A SKI RACER'S TURN CYCLE STRUCTURE DEPENDS ON SLOPE INCLINATION, SPEED AND GATE OFFSET

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Keywords: turn cycle structure, timing, turn phases, giant slalom, coaching

INTRODUCTION

In alpine ski racing, the temporal characteristic of a turn (i.e. the turn cycle structure) can provide pertinent information for coaching practice, such as the timing and placement of the turn relative to the gate. A turn can be divided into two functional turn phases: (1) a pre-gate section from turn switch to gate crossing, and (2) a post-gate section from gate crossing to the subsequent turn switch (Spörri et al., 2012). For slalom, Reid (2010) showed that the relative duration of the pre-gate section increases with increased gate distance. For giant slalom, Spörri et al. (2012) discovered that on the same course faster turns were characterized by longer relative pre-gate section durations. The aim of this study was to investigate whether in giant slalom turn cycle structure depends on slope inclination, speed, and/or gate offset.

METHODS

Four European-Cup level athletes performed two runs on a 28-gate giant slalom course each. Within this course, slope angles, skiing speeds and gate offsets varied several times (max.: 25°, 21 m/s, 8 m; min.: 5°, 15 m/s, 2 m). The athletes' relative centre of mass (CoM) and joint centre positions were computed based inertial sensors, as described in an earlier study (Fasel et al., 2016). Turn switches were defined as the time instants in which the length of the left and right ankle to athlete CoM vectors were equal. Gate crossings were detected by a magnetometer placed at the sacrum and small magnets creating a magnetic distortion at each gate. Pre-gate and post-gate sections were defined as described above, and their durations were expressed relative to the duration the corresponding turn cycles. To investigate the dependency of the relative pre-gate section duration on the predictors slope angle, speed and gate offset a multiple linear regression analysis was performed.

RESULTS

Using the stepwise method, a highly significant model emerged ($p<.001$, Adjusted R-Square =.409). Slope angle was found to be of the highest relevance to predict pre-gate section duration (beta weight: .687; $p<.001$), followed by speed (beta weight: -.452; $p<.001$) and gate offset (beta weight: -.366; $p=.003$).

DISCUSSION

These findings indicate that an athlete´s turn cycle structure strongly depends on the situation, whereas slope angle seems to play the most important role.

Moreover, the analysis revealed a positive linear relation between slope angle and pre-gate section duration, and negative linear relations between speed / gate offset and pre-gate section duration.

CONCLUSION

For coaching practice, this means that an athlete's turn cycle structure needs to be optimised for each gate in dependency on the situation. In the current study, the participating athletes intuitively solved this optimisation problem as follows: (1) the steeper the slope, the higher the percentage of the turn that the athletes performed prior gate passage, and (2) the higher the speed or the larger the gate offset, the lower the aforementioned percentage.

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