

MORPHOLOGY OF CANOE SLALOM AND CANOE SPRINT FEMALE COMPETITORS

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MATERIALS AND METHODS

The research included a total of 26 (13 canoe slalom and 13 canoe sprint) female paddlers who have been members of the broader Czech national team (junior, U23 and senior). These competitors were assessed using a battery of anthropometric dimensions according to standardized anthropometric techniques (Ridge et al., 2007) and bioimpedance analysis using the multifrequency octopolar device (Tanita Co., Tokyo, Japan) to set the body composition. Somatotypes were calculated according to Heath and Carter (1990). Paddlers were assessed on consecutive days, four weeks before the national team selection races. To eliminate inter-rater variability, all measurements were conducted by a single experienced examiner. Descriptive statistics were used to compare canoe and kayak paddlers. To determine differences between the groups an independent student's T-test was used. Statistical significance was set at $p < 0.05$. To determine practical differences between slalom and sprint paddlers Cohen's d was calculated. Effect sizes were classified as trivial (0 - 0.2), small (0.2 - 0.6), moderate (0.6 - 1.2), large (1.2 - 2.0) and very large (> 2.0) (Hopkins, 2006).

RESULTS

In the compared groups, significant differences were recorded in the circumferences of the biceps ($p=0.00$, $d=1.43$), forearms ($p=0.04$, $d=0.71$) and thighs ($p=0.00$, $d=1.87$). Canoe sprint female paddlers, on average, have a higher body weight by almost 4 kg, also a greater amount of fat-free mass, by more than 3 kg. The somatotype of canoe slalom competitors was 2.6 - 4.5 - 2.3, while the somatotype of canoe sprint competitors was 2.8 - 4.6 - 1.9.

Table 1: Comparison of the female canoe slalom and canoe sprint paddlers

Variable	Canoe slalom (n = 13)		Canoe sprint (n = 13)		Differences	
	Mean \pm SD	Range	Mean \pm SD	Range	p	d
Age (years)	20.6 \pm 3.9	16.0 - 29.0	21.3 \pm 1.4	19.0 - 24.0	0.29	0.23
Body weight (kg)	62.6 \pm 7.6	47.0 - 75.8	66.0 \pm 5.1	57.9 - 73.1	0.11	0.52
Body height (cm)	167.0 \pm 5.8	156.6 - 176.7	168.3 \pm 4.1	159.6 - 173.0	0.26	0.25
Sitting height (cm)	88.5 \pm 3.1	83.6 - 95.0	89.9 \pm 1.7	86.0 - 91.9	0.09	0.56
Arm span (cm)	167.6 \pm 7.3	157.2 - 184.6	169.5 \pm 5.7	158.0 - 179.0	0.25	0.29
Humerus breadth (cm)	6.3 \pm 0.3	5.9 - 6.7	6.4 \pm 0.4	5.7 - 7.0	0.19	0.28
Femur breadth (cm)	9.2 \pm 0.5	8.3 - 10.0	9.2 \pm 0.4	8.7 - 9.9	0.43	0.00
Forearm girth (cm)	25.1 \pm 1.5	22.6 - 27.7	26.1 \pm 1.3	23.5 - 28.3	0.04	0.71
Flexed arm girth (cm)	30.1 \pm 2.1	25.8 - 33.2	32.5 \pm 1.1	30.5 - 34.4	0.00	1.43
Calf circumference (cm)	35.4 \pm 2.7	30.1 - 40.3	35.0 \pm 2.9	31.0 - 38.3	0.43	0.21
Thigh circumference (cm)	50.5 \pm 3.5	43.0 - 56.6	56.2 \pm 2.9	51.5 - 62.0	0.00	1.87
Body Mass Index	22.4 \pm 1.7	19.2 - 24.8	23.3 \pm 1.1	21.3 - 25.2	0.07	0.62
Body fat (%)	20.2 \pm 4.6	10.0 - 26.8	20.6 \pm 3.9	10.0 - 24.0	0.42	0.09
Fat mass (kg)	12.9 \pm 3.8	4.7 - 20.3	13.7 \pm 3.0	5.8 - 17.5	0.29	0.23
Fat-free mass (kg)	49.8 \pm 4.9	41.2 - 58.8	52.4 \pm 3.7	44.7 - 57.7	0.08	0.59
Muscle mass (kg)	47.2 \pm 4.7	39.1 - 55.8	49.7 \pm 3.6	42.4 - 54.8	0.08	0.59
TBW (%)	57.3 \pm 5.8	40.6 - 65.7	58.4 \pm 3.3	54.9 - 67.0	0.27	0.23
ECW/TBW (%)	36.5 \pm 0.9	34.7 - 37.9	36.4 \pm 1.3	34.5 - 38.7	0.36	0.09
Endomorphy	2.6 \pm 0.4	1.9 - 3.5	2.8 \pm 0.8	1.3 - 3.9	0.28	0.31
Mesomorphy	4.5 \pm 0.9	3.2 - 6.4	4.6 \pm 1.4	0.3 - 6.4	0.07	0.08
Ectomorphy	2.3 \pm 0.7	1.1 - 3.4	1.9 \pm 0.5	1.2 - 2.9	0.09	0.65

Figure 1: Somatograph of the canoe sprint paddlers:
• individual somatotype • average somatotype

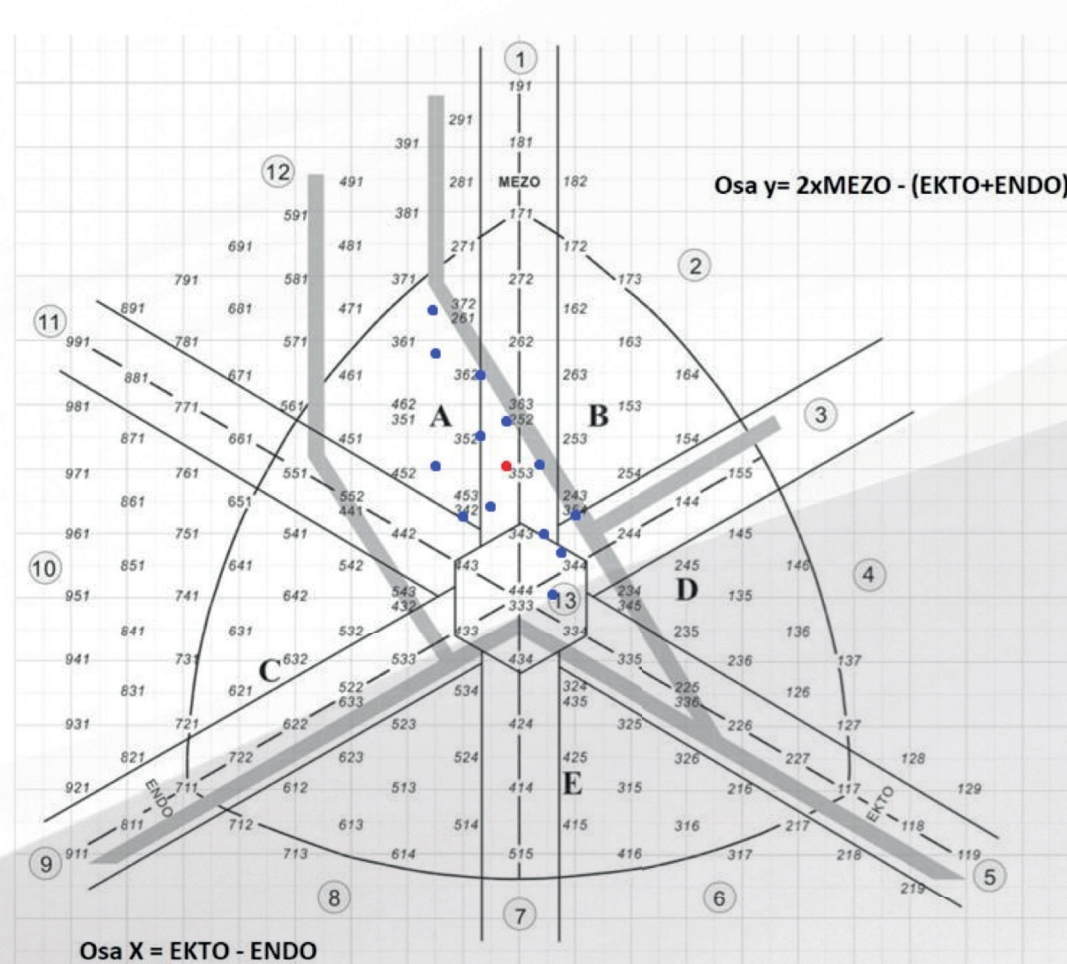
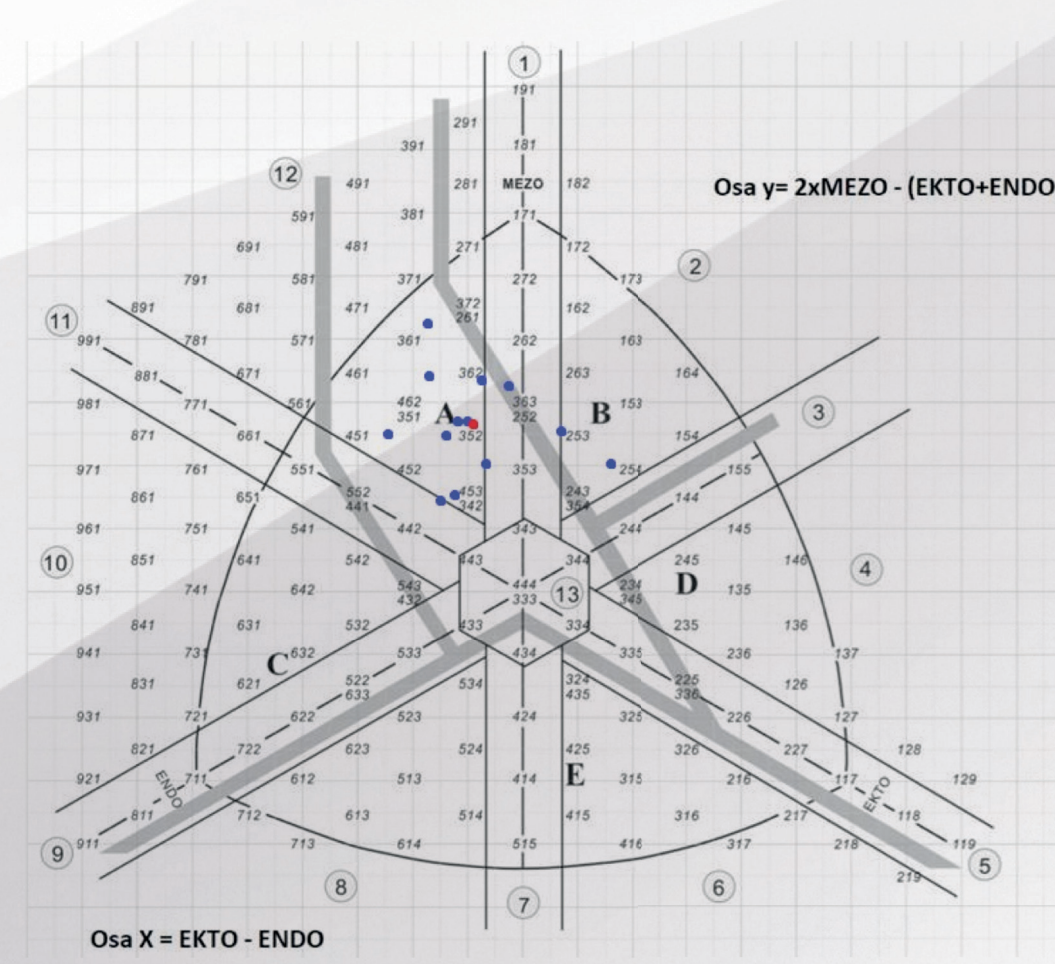


Figure 2: Somatograph of canoe slalom paddlers:
• individual somatotype • average somatotype



CONCLUSIONS

The female racers in canoe slalom and canoe sprint are more similar than male competitors in the same disciplines. However, competitors of smaller anthropometric dimensions will find their place more in canoe slalom. In the canoe sprint, higher body weight is less of a limiting factor than in canoe slalom, which requires constant starts and accelerations.

Keywords: somatotype, woman, sport, anthropometry, kayak
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BACKGROUND

Canoeing is physically very demanding discipline that requires a high fitness level, in particular a high level of relative strength - strength in relation to body weight (Busta et al., 2018). Therefore, it is not surprising that a significant factor in canoeing are body size (body measurements and proportions) and body composition (Messias et al., 2021). However, anthropometric and morphological studies conducted in canoe sport disciplines involving female athletes do not usually have a research sample of enough size (Coufalová et al., 2021; Sklad et al., 1994), are of older date and do not involve C1 category (Ridge et al., 2007; Ackland et al., 2003), participants are too young (Alacid et al., 2020; Okun et al., 2020) and boat categories/performance groups are not compared. Moreover, we are not aware of any comparison between canoe slalom (navigating a white-water course in fastest time possible) and canoe sprint (flat water straight sprint for a given distance). Women in general have been neglected in research related to canoeing disciplines. Therefore, an evidence-based approach, talent selection and fluctuation between canoe disciplines are difficult. The purpose of this study was to determine the morphology of female canoe slalom and canoe sprint paddlers and to identify if morphology differences existed between these two Olympic disciplines.



DISCUSSION

The female racers in canoe slalom and canoe sprint are more similar than elite male competitors in the same disciplines. Elite male canoe sprint paddlers are on average 5 cm taller and 5 - 10 kg heavier than elite male canoe slalom paddlers (Sitkowski, 2002; Busta et al., 2018). Female canoe slalom and canoe sprint are of very similar age, body height and in most other parameters. The difference in weight (62.6 \pm 7.6 vs. 66.0 \pm 5.1 kg) is probably determined mainly by the significantly different muscle volume of the lower limbs (thigh circumference: 50.5 \pm 3.5 vs. 56.2 \pm 2.9; $p=0.00$, $d=1.87$), which in canoe slalom fulfil rather only a stabilizing function. Canoe slalom paddlers are generally characterized by low hypertrophy of the lower limbs (Coufalová et al., 2021; Busta et al., 2022). The larger circumference of the arms and forearms can be attributed to the frequent strength training of the canoe sprint competitors. Female canoe sprint paddlers are more muscular. However, this difference was not assessed as statistically significant in terms of body composition and further studies are needed. In particular, the differences between the world's most successful female athletes and other female athletes should be studied in the future.

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