

Influence of warm-up modality on eccentric knee flexor strength prior to training in youth soccer players

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Warm Up | Nordic hamstring exercise | Monitoring | Association football

Headline

The Nordic hamstring exercise (NHE) has received much attention within the scientific literature as an eccentric strengthening exercise. (3, 10, 14) However, the effect of different warm-up modalities on eccentric knee flexor strength is not well understood. It is important for applied practitioners to be aware of the potential influence of different warm-up modalities on eccentric knee flexor strength. This is of particular concern when considering regular player monitoring using devices such as the Nordbord™.

Aim. The present study aimed to address the following question: do different warm-up modalities (light aerobic exercise, dynamic stretching or plyometric exercise) influence the peak eccentric force produced by the knee flexors during the NHE?

Design

Crossover trial

Methods

Athletes. Eighteen youth soccer players (age: 14.4±0.7 years; stature: 166.3±8.1 cm; mass: 55.7±11.3 kg) who attended the same Scottish Premiership club academy participated. All individuals joined the academy via a selection process administered by scouts affiliated with the club (subjective assessment) and were considered to be among the very best young players in Scotland. The benefits and risks associated with the current investigation were explained to the participants prior to them signing an institutionally approved informed consent form, with written informed parental consent also obtained before any testing. The study was approved by the University of Huddersfield, School of Human and Health Sciences Research Ethics Committee, and conformed to the recommendations of the Declaration of Helsinki.

Design. A randomised crossover design was adopted for the present study. Players performed three different warm-up protocols, each on a different occasion; each separated by one week. After performing the respective warm-up protocol each player performed a test of eccentric knee flexor strength using the Nordbord™.

Methodology. The warm-up protocols comprised three conditions: cycling, dynamic stretching and plyometric. The exercises, repetitions and sets are outlined herein. All testing sessions were conducted at least two days after matches and prior to any physical training on the day of testing.

Cycling. Participants cycled on a stationary bike for ten minutes, at 75-100W and a cadence of 85-100rpm.

Dynamic stretching. Participants completed five minutes of low intensity jogging (defined by a rate of perceived exertion equal to 4 or 5 on a previously reported 10-point scale), (4) followed by five minutes of dynamic stretches targeting the primary lower extremity muscle groups (gastrocnemius, quadriceps, hip flexors, adductors, hamstrings and gluteals). The participants completed two sets of the following dynamic stretching protocol: calf pumps x 20, lunges x 6 each leg, arabesque x 6 each leg, squats x 10 and leg swings x 10.

Plyometrics. Participants completed five minutes of low intensity jogging followed by two sets of five drop-jumps from a 30cm box and four sets of five repeated hurdle (height: 30cm) hops. Participants rested for 15 seconds between individual drop jumps and 90 seconds between sets, in concordance with previous research. (13)

On each occasion, participants performed two sets of three Nordic hamstring exercises using the Nordbord™ one and three minutes post performing the respective warm-up protocol. This set and rep structure was chosen to allow participants the opportunity to realize their maximum performance while seeking to minimize the influence of acute fatigue. Of the six repetitions completed, the repetition that elicited the greatest peak eccentric force (mean of right and left leg) was retained for statistical analysis.

Statistical analysis

Data are presented as the mean ± SD. Cohen's d effect sizes were calculated to demonstrate the degree of difference in peak eccentric knee flexor force between warm-up conditions and were interpreted as: trivial (0≤ES≤0.2), small (0.2≤ES≤0.6), moderate (0.6≤ES≤1.2), large (1.2≤ES≤2.0) and very large (2.0≤ES≤4.0). (6, 9) Furthermore, inference was subsequently based on the disposition of the confidence interval (90%) for the mean difference to the aforementioned effect size thresholds and calculated as per the magnitude-based inference approach using the following scale: 25-75%, possibly; 75-95%,

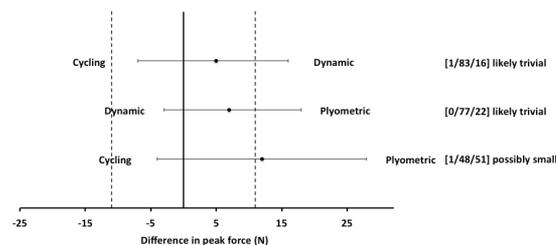


Fig. 1. Differences in peak eccentric force of the knee flexors after different warm-up modalities. Inferential statistics demonstrate the % chances of a 'true' difference between modalities.

likely; 95-99.5%, very likely; >99.5%, most likely.(9) Inference was categorised as unclear if the likelihood of both a substantially positive and negative effect, based on the smallest worthwhile change (between subject SD multiplied by 0.2) exceeded 5%.(8)

Results

The differences between cycling (282 ± 58 N) and dynamic stretching (287 ± 58 N), in addition to plyometric (294 ± 60 N) and dynamic stretching (287 ± 58 N) were likely trivial (Figure 1). Performance was possibly greater by a small magnitude after the plyometric (294 ± 60 N) warm-up when compared with cycling (282 ± 58 N)(Figure 1).

Discussion

The aim of the present study was to investigate the effect of warm-up modality on eccentric knee flexor peak force in elite youth soccer players. The results indicated limited influence of warm-up modality on peak eccentric force of the knee flexors during the NHE. A possibly small improvement was observed after the plyometric versus the cycling condition. While at first glance the difference between conditions appears to be within the bounds of true change previously reported in a reliability study using the Nordbord™(minimum detectable change at 95% level of confidence, 60.1-76.2 N) our comparisons were made at the group, not individual, level. (12) When determining if an individual has become stronger, weaker or remained the same, in the applied setting, readers should refer to the aforementioned minimum detectable change values.

An effective warm-up protocol should have a positive effect on performance and reduce subsequent injury risk.(11) HSIs account for between 12-20% of injuries within professional football and typically occur during maximal sprinting.(2, 7, 15) Regular training incorporating the NHE has demonstrated a reduction in HSI incidence among soccer players.(1, 14) The results of this study suggest that there is limited influence of warm-up modality on eccentric knee flexor peak force during the NHE. However, applied practitioners should be aware of the possibly small effect of a plyometric versus a cycling warm-up.

Regular monitoring of athlete training loads is a growing expectation of applied practitioners within soccer.(5) The Nordbord™ is one such device that practitioners may choose to use as a means of monitoring the recovery and readiness to train of their players; due to its ease of use and relevance to the sport regarding the aforementioned prevalence of HSIs. Any systematic monitoring protocol should strive to achieve consistent data collection procedures.(5) The present results provide applied practitioners with valuable information in this regard. While ideally, the exact same warm-up modality would be used before any regular testing of eccentric knee flexor strength, we observed a limited effect on subsequent force production after a cycling or dynamic stretching warm-up. However, a small positive effect was observed after a plyometric warm-up when compared with cycling.

Practical Applications

- The influence of warm-up modality on eccentric knee flexor peak force during a NHE is limited. The present study suggests that effective warm-up for the NHE is relatively simple and can easily be accommodated in a typical training or monitoring programme. When using the NHE and Nordbord™ as a monitoring tool, cycling and dynamic stretching warm-up modalities can be used interchangeably.

- A small positive effect after the plyometric warm-up was observed when compared with cycling and as such, these modalities should not be used interchangeably from a regular monitoring perspective.

Limitations

- A limitation worthy of consideration is the lack of a control group i.e. a 'no-warm-up' group. However, it was considered inappropriate to ask youth soccer players to complete maximal effort NHEs without any prior warm-up due to the demanding nature of the exercise and thus comparing warm-ups relative to each other was deemed more suitable.

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