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Analysis of West Java Swimming Athletes' Performance in Breaststroke

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Abstract

This research aims to analyze the performance of West Java swimming athletes in the 100-meter breaststroke event. This analysis is crucial given the importance of race analysis in competitive swimming and the limited specific studies on the breaststroke at the regional level. Employing a descriptive quantitative approach, performance data from eight athletes (four male and four female) from the West Java Swimming Series 2025 were analyzed. The parameters measured included stroke count, stroke rate, stroke length, time per 10-meter segment, total race time, and speed per segment. The results indicate that DE (male) and AL (female) were the fastest overall swimmers. AL, in particular, demonstrated highly competitive performance, even outperforming several male swimmers. Analysis of split times revealed a progressive deceleration pattern from segment 1 to segment 4 in most athletes due to fatigue. However, DE and AL consistently maintained their speed in the final segments. In terms of stroke count, there was a tendency for an increase from SC 1 to SC 4, while the highest stroke rate was observed in SR 4. For stroke length, SL 1 had the highest average, and Velocity 1 recorded the highest average among the speed segments. Standard deviations indicated better performance consistency among male swimmers compared to female swimmers.

How to Cite

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INTRODUCTION

In competitive swimming, the goal is to complete the race in the shortest time possible. Therefore, race analysis provides an objective and measurable breakdown of the race into smaller segments for detailed performance analysis. (Riewald & Rodeo, 2015). This analysis also provides the most comprehensive evaluation of a swimmer's actual readiness. (Riewald & Rodeo, 2015). The race is often broken down into four main segments: the start, the clean swim, the turns, and the finish. (Riewald & Rodeo, 2015). The race is usually divided into four main segments: start, clean swim, lap, and finish. (Morais, Marinho, Arellano, Barbosa, et al., 2018). The start makes a greater contribution to the finishing time in sprint events, compared to long distance races and the highest speeds occur here. (Tor et al., 2014).

To create achievements in the sport of swimming is something that is done wisely which can be done to help improve quality by carrying out one of the steps in a process called coaching management. (Dikdik Zafar Sidik et al., 2012)

In the context of achievement, every second of time recorded in a swimming race is highly dependent on the efficiency of technique, physical strength, and strategy for implementing the race. According to (Riewald & Rodeo, 2015). The speed at which a swimmer completes a certain distance is called swimming speed, it is important to monitor to improve performance. (Gordon et al., 2015)

Various studies have shown that the winners of the race are not always the swimmers with the highest clean swimming speed, but rather those who are able to display optimal performance in each segment of the race. (Smith et al., 2002). In swimming competitions, such as the one dolphin kick rule in breaststroke after the start and the turn, have brought new challenges in performance analysis. (Olstad, Gonjo, et al., 2020). This requires continuous updating in the approach to race analysis, especially in breaststroke which has the most complex technical rules among all swimming strokes.

Although there is a lot of literature on swimming competition analysis, studies that specifically analyze the 100-meter breaststroke event, especially in regional competitions such as the West Java Swimming Series, are still very limited. Moreover, a sport science-based approach has not been evenly implemented in the regional athlete training system. In fact, sport science has been proven to be able to increase technical efficiency, strategy accuracy, and reduce the risk of athlete injury.

On the other hand, breaststroke relies on efficiency of movement to minimize water resistance and maximize the body's forward thrust. Too short a stroke length or too high a stroke rate can actually decrease speed due to increased resistance and wasted energy. (Riewald & Rodeo, 2015). Therefore, coaches and athletes need comprehensive analytical data to understand their performance profiles objectively and measurably.

In line with this, performance analysis becomes an important part of strategic coaching management. In the context of West Java, which is one of the provinces with great potential in the field of sports, it is very important to have empirical data on athlete performance in various competition numbers, especially breaststroke which is part of the high technique category. Most of the competition analysis is tracked in special software or calculated from digital video recordings from several cameras with manual intervention combined with official split and race times from the electronic timing system. (Thompson et al., 2000)

Based on this background, this study was conducted with the aim of analyzing the performance of West Java swimming athletes in the 100-meter breaststroke event. The focus of the analysis includes stroke length, stroke rate, stroke count, travel time per 10 meters, and total travel time. This study not only offers theoretical contributions to the field of sport science but also provides practical insights in the form of empirical data for coaches, regional swimming organization administrators, and sports policymakers to develop more targeted and science-based training programs. The novelty of this research lies in its focus on the 100-meter breaststroke event at the regional level, an area that has received limited attention in previous studies, especially in the context of West Java's swimming athlete performance analysis.

METHODS

This study uses a descriptive quantitative approach, which is an approach that aims to describe a phenomenon or variable based on numerical or statistical data. This study does not provide treatment or intervention to the subjects, but only describes the performance of athletes based on the results of the competition that has taken place.

Quantitative descriptive research aims to measure and describe the characteristics of a group based on systematically collected numerical data. (Zhou & Creswell, 2012). Data were analyzed using Microsoft Excel to show descriptive statistics through calculations of mean, median, and standard deviation (Fadluloh et al., 2024). The results of the analysis were used to compare athlete performance based on gender and to quantitatively evaluate the efficiency of breaststroke swimming techniques.

The instruments used in this study were video recordings of the competition and official time records provided by the organizing committee. These instruments were crucial in analyzing segmental race performance, including stroke count, stroke rate, stroke length, and velocity across each 25-meter segment, as reflected in Figures 2 to 6. The video data enabled frame-by-frame observation to extract kinematic variables, while the official split times ensured timing accuracy for segment analysis (Olstad, Wathne, et al., 2020). Observations were made to identify the number of strokes, stroke length, stroke frequency, travel time per 100 meters, and swimming speed. Calculations were made using the basic speed formula V=d/tV = d/tV=d/t, and the stroke length formula SL=V/SRSL = V/SRSL=V/SR. (Riewald & Rodeo, 2015).

The population of this study were West Java swimming athletes who participated in the 2025 West Java Swimming Series in the 100 m breaststroke event, and the sampling technique was random sampling. Random sampling is a sampling technique in which each member of the population has an equal chance of being selected as a sample. This technique is important in quantitative research so that the samples taken can represent the population accurately and the research results can be generalized. (Tayc, 2004). The sample of this study was 8 athletes (4 male and 4 female).

Parameter	Formula	Common Units	Description
Stroke Rate	$SR = \frac{\text{Number of Strokes}}{\text{Time}}$	strokes/minute (spm)	Measures the frequency of strokes within a given period.
Stroke Length	$SL = \frac{\text{Distance Covered}}{\text{Number of Strokes}}$	meters/stroke (m/stroke)	Measures the distance achieved per stroke.
Velocity	$V = \frac{\text{Distance Covered}}{\text{Time}} or V = SR \times SL$	meters/second (m/s) or meters/minute (m/min)	Measures the speed of movement or rate of travel. Can be calculated from distance and time, or from the product of stroke rate and stroke length.

Figure 1. Parameter (Riewald & Rodeo, 2015).

RESULTS AND DISCUSSION

In this chapter will present and explain the results of the research that has been carried out. The data from this study are the results of the 100-meter breaststroke swimming competition in the implementation of the West Java Swimming Series 2025, then the data will be categorized. The following are the results of the analysis presented, including :

1. Total travel time in a distance of 100 m
2. Time in each segment
3. Scores achieved from stroke count, stroke rate, stroke length and velocity in each segment.

The data from the **Table 1** shows the performance details of eight individuals, four men (AD, DR, FA, CH) and four women (NA, KH, AL, MU), in a swimming race measured from various distances up to 100M with "Full time" as the total time. Overall, DR stands out as the fastest male swimmer with a time of 01:07:56, while

Table 1. Full time athlete data

Name	AD	DR	FA	CH	NA	KH	AL	MU
Gender	Male				Female			
Block	0,54	0,5	0,23	0,19	0,61	0,66	0,3	0,43
Start	7,24	5,4	8,36	6,7	9,1	4,6	6,15	6,06
Turn time	7,33	7,31	7,1	6,55	8,25	4,75	8,68	7,81
25 m	13,96	13,78	14,88	14,44	17,47	17,24	16,53	16,87
35 M	21,27	22,63	22,09	21,59	26,27	27,56	24,67	25,6
45 M	28,59	28,77	29,15	29,23	35,02	33,44	31,96	33,97
50 M	32,36	32,77	33,78	32,72	39,31	39,1	37,29	38,71
65 M	42,59	40,9	43,63	42,55	52,1	48,33	48,1	50,12
75 M	50,43	49,81	51,13	49,62	61,42	59,55	56,35	58,85
85 M	56,91	56,95	58,84	57,28	70,99	69,28	64,53	67,82
95 M	64,85	63,66	67	64,59	80,35	78,13	73,71	78,86
100 M	68,83	67,56	70,84	68,45	85,39	83,01	78,11	81,59
Full time	01:08;83	01:07;56	01:10;84	01:08;45	01:25;39	01:23;01	01:08;11	01:21;59

AL is the fastest female swimmer with 01:08:11. Interestingly, Al 's time is very competitive, even outperforming some male swimmers such as FA, AD, and CH, showing an outstanding performance despite having a relatively slower turn time compared to the others. KH, on the other hand, showed the fastest start and lap time, but her total "Full time" was not as fast as AL's, implying that her swimming speed on the lane may need improvement. Further analysis of metrics such as "Block" (start reaction time) and "Start" (start time) provide additional insights into each swimmer's starting efficiency. CH had the smallest "Block" time, indicating a very reactive start, while KH excelled in the initial "Start" time. Although there is a general difference in speed between men and women, these data highlight that efficiency in various aspects of swimming (starts, turns, and lane speed) greatly contribute to overall performance. These data can be a good basis for coaches to analyze individual strengths and weaknesses, and to design more personalized and effective training programs.

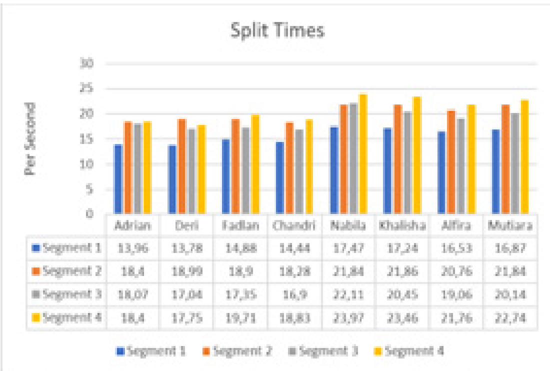

Figure 2. Time achieved per segment

The "Split Times" chart provides in-depth insight into each swimmer's performance across the four segments of the race (25M per segment). In general, there was a progressive slowdown from Segment 1 to Segment 4 for most athletes, reflecting the effects of fatigue as the distance increased. DE stood out as the most efficient athlete, starting strong in Segment 1 (13.78) and consistently maintaining a high pace in the later segments, even being the fastest in Segment 3 (17.04) and Segment 4 (17.75). His excellent consistency and endurance late in the race were key factors behind his fastest overall "Full Time". On the other hand, AD showed good early speed but slowed slightly in the final segment, while FA experienced a significant slowdown in Segment 4.

Of the women, AL demonstrated an effective pacing strategy; despite starting slower than the men, she was able to maintain her pace well in the middle and final segments, making her the fastest and most competitive female swimmer overall. In contrast, NA and KH (despite KH's fast start) showed a more drastic slowdown in the final segments, especially in Segment 4. This suggests that endurance and the ability to maintain pace in the second half of the race are key areas for them to improve. This type of split time data is invaluable for coaches to identify specific strengths and weaknesses of each athlete, allowing training programs to be tailored to optimize performance at each stage of the race..

In the **Table 2** provided, the "Mean" and "Median" values for each individual provide a brief overview of their speed performance across several measured distances (possibly 25m, 50m, 75m, and 100m). In general, significant differences in performance are seen based on gender: male participants (AD, DE, FA, CH) showed consistently lower Mean and Median values (ranging from 16.89 to 17.71 for Mean, and 17.40 to 18.13 for Median), indicating higher average speeds. In contrast, female participants (NA, KH, AL, MU) had higher Mean and Median values (ranging from 19.53 to 21.35 for Mean, and 19.91 to 21.98 for Median), indicating slower performance on average.

Interestingly, for most individuals, the Me-

Table 2. Descriptive statistics

Name	Gender	Block	Start	Turn time	25 m	50 M	75 M	100 M	Full time	Mean	Median
AD	Male	0,54	7,24	7,33	13,96	18,4	18,07	18,4	68,83	17,21	18,07
DE	Male	0,5	5,4	7,31	13,78	18,99	17,04	17,75	67,56	16,89	17,40
FA	Male	0,23	8,36	7,1	14,88	18,9	17,35	19,71	70,84	17,71	18,13
CH	Male	0,19	6,7	6,55	14,44	18,28	16,9	18,83	68,45	17,11	17,59
NA	Female	0,61	9,1	8,25	17,47	21,84	22,11	23,97	85,39	21,35	21,98
KH	Female	0,66	4,6	4,75	17,24	21,86	20,45	23,46	83,01	20,75	21,16
AL	Female	0,3	6,15	8,68	16,53	20,76	19,06	21,76	78,11	19,53	19,91
MU	Female	0,43	6,06	7,81	16,87	21,84	20,14	22,74	81,59	20,40	20,99

dian is slightly higher than the Mean. This suggests that their time distribution may be somewhat skewed, with a few faster times pulling the mean down, while the median is more representative of the middle value of the entire time series measured. DE stands out as the participant with the lowest Mean and Median, showing the best speed consistency, while NA is recorded as the slowest on both metrics.

Table 3. Descriptive statistics

Group	SD
Males	0,347
Females	0,761

The results of the standard deviation analysis showed that the male group had a standard deviation of 0.347, while the female group had a standard deviation of 0.761. This shows that the distance traveled by the male group is relatively more consistent compared to the female group. Comparison of standard deviations between the male and female groups shows that the female group has a greater variation in distance traveled compared to the male group. These results can be used as a reference for developing more effective and targeted training programs to improve athlete performance, especially for the female group which has a greater variation in distance traveled..

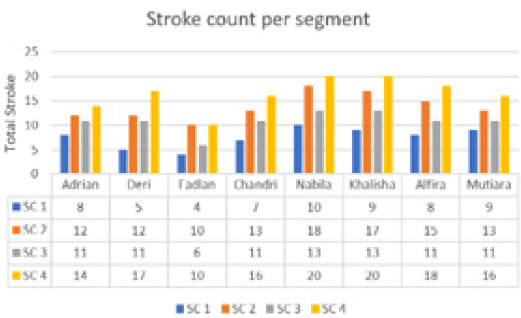

Figure 3. Stroke Count.

This group bar graph shows the number of strokes (counts) for four different segments (SC 1, SC 2, SC 3, SC 4) measured in eight individuals (AD, DE, FA, CH, NA, KH, AL, MU). In general, it can be seen that the stroke values tend to increase from SC 1 to SC 4 for most individuals. For example, AD has 8 strokes in SC 1 and increases to 14 in SC 4. Similar patterns are also seen in DE (5 to 17), CH (7 to 16), NA (10 to 20), KH (9 to 20), AL (8 to 18), and MU (9 to 16). FA shows a slight exception where SC 2 and SC 4 have the same value (10). Overall, SC 4 segment often shows the highest number of strokes among the four segments..

The average number of strokes for each segment is as follows: SC 1 has an average of 7.5 strokes ((8+5+4+7+10+9+8+9)/8=7.5). SC 2 has an average of 12.625 strokes ((12+12+10+13+18+17+15+13)/8=12.625). SC 3 has an average of 10.75 strokes ((11+11+6+11+13+13+11+11)/8=10.75). Finally, SC 4 has an average of 17.125 strokes ((14+17+10+16+20+20+18+16)/8=17.125). From these averages, it can be concluded that SC 4 has the highest average stroke, followed by SC 2, then SC 3, and SC 1 has the lowest average.

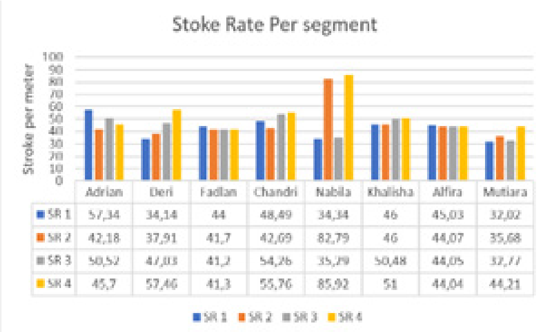

Figure 4. Stroke Rate

This group bar graph is titled "Stroke Rate Per Segment" and shows the stroke rate (counts per meter) for four different segments (SR 1, SR 2, SR 3, SR 4) measured in eight individuals (AD, DE, FA, CH, NA, KH, AL, MU). Unlike the previous graph, the pattern here shows more complex variations between segments and individuals. For example, AD has the highest SR 1 (57.34) among his segments, while NA shows much higher SR 2 and SR 4 compared to SR 1 and SR 3. FA shows a relatively consistent stroke rate across all his segments, around 40-44 strokes per meter. Overall, there is no clear upward or downward trend from SR 1 to SR 4 that applies to all individuals, indicating that stroke rate per segment varies greatly depending on the individual and the segment being measured.

To get a general idea, we can calculate the average stroke rate for each segment across individuals. The average for SR 1 is about 42.97 strokes per meter. The average for SR 2 is about 45.71 strokes per meter. The average for SR 3 is about 42.94 strokes per meter. And the average for SR 4 is about 49.46 strokes per meter. From these averages, it can be seen that SR 4 has the highest average stroke rate overall, although there is significant variation across individuals as seen in NA. This suggests that segment 4 may involve greater effort or a different stroke style that results in higher stroke rates.

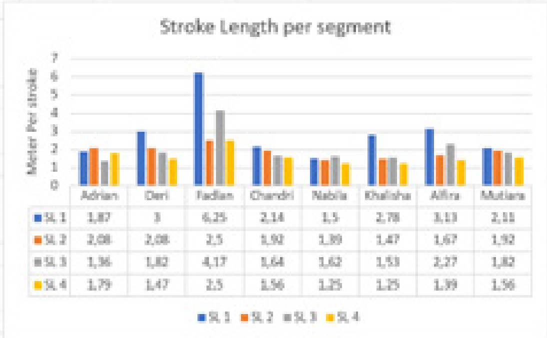

Figure 5. Stroke Length

This bar graph depicts "Stroke Length per Segment," which shows stroke length (meters per stroke) for four different segments (SL 1, SL 2, SL 3, SL 4) across eight individuals (AD, DE, FA, CH, NA, KH, AL, MU). From this graph, significant variation in stroke length is seen both between segments and between individuals. FA stands out as having the longest stroke length at SL 1 (6.25 meters per stroke) compared to other individuals and his own segments. Other individuals such as AD, DE, CH, NA, KH, AL, and MU have stroke lengths that generally range from 1 to 3 meters per stroke. There is no consistent pattern of increase or decrease in stroke length from SL 1 to SL 4 that applies to all individuals, indicating that stroke length is highly dependent on each individual's technique and perhaps the specific demands of each segment.

To get a general idea, we can calculate the average stroke length for each segment across individuals. The average for SL 1 is about 2.87 meters per stroke. The average for SL 2 is about 1.84 meters per stroke. The average for SL 3 is about 2.05 meters per stroke. And the average for SL 4 is about 1.57 meters per stroke. Based on these averages, SL 1 has the highest average stroke length overall, which is largely driven by FA's high score. Conversely, SL 4 tends to have the lowest average stroke length. This suggests that, on average, strokes in segment 1 tend to be longer, which may indicate higher efficiency, while strokes in segment 4 tend to be shorter, perhaps due to increased frequency or other factors that reduce the distance traveled per stroke.

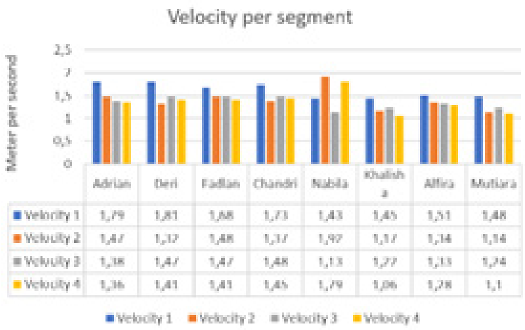

Figure 6. Velocity

This bar graph shows "Velocity per segment," which measures the speed (meters per second) for four different segments (Velocity 1, Velocity 2, Velocity 3, Velocity 4) for eight individuals (AD, DE, FA, CH, NA, KH, AL, MU). In general, it can be seen that Velocity 1 is often the highest speed for most individuals, such as AD (1.79 m/s), DE (1.81 m/s), FA (1.68 m/s), CH (1.73 m/s), and AL (1.51 m/s). However, NA shows a different pattern where Velocity 2 and Velocity 4 are higher than Velocity 1 and Velocity 3. The pattern of decreasing speed from segment 1 to segment 4 is seen in some individuals such as AD and KH, but not consistently for all. This suggests that speed can vary significantly between segments and individuals, possibly influenced by factors such as fatigue, strategy, or individual physical characteristics.

To get a clearer picture, we can calculate the average speed for each segment across all individuals. The average for Velocity 1 is about 1.62 meters per second. The average for Velocity 2 is about 1.48 meters per second. The average for Velocity 3 is about 1.38 meters per second. And the average for Velocity 4 is about 1.36 meters per second. From these averages, it can be concluded that Velocity 1 has the highest average speed overall, which then tends to decrease gradually in subsequent segments. This may indicate that individuals tend to start with higher speeds and experience a slight decrease in speed as the segment progresses. The analysis of performance data from the 100-meter breaststroke event in the West Java Swimming Series 2025 reveals several important insights related to stroke mechanics, pacing strategies, and gender differences in performance. The variation in total time, stroke count, stroke rate, stroke length, and velocity across segments provides a comprehensive picture of the swimmers' technical and physiological capabilities.

The results show that D. and A.F. were the fastest male and female swimmers, respectively. Interestingly, A.F.'s total time outperformed several male swimmers, suggesting that gender alone is not a determining factor in performance outcomes when technique and endurance are optimized. This supports findings by (Olstad, Gonjo, et al., 2020), who emphasized the importance of technical execution in short-distance breaststroke events.

The segmental split time analysis reveals a common deceleration pattern from segment 1 to segment 4, primarily due to the accumulation of fatigue. This pattern is consistent with previous findings that note the critical role of energy management and pacing strategy in maintaining speed during the final segments of a sprint race (Gordon et al., 2015). However, swimmers like D. and A.F. maintained relatively stable speeds, indicating better fatigue resistance and pacing control. According to (Morais, Marinho, Arellano, & Barbosa, 2018), effective pacing is a crucial determinant of final race performance, especially in technically demanding strokes like the breaststroke.

Stroke count data show an increase from SC 1 to SC 4 across most athletes, indicating a tendency to shorten stroke length as the race progresses. This is often a result of fatigue, leading to a reliance on more frequent, but less efficient, strokes (Riewald & Rodeo, 2015). The increasing stroke rate in SR 4 supports this observation, as athletes attempted to compensate for decreasing stroke length by increasing their frequency. This dynamic interaction between stroke rate and stroke length is crucial in optimizing swimming velocity (Olstad, Gonjo, et al., 2020).

From the velocity data, the highest average speed was observed in segment 1, gradually declining toward segment 4. This trend aligns with findings by (Tor et al., 2014), who noted that swimmers often reach their peak speed during the start and clean swim phases, with performance decreasing due to lactic acid accumulation and loss of stroke efficiency. The velocity data in this study reinforce the idea that the start phase contributes disproportionately to overall race time in sprint events.

Standard deviation analysis showed that male swimmers exhibited more consistent performance across segments compared to females, as seen from the lower variability in time and stroke parameters. This consistency may be attributed to higher training loads or physiological differences, but it also highlights the need for targeted training interventions for female athletes to improve technical consistency (Fadluloh et al., 2024).

In terms of practical application, the use of video recordings and official time records proved effective in capturing and analyzing technical race elements. This method aligns with best practices in modern race analysis, which emphasizes the integration of kinematic observation with quantitative data (Thompson et al., 2000).

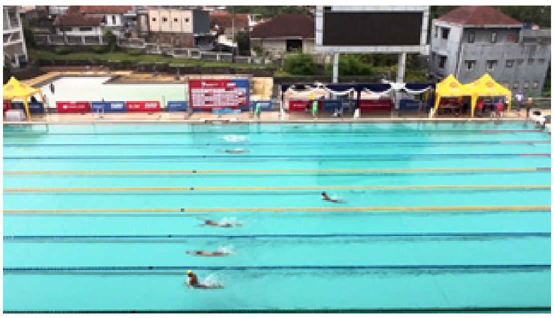

Figure 7. Recording results

Overall, this study confirms that performance in the 100-meter breaststroke is determined by a combination of technical, physiological, and tactical factors. The novelty of this study lies in its regional focus on West Java athletes, a population that has not been widely studied in sport science literature. It provides a foundational data set that can inform training design and athlete development at the provincial level.

Future research should explore biomechanical aspects using motion capture technology and expand the sample size across multiple competition events to strengthen the generalizability of findings.

CONCLUSION

This study successfully analyzed the performance of 100-meter breaststroke swimmers in West Java, providing in-depth insights into several crucial aspects such as stroke count, stroke rate, stroke length, speed, and time per segment. It was found that performance varied greatly between individuals and segments, with male athletes generally showing higher average speeds and better consistency than female athletes.

However, some female athletes showed very competitive performance. Fatigue was shown to affect speed in the final segments of the race, although some athletes showed effective pacing ability to maintain performance. These results emphasize the importance of comprehensive race analysis to identify the specific strengths and weaknesses of each athlete, allowing for the development of more personalized and strategic training programs. The data presented are expected to be a strong scientific basis for improving the quality of athlete training and management in West Java.

This study only used single events for analysis and only 8 swimmers in the race were included. Further research can be developed by looking at all swimmers who participate in other swimming competitions and combining many events in one style will give different results. Furthermore, biomechanical analysis can also be included to strengthen the RT analysis. The findings of this study provide valuable empirical data that can be utilized by coaches and policymakers to design more effective and scientifically-based training programs tailored to the needs of breaststroke swimmers.

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