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ORIGINAL CONTRIBUTION

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Is social anxiety disorder in childhood associated with developmental deficit/delay?

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Abstract Children with social anxiety disorder (SAD) have been reported to display reduced social skills. Less attention has been paid to whether neurodevelopmental deficits/delays (NDD's) in language and motor function may contribute to their impaired social skills. The present study aimed to assess the extent of language and motor impairment in children with SAD. A population-based screened sample consisting of 150 children (11–12 years) was assessed with a diagnostic interview (Kiddie-SADS), the Wechsler Abbreviated Scale of Intelligence (WASI) and the Motor Assessment Battery for Children (MABC). Test results were compared across five diagnostic groups: SAD (n = 29); ADHD (n = 23); SAD and ADHD (n = 6); "other disorder" (n = 44) and "no disorder" (n = 48). Delays in language and motor development as reported by mother were also investigated. Verbal IQ and motor skills were reduced and maternally reported delay was more frequent in the SAD group compared to the "other disorder" and "no disorder" group.

Key words social anxiety – children – neurodevelopmental deficits/delays

Introduction

Social anxiety disorder (SAD) is characterized by a marked and persistent fear of one or more situations in which the person is exposed to unfamiliar people or to possible scrutiny by others. The feared situations are avoided or are endured with intense anxiety or distress [1]. In children, the most feared social situations usually include those where the child is expected to speak (e.g., talking to peers, reading aloud in class, joining in a conversation), but situations with less such expectations (e.g., musical or athletic performances) are also commonly reported social fears [3].

Whether children with SAD fear a negative evaluation from others due to genuine skill deficits or distorted perception of their performance as seen by other people is an area of debate [8]. Studies addressing this issue have focused on social skills and found that children with SAD are rated as less socially skilled compared to peers both by self-report, parent report, and professional report [37]. Poor social skills in childhood are associated with deficits in cognition, language, and motor function [11, 13, 27]. Whether children with SAD may have subtle deficits in some of these areas has received less attention.

In contrast, selective mutism (SM) in childhood is consistently reported to be associated with neurodevelopmental deficits/delays (NDD's) in both language and motor function [16, 22, 38]. Since comorbidity rates of SAD in SM are reported as high as 100% [4], it has been suggested that SM may be an early onset and more severe form of SAD. Even

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though two recent studies comparing SM and SAD (without SM) indicate that the relationship between the two conditions may be more complex [25, 41], the high prevalence of NDD's in SM raises the question, whether similar problems are evident in SAD?

Studies focusing on childhood NDD's and psychiatric comorbidity also support a possible relationship between NDD's and social anxiety. With regard to language deficit/delay, a population-based follow-up study of children with early language impairment at age five, found that compared to normal language controls, subjects with a history of early language impairment had 2.7 times the odds of having a SAD by age 19 [39]. Another prospective study of boys with childhood developmental language disorders showed high schizotype personality scale scores including excessive social anxiety when followed up in their mid-thirties [9].

As is the association between language deficit/delay and social anxiety, several studies have shown a relationship between subtle motor deficits and anxiety over time [29, 34, 35]. Children with Developmental Coordination Disorder (DCD) also report lower self-worth and higher levels of anxiety than peers [36]. A few studies have explored a more specific relationship between motor deficits and anxiety. Impaired balance was reported in a clinical case-control study of children ($n = 20$) with a primary diagnosis of general anxiety disorder, separation anxiety disorder or PTSD [17]. However, a significant proportion of these children also fulfilled a diagnosis of ADHD or ADD. Another population-based study found a correlation between social anxiety and foot agility, but not with finger agility. The correlation reached significance in girls only [31].

In addition to elucidating the issue, whether deficits are actually evident in SAD, assessments results may also be crucial for treatment recommendations if they reveal a deviation between demands on the child and the child's actual level of functioning. In general children with NDD's may fail to cope with various developmental challenges over their life course leading to psychological stress. A thorough assessment of their coping skills and adjustment of the demands placed upon them may hopefully prevent secondary psychopathology.

The main aim of the present study was to explore the association between NDD's and SAD in a population based screened sample of 11–12 year-old children ($n = 150$). The association was examined by comparing a SAD group with other diagnostic groups and children with no disorders. NDD's were measured using verbal and performance IQ, motor skills, and maternally reported delay in language and motor development. Our main hypothesis was that SAD might be associated with NDD's.

Method

Participants

A total of 150 children (75 girls and 75 boys, aged 11–12 years) participated in the study. This particular age group was selected because SAD is reported to increase in preadolescence [8]. Previously, the families of these children had participated in a cohort study on bronchial asthma in 2001 ($n = 7266$), and had given their consent to participate in further studies ($n = 3653$). In 2003, 3,642 out of the 3,653 families received a postal questionnaire on their children's physical and mental health. Included in this questionnaire were the 22 items from the Social Anxiety Scale for Children, the SASC-R [24]; selected items on impulsive behavior [14, 18] and an invitation to participate in the present study on social anxiety in children. A total of 2,568 families (70%) returned their questionnaire and of these, 1,297 families (50.5%) agreed to participate in the social anxiety study.

The families who gave their consent to further participate in 2001 and the families who returned their questionnaires in 2003 seemed to be roughly representative of ethnic Norwegians making certain reservation of a tendency of a higher education level. However, non-ethnic Norwegians were underrepresented. The mothers and fathers who wanted to participate in the present study on social anxiety also reported significantly higher education level than those who refused participation [mothers: χ^2 (3, n = 2,494) = 47.37, $p = .001$; fathers: χ^2 (3, n = 2,453) = 12.7, $p = .01$]. However, those who wanted to participate reported significantly more life stress such as economic problems [χ^2 (1, n = 2,368) = 6.91, $p = .01$], divorce [χ^2 (1, n = 2,568) = 9.36, $p = .002$] and family illness [χ^2 (1, n = 2,425) = 4.00, $p = .05$]. The difference in mean SASC-R total score between those who consented and those who declined ($n = 1271$) was: 35.9 (10.6) vs. 35.0 (9.6) ($F = 9.49$, $p = .002$), respectively.

At the next stage, the second author selected participants for three groups based on the parental SASC-R total score and the impulsivity items (The SASC-R score and the impulsivity scores were transformed to Z-scores): 50 high-scoring children on social anxiety; 50 high-scoring children on impulsivity, and 50 low-scoring children in both domains. If a child had high scores on both social anxiety and impulsivity, the highest z-score determined which group he or she was assigned to. The reason for

including the impulsivity items was two-fold: In order to ensure a comparison group with problem behavior in addition to a presumably well functioning group and to contrast anxiety disorders with disruptive disorders. Exclusion criteria included language problems (both parents from outside Europe): $n = 16$; mild mental retardation: $n = 3$; twins: $n = 3$; adopted child: $n = 2$.

The screening procedure has been described in detail in a previous article [23]. The study was approved by the Regional Committee for Medical Research Ethics and the Norwegian Data Inspectorate.

Measures

WASI

IQ was measured using the Wechsler Abbreviated Scale of Intelligence (WASI) [40]. WASI consists of two subtests assessing verbal IQ (Vocabulary and Similarities) and two subtests assessing performance IQ (Block design and Matrix Reasoning). US standards were used. However, a study of the psychometric properties of the Norwegian WASI version reported mean T-scores and IQ, as well as intercorrelations of subtests and IQ values closely corresponding to the results in the US population [5].

MABC

The Movement Assessment Battery for children (MABC) [19] is a standardized test designed to identify motor difficulties in children. It provides a checklist for teachers and parents in addition to an individually administered performance test. Only the performance test was applied in this study. The test includes four age bands (4–6, 7–8, 9–10, and 11–12 years). All participants were tested on age band four. Three areas of motor function are assessed: Manual dexterity (three tasks); ball skills (two tasks) and static and dynamic balance (three tasks). Raw scores on each item are converted to normative scores (ranging from 0–5) and summarized to provide three subscale scores and a total sumscore. The total score ranges from 0 to 40 with higher ratings representing greater impairment. Test–retest reliability is reported to be high and the concurrent validity to be satisfactory [12].

Kiddie-SADS P/L

The Kiddie- SADS P/L is a semistructured interview providing DSM-IV Axis I child psychiatric (present and lifetime) diagnoses [21]. The instrument does not assess pervasive developmental disorders (PDD) or Axis II disorders. The diagnoses are scored as definite, probable (equal or greater to three fourth of symptom criteria met), or not present. The K-SADS P/L has a child (6–18 years) and a parent version. Usually the interviewer starts with the parent as the informant, then administers the K-SADS to the child and finally makes consensus scores based on all available information. Studies have reported sufficient interrater reliability and test-retest reliability [2, 21]. To test interrater reliability in the present study, 20 audiotaped interviews (mother and child combined) were chosen at random and scored independently by an experienced child psychiatrist. Interrater reliability for the most prevalent lifetime consensus diagnoses were: SAD: .81; specific phobia: .81; any depressive disorder: .81; ADHD: .91 and any disruptive disorder: .91.

ASSQ

The Autism Spectrum Screening Questionnaire (ASSQ) is a 27-item checklist for the assessment of Asperger's disorder and other high-functioning autism spectrum disorders. Items are scored "does not apply", "applies to some extent," and "definitely applies." Total scores range from 0 to 54. The cut-off score for a diagnosis in the present study was 22. The instrument has been found to be a valid and reliable screening measure with good to excellent sensitivity and specificity for autism spectrum disorders [15].

Maternal report on developmental delay

The mothers were asked the following question in three domains (language-; fine motor-, and gross motor skills): Compared to peers, do you think your child's development has been 1: advanced (coded: 1); 2: normal (coded: 2) or 3: delayed (coded: 3). When analyzing the data, category 1 and 2 were collapsed and delay was dichotomized into present versus absent.

State-anxiety measure

In order to include a self-report measure of state anxiety, the overall present level of anxiousness was scored on a five-point Likert-type scale: 1: not anxious at all; 2: a little anxious; 3: somewhat anxious; 4: rather anxious; 5: very anxious. The rationale for including this measure was that failure to control for state anxiety has been reported to be an important limitation in previous studies of motor impairment and psychopathology in childhood [29]. In order to evaluate the presumably most stressful moment of the assessment for children with social anxiety, the rating was administrated upon arrival. The children were asked to score how anxious they felt at the moment.

Procedure

Assessment procedure

The selected families were contacted by phone and the assessment took place in their homes or at an outpatient mental health clinic. The assessment of the children was conducted by the first author who was blind to the screening group status. The applied tests in the present article were administered in the following order: Self-reported state anxiety; MABC; WASI and then Kiddie-SADS with the child as the informant. The Kiddie-SADS interview with the mother as the informant was performed by the same author within 2 weeks after the child interview. If the assessment of the child gave any indication of a possible autism spectrum disorder, the ASSQ [15] was included when interviewing the mother.

Diagnostic groups

Composite lifetime diagnoses were made on the basis of information from each child–mother pair. The 150 children were then assigned to five different diagnostic groups: SAD, ADHD, SAD/ADHD, "other disorder" and "no disorder". The "other disorder" group mainly consisted of children with other anxiety disorders (75%). The SAD/ADHD group was small ($n = 6$), but because the comparison between children with SAD and children with ADHD was an important issue in the present study, we chose to place the children with both ADHD and SAD into a separate group. Two children (both boys) were assigned a diagnosis of Asperger's syndrome. One of them also fulfilled a diagnosis of SAD and was assigned to the SAD group; the other fulfilled a diagnosis of ADHD and was assigned to the ADHD group. With regard to comorbidity in the different diagnostic groups, the mean total number of lifetime diagnoses did not differ between the SAD and the ADHD group [3.1 (1.4) and 3.2 (1.7), respectively]. However, the children in the SAD/ADHD group had significantly more comorbidity [Mean number of lifetime diagnoses (SD): 5.0 (1.8)] compared with the three other groups, whereas "the other group" had significantly less comorbidity [Mean number of diagnoses (SD): 1.9 (1.0)]. Further details on the diagnostic procedure have been described in a previous article [23].

Statistics

χ^2 analysis or the Fisher exact test was used to examine differences between groups for categorical data. For continuous data, independent *T*-tests or ANOVA's with Bonferroni corrections were applied. Correlations were analyzed by Pearson's *r*. All *p*-values were calculated as two-tailed.

Results

Sample characteristics

Sample characteristics are presented in Table 1. The SAD group did not differ from the other groups with regard to gender ratio or parental education level. Significantly more children with SAD did not live together with both parents compared to children with "no disorder," but compared to children with ADHD, more children with SAD lived with both parents. With regard to previous or present treatment, more children with SAD had been referred to outpatient mental health clinics compared to children with "no disorder," but fewer children with SAD had been referred compared to children with ADHD.

State anxiety

Self-reported state anxiety in the different diagnostic groups (Lickert scale from 1–5) is presented in Table 1. There were no significant gender differences within the whole sample or within the SAD group. When correlating self-reported anxiety with MABC and WASI results, the only significant correlation was between the balance subtest score and self-reported anxiety score in boys with SAD ($r = .23$; $p < .05$).

Assessment of verbal and performance IQ and motor skills across different diagnostic groups

The results from the WASI and the MABC across the five diagnostic groups are presented in Table 2. With regard to verbal and performance IQ, the SAD group had poorer VIQ scores compared to children with "other disorder" and "no disorder," but did not differ from children with ADHD. There were no group differences on PIQ. Within the SAD group, there was no significant gender difference in IQ. With regard to motor skills, the MABC total score was also higher (= poorer performance) in children with SAD compared to children with "no disorder." On the subscales, the SAD group performed significantly poorer on the static and dynamic balance test compared to the "other disorder" group and/or "no disorder" group. Similar to the results on VIQ, there was no difference in motor performance between children with SAD and children with ADHD. Within the SAD group there were no gender differences on the MABC test results, but the girls with SAD performed signif-

Table 1 Sample characteristics across five diagnostic groups of 11–12-year-old children*

	SAD[1] $N = 29$ N (%)[4]	ADHD[2] $N = 23$ N (%)	SAD/ADHD $N = 6$ N (%)	Other dis[3] $N = 44$ N (%)	No dis $N = 48$ N (%)
Gender					
Boys[f i]	16 (55.2)	16 (69.6)	5 (83.3)	19 (43.2)	19 (39.6)
Girls	13 (44.8)	7 (30.4)	1 (16.7)	25 (56.8)	29 (60.4)
Age mean (SD)	11.6 (.3)	11.6 (.3)	11.8 (.3)	11.5 (.4)	11.6 (.4)
Living with both parents [a d f j k]	17 (58.6)	6 (26.1)	3 (50)	26 (59.1)	39 (81.3)
Education					
Mother[g i]					
<12 years	15 (51.7)	15 (65.2)	2 (33.3)	13 (29.5)	17 (35.4)
>12 years	14 (48.3)	8 (34.8)	4 (66.7)	31 (70.5)	31 (64.6)
Father[g l]					
<12 years	14 (50.0)	16 (72.7)	3 (50)	14 (31.8)	16 (33.3)
>12 years	14 (50.0)	6 (27.3)	3 (50)	30 (68.2)	32 (66.7)
On Ritalin medication	–	11 (47.8)	1 (16.7)	–	–
Referred to[b h] outpatient clinic	7 (24.1)	14 (60.9)	4 (66.7)	8 (18.2)	–
State anxiety[e]					
Mean (SD)	2.1 (.7)	1.8 (.9)	2.3 (1.0)	1.8 (.6)	1.6 (.6)

*Significant group differences are marked with letters. For SAD, letters are in bold
SAD ≠ ADHD: **[a]$p < .05$; [b]$p < .01$; [c]$p < .001$**
SAD ≠ No disorder: **[d]$p < .05$ [e]$p < .01$**
ADHD ≠ Other disorder: [f]$p < .05$; [g]$p < .01$; [h]$p < .001$
ADHD ≠ No disorder: [i]$p < .05$; [j]$p < .001$
Other disorder ≠ No disorder: [k]$p < .05$; [l]$p < .01$
[1]Social anxiety disorder; [2]Attention Deficit Hyperactivity Disorder; [3]Disorder; [4]Mean (SD) if mentioned in the first column

Table 2 IQ (WASI[1]) and motor skills (MABC[2]) in five diagnostic groups of 11–12-year-old children ($n = 150$)*

		SAD[3] Girls ($N = 13$) Boys ($N = 16$) Total ($N = 29$) Mean (SD)	ADHD[4] Girls ($N = 7$) Boys ($N = 16$) Total ($N = 23$) Mean (SD)	SAD/ADHD Girls ($N = 1$) Boys ($N = 5$) Total ($N = 6$) Mean (SD)	Other dis[5] Girls ($N = 25$) Boys ($N = 19$) Total ($N = 44$) Mean (SD)	No dis Girls ($N = 29$) Boys ($N = 19$) Total ($N = 48$) Mean (SD)
VIQ[6]	G[j]	91.9 (9.9)	87.1 (9.7)	92.0	99.8 (9.6)	100.8 (12.5)
	B	92.3 (15.1)	90.1 (8.0)	86.8 (17.8)	100.6 (8.7)	98.1 (10.7)
	T[a d h k]	92.1 (12.1)	89.2 (8.5)	87.7 (16.1)	99.6 (9.2)	99.8 (11.8)
PIQ[7]	G	103.2 (14.4)	101.1 (15.1)	106.0	105.8 (12.8)	109.2 (12.8)
	B	109.4 (19.9)	102.9 (18.9)	92.4 (8.3)	107.2 (9.7)	109.4 (11.2)
	T	106.6 (17.6)	102.4 (17.5)	94.7 (9.3)	106.4 (11.5)	109.3 (12.1)
Total IQ	G	97.1 (12.7)	93.0 (12.7)	99.0	103.0 (10.2)	105.5 (11.9)
	B	100.3 (17.6)	95.4 (12.7)	87.8 (12.9)	104.1 (6.8)	104.2 (9.0)
	T[g k n]	98.8 (15.4)	94.7 (12.5)	89.7 (12.4)	103.5 (8.8)	104.9 (10.8)
Manual dexterity	G[j]	6.2 (2.7)	8.7 (3.1)	6.0	5.3 (3.4)	4.7 (3.3)
	B	7.5 (3.6)	7.8 (4.9)	9.0 (1.2)	7.5 (2.9)	7.4 (3.9)
	T	6.9 (3.2)	8.1 (4.4)	8.5 (1.6)	6.3 (3.3)	5.8 (3.8)
Ball Skills	G[a]	3.7 (3.5)	2.5 (2.7)	2.0	1.3 (2.1)	1.6 (2.0)
	B[j]	1.6 (2.2)	3.3 (3.2)	3.2 (1.8)	2.2 (2.5)	0.9 (1.4)
	T	2.5 (3.0)	3.0 (3.0)	3.0 (1.7)	1.7 (2.3)	1.3 (1.8)
Balance	G[c f]	5.5 (3.5)	4.1 (2.9)	3.0	1.7 (2.2)	1.3 (2.5)
	B[d o]	4.4 (3.2)	3.7 (4.3)	7.0 (1.7)	3.4 (2.6)	1.3 (1.7)
	T[b f k m p]	4.9 (3.3)	3.8 (3.9)	6.3 (2.3)	2.4 (2.5)	1.3 (2.2)
MABC Total	G[b f g j]	15.4 (6.9)	15.4 (5.0)	11.0	8.3 (5.6)	7.7 (5.5)
	B	13.4 (7.2)	14.8 (10.5)	19.2 (1.5)	13.1 (5.2)	9.6 (5.9)
	T[e l n]	14.3 (7.0)	15.0 (9.0)	17.8 (3.6)	10.4 (5.9)	8.4 (5.7)

*Significant group differences are marked with letters. For SAD, letters in bold
SAD ≠ Other disorder: **[a]$p < .05$; [b]$p < .01$; [c]$p < .001$; SAD ≠ No disorder: [d]$p < .05$; [e]$p < .01$; [f]$p < .001$**
ADHD ≠ Other disorder: [g]$p < .05$; [h]$p < .01$; [i]$p < .001$; ADHD ≠ No disorder: [j]$p < .05$; [k]$p < .01$; [l]$p < .001$
SAD/ADHD ≠ Other disorder: [m]$p < .05$; SAD/ADHD ≠ No disorder: [n]$p < .05$; [o]$p < .01$; [p]$p < .001$
[1]Wechsler Abbreviated Scale of Intelligence; [2]Motor Assessment Battery for Children; [3]Social Anxiety Disorder; [4]Attention Deficit Hyperactivity Disorder; [5]Disorder; [6]Verbal IQ; [7]Performance IQ

icantly poorer than girls with "other disorder" and/or "no disorder" in more subtests than the boys with SAD compared to boys in the other groups. In general children with a diagnosis of SAD comorbid with ADHD ($n = 6$) obtained the poorest results on all tests, but many of the differences did not reach significance due to the small sample size.

Maternal report on developmental delay

Maternal report on developmental language or motor delay (delayed or not compared to peers) in the various diagnostic groups is presented in Table 3. With regard to language development, the SAD group was more often reported to be delayed compared to children with "no disorder." With regard to gross motor development, more children with SAD were reported to be delayed compared to both children with "no disorder" and children with "other disorder." In accordance with the assessment results there was no difference between the SAD group and the ADHD group with regard to delay in gross motor function, language or "any delay." However, compared to the SAD group, significantly more children with ADHD and children with SAD/ADHD were reported to be delayed in fine motor skills. All children with SAD/ADHD were reported to have "any delay."

In order to assess the validity of the mother's retrospective reports, MABC scores were compared between the children reported with a delay in motor development (fine or gross motor or both) ($n = 39$) and children with no delay ($n = 111$) [16.7 (7.7) vs. 9.7 (5.9), $t = 5.24$, $p < 0.000$)]. With regard to language, the verbal IQ scores between those reported to be delayed ($n = 27$) versus those who were not ($n = 123$) were 87.1 (9.8) and 98.3 (11.3) ($t = -4.76$, $p < 0.000$), respectively.

Discussion

The main aim of this study was to explore the relationship between SAD and neurodevelopmental deficit/delay (NDD) in 11–12 year old children. The association was examined by comparing a SAD group with other diagnostic groups. NDD's were measured using verbal and performance IQ, a test of motor skills and maternally reported delay in language, and motor development.

Overall the results indicate that SAD in children may be associated with subtle deficits in language and motor function. Previous studies have found reduced social skills in children with SAD [3, 37]. In childhood, language, and motor function are essential components of the more complex concept of social skills [11, 13]. Concern about negative evaluation by others is a core feature in social anxiety [30]. To be scrutinized when doing something one is not particularly good at may be anxiety provoking for people in general and for shy people in particular. Thus, these deficits may contribute to the stress children with social anxiety experience in social situations.

The findings of subtle language, and motor deficits/delays in SAD in the present study corresponds with previous reports on this relationship in both children and adults. With regard to the relationship between SAD and SM, the results are consistent with findings of NDD's in SM [22, 26] and add support to the suggestion that SM may be part of the SAD

Table 3 Language and motor developmental delay in five diagnostic groups* as reported by mother

	SAD[1] $N = 29$ N (%)	ADHD[2] $N = 23$ N (%)	SAD/ADHD $N = 6$ N (%)	Other dis[3] $N = 44$ N (%)	No dis[3] $N = 48$ N (%)
Language					
Delayed[b d j l o]	8 (27.6)	4 (17.4)	5 (83.3)	7 (15.9)	3 (6.3)
Not delayed	21 (72.4)	19 (82.6)	1 (16.7)	37 (84.1)	45 (93.8)
Fine motor					
Delayed[a b h i l n o]	4 (13.8)	10 (43.5)	4 (66.7)	3 (6.8)	1 (2.1)
Not delayed	25 (86.2)	13 (56.5)	2 (33.3)	41 (93.2)	47 (97.9)
Gross motor					
Delayed[c e g i k n]	9 (31.0)	9 (39.1)	3 (50.0)	4 (9.1)	2 (4.2)
Not delayed	20 (69.0)	14 (60.9)	3 (50.0)	40 (90.9)	46 (95.8)
Any delay					
Yes[c f g i m o]	15 (51.7)	14 (60.9)	6 (100)	12 (27.3)	6 (12.5)
No	14 (48.3)	9 (39.1)	–	32 (72.7)	42 (87.5)

*Significant group differences are marked with letters. For SAD, letters are in bold
SAD ≠ ADHD: [a]$p < .05$; SAD ≠ SAD/ADHD: [b]$p < .05$; SAD ≠ Other disorder: [c]$p < .05$; SAD ≠ No disorder: [d]$p < .05$; [e]$p < .01$; [f]$p < .001$;
ADHD ≠ SAD/ADHD: [j]$p < .01$; ADHD ≠ Other disorder: [g]$p < .01$; [h]$p < .001$; ADHD ≠ No disorder: [i]$p < .001$; SAD/ADHD ≠ Other disorder: [k]$p < .05$; [l]$p < .01$; [m]$p < .001$; SAD/ADHD ≠ No disorder: [n]$p < .01$; [o]$p < .001$
[1]Social Anxiety Disorder; [2]Attention Deficit Hyperactivity Disorder, [3]Disorder

spectrum [32]. Interestingly, deficits in speech processing have been suggested to be a discriminating factor between the two conditions [41] and one small clinical study found that children with SM (n = 14) showed some language impairment (difficulties in discriminating speech sounds) relative to children with SAD (n = 9) [25]. The present finding of subtle NDD's in SAD (without SM) questions this hypothesis, and studies including comprehensive assessment of language and motor function with larger samples of children with SAD and SM are clearly needed.

Furthermore, the reported correlation between social anxiety and foot agility but not between social anxiety and finger agility (reaching significance in girls only) [31] is in accordance with the present findings of gross motor (balance and coordination), but not fine motor problems in SAD. Finally, the verbal and motor impairment in the children with SAD is in line with neuropsychological and neurophysiological studies on SAD in adults reporting impairments in verbal processing [6, 10] and increased soft signs [20].

Unfortunately, the cross-sectional design of the present study does not allow any causal explanation of the association between the social anxiety and the verbal and motor deficits/delays. Several alternative explanations are possible including that social anxiety leads to motor and verbal impairment or that motor and verbal impairment lead to social anxiety or finally that a common organic factor may underlie both the motor and verbal deficits as well as the social anxiety. The first hypothesis implies that social anxiety has caused the poorer test results in the children with SAD. However, the only significant correlation between self-reported state anxiety and test results was rather low and was only evident for the balance subtest in boys. Other studies on childhood motor impairment that have included some measure of state/trait anxiety also found that children with poorer motor skills show higher state *and* trait anxiety compared to controls [33, 36].

The second hypothesis proposes that verbal and motor impairments lead to social anxiety in children. One could argue that because the reduced performance in the SAD group is moderate, this explanation seems to be unlikely. However, little is known about the psychosocial impact of subtle versus more apparent language and motor impairments in children [28]. Moreover, early language impairment seems to represent a distinct pathway to adolescent SAD [39]. Children with DCD report increased anxiety and lower self-worth with age [36], and longitudinal population based studies have shown that motor impairment in childhood may predict anxiety in adolescence [34, 35]. Whether the NDD's in the present study will predict persistent social anxiety will hopefully be examined in a follow-up when the children have reached late adolescence.

The third explanation implies that there is a third common organic factor responsible for both the motor and verbal impairment *and* the social anxiety, i.e., that they all reflect neurological immaturity. If so, one might expect deficiencies in other domains such as for instance attention skills. The small group of children with both social anxiety and ADHD had the poorest performance in the study. Five of these children had AHDH—inattentive type, and one could speculate whether the other children with SAD also might have milder degrees of attention problems. Interestingly, prospective studies of later behavior based on temperament report an association between sluggishness (characterized by passivity, flat affect, malleability, shyness, fearfulness, and little verbal communication) and anxiety *and* inattention [7].

Finally, these different hypotheses on the association between social anxiety and NDD's need not rule out the others. Thus a fourth possibility may be that they work in concert; i.e., children born with neurobiological vulnerability expressed by both NDD's and an anxious liability (common organic factor) may become increasingly anxious with age, as a result of the social problems caused by their motor and language impairment (NDD's cause social anxiety). Furthermore, when tested on their impaired functions, they may perform worse than their optimal level on that particularly skill (social anxiety causes NDD's).

Strengths and limitations

The strengths of this study include the use of multi-informants and multi-methods, the direct and blind assessment of the children and the fact that comparisons are made between different diagnostic groups and not only among children with SAD and controls. The limitations are that the recruitment has gone through many stages and this may have affected the representativity of the sample. Furthermore, the study did not conduct any interrater reliability testing of MABC and WASI, and blind assessment is also essentially impossible when examining extreme groups such as ADHD and SAD. Finally, the small diagnostic groups represent a limitation.

Conclusion

SAD in childhood may be associated with neurodevelopmental deficit/delay in language and or motor function. NDD's may contribute to the social fears children with SAD experience if the feared situations

include being scrutinized by others when doing something they actually are not good at. Referred children with SAD should be thoroughly assessed with regard to developmental history and language, motor and cognitive skills. If the assessment reveals impairment, it is important to adjust the demands to the child's actual level of functioning.

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