Swimming constraints in transitioning from underwater to surface swimming – gender effect

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Summary

Gender represents organismic constraints which differentiate performance of males and females, especially in short duration events, such is all out swimming. Considering that overall swimming performance is subject to improvement when split into segments, gender differences regarding swimming kinematics and coordination were observed in pre-transition, transition and free swimming phase. Male and female national swimmers swam 25 m all out once by each stroke in randomized order using push-off start. Data were collected by two sequential cameras (50 Hz, 1/1000 s) in sagittal plane. Stroke length (SL) was larger in all three swimming phases ($p<0.01$), while stroke rate (SR) was larger only during transition swimming phase ($p<0.01$). Regarding coordination, males showed larger overlapped propulsion of arms in front-crawl ($p<0.01$) and larger propulsive continuity in butterfly ($p<0.01$). Transition phase is differently manoeuvred by males and females, suggesting that special training regimes should be devoted to this phase in respect to gender.

Introduction

Segmentation of the swimming event is important strategy to improve total swimming performance, especially when disassemble into constraints that act upon a swimming portion in question. Among classic segmentation to underwater (start and turn) and surface (free) swimming, there is also phase which is between underwater and surface swimming, so called transition swimming phase [1]. The aim of the present research was to characterize kinematics and coordinative variables in 1) the last underwater phase prior transition (pre-transition), 2) the transition and 3) the surface (free swimming) phase of (inter)national competitive swimmers in regards to organismic constraint (i.e. gender).

Methods:

Thirty-three male and thirty female national swimmers swam 25 m all out once by each stroke in randomized order using push-off start, while footage was collected by two sequential cameras (50 Hz, 1/1000 s) in sagittal plane. Linear kinematics variables (average velocity, stroke length, and stroke rate) and segmental kinematics variables (percentages of stroke cycle (propulsive vs. non propulsive parts), trunk and body inclinations) were computed using algorithm equations (direct linear transformation) [2], while coordinative variables were calculated by means of discrete relative phase measurements [3].

Results and Discussion

Velocity and stroke length was higher in males in all three swimming phases ($p=0.000$), but the stroke rate was higher in male swimmers only during the transition phase (front-crawl (FC): $p=0.010$; backstroke (BS): $p=0.004$; and breaststroke (BR): $p=0.021$) (Table 1). Moreover, there was large effect of gender on transition inclinations in breaststroke (trunk inclination 1: $p=0.01$ and body inclination 2: $p=0.001$). Regarding coordination, males engaged simultaneous arms activity in front-crawl ($p=0.000$) as well as more simultaneous arms and leg activity in butterfly ($p=0.02$) (Table 2). During transition, males' swimmers outperformed females not only due to factors related to strength and anthropometrics (i.e. larger stroke lengths and greater propulsion), but also due non-strength factors (i.e. males had higher stroke rate). Since stroke rate did not differ in free swimming phase, the outcomes suggest that transition phase is differently handled by males and females.

Table 1. Pairwise gender comparison of transition (T) stroke rate and stroke length in all four strokes, $p < 0.05$

	SR (mean (SD))		SL (mean (SD))	
T	Male	Female	Male	Female
FC	56.3 (7.7)	50.6 (7.4)*	1.9 (0.3)	1.8 (0.3)*
BS	43.6 (8.0)	38.5 (5.1)*	2.2 (0.4)	2.0 (0.4)*
BF	59.6 (7.6)	57.9 (7.2)	1.8 (0.2)	1.6 (0.2)*
BR	38.2. (7.7)	34.4 (6.5)*	2.0 (0.6)	1.8 (0.3)

Conclusion

Therefore, different training regimes for transition phase should be applied for both groups, being more specific and sensitive than free swimming phase.

References

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Table 2. Pairwise gender comparison of transition discrete relative phase (DRP) in all four strokes, $p < 0.05$

	Front-crawl (mean (SD))		Backstroke (mean (SD))		Butterfly (mean (SD))		Breaststroke (mean (SD))	
Transition	Male	Female	Male	Female	Male	Female	Male	Female
$DRP1^0$	7.5 (27.9)	-27.3 (22.9)*	-34.6 (22.7)	-42.3 (26.1)	-32.7 (23.4)	-47.3 (51.3)*	-91.3 (55.9)	-109.3 (35.8)
$DRP2^0$	0.7 (31.5)	-16.2 (23.1)*	-46.5 (16.2)	-44.8 (17.9)	-22.2 (35.4)	-44.6 (49.6)*	-32.6 (64.4)	-40.0 (53.1)
$DRP3^0$					-7.0 (48.0)	-11.0 (63.6)	-34.4 (33.8)	-39.8 (27.8)
DRP4					-3.55 (46.1)	-21.1. (63.8)	14.3. (18.0)	-7.4 (20.4)*