Original Article

Influence of a physical education plan on psychomotor development profiles of preschool children

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ABSTRACT

Teixeira Costa, H.J., Abelairas-Gomez, C., Arufe-Giráldez, V., Pazos Couto, J.M., & Barcala-Furelos, R. (2015). Influence of a physical education plan on psychomotor development profiles of preschool children. *J. Hum. Sport Exerc.,10*(1), pp.126-140. This study aimed to investigate the influence of structured physical education on the psychomotor development of 3 to 5 year-old preschool children. The sample consisted of 324 students of both sexes (3 to 5 year-old) from 9 public kindergarten classes in Porto, Portugal. A battery of psychomotor tests (pre-test) was used to assess the students' psychomotor development profiles. The sample was divided in 2 groups: an experimental group (162 students) and a control group (162 students). Physical Education (PE) teachers used a structured 24-week PE plan in the experimental group. After the plan completion, the same battery of tests (post-test) was run on both groups.The outcome was that both groups grew their psychomotor profiles; however this growth was always statistically higher in the experimental group (at all ages and in all variables analysed $p < 0.001$ – Figure 3 and Table 1, 2). There were no significant deviations related to the gender ($p>0.05$). Structured physical education is important for preschool children's psychomotor development. Physical activity impact on children's interaction with the outside world was proved, through their overall development motivated by the structured physical education lessons. **Key words**: PHYSICAL ACTIVITY, PSYCHOMOTOR DEVELOPMENT, MOTOR BEHAVIOUR, TEACHING, PRESCHOOL EDUCATION.

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INTRODUCTION

The physical stimulation is critical for childhood development (Timmons, Naylor & Pfeiffer, 2007; Trudeau & Shephard, 2008). It is through motor exploration that children's self-awareness and awareness of the outside world arises. The progressive acquisition of skills concerning both mental and motor activities is defined as psychomotor development. Therefore an active lifestyle during childhood is beneficial to physical, cognitive, and mental health (Chaddock-Heyman et al., 2013; Chaddock, 2012; Tomporowski, Davis, Miller & Niglieri, 2008). Motor experiences are a vital condition for adaptation in a child's didactic learning; and can stimulate thinking. Additionally, a poor field of operation can delay and limit an individual's perceptive abilities (Thompson, 1996).

According to Lubans, Morgan, Cliff, Barnett and Okely (2010) and Cools, Martelaer, Samaey & Andries (2009), the stimulation and movement are crucial in early childhood, given that they promote the development of the physical, cognitive and social skills. Movement is in the heart of children's active lives, as they acquire their autonomy in different daily life situations.

Infant psychomotor development seeks to provide children with several necessary skills to ensure good school performance (Fisher et al., 2005; Stodden et al., 2008). Developing specific skills and necessary abilities is of most importance to prevent learning difficulties. In the early age, from 3 to 5 years, preschool children acquire a set of motor skills that enable gradual control of the body. Some of the skills that children need to grow and develop are acquired through natural movement at this age. This period is important for the development of essential movement skills (Gallahue & Donnely, 2003). Given that most preschool children are naturally curious, and usually love to play and explore, these movement skills are learned very easily; especially when stimulation, and opportunities to play and to be physically active are offered. Schools and kindergartens provide the ideal environment for these moments of pure discovery. Nevertheless, those responsible for their education (i.e., parents, teachers, and educators) must create appropriate learning opportunities (Venetsanou & Kambas, 2010). Being so, it is highly recommended to create opportunities for children to experience different motor practices in suitable places, equipped with specialised materials and prepared to run specific educational activities with teachers/educators. They know and have in mind the children's individual characteristics and needs. These opportunities can be created during physical education (PE) classes.

Physical activity is critical for children's normal growth and development and is clearly related to superior academic achievement in primary school classrooms (Becker, McClelland, Loprinzi & Trost, 2014; Castelli, Hillman, Buck, & Erwin, 2007; Chomitz et al., 2009; Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Trudeau & Shephard, 2008) and with the enhancement of cognitive function (as assessed in several validated neuropsychological and psychometric tests) (Buck, Hillman, & Castelli, 2008; Chaddock, Hillman, Buck, & Cohen, 2011; Chaddock-Heyman et al., 2013; Sibley & Etnier, 2003).

Some studies such as the meta-analysis performed by Sibley and Etnier (2003) showed that physical activity might be related with a cognitive function increase during the child's development. A positive relation was found between physical activity and cognitive function, which includes motor skills, intelligence quotient, academic achievement, verbal and mathematics tests, level of development, and academic success in school-age children.

In early studies, like the one conducted by Ismail (1968) children of 10 to 12 years old were randomly divided into a normal or "adapted" physical education program. The results obtained revealed an increased

performance on the Stanford Academic Achievement Test for children in the enhanced program. Also, McCormick et al. (1968) showed improved reading outcomes in elementary school children having participated in a seven week program (twice a week) of physical education, comparing to children randomized to a perceptual-motor training group and a control group.

Recent reviews (Trudeau and Shephard, 2008; Tomporowski et al., 2008) have identified two randomized trials showing the relation between physical education and academic achievement. Budde et al. (2008) and Ericsson (2008) in their intervention studies showed positive relations between physical education and cognitive skills, attitudes and academic achievement. Additionally, Ericsson (2008) found that extending physical education (from twice a week to a daily basis) was positively related with math, reading and writing test outcomes. This study also distinguished positive relations regarding attention, but the relations tended to dissipate over time.

The studies of Carlson et al. (2008), Dexter (1999) and Tremarche et al. (2007) examined relations between physical education and academic achievement and found positive outcomes. The study run by Heitzler (2006) with a substantial and representative sample, showed the children's beliefs on the benefits of participating in physical activity and the importance of parents' support. Della Valle et al. (1986), Maeda and Randall (2003), Norlander et al. (2005), Mahar et al. (2006), Rogers and Harvey (2012) and Cardeal et al. (2013) run studies that assessed the influence of physical activities in a classroom on: cognitive skills (e.g., aptitude, attention, memory); attitudes (e.g., mood); academic behaviours (e.g., on-task behaviour, concentration) and academic achievement (e.g., standardized test outcomes, reading literacy outcomes, and math fluency outcomes). The interventions involved the introduction of physical activities, by trained teachers, into the classroom setting. The activities lasted from five to twenty minutes per session and the intervention implementation periods extended from one day to sixteen months (most of them lasted over two to three months). The outcome of these intervention studies showed positive correlations between classroom physical activity and classroom behaviours, and academic achievement.

In Portugal, few relevant studies have been run in this field. However, Palma (2008) run a study that aimed to investigate the motor skill development and the engagement of preschool children in different play environments. In this study 95 3-year-old students were randomly divided into two groups, experimental group and a control group. To the experimental group participants two different movement programs were provided: one based in free play (Free Play in Enriched Environment); and the other consisting of a combination of exploration, free play, oriented play, and activities guided by the researcher (known as Oriented Play). The children's participation in the Oriented Play program had a positive outcome in their motor development, whereas no changes were observed neither in those in the Free Play in Enriched Environment group, nor in those in control group.

Based on these facts, this study aimed to investigate the influence of structured Physical Education plan on the psychomotor development of 3 to 5 year-old preschool students by identifying, describing, and comparing the psychomotor skill variations of an experimental group in contrast with a control group.

MATERIAL AND METHODS

The 324 subjects of the study were 3 to 5 year-old children. The project was approved by the ethics committee of the Faculty of Educational Sciences and Sports (University of Vigo) - doctoral program. All students underwent a set of psychomotor tests (pre-testing). The sample was then randomly divided in 2 groups: 162 children formed the control group (CG), and 162 children formed the experimental group (EG).

For 24 weeks, the EG students underwent a structured PE plan conducted by a PE teacher. The CG students did not have access to structured PE classes and attended the standard program of pre-school education of the Ministry of Education without a PE teacher. 24 weeks later, both groups (CG and EG) repeated the psychomotor tests (post-testing).

Sample

The study included 324 preschool children(154 boys and 170 girls). These students were 3 years old (n = 95 49 boys and 46 girls), 4 years old (n = 103 62 boys – 41 girls) and 5 years old (n = 126 - 55 boys and 71 girls). These students belonged to nine kindergartens in the municipality of Oporto, Portugal. The school board approved the research project, and besides this authorisation, the project was explained to parents, who authorised the children to participate (signing a voluntary information consent form).

Study layout

The first phase of the investigation was the selection of institutions and testing locations within the schools. In Porto, 17 kindergarten classes from 9 schools were chosen. After selecting the institution and sample, the children underwent psychomotor evaluations (pre-testing) to determine their psychomotor development profiles (PDPs) using the battery of tests as proposed by Oliveira (2008). After completing the pre-testing, the students were divided in 2 groups: a control group (CG, 162 students, 73 males and 89 females) and an experimental group (GE, 162 students, 81 males and 81 females). The battery of psychomotor tests evaluated 5 psychomotor skills: coordination and balance (CB), body scheme (BS), laterality (L), spatial organisation (SO), and temporal organisation (TO). During the 24-week period, a structured PE lesson plan was implemented. A PE teacher guided only the experimental group (EG) through these lessons, which were structured and adapted to the EG. The EG students participated in PE regular lessons twice a week, of 45 minutes long (each). The classes started in January and ended in June (6 months), comprising a total of 48 PE class sessions. Based on the psychomotor principles, the classes were designed to promote activities that would enhance the children's overall development and body awareness. Each lesson was planned according to different class sections: warm-up, principal major and cool-down activities. The warm-up focused on activation and physiological preparation for physical activity. In each session, the principal sections focused on specific activities based on several psychomotor principles, including adequate motor coordination, overall coordination, spatial structure, temporal organisation, body structure, body image, body knowledge, and laterality. We have chosen to perform most activities using circuits. Circuits are suitable for children given they consist on multiple exercises that require reduced time to accomplish. During each cool-down section, we always tried to relax the children with stretching and relaxation exercises. The CG had also moments of physical activity in the school playground or when covered by the class educator (weekly or biweekly); however, this physical activity was not structured and adapted to the group. After the 24-week intervention, the children underwent post-testing. The CG and EG underwent the same psychomotor evaluations that they performed during the pre-testing.The post-testing was performed in June and July for both groups (CG and EG) to compare the evolution of the children's PDPs in each group.

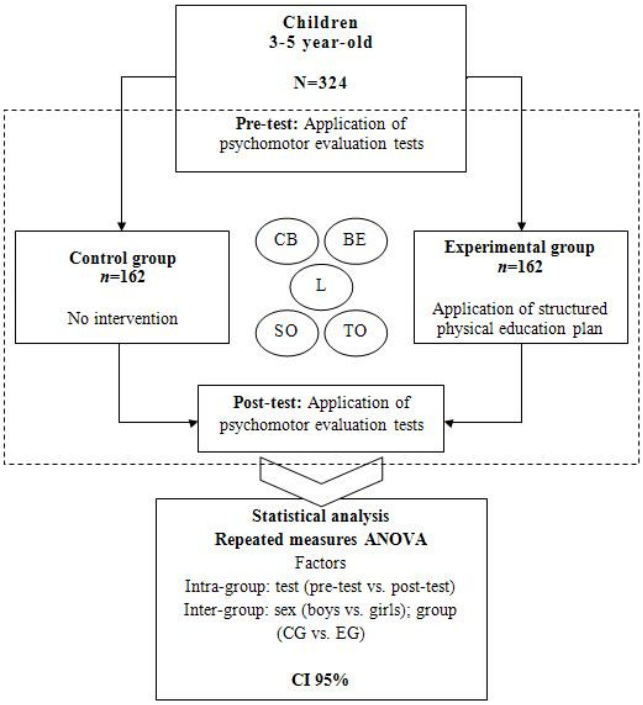

Figure 1. Study layout

Evaluation tool

A psychomotor evaluation test was created as a measurement instrument based on Oliveira's (2008) proposal. This author presents a battery of tests, based on the theory of psychomotor ages of Le Boulch (1981). Her proposal results of a five year period research, on 3 to 13 year old children, of both sexes, who did not have motor problems. In the present study the psychomotor evaluation test was slightly adapted for the Portuguese population given the analysed sample comprised Portuguese students from 3 to 5 years old. The battery of tests was approved by specialists in physical education, in childhood education, in psychomotor development and child psychology. This set of tests was applied previously in a sample of 45 students (pilot study). This instrument was authorised by the Portuguese Statistics and Education Planning Cabinet (GEPE) of the Education Ministry and validated in a pilot study in 2009.

Based on the scores acquired, a Psychomotor Development Profile (PDP) was created for each student. The psychomotor evaluations (i.e., pre-testing and post-testing) that determined the student psychomotor profiles in both groups were performed in the schools gyms. These gyms serve as a common space for every school. To design this common evaluation area, a "lab" was created with identical dimensions in each school gym. During the pre-test and post-test assessment, these measures were identical in all school gyms.

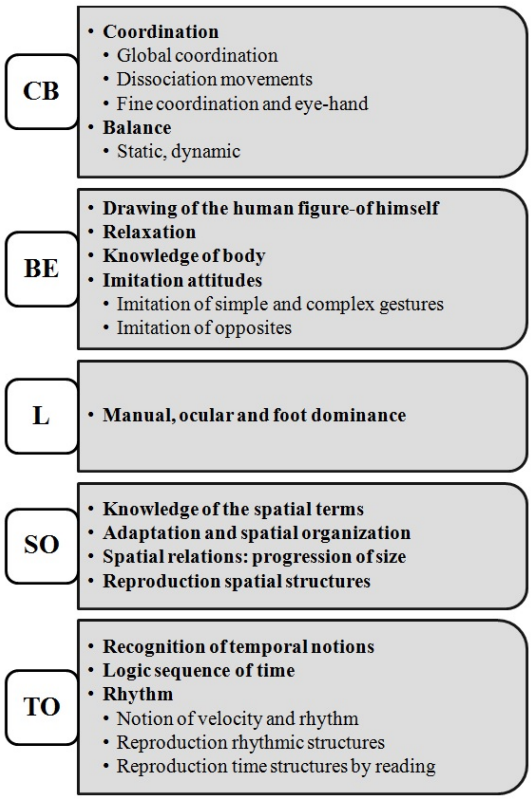

Figure 2. Structure of the psychomotor evaluation test

Statistical Analysis

The student population in Porto public preschools is 2024 (as to January 2012). The required sample size was calculated with OpenEpi (Open Source Epidemiologic Statistics for Public Health), Version 2.3.1 (2010). Additional statistical analysis was performed using SPSS for Windows, version 19 (SPSS Inc., IBM, US). The variables are presented as the mean and standard error (SE). Repeated measures ANOVA was used in order to analyse the effect of three factors: one intra-group factor (test: pre-test vs. post-test) and two inter-group factors (group: control vs. experimental; sex: boys vs. girls). Interactions between these three factors were also studied. A significance level of $P<0.05$ was considered.

RESULTS

The sample comprised 324 children (154 boys and 170 girls). It was divided into two groups: 162 children composed the control group (73 boys and 89 girls), and 162 children composed the experimental group (81 boys and 81 girls). In figure 3 it can be seen the effect of structured PE classes (through a specific program). We can observe the results obtained in the experimental group and control group in each age group at the pre-test and post-test. The scores of the experimental group are higher than those of the control group in all variables. At pre-test, the variables of coordination and balance (4 years), body schema (3, 4 and 5 years), spatial organisation (3, 4 and 5 years) and temporal organisation (4 and 5 years), had higher scores in the control group compared to those obtained in the experimental group. However, in the post-test, the experimental group had higher scores than the control group, after the implementation of the physical education specific program.

Inter-subject factors: gender (girls vs. boys) and age (3 years vs. 4 years vs. 5 years)
There were no significative statistic differences found in the inter-subject, related to the gender factor, in any of the variables analysed, p>0.05. Nor were also found in their interaction with the other two inter-subject factors analysed (age and group) or the intra-subject factor test. On the other hand, regarding the age inter-subject factor, one could find significant differences in all variables with p <0.001 (Table 1). In Figure 3 it can be seen that the scores for the youngest are always lower than those achieved by the eldest, either in the inter-subject factor group (control group vs. experimental group) and in the intra-subject factor test (pre-test vs. post-test).

Inter-subject factor group (CG vs. GE) intra-subject factor and test (pre-test vs. post-test)
When analysing the inter-subject factor group individually, significant differences were found in terms of coordination and balance (p <0.001) and laterality (p = 0.001). This happens because an independent analysis was performed to the intra-subject factor test. After examining the interaction between the two factors, we can find significant differences in all the variables analysed (p <0.001) (Table 1). After the application of the physical education specific program, the scores increased in the experimental group (post-test) compared with the pre-test scores. These differences are expressed in figure 3.

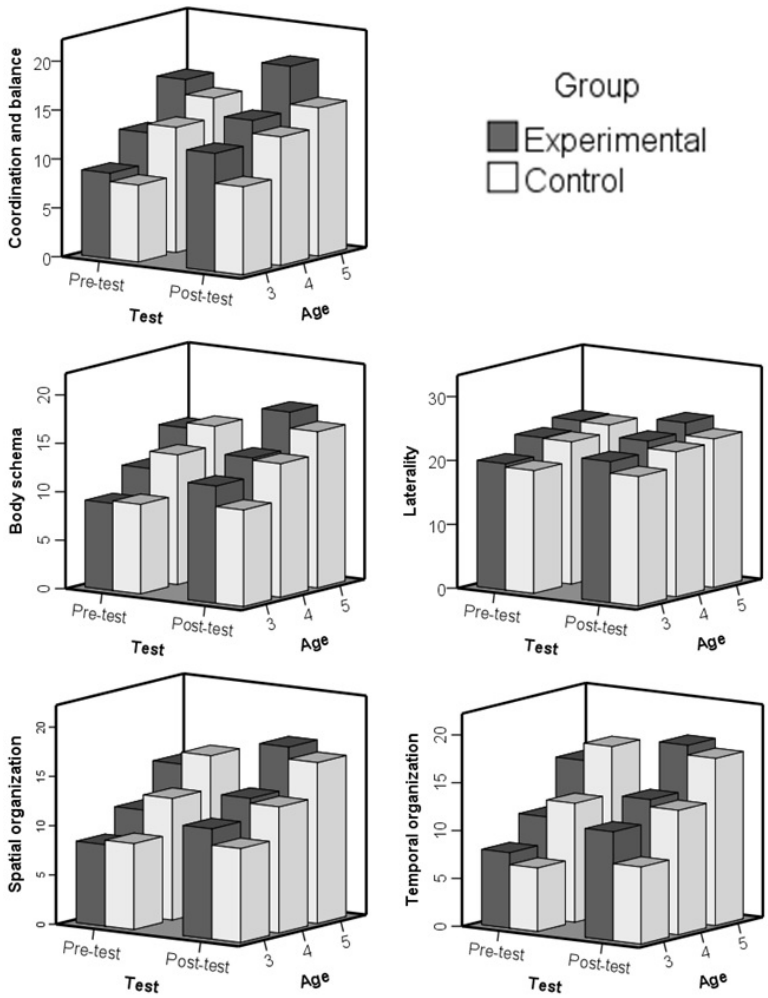

Figure 3. Interaction profile graphics between test factor (intra-group: pre-test and post-test) and group factor (inter-group: control and experimental)

Table 1. Sample descriptive stats results. Distribution of group and age scores

		Total (n = 324)			3 years (n = 95)			4 years (n = 103)			5 years (n = 126)			ANOVA			
Variable	**Test**	**Mean**	**SD**	**CI**	**Mean**	**SD**	**CI**	**Mean**	**SD**	**CI**	**Mean**	**SD**	**CI**	**A F-p**	**B F-p**	**C F-p**	**A·B F-p**
CB	**Pre-test**	12.41	4.38	11.93 12.89	8.28	3.19	7.63 8.93	12.33	3.26	11.69 12.97	15.60	3.19	15.03 16.16	466.31 < 0.001	23.48 < 0.001	146.16 < 0.001	201.42 < 0.001
	Post-test	14.12	4.28	13.65 14.58	10.52	3.13	9.88 11.15	13.83	3.23	13.19 14.46	17.07	3.56	16.44 17.70				
BS	**Pre-test**	12.51	3.69	12.10 12.91	9.09	2.69	8.55 9.64	12.47	2.75	11.93 13.00	15.11	2.81	14.62 15.61	344.16 < 0.001	1.05 0.307	140.09 < 0.001	141.35 < 0.001
	Post-test	14.24	3.73	13.83 14.65	11.01	2.68	10.46 11.56	13.90	2.66	13.38 14.42	16.94	3.08	16.40 17.49				
L	**Pre-test**	21.96	3.47	21.58 22.34	19.47	3.96	18.67 20.28	22.32	2.86	21.76 22.88	23.54	2.31	23.13 23.95	45.95 < 0.001	10.40 0.001	43.75 < 0.001	19.26 < 0.001
	Post-test	23.03	3.57	22.64 23.42	21.16	3.63	20.42 21.90	23.27	3.18	22.65 23.89	24.25	3.26	23.67 24.82				
SO	**Pre-test**	12.03	4.09	11.58 12.48	8.48	2.61	7.95 9.02	11.54	3.27	10.90 12.18	15.10	3.18	14.54 15.66	94.77 < 0.001	0.03 0.858	121.16 < 0.001	40.54 < 0.001
	Post-test	13.77	4.82	13.24 14.29	10.34	2.45	9.84 10.84	13.06	3.04	12.46 13.65	16.93	5.34	15.99 17.87				
TO	**Pre-test**	12.20	5.55	11.59 12.80	7.24	3.06	6.62 7.86	11.50	4.43	10.64 12.37	16.50	4.34	15.73 17.27	360.77 < 0.001	1.30 0.255	154.28 < 0.001	153.12 < 0.001
	Post-test	14.09	5.01	13.54 14.63	9.68	3.00	9.07 10.30	13.40	4.03	12.61 14.19	17.97	3.82	17.29 18,64				

A: Test B: Group C: Age

CB: Coordination and balance; BS: Body schema; L: Laterality; SO: Spatial organization; TO: Temporal organization

Table 2 shows the scores of the pre-test and post-test for each of the two groups (control and experimental) divided by age. The experimental group, when comparing the pre-test with the post-test, shows significant differences at all ages and all variables, always with a p <0.001.

Table 2. Score statistical results (pre-test and post-test), for each of the two groups (control and experimental) divided by age.

			Pre-test		Post-test			
Variables	Age	Group	Mean	SD	Mean	SD	Mean difference (Post - Pre)	P
CB	3	CG	7.85	2.62	9.00	2.10	1.15	< 0.001
		EG	8.72	3.66	12.06	3.27	3.34	< 0.001
	4	CG	12.80	3.53	13.14	3.37	0.34	0.075
		EG	11.89	2.93	14.47	2.99	2.58	< 0.001
	5	CG	14.84	3.07	15.16	3.31	0.32	0.148
		EG	16.37	3.14	19.05	2.61	2.68	< 0.001
BS	3	CG	9.23	2.53	9.96	2.21	0.73	0.002
		EG	8.96	2.86	12.09	2.71	3.13	< 0.001
	4	CG	13.38	2.86	13.78	2.87	0.40	0.089
		EG	11.60	2.36	14.02	2.45	2.42	< 0.001
	5	CG	15.38	2.93	16.13	3.24	0.75	0.001
		EG	14.84	2.68	17.79	2.68	2.95	< 0.001
L	3	CG	19.21	4.80	20.27	4.12	1.06	< 0.001
		EG	19.74	2.89	22.06	2.81	2.32	< 0.001
	4	CG	22.26	3.17	22.68	4.04	0.42	0.277
		EG	22.38	2.55	23.83	1.94	1.45	< 0.001
	5	CG	23.47	2.38	23.27	4.18	-0.20	0.333
		EG	23.61	2.26	25.26	1.33	1.65	< 0.001
SO	3	CG	8.71	2.59	9.52	2.41	0.82	0.072
		EG	8.26	2.63	11.17	2.22	2.91	< 0.001
	4	CG	12.34	2.88	12.80	2.98	0.46	0.291
		EG	10.79	3.47	13.30	3.12	2.51	< 0.001
	5	CG	15.70	2.64	16.33	3.81	0.63	0.218
		EG	14.48	3.58	17.55	6.53	3.07	< 0.001
TO	3	CG	6.63	2.61	8.04	2.21	1.41	< 0.001
		EG	7.87	3.37	11.36	2.79	3.49	< 0.001
	4	CG	12.42	5.06	13.00	4.56	0.58	0.028
		EG	10.64	3.60	13.77	3.47	3.13	< 0.001
	5	CG	17.39	4.15	17.47	3.88	0.08	0.878
		EG	15.58	4.38	18.48	3.72	2.90	< 0.001

CB: Coordination and balance; BS: Body schema; L: Lateral; SO: Spatial organization; TO: Temporal organization

DISCUSSION

This study aimed to investigate the influence of a structured program on the children's motor development. It is clear that physical activity decrease is an important factor in the obesity rates increase (Pate et al., 2006). Also, fitness and fatness appear to be associated with children's cognitive function (Li et al., 2008; Roberts et al., 2010; Yu, 2010) and academic achievement (Datar et al., 2004; Shore et al., 2008). According to several studies, physical activity levels are minimal at an early age (Tucker, 2008; Wang, Pereira, & Mota, 2005a; Wang, Pereira, & Mota, 2005b). Thus, in a previous study, it was observed the

increasingly low psychomotor skill levels in preschool-aged children (Stodden et al., 2008; Tucker, 2008). Children who do not receive adequate motor skill instructions and practice may show a development delay in their abilities (Stagnitti et al. 2011; Goodway & Branta, 2003). Hence, it is essential to deconstruct the commonly accepted idea, sometimes supported by academics, that children are spontaneously active.
Unfortunately, the number of children not participating in adequate physical activity is still a global concern (Guthold et al., 2010; Cohen, 2014). Some studies recommend increasing the time of physical activity engagement and the time to play for preschool children in early learning settings (Stegelin et al., 2014; Stork & Sanders, 2008; McKenzie & Kahan, 2008). Also, studies conducted by Favazza et al. (2013), Bundy et al. (2011) and Palma (2008) show that, simple interventions in a young age with children engaged in spontaneous play could be directed so as to increase their physical activity and social skills. Thus, implementing PE activities, preferentially in the form of structured PE classes, at an early age (i.e., preschool/kindergarten) helps initiate physical activity in children and increases their motor (Stodden et al., 2008) and cognitive development (Trudeau & Shephard, 2008; Sibley & Etnier, 2003). Over the last few years, Portugal has seen an exponential increase in preschool education. However, PE's role is still unclear at this educational level. Although a PE national program exists in preschool education (developed by the government), teachers and educators of this level usually lack appropriate knowledge and skills to teach adequate PE classes (Neto, 2009; Lopes, 1997). In pre-school education, PE classes run by an appropriate PE teacher are not regular. Unfortunately PE classes run by a PE teacher depend on parents and/or regional authorities' financial support.

Similarly, there have been few Portuguese studies on preschool PE teaching. According to Stone et al. (1998), the difficulty of evaluating preschool children's physical activity and designing interventions with them partially explains this research gap. The current literature has provided some promising results on PE intervention studies. In Portugal, studies run by Palma (2008) have shown the importance of structured PE in early childhood. However, these studies have been restricted to small sample sizes. The abovementioned facts motivated the development of this study, which aimed to verify the influence of properly structured PE classes, based on psychomotor principles and adapted to the group in question, on psychomotor development of 3 to 5 year-olds preschool students.

The study results show that the EG score variations were greater (and by greater we mean statistically significant) for all abilities compared with the CG score variations. These results, as in other studies (Robinson, 2011; Robinson, Goodway & Rudisill, 2009; Valentini & Rudisill, 2004; Goodway, Valentini & Rudisill, 2002), demonstrate the positive influence of structured PE's on the psychomotor development of preschool children. The 2009 pilot study differs from the current study in terms of the PE class application period. In the present study, the PE program was longer, lasting 6 months. This difference addresses a relevant aspect raised by the findings of Goodway et al. (2002) and Martin, Rudisill, and Hastie (2009), who highlighted the importance of time in training. They argued that although training depends on many additional elements, such as the individual characteristics of children and their surrounding environments, teachers/educators must dedicate adequate time to each ability (particularly in PE classes) to ensure that each student can be proficient in most movements and related skills. Examination of present results showed that the EG score variations was higher (statistically significant) on all abilities. Analysing the sample results, we verified that the EG students do not show significant score differences between genders across these diverse abilities. These findings are in-line with other studies (Andrade, Neto & Ducharne, 2008; Fischer et al., 2005; Pollatou, Katamidou & Gerodimus, 2005) that also found no gender differences at the preschool age.

Study limitations

The first limitation of this study was the sample composition, which was not heterogeneous. When choosing a significant number of Porto students, we had to accept their diversity because the most important focus was score development (i.e., the score range for the psychomotor profiles for both groups) and not the baseline (the initial psychomotor profile score – pre-testing) or final results (the final psychomotor profile score – post-testing). Additionally, we experienced some challenges during the testing application. From the beginning of the study, we had to engage all children to make them feel comfortable enough to participate in several activities.

We also tried to minimise the differences between psychomotor test spaces. Some schools did not have optimal gym conditions, and some schools did not even have a gym. In these cases, the tests were performed in other school areas, which were adapted to minimise any possible spatial differences.

CONCLUSIONS

PE or other physical activity objectives involve the harmonious work of body and mind, a balance between what the body expresses and what the mind thinks. Unfortunately, the role of PE and PE teachers in public preschool education is not well defined. Besides this fact, PE is not always taught in a proper manner. Sometimes PE is taught in a general manner, without the necessary involvement and without paying enough attention to each student's individuality.

The role of the preschool education is fundamental for the child development process. At this stage, quality teaching practices should stimulate children, considering their individual characteristics and needs, to help them acquire during development several essential abilities and skills. In this sense, studies have highlighted the importance of PE and PE teachers in the child development. By analysing the study outcome, we argue that structured PE is important for preschool children's psychomotor development because it increases their overall development.

ACKNOWLEDGMENTS

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