# The effect of balance training on FMS test scores and Y balance of national rugby team players

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## مستخلص البحث باللغة العربية

مقدمة: على الرغم من أن الإصابات جزء لا مفر منه من الرياضة، إلا أن ممارسة الرياضة كأداة لمنع الإصابات المرتبطة بالرياضة وعواقبها قد لفتت انتباه العديد من الباحثين في السنوات الأخيرة. تهدف الدراسة الحالية إلى تقييم تأثير ٨ أسابيع من تدريب التوازن على نتائج اختبارات FMS للاعبي منتخب الرجبي الوطني الذكور. الطرق: في هذا البحث التجريبي، تم تقسيم ٣٠ لاعب رجبي عشوائيا إلى مجموعتين تجريبيين ومجموعتين ضابطة. تم استخدام اختبار توازن Y واختبار FMS في بداية ونهاية البحث. ثم قامت المجموعة التجريبية بتمارين التوازن ٣ مرات في الأسبوع لمدة ٨ أسابيع. النتائج: أثرت ثمانية أسابيع من تمارين التوازن على درجة اختبار FMS في أربع اختبارات (خطوة الحواجز (P =٠.٠٠٨)، الإطلاق (P =٠.٠٠٩)، تمارين الضغط (P = ٠.٠٤٦)، والثبات الدوار (P = ٠.٠١٥)) وتوازن Y (P =٠.٠٤١). ومع ذلك، لم يؤثر ذلك على أربع اختبارات: حركة الكتف (P =١.٠٠٠)، القرفصاء العميق (P =٠.٣١٧)، ورفع الساقين المستقيمة النشط (P =٠.٨٣)، وكان مستوى الدلالة في هذه الدراسة ٠.٠٥ الخلاصة: تظهر النتائج أن تمارين التوازن على لاعبي منتخب الرجبي الوطني الذكور ضعيفة في نمط حركة الكتف والقرفصاء، ورفع الساقين النشط، وتوازن Y، لكنها تؤثر إيجابيا على نمط تجاوز العقبة، والانطلاق، والثبات، والضغط، والثبات الدوراني. لذلك، فإن اختبار فحص الحركة الوظيفية، كطريقة للوقاية من الإصابات، فعال للاعبي منتخب الرجبي الوطني الذكور. وفقا لنتائج الأبحاث، يمكن لمدربي الرياضة استخدام هذه التمارين لمنع الإصابات الرياضية وتحسين الأداء.

الكلمات المفتاحية اختبارات FMS، لاعبو الرجبي، تمارين التوازن،

## Abstract

## The effect of balance training on FMS test scores and Y balance of national rugby team players

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**Introduction: Although injuries are an inevitable part of sports, exercise as a tool to prevent sports-related injuries and their consequences has caught the attention of many researchers in recent years. The present study aims to evaluate the effect of 8 weeks of balance training on FMS test scores of male national rugby team players.**

**Methods: In this experimental research, 30 rugby players were randomly divided into two experimental and control groups. Y balance test and FMS test were used at the beginning and end of the research. Then the experimental group did balance exercises 3 times a week for 8 weeks.**

**Results: Eight weeks of balance exercises affected the FMS test score on four tests (hurdle step (P= 0.008), launch (P= 0.009), push-ups (P= 0.046), and rotary stability (P= 0.015)) and Y balance (P= 0.041). However, it had no effect on four tests shoulder mobility (P= 1.000), deep squat (P= 0.317), and active straight leg raising (P= 0.83), and the significance level in the present study was 0.05.**

**Conclusion: The findings show that the Balance exercises on the male national rugby team players are weak in the shoulder and squat movement pattern, active leg raising and Y balance, but have a positive impact on the pattern of stepping over the obstacle, launch, stability push-up, and rotational stability. Therefore, the functional movement screening test, as a method of injury prevention, are effective for the male national rugby team players. According to the research results, sports coaches can use these exercises to prevent sports injuries and improve performance.**

**Keywords :FMS tests, rugby players, balance exercises.**

## Introduction

**Rugby has gained international popularity, becoming one of the most played and watched collision sports in the world, with approximately 8.5 million registered players in over 121 countries worldwide (1). Rugby is a complex sport in which players with different abilities and physical strength compete with each other. This special feature is less visible in other sports fields. In this sport, two teams of 15 people try to win the ball and score points from the opposing team in a physical competition. The goal of the forward players is. Taking the ball and putting it in the opponent's field and getting a try. Forwards and backs are the two main groups of players in every rugby team. Forwards often participate in a lot of tackles and physical confrontations, while backs spend most of the game in free runs. The playing time of adult rugby league is 80 minutes (two halves of 40 minutes) (2,3,4). Due to the nature of rugby, the rate of injuries in the game of rugby is relatively high. Rugby is an intensely physical game with numerous collisions and contact events, interspersed with periods of lower-intensity activity, such as jogging and walking (5). The combination of high physical demands, alongside exposure to contacts and collisions, means the inherent risks of injury are substantial (6). In a study, the injury prevalence rate in amateur rugby players was reported as 46.8/1000 player hours (7). In the study by Williams et al overall pooled incidence rate of match injuries of 81/1000 player hours (8). This amount of damage is high compared to other sports like football. Therefore, it is necessary for rugby**

**players to receive a special training protocol to prevent injury. Exercise as a tool to prevent sports injuries is of great interest in today's rehabilitation actions (9). The lack of awareness of coaches and athletes for preventing sports injury has made some talented athletes quit as a result of injuries (10).**

**Sports injuries have different causes, namely improper methods of performing techniques, repetitive movements, and non-stop hard exercises. Balance is a critical factor which is necessary for any type of sport for correctly performing the techniques (11).**

**Balance is the ability to maintain the body's center of gravity at its own level of support with the least fluctuation or the most stability. Equilibrium is divided into two types: static and dynamic. Static balance is maintaining the stable state of the body in a state of rest and dynamic balance is maintaining the stable state of the body in the state of movement (12).**

**Considering the high frequency of sports injuries, pre-seasonal screening is vital in athletes nowadays. Screening is conducted for preventing injuries and improving functional techniques (13). Cook et al. introduced functional movement screen tests (FMS) based on pre-seasonal screening and implementation related factors (14). The studies on the relationship between FMS and occurrence of injuries implied that FMS scores can predict injury occurrence. It was reported in another study that the application of preventive exercises among the individuals with scores below 14 in FMS reduced the occurrence of injuries (15).**

**The primary purpose of FMS tests is to evaluate the body's movement chain system. FMS tests provide valuable information about stability and mobility and ultimately lead to the formation of accurate movements in people. This set of tests can be implemented within 5 to 10 minutes, and for this reason, it can be easily used by sports therapists for pre-season evaluations.**

**This set of tests includes Deep Squat, Hurdle Step, In-line Lunge, Active Straight-leg Raise, Trunk Stability Push-up, Rotary Stability and Shoulder Mobility (16) and The total maximum score in this test is 21, which according to the research report, a score of less than 14 makes people susceptible to injury (17).**

**The Y-Balance Test, derived from the Star Excursion Balance Test is commonly used objective measure to assess lower extremity functional symmetry, dynamic balance and stability.**

**The Y balance test for lower limb function has validity to evaluate the unilateral dynamic function of the lower limb in a closed movement chain that involves the stability and movement of the individual's body simultaneously at the highest level in the lower limb. In this test, the subject puts the weight on the lower limb and must maintain his balance on one leg, without collapsing, while with the other leg, he performs the act of reaching by obtaining the maximum distance in three directions (18). The importance of the quality of balance control in preventing injuries and musculoskeletal injuries during sports activities**

**has been emphasized and various risk factors for disorders during sports activities have been introduced. Among the factors that caused the need to study in the field of balance, there is an inverse relationship between balance control and the rate of falls and injuries in athletes (19).**

**It seems reasonable that identifying the risk factors associated with sports-related injuries could help trainers, clinicians, coaches in designing interventions and programs to address those factors and overall decrease the injury rates. No research has been done on the effect of balance exercises on upper limb function and functional movement screening tests. Therefore, due to the lack of research on the effect of balance exercises, the purpose of this research is the effect of 8 weeks of balance exercises on the FMS test scores and y balance of male rugby team players. Such research is done in order to improve sports performance and health level, as well as reduce sports injuries and return to sports.**

## Research Problem

**Rugby is recognized as a high-intensity collision sport with one of the highest injury incidence rates among team sports. The physical demands of repeated tackles, collisions, and high-speed movements place players at substantial risk of musculoskeletal injuries. Although pre-season screening tools such as the Functional Movement Screen (FMS) and the Y-Balance Test are widely used to identify injury risk factors, there remains a lack of empirical evidence regarding the effectiveness of balance-based training interventions in improving functional movement quality and dynamic balance outcomes in rugby players. In particular, limited research has examined the impact of structured balance exercises on FMS scores and balance performance, including components related to upper-limb function. This gap in the literature highlights the need for scientifically grounded investigations to determine whether balance training can serve as an effective preventive strategy to enhance functional performance and reduce injury risk among rugby players.**

## Research goals

1. **To determine the effect of balance training on overall and individual component scores of the Functional Movement Screen (FMS) in male rugby players.**
2. **To assess the impact of balance training on dynamic balance and lower-limb functional symmetry using the Y-Balance Test.**

## Research Hypotheses

1. **There will be statistically significant differences between pre-test and post-test scores in the Functional Movement Screen (FMS) in favor of the post-test following the balance training program.**
2. **There will be statistically significant differences between pre-test and post-test scores in Y-Balance Test performance in favor of the post-test following the balance training program.**

3. **Balance training will result in significant improvements in functional movement quality and dynamic balance, thereby reducing injury-related risk factors in male rugby players.**

## Research Domains

1. **Human Domain: National rugby team players.**
2. **Spatial Domain: The rugby field at the University of Baghdad.**
3. **Temporal Domain: at 12/2/2025 to 12/4/2025.**

## Methods

**The subjects of this experimental research were 30 male players of the national rugby team who participated in the study voluntarily and available. Before conducting any research, the subjects' consent to participate in the research and their personal information, including age, height, weight, sports field, and injury history were collected. The criteria for entering the study included having a sports experience of at least three years, participating in rugby training three times a week, not having a history of surgery on the trunk and lower limbs, being a member of the Iraqi national rugby team. The players had no special medical conditions, namely cardiovascular disease, weakness of the postural, vestibular disorders, and vision weakness, which might hinder their participation in the research.**

**In this research, balance exercises program was used. Also, from the functional movement screening test (lunge, deep squat, straight leg raise, shoulder mobility, rotary stability, push-up, and hurdle step) and from the Y test It was used as an evaluation tool to evaluate the function of the lower limb, which is mentioned below in the way of their implementation. Subjects were randomly divided into two control groups (15 people) and experimental group (15 people) in terms of the position of the players on the field and their sports history. The experimental group did special balance exercises for 8 weeks and 3 sessions a week, while the control group did their usual exercises. FMS tests include 7 movement tests and ٣clearing tests that can identify the limitations and changes in the natural movement patterns. This test kit is performed within 5-10 minutes, which includes deep squat, hurdle step, inline lunge, shoulder mobility, active straight leg raise, trunk stability push-up, and rotary stability tests (16). The assessment is based on qualitative analysis through the four-point scoring system (0 to 3), so that 0 reflects the state with pain and 3 represents the correct implementation of the test (14). The final FMS score ranges between 0-21, and average to high reliability levels have been reported in various studies among trained and non-trained subjects [19]. According to the research reports, a score below 14 makes the individual vulnerable to the injury (13). The subjects received the verbal instructions, described by Cook et al. by the researcher (16).**

**Lower Limb Y Balance Test: In order to perform the test, the subject stands in the location specified by the test kit with the test leg and attempts to have the highest possible**

**mobility with the other leg at Anterior, Posteromedial, and Posterolateral directions, while keeping his balance. The angle between posteromedial and posterolateral directions and the anterior direction is 135 degrees. At the time of reaching the highest trapping rate, the subject must touch the kit with the test leg very slowly and return to the initial state of the test. Then, the total sum of the distance between the anterior, Posteromedial, and Posterolateral directions is divided by three times the length of the subject's foot, and it is then normalized by multiplying by 100. This obtained value is assumed as the subject's score. The length of the test leg is the distance between the anterior superior iliac spine (ASIS) and the medial malleolus, which is measured using a standard measuring tape while the subject is standing, and the weight is evenly distributed between the two legs. A maximum of three trials is recorded as the subject's record in each of three directions. In addition, every subject exercised 4-6 times for each direction separately before the test (18).**

## Balance exercise protocol

**The exercises will be conducted under the direct supervision of the researcher for 8 weeks. The training group will perform balance exercises for 8 weeks, 3 sessions per week and each session will be approximately 45-60 minutes (5-10 minutes warm-up, 40 minutes of Balance exercise, and 10 minutes cool-down) (20).**

**Table 1. 2 The Balance Training Program**

| Exercise | Week 1 and 2 | Week 3 and 4 | Week 5 and 6 | Week 7 and 8 |
|---|---|---|---|---|
| Single-leg stance Single-leg stance while swinging the raised leg | 3*30 s | 3*35 s | 3*40 s | 3*45 s |
| Single-leg squat (30°-45°) | 3*15 s | 3*20 s | 3*25 s | 3*30 s |
| Single-leg stance while performing functional activities | 3*10 s | 3*15 s | 3*20 s | 3*25 s |
| Swinging the raised leg | 3*10 r | 3*15 r | 3*20 r | 3*25 r |
| Stance on busoball | 3*30 s | 3*35 s | 3*40 s | 3*45 s |
| Double-leg stance while rotating the board | 3*30 s | 3*35 s | 3*40 s | 3*45 s |
| Single-leg stance while rotating the board | 3*30 s | 3*35 s | 3*40 s | 3*45 s |

**S= Seconds, r= repeat**

## statistical Analysis

**Data related to the subjects' characteristics including age, weight, and height in addition to the research variables were analyzed using SPSS software version 23 (Table 2). Considering the normality of data and using the Shapiro-Wilk test, the analysis of variance (ANOVA) with repeated measures was performed for investigating the variables among the research groups. In addition, the significance level was set at P<0.05.**

## Results

**The demographic findings of the study are summarized in Table 2. The basic demographic results did not show any significant difference between the two experimental and control groups.**

**Table 2. The basic demographic results**

| group | Age, y | P | Weight,kg | P | Height,cm | P |
|---|---|---|---|---|---|---|
| Control (15) | 21±3 | 0.09 | 68±3 | 0.12 | 176±4 | 0.1 |
| Intervention (15) | 21±2 | | 67±2 | | 174±4 | |

**Table 3. Inferential statistics information**

| Variables | | Shapiro-Wilk. |
|---|---|---|
| deep squat | Pretest | 0.12 |
| | Post test | 0.25 |
| hurdle step | Pretest | 0.35 |
| | Post test | 0.14 |
| lunge | Pretest | 0.16 |
| | Post test | 0.52 |
| Shoulder mobility | Pretest | 0.28 |
| | Post test | 0.31 |
| Active straight leg raising | Pretest | 0.24 |
| | Post test | 0.39 |
| trunk stability push-up | Pretest | 0.19 |
| | Post test | 0.56 |
| rotary stability | Pretest | 0.8 |
| | Post test | 0.18 |
| Y balance A | Pretest | 0.14 |
| | Post test | 0.6 |
| Y balance PL | Pretest | 0.9 |
| | Post test | 0.17 |
| Y balance ; PM | Pretest | 0.1 |
| | Post test | 0.2 |

**As can be seen in Table 3, the distribution of data is normal, so parametric test is used in data analysis. Therefore, Repeated measures ANOVA is used to check the pre-test and post-test data of the said variables.**

| Variables | | Experimental group (mean±sd) | Control group (mean±sd) | Between-subjects | Within-subjects |
|---|---|---|---|---|---|
| deep squat | Pretest | 14.3±3.1 | 15.1±3.1 | ٠٥٢. =١F | ٠٥. =٢F |
| | Post test | 14.2±3.7 | 14.9±2.3 | =٠,٣P | =٠,٢P |
| hurdle step | Pretest | 15±3.1 | 14.1±2.2 | =١٨,٠٥F | =٣٤,٥F |
| | Post test | 20±2.1.4 | 15.3±2.1 | =٠,٠٠٤P | =٠,٠٠٢P |
| lunge | Pretest | 14±3.6 | 13.5±1.2 | =٢١,٠٥٢F | =٣٦,٢٩F |
| | Post test | 18±3.7 | 14.2±2.1 | =٠,٠٣P | =٠,٠٠٢P |
| Shoulder mobility | Pretest | 14±3.2 | 15±3.2 | =٥,٢F | =٧,٠٢F |
| | Post test | 15±3.7 | 14.3±3.2 | =١,٠١P | =٠,٠٢P |
| active straight leg raising | Pretest | 15±2.2 | 14.5±2.1 | =٥,٦F | =٦,٢F |
| | Post test | 15±3.1 | 15.1±3.3 | =١,٣P | =٠,٠٦P |
| trunk stability push-up | Pretest | 14±3.1 | 14.1±3 | =٥٦,٣F | =٤٣,٢١F |
| | Post test | 17±3.7 | 13.9±3 | =٠,٨٧P | =٠٩P |
| rotary stability | Pretest | 14±3.1 | 14.6±3 | =١١,٤F | =١٧,٣F |
| | Post test | 18±2.1.7 | 15.1±2.1 | =٠,٠٠٦P | =٠,٠٠٦P |
| Y balance A | Pretest | 64±7.3 | 64±7 | =٢٨,٢F | =١٨,٠٣١F |
| | Post test | 69±3.6 | 64.2±3 | =٠,٠٠١P | =٠,٠٣P |
| Y balance PL | Pretest | 82±10.1 | 83.8±10 | =١٣,١F | =١٩,٠٥F |
| | Post test | 87±9.2 | 82.9±8.9 | =٠,٠١P | =٠,٠٠١P |
| Y balance ; PM | Pretest | 89±6.5 | 88.4±6.3 | =١٧,٠٢١F | =٣٩,٦٣F |
| | Post test | 94±7.3 | 8.9±7.3 | =٠,١P | =٠,٠٠١P |

**SD, Standard Deviation; A, Anterior; PL, Posterolateral; PM, Posteromedial.**

**The results of the variance analysis showed that there is a statistically significant difference between the average scores of the FMS test and Y balance of the two groups in the pre- and post-test.**

## Discussion

**The purpose of this study was to be investigated of the effect of 8 weeks of balance training on FMS test scores of male national rugby team players. The results showed that carrying out eight weeks of balance exercises improves functional movement screening scores in hurdle step, launch, push-ups, and rotary stability and Y balance. Based on this, Was singer et al. (2013) reported that people Athletes perform better in upper limb performance test and there is a significant relationship between athletes and upper limb performance test (21). Considering that in most research, balance is better in athletes than non-athletes, the results of Wasinger et al.'s research are consistent with the results of the present study.**

**The first test was the deep squat, which is designed to assess dynamic flexibility, core muscle strength, balance, and overall neuromuscular control. There is evidence to support the assessment of transitional movement such as the overhead squat assessment (22). It seems that this type of evaluation, when the standard protocol is used to perform it, will be a valid and repeatable measure of the movement patterns of the lower limbs. It has also been shown that the assessment of the overhead squat shows the movement patterns of the lower limbs during jumping and landing movements (23). In the movement of hurdle step,**

**the muscles that are involved are: trunk, thigh and leg muscles. The purpose of performing this movement is to provide strength and stability to our body, as well as better functional strength of the lower legs and better control of the body during balance. In addition, the correct performance of this movement requires a good body structure and core muscles and the ability to have static stability in a standing position (24).**

**The protocol of the balance exercises improves and strengthens the effective muscles in performing the obstacle stepping test. One of the effective exercises for the lower body is the lunge. This movement strengthens the quadriceps and hamstrings. Performing the lunge movement will improve your concentration. Because when doing it, your main muscles and the front of the stomach are involved, and they must interact with each other to keep the body straight and balanced so that the movement is done in line with the pelvis. Lack of concentration in performing these movements can cause damage to the involved areas. Lunges can improve the flexibility of your muscles by bending or bending your legs at the hips (15). In each group, the muscles that are involved are: leg muscles, abdominal muscles and the muscles of the back of the thigh. The stated items confirm that the protocol of the balance exercises improve and strengthen the effective muscles in performing the launch test. active straight leg raises movement of the leg, the muscle groups that are involved are: gluteus maximus, hamstrings, gastrocnemius and soleus muscles, and the degree of core stability is important (26). Therefore, perhaps the shortness of these muscles and the weakness of the core stability cause the poor execution of this pattern. These cases confirm that the selected exercise protocol has improved and strengthened the effective muscles in performing the active leg raising test.**

**In the present research, by taking the trunk stability push-up test as a pre-test and after passing 8 weeks of selected exercises by male national rugby team players, the trunk stability push-up test was taken. As the average scores of the trunk stability push-up test did not increase significantly, this finding does not confirm the effect of the selected exercises in the trunk stability swimming test, and perhaps the logical reason for this is the high strength of the chest muscles and shoulder girdle of the special staff. The trunk stability push-up motion directly uses the pectoral muscles, triceps brachii, and the anterior deltoid and also indirectly affects the serratus anterior muscles, the brachialis and the middle part of the body. The results of this research are in line with the research of Michelle et al. and Deyder et al (27,28,29). In the movement of rotatory stability, the muscle group of the shoulder, back and abdominal muscles are involved. In the implementation of this pattern, the movement of the pelvis and lower limbs is performed at a combined level. Defects in core stability, weight transfer in a parallel plane and poor neuromuscular control can lead to poor execution of this pattern (14). Therefore, weakness in core stability and related neuromuscular coordination can be the cause of poor implementation of this model. These cases confirm that the protocol of the balance exercises has improved and strengthened the effective muscles in performing the rotatory stability test.**

**According to the results of this research, it is expected that the athletes of other disciplines, such as volleyball and sports in which people rarely support their body weight with one leg, have the ability to balance. One of the reasons for the effect of balance exercises on FMS can be the similar movement pattern and commonness in the way of execution and use of muscles and joints with some components of functional movement screening tests. For example, the balance exercises in the positioning and use of the body joints are very similar to the three functional movement tests. Also, the improvement of proprioception in body joints due to balance exercises can be one of the reasons for the significance between balance exercises and functional movement screening tests.**

## Conclusions

1. **An eight-week balance training program leads to significant improvements in Functional Movement Screen (FMS) scores, which are directly associated with injury prevention.**
2. **Balance exercises contribute to the enhancement of upper-limb functional performance, which positively affects athletic performance and sporting success.**
3. **Balance training represents an effective intervention for improving functional movement quality and overall physical preparedness in athletes.**

## Recommendations

1. **Sports coaches and practitioners are advised to incorporate balance exercises into regular training programs to reduce the risk of sports-related injuries.**
2. **Balance training should be used as a complementary approach alongside other conditioning and rehabilitation programs due to its low cost and ease of application.**
3. **Sports institutions and training centers are encouraged to adopt balance-based interventions to enhance performance levels and promote long-term athletic success.**

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