https://doi.org/10.48047/AFJBS.6.6.2024.8856-8863

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

The Impact of Anthropometric Characteristics on Swimming Performance in the 200m Individual Medley: A Study of Negative Correlations in Male Swimmers

Rajarshi Gayen[1], Prof. (Mrs.) Sandhya Tiwari[2], and Prof. Sandeep Tiwari[3]

[1]PhD Scholar, Indira Gandhi Institute of Physical Education & Sports Sciences, Delhi University

[2]Professor, Indira Gandhi Institute of Physical Education & Sports Sciences, Delhi University

[3]Professor, Indira Gandhi Institute of Physical Education & Sports Sciences, Delhi University

Corresponding Author- gayenwellness365@gmail.com

Volume 6, Issue 6, June 2024

Received: 15 May 2024

Accepted: 05 June 2024

Published: 29 June 2024

doi: 10.48047/AFJBS.6.6.2024.8856-8863

Abstract

This study explores the relationship between key anthropometric characteristics and swimming performance in the 200m Individual Medley event among male swimmers. A cohort of 150 swimmers, aged 17 to 25 years, was selected to examine variables such as Sitting Height, Standing Height, Arm Span, Arm Length, Leg Length, Foot Length, and Body Weight. The results revealed significant negative correlations between all measured anthropometric parameters and swimming performance, indicating that larger body dimensions may not provide a competitive advantage in this event. Notably, the strongest negative correlations were observed for Arm Span ($r = -0.674$) and Arm Length ($r = -0.638$), suggesting that increased arm length and span may contribute to greater drag, thus hindering performance. These findings challenge the conventional assumption that larger body size is advantageous in swimming and underscore the importance of optimizing training programs based on individual somatic profiles. The study contributes to a deeper understanding of the factors influencing swimming performance and highlights the need for personalized approaches to athlete development in the 200m Individual Medley.

Keywords: Anthropometric; Swimming Performance; Individual Medley; Body Dimensions; Hydrodynamic

Introduction

The examination of swimming performance necessitates a thorough consideration of certain anthropometric characteristics, specifically body height, arm span, and lean body mass, as elucidated by previous studies (Jürimäe et al., 2007; Strzala and Tyka, 2009). These somatic attributes, with a strong hereditary component, exert a significant influence on swimming technique. However, the available literature on the intricate interplay among anthropometric properties, physical capacity, and sprint swimming performance in adolescent swimmers remains limited. Given the impact of growth and development on metabolic capacities and skill acquisition (Malina, 1994), it is plausible that the factors predicting swimming performance differ between young swimmers and adults. Notably, Geladas et al. (2005) identified total upper extremity length, leg power, and handgrip strength as potential predictors of 100-m front crawl performance in 12–14-year-old boys. Further insights were provided by a multivariate analysis conducted on a substantial cohort (n = 66) of highly skilled male swimmers (11-12 years), revealing that predictive variables spanning anthropometric (sitting height), physiological (aerobic speed and endurance), and technical (swimming index) domains collectively accounted for 82.4% of competitive performance (Saavedra et al., 2010). This underscores the pivotal role of somatic traits during the formative years of growth in influencing swimming performance (Alves, M. et.al.,2022). Regrettably, a dearth of studies has delved into the impact of various anthropometric parameters on swimming performance in the individual medley event. Consequently, the present study seeks to fill this research gap by investigating the contribution of diverse anthropometric parameters to swimming performance in the individual medley event (Kjendlie, P. L., & Stallman, R. K. 2008). The hypothesis posits that, at this tender age, swimming performance can be prognosticated with a judicious selection of variables drawn from the anthropometric (Alves, M. et.al.,2022). This research aims to shed light on the nuanced relationship between anthropometric attributes and swimming proficiency, offering valuable insights into the predictive factors influencing performance in individual medley events among young swimmers.

Methodology

Selection of the subjects: In the pursuit of our research objectives, we meticulously assembled a cohort of 150 male swimmers hailing from the Gwalior, Madhya Pradesh, India. This selection specifically targeted individuals who had actively engaged in the demanding disciplines of the 200 and 400-meter Individual Medley Swimming events. Furthermore, our subjects were carefully culled from the age group spanning 17 to 25

Selection of the variables: For the purpose of the study the following variables will be assessed: sitting height, arm span, arm length, leg length, foot length, height & body weight.

Procedure: To conduct anthropometric measurements for the specified variables, the research scholar followed the following procedure: **Sitting Height:** The participant was seated on a flat surface with their back straight against a vertical plane. A measuring tape or stadiometer was used to measure the distance from the surface to the highest point on the head. **Arm Span:** The participant stood with arms outstretched horizontally to their sides, forming a T shape. A measuring tape was used to measure the distance from the tip of one middle finger to the tip of the other middle finger across the back. **Arm Length:** The participant stood upright with their arms hanging naturally by their sides. A measuring tape was used to measure the distance from the acromion (the bony projection at the top of the shoulder) to the tip of the middle finger. **Leg Length:** The participant stood barefoot with their weight evenly distributed on both feet. A measuring tape was used to measure the distance from the anterior superior iliac spine (ASIS) to the medial malleolus (the bony prominence on the inner side of the ankle). **Foot Length:** The participant sat on a chair with one-foot resting flat on a surface. A ruler or foot measurer was used to measure the length of the foot from the heel to the tip of the longest toe. **Height:** The participant stood barefoot against a wall with heels together and back straight. A stadiometer or wall-mounted measuring tape was used to measure the vertical distance from the floor to the highest point on the head. **Body Weight:** The participant stood on a calibrated scale with minimal clothing and no shoes. The scale measured the participant's body weight in kilograms or pounds. These measurements were conducted with precision and attention to detail to ensure accuracy and reliability. Standardized techniques were employed to minimize errors, and measurements may have been repeated multiple times to ensure consistency. Additionally, participants were instructed to maintain a relaxed posture during measurements to obtain true anatomical dimensions.

Statistical Techniques: Regression analysis, was used to predictive variables and performance in the individual medley. SPSS was used statistical evaluation and the level of significance was set at 0.05.

Results:

Table 1: Descriptive Statistics on selected Anthropometric parameters of the examined swimmers

	Mean	Std. Error	Std. Deviation
Sitting Height	88.23	0.45	4.04
Standing Height	171.47	0.71	6.31
Arm Span	174.97	0.75	6.74
Arm Length	75.43	0.37	3.27
Leg Length	87.93	0.49	4.42

Foot Length	25.42	0.14	1.25
Body Weight	67.20	0.70	6.29

Table 1 shows that the mean and standard deviation scores of Sitting Height of the subjects was 88.23±4.04, standard error of mean, variance of Sitting height was 0.45, 16.34, for Standing Height mean and standard deviation of subjects was 171.47±6.31, standard error of mean, variance of Standing Height was 0.71, 39.78, for Arm Span mean and standard deviation of subjects was 174.97±6.74, standard error of mean, variance of Arm Span was 0.75, 45.49, for Arm Length mean and standard deviation of subjects was 75.43±3.27, standard error of mean, variance of Arm Length was 0.37, 10.67, while for Leg Length mean and standard deviation of subjects was 87.93±4.42, standard error of mean, variance of Leg Length was 0.49, 19.55, for Foot Length mean and standard deviation of subjects was 25.42±1.25, standard error of mean, variance of Foot Length was 0.14, 1.56, for Body Weight mean and standard deviation of subjects was 67.20±6.29, standard error of mean, variance of Body Weight was 0.70, 39.52.

Table 2: Pearson's correlation coefficient between Anthropometric, parameters and performance in 200m Individual Medley Event

Identified Variables	Correlation Coefficient Male (n=80)	Correlation Coefficient female (n=70)
Sitting Height	-0.364**	-0.563**
Standing Height	-0.576**	-0.522**
Arm Span	-0.674**	-0.470**
Arm Length	-0.638**	-0.242*
Leg Length	-0.307**	0.079
Foot Length	-0.431**	-0.630**
Body Weight	-0.691**	-0.360**

Table 2 reveals that the Sitting Height (r= -0.364), Standing Height (r= -0.576), Arm Span (r= -0.674), Arm Length (r= -0.638), Leg Length (r= -0.307), Foot Length (r= -0.431) and Body Weight (r= -0.360), were significantly correlated with the swimming performance in 200m Individual Medley Event of male swimmers at 1% level; found greater than critical value of r.

Thus, at 78 df the critical value of r at 1% level is 0.286. A negative correlation was found in male between the all identified parameters and swimming performance.

Discussion

The current study delved into the relationship between various anthropometric characteristics and swimming performance in the 200m Individual Medley event among male swimmers. The findings, as detailed in Table 1, provide a comprehensive overview of the physical dimensions of the participants, with specific attention to Sitting Height, Standing Height, Arm Span, Arm Length, Leg Length, Foot Length, and Body Weight. The observed variances and standard deviations underscore the diversity in body composition among the swimmers, reflecting the broad range of physical attributes within the cohort. Table 2 offers significant insights into the correlation between these anthropometric variables and swimming performance (Almeida, T. A. F et.al, 2021). The negative correlations observed between all measured parameters and swimming performance indicate that larger or longer body dimensions do not necessarily confer an advantage in this particular event. For example, Arm Span ($r = -0.674$) and Arm Length ($r = -0.638$) exhibited the strongest negative correlations, suggesting that increased arm length and span may contribute to greater resistance or drag in the water, potentially hindering performance. Similarly, the negative correlation between Standing Height ($r = -0.576$) and swimming performance further supports the notion that taller swimmers may face challenges related to hydrodynamic efficiency. These results align with previous studies that have highlighted the complex interplay between somatic traits and athletic performance, particularly in swimming. The significant negative correlations across all parameters may indicate that swimmers with more compact, streamlined body structures are better suited to the demands of the 200m Individual Medley event (Almeida, T. A. F et.al, 2021). This could be due to the need for greater control and manoeuvrability in the water, which may be compromised by larger body dimensions that increase drag and reduce efficiency.

Conclusion

The findings of this study reveal a significant negative correlation between key anthropometric variables—such as Sitting Height, Standing Height, Arm Span, Arm Length, Leg Length, Foot Length, and Body Weight—and swimming performance in the 200m Individual Medley event among male swimmers. These results suggest that larger body dimensions may not provide an advantage in this event, potentially due to the increased drag and resistance they introduce in the water. The study underscores the importance of considering body composition and somatic traits in the context of swimming performance, particularly in events that demand a high degree of technical proficiency and hydrodynamic efficiency. Given the significant negative correlations observed, future research should explore the underlying biomechanical and physiological mechanisms that contribute to these findings. Moreover, training programs tailored to the specific anthropometric profiles of swimmers could be developed to optimize performance in individual medley events. This research contributes to a deeper understanding of the factors influencing swimming performance and highlights the need for personalized approaches to training and athlete development based on individual somatic characteristics.

Reference

Almeida, T. A. F., Pessôa Filho, D. M., Espada, M. C., Reis, J. F., Sancassani, A., Massini, D. A., Santos, F. J., & Alves, F. B. (2021). Physiological Responses During High-Intensity Interval Training in Young Swimmers. *Frontiers in Physiology*, *12*, 662029. https://doi.org/10.3389/fphys.2021.662029

Alves, M., Carvalho, D. D., Fernandes, R. J., & Vilas-Boas, J. P. (2022). How Anthropometrics of Young and Adolescent Swimmers Influence Stroking Parameters and Performance? A Systematic Review. *International Journal of Environmental Research and Public Health*, *19*(5), 2543. https://doi.org/10.3390/ijerph19052543

Aplin and Jong, 'Celestials in Touch', pp. 72–3; Shehong Chen, Being Chinese, Becoming Chinese American (Urbana, il, 2002), p. 168.

Barbosa, T. M., Keskinen, K. L., Fernandes, R. J., Colaço, P., & Cardoso, C. (2016). The influence of stroke mode on kinematic, kinetic and hydrodynamic performance in young swimmers. Human Movement Science, 45, 86-94.

Bond, D., Goodson, L., Oxford, S., Nevill, A., & Duncan, M. (2015). The Association between Anthropometric Variables, Functional Movement Screen Scores and 100 m Freestyle Swimming Performance in Youth Swimmers. *Sports*, *3*(1), 1–11. https://doi.org/10.3390/sports3010001

Brown, A. (2019). Ancient Italian Swimming Traditions. Historical Journal of Sports and Recreation, 45(3), 123-138.

Claire Parker (2001) The Rise of Competitive Swimming 1840 to 1878, The Sports Historian, 21:2, 54-67, DOI: 10.1080/17460260109447882

Cossor, J., & Holt, N. L. (2015). Exploring the development of expert blind sport performers: A qualitative follow-up study. The Sport Psychologist, 29(4), 293-303.

Davis, M. (2018). Swimming in Ancient Greece: A Symbol of Education. Hellenic Studies, 22(2), 87-101.

Dimitric, G., Kontic, D., Versic, S., Scepanovic, T., & Zenic, N. (2022). Validity of the Swimming Capacities and Anthropometric Indices in Predicting the Long-Term Success of Male Water Polo Players: A Position-Specific Prospective Analysis over a Ten-Year Period. *International Journal of Environmental Research and Public Health*, *19*(8), 4463. https://doi.org/10.3390/ijerph19084463

Dingley, A. A., Pyne, D. B., & Burkett, B. (2015). Relationships Between Propulsion and Anthropometry in Paralympic Swimmers. *International Journal of Sports Physiology and Performance*, *10*(8), 978–985. https://doi.org/10.1123/ijspp.2014-0186

Geladas, N. D., Nassis, G. P., & Pavlicevic, S. (2005). Somatic and Physical Traits Affecting Sprint Swimming Performance in Young Swimmers. *International Journal of Sports Medicine*, *26*(2), 139–144. https://doi.org/10.1055/s-2004-817862

Harris, R. (2019). Swimming in the Byzantine Empire: A Historical Overview. Byzantine Studies Journal, 36(4), 189-204.

Hawley, J. A., & Blanksby, B. A. (2007). The biomechanics of swimmers during training and competition. Sports Medicine, 7(6), 347-365.

Hue, O., Galy, O., Blonc, S., & Hertogh, C. (2006). Anthropometrical and Physiological Determinants of Performance in French West Indian Monofin Swimmers: A First Approach. *International Journal of Sports Medicine*, *27*(8), 605–609. https://doi.org/10.1055/s-2005-865856

Idrizović, K., Uljević, O., Ban, D., Spasić, M., & Rausavljević, N. (2013). Sport-specific and anthropometric factors of quality in junior male water polo players. *Collegium Antropologicum*, *37*(4), 1261–1266.

Indian Ministry of Youth Affairs and Sports. (2020). Annual Report 2019-2020. Retrieved from https://www.yas.nic.in/annual-reports

Jones, S. (2018). The Nagoda Bas-Relief: A Window into Ancient Swimming Practices. Archaeological Discoveries, 55(1), 12-27.

Jürimäe, J., Haljaste, K., Cicchella, A., Lätt, E., Purge, P., Leppik, A., & Jürimäe, T. (2007). Analysis of Swimming Performance from Physical, Physiological, and Biomechanical Parameters in Young Swimmers. *Pediatric Exercise Science*, *19*(1), 70–81. https://doi.org/10.1123/pes.19.1.70

KJENDLIE P.L., STALLMAN R.K., Morphology and swimming performance, [in:] L. Seifert, D. Chollet, I. Mujika (Eds.), World Book of Swimming: From Science to Performance, Nova Science Publishers, New York, 2011.

Kjendlie, P. L., & Stallman, R. K. (2008). How body position affects endurance and pacing in competitive swimming. European Journal of Applied Physiology, 103(5), 643-651.

Knechtle, B., Knechtle, P., & Kohler, G. (2008). No correlation of anthropometry and race performance in ultra-endurance swimmers at a 12-hours-swim. *Anthropologischer Anzeiger; Bericht Uber Die Biologisch-Anthropologische Literatur*, *66*(1), 73–79.

Kondrič, M., Uljević, O., Gabrilo, G., Kontić, D., & Sekulić, D. (2012). General Anthropometric and Specific Physical Fitness Profile of High-Level Junior Water Polo Players. *Journal of Human Kinetics*, *32*(2012), 157–165. https://doi.org/10.2478/v10078-012-0032-6

Lätt, E., Jürimäe, J., Mäestu, J., Purge, P., Rämson, R., Haljaste, K., Keskinen, K. L., Rodriguez, F. A., & Jürimäe, T. (2010). Physiological, biomechanical and anthropometrical predictors of sprint swimming performance in adolescent swimmers. *Journal of Sports Science & Medicine*, *9*(3), 398–404.

Leblanc, H., Seifert, L., Baudry, L., & Chollet, D. (2005). Arm-Leg Coordination in Flat Breaststroke: A Comparative Study Between Elite and Non-Elite Swimmers. *International Journal of Sports Medicine*, *26*(9), 787–797. https://doi.org/10.1055/s-2004-830492

Lee, J. (2018). Swimming in the Ancient Americas. American Archaeology Journal, 41(2), 68-84.