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Psychiatric Symptoms in Children With Gross Motor Problems

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Children with psychiatric disorders often demonstrate gross motor problems. This study investigates if the reverse also holds true by assessing psychiatric symptoms present in children with gross motor problems. Emotional, behavioral, and autism spectrum disorders (ASD), as well as psychosocial problems, were assessed in a sample of 40 children with gross motor problems from an elementary school population (aged 7 through 12 years). Sixty-five percent of the sample met the criteria for psychiatric classification. Anxiety disorders were found most often (45%), followed by ASD (25%) and attention deficit hyperactivity disorders (15%). Internalizing (51%) and social problems (41%) were prominent, as was "stereotyped behavior" (92%) and "resistance to changes" (92%). Self-perceived incompetence was restricted to domains that were indeed impaired (i.e., the athletic and social domains). The results suggest that children with gross motor problems are strongly at risk for psychiatric problems including anxiety, internalization, and ASD.

Keywords: behavioral/emotional disability, autism spectrum disorders, attention deficit/hyperactivity disorder, developmental coordination disorder, self-perceived competence, movement skill interventions

Gross motor problems, or problems with the performance of basic skills such as running, jumping, and throwing, are abundant in children with psychiatric disorders (Emck, Bosscher, Beek, & Doreleijers, 2009). For instance, poor motor coordination and balance control have been reported for children with dysthymia and anxiety disorders (Erez, Gordon, Sever, Sadeh, & Mintz, 2004; Stins, Ledebt, Emck, van Dokkum, & Beek, 2009; Vance et al., 2006), as well as for children with attention deficit hyperactivity disorders (ADHD; Chen, Tseng, Hu, & Cermak, 2009; Dewey, Cantell, & Crawford, 2007; Gillberg & Kadesjö, 2003; Miyahara, Möbs, & Doll-Tepper, 2001; Pitcher, Piek, & Barrett, 2002; Pitcher, Piek, & Hay, 2003; Tseng, Henderson, Chow, & Yao, 2004; Tseng, Howe, Chuang, & Hsieh,

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2007; Vance et al., 2006) and autism spectrum disorders (ASD; Dewey et al., 2007; Emck et al., 2009; Ghaziuddin & Butler, 1998; Green et al., 2009; Kopp, Beckung, & Gillberg, 2010).

Because psychiatric disorders are often accompanied by gross motor problems, we wondered whether the reverse is also true, i.e., are children with gross motor problems at risk for psychiatric disorders? It is well known that children with gross motor problems are less likely to participate in games and play requiring skills like jumping, running, or throwing balls and that they tend to be physically less fit than typically developing children (Cairney et al., 2005b; Cairney et al., 2007; Emck, Bosscher, van Wieringen, Beek, & Doreleijers, 2011; Hands & Larkin, 2006). Moreover, gross motor problems are associated with negative self-perceptions (Peens, Pienaar, & Nienaber, 2008; Piek, Baynam, & Barrett, 2006; Poulsen, Ziviani, & Cuskelly, 2006; Skinner & Piek, 2001). Much less is known, however, about psychiatric symptoms in children with gross motor problems. Green, Baird, and Sugden (2006) reported that a high proportion of children with developmental coordination disorder (DCD), who were referred to occupational therapy, were at risk for psychopathology. However, in their study no distinction was made between gross and fine motor problems, and the measure that was used to detect psychopathological symptoms permitted no formal psychiatric diagnoses.

Because children with gross motor problems are often referred to movement interventions, it is important to know more about specific co-occurring psychiatric problems. These problems are seldom taken into account in movement intervention programs, which might reduce the effectiveness of the programs in improving the broader health status of the children in question. Hence, we investigated psychosocial and psychiatric problems in children who were referred to a movement intervention program on the basis of observed gross motor problems. Importantly, the referral of the children to the movement program was not based on other diagnoses (physical or mental) than problems with gross motor performance.

In line with epidemiological psychiatric research (Egger & Angold, 2006), the following three broadly defined categories of child psychiatric disorders—and associated symptoms—were distinguished for the purpose of the current study: emotional disorders (ED; i.e., depression, dysthymia, and anxiety disorders), behavioral disorders (BD; ADHD, oppositional defiant disorders (ODD), conduct disorders), and autism spectrum disorders (ASD). These categories cover the main child psychiatric disorders.

We examined psychiatric outcomes both categorically (yes/no, prevalence) and dimensionally (continuous distribution based on the degree of symptom endorsement). With regard to the latter, as has been argued by Ferdinand et al. (2004), continuous measures may reveal (sub)clinical symptoms that go unnoticed when the assessment is based on categorical measures only. Finally, in view of the potential impact of gross motor problems on psychosocial functioning, we also investigated social behavior and self-perceived competence. The innovative aspect of the current study concerns a detailed account of psychosocial problems and psychiatric symptoms of children with gross motor problems. This information may help researchers and practitioners to develop more effective interventions for children with gross motor problems.

Method

Data were collected as part of a research project investigating the relationship between psychiatric and gross motor problems in children (see Emck et al., 2009, 2011). The study was approved by the Medical Ethics Committee of the Vrije Universiteit Amsterdam.

Participants

The data for this exploratory study were collected from children aged 7 through 12 years who were deemed to have motor problems and who were referred to a movement intervention program by physical education teachers from elementary schools in two regions in the Netherlands (see Procedures). Of the available 108 children, 80 (74%) were willing to participate. Reasons for nonparticipation were always related to lack of time by the parents or other organizational problems at home or in the family. Next, 36 children were excluded because they visited a child psychologist or child psychiatrist for treatment, had mild intellectual disabilities, or used medication that influenced psychomotor performance. An additional four children were excluded because no qualitative impairments in basic gross motor skills could be identified by means of the TMGD-2 (Ulrich & Sanford, 2000). The final sample consisted of 40 children (32 boys, 8 girls, *M age* 10 years, *SD* 1.25 months). Boys and girls did not differ significantly in age, $t(38) = 0.29$, $p = 0.77$.

Measures

Test of Gross Motor Development (TGMD-2; Ulrich & Sanford, 2000). The TGMD-2 was developed to evaluate gross motor skills associated with everyday games and sports in children aged 3–10 years. The TGMD-2 consists of 12 items divided into two subsets of 6 skills each: locomotor skills and object control skills. Locomotor skills are run, gallop, hop, leap, horizontal jump, and slide; object control skills are striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll. Qualitative age- and gender-dependent criteria for the skill patterns are available for each skill, as well as directives for (quantitative) scoring the degree to which an observed pattern matches the ideal pattern. A higher score indicates a better quality of the movement pattern. Raw scores for locomotor skills and object control skills are converted to standard scores for each of these subtests ($M = 10$, $SD = 3$) and to a Gross Motor Quotient (GMQ, $M = 100$, $SD = 15$) for overall gross motor ability. A GMQ below 90, or standard scores on locomotor skills or object control skills below 8 might indicate a gross motor problem (Bonifacci, 2004; Ulrich & Sanford, 2000). Adequate reliability and validity have been reported for use in typically developing children (Evaggelinou, Tsigilis, & Papa, 2002; Ulrich & Sanford, 2000), children with intellectual disabilities (Simons et al., 2007), and 6–12 year-old children with visual impairments (Houwen, Hartman, Jonker, & Visscher, 2010). In the present research, intra class correlations between two observers, ICC (2,1) absolute agreement, varied from 86 to 1.00. Although the TGMD-2 was originally developed for 3- to 10-year-old children, recent studies have employed the TGMD-2 for children up to 12 years

(Houwen et al., 2010; Hartman, Houwen, Scherder, & Visscher, 2010). We used the norms of 9- and 10-year-old children for the children who were aged 11 and 12 because no significant differences in GMQ, locomotion, or object control have been found for these age ranges (Emck et al., 2011).

Diagnostic Interview Schedule for Children—Parent Version (DISC-P; Costello, Edelbrock, Dulcan, Kalas, & Klaric, 1984; Dutch version: Ferdinand & van der Ende, 2002). The DISC-P is a highly structured parent interview, aimed at screening general and clinical populations for child psychiatric disorders, except ASD (Cox, 1994). Algorithms are provided to decide whether a disorder is present or absent, providing a dichotomous outcome measure. The reliability and validity of the DISC-P are adequate for the population of (Dutch) children aged 6- to 18 years (Costello et al., 1984; Ferdinand & van der Ende, 2002; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000).

Children's Social Behavior Questionnaire (CSBQ; Luteijn, Minderaa, & Jackson, 2002). The CSBQ is a questionnaire for parents with six subscales to identify specific symptom patterns of ASD. Four of the six subscales refer to the core areas of deficit in ASD (Hartman, Luteijn, Serra, & Minderaa, 2006; Lord & Rutter, 1994). These (primary) subscales are (a) reduced social contact and social interest, (b) difficulties in understanding social information, (c) stereotyped behavior, and (d) fear of and resistance to changes. Two additional subscales cover "not optimally tuned to the social situation" and "orientation problems in time, place, or activity." Scores range from 1 (*very low*) to 7 (*very high*); higher scores indicate more problematic behavior. For each subscale norms are provided for children with PDD-NOS, ADHD and mental retardation, as well as for the general child psychiatric population. The reliability and the validity of the CBSQ and its subscales are satisfactory (Hartman et al., 2006). In accordance with Emck et al. (2011), children who scored in or above the average category for the PDD-NOS norm group on three of the four primary subscales were classified as ASD.

Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001; Dutch version: Verhulst, van der Ende, & Koot, 1997). The CBCL is a commonly used instrument with multiple dimensions that assesses emotional and behavioral problems in children aged 4–12 years by asking parents to indicate which of 113 behaviors has been shown during the last six months by their child. We used the broad band scales Internalizing, consisting of the narrow band scales anxious/depressed, withdrawn/depressed, and somatic complaints and Externalizing, consisting of the narrow band scales rule breaking behavior and aggressive behavior. In addition, the narrow band scales social problems, thought problems, and attention problems were used. Scores on the syndrome scales are converted to T-scores and classified as falling in the normal, borderline, or clinical range. According to the manual, scores in the borderline range are considered high enough to be of concern (Achenbach & Rescorla, 2001). The test-retest reliability and the internal consistency of the scales are satisfactory (Achenbach & Rescorla, 2001; Evers, van Vliet-Mulder, & Groot, 2000).

Self-Perception Profile for Children (SPPC; Harter, 1985; Dutch version: Veerman, Straathof, Treffers, van den Bergh, & ten Brink, 1997). The SPPC is a 36-item scale that measures perceived competence in children and is appropriate for use during middle childhood. The scale consists of six subscales: "scholastic competence" reflects the child's perception of his/her school-related competence, "social acceptance" reflects the child's feeling of acceptance by peers, "athletic competence" reflects the feeling of competence about sport and outdoor activities, "physical appearance" reflects the child's feeling of satisfaction with his/her looks, "behavioral conduct" reflects the child's feeling of satisfaction with his/her behavior, and "global self-worth" reflects the child's feeling of satisfaction with one's own person, the life he/she lives, and his/her self-confidence. Items are scored on 4-point rating scales with higher scores indicating greater self-perceived competence. The 15th and 85th percentile are used as cut-off points defining low and high self-perceived competence and established for boys and girls separately (Veerman et al., 1997). Adequate internal consistency and validity have been reported (Evers et al., 2000; Harter, 1985; Veerman et al., 1997).

Procedures

The first author of this study contacted the independent organization that runs the national intervention program "Club Extra" for children who are delayed in the development of their gross motor skills. Qualified physical education teachers with additional training in adapted physical activity are responsible for providing the interventions. Permission was granted to recruit children from two locations in The Netherlands (Amersfoort and Zwolle). Two research assistants (human movement scientists) visited these locations and informed parents and children about the study orally, through a letter, and by e-mail. After children and parents agreed to participate, parents were handed a package with an informed consent to sign and two questionnaires about their child (CBCL and CSBQ), which they were asked to complete and return the next week. Data were collected in the presence of the same two research assistants in a separate part of the gym during the regular lessons, except for the interviews with the parents, which were held at their home while the child was absent.

In the first week, the SPPC was completed by the child, if necessary assisted by the research assistants who read the items aloud. On average, completion time was about 20 min. In the second week, gross motor skills were assessed by means of the TGMD-2; testing time varied from 20 to 30 min per child. General information about the child and his or her family, medical status and history of cognitive and motor development, and psychiatric symptoms were assessed by means of a parent interview (according to a checklist and the DISC-P) during the second and third week. Depending on the amount of reported symptoms, it took 1 hr to 2.5 hr to complete the interviews. After one hour, a break was suggested, and the possibility to do the interview in two sessions was offered.

Data Analysis

Numbers and percentages of children meeting the criteria for psychiatric classification according to the DISC-P and CBSQ were calculated. For the CBSQ and SPPC, median scores and interquartile ranges, as well as the numbers and percentages of children with scores in the clinical range on each of the subscales and on the total score (CBSQ), or the numbers and percentages of children with scores in either the upper or lower 15% of the scores in the norm group (SPPC) were calculated. For the CBCL, means and standard deviations of the scores, as well as the numbers and percentages of children with scores in the borderline and clinical range for both the broad and small band syndrome scores, were calculated.

The percentages of children who were classified with specific psychiatric disorders were compared with the correspondent percentages in the age-matched Dutch population (Verhulst, 2008) by means of binomial tests. The same test was used to compare the number of children that were classified with at least one psychiatric disorder with the corresponding percentage of children in the age-matched Dutch population as published by Zwirs et al. (2007).

Results

Mean GMQ was 80.27 (SD = 12.93, range 52–109), indicating that, on average, the group showed overall gross motor problems. Mean standard scores were 7.68 (SD = 2.60, range 3–13) for locomotion and 5.82 (SD = 2.36, range 1–11) for object control, indicating that, on average, the participants had greater problems in the area of object control skills. Table 1 shows the numbers and percentages of participants identified with and without a psychiatric classification, based on DISC-P and CSBQ scores. Categories of psychiatric classifications were not mutually exclusive; each participant could be identified within more than one category. Emotional disorders always concerned anxiety; no children in our sample met the criteria for depression or dysthymia. Behavioral disorders always concerned ADHD, in one case with comorbid ODD. Other identified disorders were tics, enuresis and encopresis, each of which were observed in two children.

The results of the binomial tests comparing the prevalence of psychiatric classifications in the research participants to the Dutch general child population revealed that significantly higher percentages were present in the participants of this study. In particular, a significantly ($p < .001$) higher percentage of participants in this study relative to the Dutch general child population (65% versus 8–14%, respectively) met the criteria for at least one psychiatric classification. Compared with the general child population in The Netherlands, the research sample revealed significantly higher percentages of the specific psychiatric disorders of anxiety (45% of the sample versus 3% of the population, $p < .001$), ADHD (15% of the sample versus 4% of the population, $p = 0.005$), and ASD (25% of the sample versus 1% of the population, $p < .001$).

Tables 2 and 3 show mean scores and standard deviations for clinical syndromes reported by parents (CBCL), as well as the numbers and percentages of children

Table 1 Children (Numbers and Percentages) With a Psychiatric Classification, Based on the DISC-P and the CSBQ

	No Classification	One or More Classifications	Emotional	Behavioral	ASD	Other
Boys (n = 32)	14 (43.8%)	18 (56.3%)	13 (40.6%)	5 (15.6%)	7 (21.8%)	5 (15.6%)
Girls (n = 8)	0 (0%)	8 (100%)	5 (62.5%)	1 (12.5%)	3 (37.5%)	1 (12.5%)
Total (n = 40)	14 (35.0%)	26 (65.0%)	18 (45.0%)	6 (15.0%)	10 (25.0%)	6 (15.0%)

DISC-P = Diagnostic Interview Schedule for Children, parent version; CSBQ = Children's Social Behavior Questionnaire;

ASD = Autism Spectrum Disorders. Classifications are not mutually exclusive.

Table 2 Means and Standard Deviations of T-scores on CBCL Broad Band Syndrome Scales and Number and Percentages of Children Who Score in the Borderline or Clinical Range

CBCL (n = 39)*	Total	Internalizing	Externalizing
Mean	54.7	57.7	49.0
SD	11.3	9.4	11.3
Range	31–73	39–74	33–71
Borderline range	5 (12.8%)	8 (20.5%)	4 (10.3%)
Clinical range	9 (23.1%)	12 (30.7%)	3 (7.7%)
Total	14 (35.9%)	20 (51.3%)	7 (17.9%)

CBCL = Child Behavior Checklist. CBCL cutoff- points of the broad band syndrome scales: Normal range T ≤ 59, borderline range 60 ≤ T ≤ 63, clinical range T ≥ 64. Total: number and percentage of children with scores high enough to be of concern from a clinical perspective. * One questionnaire was not returned by the parents.

scoring in the borderline and clinical range. Internalizing problem behaviors were reported more often than externalizing problem behaviors. On the small band syndrome scales, social problems were reported most frequently, followed by withdrawn/depressed and anxious/depressed problem behavior.

Median scores on CSBQ subscales fell in the average (score 3) or above average (score 4) categories of the general child psychiatry norm group, indicating serious social problems were present in many children in the research sample. The most prevalent problems were "resistance to changes" and "stereotyped behavior," two of the four subscales that refer to core symptoms of ASD. On these subscales, very high proportions of children scored in the clinical range (Table 4).

Median percentile scores on SPPC subscales, and the number and percentage of children who scored below the 15th or above the 85th percentile are shown in Table 5. "Behavioral conduct" was the domain in which the children perceived themselves as most competent, followed by "scholastic competence." Perceived competence in the athletic and social domains was low relative to the other domains assessed.

Discussion

In this exploratory study, we investigated emotional and behavioral problems in a sample of elementary school-aged children who were referred to a movement intervention program because of gross motor problems. We focused on psychiatric disorders and syndromes, social functioning, and self-perceived competence, using parent and self-reports.

Our sample was confined to gross motor problems as confirmed by low scores on the TGMD-2 (Ulrich & Sanford, 2000). The final sample was characterized by impairments in both locomotion and object control skills. A high percentage of the children in the sample (65%) met the criteria for at least one psychiatric classification and had significant social impairments. Indications for each of the three main groups of psychiatric disorders, emotional, behavioral, and autism spectrum disorders, are discussed below.

Table 3 Means and Standard Deviations of T-scores on CBCL Small Band Syndrome Scales and Number and Percentages of Children Who Score in the Borderline or Clinical Range

CBCL (n = 39)*	Anxious Depressed	Withdrawn Depressed	Somatic Complaints	Social Problems	Thought Problems	Attention Problems	Rule Breaking Behavior	Aggressive Behavior
Mean	58.3	59.6	55.3	61.5	57.9	57.6	52.4	54.7
SD	8.4	7.3	5.9	9.0	8.6	10.8	4.2	6.1
Range	50–78	50–72	50–70	50–83	50–80	50–100	50–68	50–69
Borderline Range	4 (10.3%)	8 (20.5%)	2 (5.2%)	10 (25.6%)	1 (2.6%)	1 (2.6%)	1 (2.6%)	6 (15.4%)
Clinical Range	5 (12.8%)	6 (15.4%)	1 (2.6%)	6 (15.4%)	5 (12.8%)	5 (13.8%)	0	0
Total	9 (23.1%)	14 (35.9%)	3 (7.7%)	16 (41.0%)	6 (15.3%)	6 (15.3%)	1 (2.6%)	6 (15.3%)

CBCL = Child Behavior Checklist. CBCL small band syndrome scales cutoff-points are higher (i.e., more conservative) than on the broad band syndrome scales: Normal range $T \leq 64$, borderline range $65 \leq T \leq 69$, clinical range $T \geq 70$. * One questionnaire was not returned by the parents.

Table 4 Median Categorical Scores and Interquartile Ranges on the CSBQ and Subscales, and Number and Percentages of Children Who Score in the Clinical Range

		CSBQ Subscales					
CSBQ (n = 40)	CSBQ total	Poor Social Tuning	Reduced Social Interest	Orientation Problems	Misunderstanding Social Information	Stereotyped Behavior	Resistance to Change
Median	3	3	3	3	3	4	4
Interquartile Range	3	3	2	2	2	0	1
Clinical Range	12 (30%)	12 (30.0%)	19 (47.5%)	13 (32.5%)	18 (45.0%)	37 (92.5%)	37 (92.5%)

CSBQ = Children's Social Behavior Questionnaire

Table 5 Median Categorical Scores and Interquartile Ranges on the SPPC and Number and Percentages of Children With Scores in the Upper and Lower 15% of the Norm Group

SPPC (n = 39)*	Scholastic Competence	Social Acceptance	Athletic Competence	Physical Appearance	Behavioural Conduct	Global Self Worth
Median	57.5	29.0	22.0	40.0	78.0	57.0
Interquartile range	55	60	35	48	43	59
Low	3 (7.7%)	7 (17.9%)	15 (38.5%)	5 (12.8%)	2 (5.1%)	3 (7.7%)
High	11 (28.2)	3 (7.7%)	1 (2.6%)	5 (12.8%)	15 (38.5%)	5 (12.8%)

SPPC = Self-Perception Profile for Children; Low = below 15th percentile of norm group; High =above 85th percentile of norm group.
* One questionnaire was not completed by the child.

Emotional disorders diagnosed by means of the DISC-P were manifest in 45% of the children. In each case this pertained to anxiety disorders, a finding that gains in importance in view of the observation of Sigurdsson, van Os, and Forbonne (2002) that the experience of anxiety in motor-impaired boys may persist into adolescence. Although depressive or dysthymic disorders were not present in our sample, subclinical mood symptoms were observed via the CBCL scores. On the CBCL checklist, parents reported internalizing problems for 50% of the children, in particular with regard to anxious-depressed and withdrawn-depressed behaviors. Therefore, several mood symptoms were reported, but the symptoms were not organized in patterns that qualify for the categorical diagnosis of depression (see also Cartwright-Hatton, McNicol, & Doubleday, 2006).

Co-occurrence of gross motor impairment and anxiety disorders may be partly due to genetic influences, as has been demonstrated in a recent twin study by Moruzzi et al. (2010). However, results of another twin study support the notion that anxiety in children may also be caused by unique environmental influences (Pearsall-Jones, Piek, Rigoli, Martin, & Levy, 2011). It has further been suggested that, at the neurophysiological level, a dysfunction of the parabrachial nucleus may play a role. Whereas neural circuits involved in balance control and anxiety interact at this brain structure, its dysfunction may result in balance problems, poor postural control, and anxiety (Balaban & Thayer, 2001; Erez et al., 2004; Stins et al., 2009). Since balance and postural control play major roles in the development and performance of gross motor skills, a relationship between gross motor impairment and anxiety disorders may exist as a result of a common underlying cause. Of course, this tentative neurophysiological account for the co-occurrence of motor problems and some emotional and behavioral problems does not preclude other explanations. For example, gross motor problems may hamper participation in play and games, which may negatively affect children's social and psychological development (Cairney, Veldhuizen & Szatmari, 2010).

Behavioral disorders, comprising the second main group of disorders, were found in 15% of the children. They all concerned ADHD, which concurs with studies that reported a high co-occurrence of DCD and ADHD (Chen et al., 2009; Dewey, Kaplan, Crawford, & Wilson, 2002; Dewey et al., 2007; Miyahara et al., 2001; Pitcher et al., 2002, 2003; Tseng et al., 2004, 2007) and is in concert with the aforementioned suggestion of shared genetic factors underlying motor and ADHD problems (Martin, Piek, & Hay, 2006; Moruzzi et al., 2010). However, ADHD was less prevalent in our sample than either emotional or autism spectrum disorders, which were found in 45% and 25% of the children, respectively. Moreover, as indicated by the continuous scores on the CBCL, externalizing behaviors (rule breaking behavior and aggressive behavior) and attention problems were reported less often than internalizing behaviors. We found almost no evidence of disruptive behavioral disorders in the sample of children included in this study; only one child met the criteria for ODD in combination with ADHD. Furthermore, although some children scored in the borderline range, none of the children scored in the clinical range of rule breaking behavior or aggressive behavior on the CBCL.

Importantly, our sample was selected on the basis of gross motor impairments only; fine motor skills were not assessed. To the best of our knowledge, relationships between gross and fine motor skills have very rarely been investigated. One exception is the study by Smits-Engelsman (1998), who reported significant, but

relatively low, correlations varying from 0.26 to 0.36. Given the findings of Fliers et al. (2009) that fine—and not gross—motor problems are associated with attention deficits, this might explain the low prevalence of ADHD in our sample.

The third main group of disorders concerned ASD. In 23% of the children, the criteria for this disorder were met. To our knowledge, no other studies to date have addressed the prevalence of ASD in children with motor problems, and therefore we cannot compare our findings; however, our data showed marked impairments in social functioning, supporting earlier findings (Cummins, Piek, & Dyck, 2005). We found the highest mean score on the CBCL subscale social problems; scores on this subscale indicated that 40% of the children fell in the borderline or clinical range of this domain. More detailed information about the types of social problems could be derived from the scores on the CSBQ. No less than 93% of our research sample scored in the clinical range on "stereotyped behavior" as well as on "fear of and resistance to changes," which are considered core deficits in ASD. In addition, 48% showed significant problems concerning reduced contact and social interest, and 45% experienced difficulties in understanding social information, two other core deficits in ASD. In short, the *types* of social problems in our sample matched those of children with ASD, even though the children in this study did not always meet the diagnostic criteria to be classified as such. This finding concurs with the observation by Cummins et al. (2005) that children with poor motor coordination have specific deficits in empathy (i.e., they are less competent in recognizing emotions), an aspect of social cognition that is also impaired in children with ASD.

It has been suggested that an abnormal development of brain connectivity may underlie problems in integrating functions and social behavior in ASD (Baron-Cohen & Belmonte, 2005; Belmonte et al., 2004; Kleinhans et al., 2008), and this might also be involved in the co-occurrence of motor problems and social problems encountered in our sample. A special role in this regard may be played by a circuitry in which the cerebellum is involved, which qualifies as a common neurobiological link between motor problems and ASD (Allen, Müller, & Courchene, 2004; Belmonte et al., 2004; Piek & Dyck, 2004).

Self-perceived competence was not impaired in all of the domains assessed. In agreement with Ekornäs, Lundervold, Tjus, and Heimann (2010), our sample scored rather low on self-perceived athletic competence and social acceptance relative to other competence domains measured, but global self-worth was not affected. Furthermore, the children reported feeling quite competent with respect to scholastic performance and behavioral conduct. It therefore seems that the children in our sample were realistic about their competences, given that their gross motor skills were indeed impaired, which may have hampered them in social games. However, it should be recognized that referral to a movement intervention program may well have influenced the self-perception in the motor domain.

Limitations

First, a relatively small convenience sample of children participated in this study, which militates against generalizing the results to the population of gross motor-impaired children. Second, the relatively small sample size precluded separate analyses for boys and girls. Since for most variables gender-specific scores have been used, analyzing the scores of both sexes as belonging to one group seems

warranted. The fact that all girls in the sample met the criteria for psychiatric classification, relative to 56% of the boys, might be related to referral bias, because worries regarding gross motor performance seem greater for boys than for girls (see Cairney, Hay, Faught, Mandigo, & Flouris, 2005a; Cairney, Hay, Veldhuizen, Missiuna, & Faught, 2010). However, this seems not a likely explanation because no significant difference in gross motor performance was found between the boys and the girls in our sample ($M = 79.47$, $SD = 13.76$ for boys; $M = 83.50$ and $SD = 8.3$ for girls). Third, because some children had already started with the movement intervention program, both their motor skills and psychiatric status might have been affected by their participation in the program. The intervention program included activities at several different motor skill levels in a safe but challenging environment. Special attention was paid to providing children with success experiences to increase perceptions of competence, self-esteem, and motivation.

Therefore, if an intervention effect was present, it should have resulted in improved scores on the variables assessed, thereby strengthening our findings and reinforcing our conclusions.

Implications

Considering that the children in our sample often showed significant psychosocial and psychiatric problems, we agree with Peens et al. (2008) that interventions for gross motor-impaired children should not only focus on the motor problems, but also on psychosocial impairments. Since participation in movement activities will become more difficult for these children as they grow older, interventions addressing both physical and psychosocial problems should start at an early age (Cummins et al., 2005; Wall, 2004). As stated by Kopp et al. (2010), the combination of motor impairments and emotional, behavioral, or autism spectrum disorders compromises daily living, and high quality prevention and intervention are needed. We therefore suggest that, contrary to common practice, children who are referred to movement interventions should be screened for emotional and behavioral problems, which, if present, should be taken into account in adapting the interventions to the specific needs of the children.

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