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Development of the Checklist of Psychomotor Activities for 5- to 6-Year-Old Children

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Abstract

The present research aimed to develop the Checklist of Psychomotor Activities (CPA) to measure psychomotor development in 5-6 year old children. We recruited 694 preschool children in the province of Albacete; their teachers were trained to use and complete this instrument to gather data for testing its psychometric properties (reliability, and content, construct, and discriminant validity). The CPA is composed of three subtests measuring children's performance in motor, perceptual, and emotional–social aspects of psychomotor functioning. To gather evidence of content validity, we applied the Delphi method, based on the comments of seven judges. We assessed construct validity with confirmatory factor analysis, and we tested discriminant validity by comparing the scores of premature and typically developing children and separate groups of children defined by their body mass index. We found adequate item consistency on each scale and evidence of validity from the various methods outlined. We conclude that the CPA is an effective and comprehensive tool for the assessment of psychomotor skills in children at this important stage of development.

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Introduction

Developmental psychomotricity is undergoing renewed interest among psychologists, educators, and physical education and sports professionals (Delgado & Montes, 2017; Delgado, Montes, & Prieto, 2016). Many current models have been offered to explain psychomotor development (PD) in young children, based on a large and growing body of knowledge shared by many professionals and scientists (Gil-Madrona, 2003; Ponce De León, 2009; Ponce De León & Alonso, 2010). The continuing study of PD implies the need to measure this process comprehensively by addressing children's different physical, perceptual, and emotional PD factors (Valdemoros, Ponce De León, Sanz, & Ramos, 2007). In the current research, we sought to provide psychometric data in support of a new instrument to evaluate young children's (i.e., 5-6 year olds) acquisition and use of physical-motor, perceptual-motor, and emotional–social skills. PD is the key to children's overall development and can be defined as the development and integration of cognitive, emotional, symbolic, and sensory–motor interactions that influence children's capacity to express themselves in a psychosocial context (Cueto et al., 2017). This process involves the development of essential (a) physical abilities, such as movement and coordination and (b) psychological skills, such as emotional self-control. The term and its meaning can be divided into two parts: the prefix psycho (meaning mind) and motor or motricity (meaning movement) such that psychomotricity refers to the relationship between mind and movement. The concept of psychomotricity was derived from the theoretical study of human development by 20th-century authors such as Wallon (1987), Vayer (1977), Piaget and Inhelder (1969), and Vigotsky (1978). Initially, the concept of "psychomotricity" was related to the treatment of children with physical and mental disabilities. Currently, this theory involves multiple disciplines such as genetics, education, psychology, physical education, sociology, and medicine. For this study, we accepted Cameselle's (2005) definition of psychomotricity as a science that considers the child as a whole, both in physical and mental aspects. Psychomotricity aims to develop children's maximum individual capacities by means of experience and self-knowledge of their own body's capacities, thus achieving greater awareness of their abilities in relationship to themselves and their environment.

A comprehensive, reliable, accurate, and convenient measurement of psychomotor abilities in young children is very important to all professionals involved with them, especially psychologists, educators, and physical education teachers. These professionals must evaluate children individually at various stages of their development in order to screen for any clinical concerns that may warrant further intervention and to best adapt teaching methods to the learning requirements of each student. A good PD measurement tool allows professionals in education and psychology to test the effectiveness of their methodologies and intervention programs.

Psychomotor Development Theoretical Overview

PD theorists consider this aspect of early childhood development the basis for a lifetime process. PD is especially important in the initial stages of life, as movement is the first and most fundamental way of interacting with the environment (Schilling, 2009). Among several theoretical models of PD, Kerr's (1982) model can be used in teaching, as it shows how the student must relate motor learning to the environment to solve movement problems in environmental situations. According to this model, the process of problem-solving begins with the student's collection of selected personal information, both general and specific. The student must separate relevant from irrelevant information to decide and trigger a motoric action. However, as this model is of interest to students older than the preschool age for which our assessment tool is intended, we did not rely heavily on Kerr's theory for the current study.

More recently, other authors (Gil-Madrona, Contreras, & Gómez, 2008; Gil-Madrona, Contreras, Roblizo, & Gómez, 2008; Mendiara-Rivas & Gil-Madrona, 2003) have studied and extended the psychomotor education model for preschool children, and we derived our tool from this wider literature. Within the psychomotor education model, there is a relationship between the origin of the most complex human behaviors and biological phases of human development that support them. Every child goes through a series of anatomical and morphological changes throughout life that lead to a differentiation of individual psychomotor characteristics. Thus, progression in growth and personal differentiation is linked to both hereditary factors and deep environmental influences such as physical activity and nutritional factors. Two main concepts at the base of this theoretical model are (a) a specific developmental sequence, and (b) the universality of this sequence. The sequence refers to a relatively constant appearance order of different psychomotor skills such as laterality, dynamic coordination, or motor execution. Universality means that all children go through these same ordered stages. For example, with respect to locomotion, the specific order regarding its acquisition is to first sit upright, then crawl, stand, walk, run, jump, and so on. In the same way, motor manipulation progresses from rudimentary forms of grasping, to catching objects between the index finger and the thumb. The psychomotor education model includes environmental influences and this critical element, when applied in physical education, links body work to classroom learning and explores the potential for physical activity, giving new meaning to all forms of learning (Berruezo & Adelantado, 2008). From this perspective, the most important aspect of PD is the child's perception of their own body and, through that perception, the child's relationships with self, others, and the environment. According to psychomotor education theory, the environmental stimuli provided by family, school, and social contexts have a great influence on individual PD.

Gil-Madrona (2003) and Mendiara-Rivas (2008) refer to educational psychomotricity as a holistic approach to achieving a child's overall development (i.e., a balance of motor, emotional, and cognitive skills) based on developmental psychology and active teaching methods; it is also a means of facilitating the child's relationship with the external world (the world of objects and the world of others). According to Mendiara-Rivas, through bodily (movement, emotion, and thought) and interactive experience (action, experimentation, and emotional relationships), children arrive at an understanding of relationships (i.e., interaction with the physical/social environment and social and personality development, the goal of education). Meanwhile, Berruezo and Adelantado (2008) state that the human psychomotor system comprises a set of dimensions that interact with each other: muscle tone, balance, laterality, spatial and temporal organization, and fine and gross motor skills. Other authors (Cameselle, 2005; Gil-Madrona, 2003; Gil-Madrona, Contreras, Gómez, & Gómez, 2008; Justo, 2014; Mendiara-Rivas, 2008) have identified several components of children's PD that must be addressed by professionals and parents seeking to help young children learn more effectively: body image, laterality, dynamic coordination, balance, motor execution, motor dissociation, tonic-postural control, visual–motor coordination, spatial orientation/organization, and respiratory control.

To design the current checklist, we used the above-listed PD components and added two more: social relations and emotional control. Disturbances in some of these components may precipitate general learning disabilities (Gil-Madrona et al., 2008). For this reason, it is essential to perform a reliable and valid measurement of psychomotricity that considers these factors. While some authors have proposed that the objective of measuring psychomotor skills is to detect the appearance of developmental problems (L. Ruiz, 1987), we focus here on the broader utility of PD tests and instruments in educational settings to assist teachers in optimally designing or modifying educational programs. According to Fonseca (1988) or L. M. Ruiz, Linaza, and Peñalosa (2008), a correct measurement of PD can benefit students' motor skill competence.

Current PD assessment tools for children. Numerous prior PD assessment instruments can be organized into three categories of tests (Baena, Granero, and Ruiz, 2010): (a) quantitative measurement, (b) longitudinal measurement, and (c) tests of specific aspects of perceptual-motor skills. While we developed a comprehensive test with quantitative elements that can be used longitudinally, we based our assessment mainly on specific aspects of psychomotor skills. Thus, this review will focus on a summary of prior instruments based on specific psychomotor skills. From about the 1950s, instruments measuring specific aspects of perceptual-motor skills have been developed. One such aspect has been psychomotor laterality, and the following tests are particularly worth noting: (a) Piaget-Head Battery (b) Benton's test for left–right discrimination, and, (c) Stambak (1984) for evaluating spatial orientation as an implicit coordinate system. Despite wide use of left–right orientation assessment, there is little psychometric (e.g., reliability, validity) support for these instruments. Another targeted psychomotor aspect has been body image. According to Cash and Smolak (2011), this construct is composed of attitudinal and perceptual dimensions. Some recent studies focused on the evaluation of body image in adolescents (Amaya, Alvarez, Ortega, & Mancilla, 2017), but few have been centered on childhood. According to Rigal (1994), body image assessment in children incorporates recognition of body parts and the ability to perform postures and reproduce movements. Berges, Lezine, and Ajuriaguerra (1975) proposed the gesture imitation test for children from 3-6 years old. Other instruments are based on the evaluation of drawings or figures (e.g., silhouette scales). These types of scales were present in 60.6% of the studies reviewed in a recent literature review (Neves, Cipriani, Meireles, Morgado, & Ferreira, 2017). Regarding hand–eye coordination and perception of position and space, one of the most frequently used tests is Cratty's (1979) Perceptual Motor Behavior Control List. Broad test batteries have also been designed to include several different dimensions of psychomotricity in a single assessment tool. For example, Brunet and Lezine (1978) developed a battery with five factors: posture, coordination, verbal development, social behavior, and games. Vayer (1985) used tests from different authors to design an instrument for evaluating psychomotor balance. Fonseca (1988) proposed an observation measure with seven factors: muscle tone, balance, laterality, body image, spatial-temporal organization, and fine and gross motor skills.

Despite the large number of tests available and widely used, relatively little research has been devoted to analyzing the psychometric properties of these measures. Among some psychometric research efforts, however, Dodrill and Thoreson (1993) analyzed the reliability of the Lateral Dominance Examination test for adults, and Rueda, Camacho, Florez, and Rangel (2012) studied the validity and reliability of two silhouette scales (13-CS and the Standard Figural Stimuli Scale) for assessing body image in adolescents. Moraes, Anjos, and Marinho (2012) conducted a systematic review of several silhouette scales for self-assessment of nutritional status; they found high correlations between the scales' scores and nutritional status in adults, but low correlations between these variables in children. More recently, Danisman, Esra, Zeynep, and Yaya (2016) studied the psychometric properties of the Emotional Regulation Checklist in 5-year-old children. When these authors analyzed the factor structure of the scale through Confirmatory Factor Analysis (CFA), the original factor model did not fit the data, although the battery approach yielded adequate psychometric properties of the test (Reis et al., 2016). Because of sparse psychometric research in this area, especially for tests in children, we sought to design and analyze the psychometric properties (reliability, content validity, and construct validity) of a checklist to assess psychomotor skills in 5-6-year-old children. Because one important means of testing the validity of such a checklist might be to demonstrate the test's discriminant validity for distinguishing children with and without impediments to PD, we intended to compare psychomotricity levels among groups of children with varied body mass index (BMI) and who were either full term or premature at birth. We present a brief literature review of research in these areas.

PD Among Children With Prematurity and High BMI

Regarding PD in premature children, Celik, Elbasan, Gucuyener, Kayihan, and Huri (2018) found that preterm infants are generally behind their full-term peers in sensory processing and motor development. The authors also found strong positive correlations between sensory processing and motor development in the preterm group. Along these lines, Huri, Şahin, and Kayıhan (2016) reported that autistic children with upper extremity trauma history had poorer somatosensory perception and hand function compared with other autistic children. Huri, Mehr, Altuntaş, and Kayiha (2014) observed that normally developing children choose hard objects more often than soft objects when compared with children with pervasive developmental disorder. Regarding body weight, Handal, Lozoff, Breilh, and Harlow (2007) found that BMI affects PD as overweight children have poorer motor performance compared with normal weight children. Similarly, Méndez, Estay, Calzadilla, Duran, and Díaz-Narváez (2015) reported that obese preschoolers show poorer motor skills compared with normal weight peers.

Method

Participants

Our participant sample consisted of 694 5-6-year-old children (325 girls and 369 boys) enrolled in the third year of early childhood education. Teachers of 32 groups of children completed the checklist for psychometric data analysis. All teachers and external evaluators (members of the research team) who were with the children the whole school period from 3-6 years old participated in a seminar explaining the instructions for completing the checklist. Cohen's kappa interrater reliability between evaluators and teachers oscillated from .65 to .94, indicating high interrater reliability. The final evaluation was developed jointly between the evaluator and the teacher of the group of students. To this end, both the evaluators and the teachers applied the observation checklist in 11 schools in the province of Albacete, selected at random from a pool of 50 schools (35 public and 15 private) in this province during 2016. Child participant inclusion criteria were enrollment in the selected schools and aged 5-6 years old. We obtained parental consent for all participants and we guaranteed data anonymity. The research protocol followed the ethical principles for human research proposed by the Declaration of Helsinki (World Medical Association, 2013) and met the approval of the Institutional Review Board of the University of Castilla–La Mancha.

Measures

Anthropometric measures and birth information. We included a questionnaire for parents to complete in order to obtain information regarding the children's weight and height. We used that data to calculate BMI and to ascertain from parents whether the child was born full term or was premature.

Checklist of Psychomotor Activities. This measure is composed of three scales that were designed and analyzed in the current study:

a. The Psychomotor Aspects Scale (PSAS) is composed of five factors or dimensions: laterality (LAT, seven items), dynamic coordination (DC, six items), tonic-postural control (TPC, three items), motor execution (ME, three items), and balance (BAL, five items).
b. The Perceptual-Motor Aspects Scale (PEAS) is composed of five factors or dimensions: respiratory control (RC, three items), body image (BI, four items), motor dissociation (MD, three items), visual–motor coordination (VMC, six items), and spatial orientation (SO, two items).
c. The Emotional–Social Aspects Scale (ESAS) is composed of two factors or dimensions: emotional control (EC, six items) and social relationships (SR, five items).

Teachers evaluated the children using a 5-point Likert scale from 1 (*never*) to 5 (*always*) according to the child's capacity to carry out the task proposed in each item.

Procedure

The definitive checklist was developed in four steps, following work by Gil-Madrona et al. (2008) and Mendiara-Rivas (2008). In the first step, we designed items based on a bibliographic review of relevant literature. This process led to a first version of the scale, with 70 items for evaluating the psychomotor behaviors of 5-year-old children. In the second step, we carried out a theoretical validation of the checklist using the Delphi method, with the collaboration of a group of seven experts. The Delphi method is an effective and systematic procedure that aims to gather expert opinions on a particular topic (Bass, 1983; Ludwig, 1997). The Delphi method has been widely used as a validation tool for questionnaires in numerous studies and fields of knowledge (Hung, Altschuld, & Lee, 2008); however, it has been one of the least-used tools in motor activity. After analysis and discussion by our experts, a second version of the scale was obtained; this version contained 60 items. In the third step, the expert judges reviewed the content validity of this 60-item scale. This included an evaluation of the item-objective congruence and the accuracy/adequacy of the measurements of the dimensions being tested. Finally, in Step 4, the research team developed the final version of the Checklist of Psychomotor Activities (CPA) after qualitative and quantitative analysis of the experts' responses; this final version contained 53 items measuring 12 factors.

Data Analysis

We employed Cronbach's alpha to analyze the item consistency of the CPA, so the first results presented are the reliability indices. In addition, to test the instrument's validity, we investigated three types of validity:

a. *Content validity*. We conducted a qualitative analysis of the comments of the seven experts to verify that the checklist content was consistent with its intent as a measure of children's PD.
b. *Construct validity*. To analyze the internal psychometric structure of the CPA, we performed a CFA on the asymptotic covariance matrix, using the weighted least squares method. We computed the Satorra–Bentler Chi-Square with the following goodness-of-fit indices: Root Mean Square of the Approximation Error, the comparative fit index, the nonnormed fit index, and the standardized root mean square residual. Values of the comparative fit index – nonnormed fit index close to .95 and values of the root mean square error of approximation – standardized root mean square residual lower than .06 were considered indicative of good model fit (Hu & Bentler, 1999).
c. *Other validity*. From the CFA results, we also obtained the composite reliability, the factorial saturations and the average variance extracted. Discriminant validity was examined through the Mann–Whitney test, evaluating differences between preterm infants and their full-term peers as well as testing differences between groups of children with different BMIs. We employed nonparametric statistics because the assumptions of parametric analysis were not met. A 95% significance level was used in the statistical analysis. The results were analyzed with the statistical software packages SPSS v.21 (IBM Corp., 2011), LISREL 8.80, and Prelis 2.80 (Jöreskog & Sörbom, 2006).

Results

Reliability

Satisfactory internal item consistency is illustrated with Cronbach's alpha coefficients for the component factors of each of the CPA's three scales in Table 1.

Content Validity

As noted earlier, to assess content validity, we employed the Delphi method with seven experts. The initial version of the CPA was composed of 70 items. As experts judged 10 items to be redundant, the scale was reduced to 60 items. In the second revision, the experts further advised reducing the test to 53 items and changing the wording of some of items. Experts were then satisfied that the CPA measured psychomotor activity in 5-6-year-old children as intended.

Construct Validity

We conducted CFA to determine whether the scales composing the CPA have good factor analytic fit with their theoretical intent. CFA results, as shown in Table 2, represented a good fit.

Figures 1 through 3 show the structural equation model, including the standardized factor loadings. Table 3 shows the composite reliability and the average variance extracted of each test scale.

The average variance extracted indicates that nearly all factors of the PSAS and PEAS explain more than 80% of the item variance, and that factors of the ESAS explain 56–72% of item variance. Thus, all factors explain sufficient variance to be considered a good fit with the theoretical model, as the values exceed the recommended 50% level (Hair, Black, Babin, & Anderson, 2010). The composite reliability values are higher than Cronbach's alpha and

Table 1. Cronbach's Alpha (95% Confidence Interval) for Each Scale of the CPA.

PSAS	LAT	DC	TPC	ME	BAL
	.572 (.558–.604)	.766 (.748–.814)	.597 (.578–.632)	.654 (.625–.674)	.872 (.855–.924)
PEAS	RC	BI	MD	VMC	SO
	.825 (.810–.845)	.788 (.758–.794)	.705 (.668–.721)	.782 (.742–.799)	.514 (.508–.531)
ESAS	EC	SR		Total	
	.800 (.787–.832)	.572 (.448–.577)		.935 (.904–.947)	

Note. BAL = balance; CPA = Checklist of Psychomotor Activities; DC = dynamic coordination; ESAS = Emotional–Social Aspects Scale; LAT = laterality; ME = motor execution; PEAS = Perceptual-Motor Aspects Scale; PSAS = Psychomotor Aspects Scale; TPC = tonic-postural control.

Table 2. CFA Model Fit Indices for Each Scale of the CPA.

Model	χ^2_{SB}	*gl*	*P*	CFI	NNFI	SRMR	RMSEA	90% CI
PSAS	3,842.8	242	<.001	.92	.91	.053	.054	[.050, .059]
PEAS	604.59	125	<.001	.96	.95	.055	.047	[.044, .055]
ESAS	150.96	43	<.001	.96	.95	.050	.043	[.040, .051]

Note. SB = Satorra–Bentler; CFA = confirmatory factory analysis; CFI = comparative fit index; CI = confidence interval; CPA = Checklist of Psychomotor Activities; ESAS = Emotional–Social Aspects Scale; NNFI = nonnormed fit index; PEAS = Perceptual-Motor Aspects Scale; PSAS = Psychomotor Aspects Scale; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

are satisfactory. As illustrated in Figures 1 through 3, the factor loadings are statistically significant in the three models tested, except for the last item, which is the only one of the test items that is scored in an inverse way (gets angry when loses in a game).

Discriminant Validity: Children Who Were Preterm Versus Full Term in Their Infancy

To assess discriminant validity, we tested differences between preterm and term infants using Mann–Whitney's *U* test. As would be expected for an instrument with good discriminant validity, the CPA reflected differences between children with mature and immature developmental achievement as defined by their full-term or premature status, though this difference was evident only on the sum of CPA-scaled scores (PSAS and ESAS) and not for individual factors. Table 4 shows the results for the PSAS.

According to Table 5, there were only differences in the sum of the scores but not in the individual factors, indicating that overall PD is different among children who were preterm at birth compared with those who were full term. Table 6 shows differences in emotional control and the sum of the scores. Ranks indicate high scores in the full-term children.

Table 6 indicates significant differences between preterm and term children in emotional control and the sum of the scores.

Discriminant Validity: Children of Differing BMI Categories

In addition to comparing premature and nonpremature children, we also compared children according to their BMI levels. Following recommendations of the World Health Organization (2000) regarding anthropometric indicators for evaluating overweight and obesity in pediatric contexts, the children were divided into five BMI groups (malnutrition, moderate malnutrition, normal weight, overweight, and obesity), and these groups were compared on the checklist,

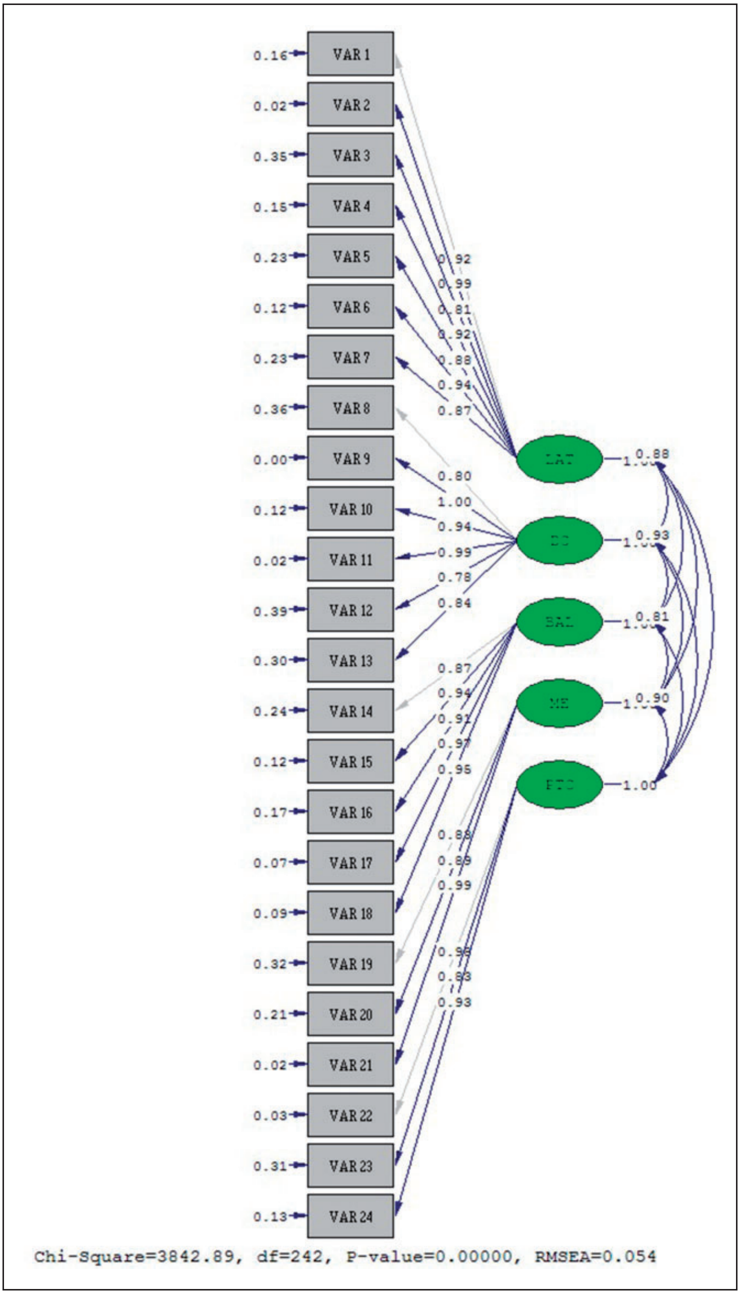

Figure 1. Structural Equation Modeling and standardized factor loadings for the PSAS scale of the CPA.

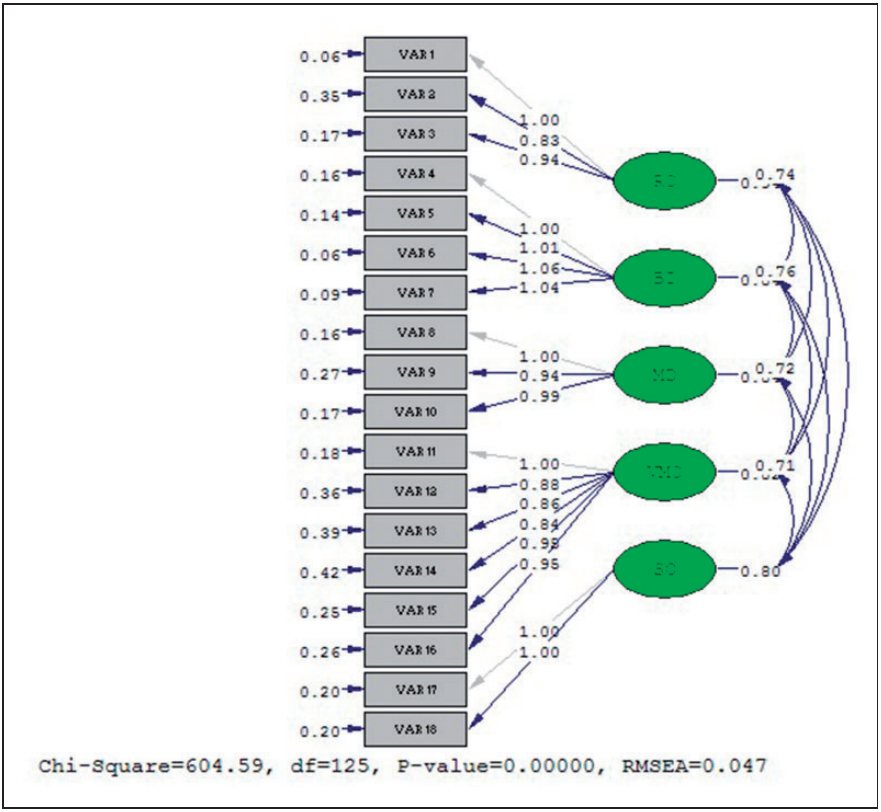

Figure 2. Structural Equation Modeling and standardized factor loadings for the PSEAS scale of the CPA.

using the nonparametric Kruskal–Wallis test. The results of this analysis are presented in Tables 7 and 8.

For BMI analyses, there were statistical differences for all factors composing the PSAS. The post hoc analysis with Mann–Whitney's *U* test and the Bonferroni correction indicate that these differences in laterality occurred among children with (a) severe malnutrition and overweight ($U = 2{,}251.5$; $Z = -3.124$; $p = .002$; $r = .123$), (b) severe malnutrition and obesity ($U = 689.5$; $Z = -4.481$; $p = .000$; $r = .176$), (c) moderate malnutrition and normal weight ($U = 5{,}549$; $Z = -2.748$; $p = .006$; $r = .108$), (d) moderate malnutrition and overweight ($U = 898.5$; $Z = -3.738$; $p = .000$; $r = .147$), and (e) moderate malnutrition and obesity ($U = 266.5$; $Z = -4.625$; $p = .000$; $r = .182$). The differences indicate stronger laterality in children with overweight, obesity, and normal weight than in children with low weight.

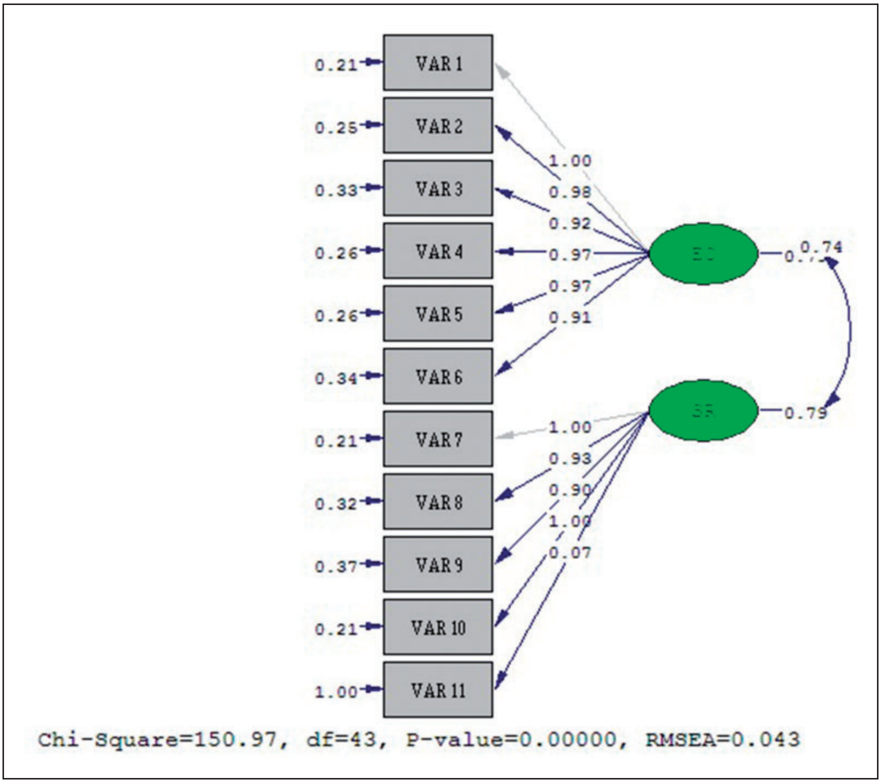

Figure 3. Structural Equation Modeling and standardized factor loadings for the ESAS scale of the CPA.

For the DC factor, differences occurred between children with severe malnutrition and normal weight ($U = 118{,}886.5$; $Z = -3.101$; $p = .002$; $r = .122$); normal weight children exhibited better coordination. In relation to TPC, there were significant differences between children with severe malnutrition and overweight ($U = 2{,}357.5$; $Z = -2.780$; $p = .005$; $r = .109$), moderate malnutrition and normal weight ($U = 5{,}896.5$; $Z = -2.344$; $p = .019$; $r = .092$), moderate malnutrition and overweight ($U = 909.5$; $Z = -3.731$; $p = .000$; $r = .147$), moderate malnutrition and obesity ($U = 487$; $Z = -2.352$; $p = .019$; $r = .092$), and normal weight and overweight ($U = 15{,}978$; $Z = -2.898$; $p = .004$; $r = .114$). These statistics indicate lower coordination scores in children with overweight.

Regarding balance, significant differences occurred among children with severe malnutrition and overweight ($U = 2{,}230$; $Z = -3.201$; $p = .001$; $r = .126$), with moderate malnutrition and overweight ($U = 1{,}152.5$; $Z = -2.341$; $p = .019$; $r = .092$), and with normal weight and overweight ($U = 15{,}382.5$; $Z = -3.345$;

Table 3. CR and AVE of the Factors of Each Scale of the CPA.

Scale	Factor	CR	AVE
PSAS	Laterality	.90	.82
	Dynamic coordination	.87	.80
	Tonic-postural control	.64	.84
	Motor execution	.63	.80
	Balance	.83	.86
PEAS	Respiratory control	.65	.80
	Body image	.79	.89
	Motor dissociation	.65	.80
	Visual–motor coordination	.86	.69
	Spatial orientation	.45	.80
ESAS	Emotional control	.87	.72
	Social relationships	.76	.58

Note. AVE = average variance extracted; CPA = Checklist of Psychomotor Activities; CR = composite reliability; ESAS = Emotional–Social Aspects Scale; PEAS = Perceptual-Motor Aspects Scale; PSAS = Psychomotor Aspects Scale.

Table 4. Mann–Whitney Test and Descriptive Statistics for Preterm and Term Infants for the PSAS.

	Mann–Whitney test					Descriptive statistics				
	U	*Z*	*p*	*r*	Premature	Mean (*SD*)	Me	Range	G1	G2
LT	9,464.0	−1.793	.073	.070	No	26.96 (5.23)	26	350.12	0.194	−1.420
					Yes	25.14 (3.39)	24	288.40	1.632	1.620
DC	9,486.5	−1.803	.071	.071	No	27.14 (3.20)	28	350.08	−1.189	1.045
					Yes	25.89 (4.14)	27	289.04	−0.927	0.100
ME	10,410.0	−1.034	.301	.041	No	13.81 (1.56)	14	348.68	−1.66	−1.100
					Yes	13.11 (2.50)	15	315.43	3.423	−0.075
TPC	11,470.0	−0.040	.968	.001	No	12.95 (2.12)	13	346.93	−1.010	0.928
					Yes	12.83 (2.52)	14	348.29	−1.061	0.383
BAL	11,242.0	−0.242	.809	.013	No	21.49 (3.44)	22	347.41	−0.734	0.023
					Yes	20.97 (4.69)	22	339.20	−1.259	0.995
SUM	9,025.5	−2.160	.031	.085[a]	No	102.35 (10.69)	103	350.78	−0.943	1.867
					Yes	97.94 (12.23)	101	275.87	−0.627	−0.322

Note. BAL = balance; DC = dynamic coordination; G1 = asymmetry index; G2 = kurtosis index; LAT = laterality; ME = motor execution; *SD* = standard deviation; SUM = total score; TPC = tonic-postural control.
[a]Significant differences, $p < .05$ and effect size (r) $< .20$.

Table 5. Mann–Whitney Test and Descriptive Statistics for Preterm and Term Infants for the ESAS.

	Mann–Whitney test					Descriptive statistics				
	U	*Z*	*p*	*r*	Premature	Mean (*SD*)	Me	Range	G1	G2
EC	8,511.5	−2.625	.009	.103[a]	N	26.36 (3.60)	27	351.56	3.104	23.94
					Yes	23.94 (5.74)	25	261.19	−1.244	1.360
SR	10,075.5	−1.259	.208	.049	No	20.61 (2.83)	21	349.19	−1.244	1.360
					Yes	19.80 (3.49)	21	305.87	0.966	0.800
SUM	8,880.5	−2.289	.022	.090[a]	No	46.97 (5.83)	48	351.00	−1.244	5.253
					Yes	40.75 (8.70)	45	271.73	1.360	0.611

Note. EC = emotional control; ESAS = Emotional–Social Aspects Scale; G1 = asymmetry index; G2 = kurtosis index; *SD* = standard deviation; SR = social relationships; SUM = total score.
[a]Significant differences, $p < .05$ and effect size (r) $< .20$.

Table 6. Mann–Whitney Test and Descriptive Statistics for Preterm and Term Infants for the ESAS.

	Mann–Whitney test					Descriptive statistics				
	U	*Z*	*p*	*r*	Premature	Mean (*SD*)	Me	Range	G1	G2
EC	8,511.5	−2.625	.009	.103[a]	No	26.36 (3.60)	27	351.56	3.104	23.94
					Yes	23.94 (5.74)	25	261.19	−1.244	1.360
SR	10,075.5	−1.259	.208	.049	No	20.61 (2.83)	21	349.19	−1.244	1.360
					Yes	19.80 (3.49)	21	305.87	0.966	0.800
SUM	8,880.5	−2.289	.022	.090[a]	No	46.97 (5.83)	48	351.00	−1.244	5.253
					Yes	40.75 (8.70)	45	271.73	1.360	0.611

Note. EC = emotional control; ESAS = Emotional–Social Aspects Scale; G1 = asymmetry index; G2 = kurtosis index; *SD* = standard deviation; SR = social relationships; SUM = total score.
[a]Significant differences, $p < .05$ and effect size (r) $< .20$.

$p = .001$; $r = .131$). The average of the ranges indicates that children with low or normal weight displayed better balance than children in the overweight group.

There were significant differences for all the factors of the PEAS scale, except for BI. The post hoc analysis indicates that these differences occurred in RC between children with severe malnutrition and overweight ($U = 1{,}790$; $Z = -4.200$; $p = .000$; $r = .165$), with moderate malnutrition and overweight ($U = 1{,}092$; $Z = -2.712$; $p = .007$; $r = .106$), and with normal weight and overweight ($U = 13{,}774.5$; $Z = -4.708$; $p = .000$; $r = .185$). Children who were overweight showed lower average ranks in RC.

Table 7. Kruskal–Wallis Test and Descriptive Statistics According to BMI for the PSAS.

	KW test				Descriptive statistics				
	H	*Z*	*p*		Mean (*SD*)	Range	Me	G1	G2
LAT	33.606	4	.000[a]	Malnutrition	25.72 (4.62)	300.57	23	0.458	0.465
				Moderate malnutrition	14.60 (4.59)	237.36	23	0.672	−0.638
				Normal	26.75 (5.00)	329.72	25	0.360	−1.190
				Overweight	28.18 (4.93)	387.00	30	0.305	1.055
				Obesity	29.44 (4.00)	455.16	29.5	0.341	0.307
DC	11.273	4	.024 (1)	Malnutrition	25.90 (3.78)	275.49	26	−0.848	0.253
				Moderate malnutrition	26.94 (3.25)	327.24	27	−1.158	1.246
				Normal	27.35 (3.12)	351.48	29	−1.260	−1.201
				Overweight	26.66 (3.54)	314.88	28	−1.158	1.034
				Obesity	27.17 (2.68)	344.43	28	−0.739	−0.572
TPC	9.597	4	.048[a]	Malnutrition	13.79 (2.11)	369.96	15	−2.016	3.547
				Moderate malnutrition	13.89 1.51)	343.61	15	−1.425	1.735
				Normal	13.83 (1.60)	343.35	15	−1.705	3.301
				Overweight	13.40 (1.54)	293.42	14	−1.271	1.840
				Obesity	13.58 (1.20)	302.08	14	−0.251	1.112
ME	17.300	4	.002[a]	Malnutrition	13.07 (2.46)	362.41	14	−1.655	2.737
				Moderate malnutrition	13.77 (1.71)	418.17	15	1.585	2.601
				Normal	12.99 (4.58)	340.16	14	−0.998	0.756
				Overweight	12.32 (2.12)	276.16	13	−0.567	−0.115
				Obesity	12.75 (1.61)	323.76	13	−0.046	−1.134
BAL	14.455	4	.006[a]	Malnutrition	21.76 (4.19)	362.41	24	−1.256	0.793
				Moderate malnutrition	21.86 (3.48)	418.17	23	−0.645	−0.875
				Normal	21.61 (3.52)	340.16	22	−0.901	0.565
				Overweight	20.48 (3.10)	276.16	20	−0.191	−0.796
				Obesity	21.14 (2.78)	323.76	21	−0.876	0.768
SUM	5.315	4	.256	Malnutrition	100.24 (12.17)	309.74	102	−1.89	2.709
				Moderate malnutrition	101.06 (9.53)	305.21	103	−1.346	3.150
				Normal	102.53 (10.81)	343.52	104	−0.773	1.002
				Overweight	101.13 (10.89)	320.33	103	−1.265	2.910
				Obesity	104.08 (8.83)	378.65	102.5	0.098	−0.244

Note. BAL = balance; DC = dynamic coordination; G1 = asymmetry index; G2 = kurtosis index; KW = Kruskal–Wallis; LAT = laterality; ME = motor execution; PSAS = Psychomotor Aspects Scale; *SD* = standard deviation; SUM = total score; TPC = tonic-postural control.

[a]Significant differences, $p < .05$ and effect size (r) $< .20$.

Table 8. Kruskal–Wallis Test and Descriptive Statistics According to BMI for the PEAS.

	KW test				Descriptive statistics				
	H	*df*	*p*		Mean (*SD*)	Range	Me	G1	G2
RC	27.471	4	.000[a]	Severe malnutrition	13.48 (2.40)	380.63	15	−1.364	2.374
				Moderate malnutrition	13.23 (2.51)	360.84	15	1.185	−1.364
				Normal	13.29 (2.24)	348.25	14	−1.401	−1.497
				Overweight	12.15 (2.36)	248.02	12	−0.575	−0.612
				Obesity	12.83 (2.06)	316.84	13	−0.838	−0.066
BI	5.268	4	.261	Severe malnutrition	18.67 (3.06)	349.37	20	−3.000	9.203
				Moderate malnutrition	18.74 (2.48)	340.51	20	−2.224	4.629
				Normal	19.08 (2.22)	342.72	20	−1.498	15.62
				Overweight	18.64 (1.63)	301.96	20	−2.271	5.733
				Obesity	18.94 (2.19)	328.51	20	−1.559	1.674
MD	11.854	4	.018[a]	Severe malnutrition	13.48 (2.48)	359.71	15	−1.845	2.55
				Moderate malnutrition	13.63 (1.95)	347.94	14	−1.791	3.179
				Normal	13.65 (1.84)	344.93	14	−1.881	4.788
				Overweight	13.06 (1.87)	276.35	13	−1.022	0.989
				Obesity	13.72 (1.42)	337.28	14	−1.041	0.573
VMC	17.300	4	.000 (1)	Severe malnutrition	24.73 (3.74)	254.11	25	−0.465	−0.508
				Moderate malnutrition	24.53 (4.27)	335.30	27	−1.325	1.561
				Normal	26.62 (3.70)	352.43	28	−1.183	4.712
				Overweight	25.85 (3.37)	302.76	27	−1.151	1.828
				Obesity	27.19 (2.38)	391.59	28	−0.603	−0.779
SO	11.357	4	.023[a]	Severe malnutrition	8.93 (1.39)	285.76	9	−1.895	4.470
				Moderate malnutrition	8.97 (1.80)	325.03	10	−2.526	6.903
				Normal	9.36 (1.35)	346.96	10	3.352	5.014
				Overweight	9.08 (1.49)	315.31	9	−3.131	11.94
				Obesity	9.58 (0.64)	376.91	10	−1.981	5.622
SUM	19.525	4	.001[a]	Severe malnutrition	79.28 (10.35)	296.95	81	−2.007	4.328
				Moderate malnutrition	80.57 (11.08)	341.71	83	−2.018	4.184
				Normal	82.00 (9.25)	355.76	85	−1.464	5.778
				Overweight	78.78 (8.73)	266.22	80	−1.683	3.753
				Obesity	82.28 (5.87)	356.84	83	−0.352	−0.794

Note. BMI = body mass index; BI = body image; G1 = asymmetry index; G2 = kurtosis index; KW = Kruskal–Wallis; MD = motor dissociation; PEAS = Perceptual-Motor Aspects Scale; RC = respiratory control; *SD* = standard deviation; SO = spatial orientation; SUM = total score; VMC = visual–motor coordination.
[a]Significant differences, $p < .05$ and effect size (r) $< .20$.

Regarding MD, there were differences between children with severe malnutrition and overweight status ($U = 2{,}411.5$; $Z = -2.647$; $p = .008$; $r = .105$) and with normal weight and overweight status ($U = 15{,}683.5$; $Z = -3.227$; $p = .001$; $r = .127$). Again, children who were overweight displayed lower ranks. Regarding VMC, there were significant differences between children with severe malnutrition and normal weight ($U = 10{,}910.5$; $Z = -3.909$; $p = .000$; $r = .154$), with severe malnutrition and obesity ($U = 822$; $Z = -3.615$; $p = .000$; $r = .142$), and with normal weight and overweight status ($U = 16{,}716.5$; $Z = -2.291$; $p = .022$; $r = .090$). These differences indicate lower ranks in overweight children. Regarding SO, significant differences occurred between children with severe malnutrition and normal weight ($U = 12{,}567$; $Z = -2.744$; $p = .006$; $r = .107$) and with severe malnutrition and obesity ($U = 999$; $Z = -2.736$; $p = .006$; $r = .107$). In terms of total scores, there were significant differences between children with severe malnutrition and normal weight ($U = 12{,}601$; $Z = -2.401$; $p = .016$; $r = .094$) and with normal weight and overweight status ($U = 14{,}508.5$; $Z = -3.958$; $p = .000$; $r = .155$); children with lower weight showed higher average ranks. Finally, there were no significant differences according to BMI for any factors of the ESAS.

Discussion

Our objective was to develop a rigorous checklist to measure PD based on the theoretical psychomotor education model for PD (Gil-Madrona, 2003; Mendiara-Rivas, 2008). We examined this instrument's internal consistency and various aspects of its validity to provide empirical support for its psychometric properties. In addition to providing an appropriate and valid instrument to measure PD, our study furthers understanding of PD in 5-6 year old children given differences found between preterm and term infants and according to BMI. First, regarding the test's reliability, we utilized two methods of reliability assessment—internal consistency and composite reliability—both of which supported all scales in terms of their item reliability.

We demonstrated the test's content validity through Delphi interviews with seven PD experts, and their input led to slight item revisions and their endorsement. Next, to demonstrate adequate internal item consistency, confirmatory analyses showed that the PSAS comprises five factors (LAT, DC, TPC, ME, and BAL), the PEAS comprises five factors (RC, BI, MD, VMC, and SO) and the ESAS comprises two factors (EC and SR). The model fit was good for the three scales and all the factor loadings were statistically significant. We provided evidence for discriminant validity by showing significant test score differences between (a) groups of children who were preterm and full term at birth infants and (b) groups of children with different BMIs. Because previous research has shown sensory processing and motor skill differences between children with premature and full-term births (Celik et al., 2018; Huri, Şahin & Kayıhan, 2016), our confirmation of these differences with this test helps to validate the instrument's discriminant validity. Our study revealed new evidence suggesting specific differences between preterm and term infants regarding their emotional self-control, body image, motor dissociation, and overall PD. We also found differences in PD according to children's BMI, with poorer performance among obese or overweight children (except in laterality), relative to other, more normal BMI categories. These results are consistent with the work of Handal et al. (2007) and Méndez et al. (2015), who also found lower levels of PD in overweight children, again lending support to impressions that our checklist can measure PD effectively.

There were important limitations of this study. Among these is that our participant sample, though large, was selected using nonprobabilistic criteria, limiting the generalizability of these results. Future studies should utilize probabilistic sampling, extend samples studied to children from other countries and cultures, and adapt this instrument as necessary, perhaps by including children at other stages of development. Another important omission in this study that must be further addressed by future researchers is a further assessment of the instrument's interrater reliability among various other respondent raters (e.g., parents and other professionals).

The main contribution of this research is the provision of psychometric support for a checklist instrument to be used by teachers in their ratings of children along all the dimensions of PD that have been considered in the most popular theoretical models of PD. This research provides important evidence that the checklist, when used by teachers, has strong psychometric properties in a large sample of Spanish children aged 5–6 years. Furthermore, the discriminant validity evidence we gathered allows professionals to design and test intervention programs that are intended to ameliorate PD deficits among children who are overweight or who were born prematurely. As children improve, their CPA scores should improve as well.

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References

Amaya, A., Alvarez, G., Ortega, M., & Mancilla, J. M. (2017). Peer influence in preadolescents and adolescents: A predictor of body dissatisfaction and disordered eating behaviors. *Revista Mexicana de Trastornos Alimentarios*, *8*(1), 31–39. doi: 10.1016/j.rmta.2016.12.001

Baena, A., Granero, A., & Ruiz, P. J. (2010). Procedimientos e instrumentos para la medición y evaluación del desarrollo motor en el sistema educativo [Procedures and instruments for the measurement and evaluation of motor development in the education system]. *Journal of Sport and Health Research*, *2*(2), 63–18.

Bass, B. M. (1983). *Organizational decision making*. Homewood, IL: Irwin.

Berges, J., Lezine, I., & Ajuriaguerra, J. (1975). *Test de imitación de gestos: técnicas de exploración del esquema corporal y de las praxias en el niño de 3 a 6 años* [Imitation test of gestures: techniques of exploration of the corporal scheme and the praxies in the child of 3 to 6 years]. Barcelona, Spain: Toray-Masson.

Berruezo, P. P., & Adelantado, J. (2008). El contenido de la Psicomotricidad: reflexiones para la delimitación de su ámbito teórico y práctico [The content of Psychomotricity: reflections for the delimitation of its theoretical and practical scope]. *Revista interuniversitaria de formación del profesorado*, *62*, 19–34.

Brunet, O., & Lezine, I. (1978). *El desarrollo psicológico de la primera infancia* [The psychological development of early childhood]. Madrid, Spain: Pablo del Rio.

Cameselle, R. P. (2005). *Psicomotricidad: Teoría y praxis del desarrollo psicomotor en la infancia* [Psychomotricity: Theory and praxis of psychomotor development in childhood]. Vigo, Spain: Ideaspropias Editorial S.L.

Cash, T. F., & Smolak, L. (2011). *Body image: A handbook of science, practice, and prevention* (2nd ed.). New York, NY: The Guilford Press.

Celik, H. I., Elbasan, B., Gucuyener, K., Kayihan, H., & Huri, M. (2018). Investigation of the relationship between sensory processing and motor development in preterm infants. *American Journal of Occupational Therapy*, *72*(1), 1–7.

Cratty, B. (1979). *Motricidad y psiquismo* [Motricity and psychism]. Valladolid, Spain: Miñon.

Cueto, S., Prieto, J. A., Nistal, P., Abelairas-Gómez, C., Barcala-Furelos, R., & López, S. (2017). Teachers' perceptions of preschool children's psychomotor development in Spain. *Perceptual and Motor Skills*, *124*(4), 725–739. doi: 10.1177/0031512517705534

Danisman, S., Esra, I., Zeynep, D., & Yaya, D. (2016). Examining the psychometric properties of the Emotional Regulation Checklist in 4- and 5-year-old preschoolers. *Electronic Journal of Research in Educational Psychology*, *14*(40), 534–556. doi: 10.25115/ejrep.40.15124

Delgado, L., & Montes, R. (2017). Relación entre el desarrollo psicomotor y la práctica de deporte escolar en niños/as de tres a seis años [Relationship between psychomotor development and the practice of school sports in children from three to six years]. *Sportis. Scientific Technical Journal*, *3*(1), 598–614. doi: 10.17979/sportis.2017.3.1.1770

Delgado, L., Montes, R., & Prieto, J. A. (2016). Prevalence of psychomotor retardation and its relation to the Sensory Profile in preschool children. *Journal of Human Growth and Development*, *26*(3), 323–330. doi: 10.7322/jhgd.122815

Dodrill, C. B., & Thoreson, N. S. (1993). Reliability of the lateral dominance examination. *Journal of Clinical and Experimental Neuropsychology*, *15*(2), 183–190. doi: 10.1080/01688639308402556

Fonseca, V. (1988). Psicomotricidad y psiconeurologia: Introdución al sistema psicomotor humano [Psychomotricity and psychoneurology: Introduction to the human psychomotor system]. *Revista de Estudios y Experiencias en Educación*, *30*(1), 25–43.

Gil-Madrona, P. (2003). *Desarrollo psicomotor en educación infantil (0–6 años)* [Psychomotor development in children's education (0–6 years)]. Sevilla, Spain: Wanceulen.

Gil-Madrona, P., Contreras, O. R., Gómez, S., & Gómez, I. (2008). Justificación de la educación física en la educación infantil [Justification of physical education in early childhood education]. *Educación y educadores*, *11*, 159–177.

Gil-Madrona, P., Contreras, O. R., & Gómez, I. (2008). Habilidades motrices en la infancia y su desarrollo desde una Educación Física animada [Motor skills in childhood and its development from an animated physical education]. *Revista Iberoamericana de Educación*, *47*, 71–96.

Gil-Madrona, P., Contreras, O. R., Roblizo, M. J., & Gómez, I. (2008). Potencial pegagógico de la educación física en la educación infantil: Atributos y convicciones [Pedagogical potential of physical education in early childhood education: Attributes and convictions]. *Infancia y Aprendizaje*, *31*(2), 165–178.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A global perspective* (7th ed.). Upper Saddle River, NJ: Pearson.

Handal, A. J., Lozoff, B., Breilh, J., & Harlow, S. D. (2007). Sociodemographic and nutritional correlates of neurobehavioral development: A study of young children in a rural region of Ecuador. *Revista Panamericana de Salud Pública*, *21*(5), 292–300.

Hu, L., & Bentler, P. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55. doi: 10.1080/10705519909540118

Hung, H. L., Altschuld, J. W., & Lee, Y. (2008). Methodological and conceptual issues confronting a cross-country Delphi study of educational program evaluation. *Evaluation and Program Planning*, *31*, 191–198. doi: 10.1016/j.evalprogplan.2008.02.005

Huri, M., Mehr, B. K., Altuntaş, O., & Kayiha, H. (2014). Yaygın gelişimsel bozukluğu olan ve normal gelişim gösteren çocukların taktil tercihlerinin karşılaştırılması [Comparison of tactile preferences of children with generalized developmental disorder and normal development]. *Ergoterapi ve Rehabilitasyon Dergisi*, *2*(1), 21–28.

Huri, M., Şahin, S., & Kayıhan, H. (2016). Investigation of hand function among children diagnosed with autism spectrum disorder with upper extremity trauma history. *Turkish Journal of Trauma and Emergency Surgery*, *22*(6), 559–565.

IBM Corp. (2011). *IBM SPSS Statistics for Windows,* Version 20.0. Armonk, NY: Author.

Jöreskog, K., & Sörbom, D. (2006). *Lisrel 8.80: A guide to the program and applications*. Chicago, IL: SPSS.

Justo, E. (2014). *Desarrollo Psicomotor en educación infantil. Base para la intervención para la psicomotricidad* [Psychomotor development in infant education. Basis for intervention for psychomotor skills]. Almería, Spain: Almería University Press.

Kerr, R. (1982). *Psychomotor learning*. Philadelphia, PA: Saunders.

Ludwig, B. G. (1997). Predicting the future: Have you considered using the Delphi methodology? *Journal of Extension (Electronic Version)*, *35*(5). Retrieved from http://www.joe.org/joe/1997october/

Méndez, M., Estay, J., Calzadilla, A., Duran, S., & Díaz-Narváez, V. P. (2015). Comparación del desarrollo psicomotor en preescolares chilenos con normopeso versus sobrepeso/obesidad [Comparison of psychomotor development in Chilean preschoolers with normal weight versus overweight/obesity]. *Nutrición Hospitalaria*, *32*(1), 151–155.

Mendiara-Rivas, J. (2008). La Psicomotricidad educativa: Un enfoque natural [Educational Psychomotricity: A natural approach]. *Revista Interuniversitaria de Formación del Profesorado*, *62*, 199–220.

Mendiara-Rivas, J., & Gil-Madrona, P. (2003). *La psicomotricidad. Evolución, corrientes y tendencias actuales* [The psychomotricity. Evolution, currents and current trends]. Sevilla, Spain: Wanceulen.

Moraes, C., Anjos, L. A., & Marinho, S. M. (2012). Development, adaptation and validation of silhouette scales for self-assessment of nutritional status: A systematic review. *Cadernos de Saude Publica*, *20*(1), 7–20. doi: 10.1590/S0102-311X2012000100002

Neves, C. M., Cipriani, F. M., Meireles, J. F., Morgado, F., & Ferreira, M. E. (2017). Body image in childhood: An integrative literature review. *Revista Paulista de Pediatria*, *35*(3), 331–339. doi: 10.1590/1984-0462/;2017;35;3;00002

Piaget, J., & Inhelder, B. (1969). *The psychology of the child*. New York, NY: Basic Books.

Ponce de León, A. (Coord.). (2009). *La educación motriz para niños de 0 a 6 años* [Motor education for children from 0 to 6 years old]. Madrid, Spain: Biblioteca Nueva.

Ponce de León, A., & Alonso, R. A. (Coord.). (2010). *La motricidad en educación infantil. Propuestas prácticas para el aula* [Motricity in infant education. Practical proposals for the classroom]. Madrid, Spain: CCS.

Reis, A. H., Silva de Oliveira, S., Ruschel, D., Cortes, N., Abteu, N., & Nara, T. (2016). Emotion regulation checklist (ERC): Preliminary studies of cross-cultural adaptation and validation for use in Brazil. *Temas em psicologia*, *24*(1). doi: 10.9788/TP2016.1-06

Rigal, R. (1994). Right–left orientation: Development of correct use of right and left terms. *Perceptual and Motor Skills*, *79*, 1259–1278. doi: 10.2466/pms.1994.79.3.1259

Rueda, G. E., Camacho, P. A., Flórez, S., & Rangel, A. M. (2012). Validity and reliability of two silhouette scales to assess the body image in adolescent students. *Revista Colombiana de Psiquiatría*, *41*(1), 101–110. doi: 10.1016/S0034-7450(14)

Ruiz, L. M. (1991). *Desarrollo Motor y Actividades Físicas* [Motor development and physical activities]. Madrid, Spain: Gymnos.

Ruiz, L. M., Linaza, J. L., & Peñaloza, R. (2008). El estudio del desarrollo motor: Entre la tradición y el futuro [The study of motor development: Between tradition and the future]. *Revista Fuentes*, *8*, 243–258.

Schilling, F. (2009). *Testzentrale: Punktiertest und Leistungs-Dominanztest für Kinder (5–12 Jahre)* [Test center: Puncture test and performance dominance test for children (5–12 years)]. Retrieved from http://www.testzentrale.de/programm/punktiertest-und-leistungs-dominanztest-fur-kinder-5-12-sjahre.html?catId=1

Stambak, M. (1984) Pruebas de nivel y de estilos motores [Manual for the psychological examination of the child]. En Zazzo et al. *Manual para el examen psicológico del niño*. Madrid: Fundamentos.

Valdemoros, M. A., Ponce de León, A., Sanz, E. & Ramos, R. (2007). El valor de la salud en las experiencias de ocio físico-deportivo de jóvenes y adolescentes: conceptualización y estado de la cuestión [The value of health in the physical-sports leisure experiences of young people and adolescents: conceptualization and state of the art]. *Contextos Educativos: Revista de Educación*, *10*, 117–132.

Vayer, P. (1977). *El diálogo corporal* [The body dialogue]. Barcelona, Spain: Científica-Médica.

Vayer, P. (1985). *El niño frente al mundo* [The kid in front of the world]. Barcelona, Spain: Científica-Médica.

Vigotsky, L. S. (1978). *Pensamiento y Lenguaje* [Thought and language]. Buenos Aires, Argentina: La Pleyade.

Wallon, H. (1987). *Psicología y educación del niño. Una comprensión dialéctica del desarrollo y la Educación Infantil* [Psychology and education of the child. A dialectical understanding of development and early childhood education]. Madrid, Spain: Visor-Mec.

World Health Organization (2000). *Technical Report Series Number 894*. Geneva: World Health Organization.

World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA*, *310*(20), 2191–2194. doi: 10.1001/jama.2013.281053

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