Acute Effect Of Different Sets Of Ballistic Stretching Protocol On Repeated Sprint Performance Among Football Players

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Abstract: This study aimed to compare the effects of different sets of ballistic stretching protocol on repeated sprint ability (RSA) performance among football players. Fourteen male university football players [age (mean ±SD) 23.4 ± 1.3 years, body mass 70.0 ± 4.8 kg, height 171.6 ± 5.8 cm, body mass index (BMI) 23.4 ± 2.1 kg.m^{-2}] underwent 4 sessions in the counterbalance design. All sessions included a general warm-up, followed by a ballistic stretching protocol (one set –DSS1; two sets –DSS2; three sets – DSS3) consists of 5 ballistic exercises (gastrocnemius, gluteus maximus, hamstrings, quadriceps femoris and hip extensions). A standardized specific warm-up was then undertaken followed by 5 x 20-m with interspersed 30-s active recovery. The finding of study shown a values of total time sprint (TST), mean time sprint (MST) and best time sprint (BST) were significant faster for BSS1 compared to BSS2 and BSS3 (P < 0.05). Fatigue index (FI) was significantly lower in BSS1 compared to BSS2 and BSS3 (P < 0.05). Heart rate and rating of perceived exertion (RPE) also were showed significantly lower value for BSS1 compared to BSS2 and BSS3 (P < 0.05). In conclusion, the performed a single set of ballistic stretching may induce a significant improvement in 20-m RSA performance.

Keywords: Fatigue, Repeated-Sprint Performance, Sets, Ballistic stretching,

1. Introduction

Stretching exercise is a part of the warm-up routine and very essential to perform before the physical activity, training session, or sports competition. It has been associated with enhance athlete performance, reduce risk of injury, accelerates recovery and decrease muscle soreness [1, 2]. Several stretching technique modalities such as static, dynamic, ballistic and proprioceptive neuromuscular facilitation (PNF) have been used in different sports setting [3, 4]. Ballistic stretching involves repetitive and bouncing movement in which the body part put into motion and momentum at the end range of motion (ROM) [5, 6]. The effect of ballistic stretching on sports performance are conflicting. Most of the studies have shown that ballistic stretching may be report unaffected or negative effects on vertical jump, strength, flexibility and sprint performance [7, 8, 9, 10]. Conversely, a few literature reviews have been show that applies ballistic stretching can acutely improve sprint time and agility [11], isokinetic power [12] and vertical jump height [4]. In a study by [7] found that ballistic stretching did not impair the vertical jump score compare to static stretching after 15 and 30-

minute rest, respectively. Moreover, a study by [13] showed a significant increase in vertical jump result following ballistic stretching compare to PNF and static stretching and a combination of both. Recently, a study by [9] and [14] revealed that ballistic stretching does not impair in sprint performance. Although a single sprint has been study by using ballistic stretching, multiple sprints still unknown the result if can affect the sprint time performance.

Recently, research indicates that the potential effect of stretching on performance seems to depend on the mode of stretching employed, intensity of stretching, duration, the volume of stretching (number of drills performed per each muscle group), training history, task specificity and frequency may play a major role for stretching response [5,15]. During pre-stretch warm-up exercise, fatigue and potentiation effects would occur concurrently [16]. It may be important to determine the various sets to perform in ballistic stretching to ascertain the volumes of activity necessary to achieve optimal performance and to minimize the concurrent fatigue. However, it is still unknown whether how many sets should be performed of ballistic stretching to detrimental the performance of repeated sprint performance.

In our knowledge, no study has been investigated the effect on various volumes of ballistic stretching on the repeated sprint performance. A clarification of the effect different sets of ballistic stretching RSA would help to coach and players to decide which sets/volume are enough to promote the best performance. Therefore, this present study aims to investigate the effect of different sets of ballistic stretching on repeated sprint performance in football players.

2. Experimental, Materials and Methods

Subjects Fourteen male football players took part in this study [age (mean ±SD) 23.4 ± 1.3 years, body mass 70.0 ± 4.8 kg, height 171.6 ± 5.8 cm, body mass index (BMI) 23.4 ± 2.1 $kg.m^{-2}$]. All subjects were recruited from a competitive University League and currently where participating in preseason workout included sport-specific training program and strength training. They must have experience of training at least five times per week and volunteered to participate in this study. The subjects had no history of musculoskeletal injury before participating in this study and free of illness during the testing periods and no one was taking any dietary supplement or pharmaceutical drugs that may affect performance during study. All the subjects signed an informed consent form after receiving verbal and briefing of potential risk and benefits derived from study participation.

Design

Subjects attended a total of 4 measurement sessions, including familiarization and remaining 3 sessions to performed ballistic stretching (BSS1-ballistic stretching one set, BSS2- ballistic stretching two sets and BSS3- ballistic stretching three sets) and followed by linear 20 meters Repeated Sprint Ability (RSA) in counterbalance. All the testing were conducted at the same time of the day (between 8.00 am and 11.00 am) to ensure no diurnal variation and under standard environmental (25°C and 70% relative humidity). For each testing, the day was separated by approximately 72 hours. Subjects were asked to refrain from caffeinated beverages and any strenuous physical activity for 48 hours before the experiment's session. The subject was strapped on the heart monitor (Polar S710, Polar Electro, Kempele, Finland) upon arrival at laboratory and undertook a 5-minute general warm-up. Afterwards, they were asked to perform one of the three different sets of ballistic stretching protocol, followed by specific warm-up activities and 5 x 20-m repeated sprint test.

Ballistic Stretching Protocols

After completion of 5-min general warm-up, subjects were instructed to perform one of the three different volumes of ballistic stretching. The ballistic stretching protocol incorporating five exercises to targeted the specific muscle for sprinting such as gastrocnemius, gluteus maximus, hamstrings, quadriceps femoris and hip extensions [9]. This muscle was involved in specific activities to mimic parts of the sprint cycle in the acceleration phase [17]. The subjects were performed ballistic stretches in the oscillatory stretching movement at a rate of 1:1 second per cycle for 1 minute and frequency is controlled by a metronome (60 b.min-1) and assisted by two strength and conditioning experts. The subjects underwent either one sets (BSS1), two sets (BSS2) or three sets (DSS3) of ballistic stretching, in which were randomized and counterbalance order of administration.

Specific Warm-up

After completion of the ballistic stretching, subjects were asked to perform approximately 5-minutes incremental intermittent sprints. The component of specific warm-up consists of 3 of 20-m at 50% maximal effort and 3 of 20-m at maximum effort with walking back to starting point to recovery. The subjects were allowed to rest 5 minutes before the actual experimental trials.

Repeated Sprint test

The sprint test protocol used consist of 5 maximal 20-m repeated sprints with 30-s of active recovery. The 20-m RSA performance is considered to a related in sports involving sprint [18] and represent the mean of sprint distance in field-based team sport [19]. Standardized verbal encouragement was given during familiarization and experimental session. Sprint test time was recorded by using timing gate (Microgate, Bolzano, Italy) with set 1-m apart, 1-m height and 1-m from the starting line. The position of the timing gate was standardized accordance with the guidelines by the manufacturer. RPE was recorded by used Borg's 6-20 scale. Sprint data for total sprint time (TST), mean sprint time (MST), best sprint time (BST) were recorded and used in the subsequent analysis. Fatigue index (FI) was calculated through the method used by [20].

Statistical Analysis

All data were analysed by Statistical Package for Social Sciences (SPSS. ver 26.0) for windows (SPSS, Chicago, IL, USA) for all parameters. A one-way repeated-measures analysis of variance was performed for all variables. A Bonferroni post-hoc test was applied to make a pairwise comparison where the main effect was present. The results are presenting as mean ± the standard deviation and 95% confidence interval (95% CI) was calculated for the difference between values for each variable. The alpha level of significance was set at $p< 0.05$.

3. Results and Discussion

The finding of this study for repeated sprint test for performance in table 1, shown that TST was significantly slower for BSS2 and BSS3 compare to BSS1 (F=47.874, p=0.000, 95% CI: 17.23-17.60 seconds) and also the result found that BSS3 slower than BSS2 in TST. Meanwhile, the results showed that MST was significantly slower for both BSS2 and BSS3 compare to BSS1 (F=19.10, p=0.000, 95% CI: 3.45-3.54 seconds).For the BST, the finding showed that BSS1 was significantly faster compared to the BSS2 and BSS3 (F=14.142, p=0.000, 95% CI: 3.33-3.54 seconds). The result of FI was revealed significantly lower in

BSS1 compared to BSS2 and BSS3 (F=6.899, p=0.004, 95% CI: 5.27-6.57 seconds). Also, the physiological responses of heart rate during repeated sprint test was observed and were showed significantly lower in BSS1 compared to the BSS2 and BSS3(F=15.631, p=0.000, 95% CI: 172.2-175.0 beats.min-1). In the RPE, results were showed significantly lower score in BSS1 condition compare to BSS2 and BSS3, respectively (F=54.053, p=0.000, 95% CI: 12.20-12.70).

Table 1. Mean ± SD values for Heart Rate, RPE and RSA Test Variables.

Variable	**BSS1**	**BSS2**	**BSS3**	**P-Value**
HR- beats.min^{-1}	171.3 ± 2.94	174.1 ± 2.83[a]	175.3 ± 2.72[a]	0.000
RPE	11.7 ± 0.61	12.6 ± 0.50[a]	12.9 ± 0.30[a]	0.000
RSA Test				
TST (s)	16.85 ± 0.41	17.37 ± 0.50[a]	18.0 ± 0.31[a,b]	0.000
MST (s)	3.37 ± 0.08	3.47 ± 0.09[a]	3.64 ± 0.18[a]	0.000
BST (s)	3.29 ± 0.07	3.36 ± 0.11[a]	3.46 ± 0.10[a]	0.000
FI	4.42 ± 1.22	6.43 ± 2.53[a]	6.92 ± 1.73[a]	0.004

Abbreviations: BSS1, ballistic stretching set 1; BSS2, ballistic stretching set 2; BSS3, ballistic stretching set; HR, Heart rate; RPE, Rate of perceived exertion; TST, total sprint time; MST, mean sprint time; BST, best sprint; FI, fatigue index.
[a]Values significantly different compare to the BSS1 condition.
[b]Values significantly different compare to the BSS2 condition.

TABLE 1 ABOUT HERE

The present study was aimed to compare the three different sets of ballistic stretching on repeated-sprint performance by using 5 x 20-m protocols with interspersed 30-s active recovery among football players. The main finding of this study reveals that performing single set (BSS1) of ballistic stretching with incorporating of five exercises in lower body musculature shown significantly improves performance for repeated-sprint parameters compared to the two sets (BSS2) and three sets (BSS3). It has been well known that pre-exercises stretching performing before training or competition is crucial to optimized performance [5]. Several studies have using ballistic stretching mostly reported the conflicting results on sub-sequence muscular strength [6, 8, 21, 22,] and power [23, 24, 25]. Study by [17] showed that applying 2 sets of ballistic stretching was significantly improves vertical jump and flexibility ($p< 0.05$). In contrast, the finding from [7, 21] were showed no significant different after 3 sets of ballistic stretching on vertical jump performance. Meanwhile, studies by [8, 22] were showed that flexibility significantly improves after using 3 sets of ballistic stretching. However, the finding from several studies by using a single sprint test tend to showed that ballistic stretching did not impair the performance [9, 14]. In a study by [14] revealed that the significant effect of ballistic stretching to maintain on 10-m and 20-m of sprint performance with four sets and five ballistics stretch.

According to [15], in order to beneficial stretching effect on performance, several factors can affect the stretching outcomes such as intensity, duration, volume, task specificity,

frequency, history of athletes must be taken into account. Considering many studies have reported that the linear sprint and repeated sprint ability to be a significant result when incorporating different volumes either one set or two sets of dynamic stretching [26, 27]. The ability to maintain multiple short sprints during a match is very crucial in football [28]. Thus, performance in repeated sprint ability (RSA) is a very important factor for success in these sport. Thus, there is a need to determine the most effective sets of ballistic stretching on subsequence RSA performance to provide information for athletes and coaches in their training routine.

In this study, the finding of BST and MST were showed that BSS1 significantly faster time sprint to compare the BSS2 and BSS3. It would be affected by the volume of ballistic stretching during warm-up were performed a single set of ballistic stretching resulted decreased by 2.1% of BST to BSS2 and 5.2% in BSS3. Besides this, we established a decrease of 2.9% following 2 sets of ballistic stretching and 8.0% following 3 sets of ballistic stretching in MST compared to a single set of ballistic stretching. The higher time sprint of two and three sets of ballistic stretching on the multiple sprints (RSA) was expected to be associated with fatigue development. Fatigue development during multiple sprints with BSS2 and BSS3is inversely to the initial of speed and power [29] and correlated with performance decrement over the multiple sprints [30]. Fatigue index was shown significantly higher by 45.4% following the BSS2 and 56.5% for BSS3 compare to the BSS1. These results indicate that higher fatigue index was associated with lower the ability of an individual to maintain the power and speed during multiple sprints. It seems that performing volume by two and three sets of ballistic stretching might be induce fatigue due to too much stimulus provided before to the repeated sprint test [31]. The higher fatigue index in BSS2 and BSS3 are speculated of the decrease in the availability of the high energy phosphates and resulted in reduced contraction capability of the muscle involved [32].

We also found that heart rate response and RPE were higher in BSS2 and BSS3 by 1.6%, 2.3% and 7.7%, 10.2%, respectively. According to [33] Borg (1982) has suggested that RPE score is a reflection of many feeling and sensation while performing a physical exercise. In this regard, higher RPE score during performed 20-m RSA test were speculated to result from intense effort during pre-warm up in BSS2 and BSS3 due to not enough recovery.

A possible explanation for the positive effect of BSS1 on 5 x 20-m RSA could be related to improving neurological effect. According to [13] explained that ballistic stretching would be producing more profound action potential with increasing the number of firing motor unit as a reaction to abrupt stretching of the muscle spindle, which it leads to myotatic reflex. This condition of BSS1 may be reflected in maximizing the synchronization of agonist and antagonist muscle activation to sustain speed and power during 20-m RSA. In line with this result, a study by [27] reveals that incorporates one or two sets of dynamic stretching have improved the sprint performance for the 20-m protocol. Meanwhile study by [28] was indicated that two sets of dynamic stretching for lower musculature can sustain the performance in 30-m RSA protocol.

Furthermore, the specific of warm-up activity (with sprint task) before the test maybe contribute to enhance in 20-m RSA performance. The previous study has been shown that completing with sprint activities for specific warm-up tend to the improvement of sprint performance by 2-3% in football players [34, 35]. However, there is scanty research evidence that supports the benefits of these practice during the RSA protocol. A present study verified that the warm-up with complemented with specific warm-up activities (e.g. 3 of 20-m at 50%

maximal effort and 3 of 20-m at maximum effort) positively affected a single set of ballistic stretching on 20-m RSA performance but not for two or three sets of ballistic stretching.

4. Conclusion

In conclusion, the results of the present study suggest that a single set of ballistic stretching with involves 5 of ballistic stretches activities of the lower body positively improve 20-m RSA protocol in football players. Furthermore, with incorporating the specific warm-up to a mimic of the sprint maximal effort would tend to aids for enhancement the repeated sprint test performance. However, the assessment of the two and three sets of ballistic stretching did not revealed meaningful improvement in 20-m RSA test performance.

5. Acknowledgment

The authors are grateful to the Research and Innovation Centre, Universiti Pendidikan Sultan Idris, Tanjong. Malim, Perak for their willingness to support the financial for publication of this study and would like to express my sincere appreciation to all the subjects and also to whom as involved directly and indirectly in this study.

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Abbreviations: BSS1, ballistic stretching set 1; BSS2, ballistic stretching set 2; BSS3, ballistic stretching set; HR, Heart rate; RPE, Rate of perceived exertion; TST, total sprint time; MST, mean sprint time; BST, best sprint; FI, fatigue index.

[a]Values significantly different compare to the BSS1 condition.

[b]Values significantly different compare to the BSS2 condition.