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Analysis of the influence of situational and temporal variables on the performance of rowing teams in the ACT traineras League

Análisis de la influencia de las variables situacionales y temporales en el rendimiento de los equipos de remo de la Liga ACT de traineras

Iván González-García[1]
Ángel Obregón-Sierra[1]
Julio Rubén Padilla del Hierro[1]

[1] Facultad de Ciencias de la Salud, Universidad Internacional Isabel I, Burgos, Spain

Correspondence:
Iván González-García
ivan.gonzalez.garcia@ui1.es

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Abstract

The influence of situational and temporal variables on performance in team sports has been extensively studied. However, this aspect has not yet been investigated within traditional fixed-bench rowing. The aim of this research was to analyse the influence of age, team situation, performance level, lane, and time of each length on the final outcome of the rowing regattas. A total of 205 boats from the 12 clubs that participated in the 18 regattas of the 2020 season of the Eusko Label Liga (league organised by the Association of Traineras Clubs, ACT) were analysed. The results show that the high-level teams recorded lower times in all the lengths compared to the medium and low-level teams. The mean difference in final times per race was 4 seconds lower for the home teams compared to the visiting teams. There is a high correlation between the times recorded on lengths 1 and 3 with respect to the final outcome of the regatta. An awareness of this aspect can help to create a race strategy to make a bigger difference during the regatta.

Key words: Fixed bench rowing, temporary parameters, final outcome, regattas, performance analysis.

Resumen

La influencia de las variables situaciones y temporales en el rendimiento de los deportes de equipo ha sido ampliamente estudiada. Sin embargo, este aspecto no ha sido aún investigado dentro del remo tradicional de banco fijo. El objetivo de esta investigación fue analizar la influencia de la edad, la situación del equipo, el nivel de rendimiento, la calle y el tiempo de cada largo en el resultado final de las regatas de traineras. Se analizaron 205 embarcaciones de los 12 clubes que participaron en las 18 regatas de la temporada 2020 de la Eusko Label Liga (liga organizada por la Asociación de Clubes de Traineras, ACT). Los resultados afirman que los equipos de nivel alto registraron tiempos menores en todos los largos con respecto a los equipos de nivel medio, y bajo. La diferencia de medias en los tiempos finales por regata fue de 4 segundos menor en los equipos locales con respecto a los equipos visitantes. Existe una correlación alta entre los tiempos registrados en el largo 1 y 3 con respecto al resultado final de la regata. El conocimiento de este aspecto puede ayudar a crear una estrategia de carrera para lograr mayores diferencias durante la regata.

Palabras clave: Remo de banco fijo, parámetros temporales, resultado final, regatas, análisis del rendimiento.

Introduction

The traineras regattas are a team sport composed of 13 rowers and a skipper, with the aim of traveling 3 nautical miles (5556 meters) in the shortest time possible (Lorenzo-Buceta et al., 2014). The traineras are rowing boats on a fixed bench since the place where the athletes sit does not move. These races have been held since the first half of the 20th century, although many aspects have changed over the years, such as the weight or type of materials used for their manufacture (Obregón, 2020). Regattas occur in an unstable and changing environment, as they can be influenced by environmental conditions such as wind, temperature, or water depth (Badiola et al., 2001). Normally, the traineras regattas take place in open sea or in estuaries, as the established regatta field allows for the alignment of at least three boats in the same batch, which allows carrying out four lengths and three turns. According to the ACT Regatta Code (2023, p. 2), in its article 3, it states in the first point that “the race grounds must, in general, have four streets, except those intended for tests against the clock”. Point number 7 specifies that “in tandem races, the minimum distance between the beacons will be 45 meters and the maximum distance will be 50 meters”. Each boat will have to make the turns in their entirety by port on the beacons of its street, and each crew must carry out the completion of the regatta on its own street. The trainera ends the competition after performing 4 lengths and cutting the imaginary finish line with its bow in the last full length (León-Guereño & Urdampilleta, 2012).

In recent years, progress has been made in sports analysis and outcome prediction thanks to machine learning (Soto-Valero, 2018), tactical analysis (Rico-González, 2020), and the creation of analytics with big data (Morgulev et al., 2018; Rein & Memmert, 2016). Other factors that influence sports performance and that many studies have given special relevance to in recent years are the psychological state of athletes, for example, their ability to manage factors that influence their sport (Navarro et al., 2020), communication with their coach (Barrios-Duarte, 2022), the possibility of conducting periods of concentrated training (Galatti et al., 2019), or the genetics itself (Medellín, 2018).

Other studies have focused on the influence of rhythm in competition (McGibbon et al., 2018), the materials with which they compete (Drašinac et al., 2015), or different strategic aspects in technical and tactical preparation (Sandbakk & Holmberg, 2014). There are other aspects that influence the competition, such as the place where it is disputed, since Lepschy et al. (2020) claim that the team or person who competes at home, the sporting experience (Baker & Young, 2014), and the sex or age of the athlete (Tønnessen et al., 2015).

Studies related to rowing are more limited. Research focuses on biomechanics (Buckeridge et al., 2015; Miarka et al., 2018; Warmenhoven et al., 2018), physiological factors (Cristi-Montero et al., 2014), and injuries that occur during mobile bench rowing (Lategan & Nolan, 2022; Millar et al., 2020; Thornton et al., 2017). Studies are even more limited in the case of fixed bench rowing. Most of these relate to performance improvement (Mejuto et al., 2012; Penichet-Tomas et al., 2016), nutrition (Aramendi, 2014), analysis of sports injuries (Penichet et al., 2012) or certain anthropometric aspects and body composition (Penichet-Tomas et al., 2021).

However, bearing in mind that there are certain performance-related aspects of traditional rowing, such as the race situation or the influence of the times on each length, these have not yet been analysed, and no studies have been published that analyse how these variables influence performance in this sport. Most studies in fixed bench rowing focus on physical and physiological factors (Baudouin & Hawkins, 2002; Cosgrove et al., 1999; Izquierdo-Gabarren et al., 2010; Steinacker, 1993) or even psychological or nutritional factors (Aramendi, 2014; Burkhard-Jagodzińska et al., 2001; Kellmann et al., 2008; Syrotuik et al., 2001). The objective of this research was to analyse the influence of age, the situation of the team, the level of performance, the street, and the time of each race on the result of the race.

Method

Sample

We analysed 205 boats from the 12 clubs that participated in the 18 races of the 2020 season of the Eusko Label League (a league organized by the Association of Traineras Clubs, ACT). The age in years of the rowers was recorded (32.01 ± 3.02) on the day of the celebration of each race (Table 1). Five age ranges were established, grouped by intervals, using the Sturges rule (González-Hernández et al., 2022).

Table 1. Age ranges of the rowers for the season 2020

Age ranges	*N*	%	*M (SD)*	Asymmetry	Median
≤ 25.21	418	14.5	22.05 (1.82)	-.092	21.97
25.21-31.86	1100	38.1	28.44 (1.61)	.044	28.49
31.86-38.50	864	30	34.76 (2.14)	.273	34.20
38.50-45.15	433	15	41.62 (1.83)	-.100	41.66
45.15 +	68	2.4	47.42 (2.22)	.456	46.65

Note: *N*: Number of participants; *M*: Mean; *SD*: Standard deviation.

Variables

The variables collected for the study were the situation of the race (if the club acted as a local or as a visitor, depending on the place of the celebration), the result of the race (depending on the position the team occupied at the end of the race), the street number where the team competes (S1, S2, S3, and S4), the final ranking (the team's position at the end of the season), the team's time at the end of each race (L1, L2, L3, and L4), and the final time in the race. In the final ranking of the season, three level groups were established depending on the final position of the season: high level (position 1st to 4th), medium level (position 5th to 8th), and low level (position 9th to 12th), according to the study of Castillo et al. (2018).

Procedure

The data were obtained from the official website of the Eusko Label League (https://www.euskolabelliga.com/), as previously done in other related studies (Muehlbauer et al., 2010). The data published in this portal were used only for the realization of this research. The study was approved by the ethics committee of the Universidad Isabel I de Castilla (Code UI1-PI041).

Data analysis

To categorize the sample, the variables were described in number, mean and standard deviation, standard error, minimum, and maximum, depending on the distribution of the variables. The Shapiro-Wilk statistical test was used to verify that the variables followed the criterion of normality. A bivariate analysis was carried out to identify the effects of the situational condition and the relationships between the study variables. To verify the association between variables, Kendall's Tau-c coefficient was used for qualitative (categorical) variables and Spearman's coefficient for quantitative variables. ANOVA of a factor was used to analyse the differences in the temporal variables according to the final ranking of the season. The post-hoc Scheffé test was used to compare the means. The statistical program IBM SPSS Statistics Application, Version 22.0 (Armonk, NY: IBM Corp.) was used for the analysis. A significance level of $p < .05$ was considered.

Results

The distance travelled in each race is set at three nautical miles (5556 m). The boats cover 1389 m. in each length. The times in each length of a total of 205 boats were analysed. The average time and speed in each of the races recorded by the winning teams at the end of the season are reflected in Table 2.

Table 2. Pace and speed of the winning teams in each race

	L1	L2	L3	L4	Total time
Reference rate (min:sec)	04:45	04:49	5:12	5:09	19:56
Speed (knots)	9.73	9.45	8.70	8.94	9.03

Source: own elaboration.

Note: min: minutes; sec: seconds; L: Length.

Table 3 shows the average time of each race depending on the race situation and the final ranking of the season. A total of 14 vessels were registered as locals and 191 vessels were registered as visitors during the season. In relation to the times in each length, the local teams obtained shorter times in L1 (7 seconds) and in L3 (6 seconds). The visiting teams obtained half-times less in L2 (1 second) and in L4 (9 seconds). The average difference in the final times per race was 4 seconds lower for the local teams compared to the visiting teams. As for the final ranking of the season, the high-level teams recorded lower times in all the lengths compared to the middle-level and low-level teams. In high-level teams, there was a difference of 15 seconds in the final times compared to middle-level teams and 31 seconds less compared to low-level teams. Middle-level teams averaged 16 seconds shorter than low-level teams.

Table 4 shows the average time of each length depending on the street on which the boat is located during the race. In L1 and L3, the shortest time was recorded in S3, but with a difference of 1 second compared to S4. In L2, the shortest time is recorded in S1, with a difference of 3 seconds compared to the time in S3. In L4, the shortest time was recorded in S1 and S2. Finally, in the final stages of the regatta, the shortest time is observed in S1, 2 seconds apart from the S3, 3 seconds apart from the S2, and 9 seconds apart from the S4.

Figure 1 shows the end times per race according to the level of the team. The average final time increases as the quality of the equipment decreases. Teams with a high level get a lower median, depending on the final race time. The speed decreases depending on the quality of the equipment. Teams with low levels get lower speed values.

Table 3. Average rates for each race depend on the race situation and the final ranking of the season

Lenght	Level	*M (SD)*	Standard error	Mínimum	Maximum
1	Local (n = 14)	04:42 (00:43)	00:11	02:31	05:44
	Visiting (n = 191)	04:49 (00:39)	00:02	02:26	06:07
	High (n = 72)	04:46 (00:38)	00:04	02:31	06:07
	Medium (n = 69)	04:49 (00:36)	00:04	02:30	05.53
	Low (n = 64)	04:51 (00:42)	00:05	02:26	05:48
	Total (n = 205)	04:49 (00.39)	00:02	02:26	06:07
2	Local (n = 14)	04:59 (00:36)	00:09	03:10	05:45
	Visiting (n = 191)	04:58 (00:29)	00:02	03:01	05:55
	High (n = 72)	04:53 (00:29)	00:03	03.01	05:29
	Medium (n = 69)	05:00 (00:28)	00:03	03:01	05:40
	Low (n = 64)	05:02 (00:31)	00:03	03:08	05:55
	Total (n = 205)	04:58 (00:29)	00:02	03:01	05:55
3	Local (n = 14)	05:11 (00:07)	00:28	04:12	06:13
	Visiting (n = 191)	05:17 (00:25)	00:01	04:11	06:18
	High (n = 72)	05:13 (00:25)	00.03	04:11	06:17
	Medium (n = 69)	05:16 (00:25)	00:03	04:17	06:18
	Low (n = 64)	05:20 (00:24)	00:03	04:24	06:13
	Total (n = 205)	05:16 (00:25)	00:01	04:11	06:18
4	Local (n = 14)	05:25 (00:19)	01:11	04:49	09:27
	Visiting (n = 191)	05:16 (01:02)	00:04	04:24	09:56
	High (n = 72)	05:13 (01.04)	00:07	04.37	09:36
	Medium (n = 69)	05:14 (00.55)	00:06	04:35	09:35
	Low (n = 64)	05: 24 (01:07)	00:08	04:24	09:56
	Total (n = 205)	05:17 (01.02)	00:04	04:24	09:56
Total time	Local (n = 14)	20:19 (00:40)	00:10	19:20	21:51
	Visiting (n = 191)	20:23 (01:02)	00:04	19:06	22:30
	High (n = 72)	20:08 (00:38)	00:04	19:15	22:16
	Medium (n = 69)	20:23 (00:37)	00:04	19:06	22:30
	Low (n = 64)	20:39 (00:34)	00:04	19:32	22:02
	Total (n = 205)	20:22 (00:38)	00:02	19:06	22:30

Note: *M*: Mean; *SD*: Standard deviation.

Table 4. Average rhythms for each length, depending on the street in which the boat competes

Lenght	Street	*M (SD)*	Standard error	Mínimum	Maximum
1	1 (n = 60)	0:04:51 (00:38)	0:00:04	0:02:27	0:05:50
	2 (n = 49)	0:04:49 (00:36)	0:00:05	0:02:26	0:05:53
	3 (n = 47)	0:04:47 (00:42)	0:00:06	0:02:28	0:05:53
	4 (n = 49)	0:04:48 (00:40)	0:00:05	0:02:31	0:06:07
	Total (n = 205)	0:04:49 (00:39)	0:00:02	0:02:26	0:06:07
2	1 (n = 60)	0:04:55 (00:28)	0:00:03	0:03:08	0:05:48
	2 (n = 49)	0:05:00 (00.26)	0:00:03	0:03:10	0:05:45
	3 (n = 47)	0:04:58 (00:32)	0:00:04	0:03:04	0:05:46
	4 (n = 49)	0:04:59 (00:33)	0:00:04	0:03:01	0:05:55
	Total (n = 205)	0:04:58 (00:29)	0:00:02	0:03:01	0:05:55
3	1 (n = 60)	0:05:17 (00:24)	0:00:03	0:04:11	0:06:13
	2 (n = 49)	0:05:17 (00:25)	0:00:03	0:04:12	0:06:15
	3 (n = 47)	0:05:15 (00:26)	0:00:03	0:04:17	0:06:18
	4 (n = 49)	0:05:16 (00:26)	0:00:03	0:04:15	0:06:17
	Total (n = 205)	0:05:16 (00:25)	0:00:01	0:04:11	0:06:18
4	1 (n = 60)	0:05:14 (01:04)	0:00:08	0:04:35	0:09:56
	2 (n = 49)	0:05:14 (00:54)	0:00:07	0:04:41	0:09:30
	3 (n = 47)	0:05:19 (01:08)	0:00:09	0:04:24	0:09:32
	4 (n = 49)	0:05:21(01:04)	0:00:09	0:04:43	0:09:28
	Total (n = 205)	0:05:17 (01.04)	0:00:04	0:04:24	0:09:56
Total time	1 (n = 60)	0:20:19 (00:36)	0:00:04	0:19:23	0:22:02
	2 (n = 49)	0:20:22 (00:37)	0:00:05	0:19:20	0:21:41
	3 (n = 47)	0:20:21 (00:38)	0:00:05	0:19:15	0:21:47
	4 (n = 49)	0:20:28 (00:43)	0:00:06	0:19:06	0:22:30
	Total (n = 205)	0:20:22 (00:38)	0:00:02	0:19:06	0:22:30

Note: ***M***: Mean; *SD*: Standard deviation.

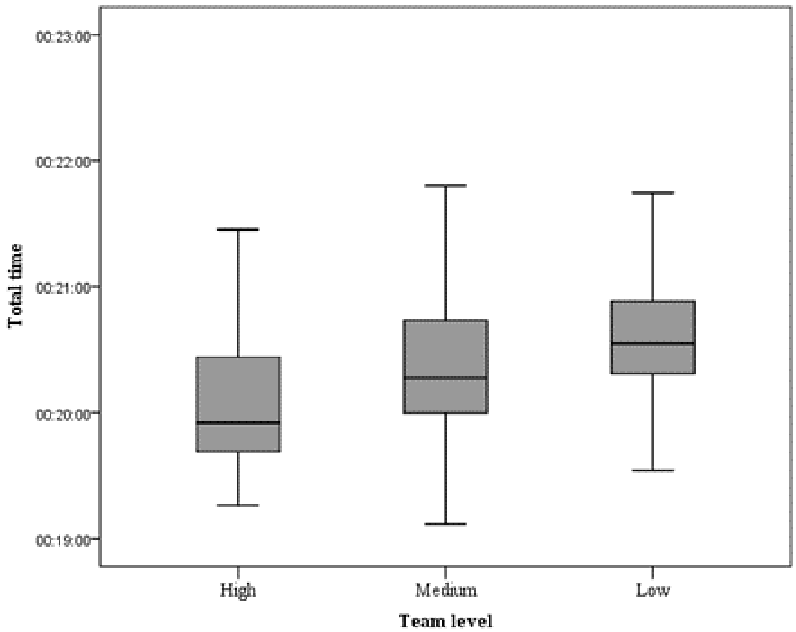

Figure 1. Relationship between the final time and the team level

The correlations between the study variables and the result of the race are shown in Table 5. There is a significant relationship (p < .01) between the final classification, the level of the team, the times in each race, and the final race time influence the result of the race. It is observed that there is a medium-high correlation between the final classification of the season and the level of the team with respect to the result of the race. It is also observed that there is a medium-high correlation between the final classification of the season, the level of the team and the result of the race. A correlation is established between the times of each race and the final time of the race, as regards the result of the race. There is a high correlation between the time obtained in L1 and the time obtained in L3. An average-high correlation is obtained between the time obtained in L1 and the time obtained in L3, with respect to the final time of the race. The results showed no correlation between the age of the rowers, the situation of the race, or the street in which each boat participated with respect to the result of the race.

Table 6 shows the confidence intervals at 95% of the rhythms in each length and the final race time of each group (high level: position 1st to 4th; middle level: position 5th to 8th; and low level: position 9th to 12th). According to ANOVA's results for only one factor, the final time of the race showed significant differences between the levels of the teams according to the final ranking of the season (F = 12.117, p = .000).

Table 5. Correlative analysis by Tau-c statistic Kendall and Spearman of study variables

	Regatta result	Final ranking	Team level	Age	Situation	Street	L1	L2	L3	L4	Total time
Regatta result	1	.550**	.632**	-.080	.021	.100					
Final ranking		1	.999**	-.173**	-.004	.040					
Team level			1	-.222**	-.007	.045					
Age				1	-.024	.067					
Situation					1	-.040					
Street						1					
L1							1	-.304**	.979**	-.568**	.704**
L2								1	-.294**	.624**	.274**
L3									1	-.565**	.711**
L4										1	.373
Total time											1

Note: L: Lenght; ***p* < .01; **p* < .05.

Table 6. ANOVA analysis of a factor with Scheffe's post-hoc test depending on the final ranking of the season

	CI 95% of difference					
	High level (1st to 4th) A	**Medium level (5th to 8th) B**	**Low level (9th to 12th) C**	**F**	***p***	**Mean difference**
L1	(04:37; 04:56)	(04:40; 04:58)	(04:41; 05:02)	0.272	.762	n.s.
L2	(04:46; 05:00)	(04:53; 05:07)	(04:54; 05:10)	1.681	.189	n.s.
L3	(05:07; 05:20)	(05:10; 05:22)	(05:14; 05:26)	1.082	.337	n.s.
L4	(04:57; 05:28)	(05:01; 05:28)	(05:07; 05:41)	0.649	.524	n.s.
Total time	(19:59; 20:17)	(20:13; 20:32)	(20:30; 20:47)	12.117	.000*	A<B,C; B<C

Note: L: Lenght; *CI*: 95% Confidence Interval; *$p < .05$; n.s.: not significant.

Discussion

The result in a traineras competition can be influenced by the time spent on each of the lengths, but it is not shown in what exact percentage they influence each of the races. There are other types of situational variables, be it the racecourse or the number of streets the crew participates in, which can be reflected in the position of each race and in the final ranking of the season.

Keep in mind that the environment can influence the performance of the rowers, and the racecourse is conditioned depending on the place and its situation. Normally, each race takes place in the place of origin of each club; therefore, on each day, one or more teams can act as locals. This factor can influence the performance of the team, when competing in the same race field where he usually trains. Despite knowing the distance to travel, the racecourses have varied markedly over time, with improvements in their measurements. For example, in the most important regatta of the traineras calendar, the Bandera de La Concha, Works Section of the San Sebastián City Council modified the regatta course in 1945 and affirmed that until then, the crews that had competed for mark number 4 had to travel 83 meters more (Obregón, 2015).

Concerning the times in each length, the results of the research show that the local teams obtained shorter times in L1 and in L3. The visiting teams obtained shorter halftimes in L2 and L4. Research in mobile bench rowing, such as that developed by Smith and Hopkins (2011), states that the differences between the venue or the environmental conditions can alter by up to 3% the variability in the results of each race. Depending on the regatta, it would be necessary to increase the sample due to the difference in the collection of data from the boats that act as premises in front of the boats that act as visitors. It would also require further research in fixed-bank rowing to establish differences with respect to the conditions of competition.

As for the final ranking of the season, the high-level teams recorded lower times in all the lengths compared to the middle-level and low-level teams. Obviously, at the end of the season, the teams classified as low-level performed better than the teams classified as high-level. Other studies (Brown et al., 2010; Klusiewicz et al., 1999) state that the level of performance is higher according to the level of competition, for example, depending on their category. In our study, all the boats belong to the superior category of the league of traineras and the times have not been compared to different leagues or with inferior categories. According to the results of the study, there is a statistically significant difference in the final times of races depending on the level of the team, showing that teams of a high level managed shorter times compared to the middle and low-level teams.

The number of batches in which it competes is established according to the general ranking and may also be influenced by the variability of the environment (tides, sea depth). The street number can also be influenced by the surrounding conditions (wind, depth, and location of the racecourse). The times observed according to the street do not have a correlation with the final time of the race. The boats with the best classification always compete in the last round; however, the streets are drawn in each race; therefore, they have no relation to the previous level of performance of the team. It should be noted that normally in regattas that occur on the same weekend, on Saturday the batches are organized according to the general classification, but on Sunday the batches are composed according to the position obtained by the boat the day before.

In the study carried out by Ofoghi et al. (2011) taking time references every 500 meters in tests carried out over 2000 meters in mobile bench rowing, they showed that depending on the time of each sector the winner of the race could be predicted. The strategy would be in this case to start the competition in first position to increase possibilities of winning the competition. As in actual investigation, the times marked in the last full-length or at the end of the competition are those that were least correlated to reach victory at the end of the competition. In the study by Brown et al. (2010), 78% of the teams winning the races scored the best time in the middle of the race and all the winning teams were in the top three. However, according to this study, setting the best times on the first length increased probabilities of ending the race victoriously. The time difference between each team can be directly influenced by the time marked in the first full length and the third full length. Garland (2005), taking as a reference mobile bench rowing tests, states that all teams adopted a strategy to start at a fast pace, although the pace set depended on the technical level of the rowing. In the study by Lorenzo et al. (2014), the strength of the paddles of the rowers was analysed along a regatta, and in the last turn, the lowest values of strength of the entire competition were found. Despite this, the last album had the highest values in net force applied.

Although race strategy is not the dominant factor that determines performance in rowing (Kleshnev, 2001), a type of strategy can be established according to the times recorded in each length. There is a high correlation between the times recorded in L1 and L3. It should be noted that the orientation of these two lengths is the same for all boats. A correlation is also established between the times recorded in L1 and L3 related to the final race time. This means that the times set by the boats in both the L1 and the L3 have a greater influence and a direct relation to the final time of the race with respect to the times marked in L2 and in L4. It may be thought that the time obtained in the last length would be decisive in the final result, but it seems that the teams with the greatest capacity to make a good time in the third full-length are finally the ones that have the best results. This aspect could help to create a race strategy to achieve greater differences during the race.

Regarding the age of the rowers, 38.1% of the total sample analysed were in a range between 25 and 31 years, establishing a mean of 28.44 ± 1.61. The next age range with the highest percentage (30%) was established between 31 and 38 years (34.76 ± 2.14), like the study by Penichet-Tomas et al. (2021), where a mean age of 27.35 ± 4.32 was fixed for experienced fixed-bank rowers. Other studies analysing mobile bench rowers established similar averages of 25.1 ± 4.5 (Greene et al., 2009) and 27.1 ± 4.1 (Kerr et al., 2007). In the study by Podstawski et al. (2022) they indicated that there were significant differences in rowers between the ages of 15 and 22. However, in our study, when comparing the relationship between age and the result of each race, no correlation was established between age and sports performance.

Conclusions and practical applications

The performance of rowing equipment depends not only on its physical and physiological characteristics. According to the results of this research, there are other variables at a temporal or situational level that determine performance and may be influenced when setting strategic and tactical objectives in each race. Aspects such as the final classification of the season and the level of the team are determined by the result in each of the races in which each boat participates.

The time in each of the races has a direct correlation with the result of the race. The times obtained in length 1 and length 3 have a greater influence on the result of the race, giving rise to a high correlation between the time obtained in length 1 and the time obtained in length 3. There is a direct relationship between the time marked in these two lengths and the result of each boat. Knowledge of this aspect can help the coach to advance a strategy to achieve victory.

According to the data obtained, the analysis of situational variables such as the racecourse or the street where each boat competes does not allow establishing differences. However, further studies should be needed where specific racecourses can be analysed to identify statistically significant differences.

The analysis of the variable situations or temporary ones in fixed bank rowing will serve to increase knowledge and achieve greater visibility and dissemination of this sport among institutions and entities. Determining which variables influence the final time of a race can help improve the performance of rowing equipment. Aspects such as the racecourse, the location, the number of the race, the street number in which the race is held, or the tactical plan chosen can influence the result. The knowledge generated through this research should be useful for its implementation within the fixed bench rowing competition.

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