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## Introduction

Double poling (DP) and diagonal stride (DS) are two of the most frequently used sub-techniques in classic cross-country (XC) skiing (Solli et al. 2018). DS has traditionally been used in uphill terrain and has been shown to be more economical than DP at inclines steeper than 3° among senior males (Andersson et al. 2017). However, the use of DP during uphill skiing has become more common in recent years (Pellegrini et al. 2018) and elite long-distance XC ski races are now mainly won by both sexes using exclusively DP (Stöggl et al. 2020).

## Objectives

This study aimed to compare physiological factors and cycle characteristics during XC roller-skiing at matched inclines and speeds using the DP and DS sub-techniques in male and female junior XC skiers.

## Materials & Methods

Following familiarization to treadmill roller-skiing, 23 well-trained junior XC skiers (12 males and 11 females; age: 18.2 ± 1.2 y; training hours: 551 ± 84 per year) completed two roller-ski tests in a randomized order using either DP or DS. The exercise protocols were identical and included a 5-min warm-up, 4 x 5-min submaximal stages and an incremental test to exhaustion, all performed at a 5° incline (Fig. 1).

## Results

Submaximal energy cost (EC), mean  $\dot{V}O_2$  kinetics response time, blood lactate concentration, heart rate (HR), rating of perceived exertion and cycle rate were all significantly lower during DS compared to DP, while cycle length was significantly higher (all  $P < 0.001$ ). In addition,  $\dot{V}O_{2peak}$  and peak HR were higher and time to exhaustion was longer during DS compared to DP (all  $P < 0.001$ ).

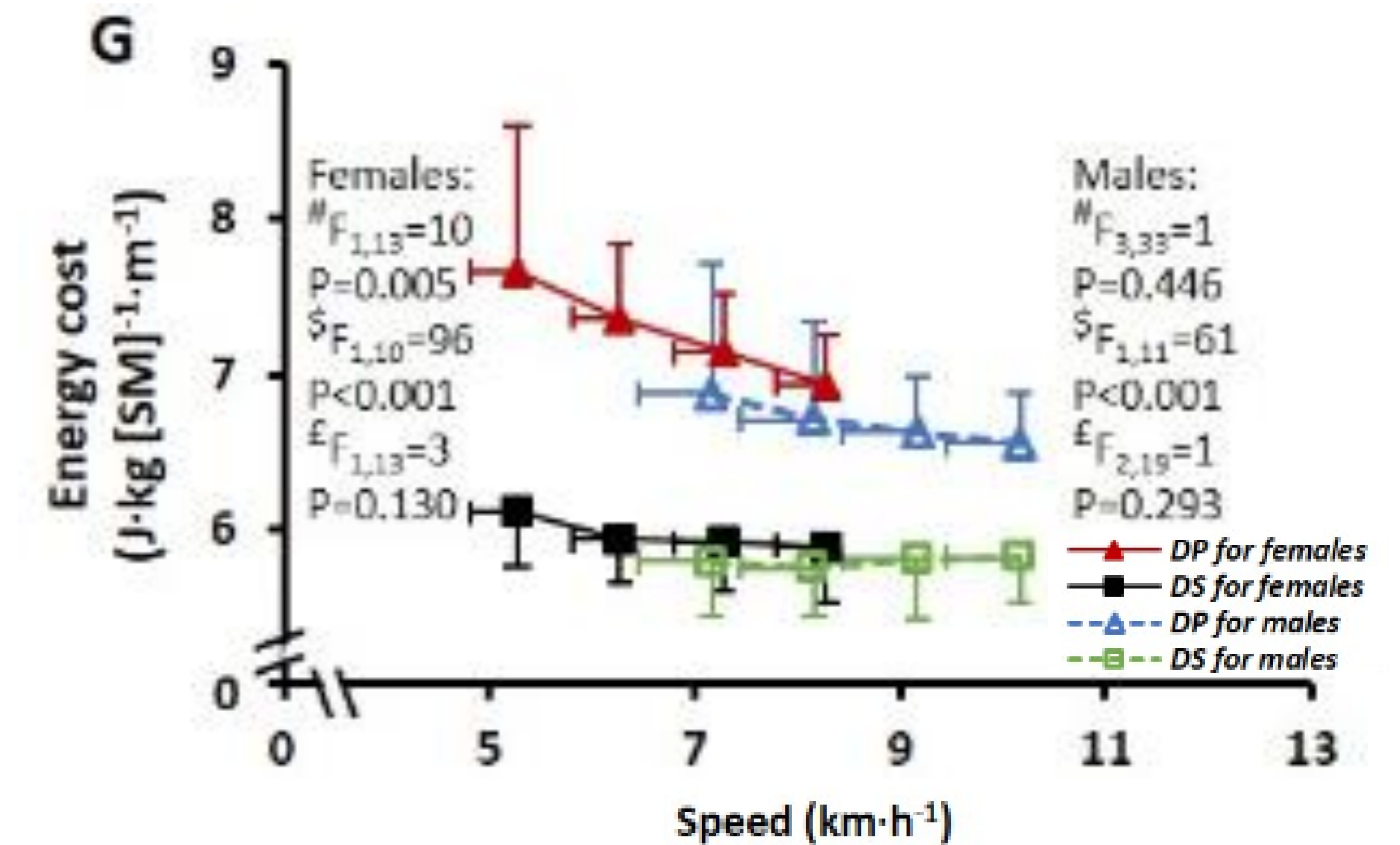


Fig. 2. EC during uphill (5°) roller-skiing using the DP and DS sub-techniques at four submaximal speeds for females and males. F and P statistics are presented for: # effect of speed; § effect of sub-technique; † interaction effect between speed and sub-technique

## Conclusions & Practical Applications

In a mixed-sex group of well-trained junior XC skiers:

- DP was found to exert a greater physiological load than DS during uphill XC roller-skiing at submaximal intensities.
- Exercise duration,  $\dot{V}O_{2peak}$  and HR values during incremental exercise to exhaustion when using DS compared to DP.

Therefore, it is important to consider the specific demands of DS and DP when planning and implementing training programs and sessions, as these two sub-techniques elicit distinct responses among junior XC skiers.

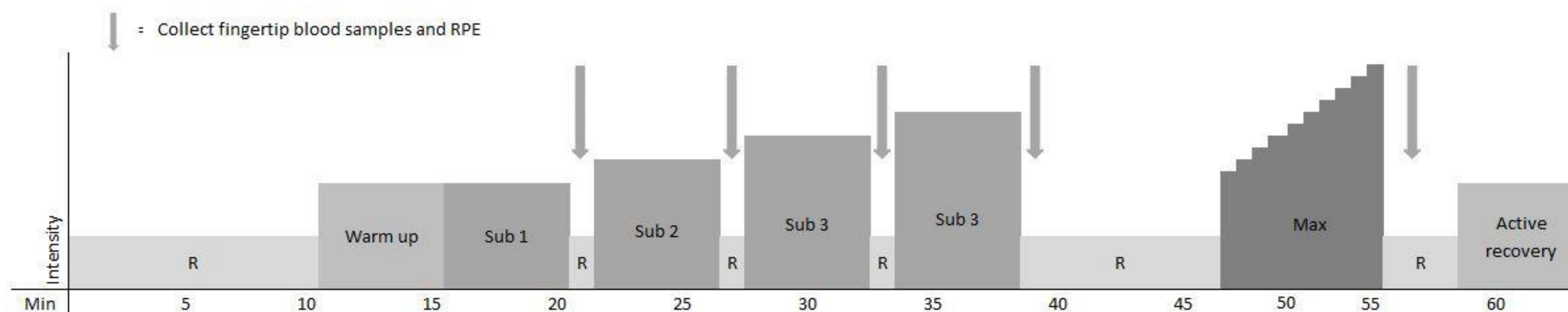


Fig. 1. A schematic of the test protocol used during both the double-poling and diagonal-stride trials.