DIFFERENT PHYSIOLOGICAL RESPONSES BETWEEN THE DOUBLE POLING AND DIAGONAL-STRIDE CROSS-COUNTRY SKIING SUB-TECHNIQUES

Andersson, E.[1,2], & Lögdahl, N.[1]

[1] Swedish Winter Sports Research Centre, Mid Sweden University, Östersund, Sweden
[2] School of Sport Sciences, Faculty of Health Sciences, UiT The Arctic University of Norway, Tromsø, Norway

Introduction & Aims

The two main sub-techniques of the classic style in cross-country (XC) skiing are double poling (DP) and diagonal-stride (DS). In DP, the propulsive power is solely generated through the poling action, while for DS both the upper and lower limbs generate propulsive power. Since these clear biomechanical differences between the sub-techniques might influence physiological responses and pacing strategies, this study aimed to compare the physiological responses and pacing strategies between DP and DS during treadmill roller skiing.

Materials & Methods

Fifteen male XC skiers (27 ± 5 y; 77 ± 7 kg) performed a submaximal protocol consisting of eight 4-min stages followed by a self-paced 4-min time trial (TT), one test using each sub-technique (DP [1.5° incline] and DS [6.5° incline]) on separate occasions in a randomized order on a treadmill. Speed and respiratory responses were measured continuously during all the tests.

For DS, the maximal accumulated oxygen deficit (MAOD) method was used to determine the total metabolic power requirement during the TT, whereas for DP, an alternative polynomial MAOD procedure was used.

Results

The average gross efficiency during the submaximal stages was 17.5 ± 1.3% and 20.0 ± 0.7% for DP and DS, respectively (**Figure 1**). The average power outputs during the TT were 278 ± 29 and 409 ± 38 W. Total and anaerobic metabolic rates are displayed in **Figure 2**. Relative anaerobic energy contributions were 14 ± 7% and 18 ± 3% in DP and DS (P=0.024). The peak VO_2 was 67 ± 4 mL/kg/min for DP and 70 ± 3 mL/kg/min for DS (P = 0.001). The average required metabolic power over the four quarters of the TT (i.e., 1-minute averages) are shown in **Figure 3**.

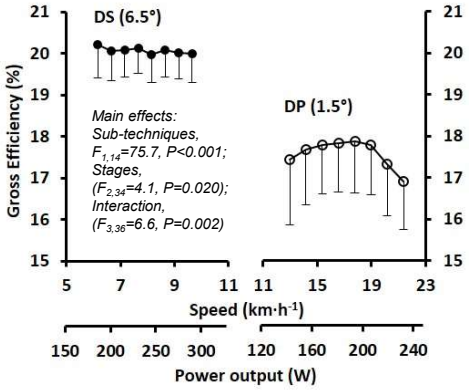

Fig. 1. Gross efficiency for the sub-maximal stages of roller skiing

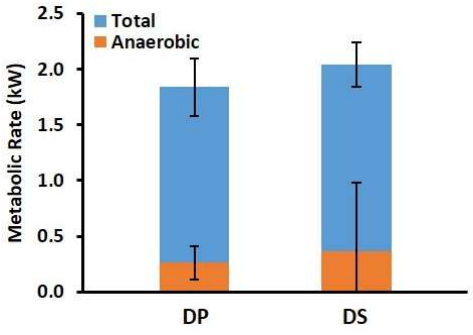

Fig. 2. Total metabolic rates and anaerobic metabolic rates during the 4-min TT in DP and DS

Conclusions & Practical Applications

The main findings of the current study were that gross efficiency, TT power output, TT anaerobic metabolic power, and TT peak VO_2 all were considerably lower for DP than DS. There was no difference in pacing strategies between the sub-techniques, as indicated by the absent interaction effect for the total metabolic rate over the four quarters of the TT.

This study show that well-trained XC skiers are unable to elicit the same physiological response for flat DP compared to uphill DS roller skiing. These data can be used as reference values for comparing sub-technique specific aerobic and anaerobic fitness and GE. These results are also of interest for the understanding of pacing optimization in XC skiing.

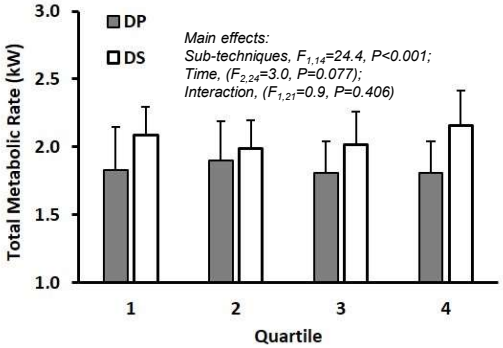

Fig. 3. Total metabolic rates during the four quartiles of the 4-min TT in DP and DS