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Original Article

Effect of training with fins on swimming performance in kids and young recreational swimmers

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Abstract:
(1) Background: Swimming is a common choice to start practicing sports. Besides, swimming can be considered an early specialization sport. Thus, it is important finding adequate methodologies to improve the teaching-learning process of the technical parameters of the swimming styles. It is unknown if the use of fins can affect the athlete's improvements at long-term, despite being a common resource in swimming schools due to its immediate effect on swimming speed; (2) Methods: 37 kids and young recreational swimmers participated in this study. 20 kids swimmers (KS) were between 7 and 9 years old and 17 young swimmers (YS), between 12 and 14 years old. At the same time, both groups were split into two subgroups – one that used fins to train (KSF and YSF) and another one that did not used fins (KSNF and YSNF). The study lasted 8 weeks, with two 1-hour weekly sessions. Weeks 1 and 8 were dedicated to the pre-test and post-test, respectively, where the time of swimming different distances freestyle, backstroke and butterfly was kept. The information was classified based on the groups and a statistical analysis was performed; (3) Results: all groups improved their performance after the intervention. However, no significant differences were found between groups except in KSF and KNSF, where KSF had a greater improvement in the backstroke test (p(ES)= 0.005(0.78)); (4) Conclusions: a 6-week training program improves performance in KS and YS. The continued use of fins does not seem to affect the performance improvement in these age groups, except in backstroke, where it helps improve significantly in KFS. These results can help the coaches of swimming schools to create more homogeneous groups in speed and to organize more easily the training session unifying swimming paces with the use of fins by slower children without the risk of affecting their improvement.
Key Words*:* **- Aquatic skills; performance; learning, propulsion**.

Introduction

Swimming is a common choice in developed countries for children and teenagers to start practicing sports. The benefits obtained from sports practice if it started at that age are numerous from the psychological and social point of view (Eime et al., 2013). There is also evidence that swimming positively affects cardiorespiratory health and body composition in multiple types of population (Lahart & Metsios, 2018). Competitive swimming can be considered an early specialization sport, because, in 2016, the average age of world-class swimmers was 22.7 ± 3.6 and 23.2 ± 3.3 years for females and males respectively (Mallett et al., 2021). In addition, the peak performance window is 2.6 ± 1.5 years for both genders. (Allen et al., 2014). Therefore, the teaching-learning process of basic swimming techniques, as well as their styles must have a properly planned and evaluated process (Morales, 2015).

For that reason, the first years of training in this discipline take a great importance. However, there is not a single methodology in the teaching-learning process of swimming, with different criteria and techniques among coaches. In this process it is essential to consider the following aspects: characteristics of the students or swimmers, biomechanical aspects of the swimming technique, goals that are intended to be achieved after the training process, as well as the didactic approaches or methods used to learn the swimming technique and its styles (Huaycha & Prado, 2017). In the first phases of teaching-learning swimming, the familiarization process and the learning of basic aquatic skills such as floating, breathing, propulsion, balance and manipulation of objects, normally take place. Once these basic aquatic skills have been acquired, the next step would be the teaching-learning of the four swimming styles. To achieve this goal, learning and improving the technique of the four swimming styles is necessary. (Barbosa & Queirós, 2004).

Among teenagers (between 13 and 19 years old) and young adults (between 20 and 34 years), the greatest source of motivation comes from interpersonal factors such as competition affiliation to a group and social recognition (Quindry et al., 2011). So, create homogeneous groups and generate environments that promote self-recognition must be mandatory if we want to ensure that they achieve the best possible performance and continue in the sport.
Training with fins can be a good solution to this problem, since the improvement in swimming speed and efficiency caused by this material would improve the subject's achievement perspective. In addition, it would also introduce an

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external agent within the training session that would change its dynamic, something that has been shown to have a positive effect on perceived effort, for example, while training with music (Kwaśna et al., 2016). Many swimming coaches introduce the use of flotation implements (pull-boy) or propulsion aids (fins) to give variety to their training. Some research have affirmed that the variety of tasks favors learning and motor development (Chua et al., 2019). However, these results have not been positive in all sports modalities (Urbán Infantes et al., 2012). In swimming, it is observed how by giving a greater variety in sports practice, the adaptive mechanisms of the swimmer to the aquatic environment are favored, as well as their learning and performance. (González & Sedlacek, 2020; Guignard et al., 2017).

In addition, the use of fins is already a valued and used resource in clubs and practitioners on their own, especially to increase the efficiency of the kick, either in kick-only or full-swim exercises (Potdevin et al., 2013). Experienced swimmers using fins show a 40% reduction in energy expenditure at submaximal speeds (Zamparo et al., 2002). This could be explained by the influence they have on the body position in displacement, which is one of the most determining aspects in the final speed of the swimmer (Wei et al., 2014). This has been measured with motion simulation systems (Nakashima et al., 2019) and with experimental studies with national level swimmers (Grigoriou et al., 2019).

However, to our knowledge, there is no scientific literature that studies if training with this material influences the performance in the long term while swimming barefoot, that is the only way allowed in official races. Solving this question would help teams and schools to create homogeneous groups without affect in the improvement of the athlete, in addition to create new methodological lines where the use of fins demonstrates benefits in the economy and speed of movement. Therefore, the present experimental study will investigate the effects of the use of fins during a training period of 6 weeks in kids and young recreational swimmers.

The hypothesis that is handled at the beginning of the study is that the use of this material will cause greater improvements in performance due to the acquisition of better technical skills on the kick, something that will influence on the position of the body in displacement and the efficiency.

Introduction should be comprehensible to the general reader. Give a clear statement of the purpose of the paper and provide relevant context to support the basis for the paper and the significance of the work. Do not exhaustively review the literature.

Methods

Participants

Forty-five kids and young recreational swimmers were considered during the enrollment process. They were divided in two big groups according to their ages group: kids swimmers' group (KS) between 7 and 9 years old and young swimmers' group (YS) between 12 and 14 years old. Eight swimmers were excluded because they did not attendance unless 90% of swimming training sessions. All participants were informed about the potential risks and benefits of the study and signed an informed consent (parental consent has been given). The Ethics Committee of the Alicante University approved the procedures of this research (Expedient UA-2022-09-29_1). All procedures were conducted according to the Declaration of Helsinki for human studies. No economic incentives were provided.

Procedure

This study was a longitudinal research with repeated measures of swimming time in different swimming styles. The randomization of the groups was performed to equate the groups according to the age, anthropometric measurements and the performance on swimming. Every group (KS and YS) was sub-divided into a training group with fins (KSF=11 participants and YSF=9 participants) and training group without fins (KSNF=9 participants and YSNF=8 participants). The data of each group are presented in table 1.

Table 1. General data of the groups

Data	KSNF	KSF	YSNF	YSF
n	9	11	8	9
Age	8.3±0.7	8.4±0.7	13.0±0.9	13.6±0.7
Height (cm1)	130.3±6.8	130.5±6.1	162.6±7.6	163.5±7.0
Weight (Kg1)	28.6±6.1	28.5±3.0	57.0±8.2	57.2±6.0
Body Mass Index	16.7±2.4	16.7±1.0	21.8±2.0	21.2±2.0
Wingspan (cm1)	130.3±10.0	126.9±9.9	165.5±7.7	164.4±8.8

1 cm: centimeters; Kg: kilograms; KSNF: kids swimmers no fins; KSF: kids swimmers fins; YSNF: young swimmers no fins; YSF: young swimmers fins.

The duration of this study was 8 weeks. First and last week were used to performed pre and posttest. From week 2 to week 7 lasted training period, which consisted in two weekly swimming training sessions of 60 minutes each one. Consequently, a total of 12 training sessions conformed the training program. 10 minuts of the training

sessions refferts the time to start and finish the session (acces to the pool, take a shower, pick up the training material, order the material at the end of te session, etc.). The structure of the effective time training session (60 minutes) followed a classic approach dividing the training session into three parts: warm up (10 minutes), main part (40 minutes) and final recreational activity (10 minutes). Warm up consisted in 5 minutes of joint mobility and 5 minutes of different sculling exercises. Main part of the session involves several technical exercises including kick training and coordination arm-kick. In the final part of the session a recreational activity was commonly used like breathing exercises, jumps, relays races, ball thoughts, etc. All groups performed the same structure in the session, but the complexity of the exercises was higher in YS than in KS because of the maturity development and the years practicing swimming. KSF and YSF performed exercises which involves kick of backstroke, butterfly and crawl using fins, while KSNF and YSNF performed same exercises but without fins. The volume of the exercise was calculated by time and no by meters, changing the exercise every 5-10 minutes. YS covered more total distance than KS during training sessions. At the same time, YSF and KSF covered more distance than YSNF and KSNF respectively. However, the exercise time was the same for all groups. The study was developed in the middle of the season (February and March), so the swimmers were familiar with the training methodology and the structure of the training session. The fin´s model was "Sporti Essential Floating Swim Fins" (Sporti, INC, USA) a model made for children and adolescents.

Pre-test took place during 2 training sessions, with a minimum 48 hours between training sessions. After a typical warm up, swimmers covered the distances using different styles. Between the warm-up and the trial, each swimmer had at least 5-10 min of complete rest. Tests were organized considering the difficulty and the energy demand of the swimming style. Besides, KS did not perform 25-m butterfly style and 100-m crawl style due to the lack of technical and physical fitness. Breaststroke style was not performed by any group because the kick of this exercise cannot be done using fins. A break of unless five minutes was used to avoid the fatigue between the tests. All tests were performed without fins, because in competition no extra material is allowed. Once finished the six weeks of training, post-test was carried out with the same structure than pre-test. The times of the different distances and corresponding styles were collected by two coaches (JG and SS) using a Finis® chronometer (FINIS, INC., USA). The swimmers were encouraged to cover the established distance in the shortest possible time with the corresponding style. Table 2 summary the test performed by the participants.

Table 2. Summary of the different tests.

	KS1	YS1
Tests of day 1	25-meter crawl 25-meter backstroke	25- meter butterfly 25-meter backstroke 25-meter crawl
Tests of day 2	50-meter crawl	50-meter crawl 100- meter crawl

1KS: kids swimmers; YS: young swimmers.

Statistical analysis

The data was classified based on age and based on the use of fins by the swimmers. The mean and standard deviation (SD) were calculated for all parameters. Not being able to guarantee normal statistical distribution a non-parametric Wilcoxon test was performed to analyze the changes in each group after the swimming course. To compare and analyze the differences among the groups an U-test de Mann-Whitney was carried out. A p-value of less than 0.05 was considered significant. We calculated the Cliff's Delta effect size. The Cliff's Delta statistic is a non-parametric effect size measure beyond p-values interpretation. The effect size was calculated to determine the smallest worthwhile differences in the measurements. The effect size was classified as trivial (0-0.19) small (0.2-0.49), medium (0.5-0.79) and large (0.8 and greater) (Cohen, 1992) .SPSS 26.0 (IBM, U.S.A) and Excel (Microsoft Office, U.S.A.) were used to perform this analysis.

Results

We showed the results of the swimming tests based on the ages of the swimmers, and the use of the fins. The results of the tests are expressed in seconds. We did not find any differences based on sex in all the swimming time (data not shown). The data of the tests in the crawl, backstroke, and butterfly in YSNF and YSF are shown in table 3, and the data of KSNF and KSF are shown in table 4.

We did not find any difference in the initial tests between KSNF and KSF (Table 4). We did not find any differences in the initial tests of YSNF and YSF as well (Table 3). As expected, we found differences based on the ages of the swimmers. However, the last ones were not considered interesting, and they were not shown.

The swimming times in all styles after the course were lower than the initial ones. However, statistical analysis revealed that all groups reached similar swimming times in crawl, breaststroke, and butterfly before and after the swimming course.

Table 3. Overall outputs of the groups 6-9 years old (KS) before and after the swimming classes

Swimming style distance	Initial test KSNF1 (Mean±SD)	Initial test KSF1 (Mean±SD)	Final test KSNF1 (Mean±SD)	Final test KSF1 (Mean±SD)	The difference in final tests KSNF1 vs KSF1 p (ES)
a25 mt1 Crawl	33.38±5.63	36.63±8.56	32.23±5.85	34.75±8.43	0.25 (0.32)
50 mt1 Crawl	75.47±11.48	80.62±11.99	73.48±11.61	76.40±12.66	0.19(0.36)
25 mt1 Backstroke	37.04±5.35	43.34±6.34	35.82±4.94	38.23±5.78	0.005**(0.78)

1 mt: meters; ES: effect size; SD: standard deviation; the differences are referred to after the swimming course; ** Significance ≤ 0.01; YSNF: young swimmers no fins; YSF: young swimmers fins; YS: young swimmers

Table 4. Overall outputs of the groups 10-14 years old (YS) before and after the swimming course

Swimming style distance	Initial test YSNF (Mean±SD)	Initial test YSF (Mean±SD)	Final test YSNF (Mean±SD)	Final test YSF (Mean±SD)	Differences YSNF vs YSF p (ES)
25 mt Crawl	19.53±3.53	18.65±1.92	18.99±2.91	18.37±1.46	0.48(0.21)
50 mt Crawl	44.13±9.49	42.55±5.29	42.22±6.65	41.4±4.52	0.72(0.11)
100 mt Crawl	105.4±19.95	99.73±10.94	101.48±7.94	96.16±7.94	1(0.00)
25 mt Butterfly	27.04±7.01	26.07±5.7	26.65±6.2	25.08±3.43	0.39(0.29)
25 mt Backstroke	25.32±6.75	23.31±2.31	24.04±4.47	22.48±1.79	0.72(0.11)

1mt: meters; ES: effect size; SD: standard deviation; the differences are referred to after the swimming course; ** Significance ≤ 0.01; KSNF: kids swimmers no fins; KSF: kids swimmers fins

The most interesting result was that in the KS and in the backstroke style, the use of fins, during the swimming classes, led to a statistical greater swimming time to the final test compared to the initial one (p value = 0.005) with a medium effect size (ES = 0.78).

Dicussion

The main objective of the research was to analyze if the training assisted with fins in recreational swimming groups in athletes between 7 and 9 years old and 12 and 14 years old affected the improvement in performance in different speed tests at different styles. The results of the intervention show no significant differences between the groups (KSF-KSNS and YSF-YSNF) except in the 25-meter backstroke in KSF, a group who had a greater improvement than KSNF.

All groups have improved their performance in the post-test, which shows that in this type of population, 6-week training programs with 2 weekly training sessions produce improvements in swimming performance. These results are in agreement with other similar studies such as the one by (Vedernikova et al., 2019), where improvements were found at the cardiovascular and skill levels in the aquatic environment after 16 weeks, or (Moura et al., 2021) where improvements in technique and motor coordination were measured after 12 weeks. In our research, the improvements were observed after a lower total volume of training than in this intervention (12 hours Vs 32 and 24 hours respectively).

As they are recreational swimmers who do not have a high amount of previous accumulated training, an increase in performance can be observed with few training sessions. The possible technical improvements produced throughout these weeks added to the gains at the aerobic and strength levels or even changes in anthropometric parameters such as height and wingspan, typical at these ages (Lätt et al., 2009), could explain the improvements in swimming time in these categories.

The only test where significant differences were found (p(ES)= 0.005(0.78)) was between KSF and KSNF in the backstroke test. This may be because this style has greater drag than crawl so the lower body can exert greater resistance to the advance (Gonjo et al., 2020). In addition, the action of the backstroke kick have a decisive role in enabling hip movements and coordination (Gonjo et al., 2018). The backstroke kick can influence more the speed of the test than it does in the crawl style, so the technical improvements derived from the use of fins may have had a greater influence on the final performance.

It has also been shown that assistant flotation material can affect the way of moving through the aquatic environment in preadolescent subjects, increasing the predisposition of horizontal movements compared to vertical (Kjendlie & Mendritzki, 2012). It is something that again could influence more in the style of backstroke compared to front crawl for the subjects who used fins, although it is not a material that increases buoyancy, it can predispose the swimmer to move more horizontally and optimally in the water (Nakashima et al., 2019)

In addition to this, even though in many schools and swimming clubs the teaching of the backstroke is given a high prominence in the first phases of the teaching-learning process, because it is not necessary to control the breath, children in their recreational activities in the water use to swim in the front crawl style because it allows them to move faster and more efficiently. For this reason, it is possible that the improvements observed in the backstroke in the fin group may have been influenced by the fact that the children have less mastery of the backstroke technique have benefited more from the help provided by the fins. to maintain a better swimming position and more efficient leg propulsion.

Despite the fact that in general terms no greater benefits have been found in the teaching of swimming with the use of fins, there is any fact that shows that it could affect the speed of learning, so it can be a good alternative for swimming schools to introduce a tool that adds more variety to the session and that helps to balance the level of the different members of the group, making them more homogeneous in speed. Besides, it is common at swimming schools a high number of swimmers by swimming lane. In this respect, it is really important a good organization to guarantee a high active time for all swimmers. The use of fins can help the swimming coaches to organize better the swimming line matching swim paces

This study has several limitations that must be commented. Firstly, the duration of the intervention was short, being necessary future investigations that focus on the effects of material on swimming performance during longer training periods. In second place the study sample was children and young people who are in growing age. We did not control the anthropometric changes that could occur during the study, so some improvements can be attributed to the physical development of age and not so much to the training program. Future lines of research could extend the idea of the present study by introducing subjects from other ranges of age and with a higher level of performance, as well as focus not only the swimming time but also biomechanical parameters such as frequency and length of stroke or even motivational predisposition. In this way, greater conclusions could be drawn on whether the use of alternative materials in swimming (paddles, fins, pull-boy, etc.) during training favors improvement.

Conclusions

The main conclusion from this study is that a program of 12 swimming training sessions in children and young people is enough to significantly improve their swimming time in different styles. The use of fins or not during these sessions does not seem to affect the improvements since both YSF and YSNF have improve in backstroke, crawl and butterfly without differences between groups. KSNF and KSF also did not differ in front crawl style. Only in the backstroke, the KSF group had an improvement in performance significantly greater than KSNF. This research could be useful for the swimming coaches to organize their training groups equating the paces of the swimmers thanks to the use of fins. Besides, the use of this implement does not negatively affect the teaching-learning process of the different swimming styles (except breaststroke).

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