Journal of Physical Education and Sport ® (JPES),Vol 21 (Supplement issue 1), Art 63 pp 560 – 566, Feb.2021
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Assessing children's gross-motor development: parent and teacher agreement. implication for school and wellbeing

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Published online: February 28, 2021
(Accepted for publication February 22, 2021)
DOI:10.7752/jpes.2021.s1063

Abstract
Psychological assessments, particularly with young children, rely on developmental estimations reported by different caregivers (i.e. parents and teachers). The degree of accordance between different informants is very important to detect early impairments or delays in different developmental domains.To date, recentresearch studies have drawn attention to the association between gross motor proficiency in infancyand later academic successorchildren's personal wellbeingthrough the long-term effects of gross motor domain on social acceptance, general participation in play, and willingness to take part in social activities in general.This investigationexamined parents' and teachers'agreement in rating107 pupils' gross motor development. Caregivers' estimationswere compared with children's actual motor skillsperformedat standardized clinical assessment testing for their accuracy. The convenient sample was composed from 47 kindergarten children, 60 first graders (age range 4-6 yearolds). Parents and teachers were interviewed with the *Vineland Adaptive Behaviour Scales*(VABS-II) and children completed the gross motor proficiency tasks of the *Movement Assessment Battery for Children-2* (MABC-2). Findings revealed significant differences in caregivers ratings of children's gross motor development with respect to the Walking and Running, Play Activity and Total Score of the VABS-II. Teachers' ratings were higher when assessing the ability to run and throwing balls but were lower when reporting children's performances in handling bikes and balance skills. Estimations differed in the Aiming and Catching and Static-Dynamic Balance subscales of the MABC-2. Overall caregiver estimations correlated with children's actual motor proficiency. Parent judgements have been found to be more accurate than those of teachers. Results are discussed in light of practical considerations for the school setting, teacher disciplinary preparation in estimating children's motor skills, and situation specificity influence on caregivers' assessment.
Key Words*:* **gross motor development ratings, parent teacher agreement, school, wellbeing**

Introduction

In recent years research on children's motor skills has been linked to cognitive development and early/long-term school achievements(Cameron et al., 2016).Some authors have argued thatcognitive and motor development are associated so that neural processes underlying motor learning are the same that regulate cognitive learning (Marsh et al., 2008).However, how much and how each skill or process can contribute to school outcomesremain largelyundefined, but an increasing number of longitudinal studies attest this association shedding new light on this interesting topic.

In this regard, fine motor skills have been found to be one of the strongestearly predictors of later school outcomes positively related with name writing, written expression, literacy and math skills being involved in reproducing visual representation or transcription of ideas(Grissmer et al., 2010); (Taverna et al., 2020). On the other hand, gross motor skills also play a key role in children'sdevelopment of social competencies and physical wellbeing (Sattelmair&Ratey, 2009), engaging pupils in learning and participating to social activities, sport and games within and outside educational context(Skinner & Piek, 2001). Particularly important are movement activities in the first years of schooling when children are more active(Eaton et al., 2001). At this time children play in groups, and movement skills contribute to their social status(Chase & Dummer, 1992). A lack in motor competenceperformance could influence a decrease of participation in social physical activities as shown bychildren with motor difficulties whoare less likely to play games(Smyth & Anderson, 2001). Moreover, gross motor skills significantly contribute to general health and physical wellbeing, reducing body mass index(Okely et al., 2004), improving cardiorespiratory fitness(Okely et al., 2001)and physical activity(Jones et al., 2020).

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Given the impact that motor competence has on further developmental functions, an early detection of delays, clumsiness or impairments in fundamental movement skills would result in an increase of likeliness of prompt and effective interventions.Psychological assessments, particularly with young children, rely on developmental estimations reported by different caregivers (i.e. parents, kindergarten educators and schoolteachers).Indeed, parent and teachers proxy-reports provide valuable insights of children's actual motor competence in their own environment(Kramer et al., 2009). Liong and colleagues(Liong et al., 2015), for example, report that parents ratings were accurate and predicted children's object control ability and locomotion skills, although sex differences in parents perception were detected and affected the appreciation of their children's movement proficiency. Physical education teachers are considered reliable informants of children's motor competence, reporting accurately pupils' motor control and being able to detect school children with coordination and motor control difficulties in all age groups between 4 and 12 years (Ruiz-Pérez, 2001).Sports teachers showed an accurate understanding of their students' physical ability potential and activity behavior and are more reliable when asked to report on general perceptions of the children's physical ability than on specific motor domains (Faught et al., 2008).However, Lalor and colleagues reported that classroom teachers predicted children's body coordination but not manual coordination, agility or strength(Lalor et al., 2016).

Moreover, numerous studies have shown that estimates of children's skills depend not only from caregivers knowledge and competences, but also from seeing subjects within the same environment and under the same conditions(Achenbach et al., 1987). Judgementsof informants playing similar social roles with respect to children (e.g. mother *vs* father)correlate to a higher degree than estimation of ratersbelonging to different contexts and having different roles(e.g. father *vs* teacher).Cross-situational assessment is further complicated by the developmental area assessed to the extent that multi-informant agreementvary with respect to skill domain (Deng et al., 2004). Parent and teacher reportson children's behavioral problems showed poor inter-rater reliability(Mitsis et al., 2000); (Antrop et al., 2002), whereas observers agreedwhen estimating children' cognitive skills(Schrader, 2001).

To date, limited attention has been paid to studying the extent of agreement or possible discrepancies between parents and teachers on children's gross motor skills leaving this domain largely unexplored. Given the fact that schoolteachers are continually exposed to their students behaviors involving physical activity, the current study was aimed at investigatingparents' and teachers' agreement on children's gross motor domain. A further objective of this study was to verify informants' estimations accuracy by comparing their developmental ratings with children's actual motor performance measured by standardized tests.

Material & methods

Participants

Participants were recruited from 5 different public schools of the Autonomous Province of Bozen, South Tyrol, a northern area in Italy. 107 children were enrolled in the research after initial interest was expressed bytheir parents contacted via mail. Children were between 4 and 6 years old (Mean= 5.94; SD= .57; age range expressed in years and months: 4.8-6.9). The convenient sample was composed by three age bands: four- (n= 2; 1.9%), five- (n= 45; 42.1%), and six-year-old children (n= 60; 56.1%)respectively. Boys were 57% of the participants (M=61; F=46) leading to anunequally gender distribution within age groups (X^2 =.973; df=2; p=.054). To be included in this study children needed to speak/understand either Italian or German and should not have received a diagnosis related to a central nervous system dysfunction.

Measures

Movement ABC-2 (Movement Assessment Battery for Children-Second Edition). The Movement Assessment Battery for Children-Second Edition (MABC-2) is the updated version of one of the most widely used tests to measure motor proficiency and identify motor impairments in children's aged between 3 and 16 years (Zoia et al., 2019). The MABC-2 measures three motor domains: manual dexterity (MD), ball skills (BS) and balance (BA).Children are asked to complete 8 tasksorganized according to a difficulty levelfor three age bands (3-6y; 7-10y; 11-16y). Motor activities are grouped into three subscales: Manual Dexterity (posting coins/placing or turning pegs; threading lace/set-up triangle; drawing), Ball Skills (catching and throwing a bean bag), and Balance (one or two leg balance; walking lines; jumping or hopping). Age-adjusted standard scores with a mean (SD) of 10 are available for each Movement ABC-2 subscale and for the total test score. Standard scores ≤−1 SD of the normative mean are considered indicative of motor impairment.

Vineland Adaptive BehaviourScales-II. The VABS-II is a clinical instrument measuring adaptive behavior for ages birth through 90. It is organized in four domains comprising: Communication, Daily Living Skills, Socialization, and Motor Skills. Within each domain, the subdomains provide v-scale scores that sum to yield the domain composite scores. For the Motor Skills Scale of the VABS-II the gross and the fine motor subdomains measure how the child uses arms and legs for movement and for coordination, and how he/she uses hands and fingers to manipulate objects respectively. Gross motor subdomain consists of the following clusters of items: Sitting, Walking and Running, Play Activity, Standing, Creeping and Crawling.

The Italian standardized version of the VABS-II Survey Form (Balboni et al., 2016)is administered as a semi-structured interview with a person that is familiar with the individual being assessed. During a normal conversation the respondent describes key developmental milestones or adaptive behaviors that represent the child's usual functioning. The examiner rates each item of the VABS-II with scores ranging from 0 to 2 depending whether the activity is never or habitually performed. Standard scores are provided for each VABS-II domain and subdomain.

Data collection and analysis

Ethics approval for the current study was obtained from the Research and Ethic Committee of the Free University of Bozen-Bolzano (BW2046).Consent form and demographic information were distributed prior to study participation. Children completed the MABC-2 tasks during class hours and were tested individually in a quiet room. VABS-II interviews were arranged at time convenient for informants and took place at school.

Statistical analysis

Tests of normality and homogeneity were conducted before test selection. There were no outliers in the data, as assessed by inspection of a boxplot for values greater than 1.5 box-lengths from the edge of the box.Paired-samples t-test were used to investigate differences between teacher and parent responsesat the VABS-II interviews on gross motor development at subdomain, cluster and item level. Pearson's correlation coefficient was calculated for inter-rater reliability, when comparing agreement between parent and teachers'ratings on the VABS-II, and to determine children's actual performances at the MABC-2.

Results

According to the inclusion criteria for the study, Table 1 presents the background characteristics of the participants. Significant differences were found onlyfor the mothers' ages. Mothers of first-grade childrenreported to be slightly older ($t_{(97)}$=-2.349; p=.021)when compared to kindergarten mothers.

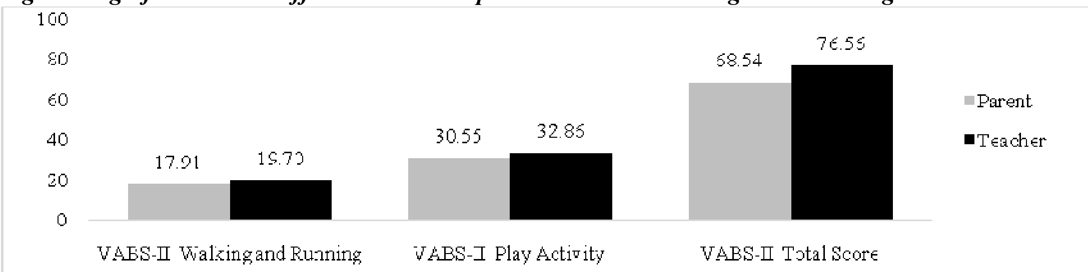
Table1 Demographic data of families included in the study (n = 107). Information are reported in absolute values, percentages, means and standard deviations.

	Kindergarten (n=57)	**First Graders (n=50)**
	n (%)	n (%)
Gender		
Boys	32 (56.1)	29 (58.0)
Girls	25 (43.9)	21 (42.0)
Age		
4	2 (3.5)	
5	45 (78.9)	
6	10 (17.5)	50 (100.0)
Mother's Educational Level		
junior secondary school (0-8yr.)	13 (22.7)	5 (10.0)
high school (9-13yr.)	32 (56.3)	25 (50.0)
university (14-18yr.)	5 (8.8)	13 (26.0)
post-university (beyond 19yr.)	3 (5.2)	2 (4.4)
not reported	4 (7.0)	5 (19.6)
Father's Educational Level		
junior secondary school (0-8yr.)	9 (15.8)	8 (16.0)
high school (9-13yr.)	34 (56.2)	28 (56.0)
university (14-18yr.)	9 (15.8)	8 (16.0)
post-university (beyond 19yr.)	1 (1.8)	1 (1.8)
not reported	6 (10.4)	5 (10.2)
Employment Mother		
housewife	11 (19.3)	7 (14.0)
process worker	10 (17.5)	9 (18.0)
office worker	30 (52.6)	26 (52.0)
professional	2 (3.5)	3 (6.0)
not reported	4 (7.0)	5 (10.0)
Employment Father		
unemployed	1 (1.8)	
process worker	23 (40.4)	18 (36.0)
office worker	21 (36.8)	15 (30.0)
professional	5 (8.8)	13 (26.0)
not reported	7 (12.3)	4 (8.0)
Number of siblings		
1 sibling	7 (12.3)	12 (24.0)
2 siblings	34 (59.6)	24 (48.0)
≥ 3 siblings	10 (17.6)	10 (20.0)
not reported	6 (10.5)	4 (8.0)
Mother's age (Mean; SD)*	36.68 (6.12)	39.48 (5.66)
Father's age (Mean; SD)	40.35 (7.29)	41.91 (9.55)

Note: * p< .01

Comparing parent and teacher ratings of children'smotor proficiency assessed with VABS-II,significant differences were detected by means of paired-samples t-tests in the gross motor total score($t_{(99)}$=-3.786; p=.0001) and two clusters scores, Walking and running($t_{(99)}$=-3.159; p=.002) and Play activity ($t_{(99)}$=-2.425; p=.017), respectively. The motor development estimates expressed by teachers are overall higher than those reported by parentsas seen in Figure 1, while no significant differences emerged exploring the following clusters: Sitting, Standing, Creeping and Crawling.

Figure 1Significant mean differences betweenparent and teacher ratings in VABS-II gross motor domain.



A series of paired-samplest-tests were run to analyze which children's motor skills highlighteda lack of agreement between parents and teachers. Findings show that teacher's ratings are significantly higher when assessing the ability to run (item 20: $t_{(99)}$=-3.129; p=.002; item 23: $t_{(98)}$=-2.242; p=.027) and throwingballs(item 26: $t_{(99)}$=-2.283; p=.025), but report significantlylower performancesin children'shandling bikes (item 35: $t_{(89)}$=4.818; p=.0001) and balance skills(item 40: $t_{(90)}$=3.885; p=.0001) as reported in Table 2.

Table2Mean differences and SD ofparent and teacher ratingsin gross motor subdomain of the VABS-II.

Walking and Running	**Parent**	**Teacher**
10. Takes at least two steps.	2.00 (0)	2.00 (0)
16. Walks across room; may be unsteady and fall occasionally.	2.00 (0)	2.00 (0)
18. Walks to get around; does not need to hold on to anything.	2.00 (0)	2.00 (0)
20. Runs without falling; may be awkward and uncoordinated.**	**1.82 (.57)**	**2.00 (0)**
21. Walks upstairs, putting both feet on each step; may use railing.	2.00 (0)	2.00 (0)
23. Runs smoothly without falling. *	**1.82 (.56)**	**1.95 (.22)**
24. Walks downstairs, facing forward, putting both feet on each step; may use railing.	1.98 (.14)	1.91 (.41)
28. Walks upstairs, alternating feet may use railing.	1.94 (.27)	1.97 (.18)
33. Walks downstairs, alternating feet; may use railing.	1.93 (.29)	1.96 (.25)
34. Runs smoothly, with changes in speed and direction.	1.98 (.21)	1.94 (.23)
Play Activity		
12. Rolls ball while sitting.	2.00 (0)	2.00 (0)
13. Climbs on and off low objects (for example, chair, step stool, slide, etc.).	2.00 (0)	2.00 (0)
17. Throws ball.	2.00 (0)	2.00 (0)
19. Climbs on and off adult-sized chair.	2.00 (0)	2.00 (0)
22. Kicks ball.	2.00 (0)	2.00 (0)
25. Jumps with both feet off floor.	1.99 (.10)	1.97 (.23)
26. Throws ball of any size in specific direction.*	**1.79 (.59)**	**1.94 (.23)**
27. Catches beach ball-sized ball with both hands from a distance of 2 or 3 feet.	1.80 (.45)	1.85 (.36)
29. Pedals tricycle or other three-wheeled toy for at least 6 feet.	1.81 (.58)	1.81 (.41)
30. Jumps or hops forward at least three times.	1.95 (.22)	1.98 (.14)
31. Hops on one foot at least once without falling; may hold on to something for balance.	1.97 (.18)	2.00 (0)
32. Climbs on and off high objects (for example, jungle gym, 4-foot slide ladder, etc.).	1.76 (.62)	1.81 (.41)
35. Rides bicycle with training wheels for at least 10 feet. ***	**1.97 (.18)**	**1.72 (.45)**
36. Catches beach-ball sized ball (from at least 6 feet away) with both hands.	1.67 (.56)	1.69 (.55)
37. Hops forward on one foot with ease.	1.88 (.36)	1.87 (.34)
38. Skips at least 5 feet.	1.61 (.61)	1.64 (.56)
39. Catches tennis or baseball-sized ball (from at least 10 feet away), moving to catch if necessary.	1.34 (.63)	1.33 (.70)
40. Rides bicycle with no training wheels without falling. ***	**1.73 (.68)**	**1.42 (.53)**

*Note:*Significant differences are reported in bold.* p <.05; ** p <.01; *** p <.001

Since the areas in which parent and teacher ratings highlighted poor agreement relate to skills assessed in the Aiming and Catching and Static-Dynamic Balance subscales of the MABC-2, a series of correlations were run to analyze the reliability of informants' estimateson children's actual locomotor competence and their reciprocal agreement. As reported in Table 3, parent and teacher reports on pupils' overall gross motor skills reveal a positive correlation ($r_{(100)}$=.255; p=.011), with a moderate association between informants on the play activity cluster of the VABS-II ($r_{(100)}$=.282; p=.004). Interestingly,the only association between parental assessments and children's performance can be observed for the dynamic balance test of walking with heels raised (MABC-2 B2: $r_{(98)}$=-.222; p=.004). The association is negative and of moderate-intensity, while as regards the teachers' judgments, no associations whatsoever can be detected.

Table 3 Pearson's product moment correlations between parent and teacher VABS-II scores in gross motor subdomain and children's performances at the MABC-2 in the Ball Skills and Balance tasks.

	VABS-II						**MABC-2**				
	GMTS-P	**GMTS-T**	**W&R-P**	**W&R-T**	**PA-P**	**PA-T**	**BS 1**	**BS 2**	**B 1**	**B 2**	**B 3**
VABS-II											
GMTS-P	1	.255*	.988***	.171	.992***	.251*	.004	.124	.096	-.222*	-.121
GMTS-T		1	.221*	.667***	.287**	.984***	.117	.138	-.011	.109	.033
W&R-P			1	.147	.966***	.218*	-.004	.078	.096	-.248*	-.123
W&R-T				1	.194	.523***	.061	.004	.038	.078	.001
PA-P					1	.282**	.019	.163	.115	-.213*	-.095
PA-T						1	.118	.154	-.021	.105	.037
MABC-2											
BS 1							1	.291**	.171	-.065	.173
BS 2								1	.274**	-.033	.120
B 1									1	-.085	.098
B 2										1	-.110
B 3											1

Note: VABS-II GMTS-P: Gross Motor Total Score Parent; GMTS-T:Gross Motor Total Score Teacher; W&R-P: Walking and Running Parent; VABS-II W&R-T: Walking and Running Teacher;PA-P: Play Activity Parent; PA-T: Play Activity Teacher; MABC-2 BS1= Ball Skills 1; BS2= Ball Skills 2; B1= Balance 1; B2= Balance 2; B3= Balance 3.
* p <.05; ** p <.01; *** p <.001

Discussion

Although gross motor skills are observable both from teachers and from parents our results show that caregivers' assessments differ with respect to some specific areas of observationof the VABS-II. Item content analysis reveals that the disagreement between informants is about coordination in running, throwing balls in any direction and riding a bicycle.Except for the cycling skill, teachersattribute to children a higher motor competence than their parents. Moreover, teachers' reports are in no way associated with gross motor skills tested in children, while parents' judgementsagree with their pupils' dynamic balance competence. Taken together, thesefindings raise some questions about interobserver reliability, the use of different informants' assessments of child's development, and the quality of opportunities / tools provided for structured observations.

First, considering poor agreement between informants as equal with unrealiabilitymeans to ignore that the situational specificity issue could also concern children's motor skills. A rich literature has illustrated how children's behavioral problems emerge in a different way according to the context of observation, giving substance to the international debate on the situational specificity topic.As already observed from Achenbach (Achenbach et al., 1987) this neglects the possibility that different informants validly contribute information which is at odds. Teachers spend a lot of time with children and are a valuable source of observation about the skills they already master or can develop in the school setting.Interobserver poor agreement or discrepancies could reflect differences in opportunities to detect the target variables depending from the specific situation rather than from the informants' reliability. Indeed, significant variations at item levelwith respect to cycling, and in an opposite direction compared to other VABS-II cluster,may raise the doubt that teachers were lacking in opportunity or tools to estimate children's cycling skills. Finally, this study has involved general classroom teachers and not physical education teachers, while other studies have shown that disciplinary preparation helps in identifying motor skills(Estevan et al., 2018). Since the use of trained and disciplinary-prepared observers to distinguish between informant and situational variance is not always possible, a valid alternative could be investing in tools and school materials with the intent towidenobservationin structured and unstructured play activities. Moreover,as already shown from Tortella and colleagues (Tortella et al., 2019); (Tortella et al., 2016)specifically designed playground that are available serve as an opportunity to promote gross motor skills in preschool children as well as school-based intervention programs including task-specific activities could improve children's motor proficiency (Mathisen, 2016).

Conclusions

This study has investigated parent and teacher agreements in rating 107 children's gross skills. Caregivers' estimations were correlated withpupil's actual motor skills performed at MABC-2 testing for their accuracy. The main findings were: (1)teachers express an overall motor development higher than that reported by parents; (2) main discrepancies emerged on running and throwing balls with teachers attributing higher motor competence thanparents, and conversely on cycling and balance skillswith parents reporting higher skills on these domains; (3) associations between caregivers' assessments and children's performances were found only for parents on balance skills.

Several useful implications follow from our analyses and from the discussion of our findings. First, any estimation of children's gross motor competence must take account of variance in the situations on which assessment takes place, requiring further research studies on the situational specificity topic related to the assessment oflocomotor skills domain. In this regard, discrepanciesbetween parents and teachersestimates would suggest differences in the opportunities for observing children skills and their actual motor performance. Second, poor or lacking correlations between informants' ratings - regardless of their type (parents or teachers) - and children's motor proficiency raise the question of the importance ofdisciplinary preparation in estimation of children's motor skills, suggesting the involvement of physical education teachers in motor assessment. Third, trained observers enhance informationreliability, but this does not overcomethe problem of limited observation opportunities which can only be resolved by equipping schools with specifically designed materials and playgrounds. Fourth, disciplinary-prepared teachers can significantly contribute to the increase of children's motor skills and wellbeing.

Conflicts of interest - Authors do not have any conflicts of interest to declare.

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