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Source / Izvornik: **Collegium Antropologicum, 2011, 35, 127 - 131**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:105:275771

Coll. Antropol. **35** (2011) 1: 127–131
Original scientific paper

Body Size Changes in Elite Junior Rowers: 1997 to 2007

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A B S T R A C T

The aim of this study was to determine whether elite international junior rowers in 2007 were heavier and taller than those evaluated in 1997, and to compare this change among finalists and non-finalists, and sweep rowers and scullers. Body weight and height data obtained by a questionnaire from a total of 398 rowers (42% female, 58% male) at the Junior World Rowing Championships in Beijing, People's Republic of China, in 2007 (65.9% of all competitors), were compared with data from 603 rowers measured at the Junior World Rowing Championships in Hazewinkel, Belgium in 1997 (36.5% female, 63.5% male, representing 90% and 89% of all competitors, respectively, by gender). Male and female rowers in 2007 were significantly taller compared to those in 1997 (1.0 cm, $p=0.009$ and 2.1 cm, $p<0.001$, respectively; one-sample t-test). No statistically significant difference was found for body mass. The finalists and sweep rowers were taller and heavier compared to nonfinalists and scullers at both Championships respectively. The heights of elite level junior rowers increased significantly over the decade. The finalists at World Junior Rowing Championships were again taller and heavier compared to the nonfinalists.

Key words: *anthropometry, body size, secular trend, sports, juniors, elite rowers*

Introduction

Although success in a given sport is the result of a combination of hereditary, training, nutrition, environmental and sociocultural influences[1,2], anthropometric parameters are significantly correlated to performance level and thus constitute a predisposing factor for success in elite sports[3–7]. Anthropometric characteristics often reflect functional and physiological demands of the specific sport[8], and determine the individual's adaptability to the training regime[9–11]. These characteristics are widely used within the sports talent identification process and are among the variables of sufficient predictive value to select athletes most likely to excel[8].

In a number of sports[12–14], a trend of increasing body size has been observed[15]. Carter[16,17] in the 1980s suggested that the height and mass of the nationally ranked athletes were increasing by about 2 cm and 5 kg *per* decade. This trend reflects both environmental and societal influences responsible for population secular growth trends[13], as well as changes in training methods and competition rules in sports[18]. In rowing, as a strength endurance sport, body mass and body size have long been recognized as factors substantially contributing to successful performance[5,19–21]. It is hence a weight-class sport, but, interestingly, thus far this categorisation exists only at the senior level – there are no weight classes in junior rowing.

The last comprehensive anthropometric investigation of elite junior rowers was performed at the 1997 World Junior Rowing Championships in Hazewinkel, Belgium[1,2,11]. The 2007 World Junior Rowing Championships provided

Received for publication February 18, 2010

an opportunity to examine the changes in body height and weight of a population of elite junior rowers over a decade. As part of a larger investigation on the incidence of injuries in junior rowers[22], the aims of this study were to: (a) determine the weight and height of the 2007 elite junior rowers and to compare these data with the 1997 rowers; (b) compare the body weight and height of the 2007 finalists and non-finalists, and to compare the results with the 1997 data; (c) compare the body weight and height of the 2007 sweep and sculling competitors, and to compare the results with the 1997 data.

Methods

Sample

At the FISA (Fédération Internationale des Sociétés d'Aviron) World Rowing Junior Championships (Beijing, People's Republic of China, August 8–11, 2007), a total of 398 rowers (231 males and 167 females) from 45 countries were administered a questionnaire, and all of them completed it. The sample represented 65.9% of all competitors, 52.5% of the A finalists (n=145), as well as 39.9% of the medalists (n=55). There were 5 reserves (3 males and 2 females, 1.3% of the sample). Coxswains were not included. 74.1% of the study participants were from Europe. The participants were aged 15.0–18.0 years (M (95% CI)=17.5 (17.4–17.6) years).

Data collection

Data on body height and weight were collected using a self-reported questionnaire[22]. The questionnaire consisted of general and rowing-specific sections followed by a medical section. The questionnaire was available in 21 languages (Bulgarian, Chinese, Croatian, Czech, Dutch, English, Estonian, Finnish, French, German, Greek, Hebrew, Italian, Japanese, Norwegian, Portuguese, Russian, Serbian, Spanish, Swedish, and Turkish). Additional communication with rowers who did not speak English was accomplished by team managers, team physicians or translators (students of Beijing Normal University preparing as volunteers for Olympic Games in Beijing 2008). The study was approved by the local ethics committee and FISA Sports Medicine Commission.

Data analysis

After testing for skew, all variables could be fitted to a normal distribution. Mean and standard deviation were calculated for all variables for the entire sample and then separately for finalists and non-finalists, and for sweep rowers and scullers. One-sample t-test was used to compare the anthropometric data obtained from the 2007 group with the reported data from the 1997 World Junior Rowing Championships[1,11]. To compare the anthropometric data of the 2007 sweep rowers and scullers, as well as that of finalists and non-finalists, independent samples t-tests were performed. Statistical significance was set at p=0.05. All statistical analyses were performed using SPSS 16.0 for Windows (SPSS Inc., Chicago, IL).

Results

Male and female rowers in 2007 were significantly taller than rowers who competed at the 1997 World Junior Rowing Championships (p=0.009 and p<0.001 respectively, one sample t-test; Table 1). No statistically significant difference was found for body mass.

Male finalists who competed in 2007 were significantly heavier and taller than non-finalists (p<0.001 for both, one sample t-test; Table 2). Female finalists were significantly heavier (p=0.032, independent samples t-test) but not taller (Table 2).

We also compared body mass and stature between the 2007 and 1997 samples in finalists and non-finalists separately. The 2007 male non-finalists were significantly heavier and taller than the 1997 non-finalists (p=0.019 and p=0.005, respectively, one sample t-test; Table 3). The 2007 female non-finalists were significantly taller than their 1997 counterparts (p<0.001, one samples t-test; Table 3).

TABLE 1
BODY MASS AND BODY HEIGHT OF MALE AND FEMALE JUNIOR ROWERS WHO COMPETED AT THE WORLD JUNIOR ROWING CHAMPIONSHIPS IN 2007 COMPARED TO ROWERS WHO COMPETED AT THE WORLD JUNIOR ROWING CHAMPIONSHIPS IN 1997

		Body mass in kg ($\bar{X}$±SD)	Stature in cm ($\bar{X}$±SD)
Men	1997 (n=383)†	82.2±7.4	187.4±5.8
	p*	0.078	0.009
	2007 (n=231)	83.2±8.2	188.4±6.1
Women	1997 (n=220)‡	69.5±6.2	174.5±6.2
	p*	0.136	<0.001
	2007 (n=167)	68.7±6.7	176.6±5.8

* One sample t-test
† Bourgois, 2000[1]
‡ Bourgois, 2001[11]

TABLE 2
DIFFERENCES IN BODY MASS AND BODY HEIGHT BETWEEN MALE AND FEMALE FINALISTS AND NON-FINALISTS WHO COMPETED AT THE WORLD JUNIOR ROWING CHAMPIONSHIPS IN 2007

		Body mass in kg ($\bar{X}$±SD)	Stature in cm ($\bar{X}$±SD)
Men	Finalists (n=73)	86.0±9.2	190.4±5.9
	p*	0.001	0.001
	Non-finalists (n=155)	82.0±7.4	187.6±5.9
Women	Finalists (n=72)	70.0±6.5	177.4±4.9
	p*	0.032	0.151
	Non-finalists (n=93)	67.7±6.8	176.0±6.4

* Independent samples t-test
The reserves (3 males and 2 females) are excluded from this analysis

TABLE 3
DIFFERENCES IN BODY MASS AND BODY HEIGHT OF MALE AND FEMALE FINALISTS AND NON-FINALISTS FROM THE WORLD JUNIOR ROWING CHAMPIONSHIPS IN 1997 AND 2007

			Body mass in kg ($\bar{X}$±SD)	Stature in cm ($\bar{X}$±SD)
Men	Finalists	1997 (n=144)†	84.8±7.1	189.3±5.0
		p*	0.266	0.117
		2007 (n=73)	86.0±9.2	190.4±5.9
	Non-finalists	1997 (n=222)†	80.6±7.0	186.3±6.1
		p*	0.019	0.005
		2007 (n=155)	82.0±7.4	187.6±5.9
Women	Finalists	1997 (n=112)‡	71.3±5.9	176.6±5.8
		p*	0.089	0.198
		2007 (n=72)	70.0±6.5	177.4±4.9
	Non-finalists	1997 (n=94)‡	67.7±6.1	172.7±6.0
		p*	0.965	<0.001
		2007 (n=93)	67.7±6.8	176.0±6.4

One sample t-test
† Bourgois, 2000
‡ Bourgois, 2001
The reserves (3 males and 2 females) are excluded from this analysis

Finally, we compared body mass and stature of sweep rowers and scullers and found that female sweep rowers were both heavier and taller than scullers (p=0.001 and p=0.004, respectively, independent two sample t-test; Table 4).

When compared by event type with the 1997 participants, the 2007 male scullers were statistically significantly heavier and taller (p=0.001 and p=0.015 respectively, one sample t-test; Table 5), while the two groups of male sweep rowers did not differ significantly. As for the females, both 2007 scullers and sweep rowers were significantly taller than the rowers in 1997 (p=0.001 for both, one sample t-test; Table 5).

TABLE 4
BODY MASS AND BODY HEIGHT DIFFERENCES BETWEEN MALE AND FEMALE SCULLERS AND SWEEP ROWERS WHO COMPETED AT THE WORLD JUNIOR ROWING CHAMPIONSHIPS IN 2007

		Body mass in kg ($\bar{X}$±SD)	Stature in cm ($\bar{X}$±SD)
Men	Scullers (n=120)	82.7±7.9	187.8±6.1
	p*	0.345	0.057
	Sweep rowers (n=108)	83.8±8.6	189.3±6.0
Women	Scullers (n=101)	67.3±6.8	175.6±6.3
	p*	0.001	0.004
	Sweep rowers (n=64)	70.9±6.1	178.2±4.5

Independent two sample t-test
The reserves (3 males and 2 females) are excluded from this analysis

TABLE 5
DIFFERENCES IN BODY MASS AND BODY HEIGHT OF MALE AND FEMALE SCULLERS AND SWEEP ROWERS FROM THE WORLD JUNIOR ROWING CHAMPIONSHIPS IN 1997 AND 2007

			Body mass in kg ($\bar{X}$±SD)	Stature in cm ($\bar{X}$±SD)
Men	Scullers	1997 (n=161)†	80.3±6.9	186.4±6.4
		p*	0.001	0.015
		2007 (n=120)	82.7±7.9	187.8±6.1
	Sweep rowers	1997 (n=222)†	83.6±7.5	188.2±5.3
		p*	0.845	0.059
		2007 (n=108)	83.8±8.6	189.3±6.0
Women	Scullers	1997 (n=111)‡	67.4±6.1	173.5±6.5
		p*	0.914	0.001
		2007 (n=101)	67.3±6.8	175.6±6.3
	Sweep rowers	1997 (n=108)‡	71.6±5.6	176.3±5.4
		p*	0.363	0.001
		2007 (n=64)	70.9±6.1	178.2±4.5

One sample t-test
† Bourgois, 2000
‡ Bourgois, 2001
The reserves (3 males and 2 females) are excluded from this analysis

The majority of participants at both competitions came from European countries (73.1% of female[11] and 75.5% of male participants in 2007 *vs.* 77.0% of female and 83.8% of male participants in 1997[1]).

Discussion

In this investigation of height and weight changes in elite junior rowers comparing populations from the FISA World Championships in 1997 and in 2007, both males and females were observed to be significantly taller in 2007. With respect to body mass, a trend toward an increase in males and a decrease in females was observed, but the differences did not reach statistical significance. The results, with the exception of the negative weight trend in females, are congruent with the findings of studies in athletes of different sports (canoe and kayak paddlers[12], water polo players[13], American National Football League and National Basketball Association (NBA) players[15], rugby union players[23]) and reaffirm the hypothesis set forth by Carter[16,17]. An overview of the available published data on anthropometric characteristics of junior rowers is presented in Table 6 for comparison with the data from this study.

As Norton and Olds state[15], sport is Darwinian, with the »fittest« reaching the highest levels. Since rowing is

TABLE 6
OVERVIEW OF THE PUBLISHED ARTICLES SORTED BY GENDER REPORTING MEAN AGE, STATURE AND BODY MASS OF JUNIOR ROWERS OF BOTH GENDERS – MEMBERS OF NATIONAL TEAMS / COMPETITORS IN INTERNATIONAL TOURNAMENTS

First author	Gender	Rowers category	n	Age (yrs) ($\bar{X}$±SD)	Stature (cm) ($\bar{X}$±SD)	Body mass (kg) ($\bar{X}$±SD)
Ditter[31]	M	German national team 1975	27	18.0	186.6	81.6
Koutedakis[32]	M	British and Greek national team 1985	8	17.6±0.7	190.2±4.2	83.1±4.3
Bourgois[1]	M	Belgian national team 1988	10	17.0	186.8	81.2
Steinacker[33]	M	German national team 1989	19	17.5±0.3	191.5±4.1	83.7±6.8
Sklad[9]	M	Polish Olympic reserve team 1991	41	17.8±1.4	189.3±3.7	83.2±7.4
Bourgois[1]	M	Hazewinkel World Championships 1997	383	17.8±0.7	187.4±5.8	82.2±7.4
Present study	M	Beijing World Championships 2007	231	17.7±0.6	188.4±6.1	83.2±8.2
Sklad[9]	F	Polish Olympic reserve team 1991	18	16.9±1.4	176.8±3.0	72.4±6.5
Bourgois[11]	F	Hazewinkel World Championships 1997	220	17.5±0.8	174.5±6.2	69.5±6.2
Present study	F	Beijing World Championships 2007	165	17.5±0.7	176.6±5.8	68.7±6.7

among sports in which »bigger« athletes may produce better results, this »size-determined« successfulness can drive athlete selection[15]. The increase in athlete body size cannot be considered without taking into account the influence of increased size in the overall population[13], yet the body size trend in sports often rises at a rate significantly higher than that predicted by the secular trend[13,15,23].

In light of the hypothesis of »expanding universe« of athletic bodies[15], our finding of a possible decrease in female rowers body weight was unexpected. This decrease could result from a number of factors including weight control in young women, increased fitness levels and/or improved training regimens in the female junior rowers. The generally growing trend of excessive weight-control in adolescent girls and young women, largely incited by the media, accompanied with the rise in the incidence of eating disorders recorded since the middle of the 20th century[24], extends also to sports, primarily the ones that emphasize leanness and/or a low body weight[25–27]. Also, the trend could reflect an increase in rowing national federations inclusion of the girls with potential to compete as lightweights in later stages. Restrictive eating patterns and other weight-control behaviors[27] are often found in female athletes, and, if combined with amenorrhea and osteopenia or osteoporosis, can progress into the female athlete triad[27]. Our finding of the negative weight trend in junior female rowers could, arguably, be put in relation with this syndrome, especially when taken into account that the five rib stress fractures reported in the 398 rowers participating at the 2007 Junior World Rowing Championships were all found in female rowers, as reported by Smoljanovic et al.[22].

Body size has been identified as an important performance related factor in rowing[1,11]. The competitive success is, in fact, biased toward the larger body size. Longer limbs, generally accompanying greater height, provide advantage for the rower in terms of leverage and power output important for boat propulsion[1,2,19,28]. Greater muscle cross-sectional area is advantageous in terms of greater force production and metabolic capacity[19]. In a number of studies, the finalists in junior rowing competitions[1] as well as winners in World Championships and Olympic Games[5,29] have been consistently heavier and taller than their less successful counterparts. The results of our study are in agreement with those studies.

The bias in favour of the larger senior athletes compelled FISA to create lightweight rowing events for men and women at the World Championships in 1974 and 1985, respectively[19], and in the Olympic Games in 1996. Khosla[29] proposed a debate on introducing height categorization into competitions, in order to assure respect of the Olympic Games charter on competition fairness and equality, providing equal competitive opportunity for the average height[29,30]. To date, the existing competition categorization is based on body mass, and is only present at the senior level. However, the findings of both body height and body mass differences between junior finalists and non-finalists[1,11], reinforce the significance that body size has at this competition level.

The primary limitation of this study is that data on body mass and stature were attained by a self-administered questionnaire and not by actual anthropometric measurement. However, we believe that the representative and large sample investigated provides acceptable counterbalance. Another source of bias might have arisen from potential differences in the countries represented in the two Championships, as newer participants from generally shorter-statured populations might have skewed the overall data. Namely, at the 2007 World Championships, the national teams whose participants had the shortest average stature came from Taiwan (157 cm (one female participant)); Japan (165 cm (two participants)), and Hong Kong (166 cm (three participants)). As the 1997 World Championships took place in Europe, and the 2007 one in Asia, the latter one likely facilitated greater participation of competitors from the Asian countries. However, as already mentioned, the majority of participants at both competitions came from European countries, decreasing the possibility of bias secondary to change in the studied populations.

Acknowledgements

The authors wish to express their appreciation to the Executive Board of FISA for their permission to set up this study and for their full support and collaboration. Many thanks to the Croatian Rowing Federation and Mr. Kerim Mujkic for provision of financial and logistic support. We are grateful to medical and rowing experts from the countries which offered their help for translation of the questionnaires. Without the support of the Organizing Committee of the 2007 Junior World Rowing Championships in Beijing 2007 and the tireless work of its medical staff and the volunteers of Beijing Normal University this investigation would not have been possible. We are also grateful for the athletes, coaches, medical staff members, and team managers for their participation in this study.

REFERENCES

1. BOURGOIS J, CLAESSENS AL, VRIJENS J, PHILIPPAERTS R, VAN RENTERGHEM B, THOMIS M, JANSSENS M, LOOS R, LEFEVRE J, Br J Sports Med, 34 (2000) 213. — 2. CLAESSENS AL, BOURGOIS J, VAN AKEN K, VAN DER AUWERA R, PHILIPPAERTS R, THOMIS M, VRIJENS J, LOOS R, LEFEVRE J, Kinesiology, 37 (2005) 123. — 3. CLAESSENS AL, LEFEVRE J, BEUNEN G, MALINA RM, J Sports Med Phys Fitness, 39 (1999) 355. — 4. REILLY T, BANGSBO J, FRANKS A, J Sports Sci, 18 (2000) 669. — 5. SLATER GJ, RICE AJ, MUJIKA I, HAHN AG, SHARPE K, JENKINS DG, Br J Sports Med, 39 (2005) 736. — 6. SÁNCHEZ-MUÑOZ C, SANZ D, ZABALA M, Br J Sports Med, 41 (2007) 793. — 7. NICHOLAS CW, Sports Med, 23 (1997) 375. — 8. BATTISTA RA, PIVARNIK JM, DUMMER GM, SAUER N, MALINA RM, J Sports Sci, 25 (2007) 651. — 9. SKLAD M, KRAWCZYK B, MAJLE B, Biol Sport, 10 (1993) 239. — 10. SKlAD M, KRAWCZYK B, MAJLE B, Biol Sport, 11 (1994) 249. — 11. BOURGOIS J, CLAESSENS AL, JANSSENS M, VAN RENTERGHEM B, LOOS R, THOMIS M, PHILIPPAERTS R, LEFEVRE J, VRIJENS J, J Sports Sci, 19 (2001) 195. — 12. ACKLAND TR, ONG KB, KERR DA, RIDGE B, J Sci Med Sport, 6 (2003) 285. — 13. LOZOVINA V, PAVIČIĆ L, Croat Med J, 45 (2004) 202. — 14. POLEDNAK AP, Am J Phys Anthropol, 42 (1975) 501. — 15. NORTON K, OLDS T, Sports Med, 31 (2001) 763. — 16. CARTER JEL, Body composition of athletes. In: CARTER JEL (Ed) Physical structure of Olympic athletes (Karger, Basel, 1982). — 17. CARTER JEL, Age and body size. In: CARTER JEL (Ed) Physical structure of Olympic athletes (Karger, Basel, 1984). — 18. KERR DA, ROSS WD, NORTON K, HUME P, KAGAWA M, ACKLAND TR, J Sports Sci, 25 (2007) 43. — 19. DEROSE EH, CRAWFORD SM, KERR DA, WARD R, ROSS WD, Int J Sports Med, 10 (1989) 292. — 20. HEBBELINCK M, ROSS WD, CARTER JEL, BORMS J, Can J Appl Sport Sci, 5 (1980) 255. — 21. MÄESTU J, JÜRIMÄE J, JÜRIMÄE T, Sports Med, 35 (2005) 597. — 22. SMOLJANOVIC T, BOJANIC I, HANNAFIN JA, HREN D, DELIMAR D, PECINA M, Am J Sports Med, 37 (2009) 1193. — 23. OLDS T, J Sports Sci, 19 (2001) 253. — 24. HOEK HW, VAN HOEKEN D, Int J Eat Disord, 34 (2003) 383. — 25. TORSTVEIT MK, SUNDGOT-BORGEN J, Med Sci Sports Exerc, 37 (2005) 184. — 26. SUDI K, OTTL K, PAYERL D, BAUMGARTL P, TAUSCHMANN K, MULLER W, Nutrition, 20 (2004) 657. — 27. NATTIV A, LOUCKS AB, MANORE MM, SANBORN CF, SUNDGOT-BORGEN J, WARREN MP, Med Sci Sports Exerc, 39 (2007) 1867. — 28. SHEPHARD RJ, J Sports Sci, 16 (1998) 603. — 29. KHOSLA T, Br Med J (Clin Res Ed), 287 (1983) 736. — 30. KHOSLA T, MCBROOM VC, Br J Sports Med, 19 (1985) 96. — 31. DITTER H, NOWACKI PE, Sportarzt Sportmed, 4 (1976) 73. — 32. KOUTEDAKIS Y, SHARP NCC, Br J Sports Med, 20 (1986) 153. — 33. STEINACKER JM, LASKE R, HETZEL WD, LORMES W, LIU Y, STAUCH M, Int J Sports Med, 14 Suppl 1 (1993) S24.

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PROMJENE VELIČINE TIJELA VRHUNSKIH VESLAČA JUNIORA – USPOREDBA VESLAČA IZ 1997. I 2007. GODINE

SAŽETAK

Cilj ovog istraživanja bio je utvrditi jesu li vrhunski međunarodni veslači juniori 2007. godine bili teži i viši od veslača mjerenih 1997. godine, kao i odrediti tu promjenu kod finalista u odnosu na nefinaliste te kod rimen veslača u odnosu na skul veslače. Podaci o tjelesnoj masi i visini prikupljeni upitnikom na uzorku od 398 veslača (42% djevojaka, 58% mladića) na Svjetskom juniorskom prvenstvu u veslanju održanom u Pekingu, u Narodnoj Republici Kini, 2007. godine (uzorak je činilo 65,9% od ukupnog broja natjecatelja), uspoređeni su s podacima 603 veslača mjerenih na Svjetskom juniorskom prvenstvu u veslanju, održanom 1997. godine u Hazewinkelu u Belgiji (36,5% djevojaka, 63,5% mladića, što je, gledano po spolu, činilo redom 90% i 89% natjecatelja). Natjecatelji i natjecateljice iz 2007. godine bili su značajno viši u odnosu na one iz 1997. godine (1,0 cm, $p=0,009$, odnosno 2,1 cm, $p<0,001$; t-test za jedan uzorak). Za tjelesnu masu nije utvrđena statistički značajna razlika. Finalisti i rimen veslači bili su viši i teži u odnosu na nefinaliste i skul veslače, i to na oba prvenstva. Dakle, vrhunski veslači juniori postali su, u razdoblju od jednog desetljeća, značajno viši, a finalisti Svjetskog juniorskog prvenstva u veslanju ponovo su bili viši i teži u odnosu na nefinaliste.