Short report

Anthropometric characteristics of elite male junior rowers

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Accepted for publication
24 November 1999

Abstract

During the 1997 Fédération Internationale des Sociétés d'Aviron World Junior Rowing Championships, anthropometric data on 383 male junior rowers were assessed. With 430 participating athletes, the sample represented 89% of the population. In addition to age, 27 dimensions were measured: body mass, six heights or lengths, four breadths, 10 girths, and six skinfolds. The elite male junior rowers were tall (187.4 (5.8) cm; mean (SD)) and heavy (82.2 (7.4) kg), with larger length, breadth, and girth dimensions than a nationally representative sample of Belgian boys of the same chronological age. A rowing specific anthropometric profile chart with norms was constructed. The stature of the junior rowers is similar to that of adult heavyweight elite rowers, except that the junior rowers are lighter. Compared with non-finalists, finalists are heavier (but still lighter than the adult heavyweight elite rower) and taller, with greater length, breadth (except for the bicristal diameter), and girth dimensions.
(*Br J Sports Med* 2000;**34**:213–217)

Keywords: anthropometry; body size; males; junior; rowers

Elite athletes of different sports differ in physical and physiological characteristics. We expected the elite athlete to represent an expression of heredity, physical training, nutrition, and sociocultural factors. Description and analysis of top level athletes include kinanthropometry, which is the study of human size, shape, proportion, composition, and gross motor function in order to understand growth, exercise performance, and maturation.[1] The chosen variables can be restricted to anthropometric dimensions. The quantification of physique, which can be called anthropometry, of top level athletes is a reference in relating sports performance and body structure.

Rowing has been extensively studied.[2] Anthropometric data for adult male and female rowers emphasise the importance of body mass[3] and body size[4–7] for rowing performance. The profile of male junior rowers may be used in evaluating models for talent identification.[8] To establish a "sport specific" anthropometric profile, a certain number of elite athletes from the same sport or event, measured for several anthropometric dimensions in standardised circumstances, are necessary.[8] The 1997 World Junior Rowing Championships provided the opportunity to carry out a comprehensive anthropometric investigation.

The aims of this study were to: (*a*) describe the body size of male junior rowers; (*b*) compare the anthropometric data of finalists (those rowers who were ranked in the top six) and non-finalists; (*c*) establish a rowing specific anthropometric profile chart for male juniors to be used for rowing training and performance.

Methods

SAMPLE

Forty three countries participated in the male events of the 1997 World Junior Rowing Championships, and participants from 41 countries were measured. Anthropometric data were collected on 383 junior male rowers, who included competitors and reserves (4.4% of the total sample). Coxwains were not measured. With 430 participating male athletes, the sample represented 89% of the population. Most of the rowers were from Europe (83.8%) and most were white (91.6%). For all rowing events, 80–100% of the competitors were measured, including 83% of the winners and medallists as well as 89% of the finalists. The age of the junior rowers varied between 15.1 and 18.6 years with a mean of 17.8 (0.7) years. They trained 7 to 10 times (10–15 hours) a week.

DATA COLLECTION

The protocols and techniques for this project were approved by the board of the Fédération Internationale des Sociétés d'Aviron. When the rowers arrived, they completed a form requesting certain personal and training data. Techniques were based on the procedures given by Claessens *et al*.[9] For some measurements, the procedures outlined by Lohman *et al*,[10] Norton *et al*,[11] and Ross and Marfell-Jones[12] were followed. The selected anthropometric dimensions were based on (*a*) the factor analytical classification of physique to characterise the

Table 1 Descriptive anthropometric characteristics for male junior rowers compared with Belgian reference data[16]

	Male jnior rowers (n=383)			
Dimension	*Mean*	*SD*	*Range*	*Belgian median (n=1098)*
Body mass (kg)	82.2	7.4	60.0–108.1	64.7
Stature (cm)	187.4	5.8	167.6–201.5	175.4
Sitting height (cm)	96.8	3.2	87.5–106.7	91.4
Leg length (cm)	90.7	3.8	78.3–99.1	84.0
Arm length (cm)	82.9	3.3	71.6–92.6	—
Biacromial diameter (cm)	41.5	1.7	37.0–48.7	39.1
Bicristal diameter (cm)	30.3	1.6	26.2–39.1	—
Humerus width (cm)	7.6	0.3	6.4–8.6	7.0
Femur width (cm)	10.3	0.6	8.7–18.2	9.6
Biceps girth (cm)*	32.9	1.9	27.4–40.0	28.1
Upper arm girth (cm)†	29.8	1.9	24.1–36.3	—
Forearm girth (cm)	28.6	1.3	24.3–33.3	—
Thigh girth (cm)	57.9	3.3	48.5–68.2	51.3
Calf girth (cm)‡	37.7	1.9	32.8–44.8	34.9
Biceps skinfold (mm)	3.9	1.0	2.0–9.3	—
Triceps skinfold (mm)	7.9	2.2	3.8–15.9	6.8
Subscapular skinfold (mm)	8.9	1.6	5.7–16.5	8.3
Suprailiac skinfold (mm)	6.6	2.2	3.5–18.0	7.7
Thigh skinfold (mm)	11.5	3.8	5.0–25.7	—
Calf skinfold (mm)	8.4	3.0	3.2–21.5	—

*Maximum girth of the tensed upper arm (maximum flexed); †midway between acromium and olecranon, arm relaxed; ‡maximum girth.
—, data not available.

different components of body build,[13] (*b*) the measurements as used in studies on male and female rowing athletes,[4–7 14 15] and (*c*) the measurements used in the physical fitness surveys on Belgian boys[16] for reference.

After each subject had been "landmarked", they were directed to one of the five stations for measurement. Each anthropometrist took the same measurements and was assisted by a recorder. In addition to age, the following measures were obtained: body mass; stature; sitting height; acromial height; radial height; dactylion height; tibial height; leg length (stature minus sitting height); arm length (acromial height minus dactylion height); biacromial diameter; bicristal diameter; humerus and femur widths; biceps, upper arm, forearm, thigh, and calf girths; and biceps, triceps, subscapular, suprailiac, thigh, and calf skinfolds. All bilateral measurements were obtained from the left side of the body.[8]

Table 2 Independent two sample t test summary of significant anthropometric differences for male junior rowers by performance: finalists (n=144) versus non-finalists (n=222)

Dimension	*Finalists (n=144)*	*Non-finalists (n=222)*	*p Value*
Body mass (kg)	84.8 (7.1)	80.6 (7.0)	<0.01
Stature (cm)	189.3 (5.0)	186.3 (6.1)	<0.01
Sitting height (cm)	97.6 (2.9)	96.2 (3.3)	<0.01
Leg length (cm)	91.6 (3.5)	90.1 (4.0)	<0.01
Arm length (cm)	83.7 (3.0)	82.4 (3.4)	<0.01
Biacromial diameter (cm)	41.9 (1.6)	41.3 (1.7)	<0.01
Humerus width (cm)	7.7 (0.3)	7.6 (0.3)	<0.01
Femur width (cm)	10.4 (0.5)	10.2 (0.5)	<0.01
Biceps girth (cm)*	33.5 (1.8)	32.6 (1.9)	<0.01
Upper arm girth (cm)†	30.4 (1.8)	29.6 (1.9)	<0.01
Forearm girth (cm)	29.1 (1.2)	28.2 (1.3)	<0.01
Thigh girth (cm)	58.7 (3.4)	57.5 (3.2)	<0.01
Calf girth (cm)‡	38.1 (1.9)	37.5 (1.9)	<0.01
Triceps skinfold (mm)	7.5 (1.9)	8.2 (2.3)	<0.01

Values are mean (SD).
*Maximum girth of the tensed upper arm (maximum flexed); †midway between acromium and olecranon, arm relaxed; ‡maximum girth.

Table 3 Anthropometric profile chart for male junior rowers (n=383)

	Percentiles						
Body dimension	*5*	*10*	*25*	*50*	*75*	*90*	*95*
Body mass (kg)	69.8	73.0	77.2	81.9	87.0	92.3	94.7
Stature (cm)	177.3	179.2	183.6	187.6	191.4	195.2	196.6
Sitting height (cm)	91.5	92.7	94.5	96.7	98.9	100.8	102.3
Leg length (cm)	84.4	85.3	88.1	90.8	93.3	95.9	97.3
Arm length (cm)	77.7	78.5	80.8	83.0	85.2	87.0	88.4
Biacromial diameter (cm)	38.6	39.4	40.4	41.5	42.5	43.5	44.2
Bicristal diameter (cm)	27.9	28.4	29.3	30.2	31.1	32.2	33.0
Humerus width (cm)	7.1	7.2	7.4	7.6	7.8	8.0	8.2
Femur width (cm)	9.6	9.8	10.0	10.3	10.6	11.0	11.1
Biceps girth (cm)	29.7	30.5	31.6	33.1	34.3	35.3	35.8
Upper arm girth (cm)	26.6	27.3	28.5	30.0	31.2	32.1	32.8
Forearm girth (cm)	26.5	27.0	27.6	28.5	29.5	30.3	30.7
Thigh girth (cm)	52.7	53.8	55.5	58.0	60.2	62.0	63.4
Calf girth (cm)	34.4	35.1	36.6	37.8	39.0	40.0	40.7
Biceps skinfold (mm)	2.7	2.9	3.2	3.6	4.4	5.4	5.9
Triceps skinfold (mm)	5.0	5.3	6.3	7.7	9.1	10.7	12.1
Subscap. skinfold (mm)	6.6	7.1	7.8	8.7	9.6	10.9	11.5
Suprailiac skinfold (mm)	4.3	4.6	5.1	6.1	7.6	9.5	10.5
Thigh skinfold (mm)	6.5	7.1	8.7	10.9	13.6	16.4	18.0
Calf skinfold (mm)	4.8	5.3	6.3	7.8	9.9	12.5	14.2

DATA ANALYSIS

Variables were tested for their skewness. Except for the biceps skinfold, the suprailiac skinfold, and the calf skinfold, all other variables fitted to a normal distribution. Mean, standard deviation, and minimum and maximum values are presented.

As most of the subjects were European and white, normative reference data (for the age closest to the mean chronological age of the male junior rowers) of Belgian secondary schoolboys aged 17.5–18 years were used for comparison.[16] A profile chart with norms, using percentiles (P values of 5, 10, 25, 50, 75, 90, 95), was constructed. To compare the anthropometric data of finalists and non-finalists, an independent two sample *t* test analysis was carried out. The 1% level was chosen to represent statistical significance. The statistical analysis system programme[17] was used.

Results

Comparisons between male junior rowers and the normative reference group show that the rowers are heavier (+ 17.5 kg), taller (+ 12.0 cm), and have a greater sitting height (+ 5.4 cm) and longer legs (+ 6.7 cm) (table 1). Junior rowers also have higher values for biacromial diameter (+ 2.4 cm), humerus width (+ 0.6 cm), femur width (+ 0.7 cm), biceps girth (+ 4.8 cm), thigh girth (+ 6.6 cm), and calf girth (+ 2.8 cm). As compared with the reference group, male junior rowers also have higher values for the triceps (+ 1.1 mm) and subscapular (+ 0.6 mm) skinfolds, but a smaller suprailiac skinfold (− 1.1 mm).

Finalists are heavier and have higher values for length, breadth (except for the bicristal diameter), and girth dimensions than the non-finalists (table 2). No significant differences are recorded between finalists and non-finalists for skinfold thicknesses, except for the triceps skinfold.

Table 3 gives an anthropometric profile chart. The scores for 20 anthropometric dimensions are located on the chart together with the corresponding percentile values—for example, P5, P10, P25, P50, P75, P90, and P95.

Table 4 Comparison of mean age, stature, and weight of male junior and elite heavyweight and lightweight rowers competing in international tournaments

Category	*n*	*Age (y)*	*Stature (cm)*	*Body mass (kg)*	*Reference*
Juniors					
German national team 1975	27	18.0	186.6	81.6	Ditter and Nowacki[23]
British and Greek national team 1985	8	17.6	190.2	83.1	Koutedakis and Sharp[24]
Belgian national team 1988	10	17.0	186.8	81.2	J Bourgois and J Vrijens
German national team 1989	19	17.5	191.5	83.7	Steinacker *et al*[25]
World Championships 1997	383	17.8	187.4	82.2	Present study
Elite heavyweight					
Olympic Games 1968	85	24.3	185.1	82.6	De Garay *et al*[18]
Olympic Games 1976	65	24.2	191.3	90.0	Carter *et al*[26]
FISA champions	14	25.6	192.0	93.0	Secher[19]
FISA competitors	13	25.1	189.0	84.0	Secher[19]
Dutch national team 1988	18	24.1	190.0	79.3	Rienks *et al*[27]
Elite lightweight					
World Championships 1985	144	24.3	180.7	70.3	Rodriguez[6]

Discussion

Rowing is a strength endurance type of sport, and body size and mass are undoubtedly performance related factors.[2, 3, 18, 19] An anthropometric profile of young rowers was carried out using a standard test battery, which includes body mass, stature, length, and breadth variables for the estimation of skeletal robustness, arm and leg girths for the evaluation of muscle development, and skinfold thicknesses for the estimation of fat mass and fat-free mass.[8] The individual data were compared with a reference group. A further step is the construction of a profile chart with norms. The American College of Sports Medicine[20] argues that youngsters should, if possible, be counselled towards sports that are realistic given the individual body type.

The male junior rowers were 7% taller and 27% heavier than the reference group.[16] On the basis of the descriptive data for 14 male adult champions,[21] Shephard[2] concluded that outstanding rowers are 10% taller and 27% heavier than the general Canadian population. Malina[22] suggested that there is no effect of regular training for rowing on statural growth and noted that rowers are already taller than average during childhood, maintaining their position relative to reference data during childhood and adolescence.

Table 4 gives a comparison of the mean age, stature, and body mass of male junior[23–25] (J Bourgois and J Vrijens, personal communication) and senior[6, 18, 19, 26, 27] rowers competing in international championships. The mean stature of elite junior rowers varies between 187 and 192 cm, which is similar to the adult heavyweight elite rower (185–192 cm). On the other hand, heavyweight rowers seem to be heavier (79–93 kg) than the elite junior rowers (81–84 kg). Weight classification is part of rowing in World Championships (since 1974) and in Olympic Games (since 1996) at the senior level, but not at the junior level. The physical characteristics of male elite lightweight rowers (maximal weight for a single rower less than 72.5 kg and an average for every boat, except the single scull, of 70.0 kg) differ from their heavier peers and junior rowers (table 4). Our group of junior rowers are on average 6.7 cm taller and 11.9 kg heavier than lightweight rowers.[6]

Junior rowers have greater length dimensions and greater breadths and girths than the reference group[16] and lightweight rowers[6] but lower values (except for the bicristal diameter) than heavyweight rowers[26] (table 5). Sklad *et al*[28] found that a year of training increased arm and chest circumferences, and relative body mass in 41 male junior rowers aged 17–18 years.

The most able young rowers could be distinguished by their stature, skeletal robustness, and muscular development.[29] This is supported when comparing the anthropometric characteristics of finalists and non-finalists. Finalists were heavier and taller, with higher values for length, breadth (except for the bicristal diameter), and girth dimensions (table 2). Data for adult heavyweight rowers indicate that winners are consistently heavier and taller than the average for competitors participating in World Championships and Olympic Games.[19, 30] Rodriguez[6] found that lightweight medallists are lighter (−0.6 kg) than non-medallists, with higher values for length, breadth, and girth dimensions.

Calculated from the mean values in the different studies,[6, 16, 26] junior rowers seem to have a lower sitting height relative to stature (51.6%) and a higher leg length relative to stature (48.4%) compared with the normative reference group[16] (52.1% and 47.9% respectively) and the heavyweight Olympic rowers[26] (52.1% and 47.9% respectively). No differences were found between junior rowers and elite lightweight rowers.[6] Long legs increase the drive phase of the rowing stroke.

As compared with Olympic heavyweight rowers,[26] junior rowers have somewhat higher values for the subscapular, thigh, and calf skinfolds, but a lower value for the triceps skinfold (table 5). Considerably thinner skinfolds were found in elite lightweight rowers.[6]

To evaluate the physical characteristics of junior rowers, an anthropometric profile chart was constructed (table 3). This profile gives an overall evaluation of the body characteristics of a subject in relation to his group. The chart can

Table 5 Comparison of mean length, breadth, girth, and skinfold measurements of male junior rowers (present study), elite heavyweight[26] and lightweight[6] rowers competing in international tournaments

Body dimensions	*Elite heavyweight (n=65)*	*Elite ligthweight (n=144)*	*Male junior rowers (n=383)*
Sitting height (cm)	99.7	93.8	96.8
Tibial height (cm)	51.4	—	50.4
Leg length (cm)	91.7	87.6	90.7
SHSR (%)	52.1	51.5	51.6
LLSR (%)	47.9	48.5	48.4
Biacromial diameter (cm)	42.5	36.0	41.5
Bicristal diameter (cm)	30.2	28.5	30.3
Humerus width (cm)	7.8	—	7.6
Femur width (cm)	10.4	—	10.3
Biceps girth (cm)	—	30.7	32.9
Forearm girth (cm)	30.3	25.6	28.6
Thigh girth (cm)	60.3	51.0	57.9
Calf girth (cm)	39.3	34.4	37.7
Triceps skinfold (mm)	8.4	5.5	7.9
Subscapular skinfold (mm)	8.7	8.0	8.9
Thigh skinfold (mm)	10.8	8.0	11.5
Calf skinfold (mm)	6.3	5.4	8.4

SHSR, sitting height to stature ratio; LLSR, leg length to stature ratio be used as a screening device and the interpretation of any profile should therefore be seen in its specific individual context.

In conclusion, elite male junior rowers are tall and heavy, with greater length, breadth, and girth dimensions than a reference group of the same chronological age. Within the group of elite male junior rowers, significant differences exist between finalists and non-finalists in length, breadth, and girth dimensions and for body mass. The anthropometric profile chart is a useful instrument for coaching and advising. It allows sport scientists and coaches to construct anthropometric profiles easily for individual rowers against templates.

The authors wish to express their appreciation to all members of the Organising Committee of the 1997 World Junior Rowing Championships, Hazewinkel-Willebroek, and to the Fédération Internationale des Sociétés d'Aviron for their permission to set up this study and for their full support and collaboration during the investigations. Many thanks to Marianne Moreau and to the following students for their assistance: Dimitri Dumery, Bert Seps, Elke Seps, and Karl Slock. Also many thanks are given to the athletes, coaches, medical staff members, and delegation chiefs for their benevolence in giving permission to measure the rowers under their authorisation. Sincere thanks also go to M De Brie and P Coorevits, who typed this manuscript.

Contributors: J B, A L C, and J V were responsible for all the financial and administrative functions of this study. J B made the initial proposal to the Fédération Internationale des Sociétés d'Aviron, initiated and coordinated the study, participated in the protocol design, data collection, and analysis, and wrote and edited the paper. A L C coordinated the study, designed the protocol, was appointed the criterion anthropometrist for this study, participated in the execution of the study, particularly data collection, data documentation, quality control, and analysis of data, and participated in writing and editing the paper. J V initiated and coordinated the study, discussed ideas, and participated in the protocol design, analysis of data, writing and editing the paper. R P, B Van R, M T, M J, and R L participated in the protocol design, discussed ideas, participated in data collection, particularly measuring and data analysis, and contributed to the paper. J L participated in the protocol design, discussed ideas, performed and interpreted statistical analysis, and contributed to the paper.

1 Ross WD, Drinkwater DT, Bailey DA, *et al*. Kinanthropometry: traditions and new perspectives. In: Ostyn M, Beunen G, Simons J, eds. *Kinanthropometry II*. Baltimore: University Park Press, 1980:3–27.
2 Shephard RJ. Science and medicine of rowing: a review. *J Sports Sci* 1998;**16**:603–20.
3 Secher NH, Vaage O. Rowing performance, a mathematical model based on analysis of body dimensions as exemplified by body weight. *Eur J Appl Physiol* 1983;**52**:88–93.
4 Hebbelinck M, Ross WD, Carter JEL, *et al*. Anthropometric characteristics of female Olympic rowers. *Canadian Journal of Applied Sports Science* 1980;**5**:255–62.
5 Hebbelinck M, Ross WD, Carter JEL, *et al*. Body build of female Olympic rowers. *Medicine in Sport* 1981;**15**:201–5.
6 Rodriguez FA. Physical structure of international lightweight rowers. In: Reilly T, Watkins J, Borms J, eds. *Kinanthropometry III*. London: E and FN Spon, 1986:255–61.
7 De Rose EH, Crawford SM, Kerr DA, *et al*. Physique characteristics of Pan American Games lightweight rowers. *Int J Sports Med* 1989;**10**:292–7.
8 Claessens AL. Talent detection and talent development: kinanthropometric issues. *Acta Kinesiologiae Universitatis Tartuensis,* 1999;**4**:47–64.
9 Claessens AL, Beunen G, Malina RM. Anthropometry, physique, body composition, and maturity assessment. In: Armstrong N, Van Mechelen W, eds. *Paediatric exercise science and medicine*. Oxford: Oxford University Press, 2000 (in press).
10 Lohman TG, Roche AF, Martorell R, eds. *Anthropometric standardization reference manual*. Champaign, IL: Human Kinetics Books, 1988.
11 Norton K, Whittingham N, Carter L, *et al*. Measurement techniques in anthropometry. In: Norton K, Olds T, eds. *Anthropometrica*. Sydney: University of New South Wales Press, 1996:25–75.
12 Ross WD, Marfell-Jones MJ. Kinanthropometry. In: MacDougall JD, Wenger HA, Green HJ, eds. *Physiological testing of the high-performance athlete*. Champaign IL: Human Kinetics Books, 1991:223–308.
13 Tanner JM. Human growth and constitution. In: Harrison GA, Weiner JM, Tanner JM, Barnicot NA, eds. *Human biology. An introduction to human evolution, variation, growth and ecology*. Oxford: Oxford University Press, 1983:299–385.
14 Fu FH, Morrison W. Anthropometric and physiological characteristics of Canadian champion rowers. *International Journal of Physical Education* 1991;**18**:19–23.
15 Pacey PJ, Quevedo M, Gibson NR, *et al*. Body composition measurement in elite heavyweight oarswomen: a comparison of five methods. *J Sports Med Phys Fitness* 1995;**35**:67–74.
16 Ostyn M, Simons J, Beunen G, *et al*, eds. *Somatic and motor development of Belgian secondary schoolboys. Norms and standards*. Leuven: Leuven University Press, 1980.
17 SAS Institute Inc. *Statistical analysis system procedures guide,* release 6.03 edition. Cary, NC: SAS Institute Inc, 1988.
18 De Garay AL, Levine L, Carter JEL. *Genetic and anthropological studies of Olympic athletes*. New York: Academic Press, 1974.
19 Secher NH. The physiology of rowing. *J Sports Sci* 1983;**1**: 23–53.
20 American College of Sports Medicine. The prevention of sport injuries of children and adolescents. (Current comment from the American College of Sports Medicine). *Med Sci Sports Exerc* 1993;**25**:1–7.
21 Secher NH. Rowing. In: Reilly T, Secher N, Snell P, *et al*, eds. *Physiology of sports*. London: E and FN Spon, 1990:259–86.
22 Malina RM. Physical activity and training: effects on stature and the adolescent growth spurt. *Med Sci Sport Exerc* 1994; **26**:759–66.
23 Ditter H, Nowacki PE. Körperliche und Kardio-pulmonale Leistungsfähigkeit der junioren - Ruder - Nationalmannschaft vor der Weltmeisterschaft 1975. *Sportarzt und Sportmedizin* 1976;**4**:73–9.
24 Koutedakis Y, Sharp NCC. A modified Wingate test for measuring anaerobic work of the upper body in junior rowers. *Br J Sports Med* 1986;**20**:153–6.
25 Steinacker JM, Laske R, Hetzel WD, *et al*. Metabolic and hormonal reactions during training in junior oarsmen. *Int J Sports Med* 1993;**14**(suppl 1):24–8.
26 Carter JEL, Ross WD, Aubry SP, *et al*. Anthropometry of Montreal Olympic ahtletes. In: Carter JEL, ed. *Physical structures of Olympic athletes. Part 1: The Montreal Olympic Games anthropological project*. Basel: Karger, 1982:25–52.
27 Rienks NH, van der Pol AJ, Toussaint HM. De evaluatie van conditie en techniek bij top: en subtoproeiers op een isokinetische roeiergometer. *Geneeskunde en Sport* 1991;**2**:34–9.
28 Sklad M, Krawczyk B, Majle B. Effects of intense annual training on body components and other somatic traits in young male and female rowers. *Biology of Sport* 1993;**10**: 239–43.
29 Piotrowski J, Sklad M, Krawczyk B, *et al*. Somatic indices of junior rowers as related to their athletic experience. *Biology of Sport* 1992;**9**:118–25.
30 Hirata KI. *Selection of Olympic champions*. Tokyo: Hirata Institute, 1979.

Take home message

The study of the body size of elite male junior rowers is very useful in view of the rapid evolution of sports and sportspeople, and against the background of secular trends in body size of the general population. This study will provide a better understanding of the relations between physical structure and performance in young rowers. The anthropometric profile chart is a useful instrument for coaching and advising.

Commentary

When researching athletic populations, it is seldom practical or possible to collect extensive data on well trained subjects. This is primarily due to limited access to such subjects and also because of the finite nature of the population. In this context, the current study provides a unique and extensive profile of the anthropometric characteristics of well trained Junior male rowers, who comprised 89% of rowers competing in the 1997 World Championships.

The data collected when compared with age matched reference data revealed a number of differences in the variables measured. Further analysis should focus on the identification of which anthropometric characteristics, if any, differentiated medal winners at the Junior World Championships and their less successful counterparts. By developing such a profile, in addition to the anthropometric profile chart presented in the study, it may be possible to discern which anthropometric characteristics, if any, are important to rowing performance in Junior rowers and therefore worth measuring from a sports specific perspective. This may have profiling implications in terms of talent identification and development of young rowers as previous research in this area has almost exclusively focused on adult rowers.

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Sporting miscellany

Jerry Morris: pathfinder for health through an active and fit way of life

We extend greetings and best wishes to Jeremy Noah Morris on the occasion of his 90th birthday celebration, 6 May 2000. Professor Morris, better known as Jerry, was born in Liverpool, educated in Glasgow and London, and today is Emeritus Professor of Public Health at the London School of Hygiene and Tropical Medicine. He is a renowned physician-epidemiologist who has made landmark scientific contributions to our understanding of physical exercise and dietary intake as they affect risk of developing coronary heart disease (CHD, or heart attack), and to our understanding of the role of social inequalities in risk of disease. As a protagonist, he has worked tirelessly to develop public policies to prevent disease, promote good health, and overcome those social factors that predispose to disease and limit access to health care. Based on three long term studies over the last half century, one of London transport workers and two of executive grade British civil servants, Jerry Morris has demonstrated conclusively that a physically active and physiologically fit lifestyle lowers risk of heart attack and prolongs high quality living. On the basis of his observations on occupational work and leisure time recreation, Professor Morris is generally considered a guiding spirit to good health through modern day sports medicine and exercise science. Here I summarise briefly some of the pertinent findings from three of his seminal studies.

The first study by Morris and his colleagues was of transport workers, which showed that highly active conductors in double decker buses were at lower risk of CHD than drivers who sat through their shifts at steering wheels. If conductors did develop the disease, it was less severe and occurred at later ages. Morris *et al* also found that postmen delivering the mail on foot had similarly lower CHD rates than sedentary postal clerks and telephonists. Analysing national death rates in an early test of their hypothesis, the Morris team found gradient levels of CHD with occupations of intermediate physical activity.

Realising that the connection between sedentary living and heart attack risk could be a two way street—that is, sedentary habits could be both a cause and an effect of heart attack—Morris and his associates effectively attacked potential selective and confounding characteristics. In a wide range of observations, they found confirmatory differences at autopsy in the hearts of men corresponding to the physical activity entailed in their jobs. Also, blood pressure levels were lower in the conductors, and at the same levels of blood pressure they suffered fewer heart attacks than the drivers. Bus drivers were indeed moreobese, but their rate of sudden heart attack death was higher, whatever their physique.

In a second pioneering study, Morris and associates chose middle aged civil servants free of clinical CHD who held sedentary desk jobs and traced them over time for CHD occurrence and death. Contrary to expectation, no benefit in lower heart attack incidence was found from high totals of leisure time physical activity. Instead, men engaging in vigorous exercise (defined as liable to reach peaks of 7.5 kcal per minute—for example, running at about 6 mph) did manifest less than half the disease of their fellow workers, who were comparable in health status and health habits. Morris *et al* also found that the rise with age in both fatal and non-fatal first heart attacks was appreciably less in the men reporting such apparently beneficial vigorous exercise. The benefit was as evident at the end of the follow up period as at the beginning. Eliminating the effect of other causes (smoking, high blood pressure, obesity) of heart disease did not change the main finding, namely protection against heart attack by moderately vigorous or vigorous activity.

In a third major study, again in civil servants, Morris *et al* showed that only the vigorous aerobic exercise (swimming, brisk walking, cycling, and intense group play as in soccer) was accompanied by lower heart attack incidence; no benefit was evidenced from miscellaneous recreational work, such as gardening and do it yourself activities. And again, totals of physical activity, including general “puttering about”, were unrelated to heart attack incidence. They also showed that incidence rates were low only among men who actively participated in contemporary (proximate) vigorous sports.

The scientific contributions of Jerry Morris have helped establish the concept that patterns of sports play, food consumption, tobacco smoking, and other lifestyle elements alter the hazards of heart disease and premature death. Favourable adjustments of such patterns promote improved health and lengthen high quality life. Heading into his ninety first year, Professor Morris continues to work on identifying the relative importance of intensity, frequency, and duration of recreational activities to promote good health. He envisages designing exercise prescriptions and intervention techniques that will prove useful to policy makers in promoting sports play for all. We wish him all the best, with continued opportunity for his own weekly exercise protocol: three days in the pool and three at the gym, 30 minutes on each occasion.

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