Original Article

The relationship between the practice of physical activity and sport and the level of motor competence in primary school children

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Abstract:
Gross motor skills are the precursors of complex activities used for performing typical daily activities and for playing games and sports. The development of this kind of skills happens between three and eight years and an adequate level of these skills is mandatory in order to develop psyco-motor, social and affective domains of learning. In this work, the gross motor development has been studied in 120 children aged 6 to 11 from three different schools in Sicily. Every child performed all the items of the TGMD test and was ranked according to their gross motor development quotient. Later, thanks to the parents' help, every child had to complete the CLASS questionnaire which had investigated on their daily routine in terms of activities done. Regression analysis was performed to establish which determinants impact the most on the skills development. Results showed that males, the children of the lower classes and those who practice a sport are more likely to have a high motor level in comparison with the respective reference categories (i.e, females, highest school classes, and students with low level of motion, respectively). These evidences are useful to understand the role of the school in the development of FMS and to plan adequate strategies in order to overcome the up-to-date limits in the physical education teaching-learning process.
Key words: test of gross motor development, class questionnaire, fundamental motor skills, locomotor skills, object control skills.

Introduction

During preschool and school age to promote healthy growth founded on correct lifestyles is necessary. Some researches (Schor EL, 2003) assert that acquiring active behavioral models during childhood and adolescence determine their maintenance in adulthood. Moreover, the participation to physical activities combats all risks of the sedentariness (WHO, 2004) and extend its benefits beyond a physical perspective until to cognitive, affective and social domains (D'Elia, 2019, D'Isanto, 2016, Gaetano, 2012). Particularly, physical activity and sport implement the socialization, identification and character structuring processes (Nelson, Neumark-Stzaaainer, Hannan, Sirard, & Story, 2006; Fox, 2000). So, since the physical activity level in developmental foretells the adult physical activity level (Telama, et al. 2005), it is necessary to lay the foundations of an active and healthy lifestyle from childhood. However, the existence of a worldwide decline's trend about the motor competences is suggest by different scientific researches (Niemeijer & Smits-Engelsman, 2007; Hardy, Reinten-Reynolds, Espinel, Zask, & Okely, 2012; Sgrò, Quinto, Messana, Pignato, Lipoma, 2017; Sgrò, Pignato, Lipoma, 2018; Sgrò, Quinto, Platania, Lipoma, 2019) and, probably, the dissemination of sedentariness among young people is the cause of this trend (Bardid, Rudd, Lenoir, Polman, & Barnett, 2015). In fact, although the international guidelines recommends that children and adolescents aged 6 to 17 years have to perform at least 60 minutes of physical activities from moderate to vigorous (Strong et al. 2005), the data published in the last years showed that the recommendations failure. By keep in mind this scenario, the purpose of this study was to investigate which determinants among daily routines, gender, and school's grade of 120 children from 6 to 11 impact the most on their level of motor competence. According to this aim, we hypothesized that level of these skills was highest in active children from early age and school's grade.

Methods

Participants and procedures

One hundred and twelve participants were recruited from different schools located in the South of Italy. Twenty-two (male=12; female=10; age: 6.68±0.48) attended the first class, twenty-four (male=9; female=15; age: 7.92±0.28) attended the second class, twenty-four (male=10; female=14; age: 8.67±0.48) attended the third class, twenty-five (male=12; female=13; age: 9.72±0.46) attended the fourth class, and twenty-five (m=15; f=10; age: 10.60±0.50) attended the fifth class.. The assessment procedures were performed in the gym of the schools,

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where four skilled operators met the participants and handled all the test sessions, meanwhile the questionnaires were filled by each child with the help of its parents. The school ethical boards and the ethical committee of the University of Enna "Kore" approved the used research methodology

FMSs Assessment

The gross-motor developmental level was measured by means of the Test of Gross-Motor Development (TGMD) (Ulrich, 1985). TGMD is composed by 12-item test divided into locomotor (run, gallop, hop, leap, standing horizontal jump, slide) and object control (strike, stationary ball bounce, catch, kick, overhand throw) subtests. Three to four skill criteria characterized each item and the operators have to identify if a child mastery or not each item's criteria. For each item, the participants performed three trials; before the assessment began, participants were involved in a low-intensity warm-up program for ten minutes. For each trial, the raw score for locomotor subtest (LO) ranges from 0 to 26, while the raw score for object control subtest (OC) ranges from 0 to 19. The raw scores of each participant are converted to the standard score for each subtest, separately, according to the age of each child. Next, the standard scores have been used to estimate the Gross Motor Development Quotient (GMDQ). The GMDQ is used to interpret the level of actual motor competence of the child according to the normative data provided within TGMD (i.e., very low, low, under the mean, mean, over the mean, high, very high). The operators video-recorded the performance of each child. Then, the evaluation of each trial was performed by each operator, separately, by means of the software Longomtach (LongoMatch, Ver. 0.20.8, http://longomatch.org) that accounts for several procedures (i.e., slow-motion, move the video forward and backwards frame-per-frame) useful for providing valid and reliable evaluation of the participants' performance. The inter-raters reliability ranged from 0.87 for locomotor subtest to 0.91 for object control subtest.

Children's Leisure Activities Study Survey (CLASS)

CLASS are questionnaires used for investigating the children's daily routine in terms of physical and sport activities (i.e., 30 items like dance, tennis, soccer, to ride a bike, etc.) and recreational activities (i.e., 14 items like playing a musical instrument) (Telford, Salmon, Jolley, & Crawford, 2004). For each activity, it was necessary to report the frequency (how many times from monday to friday and how many times on weekend) and the total time spent by the child in that activity (minutes or total hours from monday to friday and from saturday to sunday). The version of CLASS used in this study was the proxy-report, since the parents filled the questionnaire according to the activities performed by their child during the scholastic period. According to cultural and geographical location of the participants engaged in this study, some physical activities were selected and they have been all grouped together into three categories with homogeneous characteristics: sport, physical activity, and leisure. Moreover, for overcoming statistical problem related to a lot of structural zeroes obtained for many activities, the next step was to commute the time spent for each of the aforementioned three categories in dichotomous variables (LoM): a) from 0 to 120 minutes; b) more than 120 minutes. Finally, two levels of motion were defined according to the movement's time: a) Low Level of Motion (LLoM): participants were included in this category if their physical activity and sport time were from 0 to 120 minutes; b) High Level of Motion (HLoM): participants were included in this category if their physical activity and sport time were more than 120 minutes;

Data Analysis

Statistical analysis was based on the use of regression analysis, in univariate and multivariate perspective, by considering the GMDQ as dependent variables and gender, school's classes and CLASS's levels as independent variables. Overall we estimated three univariate models (i.e., one for each independent variables) and three multivariate models. These models were studied by following the principles of the significance and parsimony to identify the minimal adequate model that might be used to describe the current dataset (Collet, 2002). Then, the multivariate models were chosen by assessing the statistical significance of the parameter estimates, and the parsimony of the models (by evaluating the residual deviance using the ANOVA test). In this respect, we discussed in this manuscript two univariate and two multivariate models, respectively. The non-clinical magnitude-based inference method (MBI) was used for assessing the true effect of the estimates in univariate and multivariate models (Hopkins, Marshall, Batterham, & Hanin, 2009). The interpretation of the effects in a negative, trivial, or positive practical sense on the dependent variable (i.e., GMDQ) was based on the following thresholds: <0.5 % most unlikely; 0.5-5% very unlikely; 5-25% unlikely; 25-75% possibly; 75-95% likely; 95-99.5% very likely; and >99.5% most likely (Batterham & Hopkins, 2006). The effect statistics of the odds ratio were achieved by the spreadsheet developed by Hopkins (2007). For each effect, we reported the odds ratio estimates (OR), 90% confidence limits (CI90%), and the practical inference true effect, as suggested by Hopkins and colleagues (2009). The analyses were conducted using R and the alpha level was set to 0.05 in all tests.

Results
Table 1 and table 2 show the univariate and multivariate significant models estimated according to the perspective described above. For each model, the table reports the OR estimates, their $CI_{95\%}$ and the relative p-value.

Table 1. Simple logit models estimated for GMDQ according to gender and school class.

Variable	Levels	OR	$CI_{(95\%)}$		p-value
Gender	Males vs females*	3.98	1.98	8.93	.000
School classes	II vs I*	0.06	0.01	0.22	.000
	III vs I*	0.04	0.01	0.17	.000
	IV vs I*	0.03	0.00	0.13	.000
	V vs I*	0.03	0.00	0.13	.000

Note: *OR*: *Odds Ratio*. $CI_{(95\%)}$: 95% Confidence Interval. *The odds ratio reflects the chance improve the GMDQ level compared for each variable to the reference category.*

Table 2. Multiple logit models estimated for GMDQ as functions of developmental level according to gender and school class and CLASS indicators.

Variable	Levels	OR	$CI_{(95\%)}$		p-value
GMDQ controlling for gender and school class					
Gender	Males vs females*	5.00	2.45	11.15	.000
School class	II vs I*	0.05	0.01	0.21	.000
	III vs I*	0.03	0.01	0.14	.000
	IV vs I*	0.02	0.00	0.11	.000
	V vs I*	0.02	0.00	0.09	.000
GMDQ controlling for gender, school class, and level of sport practice (SLoM)					
Gender	Males vs females*	5.00	2.45	11.15	.000
School class	II vs I*	0.05	0.01	0.21	.000
	III vs I*	0.03	0.01	0.14	.000
	IV vs I*	0.02	0.00	0.11	.000
	V vs I*	0.02	0.00	0.09	.000
SLoM	HLoM vs LLoM*	2.40	1.08	5.43	.030

Note: *OR*: *Odds Ratio*. $CI_{(95\%)}$: 95% Confidence Interval. *The odds ratio reflects the chance improve the GMDQ level for each variable compared to the reference category.*

Results showed that males (OR = 3.98, p <0.05, 95% confidence limit from 1.98 to 8.93, most likely), the children of the lower classes (i.e., class II with OR = 0.065, p <0.05, 95% confidence limit from 0.01 to 0.22, most likely) and those who practice a sport for more than 120 minutes per week (OR = 2.4, p <0.05, 95% confidence limit from 1.08 to 5.43, very likely) are more likely to have a high motor level.

Discussion and Conclusion
The aim of this study was to investigate the daily routines of 120 children from 6 to 11 to understand their influences, with gender and classroom to which they correspond, on the GMDQ estimated from the results of Ulrich's battery tests. The univariate approach reported two statistically significant models under which gender and classroom are good predictors of response variable (i.e., GMDQ). The females are more likely to belong to lower development that is four time higher than males who are more likely to belong to highest development level. (OR= 3.98, p<0.05, 95% IC from 1.98 to 8.93). This possibility is very likely in terms of effects size. These trends are discussed extensively in the scientific community and the researchers suggest that males show fundamental motor skills better than female in different motor tasks (Barnett, et al., 2010; Goodway, et al., 2010; Hardy et al., 2012; Griffiths & Billard, 2013; Spessato, Gabbard, & Valentini, 2013; Sgrò, et al., 2017). Particularly, males have OC abilities better than females (Robinson, 2011; LeGear, et al., 2012;) while these ones show LO abilities better than males in some studies (Hardy, et al., 2010; LeGear, et al., 2012;). These results underline the need to control for gender the developmental level of fundamental movement skills. In children, gender differences in FMS are the results of environmental influences; for example, the differences between male and female are due to social factors when the assessment is process-oriented rather the product-oriented (Hardy et al., 2012). So, the superiority of males can be due to their low personal barriers in performing physical activity during his spare time or to different opportunities for participation in structured physical activity and sport practices (Spessato, et al., 2013). In fact, girls have less encouragement by the family to engage in regular physical activities or sports (Goellner, Votre, Moura, & Figueira, 2010;). Moreover, this study found that lower classes are more likely to belong to the categories with highest GMDQ. For example, the children of second grade are more likely to be ranked in the "mean" level of motor development rather than in the "under the mean" rank's level, with 6% vs the 3% of class five. (OR= 0.065, p<0.05, 95% IC from 0.01 to 0.22). This possibility is more likely than the others. Another study found similar outcomes (Sgrò, et al., 2017)

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and this support the universality's paradox of Ulrich that the chronological growth of a person doesn't corresponds to the FMS improvements. A study in Brazil shows an improving performance at 5 to 7 years whit a plateau by the age of 8 which persist until 10 years (Spessato, et al. 2013; Valentini et al. 2016).

The multivariate approach returned only two statistically significant models. The best predictors were gender-class and gender-class-sport, respectively. The superiority of male and younger children was again verified (OR=5.00, p<0.05, 95% IC from 2.35 to 11.15, most likely) with all OR < 1. The level of sport practice became significant (p<0.05) when it was considered in multivariate mode with "gender" and "class" (OR=2.4, p<0.05, IC from 1.08 to 5.43). So, playing sport less than two hours a week decreases the odd to belong to highest level of gross motor development. This eventuality is quite likely in terms of effect size. Two relatively recent studies (Fisher, et al., 2005; Williams, et al., 2008) shown that motor skills are positively linked to levels of intense physical activity for both males and females, but they are not related to mild physical activity. It seems that this relationship is influenced by the type of motor skills, the intensity of the physical activity examined, the child's gender and by the interactions between these factors. Williams and colleagues (2008) found that children with increased locomotor competence spent more time on MVPA, while Cliff and colleagues (2009) found that object control skills predicted 16.9% and 13.7% of variance in MVPA. Clearly, children who show greater motor skills are more involved in physical and sports activity because they are able to apply their motor skills to various types of activities compared to children with a low motor skill level. However, there are few studies in this direction so the strength and direction of the relationship between physical activity and better skill levels are largely unknown. On the contrary, it is known that sport increases the skill level of those who practice it (Gabbard, 2011; Palma, Camargo, & Pontes, 2012; Nazario & Vieira, 2014).

The main limits of the current research are: (a) the failure account of the ethnic origin of the sample; (b) the administration of a proxy report questionnaire that often compiled negligently by the parent and (c) the failure account of the socioeconomic factors that may affect the growth of the individual. The literature review revealed that family, economic status, educational level of the mother, and brothers' existence could influence the level of children motor competence. So, this research aims to be a starting point for a reflection about the need to increase, on the Italian territory, the motor activities proposed to the age group examined (6-11 years). The recorded association between sport and better levels of skill have to become an input to combat the motor involution of our day, which is a real emergency.

In conclusion, we can assert that our results may contribute to extent the up-to-date literature about the relationship between level of motor competence, gender, school's classes and level of sport practice. This data may be useful for all the stakeholders involved in the design and planning of school and extra-school sport activities in order to overcome the limits identified in this study and in the other with similar results.

Author Contributions

Rosaria Schembri, Antonella Quinto and Rosario Pignato were involved in the study conception and design, in the data acquisition and in the data analysis and interpretation, as well as in the manuscript drafting and revision. Fabio Aiello contributed to the statistical planning and to data analysis and processing, and to the manuscript revision. The original concept of the study was proposed by Francesco Sgrò, who supervised the work, contributed to the data analysis and interpretation and to the manuscript critical revision.

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