ORIGINAL ARTICLE

Physical Therapy Journal of Indonesia (*PTJI*) 2024, Volume 5, Number 2: 159-163
E-ISSN : 2722-6034 ; P-ISSN : 2722-0125

Effect of dual task exercise on dynamic balance in futsal player with functional ankle instability

Fortunella Levyana[1], Anita Faradilla Rahim[1*], Dimas Sondang Irawan[1]

[1]Program Study of Physiotherapy, Faculty of Health Sciences, Universitas Muhammadiyah Malang, Malang City, East Java 65113, Indonesia.

*Corresponding author:
Anita Faradilla Rahim;
Program Study of Physiotherapy, Faculty of Health Sciences, Universitas Muhammadiyah Malang, Malang City, East Java 65113, Indonesia;
anitafaradilla@umm.ac.id

Received: 2024-03-10
Accepted: 2024-06-13
Published: 2024-07-17

ABSTRACT

Background: Recurrent ankle sprains are typically caused by an athlete performing two or more duties at the same time. At least one task performance and dynamic balance are carried out in most athletic performances. This study aimed to determine an intervention that involves dual tasks for futsal players with functional ankle instability (FAI) and to investigate the effect of the exercise on dynamic balance and different characteristics of players.

Methods: The research was quasi-experimental, with a non-equivalent control group design. Thirty futsal players with FAI were recruited, as identified by the Identification of Functional Ankle Instability questionnaire. The participants were separated into experimental (n=16) and control (n=14) groups. The experimental group did plyometric exercises and cognitive activities (serial three or serial seven) for 15 minutes each, three times a week for six weeks. In contrast, the control group performed only plyometric exercises. The Y-Balance Test was used to measure dynamic balance. Participants were tested again six weeks later.

Results: The experimental group showed more significant improvement than the controls. Compared before and after intervention in each group, the dynamic balance was substantially increased ($p<0.05$). Following the intervention, no statistically significant difference was seen between the two groups ($p>0.05$).

Conclusions: In this article, we outlined the potential use of dual-task exercise (DTE) in the athlete population to support athletic performance and provide more insights to implement in injury prevention. We need further research to clarify the optimum time to make significant improvements with DTE.

Keywords: ankle sprain, dual-task exercise, functional ankle instability, sports injury.

Cite This Article: Levyana, F., Rahim, A.F., Irawan, D.S. 2024. Effect of dual task exercise on dynamic balance in futsal player with functional ankle instability. *Physical Therapy Journal of Indonesia* 5(2): 159-163. DOI: 10.51559/ptji.v5i2.214

INTRODUCTION

Futsal requires players to be ready to receive and distribute the ball rapidly under pressure from opposing players. With a relatively small field area, this game necessitates strong ball possession skills, teamwork, and cooperation among participants.[1] The game of futsal is high-speed and dynamic.[2] Futsal is a game played with high intensity and speed and requires quick and efficient decision-making.[3] All of these unique traits, combined with periods of overload from training and competition, make futsal a sport with a high incidence of injuries.[4]

Futsal is a sport that causes 55.2 injuries per 10,000 hours of training.[5] This is consistent with earlier studies, which imply that injuries in futsal sports averaged 22.4 per 1,000 hours of training.[6] The majority of injuries were reported in the lower extremities, ranging from 36.9 to 88.2%. This outcome is caused by a futsal-specific characteristic: the lower extremities are constantly under strain during futsal training due to ball possession, displacement, and engagement with opponents.[7]

Lateral ankle sprain (LAS) is one of the most prevalent futsal injuries. Specifically, dribbling and shooting increase the risk of ankle damage.[4] The most common complication after LAS is chronic ankle instability (CAI). Chronic lateral ankle instability (CLAI) is a reoccurring injury that produces intermittent discomfort, edema, ankle instability, and restricted range of motion (ROM).[8] CAI is divided into two types: functional ankle instability (FAI) and mechanical ankle instability (MAI), which are distinguished by symptoms such as giving way, pain, and repeated ankle damage. Repetitive ankle injuries are typically caused by performing two or more jobs at the same time.[9]

Following the initial LAS episode, 40% of persons will develop CAI, which can result in static or dynamic postural instability and dysfunction. It is suspected that proprioceptive disorders, postural control, neuromuscular deficits, and weakness of the surrounding muscles after ankle injury may be contributing factors to this instability.[10] Dynamic balance has a complex structure with sensory systems, including visual, somatosensory, vestibular, and proprioceptors.[11] Many cognitive skills, such as attention, decision-making, and working memory, are required for peak performance in stressful and demanding circumstances. When two tasks are performed concurrently, a lack of cognitive ability to maintain postural stability and conduct mental tasks may result in poor postural stability, cognitive performance, or both. The theory is that shifting attention permits the motor system to function spontaneously, resulting in more efficient performance. Several studies have found that dual-task exercise improves both balance and functional performance in CAI circumstances.[9]

In futsal games, each player performs dynamic movements such as heading, cutting, tackling, sprints, passing, and shooting. Thus, futsal players must have physical condition components such as agility, balance, power, reaction speed and accuracy, and coordination.[12] Based on these physical condition components, this study focuses on one of the components a futsal player needs: dynamic balance. Dynamic balance is one element that determines success in sports such as futsal.[2,13] The athlete must focus on many relevant cues during the game. Therefore, the ability of athletes to participate in dual-task affairs may differ from that of non-athletes, thus requiring deeper investigation in the field of sports.[14] Sports physiotherapy strives to prevent injuries, rehabilitate injuries in time, quickly return athletes to activity, improve athletes' strength and condition, and facilitate specific sports performance.[15] Using the information provided above, the researchers aimed to determine an intervention that involves dual tasks for futsal players with FAI and investigate the exercise's effect on dynamic balance and different characteristics of players.

METHODS

The research was quasi-experimental, with a non-equivalent control group design. The current study involved 36 futsal players. Thirty futsal players with FAI, as determined by the IdFAI questionnaire, were recruited. The participants consisted of 14 well-trained players from professional futsal clubs and 16 people who had no prior experience competing in big sporting tournaments. They divided into two groups: experimental (n = 16) and control (n = 14). Inclusion criteria included the absence of acute and overuse musculoskeletal injuries, as well as chronic neurological diseases, vestibular issues, and a history of concussion. The procedure and goal of the study were explained to all participants, who then signed the informed consent form approved by Universitas Muhammadiyah Malang. The people were interviewed and inspected to verify they met the inclusion and exclusion criteria. The individuals' heights were measured using a centimetre-precision tape measure. A digital scale was used to weigh the people (to compute body mass index (BMI)), and a Y-Balance Test was performed to assess dynamic balance.

The Y-Balance Test package included a placement platform and three pieces of stiff tape that were clearly marked in centimeters. It defined the directions for anterior, posteromedial, and posterolateral reach. The posterior directions were each 135 degrees from the previous one and 90 degrees apart. Before the exam began, individuals could conduct 4-6 practice trials in each direction. The participants were given three official test moments, followed by a 5-minute rest period.

The stance foot was placed with its toes at zero on the anterior-reach direction line. For the posteromedial and posterolateral reaches, the heel was placed at the zero mark on the anterior-reach direction line. Participants stood barefoot on one leg, hands on hips, and attempted to reach as far as possible along the tape strip. The tape was only faintly contacted by the toes, and another piece of tape marked the farthest distant point of contact. A trial was declared failed if the participants powerfully touched the tape, came to a halt at the halfway point, contacted the ground to maintain balance, or changed the foot of the stance leg. The length of the participants' right legs was measured from the anterior superior iliac spine to the most distal region of the medial malleolus.

The Y-Balance Test was graded by determining the average reach distance in each direction in centimeters. The average distance in each direction was then determined as a percentage by dividing it by the participant's leg length and multiplying by 100. The composite reach distance was computed by adding the three reach directions, dividing by three times limb length, and multiplying by 100.[16] The scores were recorded, and the information was gathered and placed into a Microsoft Excel spreadsheet. At the time of testing, all participants had been cleared for regular training.

Each participant was allocated to one of two groups: plyometric (control group) or plyometric with cognitive task (experiment group). Participants were told to leap as high as possible with little knee bend for plyometrics and never let their heels touch the ground on pogo jumps. To maximize lower leg suppleness, stay on the ball of your feet. Participants were instructed to accomplish each jump primarily with their ankles rather than their hips and knees.[17] Participants were asked to count down loudly as quickly and precisely as possible for the cognitive task, which was either one hundred to three or seven.[18] The explicit instructions were: "*Count down from 100 by sevens.*" The workout session lasted six weeks, with three sessions per week. Metronome speeds of 120 beats per minute were used during each session to ensure that all participants exercised at the same intensity. The author guided and observed the exercises. Tables 1 and 2 present the protocol in a tabular format.

This study used plyometric and cognitive task interventions for futsal players three times each week: on Tuesdays, Thursdays, and Saturdays. This study used a quasi-experimental quantitative approach using a pre-test and post-test non-equivalent control group design to determine the causal relationship between independent and dependent variables during a specific period.[19] Furthermore, an experimental study was carried out by running direct experiments on the tested variable. This trial ran for six weeks. Additionally, from May to June 2024, plyometric and cognitive challenges will be offered three times each week.

Following a descriptive review, the received data were examined with *Saphiro-Wilk* to test the hypothesis that a sample or data was normally distributed. This study was conducted utilizing statistical parametric analysis, including a paired sample *t*-test to evaluate paired data at ratio scales and an independent sample *t*-test in two groups. The result was also reached by utilizing the SPSS application to compare the *P*'s value (sig 2-tailed) to the value (0.05). H_0 was accepted if $p>0.05$, while H_1 was acceptable if $p<0.05$.

RESULTS

The current study involved 36 futsal players. Of them, 30 futsal players agreed to participate. Table 3 shows that the average age, height, and weight of the five

Table 1. **Exercise program**

Control Group	Experiment Group
DL Pogo Jumps	DL Pogo Jumps + Serial 3/7
SL Pogo Jumps	SL Pogo Jumps + Serial 3/7
Alt Pogo Jumps	Alt Pogo Jumps + Serial 3/7

DL: double leg, SL: single leg, Alt: alternate

Table 2. **Plyometric (Pogo Jumps) Dose**

Period	Work/Rest	Set	Rest
Week 1-2	10s/10s	Three sets	60s
Week 3-4	15s/15s	Three sets	60s
Week 5-6	20s/20s	Three sets	60s

Work/rest: Work/rest per exercise; Rest: Rest between sets

Table 3. **Characteristics of the participants**

Variable	Experiment Group (n=16)	Control Group (n=14)
Age (yr)	18.38±0.6	26.14±4.20
Height (m)	1.72±0.06	1.75±0.07
Weight (kg)	63.56±10.18	73.64±8.71
BMI (kg/m^2)	21.39±2.40	23.95±1.83
Leg Length (cm)	85.95±3.89	88±4.28

Mean±Standard Deviation

Table 4. **Dynamic balance changes within 30 participants before and after plyometric and plyometric with cognitive task using paired sample *t*-test**

Characteristic	Mean±SD	*t*-Value	*P*-Value
Dual-task, n=16			<0.001
Pre-test RL	90.02±2.97	-11.689	
Post-test RL	99.66±3.61		
Pre-test LL	90.87±3.30	-14.757	
Post-test LL	95.37±3.30		
Single task, n=14			<0.001
Pre-test RL	89.27±3.67	-12.551	
Post-test RL	98.23±4.01		
Pre-test-LL	92.60±4.01	-5.340	
Post-test LL	95.90±3.49		

Dual Task: Plyometric and Cognitive task, Single Task: Plyometric, RL: right leg, LL: left leg

Table 5. **Dynamic balance changes between 30 participants after plyometric and plyometric with the cognitive task using independent sample *t*-test**

	Characteristic	t-Value	P-Value
RL	Dual-task, n=16	1.024	0.315
	Single task, n=14		
LL	Dual-task, n=16	-0.430	0.670
	Single task, n=14		

RL: right leg; LL: left leg

goalkeepers, six anchors, 12 flanks, and seven pivots were 22 ± 4.9 years old, 1.73 ± 0.07 m, and 68 ± 11 kg, respectively. The majority of them (67%) identified "right" as the dominant member. A total of 30 futsal players with a history of injury scored more than 11 on the IdFAI in at least one of their limbs, indicating self-perceived instability. Of the 30 futsal players, 11 (37%) had bilateral instability, with the remaining instability in the right (n = 13, 43%) or left lower leg (n = 6, 2%).

Sixteen futsal players had no experience participating in big athletic competitions (GK, n=2; flank, n=6; anchor, n=4; pivot, n=4; right dominant leg, n=12; left dominant leg, n=4) and fourteen well-trained futsal players (GK, n=3; flank, n=6; anchor, n=2; pivot, n=3; right dominant leg, n=8; left dominant leg, n=6) took part in this study. The dynamic balance improvement before and after the plyometric with cognitive task showed the following results: Plyometric with cognitive task improved the dynamic balance with *P*<0.001 (Table 4). There was a substantial effect of combining plyometric exercises with cognitive tasks on dynamic balance in futsal players with FAI.

The measurement using the Y balance test composite score from the pre-test and post-test showed dynamic balance improvement after plyometric with *P*<0.001 (Table 4). Plyometrics alone also positively affected dynamic balance in futsal players with FAI. The measurement using the Y balance test composite score towards two intervention groups showed no significant difference between plyometric with cognitive task and plyometric alone, with *P*=0.315 for the right leg and *P*=0.670 for the left leg (Table 5).

DISCUSSION

An athlete must repeatedly use the stretch-shortening cycle when performing various sports actions such as vertical jumping, endurance running, sprint running, and performances that require direction changes. At the tissue level, with motions like these, the musculotendinous unit (MTU) behaves like a spring or elastic, stretching as the lower limb joints flex before shortening as the joints lengthen. The term "stiffness" refers to the spring-like action of musculotendinous tissue.[20]

Many different types of exercises can be utilized to treat lower limb discomfort. Plyometric exercises involve two actions for the same muscles and connective tissues: fast dynamic stretching (eccentric action) followed by muscle shortening (concentric action). Furthermore, plyometrics is concerned with how to fast or explosively transition between two separate muscle motions, such as muscle extension and contraction. Plyometrics, such as pogo jumps, are a low-cost program for improving various athletic abilities because they require little or no equipment to do. Several studies have found that plyometrics can improve biomechanical skill and neuromuscular control during high-impact exercises like cutting and landing, reducing the risk of lower-extremity injuries in team sports.[17]

Balance is a necessary component of motor abilities for maintaining posture and performing complex workout tasks.[21] Balance requires coordination between the sensory, motor, and cognitive systems. Furthermore, the dysfunction of each component affects postural maintenance. Attention is the individual's information processing capacity.[18] The peroneus longus and anterior tibial muscles help to keep the ankle stable while walking, running, and landing.[22] Contracting the muscles around the joint achieves dynamic joint stabilization. During lower-limb activities like sprinting, chopping, and jumping, the athlete employs muscle contraction, particularly eccentric control, to decrease tensions between the ground and the ankle complex.[23,24]

The collected results show that plyometric and cognitive exercises improved dynamic balance in futsal players with FAI. Although there was no statistically significant difference between the two groups, it is recommended that physiotherapists employ a dual-task paradigm to improve athletic performance while also implementing more critical insights into injury prevention.[25] The external emphasis (counting backward loudly) may have diminished conscious control over postural balance. A prior study examined the influence of dual-tasking on static and dynamic balance performance in endurance and team sport athletes. It demonstrated that the task condition (single or dual task) had a more significant influence on postural balance performance than the sport or training. Furthermore, most team players' tendency to deal with multiple responsibilities did not result in superior postural performance compared to endurance athletes. It supports their premise that secondary tasks while driving and developing training are critical and should be as sport-specific as feasible.[26]

The duration of the adaption process is also significant to consider. A recent study discovered that programs that go longer than seven weeks are more beneficial. Prescriptions of <250 jumps per week appear best for improving stiffness. In this study, the experimental and control groups made 180-foot encounters in the first two weeks, 270-foot contacts in the third and fourth weeks, and 360-foot contacts in the last two weeks. Previous research has also indicated that stiffness adaptations appear to be more assertive in untrained than trained people.[20]

This study has various limitations that must be explained. For starters, the findings of this study cannot be applied to a larger population outside of the study context. Second, the study's sample size was relatively modest. The statistical power of the effects of study treatments could differ with larger populations. The intervention for two groups cannot be done in isolation but rather as a supplementary or pitch-based warm-up to a tactical exercise. Third, the scope of this study is limited to determining the causal association between Y-Balance test composite scores and a history of past LAS. Furthermore, this study did not monitor the participants' dynamic balance following the intervention, which may have changed after the study period was over.

CONCLUSION

Our findings revealed that plyometric and plyometric exercises paired with cognitive activities (dual-task exercises) improved dynamic balance in futsal players who had functional ankle instability. Although there was no statistically significant difference between the two groups following the intervention, the dual-task exercises were more effective at managing functional ankle instability and the subjective experience of giving way.

ETHICAL CLEARANCE

The procedure and goal of the study were explained to all participants, who then signed the informed consent form approved by Universitas Muhammadiyah Malang.

CONFLICT INTEREST

This research contains no conflicts of interest.

FUNDING

There was no specific support for this research from any public, corporate, or non-profit organization.

AUTHOR CONTRIBUTIONS

FL created the study design, gathered and analyzed data, and drafted the report. AFR and DSI interpreted, analyzed, and drafted the manuscript.

REFERENCES

1. Syafaruddin S. Tinjauan olahraga futsal. Altius J Ilmu Olahraga dan Kesehatan. 2018; 7(2): 161-7.
2. Lhaksana J. Taktik dan strategi futsal modern. In Taktik dan Strategi Futsal Modern. . Penebar Swadaya Group. 2011. 10–13 p.
3. Ruiz-Pérez I, López-Valenciano A, Jiménez-Loaisa A, Elvira JLL, De Ste Croix M, Ayala F. Injury incidence, characteristics and burden among female sub-elite futsal players: a prospective study with three-year follow-up. PeerJ. 2019; 7: 1-21.
4. Cherati AS, Dousti M, Younespour S. Association between foot posture index and ankle sprain in Indoor Football Players. Glob J Health Sci. 2016 Feb 25; 8(10): 160.
5. Schmikli SL, Back SJG, Kemler HJ. "National Survey on Sports Injuries in the Netherlands: Target Populations for Sports Injury Prevention Programs." Clin J Sport Med. 2009; 19: 101–6.
6. Willick SE, Webborn N, Emery C, Blauwet CA, Pit-Grosheide P, Stomphorst J, et al. The epidemiology of injuries at the London 2012 Paralympic Games. Br J Sports Med. 2013; 47(7): 426–32.
7. Lago-Fuentes C, Jiménez-Loaisa A, Padrón-Cabo A, Calvo MM, García-Pinillos F, Rey E. Epidemiology of Injuries in Elite Female Futsal Players: A Prospective Cohort Study. Int J Sports Med. 2020; 41(12): 885–90.
8. Adhitya IPGS, Yu WY, Saraswati PAS, Winaya IMN, Lin MR. Validation of the Indonesian Version of the Foot and Ankle Outcome Score in patients with chronic lateral ankle instability. J Foot Ankle Res. 2021; 14(1): 1–15.
9. Onegh A, Akbari A, Ghiasi F, Hosseinifar M, Ashtiani AA. The effect of dual-task training on dynamic postural control in the subjects with functional ankle instability. J Biochem Tech. 2020; 11(3): 115–22.
10. Wang L, Yu G, Chen Y. Effects of dual-task training on chronic ankle instability: a systematic review and meta-analysis. BMC Musculoskelet Disord. 2023 Oct 13; 24(1): 814.
11. Al-Mohrej OA, Al-Kenani NS. Chronic ankle instability: Current perspectives. Avicenna J Med. 2016; 6(4): 103–8.
12. Ren Y, Wang C, Lu A. Effects of perceptual-cognitive tasks on inter-joint coordination of soccer players and ordinary college students. Front Psychol. 2022; 13: 1-10.

13. Muhammad R, Prastowo B, Rahmanto S. Hubungan chronic ankle instability terhadap keseimbangan dinamis pada mahasiswa pemain futsal Univeritas Muhammadiyah Malang. AVERROUS: Jurnal Kedokteran dan Kesehatan Malikussaleh. 2022; 8(2): 27-39.
14. Moreira PED, Dieguez GT de O, Bredt S da GT, Praça GM. The acute and chronic effects of dual-tasking on motor and cognitive performance in athletes: A systematic review. Int J Environ Res Public Health. 2021; 18(4): 1-14.
15. Davies G, Riemann BL, Manske R. Current concepts of plyometric exercise. Int J Sports Phys Ther. 2015; 10(6): 760–86.
16. Fratti Neves L. The Y Balance Test – How and Why to Do it? International Physical Medicine & Rehabilitation Journal. 2017; 2(4): 99-100.
17. Althawadi FO. Preseason plyometric training program for soccer players. Saudi Journal of Sports Medicine. 2023; 23(2): 38–43.
18. Shadkanlu Ostad M, Norasteh AA, Babagoltabar Samakoush H. Comparison of a static and dynamic balance of athletes of different sports in conditions with and without posture disturbances. Journal of Sport Biomechanics. 2019; 4(4): 16–27.
19. Isnawan MG. Kuasi Eksperimen. 1st ed. Sudirman MP, editor. Nusa Tenggara Barat: Nashir Al-Kutub Indonesia; 2020. 5–15 p.
20. Moran J, Liew B, Ramirez-Campillo R, Granacher U, Negra Y, Chaabene H. The effects of plyometric jump training on lower-limb stiffness in healthy individuals: A meta-analytical comparison. J Sport Health Sci. 2023; 12(2): 236–45.
21. Ramachandran AK, Singh U, Ramirez-Campillo R, Clemente FM, Afonso J, Granacher U. Effects of plyometric jump training on balance performance in healthy participants: A Systematic Review With Meta-Analysis. Front Physiol. 2021; 12: 1-22.
22. Seo JH, Lee MY. Effects of quarter heel raising exercise on balance and ankle strength in functional ankle instability subjects. Medicine (United States). 2022; 101(38): 1–5.
23. Herzog MM, Kerr ZY, Marshall SW, Wikstrom EA. Epidemiology of ankle sprains and chronic ankle instability. J Athl Train. 2019; 54(6): 603–10.
24. Aritonang NG, W. Wahyuni. The effect of strengthening exercise on the balance of athletes with chronic ankle instability: a literature review. Physical Therapy Journal of Indonesia. 2023; 4(2): 148–54.
25. Huang PY, Jankaew A, Lin CF. Effects of plyometric and balance training on neuromuscular control of recreational athletes with functional ankle instability: A randomized controlled laboratory study. Int J Environ Res Public Health. 2021; 18(10): 1-14.
26. Sarto F, Cona G, Chiossi F, Paoli A, Bisiacchi P, Patron E, et al. Dual-tasking effects on static and dynamic postural balance performance: a comparison between endurance and team sport athletes. PeerJ. 2020; 8: 1-12.