the relationship between sprinting speed and agility. They found that sprinting speed and agility should be considered as separate qualities during the assessment and management of soccer pla yers, as they are relatively unrelated to one another, despite physiological and biomechanical

simila rities (Little & Willia ms, 2005). Plyometric abilities of soccer pla yers do not only improve the players' performance on the field, but also a ssist in improving the neuro-mechanical training responses of elite youth (under 20) soccer pla yers (Loturco *et al.*, 2015).

Pre-exercise interventions exist that aim to enhance performance of athletes prior to matches and competitions. Ide *et al.* (2017) investigated the immediate effects of static and ballistic stretching and parallel squats on performance of recreational soccer players. The authors found that stretching adversely affected jump performance, but enhanced flexibility in the players. Low-level laser therapy with optimised parameters has also been used successfully pre-exercise to enhance running performance in elite male soccer players (Tomazoni *et al., 2019*). The low-level laser proved effective in reducing the time until running fatigue was reached in soccer players, but the study did not consider agility performance or plyometric ability. Traditiona lly, strapping and taping have been applied pre-exercise to enhance performance in sport. Dogan and Güzel (2021) compared the immediate effect of four different tapingand strapping methods on professional male soccer players and found that dynamic taping improved dynamic ba lance in soccer players, but that none of the taping/strapping methods improved their jump performance.

In addition to pre-exercise interventions, various exercise and rehabilitation protocols exist to improve soccer pla yers' running speed, agility and plyometrics, of which the most frequently implemented protocols include plyometric training; eccentric muscle strength training; eccentric-overload training; lower limb symmetry training; and functiona l rehabilita tion (Chelly *et al.*, 2010; Fousekis *et al.*, 2010; Kiesel *et al.*, 2011; Lorenz & Reiman, 2011; de Hoyo *et al.*, 2015). All these tra ining progra mmes and rehabilita tion protocols have shown to improve muscle strength and performance of the three key aspects required from soccer pla yers, i.e., running speed, agility and plyometric performance (Chelly *et al.*, 2010; Fousekis *et al.*, 2010; Kiesel *et al.*, 2011; Lorenz & Reiman, 2011; de Hoyo *et al.*, 2015).

However, a limita tion identified within the current muscle strength rehabilita tion protocols is that soccer pla yers participating in these programmes have to receive training for a minimum of 6 weeks and a maximum of 12 weeks before the effect of the intervention is observed (Fousekis *et al.*, 2010; Kiesel *et al.*, 2011; Lorenz & Reiman, 2011; de Hoyo *et al.*, 2015). Time lost from participating in team practice sessions and matches due to injury will have an economic and performance-related impact on the team and may influence a soccer player's selection into a team (Eira le *et al.*, 2017).

A possible solution to minimise time loss from training when a soccer pla yer undergoes injury rehabilita tion is the application of Kinesio tape (Kinesio Holding Corporation, Albuquerque, NM, USA) (Ka se *et al.*, 2003). However, the immediate effect of the application of Kinesio tape on lower limb stabiliser muscles has not been extensively investiga ted. Studies that investigated the application of Kinesio tape on the lower limbs report conflicting results on its effect and effectiveness. The application of Kinesio tape was compared to rigid strapping for the prevention of ankle injuries in soccer pla yers (Briem *et al.*, 2011). The authors found that Kinesio tape application was not effective in providing ankle stability but it facilitated muscle activation around the ankle joint (Briem *et al.*, 2011). De Hoyo *et al.* (2013) found the contrary, that is that Kinesio tape did not have a positive effect on muscle activation in young elite soccer pla yers. The participants in their study were under the age of 18 yea rs and the muscle properties

may not have developed enough to respond to the specific stimuli that the application of Kinesio tape a ims to provide (de Hoyo *et al.*, 2013). No published literature could be found on the immedia te effect of Kinesio tape on the lower limb stabiliser muscles of amateur soccer pla yers and its effect on running speed, agility and plyometric performance.

METHODOLOGY

Ethical clearance was granted by the Sefako Makgatho Health Sciences University (SMU) Research and Ethics Committee (SMUREC), ethical clearance number: SMUREC/H/304/2017:PG, prior to conducting the study.

Study design and setting

A one-group pre-test–post-test quasiexperimental design was used to determine the short-term effect of Kinesio tape application on the stabiliser muscle activa tion of the lower limb. The study was conducted at the SMU sport grounds between the months of April and August 2018. To obtain comparable results between the soccer pla yers and valid results between the pre- and post-test, data collection was only carried out on days when the outside ambient temperature was between 18°C and 24°C.

Study population and sampling

Thirty-three ama teur ma le soccer pla yers at SMU aged between 18 and 35 years old were recruited to participate in the study after they signed a written voluntary informed consent document. Soccer pla yers who played on a professional (club/national) level and/or who had undergone lower limb surgery, or who had sustained a lower limb injury up to 6 months prior to the onset of data collection, were excluded from participation.

Research procedure

Potential participants were recruited at the soccer practice sessions at SMU if they met the eligibility criteria . Once voluntary consent was obtained, the soccer players were asked to run a lap, at a comfortable pace, around two soccer fields (approximately 600 metres) as a warm-up exercise, to decrease the risk of injury during the running speed, agility and plyometric performance tests. The soccer players were not exposed to the assessment procedure prior to the assessment, to minimise the effect of motor learning on the outcome of the tests. After the wa rm-up, each soccer pla yer was a ssessed with the following tests:

- Running speed was assessed over a pre-measured 50-metre distance, using a stop watch. To ensure the validity of the test, three timekeepers measured the time it took for each soccer player to run the 50 metres and the average of the three measurements (in seconds) wa s calculated.
- The Modified Illinois Change of Direction Test (MICODT) was used to determine the baseline values for the soccer players' agility. The test was conducted as described by Hachana *et al.* (2014). Training cones were used as markers at the various turning points. Three timekeepers were used to measure the time (in seconds) it took the soccer players to complete the test. The average of the three measurements was calculated.

- The vertical jump test/Sargent jump test was performed to measure the plyometric ability of the soccer players. The procedure described by Da Costa Mendes de Salles *et al.* (2012) was used, as it has been proven valid and reliable in the soccer player population. A tape measure was used to measure the height that the soccer players jumped (in centimetres). The soccer players were asked to perform a full squat and then jump as high as they could, making a mark on the tape measure (which was secured against a wall) with a marker. To ensure the validity of the test in this study, each soccer player was asked to jump twice and the average of the two recorded heights was calculated.

The participants were given between 1 and 4 days to rest in between the pre-test and post-test. The aim with the rest period was to ensure that muscle fatigue and a learning effect did not influence the results. The number of days the soccer players rested was determined by the ambient temperature and the practice times of the participants. When the temperature was below 18°C or above 24°C muscle contractility could potentially be altered (Bell & Ferguson, 2009; Sandsund *et al.*, 2012).

The vastus medialis oblique (VMO), popliteus and gluteus medius muscles of the participants' dominant leg (with which they kicked) were strapped with Kinesio tape using the Y-strip and I-strip methods of strapping, as these methods have been shown to facilitate muscle activation (Kase *et al.*, 2003). The area over the aforementioned muscles was cleaned with a towel and alcohol to ensure that the skin was dry and to allow optimal adhesion of the Kinesio tape. No tension was applied in the application of the taping material (Fernandes de Jesus *et al.*, 2017). To ensure continuity in the application of the strapping, the principal researcher applied the strapping to all participants. The principal researcher has over 8 years of experience working with soccer players and has undergone numerous strapping course (including Kinesio tape training). The Kinesio tape was applied as illustrated in Figure 1.

Gluteus medius strapping

Vastus medialis oblique strapping

Popliteus strapping

Figure 1. **KINESIO TAPE APPLICATION.**

After application of the Kinesio tape the participants were asked to perform the warm-up (running a lap around two soccer fields) as in the pre-test procedure. Thereafter, the soccer pla yers were assessed with the same outcome measures (i.e., running speed over 50 metres, MICODT and vertical jump test). After completion of the assessment the Kinesio tape was removed and the area inspected to ensure that the participants did not have an adverse reaction to the material. None of the soccer pla yers in this study reacted adversely to the Kinesio tape.

RESULTS

The demographic data of the 33 soccer pla yers a re presented in Table 1.

Table 1. **DEMOGRAPHIC INFORMATION OF THE PARTICIPANTS (N=33)**

Demographic variable	Number of participants	Percentage (%)
Age: 18–20	10	30.3
Age: 21–24	16	48.5
Age: 25–29	7	21.2
Race: African	33	100.0
Years' experience: 1	21	63.6
Years' experience: 2	5	15.2
Years' experience: 3	3	9.1
Years' experience: 4	3	9.1
Years' experience: 5	1	3.0

The results of the pa ired-sa mple student t-test analysis that was performed on the collected data for the 50-metre running time, MICODT and vertical jump test are presented in Table 2. Pa ired-sample statistics were used to analyse the running speed of participants before and after the Kinesio tape application. The average running speed over 50 metres (pre- and post- Kinesio tape application) was measured in seconds. Thereafter, the paired-samples student t-test was used to determine the difference in running speed before and after the Kinesio tape application. The running speed of the participants improved significantly ($p \leq 0.001$; standard deviation [SD] 0.119). Paired-sample statistics were used to analyse the agility of participants before and after the Kinesio tape application. The time that participants took to complete the MICODT was measured in seconds, before and after the application of Kinesio tape. The paired-sa mples student t-test was used to determine the significance of the change in agility and revealed a significant change ($p \leq 0.001$; SD 2.313). Finally, the plyometric performance of participants was measured, using the same procedures indicated above. The height that the participants jumped was measured in centimetres and the paired-sample student t-test revea led a significa nt change (SD 2.451; $p \leq 0.001$) between the pre- and post-tests.

***Table 2*. PAIRED-SAMPLE STUDENT T-TEST STATISTICS FOR DIFFERENCES IN RUNNING SPEED, AGILITY AND PLYOMETRIC PERFORMANCE (N=33)**

	Pre-application (mean)	Post-application (mean)	Mean (difference)	SD	SEM	Significance
Running speed (sec)	6.35	5.41	0.93	0.68	0.12	p^{+}=0.000*
Agility (sec)	21.13	17.58	3.54	2.31	0.40	p^{+}=0.000*
Plyometric performance (cm)	31.27	36.12	–4.84	2.45	0.42	p^{+}=0.000*

$^{+}$ p is the exceedance probability; * $p \leq 0.05$; Mean=indicates the absolute differences in seconds/centimetres; SD=standard deviation; SEM=standard error of the mean

DISCUSSION

Owing to the dynamic and demanding nature of the game of soccer, soccer players need to perform the basic skills of the game, such as running, changing direction and jumping, optimally (Requena *et al.*, 2009; Mendez-Villanueva *et al.*, 2011). In the current study, a method to potentially enhance the immediate performance of these basic skills was investigated by applying Kinesio tape to the lower limb stabiliser muscles. The results indicated that the application of the Kinesio tape to the lower limb stabiliser muscles improved amateur soccer players' running speed, agility and plyometric abilities significantly ($p \leq 0.001$) for all three activities.

Very little evidence regarding the effect of Kinesio tape application on running speed exists to corroborate or refute the findings of this study. Lumbroso *et al.*, (2014) conducted a quasiexperimental, repeated measures study on 36 healthy male and female participants to determine the effect of Kinesio tape application on muscle flexibility, contractibility and force production – all of which could influence running speed. Prior to the onset of the Kinesio tape intervention, the participants received warm-up/stretching exercises. The authors reported significant improvement in flexibility and in force production of the quadriceps and gastrocnemius muscles of the participants (Lumbroso *et al.*, 2014). Contradictory to the findings of the current study and the findings by Lumbroso *et al.*, (2014), Lins *et al.* (2013) found that Kinesio tape application to the quadriceps muscles of healthy individuals did not alter neuromuscular performance to the extent that running speed improves. The authors divided 60 female participants into three groups and applied Kinesio tape to one group, non-elastic adhesive tape to the second group and no intervention to the third group (Lins *et al.*, 2013). They found no difference in any of the test parameters between the three test groups (Lins *et al.*, 2013).

The quadriceps muscle, especially VMO, plays a critical role in the generation and dissipation of mechanical energy during running (Yeow, 2013). In the current study, the VMO was strapped with the Kinesio tape because of its important function during running. When the VMO muscle works optimally, running speed has been found to be faster (Yeow, 2013). Similar to the VMO, the gluteus medius muscle also plays a critical role in running, by being

responsible for control of pelvic and hip stability (Semciw *et al.*, 2016). The popliteus muscle ensures stability in the knee joint during running, which is a critical function to minimise the risk of injuries (Ullrich *et al.*, 2002). In the current study, these three stabiliser muscles (VMO, gluteus medius and popliteus) were strapped because of their contribution to the running action.

The agility of the participants in our study, as measured with the MICODT, also improved significantly. The literature indicated that hip abduction and quadriceps muscle activation are two of the main factors responsible for optimal agility performance (Cortes *et al.*, 2011; Spiteri *et al.*, 2013; Hammami *et al.*, 2018). Very little published information is available to indicate the effect of Kinesio tape application on agility in soccer players and no published literature could be found to indicate the effect of Kinesio tape application on the lower limb stabiliser muscles on soccer players' agility. Eom *et al.* (2014) investigated the effect of Kinesio tape application on the ankle stabiliser muscles in healthy university-level soccer players. The authors found that the Kinesio tape enhanced performance across all agility and change of direction tests, similar to the findings in the current study (Eom *et al.*, 2014). However, Solomon *et al.* (2013) conducted a study on female college athletes and found contradictory results.

In their study, Solomon *et al.* (2013) applied Kinesio tape to eight female athletes and tested agility performance before and after the Kinesio tape application. The authors found no difference in performance with and without the Kinesio tape application (Solomon *et al*., 2013). A possible explanation for their findings might be the small sample size that was used, because Sarvestan *et al.* (2018) found that agility improved significantly in female athletes who received Kinesio tape around the ankle joints, compared with athletes who were not strapped with Kinesio tape.

As with the running speed and agility that has been reported on, plyometric performance of participants in this study also improved significantly immediately after the application of Kinesio tape. The ability to perform an effective vertical jump in soccer is an important skill for a ll pla yers (Paoli *et al.*, 2012). During jumping, the popliteus muscle plays a critical role in load acceptance, especially during the descending phase of the jump (Nyland *et al.*, 2005). The VMO is responsible for optimal power generation during the ascending phase, when the knee joint moves from a flexed to an extended position during jumping (Toumi *et al.*, 2007).

The gluteus medius muscle provides stability and directionality to the hip and pelvis during the ascending and descending phases of a jump (Lepley *et al.*, 2013). Despite the positive effects reported in literature regarding the use of Kinesio tape in healthy individuals, very limited published literature could be found where the effect of Kinesio tape was studied on plyometric performance. Lee (2014) conducted a study on 11 healthy men to determine the effect of Kinesio tape on muscle fatigue during sergeant jumps. The author found that Kinesio tape application did not prevent or slow down muscle fatigue during the performance of the sergeant jumps. However, the study did not report on the performance (i.e., if there was an improvement in jump height or jump execution) of the sergeant jumps (Lee, 2014). Mahdi and Hossein (2017) found that the plyometric performance of patients who had undergone anterior cruciate ligament surgery improved with the applica tion of Kinesio tape over the quadriceps muscle (simila r to the application performed in the current study). The results of the intervention group were compared with a control group and a placebo group and the participants who received the

Kinesio tape intervention performed significantly better in plyometric activities than both the control and the placebo groups (Mahdi & Hossein, 2017).

PRACTICAL APPLICATION AND RECOMMENDATIONS

The positive results yielded in this study indicate that Kinesio tape application could benefit soccer players in improving their immediate performance; however, further research is advised to corroborate the findings. Despite positive results from this study, the long-term effect of Kinesio tape on running speed, agility and plyometrics will have to be investigated to determine whether the observed improvements last for the duration of a match or until muscle fatigue sets in. Additional research to corroborate the findings (with larger samples) is also recommended. It should also be considered that Kinesio tape may have a placebo effect that was responsible for the observed improvements in this study – future randomised controlled trials in which various taping modalities are implemented are recommended.

CONCLUSION

Improving the physical attributes that play a major role in soccer players' performance is important to ensure optimal performance during training and matches. The results from this study indicate that application of Kinesio tape on the stabiliser muscles of the lower limbs significantly influences the running speed, agility and plyometric performance of soccer players immediately after application.

CONFLICT OF INTEREST

No conflict of interest was reported

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REFERENCES

BELL, M.P. & FURGUSON, R.A. (2009). Interaction between muscle temperature and contraction velocity affects mechanical efficiency during moderate-intensity cycling exercise in young and old women. *Journal of Applied Physiology*, 107(3): 763-769. DOI: 10.1152/japplphysiol.91654.2008.

BRIEM, K.; EYTHORSDOTTIR, H,; MAGNUSDOTTIR, R.G.; PALMARSSON, R.; RUNARSDOTTIR, T. & SVEINSSON, T. (2011). Effects of Kinesio tape compared with nonelastic sports tape and untapped ankle during a sudden inversion perturbation in male athletes. *Journal of Orthopaedic & Sport Physiotherapy*, 41(5): 328-335. DOI: https://www.jospt.org/doi/10.2519/jospt.2011.3501.

CHELLY, M.S.; GHENEM, M.A.; ABID, K.; HERMASSI, S.; TABKA, Z. & SHEPARD, R.J. (2010). Effects of in-season short-term plyometric training program on leg power, jump- and sprint performance of soccer players. *Journal of Strength & Conditioning Research*, 24(10): 2670-2676. DOI: 10.1519/JSC.0b013e3181e2728f.

CORTES, N.; ONATE, J. & VAN LUNEN, B. (2011). Pivot task increases knee frontal plane loading compared with sidestep and drop-jump. *Journal of Sport Science*, 29(1): 83-92. DOI: 10.1080/02640414.2010.523087.

DE COSTA MENDES DE SALLES, P.G.; VIEIRA DO AMARAL VASCONCELLOS, F.; DA COLSTA MENDES DE SALLES, G.F.; FONSECA, R.T. & DANTAS, E.H.M. (2012). Validity and reproducibility of the Sargent jump test in the assessment of explosive strength in soccer players. *Journal of Human Kinetics*, 33: 115-121. DOI: 10.2478/v10078-012-0050-4.

DE HOYO, M.; ALVAREZ-MESA, A.; SANUDO, B.; CARRASCO, L. & DOMINGUEZ, S. (2013). Immediate effect of Kinesio Taping on muscle response in young elite soccer players. *Journal of Sport Rehabilitation*, 22(1): 53-58. DOI: 10.1123/jsr.22.1.53.

DE HOYO, M.; POZZO, M.; SANUDO, B.; CARRASCO, L.; GONZALO-SKOK, O.; DOMINGUEZ-COBO, S. & MORAN-CAMACHO, E. (2015). Effects of a 10-week in-season eccentric-overload training program on muscle-injury prevention and performance in junior elite soccer players. *Human Kinetics Journals*, 10(1): 46-52. DOI: 10.1123/ijspp.2013-0547.

DOGAN, F.E. & GÜZEL, N.A. (2021). The acute effects of different ankle taping techniques on dynamic balance and lower extremity jumping performance in professional soccer players. *Turkish Journal of Sports Medicine*, 56(2): 86-90. DOI: 10.47447/tjsm.0489

EIRALE, C.; GILLOGLY, S.; SINGH, G. & CHAMARI, K. (2017). Injury and illness epidemiology in soccer – effects of global geographical differences – a call for standardized and consistent research studies. *Biology of Sport*, 34(3): 249-254. DOI: 10.5114/biolsport.2017.66002.

EOM, S.Y.; LEE, W.J.; LEE, J.I.I.; LEE, E.H.; LEE, H.Y. & CHUNG, E.J. (2014). The effect of ankle Kinesio taping on range of motion and agility during exercise in university students. *Physical Therapy Rehabilitation Sciences*, 3: 63-68. PMID: 22530190; PMCID: PMC3325641.

FERNANDES DE JESUS, J.; DOS SANTOS FRANCO, Y.R.; NANNINI, S.B.; NAKAOKA, G.B.; CURCIO DOS REIS, A. & BRYK, F.F. (2017). The effects of varied tensions of kinesiology taping on quadriceps strength and lower limb function. *International Journal of Sports Physical Therapy*, 12(1): 85-93. PMID: 28217419; PMCID: PMC5296714.

FOUSEKIS, K.; TSEPIS, E. & VAGENAS, G. (2010). Lower limb strength in professional soccer players: profile, asymmetry and training age. *Journal of Sports Sciences and Medicine*, 9(3): 364-373. PMID: 24149628; PMCID: PMC3761700.

GISSIS, I.; PAPADOPOULOS, C.; KALAPOTHARAKOS, V.I.; SOTRIOPOULOS, A.; KOMSIS, G. & MANALOPOULOS, E. (2006). Strength and speed characteristics of elite, subelite and recreational young soccer players. *Research in Sports Medicine*, 14(3), 205-214. DOI: 10.1080/15438620600854769.

HACHANA, Y.; CHAABENE, H.; RAJEC, G.B.; KHLIFA, R.; AOUADI, R.; CHAMARI, K. & GABBETT, T.J. (2014). Validity and reliability of new agility test among elite and subelite under 14-soccer players. *PLoS One*, 9(4): online. DOI: 10.1371/journal.pone.0095773.

HAMMAMI, M.; NEGRA, Y.; BILLAUT, F.; HERMASSI, S.; SHEPHARD, R.J. & CHELLY, M.S. (2018). Effects of lower-limb strength training on agility, repeated sprinting with changes of direction, leg peak power and neuromuscular adaptation of soccer players. *Journal of Strength and Conditioning Research*, 32(1): 37-47. DOI: 10.1519/JSC.0000000000001813.

IDE, BM.; MOREIRA, A.; SCHOENFELD, B.J.; LODO, L.; SANTOS, A.R.; BARBOSA, W.P.; LOPES, C.R. & AOKI, M.S. (2017). Acute effect of different warm-up interventions on neuromuscular performance of recreational soccer players. *Revista Brasileira de Ciência e Movimento*, 25(3):34-43. DOI: https://doi.org/10.31501/rbcm.v25i3.7053.

JULLIEN, H.; BISCH, C.; LARGOUET, N.; MANOUVRIER, C.; CARLING, C. & AMIARD, V. (2008). Does a short period of lower limb strength training improve performance in field-based tests

of running and agility in young professional soccer players? *Journal of Strength and Conditioning Research*, 22(2): 404-411. DOI: 10.1519/JSC.0b013e31816601e5.

KASE, K.; WALLIS, J. & KASE, T. (2003). *Clinical therapeutic applications of the Kinesio taping method* (2nd ed.) (pp.14; 58; 60-78). Kinesio Taping Association.

KIESEL, K.; PLISKY, P. & BUTLER, R. (2011). Functional movement test scores improve following a standardized off-season intervention program in professional football players. *Scandinavian Journal of Medicine & Science in Sports*, 21(2): 287-292. DOI: 10.1111/j.1600-0838.2009.01038.x.

LEE, B.K. (2014). Effects of Kinesio taping on repetition, heart rate, RPE and EMG responses during plyometric sergeant jumping. *The Asian Journal of Kinesiology*, 16(4), 43-52. DOI: 10.15758/jkak.2014.16.4.43.

LEPLEY, A.S.; STROUSE, A.M.; ERICKSEN, H.M.; PHILE, K.R.; GRIBBLE, P.A. & PIETROSIMONE, B.G. (2013). Relationship between gluteal muscle strength, corticospinal excitability and jump-landing biomechanics in healthy women. *Journal of Sport Rehabilitation*, 22: 239-247. DOI: 10.1123/jsr.22.4.239.

LINS, C.A.; NETO, F.L.; AMORIM, A.B.; MACEDO, LDEB. & BRASILEIRO, J.S. (2013). Kinesio taping does not alter neuromuscular performance of femoral quadriceps of lower limb function in healthy subjects: randomized, blind, controlled clinical trial. *Manual Therapy*, 18(1): 41-45. DOI: 10.1016/j.math.2012.06.009.

LITTLE, T. & WILLIAMS, A.G. (2005). Specificity of acceleration, maximum speed and agility in professional soccer players. *Journal of Strength and Conditioning Research*, 19(1): 76-78. DOI: 10.1519/14253.1.

LORENZ, D. & REIMAN, M. (2011). The role and implementation of eccentric training in athletic rehabilitation: tendinopathy, hamstring strains, and ACL reconstruction. *International Journal of Sports Physical Therapy*, 6(1): 27-44. PMID: 21655455; PMCID: PMC3105370.

LOTURCO, I.; PEREIRA, L.A.; KOBAL, R.; ZANETTI, V.; KITAMURA, K.; CAVINATO CAL ABAD, C. & NAKAMURA, F.Y. (2015). Transference effect of vertical and horizontal plyometrics on sprint performance of high-level U-20 soccer players. *Journal of Sport Science*, 33(20): 2182-2191. DOI: 10.1080/02640414.2015.1081394.

LUMBROSO, D.; ZIV, E.; VERED, E. & KALICHMAN, L. (2014). The effect of kinesio tape application on hamstring and gastrocnemius muscles in healthy young adults. *Journal of Bodywork and Movement Therapies*, 18(1): 130-138. DOI: 10.1016/j.jbmt.2013.09.011.

MAHDI, A.K. & HOSSEIN, S. (2017). The mid-term effect of Kinesio taping on peak power of quadriceps and hamstring muscles after anterior cruciate ligament reconstruction. *Physical Education of Students*, 21(1): online. DOI: 10.15561/20755279.2017.0105

MENDEZ-VILLANUEVA, A.; BUCHHEIT, M.; SIMPSON, B.; PELTOLA, E. & BOURDON, P. (2011). Does on-field sprinting performance in young soccer players depend on how fast they can run or how fast they do run? *The Journal of Strength and Conditioning Research*, 25(9): 2634-2638. DOI: 10.1519/JSC.0b013e318201c281Y.

NYLAND, J.; LACHMAN, N.; KOCABEY, Y.; BROSKY, J.; ALTUN, R. & CABORN, D. (2005). Anatomy, function and rehabilitation of the popliteus musculotendinous complex. *Journal of Orthopaedic and Sports Physical Therapy*, 35: 165-179. DOI: 10.2519/jospt.2005.35.3.165.

PAOLI, A.; BIANCO, A.; PALMA, A. & MARCOLIN, G. (2012). Training the vertical jump to head the ball in soccer. *Strength and Conditioning Journal*, 34(3): 80-85. DOI: 10.1519/SSC.0b013e3182474b3a.

REQUENA, B.; GONZALEZ-BADILLO, J.J.; DE VILLAREAL, E.S.S.; ERELINE, J.; GARCIA, I.; GAPEYEVA, H. & PAASUKE, M. (2009). Functional performance, maximal strength, and power characteristics in isometric and dynamic actions of lower extremities in soccer players. *Journal of Strength and Conditioning Research*, 23(5): 1391-1401. DOI: 10.1519/JSC.0b013e3181a4e88e.

SANDSUND, M.; SAURSAUNET, V.; WIGGEN, O.; RENBERG, J.; FAAREVIC, H. & VAN BEEKVELT, M. (2012). Effect of ambient temperature on endurance performance while wearing cross-country skiing clothing. *European Journal of Applied Physiology*, 12: online. DOI: 10.1007/s00421-012-2372-1.

SARVESTAN, J.; ALAEI, F.; KAZEMI, N.S.; KHIAL, H.P.; SHIRZAD, E. & SVOBODA, Z. (2018). Agility profile in collegiate athletes with chronic ankle sprain: the effect of Athletic and Kinesiotaping among both genders. *Sport Sciences Health*, 14: 407 (online). DOI: 10.1007/s11332-018-0453-2

SEMCIW, A.I.; NEATE, R. & PIZZARI, T. (2016). Running related gluteus medius function in health and injury: A systematic review with meta-analysis. *Journal of Electromyography and Kinesiology*, 30: online. DOI: 10.1016/j.jelekin.2016.06.005.

SOLOMON, K.F.; MCLEAN, S.P. & SMITH, J. (2013). The acute effects of Kinesio Tape on athletic performance in healthy individuals. *International Journal of Exercise Sciences*, 2(5): Article 36 (online).

SPITERI, T.; COCHRANE, J.L.; HART, N.H.; HAFF, G.G. & NIMPHIUS, S. (2013). Effect of strength on plant foot kinetics and kinematics during a change of direction task. *European Journal of Sport Science*, 13(6): 646-652. DOI: 10.1080/17461391.2013.774053.

TOMAZONI, S.S.; DOS SANTOS MONTEIRO MACHADO, C.; DE MARCHI, T.; CASALECHI, H.L.; BJORDAL, J.M.; DE CARVALHO, P.T.C. & PINTO LEAL-JUNIOR, E.C. (2019). Infrared low-level laser therapy (Photobiomodulation therapy) before intense progressive running test of high-level soccer players: effects on functional, muscle damage, inflammatory and oxidative stress markers – A randomised controlled trial. *Hindawi*, Article ID: 6239058. DOI: 10.1155/2019/6239058.

TOUMI, H.; POUMARAT, G.; BENJAMIN, M.; BEST, T.M.; F'GUYER, S. & FAIRCLOUGH, J. (2007). New insights into the function of the vastus medialis with clinical implications. *Medical Science and Sport Exercises*, 39(7): 1153-1159. DOI: 10.1249/01.mss.0b013e31804ec08d.

ULLRICH, K.; KRUDWIG, W.K. & WITZEL, U. (2002). Posterolateral aspect and stability of the knee joint. I. Anatomy and function of the popliteus muscle-tendon unit: an anatomical and biomechanical study. *Knee Surgery, Sports Traumatology, Arthroscopy*, 10: 86-90. DOI: 10.1007/s00167-001-0268-5.

YEOW, C.H. (2013). Hamstrings and quadriceps muscle contributions to energy generation and dissipation at the knee joint during stance, swing and flight phases of level running. *Knee*, 20(2): 100-105. DOI: 10.1016/j.knee.2012.09.006.

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