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ORIGINAL ARTICLE

Acute effects of short-duration isolated static stretching or combined with dynamic exercises on strength, jump and sprint performance

Effets aigus d'étirements de courte durée isolés ou combinés avec des exercices dynamiques sur la performance en force, détente verticale et sprint

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KEYWORDS
Plyometrics;
Potentiation;
Warm-up;
Anaerobic;
Power

Summary
Objective. — This study aimed to investigate the acute effects of a short-duration isolated static stretching or combined with dynamic plyometric exercises on the performance of some anaerobic parameters (strength, jumping and sprinting).
Methods. — During three distinct sessions and after a standardized warm-up, 15 participants randomly performed static stretching exercises alone, static stretching combined with plyometric exercises and no stretch. Total stretch duration was 20 seconds long per muscle group (quadriceps, hamstrings and calf muscles). Tests included maximal quadriceps muscle strength, countermovement jumps and 15 m sprints.
Results. — Whatever the condition, maximal strength and sprints were unaltered whereas the vertical jump height significantly decreased ($P < 0.05$). We conclude that isolated static stretching or combined with plyometric exercises, even with short-duration, were not efficient for strength, jump ability and sprint improvements and should be excluded from warm-up sessions.

MOTS CLÉS
Pliométrie ;

Résumé
Objectifs. — Cette étude explorait les effets aigus d'étirements statiques, isolés ou combinés avec des exercices pliométriques, sur la performance en force, détente verticale et sprint.

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Potentialisation ;
Échauffement ;
Anaérobie ;
Puissance

Sujets et méthode. — Lors de trois sessions et après un échauffement standardisé, 15 participants ont réalisé de manière aléatoire des exercices d'étirements statiques seuls, étirements statiques combinés avec des exercices pliométriques et pas d'étirements. La durée totale des étirements était de 20 secondes par groupe musculaire (quadriceps, ischios-jambiers et triceps sural). Les tests ont permis d'évaluer la force maximale du quadriceps, la hauteur des sauts avec contre mouvement et des sprints de 15 m.
Résultats. — Quelle que soit la condition, la force maximale et les sprints n'ont pas été modifiés tandis que la hauteur maximale de saut a diminué significativement ($p < 0,05$). Nous avons conclu que des étirements statiques, isolés ou combinés avec des exercices pliométriques, même avec de courtes durées, n'étaient pas efficaces pour améliorer la force, la détente verticale et la vitesse de sprints et doivent par conséquent être exclus des sessions d'échauffement.

1. Introduction

Stretching exercises could be used before, during and after training for injury prevention, performance improvement and recovery optimization. The usefulness of stretching for improving performance during warm-up remains debated. Numerous studies demonstrated the detrimental acute effects of stretching on the subsequent muscular performance such as maximal voluntary strength and vertical jump ability [1,2]. These performance reductions may originate from neural [3] and mechanical factors [4] that may last until 1 hour post-stretching [5].

Various stretch parameters (e.g., stretch modality, stretch duration) may influence the deleterious stretching-induced acute effects. Concerning stretching modality, while no statistical difference was observed between static and contract-relax stretches [6], other studies recommended using dynamic rather than static stretching during warm-up (e.g., [7]). Moreover, a dose-response relationship has been suggested [1,2]. Indeed, Kay and Blazevich [2] concluded that stretching durations, commonly performed during preexercise routines (< 30 s), resulted in no performance decreases. Quite similarly, strong evidences exist for performance impairments with total stretch duration longer than 90 seconds whereas more variability is obtained with shorter stretch durations [1]. For instance, Winchester et al. [8] demonstrated that a single 30-s stretch was sufficient enough for strength reductions.

During warm-up and whatever the stretching modality or duration, athletes usually combined stretching with dynamic exercises such as plyometrics or maximal voluntary contractions. The aim is to increase muscle temperature but also to induce a post-activation potentiation effect [9]. Some studies previously demonstrated that performing these contractions prior [10] or following muscle stretching [11] could partly reduce the stretch-induced performance impairments. For example, Gelen [11] concluded that static stretching combined with plyometric exercises was efficient to reduce the negative stretch effects on soccer players' anaerobic performance. However, contrary to dynamic exercises alone, performance was not improved. Generally, these studies applied moderate to long stretch durations, obviously accompanied with performance impairments [1,2], whereas Knudson and Noffal [12] concluded that strength declines appeared with stretch duration longer than 20 seconds (range: 20 to 40 s). Accordingly, it can be questioned whether very short-duration static stretching combined with dynamic exercises could remove the potential stretch-induced performance reductions and even increase performance. Therefore, the aim of the present study was to investigate the acute effects of an isolated short-duration static stretching or combined with plyometric exercises on muscle strength, vertical jump and sprint performance.

2. Methods

2.1. Experimental approach to the problem

The experiment was based on three separate time-matched sessions testing various conditions randomly presented:

- static stretching alone;
- static stretching followed by plyometric exercises and;
- control condition (no stretch).

These three conditions were applied after a standardized warm-up. Tests performed after the standardized warm-up (pre-tests) and immediately after the three different conditions (post-tests), included measurements of the knee extensors maximal isometric strength, vertical jump height and maximal 15-m sprints.

2.2. Participants

Fifteen healthy participants (nine men and six women) volunteered for the experiment. Their mean ± standard deviation (SD) age, body mass and height were 22.8 ± 2.0 years, 80.4 ± 10.8 kg, 181 ± 6 cm and 21.3 ± 0.5 years, 60.8 ± 5.0 kg, 162 ± 5 cm for men and women, respectively. All were recreationally active with ~7 hours training per week and were familiar with stretching as well as explosive type activities such as jumps and sprints. They agreed to participate in the study and signed an informed consent form. The study was conducted according to the declaration of Helsinki, approved by the local committee on human research and followed ethical standards [13]. Participants were asked to refrain from strenuous activity at least 24 hours preceding all testing sessions.