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ORIGINAL ARTICLE

RELATIONSHIPS AMONG PHYSICAL ACTIVITY AND PHYSICAL, MORPHOLOGICAL AND MOTOR FITNESS IN 10 YEAR-OLD CHILDREN

RELAÇÕES ENTRE A ATIVIDADE FÍSICA, APTIDÃO FÍSICA, MORFOLÓGICA E COORDENATIVA EM CRIANÇAS DE 10 ANOS DE IDADE

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ABSTRACT
The success in motor development depends on interaction among different factors, whose relationships still need to be further explained. Among such factors, physical, morphological and motor fitness (coordination) and involvement with physical activity have been identified as fundamental for establishing lifestyles that optimize motor development. The present study aimed to understand how these factors correlate in children in the end of elementary school. A total of 142 children, 52% of boys and 48% of girls, were assessed regarding their physical fitness (batteries of 6 tests), morphological fitness (BMI), motor fitness (KTK) and involvement in physical activity (Baecke questionnaire). The results confirmed the positive relationships among the generality of the factors, although with a differentiated profile per gender. Contrarily to what had been expected, the level of involvement in physical activities was not correlated with the other assessed fitness.
Keywords: Motor development Physical Activity. Fitness.

INTRODUCTION

The success in motor development during childhood appears to result from the interaction of different factors, whose relationships lack deep knowledge. Among these factors, physical fitness, motor proficiency, morphological profile and involvement in physical activities have been identified as fundamental for establishing lifestyles that optimize motor development. On the other hand, reduced levels of motor success of children and youths in the most industrialized societies probably result from situations that suppress the development and maintenance of physically active lifestyles, such as the dependency for mobility, increasing sedentarism combined with the excessive use of TV, videogames and / or computer, inadequate eating habits, etc. Associated with all these situations, these conditions raise concerns increased by health complications that can be originated in adulthood, such as cardiovascular diseases, hypertension, diabetes, depression, anxiety, low self-esteem, etc. (CARVALHAL; SILVA, 2006; EISENMANN, 2004; GRUND et al., 2001; KORSTEN-RECK, 2007; LEARY et al., 2007; MARSHALL et al., 2004; NELSON, et al., 2006; PATRICK et al., 2004; WILLE et al., 2008; WRIGHT et al., 2001).

The importance of an appropriate motor development beginning at early age obligates us, thus, to deepen knowledge about the expression of its factors and consequent interaction, in order to allow the perception of the developmental paths in the transition to adolescence and adulthood. In this context, several studies have been conducted aiming to search for relationships among physical fitness (PF), morphological fitness (MF) and motor fitness (MtF), as well as the level of involvement in physical activities (PA) of children and youths (ARA et al., 2007; BALL et al., 2001; BARNETT et al., 2008; D´HONDT et al., 2009; DENCKER et al., 2006; EISENMANN et al., 2007; FISHER et al., 2004; GRAF et al., 2004; GRUND et al., 2000; HOUWEN, HARTMAN; VISSCHER, 2008; HUME et al., 2008; KEMPER et al., 2001;

REED; METZKER, 2004; SILVA; PEDROSO; VIANA, 1999; STRATTON et al., 2007; WROTNIAK et al., 2006). On the whole, despite the methodological differences regarding the instruments used for the data collection, these studies suggested a clear existence of positive associations among the factors studied throughout the development of children and youths, also related with motor success.

The way in which the relationship among all these factors (PF, MtP, MP, PA) is organized along the ages of childhood, their reciprocal effects and relative importance in determining motor development at every age of the child constitute the focus of our concern. Therefore, in this study we have attempted to understand the correlations established among these four components of motor development at the end of the 1st cycle of primary education (4th year of schooling), as well as their importance.

METHODOLOGY

Sample

A convenience sample was recruited, consisting of 140 students (73 males and 67 females), from nine educational establishments of the 1st cycle of primary education of the school network in Amares Municipality, northern Portugal, aged between 9 and 10 years-old, enrolled in the 4th year of schooling of the 2008/2009 academic year.

Variables

Morphological Fitness (MF)

All participants had their weight (WT) and height (HT) assessed for subsequent calculation of their body mass index (BMI). To this end, it was used a digital scale with incorporated stadiometer, SECA brand (model 703 1321009). The procedures followed the protocols described in the Anthropometric Standardization Reference Manual (LOHMAN, 1988). The assessor also recorded the birth weight and height of all members of the sample, by consulting their respective child health records.

Motor Fitness (MtF)

The KTK battery of motor coordination tests (Der Körper Koordinationstest fur Kinder, of KIPHARD; SCHILLING, 1976) was applied, consisting of four separate tests: backward balance (BB), monopedal jumps (MJ), side jumps (SJ) and shifting platforms (SP). This battery indicates the standardized values for each of its constituent tests and the overall motor quotient (MQ), allowing comparison regardless of age.

Physical Fitness (PF)

The tests used for the PF assessment were sit-and-reach (SR), number of sit-ups in 60 seconds with flexed legs and crossed arms (SU), long jump without preparatory running (LJ), maximum time of suspension in bars (TSB), 4x10m shuttle run (SHR) and 20m back and forth resistance run (BFR). The first six tests belong to the AAHPERD Youth Fitness (1976) and the AAHPERD Health Related Physical Fitness (1980) batteries, and the last one belongs to the Eurofit battery of tests (1988). This selection of tests was due to criteria of rigor and familiarity and ease of administration and measurement / assessment of the various components of the physical fitness, with little or no equipment. Given the need to find a representative value (proxy) of the overall PF of the children, a factor analysis of principal components was used. This analysis has reduced to a single value the result of the various tests, considering the contribution of each of them for an

extracted (PFtot) single facet (factor).

Physical activity (PA)

PA was assessed through the Baecke Questionnaire of Habitual Physical Activity (BAECKE; BUREMA; FRIJTERS, 1982), which has been regularly used in Portugal to assess PA in youths aging from 10 years-old (FERREIRA, 1999 VASCONCELOS, 2001; MAIA et al., 2006). Its initial formulation was adapted to translate the self-assessment of PA of the children in relation to three moments of their daily life: school, involvement in sports activities and free time. Three different indexes of the PA of the children result from this questionnaire: school (IndSc), sports practice (IndSp) and free time and leisure (IndLeis). Several authors also suggest obtaining an overall value of habitual physical activity (IndHPA), as a result of the sum of the three partial indexes (MAIA et al., 2006; GUEDES et al., 2006)

Procedures

Authorizations of the Group of Schools of Amares and its head teachers were solicited and obtained for the conduction of this study. The procedures were submitted to the Scientific Council of the Institute of Children Studies of the University of Minho and were approved. All participants and their respective families received written information about the present study, in which appeared the description of the objectives of the investigation, the scheduled dates of testing and a summarized description of the tests to be performed. People responsible for the education should authorize or not the participation of their students, by signing the Informed Consent Term. The dates for data collection were scheduled with the teachers of the classes and all students were alerted about the need to wear clothes and shoes appropriate to the performance of the assessment tests. All procedures fully respected the international regulations on human experimentation expressed on the 1975 Declaration of Helsinki.

Data collection

For the data collection, the investigator went to the selected educational establishments of the 1st cycle of primary education, between January and May. The tests in each school were performed throughout three business days, consecutively. The PF tests were applied outdoors, MF tests were applied inside the main building of the establishment, and the MtF tests were performed in porches and covered areas, due to the better uniformity of the floor. Each class was divided into small groups of three or four elements defined by the teacher, who were absent from the classroom during the regular school schedule. Only the questionnaire related to the PA assessment was conducted inside the classroom and applied to all students at the same time.

Statistical procedures

The results of the tests were analyzed through descriptive statistics (mean and standard deviation). After the verification of variances among groups, the t test of pairs for independent samples was used to compare values between sexes.

The representative value of PFtot was obtained through factor analysis of principal components. This statistical procedure aims to parsimoniously explain the variance-covariance structure of the result of a set of variables, facilitating their multivariate interpretation. It results in non-correlated (orthogonal) factors which successively comprise the maximum of unique variability present in the data, and also in a single score associated with each extracted factor, in which each variable participates with a relative weight. In this case, the data analysis suggested

the extraction of a single factor with a *eigenvalue* superior to 1.0, representing 47% of the total variability of the data. The values found for the transformation matrix of the variables in a score (PFtot) demonstrated relative balance among most of the variables, except only for the SR (0.245; 0.260; 0297; 0.20; -0.271; and 0.121, respectively for SU, TSB, LJ, RBF, SHR, and SR).

Table 1 - Descriptive values (n, mean and standard deviation) of the physical activity, physical, motor and morphological fitness tests in both sexes, and comparison between sexes.

	Total		Male		Female		Sexes Differences	
	N	Mean (SD)	*N*	Mean (DD)	*N*	Mean (SD)	*t*	P
ABD	138	29.4 (8.9)	72	30.9 (8.0)	66	27.8 (9.9)	2.06	0.04
TSB	137	17.3 (17.5)	71	20.1 (19.7)	66	14.6 (15.4)	1.85	0.06
SCP	139	125.9 (20.1)	72	132.3 (19.0)	67	119.6 (21.1)	3.72	0.00
CVV	138	17.1 (6.7)	71	19.9 (8.8)	67	14.30(4.5)	4.69	0.00
SR	140	18.3 (6.0)	73	17.6 (5.3)	67	19.0 (6.6)	-1.39	0.16
SHR	137	14.4 (1.2)	71	14.1 (1.1)	66	14.8 (1.3)	-3.44	0.00
ApFtot	136	0.0 (1.0)	71	0.30 (0.9)	65	-0.33 (1.0)	3.89	0.00
ER	136	49.2 (13.0)	69	95.9 (14.2)	67	97.3 (13.5)	-0.56	0.57
SM	137	58.0 (15.6)	70	107.0 (15.3)	67	96.8 (17.7)	3.64	0.00
SL	136	52.2 (11.6)	69	100.1 (13.3)	67	83.2 (17.3)	6.42	0.00
TL	136	37.5 (6.4)	69	86.1 (12.5)	67	82.6 (13.8)	1.53	0.13
QMT	136	91.6 (15.5)	96	96.3 (13.5)	67	86.9 (16.0)	3.74	0.00
Weight	138	35.7 (8.5)	72	37.0 (9.2)	66	34.5 (7.9)	1.73	0.08
Height	138	138.7 (6.6)	72	140.0 (7.1)	66	137.4 (6.1)	2.36	0.01
BMI	138	18.4 (3.4)	72	18.7 (3.7)	66	18.1 (3.1)	1.01	0.31
Indsch	140	2.5 (0.4)	73	2.5 (0.5)	67	2.5 (0.4)	1.11	0.26
Indsp	140	2.7 (0.7)	73	2.9 (0.7)	67	2.6 (0.6)	3.17	0.00
IndLeisure	140	3.0 (0.7)	73	3.0 (0.7)	67	2.9 (0.7)	0.87	0.38
IndAFH	140	8.2 (1.3)	73	8.5 (1.4)	67	7.9 (1.1)	2.53	0.01

Relatively to the PF, the boys showed a higher performance in five of the six tests performed, and in four of them this difference was significant (SU, LJ, SHR and RBF). Only in the test of flexibility (SR) girls obtained a superior mean, and even then, it was not significant. On the composite value of physical fitness (PFtot) there was also a significant superiority of the average level of the boys.

Regarding the MF, both sexes present quite similar BMI and weight, although boys are significantly taller than their female peers.

As for the MtF, the boys demonstrated higher levels of coordination in the MJ, SJ (p = .00) tests, and also proved to possess a generalized level of MtF higher than the girls (MQ). The average performance of the boys (96.3) was comfortably within the standardized average interval recommended by the manual of the KTK battery (86-115), whilst the average performance of the girls (86.9) was only slightly higher than the minimum value.

Finally, regarding the PA, the boys had significantly higher values in the overall index of habitual physical activity (p = .00), as well as in the index relative to involvement in sporting activities (p = .00). In the indexes that assess physical activity routines at school and in the leisure time no differences have been registered between genders.

Analysis of the correlation among factors

The correlations matrix (Table 2) allows to verify that the performance on the four MtF tests correlates positively (0.21-00.54 in the boys; 0.13-0.40 in the girls) with strength, resistance and agility performances (SU, TSB, LJ, RBF and SHR), but not with the flexibility (SR). When taking the composite value of the PF, the correlations with each KTK test ranged from 0.43 to 0.53 for boys and from 0.33 to 0.47 for girls. Also, to the same extent, the correlation between the MQ and the generality of the PF tests (except for the SR test) always presents significant and higher values in males – from 0.38 to 0.59 for boys and from 0.27 to 0.45 for girls. It is also evident that the BB and SP tests are those that are most associated with the values of PF, whilst in boys it is not possible to do any distinction of this kind. In general, the association between MtF and PF is proven to be stronger in boys, as noted by the association among the overall values (0.65 x 0.50).

Relatively to the MF, it was verified a generalized association of the BMI with the PF tests, although with differences between sexes, as it is particularly visible in the values of the correlation with the PFtot (0.45 in boys; 0.29 in girls). In boys, the MF was significantly related (0.23 to 0.46) with all the PF tests, except for the SR, while in girls only the SU (0.41) and TSB (0.38) tests had significant values. As for the association between MF and MtF, it was verified only in males and, even so, in a weak and moderate way (0.17 to 0.45 in relation to the individual tests and 0.39 to the MQ). In females, this relationship was always very weak and not significant (0.10 to 0.18).

Table 2 – Values of correlations among the studied variables for both sexes

Male										
	ER	**SM**	**SL**	**TL**	**KTK**	**IndSc**	**IndSp**	**IndLeis**	**IndAF**	**IMC**
ABD60	**0.29**	**0.48**	**0.37**	**0.28**	**0.48**	0.01	-0.03	-0.04	-0.03	**-0.23**
TSB	**0.33**	**0.35**	**0.36**	**0.29**	**0.44**	-0.13	-0.11	-0.19	-0.20	**-0.46**
SCP	**0.38**	**0.54**	**0.37**	**0.49**	**0.59**	-0.17	-0.08	-0.13	-0.17	**-0.24**
CVV	**0.24**	0.21	**0.41**	**0.32**	**0.38**	-0.09	0.13	0.04	0.06	**-0.31**
SHR	**-0.30**	**-0.41**	**-0.39**	**-0.39**	**-0.49**	0.14	-0.10	0.14	0.07	**0.34**
SR	0.093	0.062	0.042	0.197	0.13	**-0.28**	0.16	0.10	0.03	-0.12
ApF TOT	**0.43**	**0.53**	**0.51**	**0.50**	**0.65**	-0.18	0.01	-0.11	-0.11	**-0.45**
IndSc	-0.04	0.00	-0.14	-0.07	-0.08					
IndSp	0.06	0.04	0.09	0.14	0.11					
IndLeis.	-0.09	-0.13	0.05	0.08	-0.04					
IndAF	-0.02	-0.04	0.02	0.09	0.01					
IMC	-0.21	**-0.45**	-0.17	**-0.32**	**-0.39**	0.03	-0.12	-0.06	-0.09	
Feminino										
ABD60	**0.28**	0.13	0.19	**.27**	**0.27**	**0.26**	-0.05	-0.09	0.01	**-0.41**
TSB	**0.28**	0.21	**0.25**	**0.34**	**0.33**	0.09	0.01	0.11	0.10	**-0.38**
SCP	**0.31**	**0.32**	**.38**	**0.38**	**0.43**	0.11	0.02	**0.28**	0.21	-0.19
CVV	**0.39**	0.31	0.15	0.27	**0.34**	0.15	0.01	0.08	0.11	-0.12
SHR	**-0.38**	**-.38**	**-.28**	**-.40**	**-0.45**	-0.16	0.01	**-0.28**	-0.21	0.07
SR	0.23	0.1	-0.04	0.2	0.14	0.00	0.11	0.14	0.15	0.08
ApF TOT	**0.45**	**0.37**	**0.33**	**0.47**	**0.50**	0.20	0.01	0.20	0.19	**-0.29**
IndSc	0.17	0.10	0.05	0.19	0.15					
IndSp	-0.10	-0.18	-0.13	-0.03	-0.14					
IndLeis.	0.15	0.05	0.13	0.15	0.15					
IndAF	0.09	-0.03	0.02	0.14	0.06					
IMC	-0.18	-0.01	-0.10	-0.11	-0.12	0.00	-0.05	0.20	0.09	

Note: correlations with significant values ($p < .05$)

With regard to the PA results, it has not been found association with any of the other tested components of fitness, regardless sex and time (indexes) of assessment of the PA (school, sports,

leisure, or overall).

Comparison of extreme groups of performance and physical activity

As for overall performances (PFtotal, MQ, BMI, and IndHPA) in each of the studied factors, the sample was subdivided into three groups of level: high, medium and low. To this end, given the difference of gender found in most cases, the intra-genders performances were transformed into z-scores and these were the values used for division into textiles and consequent comparisons. Each pair of extreme groups (high and low performance) was compared, in each factor, relatively to its position in all the others. The results are displayed in Table 3

Table 3 – Comparison of the mean values of z-scores among the extreme groups (high and low) of physical, motor and morphological fitness and physical activity.

	Physical Fitness		**Motor Fitness**	**Morphological Fitness**		**Physical Activity**						
	High	**Low**	***P***	**High**	**Low**	***P***	**High**	**Low**	***P***	**High**	**Low**	***P***
N	***(46)***	***(46)***		***(50)***	***(47)***		***(42)***	***(44)***		***(43)***	***(45)***	
PF				0.68	-0.66	*0.00*	0.34	-0.50	*0.00*	0.07	-0.08	*0.49*
MtF	0.63	-0.77	*0.00*				0.14	-0.29	*0.03*	0.09	-0.10	*0.36*
MF	-0.34	0.48	*0.00*	-0.23	0.36	*0.00*				-0.09	-0.11	*0.86*
PA	0.11	-0.11	*0.34*	0.03	-0.06	*0.70*	0.06	-0.08	*0.51*			

It is possible to observe that the children of both contrast groups (high and low) of PF also differed regarding their MtF and MF, in such a way that the physically fittest also demonstrated to be more coordinated (p = .00), morphologically fitter (p = .00) and more active (in spite of the fact that this difference does not reach statistical result: *p= .34).*

In relation to the MtF, it has been found significant superiority of the PF (p = .00) and MF (p = .00) values of the elements with higher levels of coordination, but it has not been verified any difference in the type of the PA (p = .70).

In the same line of analysis, the children who showed better MF (lower BMI) also positively differentiated in the levels of PF and MtF (p = .00) when compared with their peers with lower morphological fitness. Regarding the daily PA levels, the children with the best MF, showed a slightly higher mean, but without statistical significance (p = .51).

At last, when the extreme groups of PA level are contrasted, there is no differentiation in the values of physical, motor and morphological fitness.

DISCUSSION

This study aimed to jointly analyze factors associated with the success in motor development, that is, physical, motor and morphological fitness and their involvement in physical activities, of children studying the 4th year of the 1s cycle of primary education (3rd grade). Contextualizing our sample in the national and international scene, we realize that their morphological characteristics (weight, height and BMI) are in accordance with the overall characteristics observed with similar aged children, from different regions of the country (FREITAS et al., 2002; MAIA et al., 2006; RODRIGUES; BEZERRA; SARAIVA, 2007; VIEIRA; FRAGOSO, in press).

Despite this, it is possible to observesome differentiation between genders. The female group is shorter, lighter and has BMI lower than the male group. These average differences are not usually found among children of these ages (RODRIGUES et al., 2006) and, thus, they may mean a distinctive feature of this sample group. Based on the cutoff points defined by Cole and colleagues (Cole et al., 2000) for overweight and obesity in children aged between 9 and 10 years, it has

been found that 8% of the total sample was composed by obese (9.7% and 6.1%, male and female, respectively), and 20% were overweight (16.7% of boys versus 21.1% of girls). These incidence values differ from the values known by the Portuguese population (Maia et al., 2006; Padež et al., 2004; RODRIGUES et al., 2006).

Regarding physical fitness, the performance of the sample under study is close to the values referenced in other national studies as for SU, TSB, LJ, and SR tests, but it was lower than the expected (described) in the SHR and RBF tests (FREITAS et al., 2002; RODRIGUES; SARAIVA; BEZERRA, 2007). In the case of the SHR, the explanation for this fact may be related to the surface of the floors that were used, which were not much sticky and, therefore, did not contribute to the best performance. Although RBF it is a great proof of aerobic resistance, it has not been used before 10 years of age, due to the difficulty children have to realize the pace imposed by the different sound levels. Nevertheless, this test was used with significant success in the *Estudo Morfofuncional da Criança Vianense* [Morpho-functional Study of Children from Viana do Castelo) (RODRIGUES et al., 2006) since the age of six, because all attempts were accompanied by an adult, who set the pace and encouraged the children.

In this study, human limitations did not allow this monitoring, which may explain the lower performance found. Still, given the essentially correlational characteristic of this study, the testing conditions were similar for all subjects, and the collective performances presented expected homogeneity, which may suggest that the relative positions of the subjects might have remained, although the difficulties for perform the tests were greater.

As for the option of using a single value as representative of the PF of the individual, we are aware that this is a controversial issue, given the difficulty of expressing a multivariate profile in a single value; however, in this case the principal component analysis suggested the extraction of a single factor explaining most of the subjects variance in the PF tests, which allows us to reduce substantially and with interpretive advantages the joint results of the individual PF.

In relation to the MtF, we have found that the results were in accordance with the respective mean values of the performances observed in similar Portuguese studies, except for the MJ, in which the studied sample revealed a higher level of performance (GOMES, 1996; LOPES et al., 2003; VALDIVIA et al., 2008). Nevertheless, the results found in this sample fit well into the categorization suggested by the KTK manual as median (variation of the standardized values between 85 and 115) (SCHILLING, 1974).

Analyzing correlation matrixes for both sexes, it is verified that, despite a profile generally identical regarding its meaning, the boys showed more significant values of association among the studied factors. This peculiarity becomes more evident in the relationships with the somatic fitness (MF x PF; MF x MtF), which may be due to the fact that females presented lower performances of PF and MtF than males (since there is no differentiation regarding BMI). It is natural that at lower values of conditional and motor performance the type of morphology of the subjects is less restrictive, and is only determining for extreme performances (superior or inferior) (D'HONDT et al. 2009). Still, the results of the association between MF and PF are higher than those found in other similar studies (CASTELLI; VALLEY, 2007; HANDS et al. 2,009) in which low or null values were reported. Particular case of this relationship (MF x PF) is established with aerobic fitness, for being one of the most important in the association with health. The data relative to this study showed greater relationship among aerobic resistance performances (RBF) and BMI in boys (0.31) than in girls (0.12, not significant), which, interestingly, contradict the results found in another Portuguese study (MOTA, FLORES, FLORES et al., 2006), in which only in females (8

and 9 years old) was possible to find significant correlations (0.36) between the mile run and BMI. Maybe the explanation for such divergence is found in the test used (RBF and mile run) or in the age difference, but this is certainly an interesting subject to be explored in the future.

The positive and moderate associations observed in the present study among the PF, MtF and MF find parallelisms in other studies with similar characteristics in terms of age, objectives and / or collection instruments used (CASTELLI; VALLEY, 2007; D'HONDT et al., 2009; HAGA, 2008; MOTA; FLOWERS; RIBEIRO et al., 2006). As for the MF-MtF relationship, the values we obtained differ between both sexes. The values of the boys are similar to those observed in Belgian children, 0.34 (D'HONDT et al., 2009) and German children, 0.16 (GRAF et al., 2004), and are contrary to the association found in Australian children related to their fundamental motor skills and BMI (HUME et al., 2008). In girls, the relevance of the correlation found (0.12) was not significant, but it is still higher than that reported by Hume and colleagues in 2008 (0.02).

The particular domain of association between the PF and MtF represents the strongest relationship found in these children – it seems, by the way, intuitive that it this way, given the unquestionable sharing commonalities between these two skills - and replicates previous studies (reported values between 0.33 to 0.59) (CASTELLI; VALLEY, 2007; HANDS et al., 2009). It also noteworthy the fact that in our sample the values of this association are more important in males, contrarily to what was found in Norwegian children (HAGA, 2008).

Relatively to the relationships among PA and other components, there was not any correlation. Of all the components studied in the literature, the PA is surely the one in which the value of correlation with each of the others is the lowest and most varied (HANDS et al., 2009; HOUWEN; HARTMAN; VISSCHER, 2008; OJA, 2001). The difficulty in assessing it and the variety of instruments used are usually the factors identified as obstacles to the definition of this behavior, and because of that the comparison of our values with those reported in the literature is difficult, since these studies commonly used more accurate methodologies for assessing the PA (accelerometry, DLW, etc.). In view of the obvious limitations of the questionnaire used in this study, we are left with some doubts as for the results. It was not possible to identify if the correlations were due to the lack of sensitivity of the instrument or simply to the reality of this sample. From the point of view of sample distribution of the habitual PA index, we found possibilities of discrimination among the subjects (values ranging from 2.5 to 11.5) and data very approximate to the normality (Table 1). Thus, these null associations among PA, MF, PF and MtF are motivated by the lack of differentiation among the levels of answers of the children. On the other hand, the Baecke questionnaire has already proved its concurrent validity (moderate) in various times (GUEDES et al., 2006; MILLER; FREEDSON; KLINE, 1994), and, as already mentioned, it has been regularly used with children and young people. Because of that and the lack of better data, we are obliged to interpret this lack of generalized association of the PA with the other components as true, which suggests that, in all the factors studied, the PA in these ages will be the most independent of all.

The comparative performance analysis among the extreme groups (high x low) allowed verifying that there is an evident differentiation between each of the other components of fitness (morphological, physical and motor) in groups of children that present extreme characteristics in one of them. Such fact reinforces the idea of their association and reciprocal effect. The fact that the performances have been transformed in z-scores within each gender allows us to realize that, although the profile of performances and correlations are different between sexes, the differentiation among extreme groups of fitness is obvious for both. Thus, it is evident that, among these children, those with best PF are also those with the highest motor and morphological

levels. Those with the best motor levels distinguish regarding the results of physical fitness and morphological characteristics, and a better morphology (lower BMI) also indicates better motor and physical performances. In our opinion, in an even more evident way than the demonstrated by the analysis of correlations (conducted in the whole spectrum of performance), this particular form of contrasting extremes demonstrates the great sharing of common effects among these three fitness (physical, motor and morphological), regardless gender of the children. These results corroborate what has been recently observed in German and North-American children, according to which there are differences in the body composition of children with contrasting levels of motor proficiency (GRAF et al., 2004) and in their physical conditioning (GRUND et al., 2000; HUME et al., 2008), as well as in the motor levels of children with worse indicators of morphological fitness (CANTELL; CRAWFORD;-DOYLE BAKER, 2008; WROTNIAK et al., 2006).

Relatively to the distinction related to the levels of physical activity, the results are different from those previously described. It is noticed that children with higher levels of PF and MF present higher mean values of PA, but the difference is not significant when compared with the group of less fit children (Table 3). On the other hand, no distinction is possible in the levels of physical activity according to the motor performance, because the mean values of PAtot (z-scores) are exactly the same for both groups – of high and low motor coordination. Also, when we separated the children in extreme groups of performance of PA, we observed that it is not possible to establish a distinction among the most and least active relatively to any of the studied fitness. These results do not fit into those reported for 6 and 7 years-old German children, in which the most active ones had also significantly higher motor fitness (GRAF et al., 2004). Moreover, North-American children, who were morphological less fit (higher BMI) proved to be less active and have worse motor performance than their fittest peers (with lower BMI) (WROTNIAK et al., 2006).

From this point of view, it seems to be relevant the interpretation that physical activity alone does not allow to distinguish the level of fitness among children of these ages. The most active children (contrarily to what would be expected) were less obese, more physically fit or more coordinated than their less actives peers; however, those with less fat mass (better MF) and the physically fittest proved to be (on average) slightly more active than the least fit (morphological and physically). This crossed observation seems to suggest that the somatic and physical fitness has a relevant effect on the involvement of children in physical activities.

CONCLUSIONS

10 years-old boys and girls showed different profiles regarding relationships found in the four components which were expected to be associated with the success in the motor development (PF, MtF, MF and PA). The physical and motor fitness proved to be the two most strongly associated components, regardless of gender. In the boys, the morphological fitness related, in a moderate way, with physical fitness and motor fitness. As for the girls, it presented a low correlation with the physical fitness. Contrarily to the observed in other studies, the level of involvement in physical activities has not revealed any correlation with the level of physical conditioning, motor proficiency or body composition of the sample in the present study. Such fact possibly mean that the participation in physical activity in this ages (or until these ages) is not dependent on or related to the other components of the motor success with the same degree of intensity of relationship they present with each other. The children who reported a greater participation in habitual activities have not demonstrated improved of any fitness in particular; however, the physically fittest and

most coordinated children showed higher levels of physical activity, which may be an indication for the future. If in these ages the motivation for involvement in physical activity is still admittedly great, maybe later the importance of the expression of these fitnesses will be decisive for the maintenance of an active lifestyle.

These are also the doubts and questions that remain, considering that we are limited in this study by an eventual inadequacy of the assessment instrument of the physical activity that has been used, given the characteristics of the sample. Nevertheless, it seems vital that we continue to inquire about these relationships and their establishment throughout the ages and groups of performance, so we can have some more certainty about the characteristics that condition and stimulate the future motor success of children and youths.

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