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Original Article

Assessment of motor coordination in students aged 6 to 11 years

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Abstract:
Motor coordination is a complex slowly-acquired evolutionary process. This study aims to assess the level of motor coordination in students aged 6 to 11 years and analyze the connections between fundamental motor skills resulting from the tasks that form the 3JS test. A sample of 2649 students was used. The findings show that there are numerous differences in the maturity of motor coordination depending on the age and sex variables: the level of motor coordination increases as the age increases but this rise is lower at every age from 6-11 years and there is a higher rise in the period between 6-8 years. In order to provide an appropriate frame of reference for every age and sex, some normative tables that will allow Physical Education teachers and researchers to evaluate the level of motor coordination are suggested. The results of this study show a higher percentage of girls in the intervals of a normal, good and very good level of motor coordination. The study of the correlations shows that there is a significant relationship among the fundamental motor skills included in the motor coordination tests (<0.01). The highest dependences are found between the following skills: conduction and kick (0.62), conduction and rebound (0.58) and kick and throw (0.75).
Key words: Motor coordination, Assessment, Physical Education, Motor skills.

Introduction

The evolution of the skills linked to motor activity is mainly structured around motor coordination. Primary education is one of the pillars on which the curriculum is built, not only for the Physical Education subject but also for the overall education of students. The development of motor skills at these ages represents a lifetime warranty (Barela, 2013)

Some international researches reveal that the evolutionary problems in motor coordination exhibited by some Primary students, persisted beyond adolescence (Ruiz; Mata, & Moreno, 2007). This fact can result in psychological and social consequences such as the perception of scarce motor competence and low self-esteem leading to relational problems and lower motivation towards physical and sport activity. D´Hondt et. al. (2013) found a strong link between motor coordination and obesity and the weight of children aged from 6-10 over time. A consensus was reached by experts who met under the coordination of Torres, J. (Lorenzo, 2006) on 5 May 2000 at the Faculty of Education Sciences of Granada to define motor coordination according to the description given by Grosser, M.; Hermann, H.; Tusker, F.; Zintl, F. (1991), with some contribution from Castañer and Camerino (1996):

“The set of skills that accurately organize and regulate all the partial processes of a motor action according to a pre-established motor goal. That organization needs to be focused as an adjustment of all the forces produced internally and externally considering all the levels of autonomy of the motor apparatus and the changes of the situation”.

There are numerous definitions in the literature on motor coordination skills or the factors that integrate it and the terminology and classification depend on the field from which they have been carried out: psychology, medicine, pedagogy, etc. Despite their acknowledgment of the difficulty to synthesize and describe these factors, the group of experts coordinated by Torres suggests the following coordination abilities: combination ability, spatial and temporal orientation ability, kinesthetic differentiation ability, balance ability, reaction ability, transformation or change ability and regular and irregular rhythm ability.

These coordination skills jointly and interdependently reveal themselves resulting in a movement which, according to its higher or lower efficiency, we can say will be more or less coordinated.

The adjustment in the performance of any motor action integrates all the set of organizational and control processes to achieve some efficiency. These processes are based on sensory analyzers, which are partial

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systems of sensory perception that, based on signals of a certain quality, catch, decode, transmit and elaborate information.

According to Weineck (2005, 486), specific receptors, afferent nerve pathways and sensory centers in particular encephalic areas are included in the category of analyzers. As regards motor coordination, we are mainly interested in 5 analyzers which obviously work in conjunction complementing each other: kinesthetic analyzer, touch-sensitive analyzer, static-dynamic analyzer, optical analyzer and acoustic analyzer.

The development of motor coordination skills occurs in different ways and at different times (Weineck, 2005, 302). Since birth, the development of these skills follows an individual pace and before the age of four, less developed skills already appear due to the lack of stimuli. The highest level of improvement appears from the age of four until seven (Hahn, 1988, 84). However, Weineck (2005), quoting Stemmler (1977, 278) and Hirtz (1976, 385) states that, in general, coordination skills experience their highest boost between the age of four and puberty. Beraldo and Polletti (1991), quoted by Conde and Viciana (1997), claim that the best age for the development of motor coordination skills goes between the ages of six and eleven years even though motor intervention has to start earlier, as soon as the development of the neuromuscular and sensorimotor control and regulation of movements starts, which takes place at an early age.

The elaboration of their repertoire of motor skills (motor equipment) in every subject is carried in line with the quality of the substrate created by the set of motor coordination skills. Catañer and Camerino (1996) see a relation between the three fields of motor skills (perceptive skills, whose main content is coordination, physical and social-motor skills) and the physical-motor skills. The fundamental idea of the resulting skills is that they empower and refine themselves. In this sense, Ruiz (1987) points out the importance of the function of fundamental motor skills since they are found in every human being; they have ensured our survival and they are crucial for later motor learnings. In Physical Education, the most frequently used focus for the intervention in maturation problems of motor coordination concentrates on the development of specific motor competences linked to the following skills: to throw, to jump, to run, etc. The practice is focused on the learning of specific tasks which pupils find difficult and which are selected with a pragmatic vision so that they develop competences through their participation in essential motor skills: their movement (global motricity) as well as their control over objects (precise motricity) such as race, throw, rebound, kick or balance-related competences (Valentini & Rudisill, 2004; Ruiz, 2007). There are some tests that attempt to measure the neuro-motor capacity from the psychological perspective mostly paying particular attention to the detection of possible problems inherent to the evolution of motor coordination in pupils. In this sense, we have the TOMI (Test of Motor Impairment), whose current version is Henderson and Sugden's Movement Assessment Battery for Children (Movement ABC, 1982). This test was used in Spain in a motor competence cross-cultural study with pupils aged 7-10 years (Ruiz et al., 2005). Ulrich's Test of Gross Motor Development, second edition (TGMD-2, 2000), which was designed for the assessment of gross motor development in children aged 3 to 10 years, has been used over the past years. The KörperkoordinationsTest für Kinder (KTK), which consists of four subtests, measures gross motor coordination in children aged 5 to 15 years (Vandorpe, B.; Vandendriessche, J.; Lefevre, J.; 2011). The methodology of movement analysis used in the 3JS test was the qualitative method based on the assessment of systematic observation of the factors that contribute to the performance of each motor skill. The qualitative analysis process consists of four stages: preparation, observation, diagnostic evaluation and intervention (Knudson and Morrison, 2002). This study focuses on the third stage in order to evaluate the level of motor coordination in students aged 6 to 11 years and analyze the links between the fundamental motor skills resulting from the tasks that form the 3JS test. The secondary aim of this research was to establish a frame of reference for age and sex-appropriate development levels of motor coordination.

The current assessment guidelines in the context of education define and present teachers as professionals who plan their work, gather all the data provided by reality, analyzing them from an ecological perspective and search for alternatives to deficient situations. Furthermore, Ruiz, L.M.; Jiménez, I., Otero, R. and Peñaloza, R. (2015) support a special attention to the coordination skills from the medical and teaching perspective after its substantial decline. For this reason, this study aims to be used by teachers and researchers in motricity as reference and guide since it provides them with a rigorous scientific assessment of the factors involved in the learning process and development of motor coordination in 6-11 year-old students. This study aims to become part of a series of more exhaustive researches that analyze the evolution of motor coordination and its elements.

Method

Subjects and Sample

This study involved 2649 students from 12 state primary schools from the region of Andalusia (Spain), aged between 6 and 11 years. The representativeness within each age group was very similar, with the percentage varying between 14% (9 years) and 20% (7 years). The sample is homogeneously distributed between all the age groups that correspond to the primary stage (Table 1), 53% of the sample includes subjects aged between 6 and 8 years and the rest, 47% corresponds to those aged between 9 and 11 years.

The sample is homogeneous as regards the number of subjects of each sex. The males account for slightly more than 51% of the sample and the females represent nearly 49%.

In compliance with the ethical standards required in any study involving people, the parents of the pupils participating in the study were exhaustively informed in written form about its characteristics and their agreement was requested.

Variables

Two descriptive variables of the sample that refer to permanent demographic characteristics (gender and age) were used. The 3JS tool assesses 7 tasks, each of which is turned into a variable. These are quantitative and discrete variables, which were measured in the ordinal level (the assigned values were: 1, 2, 3 and 4). We define them as jump, turn, throw, kick, race, rebound and conduction.

In addition, we have an eighth variable (also quantitative and discrete) which results from the sum of the previous seven ones and which we shall call coordination. The fundamental motor skills included in the 7 tasks of the 3JS test gather all the set of motor coordination skills accounting for the level of coordination of the subject.

Instrument

The 3JS tool is a validated test that evaluates the development of motor coordination in the two-related aspects of locomotion and visuomotor. It uses a qualitative procedure of objective observation and evaluation of the performance achieved in each task. It is a tool that can be applied throughout all the primary education stage (from 6 to 12 years), which allows us to check the improvement of coordination during all this educational period (Cenizo, J.M.; Ravelo, J.; Morilla, S. Ramírez, J.M.; Fernández, J.C.; in press).

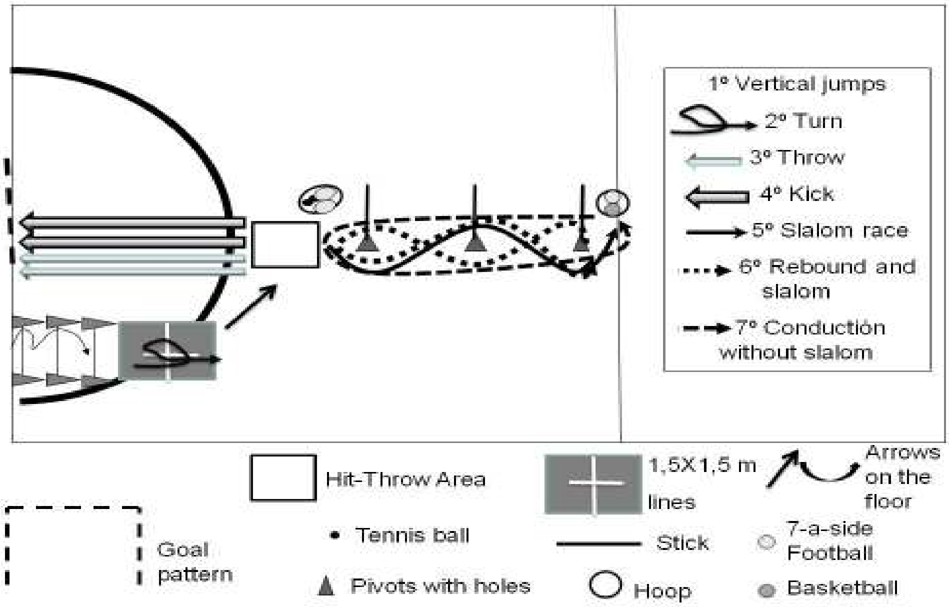

Fig.1.Organization of the equipment and tasks in the circuit of the motor coordination test

The pupils go through a circuit (Figure 1) where they carry out 7 consecutive activities without a break in the middle. They perform a different motor task in each of them where a different kind of coordination is revealed (dynamic, general or segmental). The qualitative assessment is carried out through observation and the record of the performance of the 7 tasks. Each task is rated from 1 to 4, where 1 is assigned to the most immature performance and 4 is the optimal mark.

Results

Analysis of the tasks forming 3JS test

The average value indicates the maturity or the level of coordination showed by all the students for each task. The lowest average corresponds to the conduction task and it is also the one with the highest typical deviation (table 1). Therefore, this is the most challenging task for children aged 6-11 years and it also shows the most heterogeneous results. The task with the highest maturity (the highest average) is the turn with 3.24, closely followed by the throw 3.07 and the jump 3.04.

Table 1. Statistics of the seven motor skills (tasks of the 3JS test) and motor coordination

	Jump	Turn	Throw	Kick	Race	Rebound	Conduction	Motor Coordination
Average	3.04	3.24	3.07	2.68	2.95	2.45	2.22	19.62
Medium	3.00	3.00	3.00	3.00	3.00	2.00	2.00	19.00
Mode	3	3	3	2	3	3	2	18
Aver. Dev.	0.70	0.68	0.69	0.89	0.69	0.88	0.93	3.82

The assessment of the tasks that form the test show a particular evolution of every task. This evolution is defined by the distribution of the scores obtained by the pupils and the values of the statistical data corresponding to each gender and age. A higher percentage of low scores indicate a lower maturity in the performance of the different tasks and, on the contrary, a greater percentage of high scores show a higher maturity or the maximum score even expresses a full command of a certain task (table 2).

Generally speaking, rebound and conduction are the tasks that present lower maturity. Turn is the task in which a greater percentage of pupils (38%) get the maximum score. For all the tasks that make the test, the highest relative frequency occurs for intermediary scores (2 and 3). In the first 5 tasks the value with the lowest frequency is the most immature stage (1 point). For rebound and conduction, the lowest percentage is for the maximum scoring stage (4 points).

Table 2. Relative frequencies of the seven fundamental motor skills

	Component tasks of the 3JS test						
Score	Jump	Turn	Throw	Kick	Race	Rebound	Conduction
1	2.9 %	0.6 %	1.3 %	6.3 %	1.3 %	15.3 %	23.8 %
2	14.4 %	12.7 %	16.7 %	42.4 %	23.0 %	36.3 %	42.4 %
3	58.4 %	49.1 %	55.1 %	28.7 %	55.0 %	36.9 %	22.1 %
4	24.2 %	37.7 %	26.8 %	22.6 %	20.7 %	11.6 %	11.7 %

Thanks to the test performance protocol no values were lost in the study. In all the tasks the minimum was 1 and the maximum was 4, which correspond respectively to the minimum and maximum scores.

The study of the correlations (table 3) shows that all the variables influence each other since the significant values are inferior to 0.01, which leads us to the claim that there is a significant effect of all the dependent variables among themselves. The coordination variable results from the 7 tasks, so its strong correlation between them was expected. However, we can see that the intensity level of the relation between coordination and the different tasks differs from one to another.

The highest correlation is found between the conduction-coordination and the kick-coordination. The jump is the lowest correlation or the task that has the lowest level of dependence on motor coordination.

When we analyze the correlations between the tasks (table 3), we note that the highest dependence is found between the conduction and kick, conduction and rebound and kick and throw skills. The lowest correlations are found between the kick and jump skills.

Table 3. Correlations between the fundamental motor skills of the 3JS test tasks

		Jump	Turn	Throw	Kick	Race	Rebound	Conduction	Motor coordination
Jump	Rho de Spearman	1							
	Sig. (bilateral)	.							
Turn	Rho de Spearman	0.36(*)	1						
	Sig. (bilateral)	.000	.						
Throw	Rho de Spearman	0.27(*)	0.31(*)	1					
	Sig. (bilateral)	.000	.000	.					
Kick	Rho de Spearman	0.20(*)	0.26(*)	0.56(*)	1				
	Sig. (bilateral)	.000	.000	.000	.				
Race	Rho de Spearman	0.33(*)	0.32(*)	0.42(*)	0.44(*)	1			
	Sig. (bilateral)	.000	.000	.000	.000	.			
Rebound	Rho de Spearman	0.30(*)	0.32(*)	0.40(*)	0.46(*)	0.39(*)	1		
	Sig. (bilateral)	.000	.000	.000	.000	.000	.		
Conduction	Rho de Spearman	0.28(*)	0.31(*)	0.49(*)	0.62(*)	0.40(*)	0.58(*)	1	
	Sig. (bilateral)	.000	.000	.000	.000	.000	.000	.	
Motor coordination	Rho de Spearman	0.50(*)	0.55(*)	0.67(*)	0.72(*)	0.63(*)	0.70(*)	0.75(*)	1
	Sig. (bilateral)	.000	.000	.000	.000	.000	.000	.000	.

** The correlation is significant at the level .001 (bilateral)

When we conducted the study according to gender, we found that the correlations between the 7 tasks are stronger for the male. For the female, the lowest correlation is found in the jump-kick tasks with a value of

0.134* and the highest correlation is found in the rebound-conduction tasks (0.445*). In boys the highest correlation is found in the relation kick-conduction (0.638*) and the lowest in the relation jump-kick (0.282**).

When we consider the correlations by age we realize that the power of the relations increases with age in all the variables except the turn variable. With this information, we can claim that the relations between the different tasks that form the 3JS test and coordination are stronger the older the subjects are.

Motor coordination analysis

This variable derives from the sum of the scores obtained in the tasks of the test. It is a resulting variable that measures the coordination showed by the pupils. They can get a minimum score of 7 points (one point in each of the 7 tasks) and a maximum of 28 (four points in each task) (figure 2).

In the distribution by percentage for the entire sample, it is noticed that the older the age, the higher the scores of the coordination variable. Thus at the age of 7 years approximately 54% of the students get 17 points or less. However, at the age of 11 years the same score is obtained by less than 12%. Similarly, we can see how at the age of 6 years the accumulated percentage of the students who score 23 or more is nearly 5% whereas at the age of 11 years this score already represents 35%.

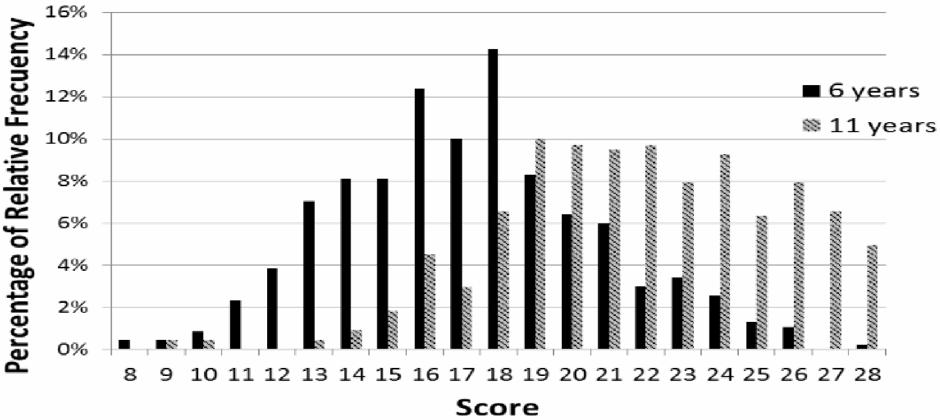

Fig. 2. Variable for motor coordination at 6 and 11 years

The development of coordination during the primary education stage becomes more obvious when we compare the percentage of the relative frequency of the youngest subjects (6 years) with that of the oldest subjects (11 years).

There was never a case where the lowest score (7 points) might have been obtained. 1.4% of the sample gets the highest score (28 points). 39.5% of the sample gets 20 or more points.

Age and sex and the 3JS test tasks

In order to analyze the normality of the data according to the gender and tasks variables on the one hand and the age and tasks variables on the other, we used the Kolmogorov-Smirnov test since the sample size for the different samples is higher than or equals 50. The p-value in each task is lower than 0.05. Therefore the sample normality hypothesis is ruled out.

We used the Mann-Whitney U test to check whether there were significant differences in each test according to the gender variable due to the lack of normality in the data. In the case of the jump variable, we can note that at a confidence level of 95% the equal score hypothesis is accepted since the p-value obtained is 0.164. For the rest of the tasks, including the coordination variable, we note that the p-value is lower than 0.05, from which we can deduce that there are differences in the average score between boys and girls.

In order to check whether the age variable significantly influences the scores obtained in each task, we used the Kruskal-Wallis test due to the lack of normality in the data. We note that at a confidence level of 95%, the null hypothesis of equal scores according to all age levels is discarded. If we analyze the average scores and ranks obtained in that test, we can deduce that the older the age the higher the score obtained in the different tasks.

When we compare the descriptive statistics obtained from the tasks of the test according to age (table 4), we realize that the lowest average for all ages is the conduction task. The jump, turn and throw tasks show better averages for all ages.

In the gender-based comparison, we proceeded from the aforementioned fact that the differences according to gender are significant ($p<.05$) for all the tasks except for the jump. The analysis of descriptive statistics (table 4) reveals that the greatest difference is found in the conduction task and the lowest difference is in the turn. As already mentioned, the equal scores hypothesis between males and females is accepted in the jump variable.

Table 4. Descriptive statistics of the fundamental motor skills according to age and sex

	6 years		7 years		8 years		9 years		10 years		11 years		Male		Female	
	Avg.	T.D.	Avg.	T.D.	Avg.	T.D.	Avg.	T.D.	Avg.	T.D.	Avg.	T.D.	Avg.	T.D.	Avg.	T.D.
JU	2.79	0.77	2.93	0.65	3.04	0.63	3.07	0.74	3.23	0.68	3.22	0.66	3.05	0.73	3.03	0.67
TU	2.84	0.66	3.05	0.65	3.22	0.62	3.37	0.62	3.50	0.60	3.54	0.63	3.28	0.68	3.20	0.68
TH	2.88	0.71	2.89	0.63	3.03	0.67	3.20	0.63	3.22	0.69	3.29	0.69	3.32	0.67	2.82	0.62
KI	2.47	0.91	2.54	0.81	2.62	0.86	2.67	0.91	2.81	0.89	2.99	0.86	3.11	0.85	2.22	0.68
RA	2.76	0.73	2.81	0.67	2.92	0.68	3.03	0.68	3.06	0.64	3.17	0.66	3.08	0.67	2.81	0.69
RE	1.76	0.77	2.18	0.74	2.42	0.77	2.58	0.81	2.89	0.76	2.98	0.79	2.68	0.88	2.20	0.81
CON	1.71	0.77	2.03	0.88	2.23	0.91	2.31	0.89	2.49	0.95	2.60	0.90	2.69	0.92	1.73	0.66
COO	17.22	3.50	18.44	3.22	19.47	3.50	20.25	3.47	21.03	3.59	21.78	3.70	21.12	3.88	18.06	3.07

TD=Typical Deviation; JU=Jump; TU= Turn; TH=Throw; KI=Kick; RA=Race; RE=Rebound; CON=Conduction; COO=Motor Coordination

Evolution of motor coordination in students aged 6 to 11 years

The age variable significantly influences the scores obtained in each task ($p<.05$) and the older the age the higher the score obtained in the different tasks. This increase in the coordination variable is not produced with the same intensity for each age. On the contrary, it progressively decreases at every age from 6 years to 11 years.

If we conduct the same study taking the gender variable into account, we find that the increase that they experience when they are 6 to 8 years remains the highest, with a parallel growth between both: 13.12% for the boys and 13.57% for the girls. This increase is higher than that produced from 8 to 11 years (11.33% for the boys and 10.90% for the girls).

The previous analysis showed that the coordination variable increases as long as the age of the subjects increases. This maturation of the coordination of primary pupils describes a linear curve with an estimate of $r=1$. The percentiles corresponding to this variable display similar curves with an approximation to the adjustment of the linear curve of values: 0.98 for the 25 percentile; 1 for the 50; 0.99 for the 75 (figure 3).

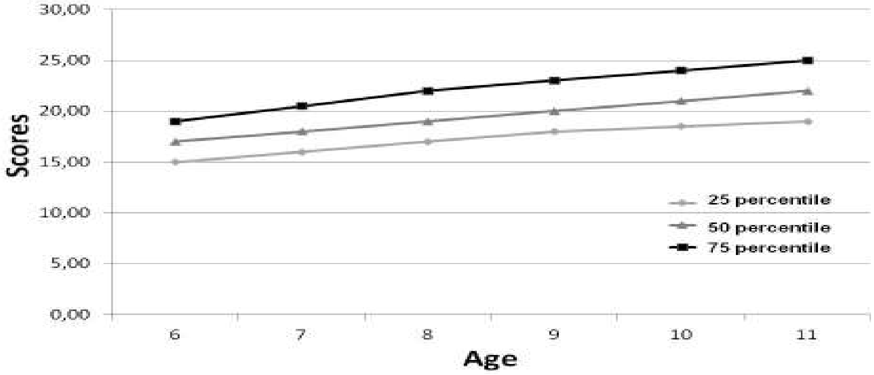

Fig. 3. Curves of the 25, 50 and 75 percentiles corresponding to motor coordination

In Physical Education, the evaluation of motor capacity based on rules stems from Arnold Gessell (1992, a, b, c) and his theory on growth and as well as the human being development. Some well-known tools for such evaluation are for example the Picq and Vayer psychomotor profile (1977), the AAHPER Test Battery (1965) or the Eurofit Test Battery (1988). This assessment provides teachers with information on the situation of their pupils within what can be considered as normal parameters of competence and motor development. For that, we present some figures with percentile tables where the population is divided according to gender into 4 groups: 1 to 25 percentile, 26 to 50 percentile, 51 to 75 percentile and 76 to 100 percentile (figure 4).

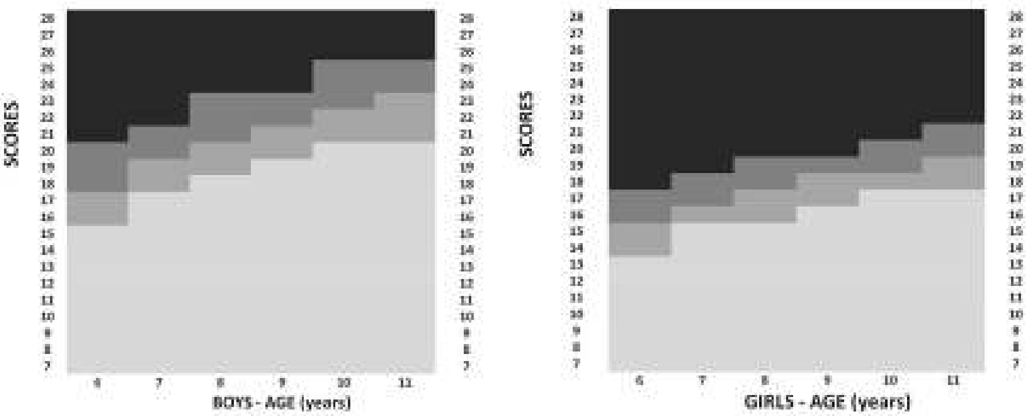

Fig. 4. Motor coordination variable in boys and girls for each age: 25, 50 and 75 percentiles shaded in different tones.

We can monitor each subject with regard to others for coordination thanks to these percentile tables; that is to say, how many subjects of the same gender and age are above and below. However, we notice the difficulty that there is not a constant unit on the coordination variable between one percentile and another but the same proportion of subjects. In order to deeply examine the diagnosis of coordination and simplify the decision-making process, we have to group the scores with regard to an absolute criterion and in intervals that let us establish different levels in connection with coordination.

If the age-based sample is divided into 5 intervals (Morales, 2008), where each of them includes a typical deviation (except the two extremes), we obtain five groups of level of coordination where each interval equals the same difference (typical deviation) except the first and last intervals. This distribution in intervals offers the opportunity to observe an identical increase (1.0 T.D.), except in the extreme intervals. This division of the scores from the sample leads us to an absolute measure (typical deviation) that allows us to measure the distance of each subject in relation to the age group average. Each of the intervals corresponds to a different assessment of the motor coordination through the 3JS test (table 5).

Table 5. Intervals corresponding to motor coordination in boys and girls for each age.

		6 years	7 years	8 years	9 years	10 years	11 years	Level of motor coordination
BOYS	**Interval 5**	24 – 28	25 – 28	26 – 28	27 – 28	28	28	Very good
	Interval 4	20 – 23	21 – 24	23 – 25	23 – 26	25 – 27	25 - 27	Good
	Interval 3	17 – 19	18 – 20	19 – 22	20 – 22	21 – 24	22 – 24	Normal
	Interval 2	13 – 16	14 – 17	16 – 18	16 – 19	18 – 20	18 – 21	Quite bad
	Interval 1	7 – 12	7 – 13	7 – 15	7 – 15	7 – 17	7 – 17	Bad
	Average	18.52	19.73	21.03	21.64	22.81	23.40	
	TD	3.453	3.506	3.612	3.513	3.435	3.378	
GIRLS	**Interval 5**	20 – 28	21 – 28	22 – 28	23 – 28	23 – 28	25 – 28	Very good
	Interval 4	17 – 19	18 – 20	19 – 21	20 – 22	20 – 22	22 – 24	Good
	Interval 3	14 – 16	16 – 17	17 – 18	17 – 19	18 – 19	18 – 21	Normal
	Interval 2	11 – 13	14 – 15	14 – 16	15 – 16	15 – 17	15 –17	Quite bad
	Interval 1	7 – 10	7 – 13	7 – 13	7 – 14	7 – 14	7 – 14	Bad
	Average	15.76	17.25	17.96	18.66	19.09	20.05	
	TD	2.949	2.385	2.623	2.655	2.641	3.235	

Discussion

This is the first study where data on motor coordination assessment at these ages are provided using the 3JS test. Comparing the assessments obtained from some researches using the KTK test (Kiphard and Schilling, 1974; Vandorpeet al. el., 2011; Lopes et al., 2003; Collet et.al., 2008; Bustamante et. al. 2008; Torralba et. al., in press), the TGMD-2 (Freitas et al, 2015) and the MACB test (Ruiz et al, 2003), we note similarities in the results with regard to our study. There is a progression in the mean values of the different tests and in the motor coordination variable regarding age and gender.

The evidence on the influence of gender in the fundamental motor skills and motor coordination in this study is similar to that observed in children from Peru (Bustamante et al., 2008), Portugal (Faustino et al, 2004a; Faustino et al, 2004b), Brazil (Pelozin, 2009) and Spain (Ruiz et al, 2003 and Torralba et. Al., in press).

The strong correlation between the fundamental motor skills (3JS test) and motor coordination in this study supports some of the conclusions provided by other researches. There is a link between children with impairment development of motor coordination in the KTK test and their low score in the fundamental motor skills in the TGMD-2 test (Oliveira et. al., 2011). Likewise, there is some evolution on locomotor skills and the control of objects after an intervention period in order to develop motor coordination (Bardid et. al., 2013).

As regards pupils with motor coordination evolutionary disorders (MCED), Ruiz et al. (2007) mention the necessity of reaching certain consensus between experts in Physical Education. They point that the 15 percentile is commonly taken as reference and limit in the literature in order to start suspecting about the presence of difficulties when comparing a pupil with the norm of a test, and consider the percentile 5 as the limit below which the presence of a real difficulty is perceived. In a percentile table, two pupils of different age and/or gender located in the percentile 15 can be at a different distance from the average although, statistically, in both cases, there would always be 14 subjects below and 85 subjects above in every 100 pupils.

With the 3JS tool, it seems less appropriate to establish a percentage from which to draw reference than to use an absolute value, which can be the distance in relation to the average and the typical deviation. Thus, it is suggested we should establish that pupils with MCED are at a distance from a deviation and average below the average, that is to say, in interval 1 for their gender and age. Similarly, interval 5 is considered to represent pupils with high motor skills.

The results obtained in this study indicate that there are more children within interval 5. Furthermore, the girls' percentage with poor or bad scores in motor coordination is lower than for the boys at 6, 7, 9 and 11 years and quite similar in the rest (table 5).

If we take as a reference the boys' and girls' percentage located below the average coordination (intervals 4 and 5), we find an average value of 24.8%. The girls with quite bad and bad coordination obtain an average value below the aforementioned (22.01%) and the boys above it (27.61%) (Table 6).

Comparing the overall percentage of the students that reach values corresponding to intervals 4 and 5 with the 3JS test (24.8%) in our study and those found in the so-called motor coordination deficient or disordered ranges using the KTK in other researches, it is observed that: in some cases, the percentage is above the 16% obtained with pupils between 4.5 and 14.5 years in Germany (Kiphard and Schiling, 1974) and above the 21.1% from the research developed in Belgium (Vandorpe et al., 2010). On the contrary, we find a percentage below the 30.7% obtained in another study in Germany (Graf, 2004), the 70% in Brazil with pupils between 7-10 years (Carminato, 2010) and the 40% in Barcelona (Torralba et. Al., in press).

On the basis of this analysis, in our study we find lower values (27.6% in boys and 22% in girls) in both genders with regard to those obtained in the recent study in Barcelona (35.7% and 40.9% respectively).

Table 6. Percentage of boys and girls found in each motor coordination interval.

	6 YEARS		**7 YEARS**		**8 YEARS**		**9 YEARS**		**10 YEARS**		**11 YEARS**	
	Boys	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
1. Very good	8.46	9.95	3.62	9.29	9.8	7.14	3.92	8.09	3.5	10	8.77	9.34
2. Good	27.82	27.6	24.59	34.57	26.5	31.9	32.35	27.7	33.3	33.5	32.45	21.5
3. Normal	37.09	39.81	36.29	35.31	39.7	35.23	33.33	43.4	40.8	33.5	32.01	50
4. Quite bad	22.58	19.9	27.41	15.61	15.7	20.47	22.05	15.6	14.5	16.3	22.36	15.9
5. Bad	4.03	2.71	8.06	5.2	8.34	5.23	8.33	5.2	7.89	6.69	4.38	3.27

Conclusion

In accordance with the objectives set in this research we conclude that:

The results obtained with the sample used in this study show that the older the age the higher coordination level. In addition, it was found that:

- This increase is not produced with the same intensity for each age, but it progressively decreases at every age from 6 years to 11 years.
- As age increases, the correlations between the different tasks that form the 3JS test and the motor coordination are stronger.
- There are more boys than girls in the so-called quite bad and bad interval.
- The increase experienced in both genders from 6 to 8 years remains the most relevant.
- The assessment of the seven tasks that form the 3JS test, corresponding to the seven fundamental motor skills, shows a specific evolution of every task:
- Rebound and conduction are the tasks that present lower maturity. There is a higher maturity in turn, throw and jump.
- There are significant differences in each task according to gender, except for the jump. The greatest difference is found in conduction and the least in turn.
- The older the age the higher the score obtained in the different tasks.
- The study of the correlations shows a significant effect among all the skills analyzed in the 3JS test.

The highest dependence is found between the conduction and kick, conduction and rebound and kick, and throw skills. The weakest correlations are found between the kick and jump skills. In the gender-based analysis, we found that the correlations between the 7 tasks are stronger for the male. For the female, the highest correlation is found in the rebound-conduction tasks and the lowest is found in the jump-kick. In boys, the highest correlation is found in the relation kick-conduction tasks and the lowest in the jump-kick.

In order to provide an appropriate frame of reference for pupils between 6 and 11 years, some normative tables and an interval age-based system that will allow Physical Education teachers and researchers to evaluate the level of motor coordination are suggested.

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