International Journal of Research in Medical Sciences
Pinto RF et al. Int J Res Med Sci. 2025 Jun;13(6):2504-2509
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20251643

Original Research Article

An experimental study on the effect of fatigue on agility and balance in male recreational football players

Royline Fathima Pinto*, Athul Krishna K. R., Pooja U. Shetty, Riyas Basheer K. B.

Tejasvini Physiotherapy College, Kudupu, Mangalore, Karnataka, India

Received: 13 April 2025
Revised: 12 May 2025
Accepted: 21 May 2025

***Correspondence:**

Dr. Royline Fathima Pinto,
E-mail: roylinepinto10@gmail.com

ABSTRACT

Background: Fatigue stands as a key injury contributor in sports, affecting attributes to such agility and balance. Although elite and sub elite athletes have been studied, the research gap lies in investigating fatigue's impact on agility and balance in recreational football players, which this study aims to address. The study aims to find out the effect of fatigue on these components in young men aged between 18-25 years.
Methods: A total of 40 male students aged 18-25 years volunteered to participate as subjects based on inclusion and exclusion criteria. The descriptive data age, weight and height were collected from each participant. Agility was assessed using T-test and balance was assessed using Y balance test. After taking their agility and balance scores, fatigue was induced in the participants via sprint fatigue tests. Pre- and post-values were collected for statistical analysis in order to assess the difference between agility and balance
Results: The average agility T-test score before inducing fatigue was 12.34 sec 93.42 and 92.47 for Y balance test in right and left respectively and 13.82sec 89.54 and 90.37 after inducing fatigue. The mean fatigue score among the test individuals was 93.32±5.66%.
Conclusions: The study concludes that with increase in fatigue persons agility and balance declines, which could lead to injuries. With this study we are reviewing that the negative effect of fatigue in male recreational players is similar to that in elite and sub elite population.

Keywords: Agility, Balance, Sprint fatigue test, T Test, Y balance test

INTRODUCTION

Agility is the ability of an individual to quickly change speed and direction in response to a stimulus externally.[1,2] This trait is acknowledged as a key component of health-related fitness and a vital attribute in certain professional activities. However, agility is primarily regarded as a critical conditioning skill in competitive team sports, such as football.[3] In team sports agility involves not only changing the direction of motion but also involves the ability to anticipate the opponent's movement, interpret game situations and respond effectively.[2] Agility is receiving growing interest in soccer research, with an emphasis on finding out the key factors effecting agility performance, developing effective training and evaluation technique to improve it.[4] In a football match, players execute 150 to 250 distinct actions, requiring them to perform unilateral and bilateral, repetitive and explosive movements. These movements include sudden acceleration and deceleration tasks, rapid changes in direction, shots and jumps where unilateral dynamic balance plays a crucial role in providing safety and accuracy.[5-8]

Balance is a fundamental yet often overlooked aspect of soccer performance and injury prevention. Exceptional

balance skills are essential for soccer players to perform at their best on the field and minimize the risk of lower limb injuries.[8,9] Strong balance allows players to stay in control while dribbling, passing and shooting. It helps them make rapid directional changes, avoid defenders and maintain stability in demanding game scenarios. Players with exceptional balance tend to be more agile and capable of performing precise movements, providing them with a competitive advantage.[10] Research on fatigue in football players is crucial for optimizing performance, maintaining health and ensuring career longevity.

Fatigue impairs physical and cognitive functions, affecting motivation, causing stress and leading to depressive states. Early detection and management are essential for preserving players' psychological well-being.[11] Change of direction is frequently considered a key factor in overall sports performance and occurs repeatedly in field sports.[12,13] Fatigue resulting from these intense metabolic and neuromuscular demands can adversely affect performance.[14] The various physical demands of soccer make conditioning players a challenging task.[15]

While football's popularity is growing among elite and sub-elite players, there is limited knowledge about the training practices and injury histories of recreational players, which are crucial for creating effective injury prevention strategies.

While numerous studies have investigated on agility and balance variables in elite and sub-elite players, there is a lack of research on the recreational population. Therefore, this study aims to address this gap in knowledge by examining how fatigue affects the agility and balance of recreational players.

METHODS

Study design and setting

This experimental study was carried out at Tejasvini Hospital Group of Institutions, Mangalore, Karnataka, over an eight-month period from March to November 2023.

Study participants and sampling

The study initially recruited 100 participants, narrowing down to 40 after screening.

Inclusion criteria

The inclusion criteria focused on male students aged 18 to 23 who play football intermittently or irregularly.

Exclusion criteria

Exclusion criteria included individuals with recent surgeries (within 6 months), respiratory issues, recent road traffic accidents, disabilities, neurological lower limb conditions, soft tissue injuries, recent fractures (within 6 months) and female participants. This thorough selection process ensures the study targets a specific demographic and physiological profile aligned with its research goals.

Data collection tool and technique

In this study, informed consent was obtained before data collection and participants were familiarized with the procedures, including practice trials to reduce unfamiliarity. Pre-fatigue assessments measured agility (Agility T-test) and dynamic balance (Y-Balance test) to establish baseline performance. Participants then underwent rigorous endurance test to induce fatigue, carefully designed to ensure safety. Post-fatigue assessments used the same tests to evaluate changes in agility and balance. The data were analysed to identify immediate effects of fatigue on these physical capabilities.

Outcome measures

The study utilized a standardized T-Test adapted from previous research, modifying the course to a 10×10 m layout with measurements in meters. The cone-touching task was removed and participants followed a specific movement sequence as outlined by Miller et al. Disqualification criteria were clearly defined.[16] The time to complete each trial was recorded in seconds, with participants performing three trials, each separated by a 3-minute recovery period. The best trial was selected for analysis.[17]

The Y-balance test assessed dynamic balance during a single-legged stance by having participants reach in three directions with the opposite limb. Before testing, lower limb length was measured and the pelvis was aligned. Participants stood at the platform's centre and pushed the reach indicator into the red target zone while balancing on the opposite leg. A trial was deemed unsuccessful if the participant lost their unilateral stance, failed to maintain contact with the indicator, used it for support or did not return the reaching foot to the starting position. The maximum reach in each direction was recorded for analysis.[18,19]

Sprint fatigue test was used to evaluate the ability to recover between sprints and maintain consistent power output. The required equipment includes two stopwatches, a measuring tape, marker cones and a track of at least 50 meters. Before the test, explain the procedures, perform health risk screening and obtain consent. Record basic information and conduct a proper warm-up. Place marker cones 30 meters apart to mark the sprint distance, with additional cones 10 meters beyond each end. At the starting line, the subject sprints maximally for 30 meters upon the command 'go'.

Record the time of the first sprint using one stopwatch, while the other continues running. The subject slows down, turns at the 10-meter cone and returns to the

30-meter finishing point, which becomes the new start line for the next sprint in the opposite direction. Each sprint begins at predetermined intervals (e.g., 30 seconds, 1 minute, 1.5 minutes) after the start of the first sprint. This cycle continues until ten sprints are completed. Scoring involves calculating the fatigue index by dividing the average time of the first three sprints by the average time of the last three sprints. The resulting value falls between 75 and 95%, with a lower value indicating better anaerobic capacity and recovery ability.[12]

Statistical analysis

Data was analysed using SPSS 21.0 software. The test for normality was performed by using Shapiro-wilk test (sample size=40) and found data normally distributed. All the quantitative descriptive statistics were expressed in mean and standard deviation and categorized data were expressed in percentage. The pre and post effectiveness of agility T test and Y balance test were analysed by using paired T test. The relationship between fatigue and Y balance test were assessed by using Pearson correlation coefficient. The significance level for the study was set at a 95% confidence interval ($p<0.05$).

RESULTS

Shapiro-Wilk test was used to assess the normality of the study results. It was found that the variables including age, height, weight, BMI and Fatigue Index Score followed a normal distribution and were expressed in mean and standard deviation (Table 1). Since the variables like BMI and fatigue index score follows category, the data were further expressed in percentage (Figure 1 and 2).

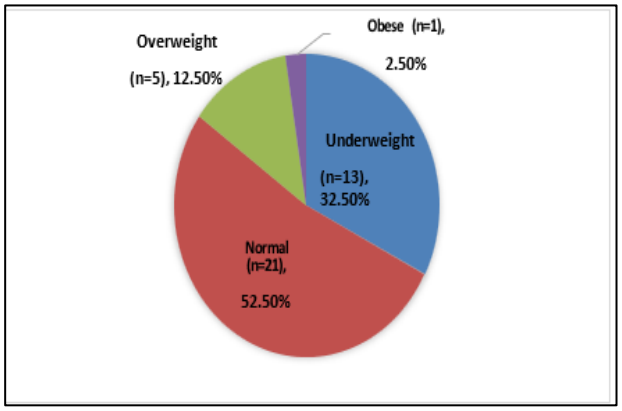

Figure 1: Distribution BMI frequency among the study sample.

Pre and post changes in agility test and Y balance test

Mean values of pre and post agility and balance (left and right) are expressed in the bar diagram. The mean of agility was 12.34 sec before and 13.82 sec after inducing fatigue. The mean value of y balance right was 92.43% before and 89.54% after inducing fatigue. The mean values of Y-balance left were 92.47% before and 90.37% after inducing fatigue (Figure 3).

The following data's shows the effects of fatigue on agility and balance. Paired t test performed, showed that Pre vs post agility, right Y balance and left Y balance were statistically significant ($p<0.05$). Table 2 describes the mean difference and standard deviation between the pre and post values and their statistical significance.

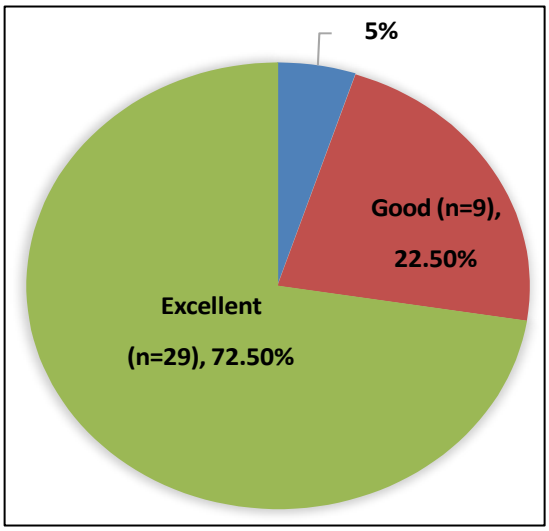

Figure 2: Distribution of fatigue index among the participants.

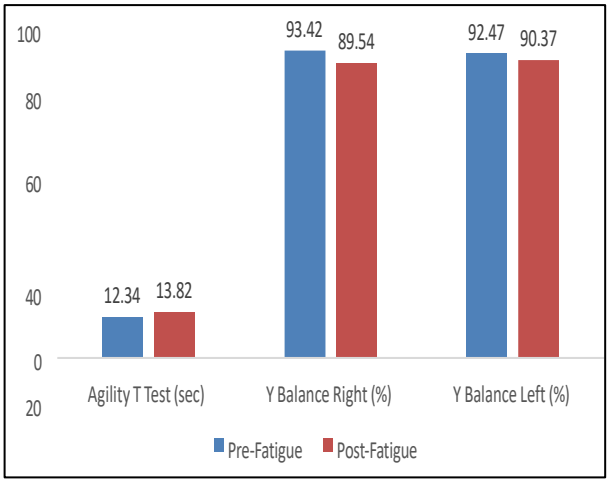

Figure 3: Agility and dynamic balance status before and after inducing fatigue.

Correlation between fatigue index and other variables

The Pre and post analysis between fatigue with agility showed a negative correlation. That is as fatigue increases agility decreases with a strong statistical significance ($P=0.012$). But left and right Y balance score shows a weak correlation and it's not statistically significant.

Table 1: Demographic data.

Variables	Mean ± SD
Age (in years)	21.05±1.19
Height (cm)	170.46±4.22
Weight (Kg)	60.72±10.51
BMI (Kg/M^2)	20.85±3.19
Fatigue index score	93.32±5.66

Table 2: Pre and post analysis of agility and dynamic balance following fatigue.

Variables	Mean difference	SD	t value	Sig. (2-tailed)
Pre vs post agility	1.477	0.78	12.008	0.000*
Pre vs post right Y balance	3.880	2.75	8.911	0.000*
Pre vs post left Y balance	2.101	3.08	4.313	0.000*

*Test performed was paired t test and statistically significant (p<0.05).

Table 3: Correlation between fatigue index and other variables.

Variables	Fatigue index	
	r value	**Sig**
Post agility Score	-0.389	0.012*
Post Y balance right leg	0.207	0.199
Post Y balance left leg	0.149	0.360

*Pearson correlation coefficient test was performed.

DISCUSSION

This study aimed to examine the impact of fatigue on agility and balance among male recreational football players aged 18–25 years. Findings reinforce previous research suggesting that neuromuscular performance is significantly compromised under fatigued conditions, leading to impaired coordination and stability.[20] Agility, a crucial attribute for football players, was found to be negatively affected by fatigue, with a statistically significant decline in T-test scores post-fatigue (p<0.05). The decline in agility, as evidenced by T-test performance post-fatigue, supports previous studies demonstrating that exhaustion disrupts rapid directional changes due to diminished neuromuscular control.[21] Similarly, Morral-Yepes et al, emphasized that agility performance is highly dependent on fatigue-sensitive motor responses, further validating our outcomes.[22]

Fatigue-induced balance deterioration, observed through reduced Y-balance test scores, aligns with previous findings on proprioceptive control and dynamic stability deficits Cruz-Diaz et al.[23] However, the weaker correlation between balance and fatigue suggests that balance maintenance may involve compensatory mechanisms that mitigate performance deterioration by Wang et al.[24] This indicates the potential for specialized balance training interventions to counteract fatigue-induced impairments. Our correlation analysis demonstrated a negative relationship between fatigue index and agility, while balance showed a relatively weaker association with fatigue. Jakobsson et al, suggest that agility is primarily dependent on neuromuscular efficiency, whereas balance integrates sensory processing factors, which may contribute to its stability despite exhaustion.[20] These findings underscore the necessity for tailored training programs where agility conditioning focuses on endurance adaptations and balance training incorporates proprioceptive reinforcement drills to optimize athletic performance under fatigued conditions. The universal impact of fatigue-induced performance declines across different skill levels, as reported by Stevenson et al, highlights the importance of fatigue management strategies in sports training programs.[25] Recovery protocols, hydration strategies and interval-based endurance training have been identified as effective interventions for mitigating fatigue-related declines in performance by Nedelec et al.[26] Implementing these measures within recreational football training regimes may enhance neuromuscular endurance and game performance.

Beyond sports performance, our findings have implications for injury prevention. Fatigue-induced agility and balance impairments heighten the risk of lower limb injuries, as noted by Perez-Gomez et al.[27] Educating players on fatigue-management strategies, including proprioceptive exercises and structured recovery protocols, may help minimize injury rates among recreational football athletes. These strategies align with previous studies advocating for strength and proprioceptive training to counteract postural instability caused by fatigue.[28] However, our study has limitations. The sample size, while statistically adequate, may benefit from expansion to improve generalizability. Additionally, future research should explore gender-based differences in fatigue responses, as suggested by Liu et al.[29] Longitudinal

assessments investigating fatigue adaptation mechanisms may also provide further insights into neuromuscular resilience over time.

CONCLUSION

The study successfully establishes the connection between fatigue with agility and balance in male recreational football players between the age 18–24 years. Notably, a strong negative correlation was found between fatigue and agility and a weak correlation between fatigue and balance. As fatigue increases there is a significant reduction in these components. Our study aligns with and extends existing research, shedding light on the impact of fatigue on agility and balance in recreational soccer players and emphasizing the importance of fatigue management in sports performance.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Wang P, Shi C, Chen J, Gao X, Wang Z, Fan Y, et al. Training methods and evaluation of basketball players' agility quality: A systematic review. Heliyon. 2020;15(1):10.
2. Abidin D, Muhamad M, Haqiyah A, Gusriadi AR. Agility and balance on the speed of dribbling in soccer. In: Proceedings of the 1st South Borneo International Conference on Sport Science and Education. 2019;27:208-10.
3. Morral-Yepes M, Moras G, Bishop C, Gonzalo-Skok O. Assessing the reliability and validity of agility testing in team sports: a systematic review. J Str Cond Res. 2022;36(7):2035-49.
4. Paul DJ, Gabbett TJ, Nassis GP. Agility in team sports: Testing, training and factors affecting performance. Sports Med. 2016;46:421-42.
5. Bogalho D, Gomes R, Mendes R, Dias G, Castro MA. Impact of flexibility on vertical jump, balance and speed in amateur football players. Applied Sciences. 2022;27;12(11):5425.
6. Andrzejewski M, Chmura J, Pluta B, Konarski J.M. Sprinting activities and distance covered by top level Europa league soccer players. Int J Sports Sci Coach. 2015;(10):39–50.
7. Kartal A. The relationships between dynamic balance and sprint, flexibility, strength, jump in junior soccer players. Pedagogy Phys Cult Sports. 2020;24:285–9.
8. López-Valenciano A, Ayala F, De Ste Croix M, Barbado D, Vera-Garcia FJ. Different neuromuscular parameters influence dynamic balance in male and female football players. Knee Surg, Sports Traumatol, Arthrosc. 2019;14(27):962-70.
9. Cortes N, Quammen D, Lucci S, Greska E, Onate J. A functional agility short-term fatigue protocol changes lower extremity mechanics. J Sport Sci. 2012;30(8):797-805.
10. Cruz-Diaz D, Lomas-Vega R, Osuna-Pérez MC, Contreras FH, Martínez-Amat A. Effects of 6 weeks of balance training on chronic ankle instability in athletes: a randomized controlled trial. Int J Sport Med. 2015;36(9):754-60.
11. Shcherbak T, Lukashov O, Koval I, Kruglov K, Minin M, Nosov P, et al. Compensatory phase of fatigue among football players in the organization of motivational structure. J Phys Edu Sport. 2024;1;24(11):67.
12. Jakobsson SK, Amasay T, Mier CM, Tamulevicius N. Influence of fatigue on change of direction performance in soccer players. International J Ex Sci. 2020;13(1):656.
13. Sekulic D, Spasic M, Mirkov D, Cavar M, Sattler T. Gender-specific influences of balance, speed and power on agility performance. J Stren Cond Res. 2013;27(3):802-11.
14. Ruscello B, Tozzo N, Briotti G, Padua E, Ponzetti F, D'Ottavio S. Influence of the number of trials and the exercise to rest ratio in repeated sprint ability, with changes of direction and orientation. J Str Cond Res. 2013;27(7):1904-19.
15. Jovanovic M, Sporis G, Omrcen D, Fiorentini F. Effects of speed, agility, quickness training method on power performance in elite soccer players. J Str Cond Res. 2011;25(5):1285-92.
16. Walker KE. The Effects of Fatigue on the Reactive Agility Test: Looking at the Difference Between Normal Game Play and the Hurry-Up Offense in Football Game Simulations. The University of Western Ontario (Canada). 2015.
17. Vitale J A, Povìa V, Vitale N D, Bassani T, Lombardi G, Giacomelli L, et al. The effect of two different speed endurance training protocols on a multiple shuttle run performance in young elite male soccer players. Res Sports Med. 2018;26(4):436-49.
18. Pfirrmann D, Herbst M, Ingelfinger P, Simon P, Tug S. Analysis of injury incidences in male professional adult and elite youth soccer players: a systematic review. J Athletic Train. 2016;51(5):410-24.
19. Hrysomallis C. Balance ability and athletic performance. Sports medicine. 2011; 41:221-32.
20. Jakobsson SK, Amasay T, Mier CM, Tamulevicius N. Influence of fatigue on change of direction performance in soccer players. International J Exercise Sci. 2020;1;13(1):656.
21. Vázquez Paul, Hristovski R and Balagué N. The Path to Exhaustion: Time-Variability Properties of Coordinative Variables during Continuous Exercise. Front Physiol. 2016;7:37.
22. Morral-Yepes M, Gonzalo-Skok O, Dos ´Santos T, Moras Feliu G. Are change of direction speed and agility different abilities from time and coordinative perspectives. PLoS ONE. 2023;18(12):295405.
23. Cruz-Díaz David. Effects of 6 Weeks of Balance Training on Chronic Ankle Instability in Athletes:

A Randomized Controlled Trial. Int J Sports Med. 2015;36(09):754-60.
24. Wang C, Trongnetrpunya A, Samuel IB, Ding M, Kluger BM. Compensatory Neural Activity in Response to Cognitive Fatigue. J Neurosci. 2016;36(14):3919-24.
25. Bestwick-Stevenson T, Toone R, Neupert E, Edwards K, Kluzek S. Assessment of Fatigue and Recovery in Sport: Narrative Review. Int J Sports Med. 2022;43(14):1151-62.
26. Nedelec M, Mccall A, Carling C, Legall F, Berthoin S. Recovery in soccer part i – post-match fatigue and time course of recovery. Sports Med. 2012;5:1-19.
27. Gomez JP, Adsuar JC, Alcaraz PE, Vivas JC. Physical exercise for preventing injuries among adult male football players: a systematic review. J Sport Health Sci. 2022;11(1):115-22.
28. Alexander J, Rhodes D. The Effect of Proprioceptive Training on Directional Dynamic Stabilization. J Sport Rehab. 2020; 30(2):248-54.
29. Liu C, Peng W, Qu W, Zhang Z, Sun J, He J, et al. Gender differences in the impact of fatigue on lower limb landing biomechanics and their association with anterior cruciate ligament (ACL) injuries: A systematic review and meta-analysis. PLoS One. 2025;20(5):321925.

Cite this article as: Pinto RF, Athul Krishna KR, Shetty PU, Riyas Basheer KB. An experimental study on the effect of fatigue on agility and balance in male recreational football players. Int J Res Med Sci 2025;13:2504-9.