

IMPACT OF SLACKLINE TRAINING & FIFA 11+ EXERCISE PROGRAM IN PREVENTING LOWER LIMB SOFT TISSUE INJURIES AMONG SEMI-PROFESSIONAL FOOTBALL PLAYERS: A COMPARATIVE STUDY

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ABSTRACT

Elite semi-professional football showed a high incidence of soft tissue injury. The positive impact of slackline training on static and dynamic balance could indicate the usefulness of slackline training in injury prevention. The study aimed to compare the impact of slackline training and the FIFA 11+ exercise program on the Y-balance test to prevent soft tissue injuries in the lower limb among semi-professional football players. 30 subjects were recruited and randomly divided into 2 groups [Group A & Group B]. The Y-balance test score was assessed for all participants. Group A followed a supervised slackline training program, and Group B was involved in the FIFA 11+ exercise program. For both groups, the frequency of training was 3 days per week for eight weeks. On statistical analysis, the post-test values showed that the p-value of YBT AT, YBT PL, YBT PM scores between the 2 groups are < 0.05 , < 0.01 , and < 0.001 respectively. Though both groups showed improvement in Y-balance test scores, Group A showed significant improvement over Group B subjects. In conclusion, slackline training is a better method to improve dynamic balance and thereby prevent injuries than the FIFA 11+ exercise program.

Keywords: *slackline training, FIFA 11+ exercise program, balance test, soft tissue injury, semi-professional football player*

INTRODUCTION

Football is the most popular sport in the world. The basic skills of a footballer are running, passing, dribbling, and shooting. Since the football match lasts 90 minutes, the footballer must have good endurance skills (Nicholls & Sintonen, 2018) reported that the overall injury incidence was 9.7 per 1000 h football exposure, and the prevalence with at least one injury was 79%. The highest overall injury incidence in elite junior football was 10.4 in 1000 h football exposure. (Loose et al., 2019). Most soccer injuries occur in the lower limbs (60–90%), especially the ankle, knee, and thigh (López-Valenciano et al., 2020). Among male players, the most common injuries affect the hamstring muscles followed by the ankle, knee, and groin (Feria-Arias et al., 2018). Soccer-related injuries are associated with both non-modifiable factors, such as sex and age, and modifiable factors, such as those that can be improved through programs that influence force, balance, and flexibility. Although both sets of factors interact and are risk determinants, professional players stop participating in soccer because of many modifiable causes. The evaluation and implementation of preventive soccer training routines are essential, as injuries are associated with expensive treatment and prolonged withdrawal duration (Woods et al., 2002).

Deficiencies in dynamic balance and altered postural control increase the risk of lower limb lesions. Soccer players with dynamic balance asymmetries are more likely to sustain a lower limb injury. The dynamic balance represents the ability to perform an action while maintaining or restoring a stable position and plays a crucial role in many sports activities. Football is a sport that requires a good dynamic balance during actions such as kicking, passing, dribbling, and cutting manoeuvres. Specifically, soccer players have inferior balance when compared with gymnasts and dancers but superior balance when compared with basketball players and control participants (Gerbino et al., 2007). There are several tests that can evaluate dynamic balance in athletes, including single-leg balance tests, jumping and landing tests. One of the most promising is the evaluation of the dynamic balance using the Y Balance Test (YBT).

Slacklining can be defined as standing or moving on a tightened band while maintaining postural balance. Performance of the task requires the integration of sensory input and neuromuscular response, balance, postural control, and muscle strength. It allows a high variability of movement with a small and unstable base of support that produces mediolateral disturbances to the body, continually challenging balance (Reyes-Ferrada et al., 2021). The response strategies that occur during slacklining are relevant to prehabilitation, rehabilitation, sporting achievement and simply having fun. However, practitioners should consider how to quantify a patient's progression through the sequential stages of motor learning from 'novice' to 'accomplished'. This progression can be achieved and documented in a standardized way through the use of a four-stage, 20-step program for slacklining as proposed by Gabel and Mendoza (Gabel, 2014).

The FIFA 11+ injury prevention program was developed in 2006 to address this matter, under the leadership of the FIFA Medical Assessment and Research Centre and in collaboration with the Oslo Sports Trauma Research Center and the Santa Monica Orthopaedic and Sports Medicine Center. The program comprises a complete warm-up procedure aimed at injury prevention in soccer players (Bizzini et al., 2015). The current evidence suggests that the FIFA 11+ exercise program can decrease the incidence of injuries in male and female amateur football players and also improve motor/neuromuscular performance (Barengo et al., 2014). In this study, we compared the effect of slackline training and the FIFA 11+ exercise program on

dynamic balance to prevent the incidence of lower extremity injury in semi-professional football players.

AIM OF THE STUDY

The objective of this study is to compare the impact of slackline training and the FIFA 11+ exercise program on dynamic balance to prevent the incidence of lower extremity injury in semi-professional football players.

Specifically, the objectives are as follows:

1. To determine the impact of Slackline training in preventing lower limb soft tissue injuries among semi-professional football players.
2. To determine the impact of the FIFA 11+ Exercise Program in preventing lower limb soft tissue injuries among semi-professional football players.
3. To compare the impacts of Slackline training & FIFA 11+ exercise program in preventing lower limb soft tissue injuries among semi-professional football players.

METHODS

A comparative study design was adopted for this study. This study was conducted at football clubs in the Kannur district of Kerala, India. Male semi-professional football players between 18 and 28 years of age with no injury in the past 6 months were included in this study. A Y-balance test score greater than or equal to 4 was another criterion for inclusion. Football players with lower limb injury, recent lower limb surgery, diabetes, and vestibular dysfunction were excluded from the study.

Outcome measure

The YBT is a functional test that requires strength, flexibility, neuromuscular control, balance, stability, and range of motion (ROM). The YBT will be useful during pre-season testing and when attempting to determine when the player is able to return to sport after an injury. The test kit consists of a centralized platform to which three pipes were attached representing the anterior (AT), posteromedial (PM), and posterolateral (PL) reach directions (Schwiertz et al., 2018). The YBT showed good relative and absolute interrater, test-retest reliability among raters with no experience in the use of the YBT. The YBT is thus considered suitable at both group and individual levels in young, healthy, and physically active populations (Foldager et al., 2023).

Procedure

40 subjects were screened based on the inclusion and exclusion criteria. Informed consent was obtained from all subjects and the procedure was explained to the participants. The players for screening. The anterior reach, posterior lateral reach, and posterior medial reach distances were measured using a YBT test kit. After screening 30 players were selected and they were randomly distributed into Group A (Slackline, N = 15) and Group B (FIFA 11+ Exercise Program, N = 15). No dropouts occurred due to injuries. Data on those players were not included in the analysis.

Eight minutes of warm-up exercises were given to each group prior to the treatment. The exercises are running straight ahead, running hip out, running hip in, running circling partner, running shoulder contact, and running quick forwards and backward. The trial period was eight weeks. Slackline training was given to Group A. and the participants of Group B received FIFA 11+ Exercise Program. the frequency was 3 days per week for eight weeks (Table 1). For both groups, it took 30 minutes to complete the training and the frequency was 3 days per week for eight weeks.

Table 1: Slackline training given to Group A and FIFA 11+ Exercise Program. For Group B

Group training	Stages	Training
Group A: Slackline training	Stage 1- Beginner: Stand	Single leg stand – dominant Single leg stand – non-dominant Single leg dominant and touch behind Single leg non-dominant and touch front Single leg non-dominant and touch behind Single leg dominant and touch front
	Stage 2-Moderate: Walk	Walk forward Walk back Tandem stance dominant back Tandem stance dominant forward
	Stage 3-Intermediate: Tandem	Tandem stance: turn on two feet to the natural side with the nondominant forward Tandem stance: turn on two feet to the non-natural side with the nondominant forward Tandem stance: turn on two feet to the natural side with dominant forward Tandem stance: turn on two feet to the non-natural side with dominant forward Side stand surf posture with feet perpendicular to the slackline
	Stage 4-Advanced: Squats	Surfer: Squat in side stand Squat in tandem dominant behind Squat in tandem dominant front Single leg squat on dominant Single leg squat on non-dominant
Group B: FIFA 11+ Exercise Program	Sideways Bench	Level 1: Static Level 2: Raise and lower hip Level 3: With leg lift
	Hamstrings	Level 1: Beginner Level 2: Intermediate Level 3: Advanced
	Single-leg Stance	Level 1: hold the Ball Level 2: throwing the ball with the partner Level 3: test your partner
	Squats	Level 1: With toe raise Level 2: Walking lunges Level 3: One-leg squat
	Jumping	Level 1: Vertical jumps Level 2: Lateral jumps Level 3: Box jumps
	Running Exercises	Running across the pitch Running bounding Running plant and cut

The YBT was administered at the beginning and at the end of 8 weeks of training for all participants.

Statistical analysis

All data were analysed using the SPSS 22.0 version (IBM, Chicago, IL). In this study, pre-test and post-test interventional differences within the groups were analysed using paired t-test and between the two groups were analysed by unpaired t-test.

RESULTS

A total of 30 football players ((20.68 ± 2.30 years) participated in this trial.

On analysis, it was found that there is no significant difference in pre-test YBT scores (AT, PL, and PM) between the groups. So, we can consider the groups as homogenous at the baseline level (p value > 0.05). There is a significant difference existing between the pre-test and post-test YBT scores (AT, PL, and PM) among semi-professional football players in group A. This proves that there is a significant improvement in YBT PL among semi-professional football players given slackline training. The findings are summarised in Table 2.

Table 2: Mean, SD and t-value comparing the pre-test and post-test YBT-AT, YBT-PL and YBT-PM of Group A using paired t-test

YBT Direction	Test	Mean	SD	Difference in mean	n	t	df	p-value
YBT-AT	Pre-test	4.87	2.69	3.8	15	6.47	14	p < 0.001
	Post-test	1.07	0.79					
YBT-PL	Pre-test	5.27	3.03	2.87	15	4.65	14	p < 0.001
	Post-test	2.4	2.29					
YBT-PM	Pre-test	7.07	4.63	3.87	15	4.43	14	p < 0.001
	Post-test	3.2	1.82					

On statistical analysis, there is a significant difference existing between the pre-test and post-test YBT scores (AT, PL, and PM) among semi-professional football players in group B. This proves that there is a significant improvement in YBT scores among semi-professional football players given FIFA 11+ exercise program (p < 0.01). The findings are summarised in Table 3.

Table 3: Mean, SD and t-value comparing the pre-test and post-test YBT-AT, YBT-PL and YBT-PM of Group B using paired t-test

YBT Direction	Test	Mean	SD	Difference in mean	n	t	df	p-value
YBT-AT	Pre-test	4.13	3.66	1.6	15	3.43	14	p < 0.01
	Post-test	2.53	2.64					
YBT-PL	Pre-test	5.47	1.81	1.14	15	4.79	14	p < 0.001
	Post-test	4.33	1.45					
YBT-PM	Pre-test	7.13	4.02	1.73	15	4.38	14	p < 0.001
	Post-test	5.4	2.82					

When comparing post-test values of YBT AT in Group A and Group B using a t-test. The difference (1.46) shows the difference between the mean in the two groups (1.07&2.53). Since the *t-value* 2.1, shows a *p-value* < 0.05, there is a significant difference in post-test YBT AT between the groups. The YBT AT in Group A is significantly lower than that in Group B. Hence, we can conclude that slackline training is significantly more effective than the FIFA 11+ exercise program on YBT AR among semi-professional football players.

When comparing post-test YBT PL in Group A and Group B using a t-test, the difference (1.93) shows the difference between the mean in the two groups (2.4&4.33). Since the *t-value* of 2.77, shows a *p-value* < 0.01, there is a significant difference in post-test YBT PL between the groups. The YBT PL in Group A is significantly lower than that in Group B. Hence, we can conclude that slackline training is significantly more effective than the FIFA 11+ exercise program on YBT PL among semi-professional football players.

When comparing post-test YBT PM in Group A and Group B, the difference (2.2) shows the difference between the mean in the two groups (3.2&5.4). Since the *t value* 2.54, shows *p-value* < 0.05, there is a significant difference in post-test YBT PM between the groups. The YBT PM in Group A is significantly lower than that in Group B. Hence, we can conclude that slack line training is significantly more effective than the FIFA 11+ exercise program on YBT PM among semi-professional football players. The findings are summarised in Table 4.

Table 4: Mean, SD and *t-value* to compare the post-test YBT-AT, YBT-PL and YBT-PM between Group A and Group B using unpaired *t-test*

YBT Direction	Group	Post-test Mean	SD	Difference in mean	<i>n</i>	<i>t</i>	<i>df</i>	<i>p-value</i>
YBT-AT	Group A	1.07	0.79	1.46	30	2.1	28	<i>p</i> < 0.05
	Group B	2.53	2.64					
YBT-PL	Group A	2.4	2.29	1.93	30	2.77	28	<i>p</i> < 0.01
	Group B	4.33	1.45					
YBT-PM	Group A	3.2	1.82	2.2	30	2.54	28	<i>p</i> < 0.05
	Group B	5.4	2.82					

Results from the present study showed that slackline training produced significant gains in dynamic balance over FIFA 11+ Exercise Program among semi-professional football players thereby helping in preventing lower limb soft tissue injuries.

DISCUSSION

Football is one of the most popular games in the world, it is a sport that requires a good dynamic balance during actions such as kicking, passing, dribbling, and cutting manoeuvres (Pau et al., 2015). Balance is a component that affects the implementation of football skill movements both from the moment of receiving the ball until the ball is passed back to other players, which is to produce good dribbling movements from the preparation, execution, and final movement stages and continuously until the ball is given to a friend. So, to be able to produce good and effective dribbling skills, good dynamic balance is needed as well (Bukowska et al., 2021). Deficiencies in dynamic balance and altered postural control increase the risk of lower limb lesions (Onofrei et al., 2019; Butler et al., 2013). The overall injury incidence in semi-professional football was 9.7 per 1000h football exposure (training 4.5/1000h, match 27.1/1000 h) (Loose et al., 2019). this

study aimed to compare two interventions that influence dynamic balance to prevent injury in semi-professional football players.

The FIFA 11+ training program focuses on core/leg strength, balance, and plyometrics. According to studies, players who undertook FIFA 11+ during the season improved their functional balance. Neuromuscular control is one of the crucial factors so as to have functional balance efficiency which can be averted. The FIFA 11+ program provokes core and hip musculature and improves neuromuscular control and triggers core muscle activation and with that effect, it may improve core stability in individuals. The core is important because it is defined as the lumbo-pelvic-hip complex where a person's centre of gravity is located and all movement begins (Sadeghia et al., 2013). The key is to control the body's centre of gravity, the point around which the body balances most perfectly. By keeping the centre of gravity between the bases of support, the athletes can more easily change direction. In addition, lowering the centre of gravity adds stability. Implementation of core stability also increased control of the centre of mass. As the centre of mass moves away from the base of support, there is an increased potential for biomechanical deviations to occur in the lower extremity (Kilber, et al, 2006).

This program can also improve performance with better hamstring/quadriceps strength ratio, jumping, and agility skills. During dynamic movement, co-contraction of agonist and antagonist muscles is important for joint stabilization. Researchers have proposed that in order to maintain the ideal joint position, balance of these opposing muscles is very important, during athletic movements such as jumping, pivoting, and cross-cutting hamstring/quadriceps strength ratio is a critical factor for avoiding injuries. Bizzini and Dvorak (2015) stated that physiological responses, performance, and static and dynamic balance were improved immediately after the FIFA 11+ program. So, it can be concluded that FIFA 11+ exercises (strength, balance, plyometric) due to the variety it provides for athletes, can cause an increase in the dynamic balance of athletes.

There is a significant difference in post-test YBT AT scores between Group A and Group B. In the case of posterolateral score, the mean pre-test score of group A and group B are 5.27 and 5.47, and the mean post-test score of group A and group B are 2.4 and 4. Since the P-value is < 0.01 , there is a significant difference in post-test YBT PL between the groups. The mean pre-test YBT PM scores of Group A and Group B are 7.07 and 7.13 and the mean post-test score of Group A and Group B are 3.2 and 5.4 respectively. Since the p-value is < 0.001 there is a significant difference existing between the pre-test and post-test posteromedial score between the groups.

The participants in Group A that performed Slackline Training demonstrated improvements in YBT AT, YBT-PL, and YBT-PM measurements. It indicates that this type of cross-training exercise could be of great help to develop dynamic balance. This finding could be considered remarkable because soccer players perform between 1000-1400 short activities during a game (Stølen et al., 2005). The findings of this study are in accordance with the results of a previous study conducted among footballers (Fernández-Rio et al., 2019). The quadriceps, gastrocnemius, and tibialis anterior were the most exerted muscles while slacklining. Gamble (2012) included strength qualities as trainable determinants of acceleration, but also postural control and stability. Dynamic balance could be considered a key element for football players; since its improvement has been connected with a positive impact on their performance (Little

and Williams, 2005). Results from the present study indicate that a slackline training program can help improve football players' dynamic balance.

Dynamic balance performance has previously been associated with increased injury risk in varied populations (de Noronha et al., 2012). Previous work by Plisky et al. observed that high school basketball players who exhibited asymmetry (>4 cm) or low performance (lower one-third of the population) on the Star Excursion Balance Test (SEBT) were at an elevated risk for lower extremity injury. In addition, poor performance in the posterolateral direction of the SEBT is a strong predictor of ankle sprains in recreational adults (Meyers, 2010). Not surprisingly, poor performance in dynamic balance has been observed in patients with a history of injury. Individuals with a history of chronic ankle instability perform worse on the SEBT in comparison with uninjured controls (Sefton et al., 2009). Likewise, patients with a history of an anterior cruciate ligament (ACL) tear perform worse on the SEBT when compared with controls (Herrington et al., 2009). As a result, it appears as if dynamic balance is related to increased injury risk and that following injury, changes in dynamic balance occur that decrease dynamic balance ability. Dynamic balance screening may provide additional information to identify football players at an elevated risk for injury. Different types of athletes have agreed that slacklining is not a demanding exercise. Therefore, it can be easily introduced in any training schedule (Santos et al., 2014; Santos et al., 2016). More important, researchers observed that athletes considered it an enjoyable activity, which is important to motivate them in long, tiring training sessions during a regular season.

Unstable surfaces provide sudden alteration in joints to stimulate reflex joint stabilization this makes training more dynamic and possibly applicable to sporting contexts. Unstable surfaces require an increase in lower leg muscle activity and proprioception during standing to a much greater extent than a rigid floor. Unstable surface training will enhance performance via the improvement of balance, kinaesthetic sense, and proprioception. Unstable surface training aims to develop afferent efficiency to reduce injury risk and improve performance such training may help to establish proper agonist-antagonist co-contraction for joint stability and improve the rate of force development. When comparing beginners to slackline-trained individuals, trained slackliners show a more precise control of the acceleration of the centre of mass, projecting it close to the centre of the foot and allowing better balance control over time (Stein & Mombaur, 2019). These adaptations of slackline practice may be translated into a greater ability to keep the centre of gravity stable within the base of support through the maintained action of core muscles in those who practice slackline when compared to physically inactive individuals without experience in this type of training.

Though both the training programs demonstrated an increase in YBT scores, a better improvement was seen in participants that underwent slackline training. The only study conducted among youth soccer players showed larger training effects of slackline training compared to the FIFA 11+ program (Jäger et al., 2017), and our results reinforce this idea. Slacklining produces very high movement variability and very fast mediolateral disturbances to the body (Pfusterchmied et al., 2013). These seem to stimulate the individual's PCS in the mediolateral and anterior-posterior directions. Our results are in line with previous studies conducted on basketball players (Santos et al., 2016). Since slacklining provides a highly movable surface, gains should be more evident on tests conducted on compliant surfaces.

One of the most consistent risk factors for injury across epidemiologic studies in sports is previous injury. However, this was not considered in the present study as the inclusion criteria

of no injury in the past 6 months. The primary limitation of the current study is limited external validity due to the specific population examined. This limitation is lessened because of the prior finding of poor dynamic balance being associated with noncontact injury in high school basketball players and in a general recreational population. (de Noronha et al., 2012; Plisky et al., 2006). The study has been conducted on a small size sample only. Future studies should consider a larger sample size.

CONCLUSION

It was observed that both the groups showed improvement in anterior, posterolateral, and posteromedial scores of the Y balance test, but Group A showed significant improvement over Group B. So, it can be concluded that the dynamic balance of Group A subjects showed a significant improvement over Group B subjects, so Slackline training improves dynamic balance more significantly than the FIFA 11+ exercise program. Hence it can be included in pre-season training to prevent non-contact soft tissue injuries of the lower limb.

Conflict of Interest

The authors declare no conflict of interest.

Author's Contributions

Nizar Abdul MK conceptualized and designed the study, prepared the draft of the manuscript, and reviewed the manuscript; Shibin RP, led the data collection, and communicated with all participants, data analysis and interpretation, and reviewed the manuscript; Aparna S, gave substantial contributions to conception and reviewed the manuscript.

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