Malaysian Journal of Sport Science and Recreation
Vol. 22 . No. 1. 1-10, 2026.
DOI: https://doi.org/10.24191/mjssr.v22i1.9202

IMPACT OF COMMERCIALLY MANUFACTURED AND HANDCRAFTED HAND PADDLES ON MALE SWIMMERS' PERFORMANCE: A COMPARATIVE ANALYSIS

Gopal Chandra Saha[1]*, Ashish Kumar Gupta[1], Smriti Mondal[1],

Visva-Bharati University

*Corresponding author's email: gopalchandra.saha@visva-bharati.ac.in

ABSTRACT

Swimming has been well known to have a lot of physical, psychological, and social health benefits, and as such, physical training props like hand paddles both company-made and handcrafted are frequently employed to improve performance. The current research was to evaluate the impact of commercially produced hand paddles and handcrafted paddles on short-distance (50 m) and endurance-based (400 m) swimming among adolescent male swimmers. Twenty competitive 13-17-year-old swimmers were involved in a quasi-experimental within-subject design. The swimmers were put through a series of two tests: a 50 m and a 400 m front crawl in two conditions, using company-made paddles and handcrafted paddles. Trials were randomised and separated by a sufficient rest (24 h 50 m; 48 h 400 m). Paired-samples t-tests were used to analyse performance times. Findings revealed that in the 400 m test, paddles made by the company had a significant improvement in performance over that of paddles made by the hands (496 ± 73.9 s vs. 506 ± 73.2 s; $t(19) = 2.28$, $p < .05$) but the 50 m test did not show any significant difference (50.6 ± 4.8 s vs. 53.5 ± 5.3 s; $t(19) = 1.90$, $p = .073$). The results indicate that commercially produced paddles can offer a performance benefit in endurance swimming but not in short-sprint performance. The findings are of practical applications to coaches and athletes in the choice of training tools in a certain performance goal.

Keywords: *Swimming Performance, Hand Paddles, Front Crawl, Adolescent Swimmers, Endurance Training, Sprint Swimming, Training Tools*

INTRODUCTION

Swimming is one of the most common healthy physical activities in the world and is very helpful in physical health at any age. Swimming is practiced in a water environment that involves movement of the body with weight, provides more humidity, reduces the level of heat load, and is safer in those with the risk of falls. These properties make swimming the exercise of choice to not only healthy humans but also to subjects with ailments like chronic respiratory conditions, arthritis, and neurological complications among others. Studies discovered that through demonstrating the preventative and

rehabilitative effects, swimming reduces the mortality rates and the rate of falls in the future (Flourizel et al., 2024; Wróblewski et al., 2024). Besides physical health, swimming is also a means of improving mental health and social experience, and a better connection to the outdoors. The popularity of swimming is on the upswing because it offers advantages not only in physical fitness, as the subjects reported, but also in the area of mental health. In addition, being aware of the environment and a sense of belonging to a greater environmental system also contribute to the engagement in natural water environments, which is connected to environmental sustainability (Olive, 2023; Oliver et al., 2023).Swimming offers important physical health benefits, such as better cardiovascular health, muscular health, and a decreased chance of chronic illness. It helps specifically people who have low mobility, elderly people, and people who have to struggle with obesity or stress (Biró et al., 2021; Dakal, 2022). With these mixed benefits, swimming has an extraordinary opportunity not only to achieve individual health but also as a component of the so-called blue economy, in which it encourages a complex economic rise, social progress, and environmental friendliness in any life activity connected with water. Research and policy formulation needs to be continued to maximize as far as possible the health, social and ecological outcomes of swimming in terms of a rise in the numbers of several populations affected (Flourizel et al., 2024).It is known that swimming is healthy and disease-preventive as a whole body exercise that improves cardiovascular conditioning, body strength, and flexibility. Even though recreational swimming is capable of alleviating some of the risk factors that can be linked to coronary heart disease (CHD) (Lavoie & Montpetit, 1986; Tanaka, 2009). In practice, the majority of methods reflected positive outcomes, yet the quality of studies varies as many of them have not been designed rigorously or theoretically (7). As a supplement to mastering skills, the interest of young learners can be enhanced with the help of the new pedagogical methods, such as in the form of games and instructional media (Hadyansah et al., 2022). Swimming is an extremely taxing, physically and technically demanding activity where an athlete must have strength, technique, and endurance. Swimmers are likely to train with multiple sets of equipment, and one of the most commonly used is the use of hand paddles. The primary goal of the utilization of paddles is the overloading of the upper body muscles to help a swimmer achieve more propulsive power and master a stroke. Paddles are used to push more water per stroke with a larger area of the hand, which may lead to faster swimming, longer strokes, and efficient swimming (Barbosa et al., 2013). Gourgoulis et al. (2008) reported that hand paddles also increased the propelling efficiency, the stroke length and the swimming velocity, mainly because of the larger propulsive areas of the hand in comparison with free swimming. Matos et al. (2013) opined that to crawl, paddles can change the averages of stroke length and stroke rate, the average swimming speed, the absolute duration of the stroke phases and the index of coordination. Even though the use of paddles can be effective in terms of strength and technique development, they must be used in relation to the level of the swimmer and his/her training goals. Although short term paddle training may not always lead to significant performance gains in established swimmers, it may be particularly effective when applied to novices and young athletes who desire to be faster and sharpen their mechanics (Barbosa et al., 2013; Syafrial et al., 2023).The use of hand paddles is aimed at increasing the size of the hands of the swimmer and therefore provide increased resistance when making the strokes. Stroke distance can be also enhanced with the use of hand paddles; most swimmers consider hand paddles to be useful in motivating a longer pull in water. This will help the swimmers to go an extra distance with each stroke and that is particularly handy when it concerns competitions (de Matos et al., 2013). Also, paddle resistance to the stroke rate can also increase. The process by which swimmers get adjusted to the frequency of stroke may further improve the overall efficacy of the process as it becomes quicker (de Matos et al., 2013). The training of hand paddlers involves more muscles in the upper body as it involves the shoulder and arm muscles, particularly the back. This augmented neurostimulation could lead to an increase in muscle strength, which is necessary in improving the swimming performance (Barbosa et al., 2013; de Matos et al., 2013). Swimming using hand paddles offers a higher propelling force whereby swimmers can cover higher speeds expending less energy (Gourgoulis et al., 2008).

This study aims at exploring whether there are marked differences in the performance of speed in the two types of paddles such as company made hand paddle and hand mad made hand paddle, by comparing short distance (50 meters) and endurance based (400 meters) performance of the front crawl swimming.

The results of the present study will provide the practical applicative information about the effectiveness of the various training tools and its consequences on athlete development and training practices.

METHODOLOGY

Participants

The present study included twenty (N = 20) male swimmers aged 13-17 years (M = 15.0 +/- 1.3 years), whose average weight was 52.6 +/- 4.7 kg, height 163.4 +/- 5.5 cm and their body mass index were 19.7 +/- 1.8 kg/m ^{2}. The subjects (n = 20) were taken randomly from the 38th Ward Vidyasagar Swimming Coaching Centre (4/2/1A, Ramkrishna Das Lane, Kolkata-700009, West Bengal, India) and the Bahu Bazar Swimming Club. The subjects were all more than one year old in terms of experience in competitive swimming and had attended the Kolkata District Swimming Meet or other district level competitions. A priori power analysis aided in the calculation of the sample size, and it was done using G*Power 3.1.9.7. This analysis, assuming an effect size of 0.77, an alpha level of 0.05, and a power of 0.95, was based on a paired-samples t-test and concluded that a sample size of 20 individuals would be adequate in determining whether there will be statistically significant results. Therefore, 20 swimmers were recruited for the present study. The sample was selected through purposive random sampling, and participants were selected based on the inclusion criteria of active training and competitive experience. The demographic data, such as age, anthropometric data, and training history, were measured in terms of standardised assessment forms. Before the collection of the data, all participants were instructed and demonstrated accordingly. Further Informed consent was obtained from all participants and their legal guardians before they were included in the study and all procedures were conducted by the ethical guidelines of the latest version of the Helsinki Declaration and ethical approval has been obtained by the researcher from Visva-Bharati University bearing (Ref.no: VB-1313 of 2021-22).

Study Design

The purpose of the study was to test the effects of commercially manufactured/ handcrafted hand paddles on male swimmers through the quasi-experimental comparative research design. A purposive random sampling technique was used, whereby the respondents were first identified based on certain inclusion criteria, and then some were chosen upon them randomly. The strategy guaranteed the relevance of the sample to the research purpose without the selection bias in the targeted population.

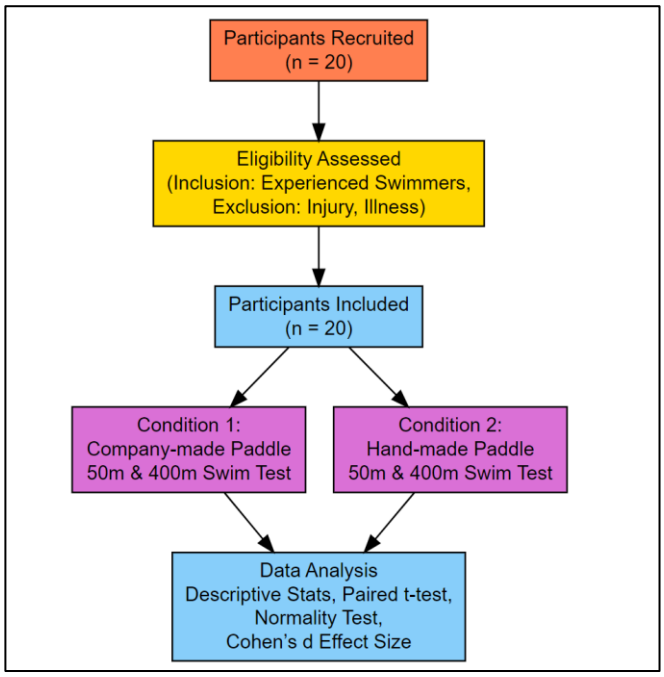

Fig 1 demonstrate flow diagram outlining the study design

Inclusion and Exclusion Criteria

Its respondents were male swimmers who were active participants at the Vidyasagar Swimming Coaching Centre (V.S.C.C.), based in Ward 38, and their ages ranged between 13 and 17 years and belonged to the district-level participation in swimming. The participants who were medically fit, free of musculoskeletal injury, and had no condition that would disrupt their performance during swimming were the only individuals included in the study. Individuals were excluded if they were not within the age range, not members of V.S.C.C. Further, swimmers who had a prior history of neurological, cardiovascular, orthopaedic diseases or any active physical and mental condition that could interfere with the test were removed. The inability to regulate food consumption, low motivation, poor sleep schedules, and environmental factors (extreme weather conditions) were also excluded to minimize potential confounding factors to ensure the accuracy of the received data and its consistency.

Testing Protocol

Equipment

There were two types of paddles used in this present study those are:

Company-made hand paddle: These consisted of ergonomically designed plastic finger-holed hand paddles with adjustable straps, which were very comfortable, durable, and provided constant and consistent resistance during the swimming workout.

Hand-made hand paddle: Locally made out of flat wooden or plastic sheets with straps made of elastic/rubber. These paddles were less polished but offered adequate resistance and were affordable, so they can be used by institutions or in training.

Fig.2 Company-made hand paddle

Fig.3 Hand-made hand paddle

50-Meter Front Crawl Swimming Test

This test aimed to understand how quickly participants swam with commercially manufactured and handcrafted paddles when performing the front crawl stroke. Every participant did the 50-meter swim using front crawl strokes under two conditions, which were: with commercially produced paddles and handmade paddles. To address the similarities and to minimize fatigue effects, the test subjects were put through an all-out swim in both trials with a recovery period of 24 hours. The random order or counterbalancing of the use of the paddles was done to reduce order effects that might have occurred. Performance was also measured in how long it took one to finish one of the swims; the stopwatch or

electronic timing system was used to ascertain accuracy and precision over the exact time it will take one to accomplish a specific swim.

400-Meter Front Crawl Swimming Test

The test aimed to measure the swimming speed of the participants with the use of commercially prepared and handmade paddles when they swam a 400m front crawl. The 400-meter swimming test was done under two conditions: with the commercially manufactured hand paddles and the hand-made paddles. They were asked to give their best during the two trials when swimming. To make the results valid and reliable, the sequence of use of paddles was randomized or counterbalanced to avoid any order effects, as much as possible. Between the two trials, a recovery window of 48 h was given to give the two sufficient rest and exclude the aspect of fatigue on performance. This was assessed by timing how long it takes to swim each 400-meter lap with a stopwatch or electronic timing device, with a shorter time representing an increased swimming speed.

Statistical Analysis

In order to test the hypothesis of the fact that the form of hand (handcrafted vs. commercially manufactured) exerted a profound impact on the swimming of 50 meters and 400 meters, data were analyzed by the statistical software Jamovi (Version 2.4). To summarize the performance deviation outcomes of each condition, descriptive statistics with the mean, standard deviation (SD), minimum, and maximum value were calculated. The normality of distribution variation between paired measurements proved to be normal as indicated through the Shapiro-Wilk test ($p > 0.05$), and thus the use of parametric tests was valid. The paired samples t-tests were adopted to evaluate both the challenges of the swimming performance in both the 50 m and 400 m trials between the two paddle types. The statistical significance was established at $p < 0.05$ to establish whether there was any significant difference in the swim times as a result of the type of hand paddle to be used. Also, the effect size was estimated as Cohen's d and allowed for interpreting the extent of the difference between the two conditions. Fig. 2 and Fig. 3 demonstrate a raincloud plot that supersedes multiple visual tools, including density plots, boxplots, and raw data points, to display the distribution and summaries of 400m speed and 50m speed data, specifically for two types of hand paddles: Company-made and Hand-made.

RESULT

The efficiency of the participants who utilized the hand-made and company-made hand paddles was assessed by using a 400-meter and a 50-meter speed swimming test. During the speed test of 400 meters, the average time it took to complete the course using the handmade paddle was 506 seconds (SD = 73.2), and the time limits varied between 403 seconds and 660 seconds. The company-manufactured led to a reduced mean time of 496 seconds (SD = 73.9); the time limits varied between 410 seconds and 655 seconds. The difference was found to be significant, and the paired sample t-test showed a statistically significant result ($t(19) = 2.28$, $p<.001$), indicating that the company-manufactured paddle was more functional in longer-distance swimming. The average time when using the handmade paddle in the 50-meter speed test was 53.5 seconds (SD = 5.32), with the lowest and the highest results achieving 40.3 and 60.0 seconds, respectively. The mean time was a bit less (50.6 sec; SD = 4.76) with the range of 42.5 - 59.4 sec shown on the company-manufactured paddle. Nonetheless, the change in two types of paddles during the 50-meter test was not statistically significant ($t(19) = 1.90$, $p = 0.073$). These results imply that, whereas the company-manufactured paddle could provide a performance boost in long-range swimming races, including the 400 meters, it will not provide any significant contribution to short-range sprinting activity (the 50 meters)

Table 1

Descriptive Statistics

Test	N	Mean	SD	Minimum	Maximum
400-meter Speed (Handmade hand paddle)	20	506.0	73.2	403.0	660.0
400-meter Speed (Company-made hand paddle)	20	495.0	73.9	410.0	655.0
50-meter Speed (Handmade hand paddle)	20	53.5	5.32	40.3	60.0
50-meter Speed (Company-made hand paddle)	20	50.6	4.76	42.5	59.4

Table 2

Paired sample t-test

Variable	t	df	p-value	Mean Difference	SE Difference	Cohen's d
400-meter Speed	2.28	19.0	< .001	11.00	4.80	0.510
50-meter Speed	1.90	19.0	0.073	2.83	1.49	0.425

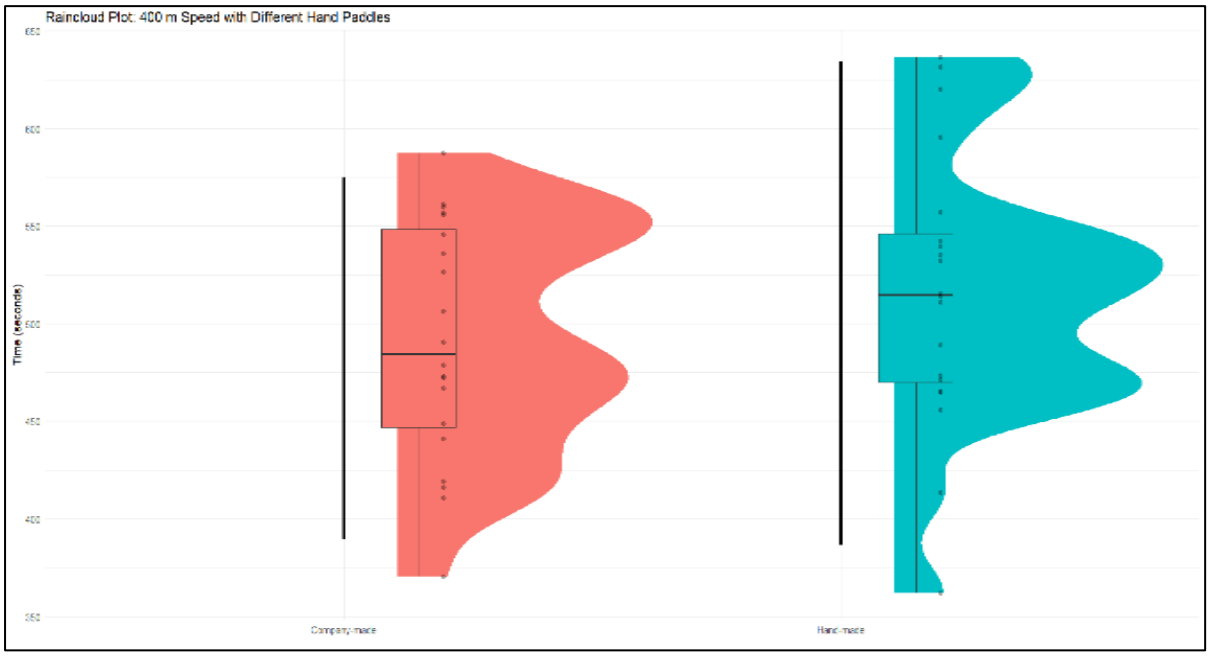

Fig. 4 Raincloud plot of 400m speed

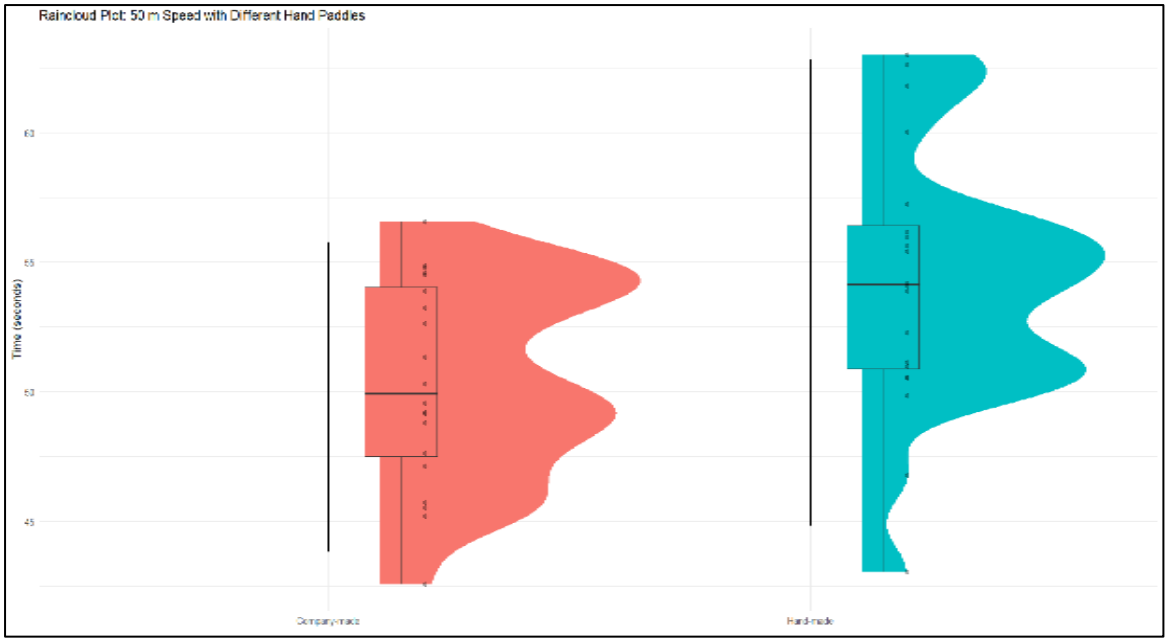

Fig. 5 Raincloud plot of 50m speed

DISCUSSION

Swimming performance is the product of a complex interaction between technical proficiency, muscular strength, and endurance capacity. The benefits linked with swimming at all ages include better cardiovascular fitness, musculoskeletal strength, and lower risk of getting chronic diseases. It is especially helpful in individuals with low mobility or chronic status, and is associated with decreased all-cause mortality and risk of falls in elderly people (Flourizel et al., 2024).To the best of our knowledge, the current research is the first one to directly compare the performance effects of commercially produced hand paddles with handmade ones in adolescent swimmers. The present study examined the effect of hand-made paddles on performance, with a particular focus on the 400-meter and 50-meter events. The results indicated that swimmers using commercially manufactured paddles achieved better performance compared to handmade paddles. This improvement can be explained through the principles of resistance-based training, wherein the increased surface area provided by paddles augments propulsive force, thereby stimulating greater muscular activation and refining stroke mechanics over repeated training sessions. Paddles help generate a more powerful force by the hands, make propelling more efficient, allow a longer stroke, and tend to decrease stroke rate. And bigger paddles only enhance all these to a certain point, as bigger paddles will not always have a positively proportional improvement; sometimes, it has diminishing returns, or more energy is consumed per stroke (Barbosa et al., 2013; Tsunokawa et al., 2019). Paddles further biased some more of the force toward the propulsive direction, enhancing mechanical efficiency without necessarily, at the same time, elevating total metabolic demand (Ogita et al., 1999; Tsunokawa et al., 2019). It has been found that paddle use can enhance peak force, impulse, and swimming velocity, and both stroke rate and hand velocity are usually lower. Paddles are also of use in improving propelling efficiency (Froude efficiency) and stroke length, the two parameters that render each stroke more effective. Nevertheless, these improvements are paddle-size dependent and swimmer experience dependent; larger paddles exaggerate these perfections, although improper use can break down technique or result in injury (Barbosa et al., 2013; Crocker et al., 2018; Tsunokawa et al., 2019). The present findings partially align with previous research. For instance, Irwanto et al. (2022) reported that the use of hand paddles and leg loads positively influenced swimming speed in athletes (Irwanto et al., 2022). Similarly, another study found that arm coordination and motor patterns were significantly altered when paddles were used at a fixed stroke rate, indicating that while paddles can enhance resistance training, they may also influence natural stroke mechanics (Sidney',' et al., 2001). Gourgoulis et al. (2006) demonstrated that hand paddles significantly increased stroke length, reinforcing the idea that changes in movement patterns, rather than hand velocity alone, are critical for performance improvements. Moreover, another study reported that larger paddles reduced the cost of

transport (COT) by decreasing arm cadence and increasing distance per stroke, suggesting a potential efficiency benefit when paddles are used strategically (Crocker et al., 2018). In freestyle and backstroke, hand paddles may be used to give a greater propulsive area and, therefore, can substantially improve the speed and distance that a swimmer can cover. Research has demonstrated that it is quite normal to find improved speed and efficiency among both swimmers and beginners, building on the use of paddles, and this might depend on the size of the paddles and the level of proficiency of the swimmer (Syafrial et al., 2023; Valent et al., 2025). Longer paddle training (e.g., 4 weeks) might be necessary to improve performance even when working with experienced swimmers, implying that the parameter that determines the benefits of training would be its duration, intensity, and individual adaptation (Barbosa et al., 2013; Gourgoulis et al., 2008). The use of a paddle may increase the rate of gains in speed and skill for beginning swimmers and children learning to swim (Rakafadni Historian et al., 2024; Valent et al., 2025). Overall, the current findings contribute to the growing body of literature suggesting that hand-made paddles can be an effective training aid for improving endurance swimming performance, particularly in longer-distance events such as the 400 meters. However, variations in outcomes across studies highlight the need for further research to determine optimal paddle size, training protocols, and swimmer profiles for maximizing performance benefits while minimizing potential negative alterations in stroke mechanics. The findings of this study indicate that the use of commercially manufactured paddles did not result in a statistically significant improvement in 50-meter freestyle performance. While paddles are widely recognized for their role in developing upper-body strength and refining stroke mechanics over prolonged training cycles, their benefits appear to be less applicable to short-distance sprint events. The 50-meter freestyle is characterized by maximal effort and explosive power. A controlled study in collegiate swimmers found that using large hand paddles (in combination with a parachute) during warm-up did not significantly affect 50-meter freestyle performance (Bufalo et al., 2023). While hand paddles can alter stroke mechanics—such as increasing stroke length and propelling efficiency in short sprints—these changes do not consistently translate into faster 50-meter race times. Studies show that although paddles may increase swimming velocity and force output in controlled, short-distance trials, these effects are not significant in actual 50-meter performance settings for trained swimmers (Barbosa et al., 2013). Critical evidence indicates that paddles do not significantly improve 50-meter swimming performance in trained athletes. While they may alter stroke mechanics, these changes do not result in faster race times over 50 meters (Ogita et al., 1999). From a biomechanical perspective, the use of hand paddles alters stroke mechanics by increasing the effective surface area of the hand, thereby enhancing hydrodynamic resistance during the pull phase. This increased resistance requires greater force production from the shoulder, arm, and trunk muscles, which may influence propulsion efficiency and stroke coordination. Previous studies on paddle-assisted swimming have reported similar increases in muscular demand and changes in stroke length and force application, supporting the present findings. Compared with handmade paddles, commercially manufactured paddles typically offer standardized dimensions and smoother edges, leading to more consistent resistance and more uniform biomechanical loading across strokes. These factors may explain the observed differences in performance outcomes and align the present results with earlier research on paddle-based training interventions.

Finally Commercial paddles are typically produced with standardized dimensions, consistent surface area, uniform stiffness, and optimized hydrodynamic properties, which can lead to more predictable and reproducible resistance during movement. In contrast, handmade paddles may vary in size, shape, material, and edge finish, potentially resulting in inconsistent water resistance and greater variability in performance outcomes.

CONCLUSION

The study demonstrated that commercially manufactured paddles may provide a performance advantage in longer-distance swimming, as evidenced by significantly faster times in the 400-meter test compared to hand-made paddles. This suggests that the commercially manufactured paddles may be more efficient in sustaining propulsion over extended distances. In contrast, no significant performance difference was observed between the two paddle types in the 50-meter sprint, indicating that paddle design may have less impact on short-duration, high-intensity efforts. Overall, the findings highlight the potential of custom

paddle designs to improve swimming performance in endurance events, warranting further research into their specific structural and biomechanical features.

AUTHORS' CONTRIBUTION

Gopal Chandra Saha-Study Design, Conducted the Data Collection, Data Analysis
Ashish Kumar Gupta-Manuscript Preparation, Data Collection, Funds Collection
Smriti Mondal- Manuscript Preparation , writing of the research

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest associated with this manuscript.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to all of the wonderful volunteers whose contributions has greatly enhanced the research.

REFERENCES

Barbosa, A. C., de Souza Castro, F., Dopsaj, M., Cunha, S. A., & Júnior, O. A. (2013). Acute responses of biomechanical parameters to different sizes of hand paddles in front-crawl stroke. *Journal of Sports Sciences*, *31*(9). https://doi.org/10.1080/02640414.2012.762597

Biró, M., Müller, A., Lenténé - Puskás, A., Pucsok, J. M., Mórik, K., & Orsolya Czeglédi, H. (2021). The role of swimming in preserving health. *Slovak Journal of Sport Science*, *7*(2). https://doi.org/10.24040/sjss.2020.6.2.30-40

Bufalo, S. S., Fontanetti, G., Barreto, R. V., Benazzi, G. R., Junior, R. C., Marangoni, V., Bassan, N. de M., Denadai, B. S., Greco, C. C., Vilas-Boas, J. P., & Lima, L. C. R. de. (2023). Post-activation performance enhancement does not occur following a large hand-paddles and parachute-resisted warm-up routine in collegiate swimmers. *Frontiers in Sports and Active Living*, *5*. https://doi.org/10.3389/fspor.2023.1244168

Crocker, G. H., Moon, J. F., Nessler, J. A., & Newcomer, S. C. (2018). *Energetics of swimming with hand paddles of different surface areas*. www.nsca.com

Dakal, N. (2022). The influence of swimming classes on improving the health of student youth. *Scientific Journal of National Pedagogical Dragomanov University. Series 15. Scientific and Pedagogical Problems of Physical Culture (Physical Culture and Sports)*, *11(157)*. https://doi.org/10.31392/npu-nc.series15.2022.11(157).02

Flourizel, I., Balogun, ;, Nelson, J., & Nake, N.-E. (2024). Citation: Flourizel I, Nelson B.J. and Nake N (2024) The Pros of Swimming for Human Health and Recreational Fisheries in the Blue Economy: Review. *International Journal of Fisheries and Aquaculture Research*, *10*(2), 1–13. https://doi.org/10.37745/ijfar.15/vol10n2113

Gourgoulis, V., Aggeloussis, N., Vezos, N., Kasimatis, P., Antoniou, P., & Mavromatis, G. (2008). Estimation of hand forces and propelling efficiency during front crawl swimming with hand paddles. Journal of Biomechanics, 41(1), 208–215. https://doi.org/10.1016/j.jbiomech.2007.06.032

Hadyansah, D., Hidayatuloh, R., Hasmarita, S., & Bakhri, R. S. (2022). Games Approach Implementation: Improvement of Basic Swimming Exercises in Introduction to Water for Preschool, Kindergarten, and School Age Categories. *JUARA : Jurnal Olahraga*, *7*(3). https://doi.org/10.33222/juara.v7i3.2268

Irwanto, A., Sumartiningsih, S., Baskora Aji Putra, R., & Wahyudi, A. (2022). The Effect of Using Hand Paddles and Leg Loads on the Speed of 50 Meter Freestyle Swimming in Rejang Lebong Regency. *Journal of Physical Education and Sports*, *11*(4), 510–516. https://journal.unnes.ac.id/sju/index.php/jpes

Lavoie, J. M., & Montpetit, R. R. (1986). Applied Physiology of Swimming. In *Sports Medicine: An International Journal of Applied Medicine and Science in Sport and Exercise* (Vol. 3, Issue 3). https://doi.org/10.2165/00007256-198603030-00002

Matos, C. C. de, Barbosa, A. C., & Castro, F. A. de S. (2013). The use of hand paddles and fins in front crawl: Biomechanical and physiological responses. Revista Brasileira de Cineantropometria & Desempenho Humano, 15(3), 382–392. https://doi.org/10.5007/1980-0037.2013v15n3p382

Ogita, F., Onodera, T., & Tabata, I. (1999). Effect of hand paddles on anaerobic energy release during supramaximal swimming. *Medicine and Science in Sports and Exercise*, *31*(5). https://doi.org/10.1097/00005768-199905000-00017

Olive, R. (2023). Swimming and surfing in ocean ecologies: encounter and vulnerability in nature-based sport and physical activity. *Leisure Studies*, *42*(5). https://doi.org/10.1080/02614367.2022.2149842

Oliver, D. M., McDougall, C. W., Robertson, T., Grant, B., Hanley, N., & Quilliam, R. S. (2023). Self-reported benefits and risks of open water swimming to health, wellbeing and the environment: Cross-sectional evidence from a survey of Scottish swimmers. *PLoS ONE*, *18*(8 August). https://doi.org/10.1371/journal.pone.0290834

Rakafadni Historian, Dewi Susilawati, & Respaty Mulyanto. (2024). The Effect of Hand Paddle and Push Up Exercises to Increase Swimming Speed in Children Aged 11-12 Years. *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani*, *8*(1), 57–64. https://doi.org/10.33369/jk.v8i1.33043

Sidney, M., Caillette, S., Hespel, J.-M., & Pelayo, P. (2001). Effect of swim paddles on the intra-cyclic velocity variations and on the arm coordination of front crawl stroke. Journal of Sports Sciences, 19(11), 825–832. https://doi.org/10.1080/026404101753113802

Syafrial, S., Tono Sugihartono, Ari Sutisyana, Arwin, A., Andes Permadi, Oddie Barnanda Rizky, & Iqbal Kurniawan. (2023). The Effect of Training using Hand Paddles on the Speed of Freestyle Swimming in Beginners at the USC Club. *Kinestetik : Jurnal Ilmiah Pendidikan Jasmani*, *7*(4), 1198–2005. https://doi.org/10.33369/jk.v7i4.28533

Tanaka, H. (2009). Swimming Exercise Impact of Aquatic Exercise on Cardiovascular Health. *Sports Med*, *39*(5).

Tsunokawa, T., Mankyu, H., Takagi, H., & Ogita, F. (2019). The effect of using paddles on hand propulsive forces and Froude efficiency in arm-stroke-only front-crawl swimming at various velocities. *Human Movement Science*, *64*. https://doi.org/10.1016/j.humov.2019.03.007

Valent, M. K., Astuty, L. T., & Martiani, M. (2025). Pengaruh Latihan Menggunakan Alat Bantu Hand Paddle Terhadap Kecepatan Renang Gaya Bebas 15 Meter Pada Perenang Di Spc Swimming Klub. In *Social Sciences Journal* (Vol. 1, Issue 3).

Wróblewski, J., Kawecka, W., Wróblewski, W., Zalewski, P., & Biłogras, J. (2024). The impact of swimming and other aquatics on human development, physiology, and the course of some diseases. *Quality in Sport*, *16*, 52504. https://doi.org/10.12775/qs.2024.16.52504