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Research Article

ANTHROPOMETRIC COMPARISON BETWEEN YOUNG ESTONIAN AND CHINESE SWIMMERS

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ABSTRACT

Due to the progressive lowering of the age of peak performance among swimmers, it became important to better understand the factors influencing performance in prepuberal boys and girls. Aim of this study is to compare two different racial/ethnic groups of young swimmers, one from Nord-Europe, Estonia (Tartuma Region), and the other from China (Shanghai District) in order to assess existing differences in respect to body dimension, body fat, technical parameters of swimming performance and maximum lactate production. 26 Estonian and 7 Chinese female and 25 Estonian and 10 Chinese male, from two swimming schools, took part in the study. Anthropometric parameters were measured in accord with ISAK guidelines. BMI, Stroke Index, Stroke Length, mean velocity on a 200 m freestyle all out, and blood lactate after three minutes were measured. Significant differences exist in anthropometry between Nord-European and Asian young swimmers. These differences are more pronounced in female, with higher fat tissue in Nordic girls. Leg lengths are different between Chinese and Estonian girls having the Estonian longer legs. Hands lengths are different both in male and in female subjects. Being the Chinese groups of higher level of performance (higher mean velocity in the 200 m freestyle, such differences seems not to be as major determinants of the performance, also if they are often indicated as determinants of buoyancy and stroke efficiency.

Key words: *swimmers, anthropometry, Chinese, Estonian*

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INTRODUCTION

Due to the progressive lowering of peak age performance among swimmers, it has become important to better understand the factors that influence performance in young boys and girls. Many studies have been published that discuss the anthropometric and performance characteristics of young swimmers (Duchè et al., 1993; Pelayo et al., 1997; Poujade et al., 2002; Kjendle et al., 2004; Zamparo, 2006; Jürimäe et al., 2007).

Anthropometry is a well know factor affecting performance, specific parameters that play an important role in swimming are: hand dimension is an important determinant of the push efficiency, and body fat is a well know determinant of buoyancy.

Asian boys and girls have less body fat in comparison to Caucasian (World Health Organization, 2007). In Asia, presently China has a rapidly growing economy, which is provoking consistent life-style changes (eating habits, transportation, sedentary works) that subsequently influence body size (body fat) of young Chinese sportsmen and women.

The aim of this study is to compare two different racial/ethnic groups of young swimmers, one from Northern-Europe, Estonia (Tartuma Region), and the other from China (Shanghai District) in order to assess if differences in anthropometric and technical parameters exist between the groups, as well as maximum lactate production.

MATERIAL AND METHODS

Subjects

Study participants were 26 Estonian and 7 Chinese female (mean age 12 ,7 and 12,8 years; 163,62 and 162,60 cm body height; 50,31 and 48,14 kg body weight respectively) and 25 Estonian and 10 Chinese male (mean age 13 and 12,6 years; 163,62 and 162,60 cm body height; 51,59 and 50,67 body weight) from two swimming schools. Subjects and their respective parents were thoroughly informed as to the purpose and procedures of the study and were asked to consent before commencing the study. All subjects participated regularly in swim training: a mean period of 5 years in Chinese male, 3 years in Estonian male, 7 years in Chinese female, and 2 years in Estonian female. All Estonian subjects trained at least 2 hours per day, while the Chinese subjects trained twice a day for a total of 4 hours per day, and were consequently at a higher level of performance (Table 1).

Methods

Anthropometric parameters were measured in accord with ISAK guidelines (Marfell-Jones et al., 2006). Height was measured with a Seca stadiometer and weight with a Tanita electronic scale. BMI was calculated with the formula: weight (kg) / height (m^2). Mean swimming velocity, Stroke Index (number of strokes/time), Stroke Length (mean speed/stroke frequency), were all calculated using a video registration of a 200m test. For stroke parameters calculation only the effective distance out of water was considered. Finger prick blood samples were collected three minutes after the 200 m trial and lactate was determined with a Sphincx 722 lactate analyzer. The following body plicae were measured with a Harpenden caliper: triceps, biceps, subscapular, suprailiac, supraspinal, abdominal horizontal and vertical. The following lengths were measured with an inextensible meter: hands, lower

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limb, tight, shank, upper arm, forearm, right foot. The following circumferences were also measured: thorax, abdomen, wrist, thigh (proximal and distal), calf and ankle.

Multiple *t*-test (two tailed) for unpaired data was employed for the comparison between groups. Homoscedasticity or eteroscedasticity were assessed with the *F*-Test, before performing the *t*-test (Excel 2007). A non parametric L statistic were used following the *t*-test, in order to establish the significance level, according to the formula: L = t2/(t2+df) (Puri & Sen, 1985). The resulting α level was 0,5.

RESULTS

Stroke parameters, swimming velocity and lactate for male and female are reported in table 1 and 2. As expected, mean lactate levels in both males groups were lower than those reported from higher level performance athletes (Madsen & Lohberg, 1987) at the same swimming velocity (4,64 and 6,29 mm/L at swimming velocities of 1,03 and 1,16 m/sec in our groups, in comparison to 1,48 m/sec at a blood lactate concentration of 6 mm/L). No statistical significant difference was found between the Estonian and Chinese swimmers for these parameters, both in male than in female athletes.

Table 1. *ES=Estonian, Ch=Chinese. PRA=Years of practice, ST.LE=Stroke Length, SI=Stroke Index, VEL=Vel200m freestyle, lact=blood lactate, for Estonian (n=25) and Chinese (n=10) swimmer (boys)*

	ES PRA	CH PRA	ES ST.LE.	CH ST.LE.	ES SI	CH SI	ES VEL	CH VEL	ES lact.	CH lact.
	years	years	(m)	(m)	(cycles/sec)	(cycles/sec)	(m/sec)	(m/sec)	(mmol/L)	(mmol/L)
Mean	3	5,9	0,92	1,22	0,99	1,39	1,03	1,16	4,64	6,29
Min	1	5	0,66	0,95	0,6	1,18	0,78	1,04	0,87	3,23
Max	6	11	1,13	1,69	1,46	1,79	1,28	1,48	12	7,45

Table 2. *ES=Estonian, Ch=Chinese. PRA=Years of practice, ST.LE=Stroke Length, SI=Stroke Index, VEL=Vel200m freestyle, lact=blood lactate, for Estonian (n=26) and Chinese (n=7) swimmers (girls)*

	ES PRA	CH PRA	ES ST.LE.	CH ST.LE.	ES SI	CH SI	ES VEL	CH VEL	ES lact.	CH lact.
	years	years	(m)	(m)	(cycles/sec)	(cycles/sec)	(m/sec)	(m/sec)	(mmol/L)	(mmol/L)
Mean	3	5,9	0,92	1,22	0,99	1,39	1,03	1,16	4,64	6,29
Min	1	5	0,66	0,95	0,6	1,18	0,78	1,04	0,87	3,23
Max	6	11	1,13	1,69	1,46	1,79	1,28	1,48	12	7,45

BMI, and plicae are reported in table 3 and 4. No significant differences in BMI were found between Estonian and Chinese swimmers, both in male and in female. Estonian male young swimmers shows a BMI of 18,86 and female of 19,55 while the Chinese male have a BMI of 18,83 and female of 18,91. All group are above the general population 50th percentile (18 for male and 18,50 for female) of the same age (World Health Organization, 2007).

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Table 3. *Bmi (weight/height^2) and plicae for boys. Es=Estonian, CH=Chinese. Tri=triceps, subs=subscapularis, bic=biceps, supil=suprailiaca, supsp=supraspinalis, adhor=abdominal horizontal, adver=abdominal vertical. All plicae are in mm.*

	ES bmi (w/h^2)	CHI bmi (w/h^2)	*ES tri*	*CH tri*	*ESsubs*	*Chsubs*	*ES bic*	*CH bic*	*ES supil*	*CH supil*	*ES supsp*	*CH supsp*	*ES adhor*	*CH adhor*	*ES adver*	*CH adver*
Mean	18,86	18,83	8,17	6,50	7,07	8,17	5,79	9,17	6,28	9,75	6	7,17	10,31	9,25	13,17	9,25
Min	14,47	15,74	5	1	3	4	2	4	3	5	2	3	3	3	6	3
Max	23,5	23,5	15	12	19	14	11	16	16	13	16	13	35	18	26	15

Table 4. *Bmi (weight/height^2) and plicae for girls. Es=Estonian, CH=Chinese. Tri=triceps, subs=subscapularis, bic=biceps, supil=suprailiaca, supsp=supraspinalis, adhor=abdominal horizontal, adver=abdominal vertical. All plicae are in mm.*

	ES bmi	CH bmi	ES tri	CH tri	*ESsubs*	*Chsubs*	*ES bic*	*CH bic*	*ES supil*	*CH supil*	*ES supsp*	*CH supsp*	*ES adhor*	*CH adhor*	*ES adver*	*CH adver*
Mean	19,55	18,91	12,06	6,43	10,37	7,57	8,23	12	15,85	7	10,92	7,71	16,85	6,71	23,87	5,43
Min	18,70	17,70	10,50	4	7,50	4	6	10	13	5	9	5	15	5	19,50	5
Max	22,56	20,90	18	12	19	11	15	18	32	10	23	11	36	11	34	6

Mean male upper limb lengths for Estonian (60,97 cm) and for Chinese (58,08 cm) are higher (Table 5) than those reported in a previous study (Zamparo, 2006) (54,5 cm). Females upper limb length (54,25 cm Estonian and 54,63 cm Chinese, table 6), are similar to those published (52 cm) for a group of swimmers of the same age and sex (Zamparo, 2006).

Table 5. *Segments Lengths of boys. Es=Estonia, CH=Chinese. rhand=right hand, lfhand=left hand, uplim=upper limb, far=forearm, Ft=foot.*

	ES rhand	*CH rhand*	*ES lfhand*	*CH fhand*	*ES uplim*	*CH uplim*	*ES far*	*CH far*	*ES thight*	*CH thight*	*ES shank*	*CH shank*	*ES Ft*	*CH Ft*
Mean	26,25	17,74	24,33	17,73	60,97	58,08	26,59	26,98	49,32	45,79	32,51	38,42	25,14	24,23
Min	20,1	14,6	19	14,8	51,30	46,8	22,4	21,3	40,6	40,5	26,7	29,2	21,8	21,3
Max	32,4	19,5	30,6	19,5	72,7	83,5	31	42,4	57,8	54,3	39,9	45,9	28,7	27,1

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Table 6. *Segments Lengths of girls. Es = Estonia, CH = Chinese. Rhand = right hand, lfhand = left hand,, uplim = upper limb, far= forearm, Ft = foot.*

	ES rhand	CH rhand	ES lfhand	CH fhand	ES uplim	CH uplim	ES far	CH far	ES thight	CH thight	ES shank	CH shank	ES Ft	CH Ft
Mean	25,37	15,87	24,50	15,93	54,25	54,63	25,25	24,24	51,77	47,46	32,24	37,71	24,08	24,10
Min	25,37	15,87	24,00	15,93	51,90	51,50	23,50	21,50	42,00	41,20	28,60	31,80	22,80	21,80
Max	26,90	18,20	25,00	18,30	39,10	56,50	28,10	26,20	57,00	53,00	34,50	42,10	25,40	26,00

Table 7-8 reports the limb circumference. No significant difference was found in circumference between Estonian and Chinese participants.

Table 7. *Perimeters of boys. Es=Estonian, CH=Chinese. wri=wrist, Thor=thorax, wai=waist, thprox= thight proximal, thdis=thight distal*

	ES wri	CH wri	ES Thor	CH Thor	ES wai	CH wai	ES thprox	CH thprox	Es thdis	CH thdist	ES calf	CH calf	ES ankle	CH ankle
Mean	15,34	15,21	80,96	76,25	67,06	67,32	47,66	47,44	44,80	45,31	32,51	32,93	21,25	21,97
Min	13,40	13,20	64,30	49	56,20	60	38,60	39	36,10	38	26,70	27,90	18	18
Max	17,90	17	95,50	92	80,20	76,50	55	57,80	51,20	53	39,90	39,50	24,30	26,50

Table 8. *Perimeters of girls. Es=Estonian, CH=Chinese. wri=wrist, Thor=thorax, wai=waist, thprox=thight proximal, thdis=thight distal*

	ES wri	CH wri	ES Thor	CH Thor	ES wai	CH wai	ES Thprox	CH thprox	Es thdis	CH thdist	ES calf	CH calf	ES ankle	CH ankle
Mean	14,50	14,06	79,24	77,34	64,27	65,37	49,74	49,13	46,86	45,53	30,03	31,95	20,65	20,40
Min	12,80	12,40	70,50	71,80	56	60,90	40	45,50	39	43	27,20	30	18,20	19
Max	15	15,20	84	85,30	68,70	69,20	55	57	50	50	32,20	35,70	22,40	21,90

The *t*-test concludes that hand lengths in male and female are significantly different between the Estonian and Chinese, Estonians with longer hands. Estonian and Chinese girls, are significantly different in lower limb lengths, with Estonian girls having longer legs. As expected, girls (Table 10) showed a greater number of significant differences in plicae in comparison to male (Table 9). A possible explanation is the influence of climate on higher fat intake by the Estonian girls in comparison with Chinese girls, whose diet is based mainly on vegetables, poultry and fish. Between male groups, the only significant difference in plicae was found in the vertical abdominal plica.

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Table 9. *Significant differences between Estonian and Chinese swimmers (boys). α level= 0.5. Critical L= 0,16.*

Measure	Dof	t	critical t	L	F
Abdominal ver	28	3,45	2,04	0,27	0,09
Right hand	39	10,17	2,02	0,76	0,077
Left hand	33	7,94	2,03	0,67	0,087

Table 10. *Significant differences between Estonian and Chinese swimmers (girls). α level=0.5. Critical L=0,16.*

Measure	Dof	t	critical t	L	F
Thight Length	13	4,24	2,16	0,36	0,44
Right hand	7	6,9	2,36	0,64	0,11
Left hand	12	5,26	2,18	0,46	0,55
Triceps plica	13	4,23	2,16	0,36	0,37
Subscapular	13	2,19	2,16	0,16	0,37
Suprailiac	28	5,2	2,04	0,46	0,18
Abdominal hor	29	4,78	2,04	0,42	0,13
Abdominal ver	27	11,96	2,05	0,82	0

CONCLUSION

This study, put into evidence the differences between two racial/ethnic group of young swimmers.

Significant differences exist in anthropometry between Northern-European and Asian young swimmers, even if swim training or selection made by sport recruiting itself seems to have a levelling effect between Estonian and Chinese in male. These differences are more pronounced in fat tissue in girls, having nordic girls with higher subcutaneous body fat. Leg lengths are also significantly different between Chinese and Estonian girls.

Hands lengths are different between the two ethnic groups, in both male and in female groups.

Even if the Chinese group was found to be at a higher level of performance (higher mean velocity in the 200 m freestyle and higher mean lactate production) the differences found are not major determinants of performance, even if parameters reported influence buoyancy (fat) and stroke efficiency (hand length).

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