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Anthropometric Characteristics and Somatotype of Dragon Boat Paddlers

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Resumen

Introducción: Dragon Boating es un deporte acuático con remo que se originó en China hace más de 2000 años. Las carreras de Dragon Boat eran parte de la cultura tradicional china. Las carreras de Dragon Boat se han convertido en un deporte popular popular en todo el mund. **Métodos:** Se midieron las características físicas y la composición corporal de 29 remeros femeninos y 36 masculinos del equipo nacional indio Dragon Boat que participaron en el 16.º Campeonato Mundial de Dragon Boat Racing IDBF 2023 en Pattaya, Tailandia, antes de su participación en un campo de entrenamiento nacional en Calcuta. , India. Para la somatotipificación se siguió el método de Heath-Carter (1967). Se utilizó la ecuación de Durnin y Womersley (1974) para calcular la composición corporal y la ecuación de Siri (1956) para calcular el porcentaje de grasa. **Resultados:** La edad promedio, la altura, el peso, el % de grasa y el somatotipo de los palistas masculinos de Dragon Boat fueron 26,6 (± 6,9), 170,1 (± 5,2), 68,1 (± 9,1), 16,9 %, y 3,4 (± 1,4) -5,0 (± 0,9)-2,1(±1,0) respectivamente, mientras que los de las remeras femeninas de Dragon Boat fueron 21,9(±4,5), 162,0(±6,5), 58,9(±12,8), 29,7(±4,9) y 5,6(±1,5)-3,5(±1,2)-2,4(±1,4) respectivamente. **Conclusión:** Los palistas femeninos del Indian National Dragon Boat Racing eran endomórficos con baja musculatura en promedio, mientras que los palistas masculinos del Dragon Boat Racing eran mesomorfos con más adiposidad en promedio.

Palabras Clave: Dragon Boat, Remero, Somatotipo, % de Grasa

Abstract

Introduction: Dragon Boating is a paddle-driven water sport that originated in China over 2000 years ago. Dragon Boat racing was a part of Chinese traditional culture .Dragon Boat racing has become a popular folk sport across the world. **Methods:** 29 Female and 36 male paddlers of the Indian National Dragon Boat team who participated in the 16th IDBF World Dragon Boat Racing Championship 2023 at Pattaya, Thailand were measured for their physical characteristics and body composition before their participation at a national training camp at Kolkata, India. Heath-Carter method(1967) was followed for Somatotyping. Durnin and Womersley (1974) equation was used to calculate body composition and Siri (1956) equation was followed for calculation of Fat %. **Results:** Average age, height, weight , Fat % and Somatotype of male Dragon Boat paddlers were 26.6(±6.9), 170.1(±5.2), 68.1(±9.1),16.9 %, and 3.4(±1.4)-5.0(±0.9)-2.1(±1.0) respectively whereas those of Female Dragon Boat paddlers were 21.9(±4.5) , 162.0(±6.5), 58.9(±12.8), 29.7(±4.9), and 5.6(±1.5)-3.5(±1.2)-2.4(±1.4) respectively. **Conclusion:** Indian National Female Dragon Boat Racing paddlers were Endomorphic with low muscularity in average whereas the Male National Dragon Boat Racing paddlers were Mesomorphic with more adiposity in average.

Keywords: Dragon Boat, Paddler, Somatotype, Fat %,

Introduction

Dragon Boating is a paddle-driven water sport that originated in China over 2000 years ago. Dragon Boat racing was a part of Chinese traditional culture which held on the 5th day of the 5th lunar month of the Chinese calendar. The boating was held in China to avert misfortune and encourage rains for prosperity. Today, Dragon boat

racing has become a popular folk sport across the world, and in around 90 countries including the US, Canada, the UK, Japan, and India play and participate in dragon boat racing competitions. The International Dragon Boat Federation (IDBF) based in the United Kingdom along with the European Dragon Boat Federation (EDBF) and Asian Dragon Boat Federation (ADBF) govern Dragon Boating as a sport in over 90 countries.

There are very few research works on Dragon boat paddlers but no research work has been done to date on Somatotype characteristics of Dragon Boat paddlers (Singh et al. 1995, Marrin & Pout 2005, Ho et al. 2009. Zandi et al. 2010, Ho et al. 2013, Brooke 2015, Broadbent et al. 2014, 2016, Shabani et al. 2016, Mellecker et al. 2016, Zhang et al. 2022, Wu Q et al. 2023).

Thus, the present study aimed to find out the Anthropometric and somatotype characteristics of Indian national Dragon Boat Paddlers which can be used as a reference for future research.

Materials and Methods

Studied Population

29 Female and 36 male paddlers of the Indian National Dragon Boat team who participated in the 16th IDBF World Dragon Boat Racing Championship 2023 at Pattaya, Thailand were measured for their physical characteristics and body composition before their participation at a national training camp at Kolkata, India.

Anthropometrical measurements

Anthropometric measurements were taken two times on the same day for each paddler to avoid the Technical error of Measurements (TEM). Measurements were taken by two accredited anthropometrists. Anthropometric measurements were measured according to methods standardized by the International Society for The Advancement of Kinanthropometry (ISAK) following the ISAK manual (2019).

Stature was measured with a Stadiometer and body mass was measured with an electronic weighing scale. Harpenden Skinfold caliper (Bety, UK) was used to measure skinfold thicknesses. For girth measurement, an anthropometric tape (CESCORF, Brazil) was used. A sliding caliper (CESCORF) was used to measure bone diameters.

Somatotype

Somatotype rating was done by the Heath-Carter (1967) method. The following equations were used for calculating somatotype :.

Endomorphy = — 0.7182 + 0.1451 × ΣSF — 0.00068 × ΣSF2 + 0.0000014 × ΣSF3

where ΣSF = (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm).

Mesomorphy = 0.858 × Humerus breadth + 0.601 × Femur breadth + 0.188 × corrected arm girth + 0.161 × corrected Calf girth — Height × 0.131 + 4.5

Three different equations use for calculating ectomorphy according to the Height -Weight ratio (HWR):

If HWR is greater than or equal to 40.75 then, Ectomorphy = 0.732 × HWR — 28.58

If HWR is less than 40.75 and greater than 38.25 then, Ectomorphy = 0.463 × HWR — 17.63

If HWR is equal to or less than 38.25 then, Ectomorphy = 0.1

Body Fat %

Durnin and Womersley (1974) technique was followed for body density. Body fat% was derived from the equation of Siri (1956).

Results

Table 1. Anthropometric characteristics and somatotype of Female Indian Dragon Boat Racing Paddlers (n=28)

Parameters	Average	SD (±)	Minimum	Maximum
Age (yrs)	21.9	4.5	17	35

Height (cm)	162.0	6.5	150.5	175.5
Weight (kg)	58.9	12.8	42.0	101.0
Endomorphy	5.6	1.5	2.7	8.6
Mesomorphy	3.5	1.2	1.8	5.9
Ectomorphy	2.4	1.4	0.1	5.3
Fat%	29.7	4.9	20	41.2

Table 2. Anthropometric characteristics and somatotype of Male Indian Dragon Boat Racing Paddlers (n=36)

Parameters	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Age (yrs)	26.6	6.9	18	41
Height (cm)	170.1	5.2	159.5	182.1
Weight (kg)	68.1	9.1	51	92
Endomorphy	3.4	1.4	1.1	6.3
Mesomorphy	5.0	0.9	3.9	7.0
Ectomorphy	2.1	1.0	0.5	3.8
Fat%	16.1	6.9	4.3	27.5

Table 3. Somatotype categories of Male and Female Dragon Boat Paddlers

Somatotype Categories	Male (n=36)		Female (n=28)	
	Number	Percent	Number	Percent
Endomorphic mesomorph	12	33.3 %	1	3.6 %
Mesomorphic endomorph	3	8.4 %	12	42.9 %
Endomorph mesomorph	5	13.9 %	1	3.6 %
Ectomorphic endomorph	0	0 %	3	10.6 %
Endomorphic ectomorph	0	0 %	1	3.6 %
Balanced endomorph	0	0 %	6	21.4 %
Balanced ectomorph	0	0 %	1	3.6 %
Central	2	5.5 %	1	3.6 %
Mesomorph ectomorph	2	5.5 %	0	0 %
Balanced mesomorph	6	16.7 %	0	0 %
Ectomorphic mesomorph	6	16.7 %	0	0 %
Endomorph ectomorph	0	0 %	2	7.1 %

Table 4. Physical characteristics of Male Dragon Boat paddlers of different countries

Country	**Studies**	**Age (yr)**	**Height (cm)**	**Weight (kg)**
Malaysia	Singh et al. 1995	25.4(±1.2)	169.9(±1.3)	64.9(±1.2)
Japan	Ho et al.2013	Unavailable	172.3	76.2
China	Zhang et al.2022	20.08 ± 1.12	183.54 ± 4.74	83.23 ± 8.25
China	Wu et al. 2023	19.72 ± 1.08	176.24 ± 5.57	73.64 ± 9.53
Chaina	Wu et al. 2023	20.46 ± 0.93	183.92 ± 5.71	85.42 ± 9.26
Australia	Gomory et al.2011	24	191.0	102
India	Present Study	26.6±6.9	170.1±5.2	68.1±9.1

Table 5. Physical characteristics of Female Dragon Boat paddlers of different countries

Country	Studies	Age (yr)	Height (cm)	Weight (kg)
Australia	Broadbent et al. 2016	56.7±7	164.5 ± 8	68.7 ± 8
Iran	Shabani et al.2016	23.60±3.49	162.90±6.20	61.70±4.32
Thailand	Senakham et al. 2015	19.52 ±2.77	163.24 ±4.84	59.88 ±7.70
India	Present Study	21.9±4.5	162.0±6.5	58.9±12.8

Table 6. Carter (1990) Rating values and Relative meanings for all three components

Component values	Categories
$^1/_2$ to $2^1/_2$	LOW
3 -5	MODERATE
$5^1/_2$ to 7	HIGH
$7^1/_2$ & above	HIGH

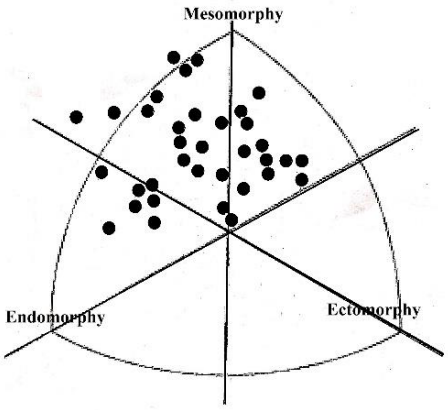

Figure 1. Somatochart of Male Indian National Dragon Boat Racing Paddlers

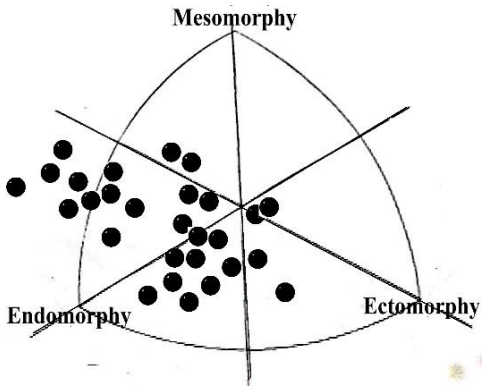

Figure 2. Somatochart of Female Indian National Dragon Boat Racing Paddlers

Discussion

Dragon Boat racing is a paddle-driven water sport where physical characteristics and somatotype are very important factors for better performance besides other factors like physiological, biomechanical, psychological, and

technical factors. The racing is very similar to Canoeing and Kayaking where body weight and height play an important role in creating a biomechanical force for advancing the boat into the water.

In the present study, the average height of the male paddlers was 170.1 (±5.2) cm with a range between 159.5 cm and 182.1 whereas that of Female paddlers was 162.0 (±6.5) cm with a range between 150.5 cm and 175.5 cm (Table 2). The average height of the male Indian Dragon Boat paddlers was very similar to Malaysian Dragon Boat paddlers but less than Japanese, Chinese and Australian male Dragon Boat Paddlers (Table 4). The average Body weight of Indian male Dragon Boat paddlers was higher than the Malaysian paddlers but less than their Japanese, Chinese and Australian counterparts (Table 4). The average height of the Indian Female Dragon Boat paddlers was slightly less than the Australian female Dragon Boat paddlers but close to or very similar to Iranian and Thai female counterparts (Table 5). These differences and similarities in physical characteristics might be due to geographical variances as except for Australian paddlers, all other paddlers were from Asian countries (Table 4, Table 5).

The average Somatotype category of Indian female Dragon Boat paddlers was Mesomorphic Endomorph (5.6-3.5-2.4) with moderate muscularity (Table 1) whereas the Indian male Dragon Boat paddlers were Endomorphic mesomorph (3.4-5.0-2.1) in average with Moderate muscularity (Table 2). Thus, both male and female paddlers of the present study were with moderate muscularity in average according to the Classification of Carter 1990 (Table 6) which should be high or more. The average Endomoprphic component of the Indian male Dragon Boat paddlers of the present study was in the Low category whereas that of Females was in the High category (Table 1, Table 2). The average high adiposity of the female paddlers was also reflected in the presence of a high percentage of Fat both in male and female paddlers (Table 1 and 2). 33.3 % of male paddlers were Endomorphic mesomorph whereas only 3.6 % of female paddlers were of that category. On the contrary, 42. 9 % of female paddlers were Mesomorphic endomorph whereas only 8.4 % of male counterparts were of that category. Thus, adiposity was more in female paddlers than in male counterparts which might be due to gender differences. Ectomoprhic mesomorph which was supposed to be the ideal body type for both male and female athletes was very less (16.7%) in male paddlers and absent in female paddlers. Instead of that Balanced Endomorph (21.4%) was more in female paddlers and Balanced mesomorph was absent. 5.5 % of male paddlers were in central whereas only 3.6 % of female paddlers were in central. 16.7 % of male paddlers were in the Balanced mesomorph category whereas another 16.7 % were in the Ectomorphic mesomorph category. There were no Endomorph ectomorph category paddlers in the male group whereas 7.1 % of females were of Endomorph ectomorph category (Table 3). Sufficient muscle mass with a rich ATP-CP system is required to generate more energy during paddling (McArdle and Katch 2010, Adhikari and Chakrabarti 2022, Chakrabarti and Adhikari 2023). Ectomorphic Mesomorph body type with high mesomorph components may be one of the important and required Physical demands for good performance in Rowing (Adhikari and Chakrabarti 2022, 2023). Somatochart plotting showed Endomorphic, Ectomorphic endomorph, and Endomorphic ectomorph zones for the female Dragon boat paddlers of the present study except one who Endomorphic measomorph with less muscle mass (Fig 1). Male Dragon boat paddlers of the present study were in the Mesomorphic zone but a large number of males were in Endomorphic mesomorph zone indicating more fat in the body along with muscle mass (Fig 2). Paddlers of Water Sports like Rowing, Canoeing, and Kayaking need good muscularity to create forces to move the boat forward. Dragon Sports racing also needs force to move forward which is created by the Dragon boat paddlers.

Conclusion

Thus, from the above discussions it could be concluded that the Indian National Female Dragon Boat Racing paddlers were Endomorphic with low muscularity in average whereas the Male National Dragon Boat Racing paddlers were Mesomorphic with more adiposity in average.

References

Adhikari, A. Chakrabarti, D. (2022). Somatotype and Anthropometric Characteristics of Indian Female Rowers. *International Journal of Kinanthropometry*, 2(2): 65-69. https://doi.org/10.34256/ijk2227

Broadbent, S., Coutts, R., Coetzee,S. (2014). Physical and Injury Profiles of Australian Female Dragon Boat Paddlers: A Pilot Study, *Journal of Fitness Research*, 3(2): 3-12.

Broadbent, S., Coutts, R., Coetzee, S. (2016). Targeted exercise interventions in improving injuries, flexibility and strength in female dragon boat paddlers, *International Journal of Therapy and Rehabilitation*, 23 (1):11-18. https://doi.org/10.12968/ijtr.2016.23.1.11

Brooke, M. (2015). Fongzi, dragons and corporate culture: An analysis of corporate dragon-boat paddlers' motivations, *Asia Pacific Journal of Sport and Social Science*, 4(2): 99-112. https://doi.org/10.12968/ijtr.2016.23.1.11

Carter, J.E.L., Heath, B.H. (1990). Somatotyping-Development and Applications, *Cambridge University Press*, Cambridge.

Chakrabarti, D., Adhikari, A. (2023). Somatotype Characteristics of Indian National Canoeists and Kayakers, *International Journal of Kinanthropometry,* 3(1): 118-123. https://doi.org/10.34256/ijk23113

Durnin, J.V.G.A., Womersly, J. (1974). Body fat assessed from total from total body density and its estimation from skinfold thicknesses. *Brtish Journal Nutrition*, 32: 77-79. https://doi.org/10.1079/BJN19740060

Gomory, J., Ball, K., Stokes, R. (2011). A system to measure the kinematics, kinetics and effort of dragon boat paddling. Proceeding of 5th Asia-Pacific Congress on Sports Technology (APCST), *ScienceDirect*, Procedia Engineering 13: 457-463. https://doi.org/10.1016/j.proeng.2011.05.114

Heath, B.H., Carter. J.E.L. (1967). A modified Somatotype method, *American Journal of Physical Anthropology*, 27:57-74. https://doi.org/10.1002/ajpa.1330270108

Ho, S.R., Smith, R.M. O'Meara, D. (2009). Biomechanical analysis of dragon boat paddling: A comparison of elite and sub-elite paddlers, *Journal of Sports Sciences*, 27(1): 37-47. https://doi.org/10.1080/02640410802491350

Ho, S.R., Smith, R.M, Chapman, P.G., Sinclair, P.J., Funato, K. (2013). Physiological and physical characteristics of elite dragon boat paddlers. Journal of Strength Conditioning Research, 27(1): 137–145. https://doi.org/10.1519/JSC.0b013e318252f612

Hu, Y., Zhao, E., Liu, H., Zhou, H., Cai, J. (2023). The Analysis of Forecast Bias and Causes of Extreme 'Dragon Boat Water' in Hunan Province in 2022. *Environmental Science and Engineering,* Springer, Cham. https://doi.org/10.1007/978-3-031-31808-5_6

ISAK Manual (2019). International Standards for Anthropometric Assessment. International Society for the Advancement of Kinanthropometry. Edited by: Francisco Esparza-Ros, Raquel Vaquero-Cristóbal, Michael Marfell-Jones, UCAM Universidad Católica de Murcia, Spain.

McArdle, W.D., Katch, F.I., Katch, V.I. (2010). Exercise Physiology: Nutrition, Energy, and Human Performance, *Lippincott Williams & Wilkins*, USA

Marrin, K., Pout, M.J. (2005). Anthropometric and physiological characteristics of elite male dragon boat paddlers. *Journal of Sports Science*, 23:1204.

Mellecker, R.R, Fong, S.S.M., Macfarlane, D.J., Zhang, J., Wu, K.M. (2016) Comparison of Musculoskeletal Strength and Body Composition of Hong Kong Chinese Rugby Players, Dragon Boat Paddlers, and Controls. *Journal of Athletic Enhancement*, 5: 2. https://doi.org/10.4172/2324-9080.1000224

Shabani, R., Rahmatian, R., Izaddoust, F. (2016). Effects of high dose coffee intake on aerobic power in dragon female athletes. *Physical education of students*, 4: 51–56. https://doi.org/10.15561/20755279.2016.0406

Senakham, T., Phongsri, K., Punthipayanon, S, & Suwannathat,N. (2015). Prediction of 500-M Sprint Dragon Boat Performance in Women Paddlers, ÇÒÁÇÔ¨ÑÂ PE, 69-78

Sh. Zandi, Rajabi, R., Tavanaei, A.R. (2010). Are Gender, Position in Boat and Training Load Associated with the Injuries in Elite Dragon Boat Paddlers?. *World Journal of Sport Sciences*, 3 (2): 113-118.

Siri, W.E. (1956). Body composition from fluid spaces and density, Report 19. *University of California Press*, Berkeley, California.

Singh, R., Singh, H.J., Sirisinghe, R.G. (1995). Physical and physiological profiles of Malaysian dragon boat rowers, *British Journal of Sports. Medicine*, 29(1): 13-15. https://doi.org/10.1136/bjsm.29.1.13

Wu, Q., Jiang, H., Shao, C., Zhang, Y., Zhou, W., Cao, Y., Song, J., Shi, B., Chi, A., Wang, C. (2023) Characteristics of changes in the functional status of the brain before and after 1,000 m all-out paddling for different levels of dragon boat athletes. *Frontiers in psychology,* 14: 1109949. https://doi.org/10.3389/fpsyg.2023.1109949

Zhang, Y., Jiang, H., Zhou, W., Cao,Y., Shao,C., Song, J., Chi, A. (2022). Comparison of Electroencephalogram Power Spectrum Characteristics of Left and Right Dragon Boat Athletes after 1 km of Rowing. *Brain Science,*12(12), 1621-1633. https://doi.org/10.3390/brainsci12121621

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Conflicts of Interest

The authors have no conflicts of interest to declare that they are relevant to the content of this article.