RESEARCH ARTICLE

INTERNATIONAL JOURNAL OF KINANTHROPOMETRY

DOI: 10.34256/ijk2214

Comparison of physical and anthropometrical parameters of teen-age male rowers, kayakers, canoers and sedentary school children

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DOI: https://doi.org/10.34256/ijk2214

Received: 13-04-2022; Revised: 10-06-2022; Accepted: 11-06-2022; Published: 30-06-2022

Resumen

Objetivo: Comparar los parámetros antropométricos y físicos de los jóvenes remeros, kayakistas, canoeros y la población de control. **Métodos:** Nuestro estudio se llevó a cabo en 173 niños (n=53 remeros, edad=16,24±1,51 años; n=38 kayakistas, edad= 17,0±3,99 años; n= 37 canoeros, edad= 15,1±0,53 años; y grupo control, n=45, edad=15,0±0,46). Varios bioparámetros, altura corporal (cm), peso corporal (kg) e (índice de masa corporal) (kg/m2), grosor del pliegue cutáneo (mm) bíceps, tríceps, subescapular, suprailíaco y pantorrilla, diámetros de humorístico y fémur (cm), longitud del brazo (cm), longitud del brazo (cm), longitud de la parte delantera de la pierna (cm), longitud del muslo (cm), longitud del pie (cm), longitud de la parte superior del brazo, longitud del antebrazo (cm), hombro Se midieron la anchura (cm), la longitud del tronco (cm), la circunferencia del muslo y la pantorrilla (cm), el porcentaje de grasa corporal, la fuerza de agarre (derecha e izquierda) de las manos, la flexibilidad del tronco, la fuerza relativa de la espalda, los abdominales y las flexiones.**Resultados:**La altura corporal (cm) de los remeros masculinos fue mayor que la de los canoeros masculinos y el grupo control (p<0,05). El salto largo de pie (cm) de los remeros masculinos fue significativamente mayor que los kayakistas y el grupo de control (p<0,05). La flexibilidad de los remeros masculinos fue significativamente mayor que la de los piragüistas masculinos y el grupo de control (p<0.0.5). La fuerza relativa de la espalda (kg) de los remeros, kayakistas y canoeros masculinos fue significativamente mayor que la del grupo de control. Sentarse/minuto de los canoeros masculinos fue significativamente mayor que los remeros masculinos (p<0,01) y los kayakistas (p<0,05). El empuje hacia arriba/minuto de los canoistas masculinos se observó significativamente más alto que el grupo de control (p <0,01) y los kayakistas y remeros (p <0,05). La envergadura de los brazos de los remeros fue significativamente mayor que la del grupo control (p<0,01) y la de los kayakistas y canoeros (p<0,05). La longitud del antebrazo (cm) de los remeros masculinos fue significativamente mayor que la del grupo de control (p<0,01). También se encontró más alto en kayakistas y canoeros masculinos que en el grupo de control (p<0.05).**Conclusión:**Nuestros atletas tienen una diferencia significativa en algunos parámetros ya que están bien entrenados y el grupo de control no tiene entrenamiento previo en absoluto.

Palabras Clave: IMC, % de grasa, abdominales, flexiones, longitud del brazo, agarre manual

Abstract

Aim: It is to compare anthropometrical and physical parameters of teen-aged young male rowers, kayakers, canoers and control population. **Methods:** Our study was carried on 173 children (n=53 rowers, age=16.24±1.51 years; n=38 kayakers, age= 17.0±3.99 years; n= 37 canoers, age= 15.1±0.53 years; and control group, n=45, age=15.0±0.46). Several bio-parameters, body height (cm), body weight (kg) and (body mass index) (kg/m^2), skin fold thickness (mm) biceps, triceps, sub-scapula, supra-illiac and calf, diameters of humorous and femur (cm), arm length (cm), arm span (cm), fore leg length (cm), thigh length (cm), foot length (cm), upper arm length, fore arm length (cm), shoulder breadth (cm), trunk length (cm), thigh and calf girth (cm), body fat percentage, the grip strength (right and left) hands, trunk flexibility, relative back strength, sit up, push up were measured. **Results:** Body height (cm) of male rowers was higher than male canoers and control group (p<0.05). Standing broad jump (cm) of male rowers was significantly higher than kayakers and control group ($p<0.05$). Flexibility of male rowers was significantly higher than male canoers and control group ($p<0.0.5$). Relative back strength (kg) of male rowers, kayakers and canoers was significantly higher than control group. Sit up /minute of male canoers was significantly higher than both male rowers ($p<0.01$) and kayakers ($p<0.05$). Push up/minute of male canoers was noted higher significantly than control group ($p<0.01$) and kayakers and rower ($p<0.05$). The arm span of rowers was significantly higher than control group ($p<0.01$) and kayakers and canoers ($p<0.05$). Fore arm length (cm) of male rowers was significantly higher than control group ($p<0.01$). It was also found higher in male kayakers and canoers than control group ($p<0.05$). **Conclusion:** Our athletes have significant difference in some parameters as they are well trained and the control group has no such previous training at all.

Keywords: BMI, Fat %, Sit-up, Push-up, Arm-length, Hand-grip

Introduction

Once upon a time life emerges from water. For this reason nature made us more attached to the environment when we remain in front of water body. There are a large number of sports involving water. Most of these are very popular involving motor skill and power. Rowing, canoeing and kayaking are not exempted from those excellences (Tesch 1983; Steinbright 2002; Mitchell et al. 2005). Competitive rowing is one of the most unique of all endurance sports as it involves two or more athletes working together in a rhythmic, synchronous manner. Strength testing and training seems to be relatively ingrained as a part of the physical preparation for rowers (Gee et al. 2011). Canoeing and kayaking are more focused on muscle endurance. Kayaking is a water sport with two bladed paddles. The movement of canoers is rhythmical, systematic and cyclic by using single bladed paddle.

Materials and method

Participants:

Our study was carried on 173 children (n=53 rowers, age=16.24±1.51 years, n=38 kayakers, age= 17.0±3.99 years, n= 37 canoers, age= 15.1±0.53 years and n=45 control group, age=15.0±0.46). All these athletes belonged to the Special Area Game scheme (SAG) of Sports Authority of India (SAI) Jagatpur, Orissa. Each athlete was at least a state level performer with a minimum of 4–5 years of formal training experience. They belonged to the same socio-economic status with similar nutritional status and undergoing similar training regimen at same geographical and atmospheric conditions. Hence, they were treated as homogenous subjects. Control population (sedentary group) were analysed from a reputed school of Kolkata. They all belong to upper middleclass family.

Physical Parameters:

Height (in cm) – It was measured by anthropometer /stadiometer.

Weight (in kg) – It was taken with the help of weighing pan.

Body mass index or, BMI (kg/m^2) – It was analyzed as BMI = Weight (kg) / Height $(m)^2$ (WHO 1995).

Anthropometrical Parameters:

Skin fold thickness (mm): Biceps, triceps, sub-scapula, supra-iliac and calf were measured by Harpenden skin fold calliper.

Humerous and Femur (cm): These were measured by sliding calliper.

Arm length (cm), arm span (cm), fore leg length (cm), thigh length (cm), foot length (cm), upper arm length, fore arm length (cm), shoulder breadth (cm), trunk length (cm), thigh and Calf girth (cm): These were measured with anthropometrical tape.

Body fat percentage: It was diagnosed by applying the Siri’s equation (Siri, 1961).

Strength of Athletes:

Hand grip strength (in kg): The strength of both hands was estimated with a digital hand dynamometer (Manna and Adhikari 2018).

Relative back strength: This was estimated with digital back dynamometer (Manna and Adhikari 2018).

Standing Broad Jump (SBJ) (cm): This was done for estimation of lower body explosive strength.

Trunk flexibility (in cm): The trunk flexibility was measured with the help of a flexometer (Lafayette Instrumental Co., USA) following a standard procedure (Manna and Adhikari 2018).

Sit up and push up / minute: These were also done by standard method.

Data Analysis:

It was carried out with the help of Statistical Program for the Social Sciences (SPSS) version 26.0 for Windows (SPSS Inc., Chicago, Il, USA). Differences between groups for all parameters according to their sports type were analysed using a one-way analysis of variance (ANOVA), then Scheffe`s Post hoc test was performed for multiple comparisons. A confidence level at $p<0.01$ and $p < 0.05$ was taken as level of significance.

Results

Table1. Comparison of various physical and motor ability performances of Rowers, Kayakers, Canoers and Control (school children)

Variables	Subjects				F Value (Level of Significance)	Scheffe`s Post Hoc
	Rowers (N=53)	Kayakers (N=38)	Canoers (N=37)	Control (n=45)		
Age(years)	16.24±1.51	17.0±3.99	15.1±0.53	15.0±0.46	1.319(Ns)	-
Body Height(cm)	176.12±7.97	173.15±3.74	169.7±2.51	161.0±3.45	3.907*	R*Vs.C R*VsC1
Body Weight(kg)	63.3±5.32	64.39±8.61	63.0±4.42	65.56±5.05	.217(Ns)	-
BMI(kg/m^2)	21.2±1.36	20.8±2.67	21.9±1.37	20.7±1.78	.855(Ns)	-
Right Hand Grip Strength(kg)	42.6±4.38	44.7±8.34	42.5±4.03	28.7±2.23	.397(Ns)	
Left Hand Grip Strength(kg)	41.6±5.15	44.6±7.30	43.4±4.03	26.6±1.14	.660(Ns)	-

Values are (mean ± standard deviation) "*" $p<0.05$; "**"$p<0.01$; Ns= not significant R= Rowers, K=Kayakers, C=Canoers, C1=Control group, (NS) = Not significant, Vs=Versus.

Table 2. Comparison of different physical and motor ability parameters among male Rowers, Kayakers, Canoers and control

Variables	Subjects				F Value	Scheffe`s Post Hoc
	Rowers (N=53)	Kayakers (N=38)	Canoers (N=37)	Control (N=45)		
Sbj (cm)	263.1±20.92	252.75±17.49	258.8±18.33	198.5±16.18	.649*	R*Vs. K R*Vs.C1
Flexibility (cm)	20.5±4.91	18±4.29	12.75±5.12	9.18±5.34	5.160*	R*Vs.C R*Vs.C1
Relative Back Strength	1.89±0.34	1.91±0.21	2.02±0.16	0.9±4.56	.634*	C*VsC1 R*Vs.C1

						K*Vs.C1
Sit Up/min	77.5±9.90	74.0±13.60	82.4±14.0	53.46±12.39	.252(Ns)	C**Vs.C1 R*Vs.C1 K*Vs.C1
Push Up/min	55.7±9.81	59.6±12.21	72±10.63	40.15±10.89	3.305(Ns)	C**Vs.C1 C*Vs. R C*Vs.K

Values are (mean ± standard deviation) "*" p<0.05; "**"p<0.01; NS, not significant R= Rowers, K=Kayakers, C=Canoers. , C1=Control group, (NS) = Not significant. Vs=Versus

Table 1 depicts that there is no significant changes in body weight BMI (kg/m^2), right and left hand grip strength (kg), except body height of male rowers which was noted to be significantly higher than male canoers and control group (p<0.05).

Table 2 reflects that standing broad jump (SBJ) (cm) of male rowers was noted to be significantly higher than kayakers and control group at (p<0.05), flexibility of male rowers was noted to be significantly higher than male canoers and control group at (p<0.0.5), relative back strength (kg) of male rowers, kayakers and canoers was noted to be significantly higher than control group, sit up performance / minute of male canoers was noted to be higher significantly (p<0.01) ,male rowers and kayakers (p<0.05). Push up performance /minute of male canoers was noted to be higher significantly (p<0.01) than control group, male kayakers and rower (p<0.05).

Table 3. Comparison of various physical and anthropometrical measurements of male rowers, kayakers, canoers and control

Variables	Subjects				F value	Scheffe`s Post Hoc
	Rowers (N=53)	Kayakers (N=38)	Canoers (N=37)	Control (N=45)		
Body Fat%	14.4±3.43	14.9±3.76	16.3±3.30	18.01±2.67	.679(Ns)	-
Arm Span (cm)	183.9±5.15	171.2±28.25	176.2±4.17	163.45±3.16	6.281**	R**Vs.C1 R*Vs. K R*Vs C
Fore Leg Length (cm)	44.8±5.57	42.5±3.62	40.1±2.23	38.06±2.14	2.756(Ns)	-
Thigh Length cm)	49.2±6.28	53.9±5.03	50.9±4.99	46.9±3.05	1.594(Ns)	-
Foot Length (cm)	25.8±1.47	26.1±1.73	24.6±0.92	22.5±1.24	2.509(Ns)	-
Upper Arm Length (cm)	25.8±1.47	32.7±2.60	31.2±1.83	21.35±3.05	1.484(Ns)	-
Fore Arm Length (cm)	34±2.07	31.6±0.84	30.2±2.25	28.13±2.16	10.002(Ns)	R**Vs.C1 K*Vs.C1 C*Vs.C1
Shoulder Breadth (cm)	50.3±3.13	48.6±1.68	48.4±2.77	44.86±3.15	1.434(Ns)	-
Trunk Length (cm)	51.8±1.87	54.2±3.37	52.1±2.29	48.97±2.20	2.324(Ns)	-
Calf Circumference (cm)	34±2.39	34.1±2.57	33.6±2.45	31.8±3.46	100(Ns)	-
Thigh Circumference(cm)	45.6±1.81	45.2±3.19	47.4±2.58	42.56±2.13	1.735(Ns)	-
Mid Upper Arm Length (cm)	27.25±1.60	27.7±2.64	28.6±1.90	25.09±2.07	.999(Ns)	-
Biceps (mm)	5.9±2.55	7.2±3.49	5.8±0.99.	4.17 ±0.88	.766(Ns)	-
Triceps (mm)	9.1±2.25	9.3±2.71	8.7±2.14	8.05±2.02	.146(Ns)	-
Subscapular (mm)	9.9±1.71	11.5±3.71	11.3±3.31	12.09 ±4.02	786(Ns)	

Suprailliac (mm)	11.8±3.21	12.4±5.12	10.8±3.77	13.89±3.32	.289(Ns)	-
Calf (mm)	10.2±4.12	10.6±3.43	9.2±3.04	11.09±4.15	340(Ns)	-
Humerous Breadth (cm)	5.7±0.77	5.3±0.18	5.2±0.27	5.0±1.23	1.977(Ns)	-
Femur Breadth (cm)	8.8±0.69	8.7±0. 69	8.2±0.35	7.5±2.23	1.712(Ns)	-

Values are (mean ± standard deviation) "*" p<0.05; "**"p<0.01; NS = Not significant; R=Rowers, K=Kayakers, C=Canoers and C1=Control group, Vs=Versus

Table 3 represents that the arm span of rowers was noted significantly higher than control group (p<0.01) and kayakers and canoers (p<0.05). Fore arm length (cm) of male rowers was noted to be significantly higher than control group (p<0.01). Fore arm length of male kayakers and canoers was noted to be significantly higher than control group (p<0.05).

Discussion

Sport performance is a combined result of natural growth and development of a particular athlete, impact of climate and sports specific training. In our present study the height of male rowers (176.12±7.97) was noted to be significantly higher than male canoers (169.7±2.51) and control group(161.0±3.45) (p<0.05) and shorter than that of their international counterparts (189.3± 5.0), as observed by Penichet-Tomas et al. in 2021, shown in table 1. Stroke rate is very much crucial in case of rowing. Wider strokes are performed by taller rowers. Increased rowing performance is immensely related with greater stroke range**.** In case of body weight, BMI, fat%, right and left hand grip strength no significant difference was noted among four groups. Standing broad jump performance of male rowers (263.1±20.92) of our present study was noted to be significantly higher than male kayakers (252.75±17.49) and control group (198.5±16.18) (p<0.05). Strong legs prolong the drive phase of the rowing stroke. The eligible young rowers are mainly identified by their stature, skeletal get up, and muscular strength (Bourgois et al, 2000). Flexibility (cm) of male rowers (20.5±4.91) of our present study was noted to be higher significantly than male canoers (12.75±5.12) and control group (9.18±5.34) (p<0.05). Flexibility is very much crucial for rowers as they move forward by leaning their body through rotation of hip by stretching hamstring rather than the back. Relative back strength of male rowers (1.89±0.34), kayakers (1.91±0.21) and canoers (2.02±0.16) of our present study was noted to be higher significantly than control group (0.9±4.56) (sedentary school children). Lower back muscles or lats plays a crucial role in all three disciplines. Sit up performance of 1 minute of male rowers (77.5±9.90), kayakers (74.0±13.60) and canoers (82.4±14.0) of our present study was noted to be higher significantly than control group (53.46±12.39) as shown in table 2. Sit up mainly helps in toning the abdominal muscles. Push up 1 minute performance of male canoers (72±10.63) was noted to be higher than rowers (55.7±9.81), kayakers (59.6±12.21) and control group (40.15±10.89) (p<0.05) as shown in table 2. Whole body movement is required in canoeing; push up plays a very crucial role for this.

In our present study the body height (cm) (173.15±3.74) and body weight (kg) (64.39±8.61) of kayakers was found to be less than their international counterparts (184.9 ± 5.8 and 78.1 ± 4.9 respectively). Fat % of male kayakers (14.9±3.76) noted greater than their international counterparts (0.78 ± 0.02). Body height (cm) (169.7±2.51), body weight (kg) (63.0±4.42) of male canoers of our present study were noted lower; while, fat percentage (16.3±3.30) was noted higher than previous research (176.9 ± 6.9, 75.5 ± 8.0 and 0.81 ± 0.02 respectively) as observed by Hagner-Derengowska (2014)**.** Humerous, (5.3±0.18), (5.2±0.27) and femur (8.7±0. 69), (8.2±0.35) diameter of male kayakers and canoers of our present study was noted to be shorter than their international counterparts as shown in table 3. Calf circumference (cm) of male kayakers and canoers (34.1±2.57), (33.6±2.45) are lesser than previous research as shown in table 3 (Alacid et al. 2015).

In our present study the arm span (cm) of male rowers (183.9±5.15) was noted to be higher significantly than male kayakers (171.2±28.25), canoers (176.2±4.17) and control group (163.45±3.16) (p<0.05). Fore arm length (cm) of male rowers (34±2.07), kayakers (31.6±0.84) and canoers (30.2±2.25) was noted to be higher significantly than control group (28.13±2.16) (p<0.05). For maximum propulsion, long arm length is very much important. Athletes with greater arm length denote larger lever length. No significant changes have been found in fore leg length, thigh length, foot length, upper arm length, shoulder length, trunk length, calf circumference, thigh circumference, mid-upper arm circumference (MUAC) and skin folds, biceps(mm), triceps(mm),sup scapular(mm), suprailliac (mm) , calf (mm), humerous (cm) and femur (cm). In case of rowing, a rower has to put pressure on footboard by holding the oar in position and the seat moves back along with the oar. Centre of gravity is low in rowing and it is stable. In kayaking, when kayaker pushes water from the left, the right side comes forward. Push in kayak is almost continuous. In canoeing, after completing one stroke; canoers needs to bring the paddle in front for the next stroke. Training regimen for these three disciplines are also specific.

Much importance should have to be given to the training protocols of our athletes so, that they could reach the peak of their performance in near future.

Conclusions

Our athletes have significant difference in some physical and anthropometrical parameters as they are well trained and the control group has no such previous training at all. Basic concept of three disciplines i.e., rowing, kayaking and canoeing is same, which is to push water, but the mechanics of pushing water are completely different requiring critical motor ability and body stature. Further investigation is required for such discrimination which will help to design proper training to elevate the athletes at the zenith of their success.

References

Alacid, F., Marfell-Jones, M., Muyor, J.M., Lopez-inarro, P.A., Martinez, I., (2015). Kinanthropometric Comparison between Young Elite Kayakers and Canoeists, *Collegium Antropologicum,* 39 (1): 119–126.

Bourgois, J., Claessen,s A.L., Vrijens, J., Philippaerts, R., Renterghem, B.V., Thomis, M., Janssens, M., Loos, R., Lefevre, J., (2000). Anthropometric characteristics of elite male junior rowers, *British Journal of Sports Medicine*, 34 (3):213–217. https://doi.org/10.1136/bjsm.34.3.213

Gee, T., Olsen, P., Berger, N., Golby, J., Thompson, K., (2011). Strength and conditioning practices in rowing, *Journal of Strength and Conditioning Research*, 25(3): 668-682. https://doi.org/10.1519/JSC.0b013e3181e2e10e

Hagner-Derengowska, M., Hagner, W., Zubrzycki, I.Z., Krakowiak, H., Słomko, W., Dzierżanowski, M., Rakowski, A., Wiącek-Zubrzycka, M., (2014). Body structure and composition of canoeist and kayakers: Analysis of Junior and teenage Polish national canoeing team, *Biology of Sport,* 31(4):323-326. https://doi.org/10.5604/20831862.1133937

Manna, T., Adhikari S., (2018). A comparative study of anthropometric and physical profiles of male junior rowers, kayakers and canoers, *Medicina Sportiva*, 14 (2): 3028-3036.

Mitchell, J.H., Haskell, W., Snell, P., Van Camp, S.P., (2005). Task Force 8: Classification of Sports, *Journal of the American College of Cardiology,* 45(8):1364–1367. https://doi.org/10.1016/j.jacc.2005.02.015

Penichet-Tomas, A., Pueo, B., Selles-Perez, S., Jimenez-Olmedo, J.M., (2021). Analysis of Anthropometric and Body Composition Profile in Male and Female Traditional Rowers, *International Journal of Environmental Research and Public Health,* 18(5):7826. https://doi.org/10.3390/ijerph18157826

Siri, W.E., (1961). Body composition from fluid spaces and density analysis of methods, *National Academy of Sciences*, Washington DC, 223–244.

Steinbright, J., (2002). Qayaqs and Canoes: Native Ways of Knowing, *Alaska Native Heritage Center*, Achorage, Alaska, United States.

Tesch, P.A., (1983). Physiological characteristics of elite kayak paddlers, *Canadian journal of applied sport sciences,* 8(2): 87–91.

WHO, (1995). Physical status: the use and interpretation of anthropometry, Report of a WHO Expert Committee, *World Health Organization Technical Report Series*, 854:1-452.

Conflict of interest

The Authors do not have any conflicts of interest to declare.

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