INFLUENCE OF AGE AND HAND GRIP STRENGTH ON FREESTYLE PERFORMANCES IN MASTER SWIMMERS

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The aim of our work was to examine whether age and hand grip strength are correlated with 50m, 100m, 200m, 400m, 800m swimming performance times in Master swimmers and how correlation varies considering short, middle or long distances. The main finding of this work was that hand grip strength and age correlated significantly at each distance. Hand grip strength showed a relevant influence on performance time and explained 52% of variance of performance time in 50m race freestyle and only 15% in 800m race. Increasing age was a disadvantageous factor for performance time, and explained 45% of variance of performance time in 800m race freestyle and only 20% in 50 m race.

KEY WORDS: swimming time, aging, swimming distances

INTRODUCTION: The correlation of hand grip strength with time of performance in swimmers has already been studied in previous works on sprint races (Geladas et al. 2004) but little is known on adult swimmers performances. In this respect, a population of special interest are Master swimmers athletes who, having trained for a long period and showing a good stability of the anthropometric parameters, are an ideal model for studying main factors to describe the time of performance. The aim of our work was to examine whether age and hand grip strength are correlated with 50m, 100m, 200m, 400m, 800m swimming performance times in Master swimmers and how the correlation varies considering short, middle or long distances.

METHODS: The study was carried out with 261 Master swimmers, aged 40-80, taking part of middle technical level, competitors for the 50m (n=60), 100m (n=62), 200m (n=45), 400m (n=49) and 800m (n=45) freestyle races. A field laboratory was organized beside the swimming pool where anthropometric characteristics and hand grip strength were measured before the competitions. All participants were healthy and had no symptoms or signs of relevant pathologies affecting the neuromuscular system or the cardio-respiratory system.
Written informed consent was obtained from all the subjects and an ethical approval was received from the Urbino University ethics committee.

Procedures: *Performance Time.* The swimming time expressed in seconds was adopted as a measure of the performance in the five freestyle race distances 50m, 100m , 200m, 400m and 800m. Time data were kept with the Automatic Officiating Equipment with S.E.L. (Sony Electronics) touch pads, belonging to Italian Timekeeping Federation (F.I.CR.) and processed with Software "Nuotoplus". *Anthropometric measures.* Every subject was submitted to the following anthropometric measurements: stature, weight, arm and forearm length. Standing stature (cm) was measured with precision of 0.1 cm with a stadiometer. Weight (kg) was recorded with a scale to the nearest 100g. The BMI (Body Mass Index) was conventionally calculated as height/weight^2 (kg/m^2). *Hand grip strength.* The hand grip strength (hgm) was measured using a Jamar Dynamometer (Asimov Engineering Co., Los Angeles, USA) which was calibrated at the start of each daily measurement session. The reliability of this device has been previously reported (American Society of Hand Therapists, 1992: Mathiowetz et al. 1984) as 0.95 (ICC). Each subject maintained the right hand in line with the forearm and the arm hanging down. Maximum grip strength was then determined in two consecutive attempts separated by at least 1 min resting interval. The subjects were instructed to produce a maximal effort and to maintain it for at least 3-4 seconds before relaxing. During the test also a strong verbal encouragement was provided. The mean value of two repeated measurements for the dominant hand was reported and ICC between repeated measures were calculated.

Data Analysis: The subjects were grouped for the races of competition (50m, 100m, 200m, 400m, and 800m freestyle). Normal distribution of variables was checked and ANOVA (analysis of variance) was used to verify the homogeneity of all variables (age, stature, weight, BMI and hand grip strength) between the groups. Then, Pearson's correlations (zero order) and partial correlations with relative level of significance were calculated between time of performance and age and time of performance and hgm. To see if our sample shows a strength decline with age, zero order correlation was performed between hgm and age.

RESULTS: Age, hand grip strength and times of performance are presented in table 1. Anthropometric characteristics and hand grip strength were not significantly different between the groups (p>0.05) indicating the homogeneity of the groups. As expected, times of performance presented significant differences between the race groups. Hgm and age had very poor correlation (figure 1). At each distance, age and hand grip strength were significantly correlated with time of performance in both zero order and partial correlations (table 2 and table 3). Hgm presented a very high inverse correlation with time of performance in short races (r=-0.719, p=0.000 in 50 m race), decreasing in long races (r=-0.392, p=0.008 in 800m race); age presented a very high positive correlation with time of performance in long race (r=0.675, p=0.000 in 800 m race), decreasing in short races (r=0.443, p=0.000 in 50 m race). Partial correlation results were very similar to zero order correlation (table 3). Time vs. hgm (figure 2a) and time vs. age (figure 2b) scatter-dot graphics at each distance are plotted below.

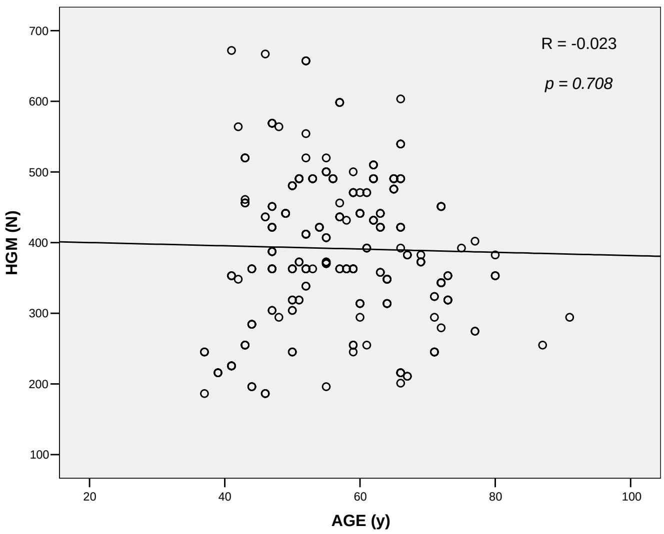

Fig. 1: Hand grip strength vs. age scatter dot plot.

Table 1. Age, hand grip strength and times of performances of the subjects at each distance. Mean values and SD of the subjects' characteristics for each race group and ANOVA analysis of variance between groups.

		50m N=60	100m N=62	200m N=45	400m N=49	800m N=45	Total N=261	*F*	*Sig.*
AGE	Mean	*56,75*	*56,42*	*58,62*	*56,63*	*57,58*	*57,11*		
years	SD	*10,37*	*10,48*	*10,31*	*10,69*	*9,45*	*10,25*	*,380*	*,823*
HGM	Mean	*392,77*	*389,59*	*404,50*	*375,98*	*397,09*	*391,63*		
N	SD	*108,85*	*101,09*	*91,46*	*103,96*	*97,10*	*100,87*	*,515*	*,725*
Tempi	Mean	*37,55*	*80,40*	*185,92*	*380,02*	*789,90*	*267,32*		
s	SD	*7,27*	*17,70*	*48,74*	*82,62*	*142,34*	*276,58*	*881,821*	*,000*

Table 2. Pearson correlation coefficients (zero order correlations) between time of performances and age and time of performances and hand grip strength at each distance.

	50 m	100 m	200 m	400 m	800 m
Age	,443(**)	,345(**)	,619(**)	,546(**)	,675(**)
Sig. (p-value)	*,000*	*,006*	*,000*	*,000*	*,000*
Hand grip strength	-,719(**)	-,569(**)	-,583(**)	-,572(**)	-,392(**)
Sig. (p-value)	*,000*	*,000*	*,000*	*,000*	*,008*

**Correlation is high significant at the 0.01 level (2-tailed).

Table 3. Partial correlations between time of performances and age and time of performances and hand grip strength at each distance. **Correlation is high significant at the 0.01 level (2-tailed).

	50 m	100 m	200 m	400 m	800 m
Age	,549(**)	,561(**)	,667(**)	,605(**)	,701(**)
Sig. (p-value)	*,000*	*,000*	*,000*	*,000*	*,000*
Hand grip strength	-,762(**)	-,688(**)	-,637(**)	-,627(**)	-,456(**)
Sig. (p-value)	*,000*	*,000*	*,000*	*,000*	*,002*

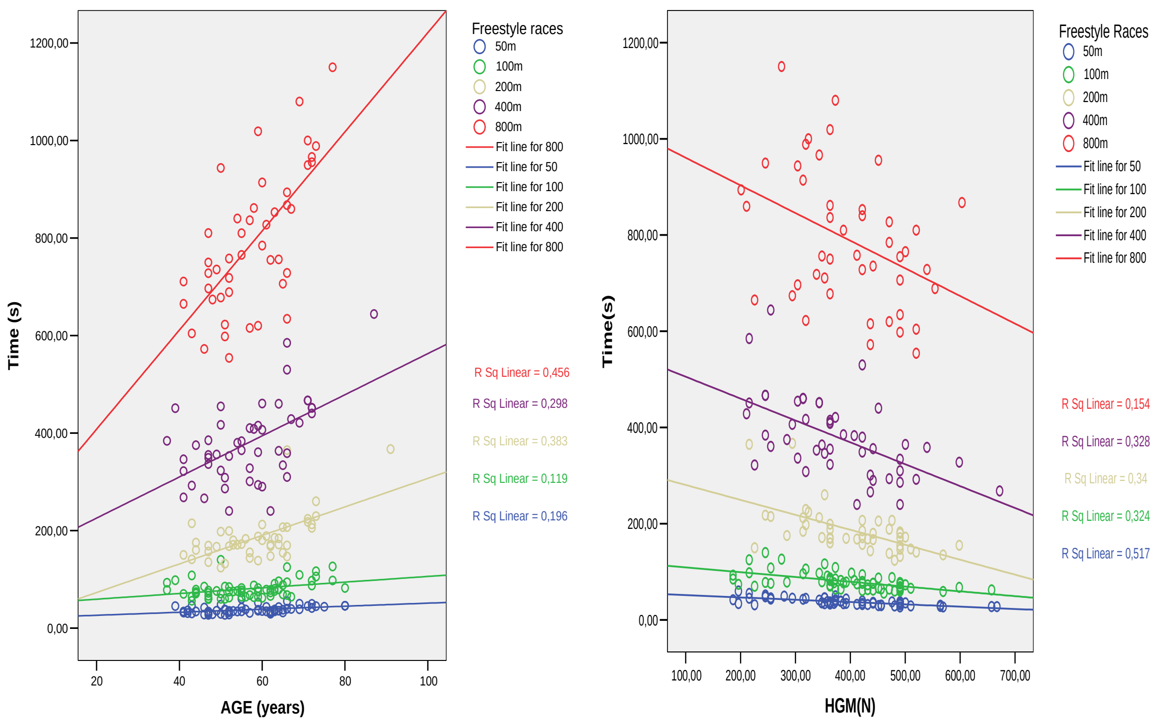

Figure 2: Time of performance vs. Age (a) and Hand grip strength (b) at each freestyle race. Fit lines

and R^2 for each race are reported.

DISCUSSION: The main finding of this work was that hand grip strength and age correlated significantly with 50m, 100m, 200m, 400m, 800m swimming performance times.
In particular hand grip strength showed an inverse correlation with time and explained 52% of variance of performance time in 50 m race freestyle and only 15% in 800m race. These results indicate that maximum isometric strength could be more influential in determining good performance in short races than in long races. This suggests that upper arm muscular strength and power are important requirements for successful swimming in short races (Geladas et al. 2004, Strass et al. 1988). Age showed a positive correlation with time and explained 45% of variance of performance time in 800m race freestyle and only 20% in 50m race. Considering that age is directly correlated with time, increasing age means increasing time of race, but since the influence of age is lower in short races, this result could indicate that older people could gain better results in short freestyle races. Similar results are described by Tanaka who noticed that, compared with the 1,500-m freestyle, performance in the 50-m freestyle (short-duration task) showed only a modest decline until ages 75 and 80 yr (Tanaka 1997). The very poor correlation found between hgm and age excludes strong interactions between these effects in our sample, indicating that their influence on performance time could be considered separately.

CONCLUSION: Concluding, in our sample of master swimmers, we found a relevant influence of hand grip strength on performance time, which was stronger in short races. Increasing age confirmed a disadvantageous factor on performance time, which was more evident in long than in short distances.

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