

Sport classification for athletes with visual impairment and its relation with swimming performance

Classificação esportiva para atletas com deficiência visual e sua relação com o desempenho na natação

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Abstract – The medical classification (MC) adopted for swimmers with vision visual impairment (VI) does not clearly elucidate the influence of vision loss on performance. In a documentary research, the final time in the 50-, 100- and 400-m freestyle events and MC (S11, S12 and S13) of national ($n = 40$) and international ($n = 72$) elite swimmers was analyzed. The analysis was performed using the Kruskal-Wallis test and Spearman's correlation with 95% confidence ($P < 0.05$) and Cohen's d was calculated. There was a large effect of MC on the final time in the 50-m ($P = 0.034$, $d = 1.55$) for national athletes and in the 50-m ($P = 0.001$, $d = 2.64$), 100-m ($P = 0.001$, $d = 3.01$) and 400-m ($P = 0.001$, $d = 2.88$) for international athletes. S12 and S13 classes were faster compared to S11 class for all international events, but only in the 50-m for the national event ($P < 0.05$). It was found a strong negative relationship between the final time and MC for international athletes (Spearman's $Rho \geq 0.78$). There was a significant influence of MC on the performance of swimmers in freestyle races, especially in international swimmers. Thus, having a visual residue seems to be sufficient for S12 and S13 swimmers to achieve similar performance.

Key words: Athletic performance; Blindness; Low vision; Sports for persons with disabilities.

Resumo – A classificação médica (CM) adotada aos nadadores com deficiência visual (DV) não consegue elucidar claramente a influência da perda da visão no desempenho. Em uma pesquisa documental, analisou-se o tempo final de prova dos 50, 100 e 400m livre e a CM (S11, S12 e S13) de nadadores nacionais ($n = 40$) e internacionais ($n = 72$) de elite. Utilizou-se o teste de Kruskal-Wallis e a correlação de Spearman, com 95% de confiança ($P < 0,05$) e o tamanho do efeito d de Cohen foi calculado. Verificou-se um grande efeito da CM no tempo final de prova dos 50m ($P = 0,034$; $d = 1,55$) para atletas nacionais e dos 50m ($P = 0,001$; $d = 2,64$), 100m ($P = 0,001$; $d = 3,01$) e 400m ($P = 0,001$; $d = 2,88$) para atletas internacionais. As classes S12 e S13 foram mais rápidas comparadas à classe S11 em todas as provas internacionais, mas apenas nos 50m nas provas nacionais ($P < 0,05$). Foram encontrados fortes relacionamentos negativos entre o tempo final de prova e a CM para os atletas internacionais (Rho de Spearman $\geq 0,78$). Houve uma significativa influência da CM no desempenho de nadadores nas provas do nado livre, especialmente em nadadores internacionais. Assim, ter um resíduo visual parece ser o suficiente para que os nadadores com baixa visão, nas classes S12 e S13, adquiram performance semelhante.

Palavras-chave: Baixa visão; Cegueira; Desempenho atlético; Esportes para pessoas com deficiência.

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INTRODUCTION

Classification in sports reduces the likelihood that the results in competitions are biased¹, being essential in sporting events, especially in Paralympics. As in other modalities, swimmers with visual impairment (VI) have the classification model based on disability, also known as medical classification (MC)^{2,3}. However, the International Paralympic Committee (IPC) is reviewing this classification system for the evaluation of swimming functionality based on VI⁴. Thus, investigations in the current system may support this reformulation.

To date, three classes divide athletes with VI (B1, B2 and B3), with visual acuity less than or equal to the logarithm of the minimum resolution angle (LogMAR) 1.0 or restricted visual field less than 40 degrees, with different nomenclatures in each modality⁵. For swimming, these classes are replaced by prefix “S” for freestyle, backstroke and butterfly events, “SB” for breaststroke and “SM” for medley events, plus the numbers 11, 12 and 13 for the impairment degree. Number 11 is poorer visual acuity than LogMar 2.6, 12 with visual acuity ranging from LogMar 1.5 to 2.6 and / or visual field less than 10 degrees and 13 with visual acuity from LogMar 1.4 to 1 and / or visual field less than 40 degrees⁵.

Therefore, in a fair competition, the influence of VI should be similar at all competitive levels. Thus, it is expected that swimmers in the upper classes will outperform those in the lower classes and that similar results will be shown in the same class. However, the formulation of the non-evidence-based classification system consists of one of the reasons for revisions in the criteria adopted¹, as well as the pressure caused by the commercialization process of the Paralympic sport, with reduction in the number of events and, consequently, in the number of classes, to attract greater media attention, spectators, and sponsors⁶.

Regardless of possible changes in the classification system for VI by the IPC, investigations in this area are necessary to expand discussions on positive aspects and possible intervening variables in order to contribute to a more effective system. Recent studies with Paralympic coaches, athletes, classifiers and administrators have pointed out that they agreed that additional tests are needed to better control the impact of disability on sport performance, as well as the acuity and visual field tests used in MC⁷. Considering that freestyle event has greater participation of athletes in competitions at different distances, it is relevant to observe the classification applied to swimmers with VI in different events and competitions.

Few studies have analyzed the relationship between vision loss and performance at major international swimming events⁸⁻¹¹. Souto, Oliveira and Santos Filho⁸ verified that the MC system was related to the final time of national and international athletes in the 50-m freestyle event. Similarly, Malone et al.¹⁰ verified that stroke parameters during swimming were affected by VI at 50- and 100-m freestyle event at the 1996 Atlanta Paralympic Games. On the other hand, Daly et al.⁹ reported

that the degree of VI seems not to be the main distinguishing factor of the performance of Paralympic athletes in the 100-m freestyle event at the 2000 Sydney Paralympic Games, and Makris et al.¹¹ found that MC was a significant determinant only for the breaststroke event in the 2009 European Championship.

In this sense, there seems to be no consensus that differences in acuity and visual field established in the classes are proportional in sport. In addition, the literature does not present information on the final time in all national and / or international freestyle events related to VI. Therefore, this study analyzed and compared the final time of national and international athletes in different classes (S11, S12, S13) in the 50-, 100- and 400-m freestyle events. It is speculated that MC, based on the deficiency, influences the performance in all events, regardless of the competitive level.

METHODOLOGICAL PROCEDURES

Study characterization

This is a documentary research by secondary sources¹². Since the information is public domain, there was no need for use the informed consent form.

Procedures

Two independent researchers accessed the websites of the Brazilian Paralympic Committee¹³ and the International Paralympic Committee¹⁴ in order to collect the final time of athletes (in seconds) in the 50-, 100- and 400-m freestyle events of the 3rd National Stage of the “Circuito Loterias da Caixa Brasil de Atletismo, Natação e Halterofilismo”, held in Fortaleza / CE in December 2013, as well as data from the Paralympic Games in London, in August 2012. The selection of these events occurred because they brought together the best athletes in their respective years of accomplishment. In turn, events were chosen because they are the fastest and with the largest number of swimmers.

Data from all male finalists of S11, S12 and S13 classes were included in the 50-, 100- and 400-m freestyle events. Results from finalists who, for some reason, were disqualified or did not complete the race were excluded. Thus, the performance of 40 national and 72 international athletes was analyzed. Table 1 summarizes the number of participants per race and competitive level.

Data analysis

Data were reported by median and interquartile range, since they did not present normal distribution (Shapiro-Wilk test, $P < 0.05$). Comparisons among classes were performed using the Kruskal-Wallis test and, in cases where there was significant difference, paired comparisons were verified using the Dunn post hoc test. Cohen effect size (d) was calculated for differences among classes, using the Psychometrica software¹⁵, with $d = 0.2-0.4$, $d = 0.5-0.7$ and ≥ 0.8 being considered as small, medium and large, respectively¹⁶. Differences among competitive levels in each event

were verified by the Mann-Whitney U test. In addition, the relationship between classes (S11, S12 and S13) and the final time were verified by the Spearman correlation (*Rho*). All analyses were performed with 95% confidence ($P < 0.05$).

Table 1. Absolute frequency of participants per event, class based on visual impairment and competitive level.

Event	Class	National level	International level	Total
50-m freestyle	S11	8	8	16
	S12	5	8	13
	S13	5	8	13
	Total	18	24	42
100-m freestyle	S11	5	8	13
	S12	2	8	10
	S13	4	8	12
	Total	11	24	35
400-m freestyle	S11	4	8	12
	S12	4	8	12
	S13	3	8	11
	Total	11	24	35

RESULTS

The final time according to the competitive level, test and classification based on VI is reported in Table 2. International athletes presented better performance in all events and classes compared to national athletes ($P < 0.05$). A large effect of MC was observed in the final time in the national 50-m event ($\chi^2_{(2)} = 6.76$, $P = 0.034$, $d = 1.55$). National swimmers' time in the 50-m event was shorter only in the S13 class compared to S11 ($P = 0.001$). National swimmers' performance in the 400-m event was similar among classes ($\chi^2_{(2)} = 0.053$, $P = 0.974$). The 100-m national event was not analyzed due to the small number of athletes ($n = 2$). In addition, a great variability was observed in the national results within classes.

On the other hand, a significant effect of MC on performance for all international events analyzed was observed: 50-m ($\chi^2_{(2)} = 15.26$, $P = 0.001$, $d = 2.64$), 100-m ($\chi^2_{(2)} = 16.64$, $P = 0.001$, $d = 3.01$) and 400-m ($\chi^2_{(2)} = 15.26$, $P = 0.001$, $d = 2.88$). Thus, time was shorter for S13 ($P = 0.001$) and S12 ($P = 0.014$) compared to S11 for 50-m. In the 100-m event, the final time was shorter for S13 ($P = 0.001$) and S12 ($P = 0.014$) compared to S11. The same result was found in the 400-m event, with shorter time for S13 ($P = 0.001$) and S12 ($P = 0.027$) compared to S11. The performance of S12 and S13 classes was similar in all tests and competitive levels ($P > 0.05$).

In addition, moderate and weak negative correlations were found between MC and the final time of national swimmers, respectively for the 50- and 100-m freestyle events. On the other hand, strong negative relationships were observed in all international events, indicating that the lower the class, the longer the final time and vice versa (Table 3).

Table 2. Final time of national and international swimmers in the 50-, 100- and 400-m freestyle events of S11, S12 and S13 classes.

Competitive level	Event	Class		
		S11	S12	S13
National	50-m	31.7 (2.0)	30.2 (3.4)	29.9 (4.3)*
	100-m	71.1 (8.5)	67.8 (-)**	65.7 (12.4)
	400-m	340.1 (26.0)	342.3 (42.2)	349.1 (6.3)
International	50-m	26.6 (1.4)†	24.8 (1.4)*†	24.2 (0.6)*†
	100-m	61.0 (3.5)†	55.0 (3.1)*†	53.6 (0.7)*†
	400-m	291.2 (20.1)†	262.7 (18.1)*†	253.4 (12.7)*†

Values reported by median and interquartile range. * Significant difference for S11 at the same competitive level ($P < 0.05$). † Significant difference among competitive levels for the same event and MC ($P < 0.05$). ** S12 in the 100-m at national level shows no dispersion or was compared because it has only two athletes.

Table 3. Relationship between medical classification (S11, S12 and S13) and final time of national and international swimmers in the 50-, 100- and 400-m freestyle events.

Event	National level	International level
50-m	-0.610 [-0.838; -0.201]*	-0.781 [-0.900; -0.552]*
100-m	-0.446 [-0.825; 0.210]*	-0.826 [-0.922; -0.634]*
400-m	0.072 [-0.551; 0.644]	-0.826 [-0.922; -0.634]*

Spearman's Rho coefficient data with 95% confidence interval. * Significant correlation ($P < 0.05$).

DISCUSSION

This study analyzed and compared the final time of national and international athletes of different classes (S11, S12, S13) in the 50-, 100- and 400-m freestyle events. The main finding is that the greater the degree of VI, the longer the final time of international swimmers in the 50-, 100- and 400-m freestyle events; however, this phenomenon is only observed in national athletes in the 50-m freestyle event. Nevertheless, it was not possible to clearly observe differences in S12 and S13 classes, regardless of competitive level, suggesting the integration of these classes from the final time in events analyzed, especially at international level. Thus, our hypothesis was partially confirmed.

During the 1996 Paralympic Games, one of the reasons attributed to the similarity in 57% of adjacent classes among international disabled swimmers was the reduced number of participants in some classes, leading them directly to the finals¹⁷. It is likely that the limited relationship among classes and the final time of national disabled swimmers is also related to the reduced number of competitors that may have influenced the athlete's commitment to win the race, since only in the 50-m event in S11 class, there were the same number of international swimmers. In this situation, it is not necessary for the athlete to participate in qualifying stages, contributing to a lower average speed than predicted, saving energy for preferential events.

In addition, intraclass variability found at national level may be related to the level of sports maturity and access to more appropriate training programs¹⁰. A previous study demonstrated that the most consistent predictor

of performance in freestyle and breaststroke events was the number of hours of training per week, with no distinction among classes and results in the 100-, 200- and 400-m freestyle events¹¹. In our investigation, we did not have access to information about training. However, in view of the evolution of Paralympic sports in the country, it was expected that these athletes had high level of training, because it is the last event of the year and with the best athletes of Brazil.

It is speculated that the current classification system presents relative difficulty in differentiating performance in swimming^{7,8}. Lack of vision seems to actually impact performance, which is not so evident in low vision swimmers, suggesting that seeing a little seems to be enough for better performance¹⁸. As observed in our study in the final times in freestyle events, both in the 2000 Sydney Paralympic Games⁹ and in 1996 Atlanta Paralympic Games¹⁰, class S11 swimmers were slower, and those in S12 and S13 classes were not distinguishable. Therefore, in addition to the cohesion in the intraclass performance verified for international athletes, these results suggest the integration of these two classes, among low vision swimmers during the Paralympic Games.

The visual residue of classes S12 and S13 seems to be sufficient for swimmers to use visual cues such as the bottom lines of the pool to accurately define their position and orientation⁹, contributing to the performance similarity. However, it is not enough to compete with non-disabled athletes. Taylor et al.¹⁹ observed different high-performance events between 2006 and 2012 in the 400-m freestyle, comparing S13 class swimmers with non-disabled athletes. These authors found that athletes in this class were slower, but as fast as athletes with minimal physical disability (S10), recommending that despite the difference in type of disability, these classes could compete together.

The possible implications for the results found may also be linked to the evaluation method applied to class identification. Experts consider that the assessment of visual acuity and visual field is not enough to define the athlete's class, being of greater consensus the insertion of tests of contrast sensitivity, visual dynamics and light sensitivity⁷. In addition, current tests are performed in a room, without water interference and in different lighting conditions than in swimming pools, which may influence the assessment of light sensitivity and underwater vision.

Nevertheless, the differentiation of S11 with S12 and S13 classes seems to be linked to the compulsory use of opaque glasses for S11 class during competition⁷, which does not allow the use of visual residue. S11 class athletes collide more frequently in the swimming lane and swing the direction, increasing their final time. In addition, the total loss of vision implies difficulties with feedback for the construction of a more accurate technique¹⁰, naturally hindering performance. Acquisition time and type of blindness (congenital or acquired) are also not taken into account in the current classification system, which may reduce the evaluation sensitivity, since individuals with later onset of blindness and greater visual acuity

have better performance²⁰.

It is noteworthy that the swimming turning is an important factor in the final result. Martens, Einarsson and Daly found a 1.73 second difference between S11 and S12-S13 classes in the turning of a 100-m freestyle event¹⁸. From these ideas, considering that an athlete performs seven turns in the 400-m, our results corroborate the superiority of athletes with less visual impairment (S12 and S13) compared to those of class S11, as occurred in the 50-m test at national and in all events at international level. However, in our study, it is possible that the variability of results (interquartile range) and the restricted number of participants have reduced the statistical power of analyses in the national event, and it was not possible to detect these differences in the 400-m event.

Other limitations of this study are the absence of information about the disability, such as diagnosis and time of acquisition, and aspects related to training, such as time involved with competitive sports, training format and athlete's preferential event. This information could be analyzed together with information on the final time to observe possible interferences of these variables. Further studies could include different swimming styles and events as well as females.

CONCLUSION

There was a significant influence of MC on the performance of swimmers in freestyle events, especially in international swimmers. Thus, having a visual residue seems to be sufficient for S12 and S13 swimmers to achieve similar performance. However, it is emphasized that any union or creation of a new class for athletes with VI eligible in the Paralympic sport must follow the path of research based on scientific evidence (e.g., studies related to functional aspects, learning, competition rules, interviews with coaches and athletes). In addition to performance data, further investigations should be carried out taking into account the evaluation from different aspects of function and visual functionality, among others.

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