SEX DIFFERENCES IN RACE PROFILE AND STROKE VARIABLES DURING 200-M SPRINT IN JUNIOR KAYAKERS

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The purpose of present study was to examine sex differences in race profile and stroke variables during 200-m sprint in junior kayakers. 200-m race time of the male kayakers showed 11% shorter than the female kayakers. In both groups, significant positive correlations were found between kayak velocity and stroke rate. In the three part of duration (Initial: 0-25m, Middle: 100-125m, Finish: 175-200m), male kayakers were faster than female kayakers. Kayak velocity of male kayakers significantly decreased in the finish part from the middle part, while the kayak velocity of female kayakers showed a most constant. In conclusion, these different race profiles might be explained by physiological differences in the upper body power or anaerobic capacities between males and females.

KEY WORDS: kayak, sex differences, stroke variables.

INTRODUCTION: Flatwater sprint kayaking is competed over 200-m, 500-m, and 1000-m distance. Theoretically, kayak velocity (V_k) is a product of stroke rate (SR) and displacement per stroke (DPS). In the previous study for adult kayakers, V_k during the race has been reported to be strongly associated with stroke time (Mononen & Viitasalo, 1995; McDonnell et al., 2013). However, the previous study has not been reported these classical variables of junior kayakers. Furthermore, large upper body musculature may be required to produce enough power to achieve or sustain high SR without decreasing DPS (McDonnell et al., 2013). Significant relationships with 200-m race time were found for the biceps and flexed biceps girth (Acka & Muniroglu, 2008). On the other hand, the cross-sectional area of the elbow flexion muscles of women is about 50% of men (Kanehisa et al., 1994). Sex differences in such body may have an influence on the sports performance and strategy. Therefore, the purpose of present study was to examine sex differences in race profile and stroke variables during 200-m sprint in junior kayakers.

METHODS: We analyzed 52 junior male kayakers (Race time: 43.177 ± 2.044 s, ranging from 38.569 to 47.561 s) and 52 junior female kayakers (Race time: 51.612 ± 3.617 s, ranging from 46.127 to 61.387 s). The race movies were taken at the Japan Canoe Sprint Junior Championship in 2015 in Fujikawaguchiko-machi using three video cameras (Sony Handycam HDR-PJ800, Sony Inc., Tokyo, Japan, and 60fps). The video cameras were positioned on the front of the 25m section of all 9 courses that are all based on the buoy installed in 25m intervals on the course. Video for each kayaker was analyzed frame-by-frame in Apple QuickTime Pro. During the competition, three parts of durations; 0-25m (Initial part), 100-125m (Middle part), and 175m-200m (Finish part) were selected for the analysis such as V_k. The V_k of each kayaker was obtained by dividing the each part distance (25m) by the 25m interval times, thus,

$$V_k = 25 \,/\, \text{interval times} \tag{1}$$

The SR (strokes/min) was calculated as

SR = 60 / (6 stroke times / 6 strokes) (2)

Further, we calculated DPS (m) by

DPS = $V_k \times (60 / SR)$ (3)

Pearson's correlation coefficients were used to examine the relationships between V_k, SR, and DPS in all kayakers. Further, the two-way repeated ANOVA was performed to examine the effect of different groups and sections on V_k, SR, and DPS. A Bonferroni post hoc multiple comparison test was performed if a significant main effect was observed. In each statistical analysis, the level of significance was set to be $p < 0.05$.

RESULTS: Relationship between V_k and 200-m race time for three parts are shown in Figure 1. In both groups, significant negative correlations were found between V_k and 200-m race time for three parts. V_k of the middle part had been strongly associated with the 200-m race time for both groups (Male: r =-0.968, $p < 0.001$, Female: r = -0.988, $p < 0.001$).

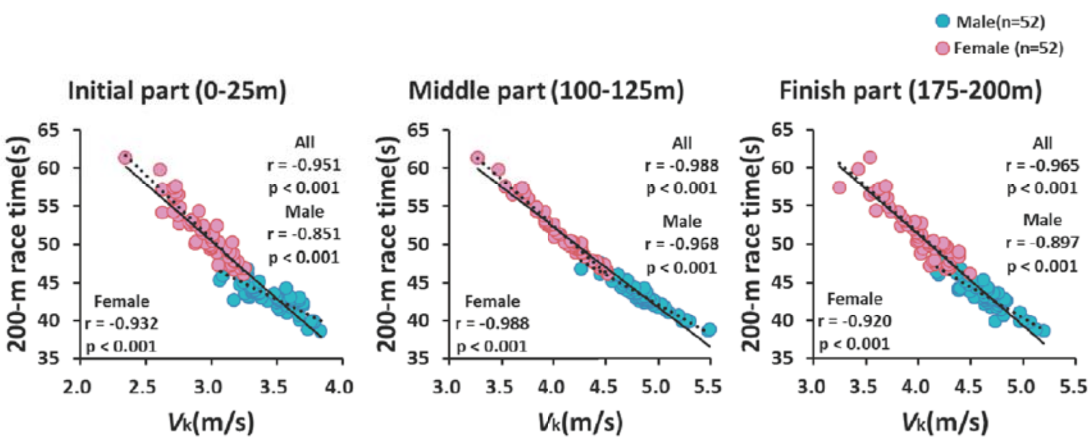

Figure 1: Relationship between V_k and 200-m race time for three parts.

Relationship between stroke variables and V_k are shown in Figure 2. In both groups, significant positive correlations were found between V_k and SR. For male kayakers, a significant positive correlation was found between V_k and DPS only at the Initial part (r = 0.382, $p < 0.001$), however, the V_k and DPS of female kayakers had a significant relationship in all the sections (Initial part: r = 0.363, $p < 0.01$, Middle part: r = 0.401, $p < 0.01$, Finish part: r = 0.348, $p < 0.05$).

Changes in the V_k, SR and DPS through the three parts on the both groups are shown in Figure 3. In the all parts, male kayaker value was higher than female (All: $p < 0.01$). V_k of male kayakers were significantly decreased in the finish part from the middle part ($p < 0.001$), while the V_k of female kayakers showed a most constant.

DISCUSSION: Exercise time of 200-m kayak race is about 40 seconds. According to the results shown in Figure 1, a strong correlation was observed between 200m race time and the middle part V_k. From this result, one of the most important key factors to improve the performance in the 200-m sprint kayaking should increase the maximum velocity.

As shown in Figure 2, significant positive correlations with three parts were found between V_k and SR to both groups. These results of the present study agree with the past findings that SR was significantly related to kayak velocity in adult kayakers due to the decrease in water phase time (Mononen & Viitasalo, 1995; McDonnell et al., 2013). For male kayakers,

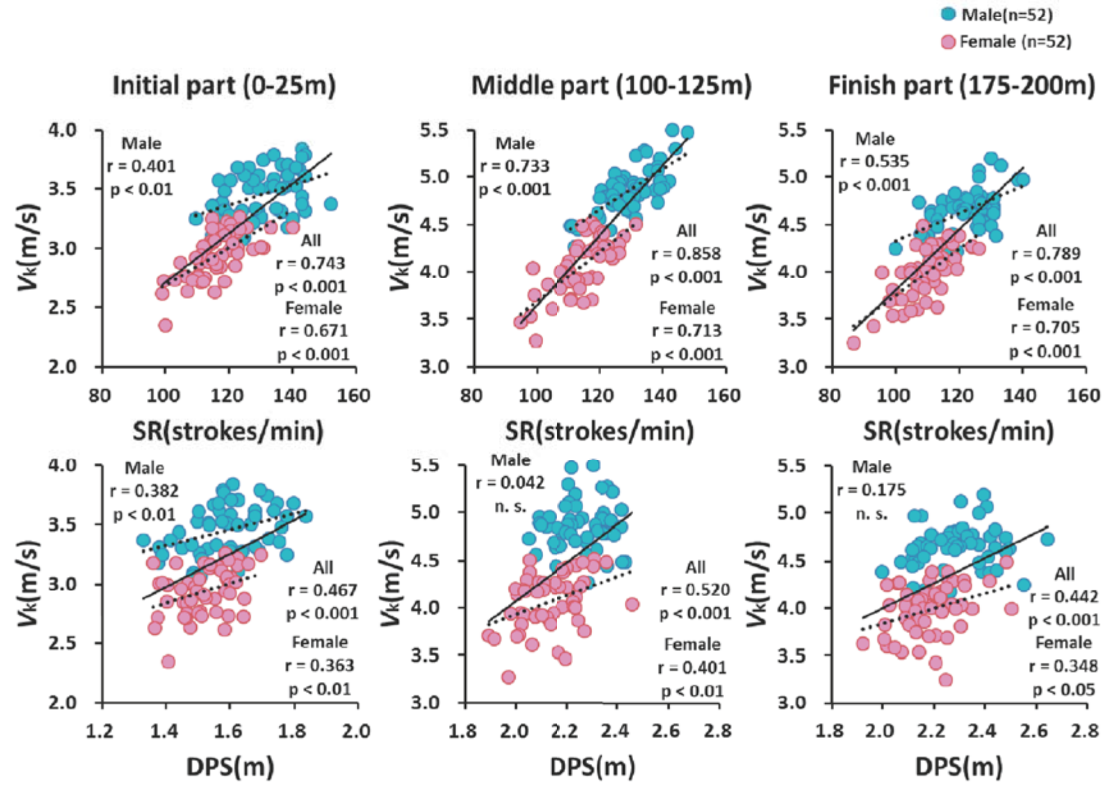

Figure 2: Relationship between stroke variables and V_k for three parts.

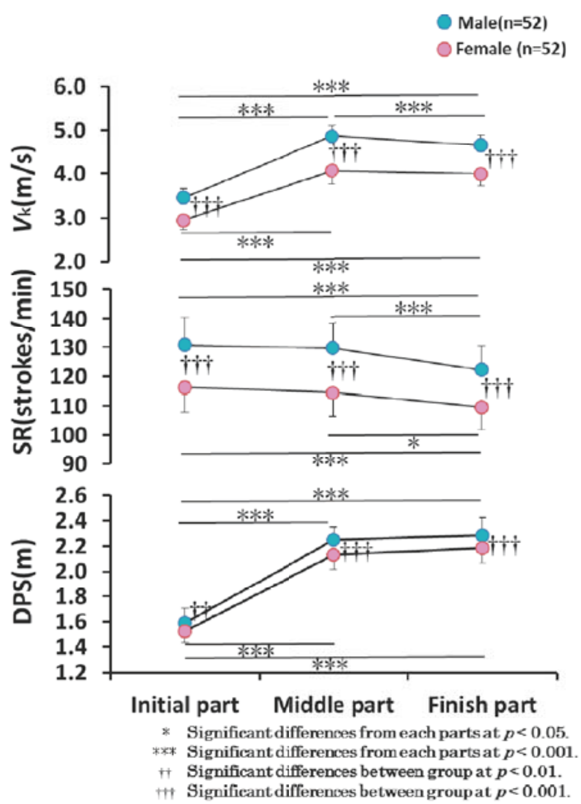

Figure 3: Changes in the V_k, SR and DPS through the three parts on the both groups.

a significant positive correlation was found between V_k and DPS only at the Initial part, however, the V_k and DPS of female kayakers had a significant relationship in all the sections (Figure 2). This result is believed to be due to sex differences in upper body muscles. The relationship between the female kayakers of the V_k and DPS was observed, it may be due to small propulsion power associated with the SR.

In the all parts, male kayaker's values were higher than female kayaker's (Figure 3). Also, V_k of male kayakers were significantly decreased in the finish part from the middle part, while the V_k of female kayakers did not change (Figure 3). These results indicated the difference between male and female kayakers of the race profile. The cross-sectional area of the elbow flexor group of male is larger than female (Kanehisa et al., 1994). Therefore, Male kayakers were higher SR for performing high power exerted in water phase. As a result, male kayakers might be shortening the race time to have a strategy to select a high SR even invited fatigue.

CONCLUSION: Analysis on the sex differences in race profile and stroke variables during 200-m sprint in junior kayakers shows: (1) 200-m race time of the male kayakers showed 11% shorter than the female kayakers. (2) In both groups, significant positive correlations were found between kayak velocity and stroke rate. (3) Male junior kayakers and female junior kayakers have a different race profile in 200-m sprint kayaking.

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