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EFFECTS OF THREE DIFFERENT STRETCHING TECHNIQUES ON ACCELERATION AND SPRINT PERFORMANCE IN WOMEN COLLEGIATE SOCCER PLAYERS

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ABSTRACT

Bullis JM, Van Boxtel BA, Harnell HK, Ostrowski TL, Holzem MM. Effects of Three Different Stretching Techniques on Acceleration and Sprint Performance in Women Collegiate Soccer Players, *Journal of Undergraduate Kinesiology Research* 2007;3(1):9-17. Stretching prior to sport performance has been an ongoing debate on whether its effects are positive or negative to the athlete. Furthermore, if stretching is beneficial for the athlete, then the type of stretch which should be used with acceleration and sprinting type exercises needs to be determined. **Purpose:** The purpose of the study was to determine what type of stretch is more effective in terms of acceleration and sprint performance by measuring 10 yard and 40 yard dash times respectively. **Methods:** Twelve UWEC Women's Soccer players were the subjects for the study. Subjects were randomly assigned one of the following stretch protocols at four different sessions: passive static, active dynamic, and contract-relax PNF, as well as using a no stretch control group. Subjects were then asked to run a 40-yard dash and both 10 and 40-yard dash times were recorded. The second sprinting trial was repeated after a two minute break. **Results:** The 10 yard acceleration mean times for no stretch, passive static, active dynamic, and contract-relax PNF were 1.92 ± 0.15 , 1.87 ± 0.15 , 1.98 ± 0.06 , and 2.00 ± 0.07 seconds respectively. The 40 yard times to measure sprint performance were 5.79 ± 0.19 , 5.74 ± 0.22 , 5.90 ± 0.17 , and 5.82 ± 0.15 for no stretch, passive static, active dynamic, and contract-relax PNF respectively. Therefore, we found that passive static stretching was the most effective in decreasing 10 and 40-yard times. **Conclusion:** It is recommended that passive static stretching, as compared to other forms of stretching, should be performed prior to short bout acceleration and sprint performances.

Key Words: contract-relax PNF stretching, passive static stretching, active dynamic stretching, acceleration, sprinting, time, 40 yard dash, 10 yard dash

INTRODUCTION

For over thirty years now stretching has been looked at as a component of injury prevention and improvement of competitive performance (1). Recently, many different experiments have been conducted, and many different outcomes and conclusions have been made. Some research has found that stretching has a negative impact on sprint performance. Specifically, one study showed that the time of a 20 meter sprint was significantly increased after passive static stretching (2). Passive static, active dynamic, and contract-relax proprioceptive neuromuscular facilitation (PNF) stretches have all been used before athletic activities. Passive static stretching is performed in a slow, consistent lengthening of a relaxed muscle (3). Active dynamic stretching is defined as controlled movement through full, active range of motion (4). Finally, contract-relax PNF stretching is facilitated by first having the subject hold a passive static stretch, then contracting the muscle that is being stretched against a partner's resistance, and then relaxing the muscle thus producing a further end point range (5).

There have been past studies that have compared effects of acute bouts of stretching prior to sprint performance (6). Most studies only assessed one form of stretching against the control of no stretching prior to performance (7, 8, 9). The most common form of stretching is passive static. Passive static stretching is the most convenient form because it does not require a partner, it is effective at improving joint range of motion, and it does not require a lot of time or effort (10). This has then resulted in more studies being conducted involving passive static stretching than any other form (7, 8, 9). No studies were found that compared which is the best overall stretch protocol on sprint performance and acceleration between passive static, active dynamic, and contract-relax PNF stretching. Therefore, this study is intended to compare all three stretch protocols against a no stretch practice to find the best overall technique for acceleration and sprint performance.

One study compared the effects of passive static and active dynamic stretching in 20 meter sprint performance in rugby union players (4). They found a significant decrease in sprint time of 0.05 seconds following active dynamic stretching, as well as an increase in sprint time of 0.05 seconds following passive static stretching (4). Another study looked at track-and-field athletes and the effects of combined passive static and active dynamic stretch protocols. Their results show that active dynamic stretching decreased sprint time significantly by a mean of 0.16 seconds for men and 0.1 seconds for women when compared to the passive static active dynamic sprint times (11). Furthermore, when passive static stretching and active dynamic stretching were combined, there was still a significant increase in sprint time of at least 0.05 seconds (11). In an article that reviewed many different scientific stretching studies, they concluded that passive static stretching decreased performance, thus increasing sprint time (9). However, only one study was found specifically looking at soccer players and the effects of stretching and sprint performance. It was found that both passive static and active dynamic stretching increased performance in the 20 meter maximal speed test and the 10 meter acceleration test when compared to no prior stretching (11). This finding was contradictory to other studies done on the effects of passive static stretching on sprint performance, but there were no conflicting findings surrounding the positive effects of active dynamic stretching. Also, one study looked at the differences of stretching effects on sprint performance between genders and found no significant difference. Therefore, it is not expected that using only female subjects would result in different findings.

The main purpose of the study is to determine what type of stretching is more effective in terms of 40 yard dash time as well as 10 yard dash time to measure acceleration in female soccer athletes. The anticipated outcome of this study is that active dynamic stretching before testing a 40 yard dash will increase performance both on overall time and acceleration, while contract-relax PNF and passive static stretching will decrease performance.

This study is being conducted to further help and educate both female athletes and Athletic Trainers working with those athletes. These soccer players were selected because there are a lot of short sprints required in the sport of soccer. Being a successful collegiate team, it would be beneficial to determine how to best prepare for sprint performance. Since there is controversy over the effects of various stretching techniques, the goal is to help figure out what works best in terms of acceleration and sprint performance in sports that involve short bouts of sprinting. Since acceleration and sprint performance are stressed in almost every sport today, this study is very relevant to the athletic world.

METHODS

Subjects

The subjects were 12 females from the University of Wisconsin—Eau Claire Varsity soccer team. They all adhered to the same rigorous aerobic and resistance training program. The female athletes were between the ages of 18 and 22. The heights ranged from 18 to 22, and weight ranged from 51.82 to 71.73 inches. The soccer team was emailed, requesting volunteer participation in this study. Out of 28 women on the Varsity team, 17 agreed to participate; however only 12 were able to make it due to schedule conflicts. Consent forms were obtained from all subjects as well as approval by the University Human Subjects Institutional Review Board.

Instrumentation

Instruments used in this study included a stadiometer for weight (Detecto) and height measurements. The tape measure used was an open reel Komelon Fiberglass manufactured by MF Athletics. This was used to measure out 10 and 40 yard distances on the indoor track. The timing system used was a stopwatch manufactured by Sportline. Computer programs used were Microsoft Office 2007 for Excel and Word Documents and SPSS 15.0 for Windows. All of the instruments used were both reliable and valid. They created very consistent and reasonable readings.

Procedures

Subjects met at the same time, two days of the week for two straight weeks. Individuals were picked at random for which stretch protocol, if any, they would perform before their sprint. This helped to rule out familiarization with the study. The three stretching protocols were passive static, contract-relax PNF and active dynamic. Every subject completed all three stretching protocols in addition to the no stretch at one of the four sessions. See Table 1. below for the randomized orders.

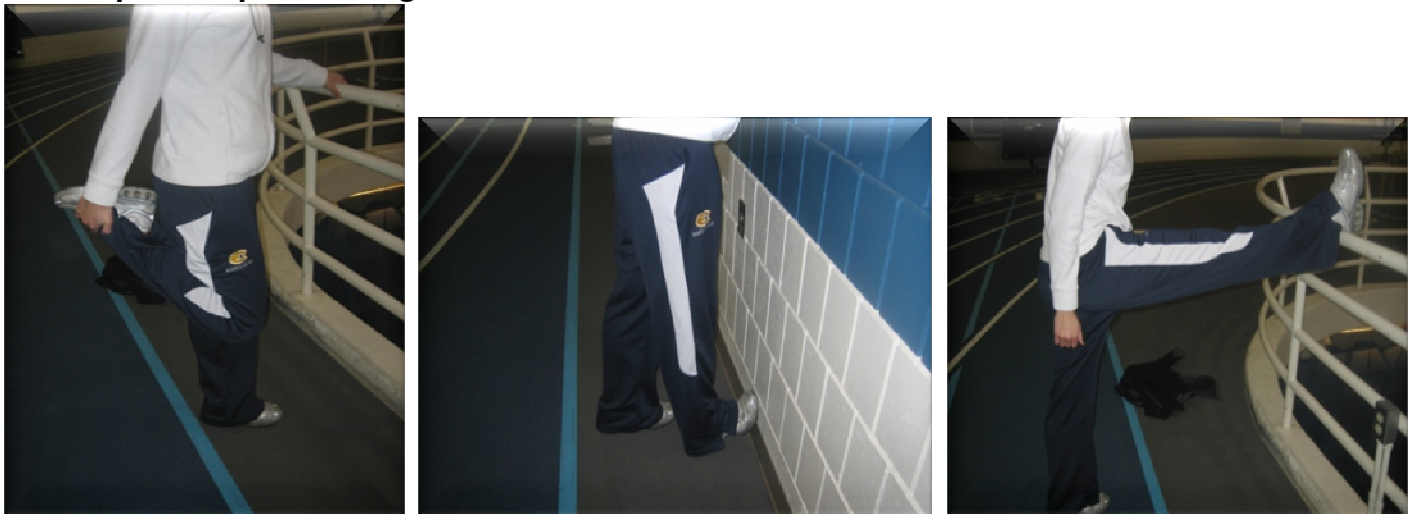
Table 1. Stretch Protocols

Subjects	Day 1	Day 2	Day 3	Day 4
1	no stretch	static	dynamic	PNF
2	static	dynamic	PNF	no stretch
3	dynamic	PNF	no stretch	static
4	PNF	no stretch	static	dynamic
5	no stretch	dynamic	static	PNF
6	dynamic	static	PNF	no stretch
7	PNF	no stretch	dynamic	static
8	static	PNF	no stretch	dynamic
9	no stretch	PNF	static	dynamic
10	PNF	static	dynamic	no stretch
11	dynamic	no stretch	PNF	static
12	no stretch	static	PNF	dynamic

The data collection was recorded on an indoor track at the local university. Subjects were in running shoes, without start blocks. All individuals completed a one lap self-paced jog, around the university track, equivalent to roughly 1/8 of a mile, 201.16 meters, before being stretched. Immediately following the warm-up, the female athletes performed their assigned stretch for that session (see Table 1. above). Only one stretch protocol was performed per session. Within one minute of completing their stretch protocol, the first sprint was executed. The 10 yard and 40 yard sprints times were clocked with four stop watches and recorded. The female athletes were given two minutes of rest time to recover before running the second sprint trial. The second sprint trial was done to ensure more reliable results when averaged together.

All different forms of stretching consisted of stretching the three major muscle groups of the lower extremity; the quadriceps, hamstrings, and calf muscles. Passive static stretches consisted of a hurdlers stretch to stretch the hamstrings, a standing calf muscle stretch, and a standing forced flexion of the knee for the quadriceps (see Figure 1.). During the hurdler stretch, the subject put her leg up on a table parallel to the floor and slowly put her chest to her leg while keeping her low back in a neutral position. With the calf muscle stretch, the subject kept her knee straight while firmly dorsiflexing her foot against a wall. Throughout the quadriceps stretch, the subject stood on one leg with the other leg bent behind her. Each passive static stretch was performed twice on each muscle group for a duration of 30 seconds each, calculating for a total of six minutes for both legs.

Figure 1. (Left to right) Hurdlers stretch for the hamstring, standing forced flexion of the knee for the quadriceps standing calf muscle stretch.



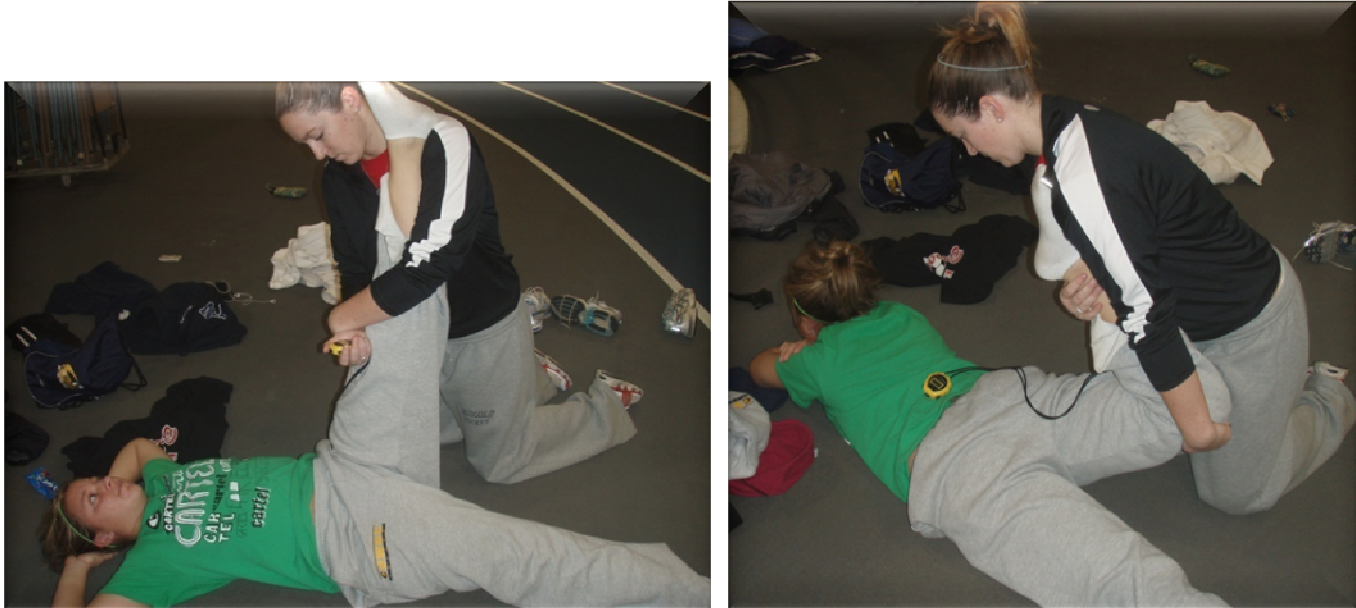
Active dynamic stretches consisted of butt kicks to stretch the quadriceps, alternating extended leg kicks to stretch out the hamstrings, and high skips to stretch out the calf muscles (see Figure 2.). Each active dynamic stretch was done for two minutes, for a total of six minutes of constant active dynamic stretching.

Figure 2. (Left to Right) Butt kicks to stretch the quadriceps, high skips for the calf muscles.



Contract-relax PNF stretches consisted of a passive hold-relax technique performed by the evaluator for the hamstrings, quadriceps, and calf muscles (see Figure 3.). The subject held a passive static stretch for 10 seconds, then resisted for 6 seconds, and finally went back into a passive static stretch for 30 seconds. The contract-relax PNF stretch was performed once to each muscle group on each leg.

Figure 3. (Left to Right) Contract-relax PNF for the hamstrings and for the quadriceps.



Statistical Analysis

All analyses were performed using Statistical Package for the Social Sciences, Version 15.0 (SPSS, Inc, Chicago, IL). Measures of centrality and spread are presented as mean \pm SD. Mean differences in 10-yd and 40-yd dash performance following no stretching, contract-relax PNF stretching, passive static stretching, and active dynamic stretching were assessed with one-way analysis of variance

(ANOVA). Tukey's post hoc tests were performed to determine differences between treatment groups. The probability of making a Type I error was set at $p \leq 0.05$ for all statistical analyses.

RESULTS

The baseline characteristics for subjects who completed the study are shown in Table 2. below. Statistical analysis revealed no significant differences in 40-yd dash time between treatment groups [$F(3, 44) = 1.433$; $p \leq 0.05$]. Comparatively, there were significant differences in 10-yd dash time between treatment groups [$F(3, 44) = 2.964$; $p = 0.042$]. Tukey's post hoc analysis revealed that 10-yd acceleration times following contract-relax PNF stretching ($M = 2.00$) were significantly slower ($p < 0.05$) compared to passive static stretching ($M = 1.87$). The mean values and standard deviations (SD) for 10-yd and 40-yd dash performances for all treatment groups are presented in Figure 4. below.

Table 2. Descriptive data of the subjects.

Conditions	N	Mean	Standard Deviation	Range
Age	48	19.58	1.27	18-22
Height	48	65.46	2.25	60.5-68.5
Weight	48	62.39	6.71	51.82-71.73
Valid N (listwise)	48			

Figure 4. Sprint and Acceleration Means.

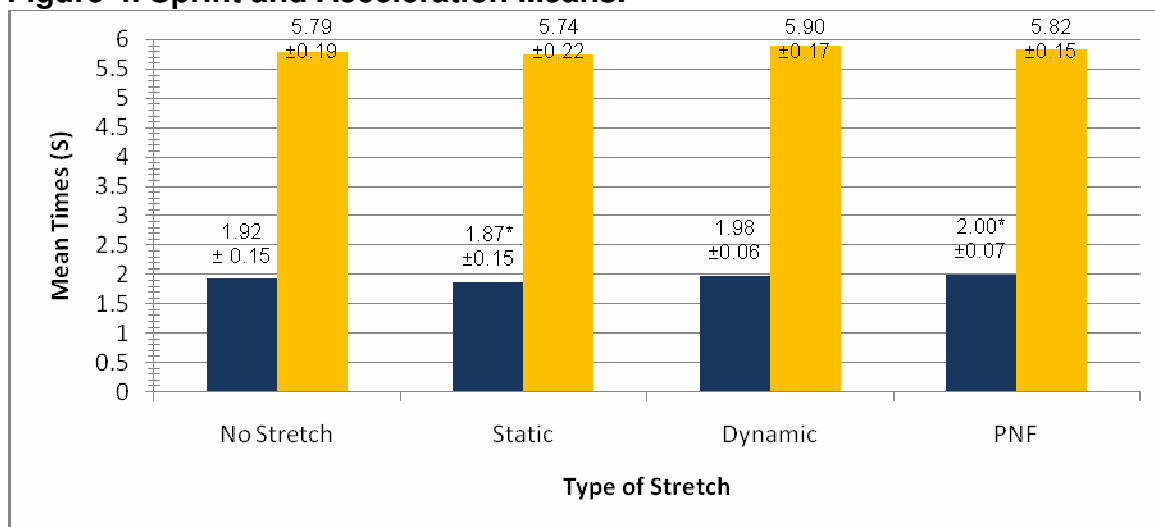


Figure 4. The yellow line shows 10 yard acceleration times, blue shows 40 yard sprint performance times. Stars indicate a significant difference was found.

DISCUSSION

After conducting research, the initial hypothesis of active dynamic stretching increasing acceleration and decreasing sprint performance time was rejected. This study found a significant difference in acceleration between contract-relax PNF stretching and passive static stretching. Passive static stretching when compared to contract-relax PNF stretching resulted in a significant difference of 0.054 seconds. In sprint performance there was no significant difference in sprint times; however,

passive static stretching produced the fastest times and active dynamic stretching produced the slowest times.

It would be thought that if there were any significant differences at all it would be within the 40 yard dash times. Furthermore, if there was a significant finding between the 10 yard dash times, there would definitely be a significant finding between the 40 yard dash times as well. However, this was not the outcome in this study. The exact cause for this is unknown, yet there are a few theories as to why this occurred. One reason could be due to the female's bodies responding to the stretch initially and then the response decreased as the sprint went on. It could also be due to the fact that the study took place after practice so the players gave a great initial effort and then tapered off at the end.

These two findings were not consistent with previous studies that were conducted. Authors (3) found noteworthy differences between active dynamic, passive static and contract-relax PNF. The results of the study showed active dynamic stretching subjects had a faster sprint performance time than passive static and contract-relax PNF. One other study (5) compared the effects of passive static and active dynamic stretching and found a significant decrease in sprint time with the use of active dynamic versus passive static. The mean decrease was 0.16 seconds for men and 0.10 seconds for women.

Researchers (6) did find a similar comparison between passive static and no stretch in sprint performance in professional soccer players. According to the study, passive static stretch, when compared to no stretch, produced a significant difference in 20 meter sprint performance. With this study, there were four different measures used, and this was the only significant finding. One of the measures used was 10 meter acceleration, however no considerable differences were found when using passive static stretching prior to the sprint.

Stretch reflex is when muscles are under conditions of excessive stretch and the muscle spindle receptors signal the muscle to contract. These receptors are located in skeletal muscles and are able to get feedback from the engaged muscle. Muscle spindles indicate lengthening of the muscle which sends a signal back to the brain and initiates a contraction to reduce the stretch of the muscle. Golgi Tendon Organs (GTO's) detect the amount of force, which causes a muscle to relax. The GTO's are considered a safety mechanism in case the tension becomes excessive, which would damage the muscle or cause the muscle to pull away from attachment sites. After the muscle is signaled to relax the antagonist muscle is contracted. Stretch reflex is seen in all types of stretching, but is commonly associated with contract-relax PNF stretching.

The results of this study are unique from all previous studies because all three stretch protocols were compared to each other as well as to the control of no stretch. Through the extensive research conducted, no prior studies compared all three stretches with a no stretch control group. Past studies have only compared either two stretches to each other or one against the control of no stretch. Because of all the different comparative methods the results may have been skewed due to a variety of possible limitations. With four different options to perform before sprinting, it creates more room for varied findings.

This study looked exclusively at the effects of different stretch protocols on female soccer athletes. There was one other study that looked at soccer players specifically which found static stretch to improve sprint performance significantly compared to no stretch (6). Also, there was a study done that found no gender differences in the effects of passive static or active dynamic stretching on sprint time (11). Therefore, while this study consisted of only female subjects, it is unlikely that male subjects would produce different findings.

There were many assumptions made throughout the data collection process. It was assumed that all subjects stretched consistently to maximal effort. Subjects were instructed to not perform weightlifting involving the lower body prior to participating on days of data collection. It was also presumed that each subject ran to their full capacity on every timed sprint.

There were also limitations that may have affected the outcome of the study. Since the data collection was obtained following team practice, the attitudes of the subjects fluctuated depending on the intensity and mood levels at practice. This change in attitude could have affected the effort given in the study. Another possible limitation could include the training and conditioning drills executed in practice that day. If the subjects conditioned hard earlier at practice, their lower extremity muscles could be more fatigued for the study, compared to sessions following lighter practices. Outside influence of factors besides stretching that could have affected results may also include participants' health and motivation throughout the two weeks of data collection. One known limitation was the reaction time of timers. This varied reaction time could have played a role in the significant differences found.

CONCLUSIONS

Based on the findings of this study, it is recommended that passive static stretching, as compared to other forms of stretching, should be performed prior to physical activity involving short bouts of sprinting. Out of the different types of stretching that may be done, it is best to avoid contract-relax PNF stretching due to the stretch-reflex of the muscle fibers.

It is believed that athletes, athletic trainers, and coaches would be interested in this study's findings. Adhering to the recommendations based on this study could prove to be beneficial to the athletes' performance and the coaches' regime, along with the athletic trainers' suggestion on stretching technique.

Passive static stretching when compared to active dynamic, contract-relax PNF, and no stretch is the best option prior to sprint performance in sports such as soccer. It has been proven in this study that passive static stretching significantly decreases acceleration time and improves overall sprint performance time.

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