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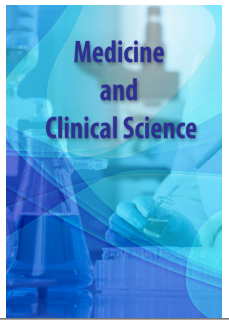
Original Article



Effect of Static Stretching on Dynamic Balance and Performance of the Saudi Recreational Football Players

Mohammed A Takroni[1], Waleed S Bakallah[2], Tola CO Akomolafe[1]

[1]Physical Rehabilitation Department, King Faisal Specialist Hospital and Research Center, Riyadh, KSA
[2]Physical Therapy Department, King Faisal Specialist Hospital and Research Center, Jeddah, KSA

Correspondence
Mohammed Takroni
King Faisal Specialist Hospital and Research Center, Physical Rehabilitation Department, Riyadh, KSA
E-mail: taki2002@hotmail.com

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Stretching, Static Balance, Dynamic Balance, Football, Soccer, Performance

Abstract

Back ground There have been rather controversial reports that some sport performances are negatively affected by stretching. It is widely believed that pre-exercise static stretching reduces the risk of injury and enhances performance. Several studies reported that pre-exercise static stretching decreases maximal force production, jump height and speed. (Does static stretching has a negative influence on balance and/or athletic performance?)
Aim of study: To determine the effect of static stretching (SS) on static and dynamic balance (DB) and its influence on the performance of the Saudi recreational football players.
Material & methods: 40 healthy male Saudi recreational football players, their mean age was 21 years old. Participants were randomly divided into two groups A (n=20) started dynamic balance first then the static balance, while group B (n=20) started the static balance test first and
Intervention: Participants at each group were asked to preform static stretching exercises for each muscle group (hamstring, quadriceps, and gastrocnemius) three times. Holding period of SS was 30 seconds with 10 seconds rest. The static balanced (SB) test was measured using "Balance Master System", while Modified Star Excursion Balance Tests was used to measure the DB. Group A started SB test first and group B started DB test first.
Results: The results indicated statistically significant effect for groups (P= 0.017) and for the interaction between group and time (P= 0.001). However, the main effect for time was not significant (P= 0.533). Group B significantly showed better mean score of SB compared to group A in both period (P= 0.017). group B demonstrated slightly lower mean score immediately post stretching which, indicate an improvement of the SB while, group A demonstrated an increase in the mean score of the SB indicating low SB.
Conclusion: Static stretching has an immediate (acute) positive effect on the static and dynamic balance of recreational football players. This effect decreased over time.

Introduction

Football (soccer) is the most popular sport worldwide [1]. It is a contact sport associated with an increased preponderance of injuries [2]. Different aspects of injury related to this sport have been studied, however the majority of these studies were in professional and young adult players [3-4]. Studies have found that soccer is one of the most common sports resulting in injury among youth [5-7]. Warm-up is a common pre-exercise routine performed with the intention of improving performance and reducing risk of injury. Flexibility is an important component of fitness and is defined as "the ability to move a joint through a normal range of motion (ROM) without undue stress to the muscular-tendinous unit [8]. There is little sound empirical evidence, however, to substantiate the role of stretching exercises and consequently increased flexibility on injury prevention in football [9]. It has been reported that balance ability was related to competition level for some sports with the more proficient athletes displaying greater balance ability [10]. National soccer players had superior static and dynamic balance compared to regional level players. Moreover, studies showed that balance performance has a fundamental role in many athletic activities, and skills in postural control that may designate successful performance [11]. Furthermore, Paillard et al [12]. declared that postural talents might be considered as an indicator of performance in the playing of football. Although the, use of stretching to prevent injury and improve performance has been widely accepted and promoted in sports, several studies have indicated that the stretching exercises is negatively effects the anaerobic activities such as muscle strength [13-14], vertical jump 15-17], sprint performance [18-19] and agility [20]. The decline in strength occurring following the static stretching exercises has been claimed to be due a decrease in the stiffness of both musculo-tendinous unit and muscle activation [21]. A number of studies reported that stretching has a positive effect on performance, it increases

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flexibility and reduces the risk of injury, decreases muscle stiffness, increases range of motion (ROM), alleviates pain, and improves athletic performance [21-25]. Previous studies showed that acute dynamic stretching exercises have positive effects on sprint performance, strength and jump height [26-29], while other studies in the literature reported that dynamic stretching exercises have no effect on performance [30-32]. Up to date coaches, Athletic trainers, and physiotherapists, still having argument about the benefits of static stretching, and its influence on athletic performance [33]. To our knowledge there is no previous study in the Kingdome of Saudi Arabia (KSA) that assessed the effect of stretching on Saudi athletic performance. The aim of this study was to evaluate the effect of static stretching (SS) on static and dynamic balance (DB) of Saudi recreational football players. And to verify the relation between Static and dynamic balance and it influence on athlete's performance.

Material & methods

Participant

Forty healthy male Saudi recreational football players volunteered to participate in the study. Participants were recruited from local football club using posters and/or by word of mouth. All participants were selected based on the following criteria:

Inclusion Criteria

- Healthy males
- Recreational Football players
- Age range between 18-30 years old.
- Participating soccer at least 3-4 times/week.
- Only right dominant leg participants were involved in this study.

Exclusion Criteria

- Participants with a history of musculoskeletal injury in the last 6 months
- History of lower limb surgery in the last 6 months or eve
- Any pathological joint laxity
- History of vision disorders,
- Any musculoskeletal or neurological pathology in the last 6 months.

Ethical consideration

A written informed consent was obtained and singed by each participant after the approval of the Ethics Committees at King Faisal Specialist Hospital and Research Centre (KFSH&RC). The informed consent was designed in both languages (Arabic and English); a statement of no objection from the participants to participate in this study, description of the research potential risks, discomforts, potential benefits, and reimbursements were included. The purpose and the nature of the research study was explained to the participants. All information obtained from the participants was treated confidentially. Initially all participants were medically screened and basic demographic data was obtained. The physical characteristic of both groups are represented in Table 1.

Table 1. *Physical Characteristics Data*

GROUPS	AGE (YEARS)	HEIGHT (CM)	WEIGHT (Kg)	MI (Kg^2/cm)
A(n=20)	21(1.9)	170(5.7)	62(4.9)	21(1.1)
B(n=20)	20(2.1)	171(5.8)	60(5.2)	21(1.4)

Study design

This study employed a two groups, repeated measures design. Static and dynamic balances represented the primary outcome measures. Both tests were performed by all participants three times (before stretching, immediately after stretching and then post 20 minutes from the end of the stretching, regardless how long the static and dynamic balance took from each participant). Stop watch was used to measure the time. Tests were performed on the dominant leg of each participant (standing leg). Balance Master System (BMS) [34] was used for measuring static balance (SB), while the Modified Star Excursion Balance Tests (MSEBT) [35] which offers a simple, reliable, and low-cost instrument available currently to assess balance was used for measuring dynamic balance (DB).

Study intervention

All the participants were trained how to do the self-static stretching program for the three muscle groups (Hamstring, Quadriceps and Gastrocnemius) a week prior to the actual test. Participant were also given all the required instructions including safety issues and proper sport clothes. Prior to the actual test. All participants were asked to practice (SB and DB) tests one day before the testing date and again on the testing day prior to the actual tests in order to control any learning effect. Participants were divided randomly into two group: Group A (n=20) and Group B (n=20). Group A: started the dynamic balance first then the static balance, while group B started the static balance test first then the dynamic balance in order to find out if there is any influence of one the balance test on the other.

Stretching programme

The stretching exercises program were performed for three muscle groups and was repeated three times for each muscle group, with a holding period of 30 seconds and 10 seconds rest in between stretches. The stretching programme for the selected muscles group is demonstrated in Table 2.

Table 2. *Stretching and Intervention Parameters*

Intervention parameters	Group A: Started the dynamic balance first.	Group B: Started with the static balance test first.
Frequency	Stretching program was repeated three times for each muscle group.	Stretching program repeated three times for each muscle group.
Intensity	Moderate – high stretching	Moderate - high stretching
Type	Self-stretching exercises (Static).	Self-stretching exercises (static).
Time	The holding period was 30 seconds with 10 seconds rest in between.	The holding period was 30 seconds with 10 seconds rest in between.
Siting	King Faisal Specialist Hospital and Research Center, Physical Rehabilitation Department, Gymnasium, Riyadh. Saudi Arabia.	King Faisal Specialist Hospital and Research Center, Physical Rehabilitation Department, Gymnasium, Riyadh. Saudi Arabia.
Who	Senior Physiotherapist	Senior Physiotherapist
Motivation	By Physiotherapist	By Physiotherapist

Data are mean(SD)

Hamstring Muscles Stretch

Each participant was asked to sit on a mat extending the right leg straight out in front of him, with the other leg tucked in towards the opposite thigh. Participant then asked to bend his trunk forward trying to reach the toes of his extended leg by both hands, keeping back as straight as possible [36, 37]. Each participant instructed to hold this position for 30 seconds. This stretching maneuver was repeated three times with 10 seconds rest in between stretches [38-40] (Figure 1).

Figure 1. *Hamstring Muscle Stretching*

Quadriceps Muscle Stretch

Each participant was asked to stand up tall and straight about one feet away from a wall on one leg, maintaining good balance by having one hand against the wall. The toes of the left leg were pointing straight ahead, and the left knee was slightly bent. The participant was then asked to lift his right leg from the floor and bend it behind and grab his ankle. Keeping his knee as close as possible to the other leg, and slowly pull his ankle up toward his head and push forward through his right hip until he felt the stretch in the front of his right thigh (heel was facing to buttock and knee was pointed down towards to the floor). Each participant was asked to hold the stretch for 30 seconds and to repeat it three times, with 10 seconds rest in between each stretch see Figure 2.

Gastrocnemius Stretch

The participant was asked to stand facing a wall 3 feet away. Then to take one step toward the wall with non-dominant leg. Participant was then asked to place his forefoot his dominant leg over a 10 centimeters height step keeping his heel positioned on the floor all the time and to lean forward placing both palms on the wall while bending the non-dominant t and keeping the knee of the stretched leg straight see Figure 3. All participants were asked to hold the stretch for 30 seconds and to repeat it three times with 10 second rest in between each stretch.

Figure 1. *Quadriceps Muscle Stretch from Standing*

Figure 3. *Gastrocnemius Muscle Stretch from Standing*

Stretching programme

Static Balance Test (SBT)

Balance Master System (NeuroCom. International, inc. USA.), Unilateral stance (US) was used to assess static standing balance through a computerized system. This system is able to measure the ability of the individual to control the center of gravity (COG) over the base of support [34]. The Postural Sway Velocity, which is a ratio of distance to time (D/T) was measured to determine the absence of sway "stability". This system has been reported to be a reliable and valid assessment instrument in the evaluation of balance [41].

Each particiant was asked to step on the platform barefooted, and stand still. The displacement of the COG was then measured for 10 seconds per trial. The test was started after the participant was able to hold himself steady standing on the dominant leg (the stance foot placement instruction was explained as it appeared on the screen). The hip and knee of the contralateral leg were flexed to 90 degrees. Arms were kept at waist level. Each participant allowed to repeat the test three times and the system will calculate and obtain the average reading. In this test it should be noticed that low score means good static balance and higher score means poor static balance see Figure 4.

Figure 4. *Participant during static balance test*

Dynamic Balance Test (DBT)

Star Excursion Balance Test

Star Excursion Balance Test (SEBT) was applied for all participants as described by Oldmsted et al [35] and Bressel et al [42]. The SEBT has been established as highly reliable and valid for both research and clinical purposes [41]. In this study the modified Star Excursion Balance Test was used to measure the dynamic balance test. This test consists of four directions: Anterior, Lateral, Posterior and Medial. These directions were made by athletic tape extending out at 900 from each other. To perform the test, each participant was asked to maintain single leg stance on leg (dominant leg) while

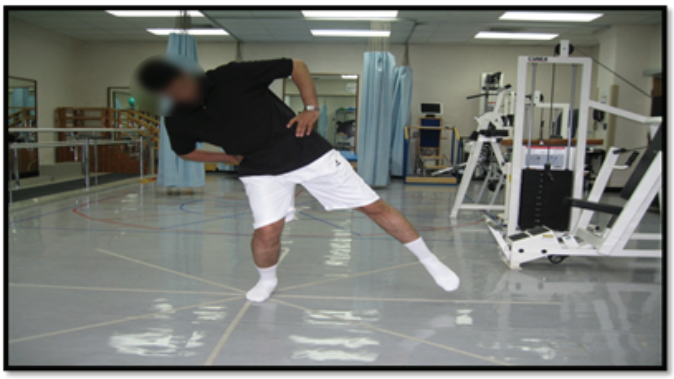


Figure 5. *Participant performing dynamic balance test*

reaching as far as possible with the contra-lateral leg (reach leg) see Figure 5. The Participant was instructed to touch the outlying point on the line with the reach foot (toe only) as lightly as possible in order to ensure that stability was maintained through adequate neuromuscular control of the stance leg.

The reached distance was then measured manually by the examiner, from the center of the grid to the touch point with a tape measure in centimeter. Three reaches in each direction were recorded. Participants were given 15 seconds of rest between reaches. The average of the three reaches in each of the four directions was recorded. The order of the performed dynamic test was toward clockwise and the directions of the first excursion (anterior, lateral, posterior and medial) were counterbalanced to control for any learning effect. Trials were discarded and repeated if the participant did not touch the line with the reach foot while maintaining weight bearing on the stance leg, lifted the stance foot from the center grid, lost balance at any point or did not maintain start and return positions for one full second. All participants were allowed to practice the (SEBT) one day before the actual test and on the testing day. Al participants were asked to do a three trials in order to offset the learning effect as recommended by Rasool and George [43]. (In this test it should be noted that high score means good DB and low score means poor DB).

Dynamic B

Data was descriptively analyzed using mean of standard deviation (mean-SD). The initial data analysis was employed to assess the effect static stretching on static and dynamic balance of Saudi recreational football players. The dependent variables (DV) were (SB and DB), while the independent variables were stretching and time with three levels (pre-stretching, immediately post-stretching and 20 minutes post-stretching). 2x3 mixed analyses of variances (ANOVA) were used. The between-group factors were with two levels (group A started DB test 1st & group B started SB test 1st), while the within-group factor was the time with its three levels and the direction in the DB test with four levels (Anterior, Lateral, Posterior, and Medial). All data were collected and analyzed using software SPSS (V. 22.0). The critical alpha level was set at ($p \leq 0.05$).

Results

The Results of this study showed a significant main effect for groups (A & B) ($F(1, 38) = 6.17$, $P = 0.017$) for the between participants' factor, while the within-participant factors were not significant ($F(2, 38) = 0.643$, $P = 0.533$). Table 2 showed the mean-SD for both groups over time. The analysis of variance results also indicated that the interaction between group and time was significant (F

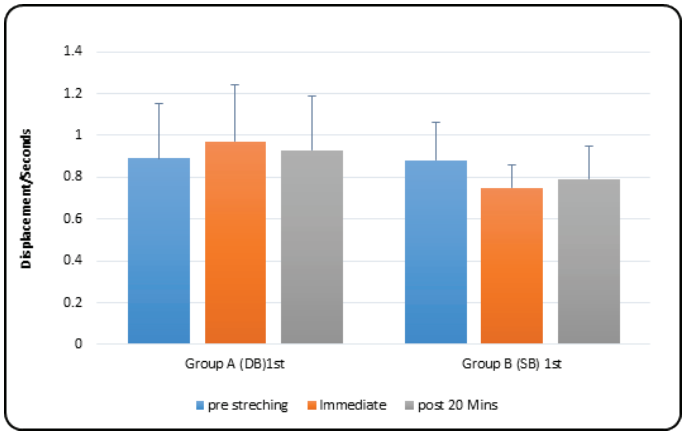
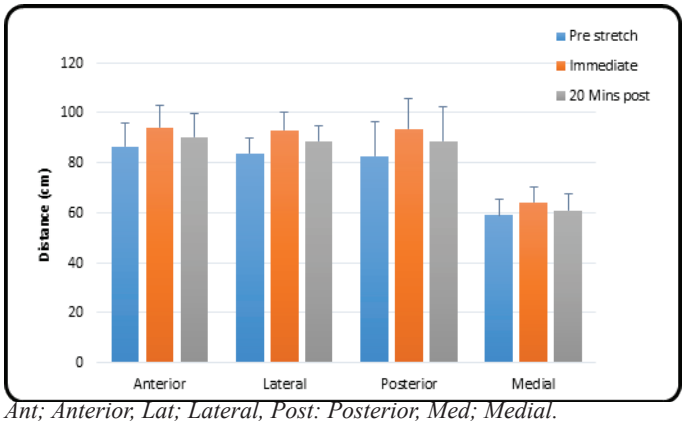


Figure 6. *Static balance test score for group A& B*



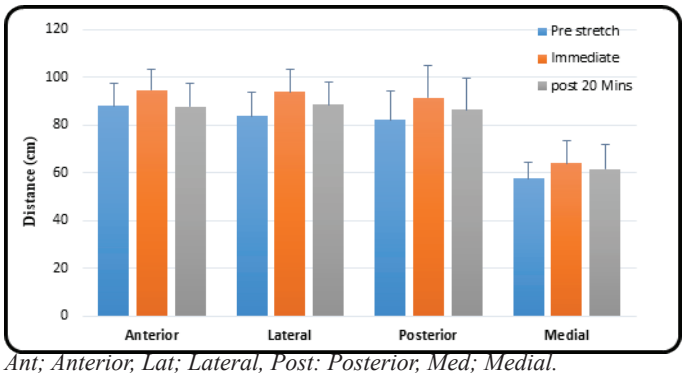
Ant; Anterior, Lat; Lateral, Post: Posterior, Med; Medial.

Figure 8. *Static balance test score for group A& B*

(2, 38) =07.91, P= 0.001). Overall, group B demonstrated slightly lower mean score immediately post stretching which, indicate an improvement of the SB while, group A demonstrated an increase in the mean score of the SB indicating low SB. The results of the static balance test score for group A& B pre, immediate and post static stretching exercises is demonstrated in Figure 6.

Table 3 demonstrated DB test data (mean(SD)) for both groups. The analysis of variance results of the DB test revealed that for the four directions (anterior, lateral, posterior, and medial) the main effect for time was significant, while the main effect for group and the interaction between time and group was not significant. Although, For anterior direction the main effect for group was not significant ($F_{(1,38)}$=0.022, P=0.883), the main effect for time was significant $F_{(2,38)}$= 35.121, and the interaction between time and group was not significant ($F_{(2,38)}$=2.947, P=0.059).

For the lateral direction the main effect for group was not significant ($F_{(1,38)}$ =0.007, P=0.934), the main effect for time was significant ($F_{(2,38)}$ =58.398, P=0.000), the interaction between time and group was not significant ($F_{(1,38)}$ = 0.209, P=0.812). For the posterior direction the main effect for group was not significant ($F_{(1,38)}$ =0.170, P=0.683), the main effect for time was significant ($F_{(2,38)}$ =35.513, P=0.000), and the interaction between time and group was not significant ($F_{(2,38)}$ =0.250, P=0.780).



Ant; Anterior, Lat; Lateral, Post: Posterior, Med; Medial.

Figure 7. *Dynamic balance test score for group A pre, immediate and post static*

For the medial direction the main effect for group was not significant ($F_{(1,38)}$ =0.047, P=0.0.830), the main effect for time was significant ($F_{(2, 38)}$ =29.319, P=0.000), and the interaction between time and group was not significant. In general, all of the DBT mean(SD) scores (for the 4 directions) were increased immediately post stretching then it decreased again after 20 minutes, but almost less than the baseline scores. The results also showed that the effect of the stretching on SB of group A decreased immediately post-stretch and then improved over time (from immediate to 20 minutes post-stretching) but, the opposite occurred for Group B. Although, the DB of both groups improved over time. (Figures 7 and 8).

Discussion

TIn this study the hypothesis stated that static stretching will have a negative influence on the static and dynamic balance of the Saudi football players. The results of the study demonstrated that static stretching of the three muscles group (Quadriceps, hamstring and calf muscles) have positive effects on static and dynamic balance immediately post stretching. This effect appears to be an acute effect, since the results of the study revealed that the SB test scores decreased immediately post stretching meaning that static balance became better after stretching. The DB test scores increased immediately post the stretching program which indicated that the DB test also improved immediately after the muscles stretching, although this increase returned back near to the pre-stretching scores after 20 minutes. There was no significant effect for time (p> 0.05) but, the results were significant for groups and for the interaction between time and group. The results of this study demonstrated that group B (started the SB test first) had better balance than group A (started DB test first) since the mean score of group A increased immediately post- stretching which means poor balance, then it decreased again near to the pre-stretching score, while, the mean score of group B decreased immediately post stretching then it increased again near to the pre-stretching scores. This decreased in static balance for group A could be due to fatigue or exertion [44] from performing the DB test as each participant from group A repeated this test three times and in four directions before starting the SB test, which also could lead to moderate the acute effect of stretching. Numerous studies have been conducted on static stretching, the majority of these studies looked at the influence of static stretching on muscle power, force, peak torque, and performance [42, 45, 46.47]. Despite that most of the studies reported that the decrease in balance was due to the decrease of muscle force or power. The results of our study contradicted with Behms' study [48] since our results showed

positive effect of static stretching on balance. First, the improvement which was observed in the SB test and DB test immediately post stretching could be as a result of increased muscle flexibility and joint range of motion (ROM) as one of the main acute effects of static stretching [49, 50, 51]. Secondly, it could be as a result of the change in joint proprioception, because muscle spindle activity is associated with muscle stiffness and acute stretching increases ROM and has been shown to reduce muscle stiffness and tension [52]. However, Larsen et al. [53] reported that no effect on knee joint position sense after stretching., a study done by Ogura et al. [47] concluded that the short term duration (30 seconds) of static duration did not have a negative effect on the muscle force production. Therefor a question could be raised whether the static stretching intervention in our study was enough to achieve the reduction in muscle tension, muscle stiffness, impaired balance, worsen reaction and movement times. It was not possible to ascertain this because we did not directly measure muscle stiffness, force, movement time or joint ROM. Although, it is important to point out that the type and the amount of stretching in our study was as recommended as adequate for achieving muscle-tendon unit lengthening and was therefore, a common protocol in the field [47, 53, 54]. Furthermore, the validity and test-retest reliability of the measurement tools which were used to measure the static and dynamic balance in our study were highly recommended and the learning effect was controlled [55, 56]. Therefore, the hypothesis of this study was rejected and the results of this study added to the exist evidence that SS has a positive effect on SB and DB.

Conclusion

The study concluded that static stretching technique has an immediate (acute) positive effect on the static and dynamic balance of the Saudi recreational football players. However, this effect was decreased over time. The results also showed that the DB test has a negative influence on the SB test but, not vice versa. Finally, this study suggests that static stretching is useful for athletes who wish to increase their balance and flexibility during warm-up procedures, prior to exercise or competition.

Limitation of the studs

This study included only male participant due to the difficulties of finding female recreational and cultural considerations. Thus this results cannot be generalized.

Conflict of Interest

The authors declare no conflict of interest.

Contribution/Originality

The primary contribution of this paper is to highlight on the relation between Static and dynamic balance and its influence on athlete's performance. To verify the relation between Static and dynamic balance and its influence on athlete's performance.

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