



Student–teacher relationship quality in children with and without ADHD: A cross-sectional community based study

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ABSTRACT

The relationships children form with their teachers in early childhood are known to be important in the context of their ongoing learning and development. This study investigated student–teacher relationship quality (STRQ) in grade one students with ($n = 177$) and without ($n = 208$) attention-deficit/hyperactivity disorder (ADHD). We also examined whether a range of child and teacher factors were associated with STRQ. Children ($M = 7.3$ years; $SD = 0.4$) were recruited through 43 schools and screened for ADHD using parent and teacher screening questionnaires (Conners 3 ADHD index). ADHD cases were confirmed using the diagnostic interview schedule for children version IV. STRQ was rated by teachers using the student–teacher relationship scale – short form. Results showed that children with ADHD experienced poorer STRQ compared to children without ADHD (Cohen's $d = 1.11$). STRQ was associated with child sex, medication use, ADHD subtype, cognitive/academic functioning and behavior, teacher experience, and self-efficacy, and parent education and socio-economic status. After controlling for school and teacher clustering, children's prosocial behavior and teacher years of experience were positively associated with STRQ in both groups. In children with ADHD, conduct problems and child sex (boys) predicted poorer teacher relationship quality. For children without ADHD, higher socio-economic status was associated with better STRQ. Targeting modifiable factors associated with STRQ for children with and without ADHD and their teachers may be one way of improving school outcomes for at-risk children. Promoting prosocial behavior in classrooms may benefit STRQ for all children.

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1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a highly prevalent neurodevelopmental disorder affecting approximately 5% of children worldwide (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014). ADHD is characterized by developmentally inappropriate levels of inattention, hyperactivity, impulsivity, and co-occurring behavior and self-regulation difficulties (American Psychiatric Association, 2013). Due to symptoms and characteristics associated with the disorder, children with ADHD tend to

experience considerable difficulties in the school environment (Kos, Richdale, & Hay, 2006). Children with ADHD have been found to experience academic underachievement (Masseti et al., 2008), and are rated below their peers on behaviors that enable academic success, such as classroom engagement, academic motivation, interpersonal skills and study skills (Vile Junod, DuPaul, Jitendra, Volpe, & Cleary, 2006; Volpe et al., 2006). Over the long-term, educational outcomes remain poor and social difficulties are likely to persist (Loe & Feldman, 2007). ADHD in childhood predicts a reduced overall quality of life and ADHD remains associated with substantial social, health and economic problems later in life (Barkley, Fischer, Smallish, & Fletcher, 2006; Harpin, 2005).

While school difficulties experienced by children with ADHD are well recognized, little is known about the factors that may protect children with ADHD from poor school functioning. One

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possible buffer is the extent to which a child has a supportive, non-conflictual relationship with his/her classroom teacher (Baker, 2006; Roorda, Koomen, Spilt, & Oort, 2011). Whilst student–teacher relationships for children with behavioral difficulties (e.g., aggression) have been shown to involve more conflict and less closeness (Crum, Waschbusch, & Willoughby, 2016; Lei, Cui, & Chiu, 2016), little is known about the nature of student–teacher relationships for children with ADHD. It is also unclear whether poor student–teacher relationship quality (STRQ) arises primarily from behavioral problems that often accompany ADHD, or whether there are other important factors that may offer opportunity for interventions tailored to children with ADHD. This cross-sectional study compared STRQ between children with and without ADHD in a large community sample in grade one (second year of schooling) with the aim of identifying child and teacher-level factors associated with STRQ.

1.1. Student–teacher relationship quality

Teachers can influence a broad range of student outcomes in the early school years including student academic achievement and social-emotional functioning through the classroom environment that they foster (Hamre & Pianta, 2005; Maldonado-Carreno & Votruba-Drzal, 2011). Classroom interactions that are supportive, and which instigate child interest and initiative, allow teachers to not only influence positive academic, cognitive and behavioral outcomes but to also facilitate positive child self-perception and self-efficacy (Hamre & Pianta, 2005; Pianta & Stuhlman, 2004). Accordingly, it has been shown that teachers have the capacity to set children onto a trajectory for both higher academic achievement and better social adjustment in a child's later years of school (Maldonado-Carreno & Votruba-Drzal, 2011; O'Connor & McCartney, 2007).

Naturally, student–teacher relationships vary in nature and quality and can be conceptualized by examining two aspects of the quality of the interactions between the student and teacher: closeness and conflict (Mason, Hajovsky, McCune, & Turek, 2017). Closeness captures the extent to which the student and teacher have a warm and caring relationship, whereas conflict captures the degree to which the relationship is conflictual and negative between student and teacher. Together, the dimensions of conflict and closeness examine both positive and negative aspects of a teacher's relationship with a child (Pianta & Stuhlman, 2004).

Teacher-reported conflict in the student–teacher relationship has been related to many of the classroom challenges present when teaching a child with ADHD that is, disruptive child misbehaviors, off-task behaviors, negative emotional interactions, and difficult classroom/behavior management (Pianta, 1999). In contrast, closeness in the student–teacher relationship has been strongly associated with positive emotional child–teacher interactions (Pianta, 1999). Evidence from several studies suggests that attention and behavioral problems, including poor self-control, can negatively impact on the quality of the relationships these children have with their teachers (Mautone, Lefler, & Power, 2011; Portilla, Ballard, Adler, Boyce, & Obradović, 2014; Rogers, Belanger-Lejars, Toste, & Heath, 2015). Further, student–teacher relationships in children entering school with symptoms of inattention and impulsivity have been associated with poorer STRQ, characterized as being more conflictual and less close relationships (Portilla et al., 2014), suggesting both aspects of the relationship are important for children with ADHD.

Various psychological models have theorized why and how individual factors might contribute to the development of STRQ (Davis, 2003). Social motivation theory posits that teacher expectations, instruction, and beliefs influence children and STRQ (Brophy, 2004). Whilst attachment theory suggests that parent's socialization of

their children (i.e., child's behavior, social interactions, and thinking skills) influences STRQ (Cassidy & Shaver, 2008). Alternatively, developmental systems theory considers STRQ to result from the culmination of the goals, temperament, feelings, needs and behavioral styles of both the child and the teacher, as well as external influences (e.g., school policy), which all interact reciprocally and bi-directionally (Pianta, Hamre, & Stuhlman, 2003). Altogether, the above theories suggest that both child and teacher-level factors are likely to contribute to STRQ.

1.2. STRQ in children with ADHD

Whilst research demonstrates that STRQ is prospectively associated with positive school-based functioning in typically developing children (Maldonado-Carreno & Votruba-Drzal, 2011; Roorda et al., 2011), studies that have examined STRQ in children with ADHD and the factors associated with the quality of this relationship remain limited. This is surprising given that children with ADHD are indeed at risk for poorer school outcomes (Loe & Feldman, 2007; Massetti et al., 2008), and could potentially benefit from positive relational experiences with their teachers. In examining child perceptions of their classroom environments, Rogers and Tannock (2013) found that children with clinical levels of ADHD symptoms ($n=33$) reported feeling less supported and a lack of relatedness with their teachers than their non-ADHD peers ($n=34$), although effects were small. These findings were corroborated by teacher report, as in the same sample of children, teachers reported feeling less emotionally connected and lower levels of collaboration with children in the ADHD group compared to children without ADHD (Rogers et al., 2015). In a recent study that examined teacher-reported STRQ in various groups of children with special educational needs, children with high levels of ADHD symptoms ($n=56$) were found to have more conflictual ($d=1.43$) and less close ($d=.64$) relationships with their teachers compared to children with low/no ADHD symptoms ($n=56$) (Prino, Pasta, Gastaldi, & Longobardi, 2016).

Although the findings from these studies provide some insight into the nature of STRQ for children with ADHD, they are limited by small sample sizes and lack of a gold-standard ADHD diagnosis (i.e., assessed against diagnostic criteria on a validated rating scale). As a result, a research gap also remains in understanding how STRQ may be associated with or vary between the three defined ADHD presentations (American Psychiatric Association, 2013). The inattentive type (ADHD-I) accounts for approximately half of all ADHD cases in community-based samples and is characterized by clinically significant inattentive symptoms in the absence of hyperactivity. The hyperactive-impulsive type (ADHD-H) characterized by predominantly hyperactive symptoms and combined subtypes (ADHD-C), characterized by clinical symptoms of both inattention and hyperactivity/impulsivity, account for about 25% each (Willcutt et al., 2012). To the best of our knowledge, no studies have examined if STRQ varies by ADHD presentation, however, it is likely that increased conflict in the STRQ may result from children who more frequently violate classroom rules and do not follow teacher instructions, which are often behaviors more typical of children with ADHD-H and ADHD-C presentations (Greene, Beszterczey, Katzenstein, Park, & Goring, 2002).

1.3. Child and teacher-level factors associated with student–teacher relationship quality

Currently, the majority of literature available on factors that predict STRQ stems from studies of students with typical development. Prior research has indicated that STRQ is predicted by child-level factors, particularly behavioral functioning (Doumen et al., 2008; Mejia & Hoglund, 2016). Indeed, externalizing prob-

lems (e.g., aggression, hyperactivity, oppositional behavior) have been found to place children at greater risk of developing poorer STRQ. Jerome, Hamre, and Pianta (Jerome, Hamre, & Pianta, 2009), for example, found that externalizing symptoms in early childhood predicted greater teacher-perceived conflict in the final year of primary school. Another prospective study revealed that externalizing behaviors in primary school-aged children predicted greater conflict in student–teacher relationships two years later (Pakarinen et al., 2017). Internalizing problems (e.g., anxiety, mood symptoms) in children have also been found to predict negative STRQ. In a small prospective study, children with internalizing (and not externalizing) difficulties were found to have less close relationships with teachers over time compared to healthy children (Henricsson & Rydell, 2004). A larger study found similar results, where internalizing symptoms in children prospectively predicted poorer teacher-perceived STRQ (Mejia & Hoglund, 2016). These findings are unsurprising, given emotional problems for children may lead to withdrawal, constrained student–teacher interactions and thus, limited opportunities for the development of positive STRQ (Rudasill, 2011).

Other child-level factors have also been found to be associated with the development of STRQ. A seminal study in the area found social functioning in children to be prospectively associated with positive STRQ (Birch & Ladd, 1998). Preliminary research of STRQ in children with autism spectrum disorder (ASD) has revealed similar results. Both cognitive and academic functioning in children has also been posited to influence STRQ. In children, better cognitive functioning has been associated with positive observation-based student–teacher interactions in two large cross-sectional studies (Howes & Smith, 1995; Hu et al., 2017). An experimental study that primed children with an image of their classroom teacher also found that children with closer student–teacher relationships demonstrated faster cognitive processing (Ahnert, Milatz, Kappler, Schneiderwind, & Fischer, 2013). Longitudinal studies have also shown prospective associations between lower academic achievement and poorer STRQ (Hajovsky, Mason, & McCune, 2017). Together, these findings suggest it may be easier for teachers to build relationships with children they perceive as having more social, cognitive and academic competence. Teacher characteristics associated with positive STRQ include greater years of teaching experience and higher teacher self-efficacy (Klassen & Tze, 2014; Mashburn, Hamre, Downer, & Pianta, 2006).

For children with ADHD, it is possible that medication use may be an important predictor of STRQ. It is well-established that ADHD medication use is associated with improvements in inattention and hyperactivity symptoms, classroom behavior, aggression, and social skills as rated by teachers (MTA Cooperative Group, 1999). Given that these domains have been associated with more positive STRQ in the general population, it is plausible that children with ADHD who are taking medication to manage their symptoms may have improved STRQ compared to children with ADHD not taking medication. Research in general student populations also suggests the child's sex may predict STRQ, with teacher's consistently reporting closer and less conflictual relationships with girls than with boys in their class (Baker, 2006; Pianta et al., 2003).

1.4. The current study

Given that the symptoms and impairments associated with ADHD are evident in the early years of school (Efron et al., 2014), examining STRQ in this population in the first years of a child's school experience is critical. This may provide an important opportunity for early intervention to help children to shift towards a more positive school-based trajectory that may promote more positive relationships with teachers and peers and foster academic and cognitive gains. This study aimed to investigate whether children

with ADHD experience poorer STRQ compared to non-ADHD controls. In addition, we examined the nature of STRQ between the three defined ADHD presentations. We also explored child (e.g., social, emotional and behavioral functioning) and teacher (e.g., years' experience and self-efficacy) factors associated with STRQ in children with and without ADHD, while also accounting for family demographic factors.

It was hypothesized that compared to non-ADHD controls, children with ADHD would have poorer STRQ including higher levels of conflict and lower levels of closeness. Based on findings that children with the ADHD combined subtype experience greater impairment on several factors posited to contribute to positive STRQ (Efron et al., 2014; Gaub & Carlson, 1997; Nikolas & Nigg, 2013), we further hypothesized that children with ADHD combined would have poorer STRQ (i.e., higher levels of conflict and lower levels of closeness) than children with the other ADHD subtypes. We also expected that in both children with and without ADHD more positive STRQ would be associated with:

- a Higher child academic achievement and cognitive abilities;
- b More positive socio-emotional and behavioral functioning;
- c More years of teaching experience and higher teacher self-efficacy.

2. Method

This cross-sectional study used baseline data from the Children's Attention Project, a longitudinal study examining the long-term outcomes for children with ADHD (Sciberras et al., 2013). The study received approval from the Human Research Ethics Committees of the Royal Children's Hospital (#31056) and the Victorian Department of Education and Early Childhood Development (#2011.001095).

2.1. Participants

Families were recruited from 43 government elementary schools across Melbourne, Victoria and children were in their second year of formal schooling (Grade 1). Following screening and ADHD group classification (see procedure section for details), the final sample consisted of 391 children (ADHD, $n = 179$; non-ADHD controls, $n = 212$), aged 6–8 years ($M = 7.3$ years; $SD = 0.4$; 66.2% male), and their parents and teachers. Participating schools were recruited from education regions selected for the representation of diverse socioeconomic neighborhoods. Participating schools were all English speaking and had students from a range of ethnic backgrounds. As such, participating families ranged in SES, with the average SES (SEIFA) score of 1013 ($SD = 44$), slightly higher than the state average of 1000 ($SD = 100$). Primary caregivers were more likely to be mothers (90%), with most (73 %) having completed high school. Participating teachers ($n = 138$) were more likely to be female, had a mean age of 37.2 ($SD = 12.4$) and had an average of 11.4 years of teaching experience. The number of participants in the same classroom ranged from 1 to 4; on average 1.4 participating students were in each classroom for both groups.

Families were excluded if they had insufficient English to complete study measures or if the child had an intellectual disability, genetic disorder, moderate-severe sensory impairment, neurological problem or a serious medical condition. Six participants with missing STRQ data were excluded from this study.

2.2. Measures

2.2.1. Conners 3 ADHD index

The parent-reported Conners (Conners, 2008) ADHD 10-item scale was used to screen for ADHD symptoms. Items (e.g., rest-

less, overactive) are rated on the rate of occurrence from 1 (*never/seldom*) to 3 (*very often/very frequent*), with higher scores indicating greater symptom severity. This measure has been shown to have strong internal consistency (parent $\alpha = 0.92$) and test-retest reliability (Kao & Thomas, 2010). Internal consistency was excellent for the current sample (Cronbach's $\alpha = .97$).

2.2.2. Diagnostic interview schedule for children – 4th edition (DISC-IV)

The DISC-IV (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) is a computerized structured diagnostic interview with good validity and reliability. The ADHD module of the DISC-IV uses criteria outlined in the Diagnostic and Statistical Manual for Mental Disorders-IV (American Psychiatric Association, 2013) to assess for ADHD and ADHD presentations. The DISC algorithms determine ADHD diagnostic status and ascertain ADHD presentation based on symptom counts. ADHD presentations have adequate reliability, with weaker evidence for ADHD-H beyond first grade (Willcutt et al., 2012). In the current study, within the ADHD group 92 (52%) met DSM-IV criteria for ADHD-C (i.e., both hyperactive and inattentive), 63 (36%) met criteria for ADHD-I (i.e., predominantly inattentive), and 22 (12%) met criteria for ADHD-H (i.e., predominantly hyperactive/impulsive).

2.2.3. Student–teacher relationship scale-short form (STRS-SF)

The STRS-SF (Pianta, 2001) is a teacher-reported 15-item measure used to assess two dimensions of the student–teacher relationship quality (STRQ): Closeness (7-items; e.g., I share an affectionate, warm relationship with this child), and Conflict (8-items; e.g., this child easily becomes angry with me). Items are rated on a 5-point Likert scale ranging from 1 (*definitely does not apply*) to 5 (*definitely applies*). Higher summed item scores on each scale indicate higher levels of the construct being measured. To create a total STRQ overall quality score, ranging from 15 to 75, items from the Conflict scale are reverse coded and summed with the items from the Closeness scale such that higher scores indicate more positive STRQ. Internal consistency in the current study was good (closeness $\alpha = .80$, conflict $\alpha = .90$ and overall quality $\alpha = .86$).

2.2.4. Strengths and difficulties questionnaire (SDQ)

The parent-reported SDQ was used to measure child socio-emotional and behavioral functioning (Hawes & Dadds, 2004). The 25-item measure consists of five subscales, each with 5-items: emotional problems (e.g., many difficulties, easily scared), conduct problems (e.g., often fights with other children or bullies them), peer problems (e.g., has at least one good friend), inattention/hyperactivity (e.g., constantly fidgeting or squirming) and prosocial behavior (e.g., helpful if someone else is hurt, upset or feeling ill). Items are rated on a 3-point scale from 0 (*not true*) to 2 (*certainly true*), with total scores ranging from 0 to 10 for each subscale. Some items are reversed scored. Higher scores represent greater difficulties, except for prosocial behavior, where higher scores indicate more positive behavior. This measure has adequate reliability (Stone, Otten, Engels, Vermulst, & Janssens, 2010) and SDQ scales showed satisfactory measurement reliability with internal consistencies ($\alpha = .75-.85$) across all SDQ subscales.

2.2.5. Wide range achievement test – 4th edition (WRAT 4)

The Word Reading and Math Computation subtests of the WRAT 4 were used to assess academic achievement (Wilkinson & Robertson, 2006). Word Reading assesses letter and word decoding through letter identification and word recognition. Math Computation assesses basic mathematical ability through counting, identifying numbers, and solving oral and written math problems.

Raw scores were converted into standard scores ($M = 100$, $SD = 15$). The measure shows good reliability (Wilkinson & Robertson, 2006).

2.2.6. Wechsler intelligence scale for children – 4th edition (WISC-IV)

The well-validated Digit Span subtest of the WISC-IV was used to assess auditory memory span and working memory (Wechsler, 2003). Raw scores were converted to scaled scores ranging from 1 to 19 ($M = 10$, $SD = 2$). The measure has excellent internal reliability (Williams, Weiss, & Rolfhus, 2003).

2.2.7. Wechsler abbreviated scales of intelligence (WASI)

The vocabulary and matrix reasoning subtests of the WASI were used to measure verbal reasoning, visual information processing and abstract reasoning skills (Wechsler, 1999). Subtest raw scores were converted into T scores ($M = 50$, $SD = 10$). This measure is a well-recognized measure of cognitive abilities with excellent reliability (Wechsler, 1999).

2.2.8. Teacher self-efficacy scale

This 4-item self-rating scale was used to assess teacher perceived competency (Whitley, 2010). Items (e.g., I have a strong effect on the academic achievement of the students I teach) were rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), with total scores ranging from 4 to 20. Internal consistency of the scale was good ($\alpha = .84$). Higher scores reflect greater self-efficacy.

2.2.9. Other child, teacher & demographic factors

Information on child ADHD medication use was reported by parents. Teachers self-reported on the number of years spent working as a teacher. Other sample demographic factors included the age and sex of children and teachers and the educational qualification of parents. Neighborhood socioeconomic (SES) status was assessed using the Socio-Economic Indexes for Areas (SEIFA) code based on each child's home postcode. The SEIFA provides a rank of socio-economic advantage and disadvantage based on geographic area (Australian Bureau of Statistics, 2011), ($M = 1000$, $SD = 100$; higher scores reflect less disadvantage).

2.3. Procedure

2.3.1. Screening

A total of 5922 screening questionnaires consisting of the 10-item Conners 3 ADHD index (Conners, 2008) were distributed in participating schools to parents, and to teachers of children for whom parents provided consent. Complete parent and teacher screening survey data were available for 3734 children (63% response rate). Responders were more likely to be from socially advantaged areas, although there were no differences between responders and non-responders in terms of child age and sex.

Children were considered as screening positive for ADHD if scores on both parent and teacher Conners 3 indices were ≥ 75 th percentile for males and ≥ 80 th percentile for females, or if they had a parent-reported pre-existing ADHD diagnosis. Children below these cut-off on both parent and teacher-reported Conners 3, and with no parent-reported previous ADHD diagnosis were considered as screening negative. Positively screening children ($n = 412$) were matched with negatively screening children ($n = 412$) on sex and school and invited to participate in the CAP main study. Families of 267 (65%) positively screening children and 231 negatively screening children (55%) were eligible and consented to participate. During case confirmation, 179 met criteria for ADHD, and 212 did not meet criteria for ADHD. The non-ADHD controls included children who screened negative for ADHD and do not meet criteria for ADHD on the DISC-IV. The ADHD group included children who

screened positive for ADHD and met diagnostic criteria for ADHD on the DISC-IV. The third group ($n = 88$) of children “at-risk” of ADHD, screened positive for ADHD but did not meet criteria for ADHD on the DISC-IV or screened negative for ADHD but met criteria for ADHD on the DISC-IV, were excluded from this study.

2.3.2. ADHD group classification

The DISC-IV (Shaffer et al., 2000) was used to confirm ADHD status and was completed with parents at the family home or at the child’s school. Following this, 179 positively screening children were confirmed as meeting criteria for ADHD and were classified into the ADHD group, while 212 negatively screening children were confirmed as not meeting criteria and classified into the non-ADHD control group.

2.3.3. Assessment

Direct child assessments including the WISC-IV, WASI and WRAT-4 were administered by trained research assistants with a minimum four-year degree in psychology. Detailed surveys containing questions about the study child’s behavior and functioning, as well as demographic information were mailed to parents and teachers. Teacher surveys additionally included questions regarding their relationship with the student and level of teacher self-efficacy. Research assistants were blinded to participant group classification.

2.4. Data analysis

Descriptive statistics were generated to examine sample demographic factors, and independent samples t -tests or chi-square tests were used to compare these factors between the ADHD and non-ADHD control group. For aim 1, three independent samples t -tests were conducted to compare closeness, conflict and overall STRQ in children with ADHD and non-ADHD controls with STRQ data available at baseline (385 out of 391). Participants with and without STRQ data (4 controls and 2 ADHD) were similar in regards to age, sex, ADHD symptoms, and neighborhood SES. Cohen’s d was used as a measure of effect size, with a value of 0.3 considered small, 0.5 considered moderate, and 0.7 considered large (Cohen, 1988).

To address aim 2, a one-way analysis of variance (ANOVA) was calculated to determine if STRQ differed significantly by ADHD presentation (ADHD-C, ADHD-I, and ADHD-H).

For aim 3, preliminary analysis using Pearson’s correlations was conducted to assess whether child, teacher and family demographic factors were associated with STRQ. Thereafter, all variables showing a significant correlation ($p < .1$) were entered simultaneously as predictors in regression models to estimate the strongest predictors of STRQ. We used linear mixed effect modeling to account for clustering at the level of both the school and teacher (Barr, Levy, Scheepers, & Tily, 2013). Separate models were run for the ADHD and non-ADHD groups. A high proportion of participants with ADHD (84%) and controls (90%) had complete data available across all predictor variables examined. Participants with incomplete predictor variables were excluded from the regression analyses. For the regression analyses, all continuous predictor variables were standardized to have a mean of zero and a SD of one. Analyses were conducted using Stata Version 15.1 (Stata Corp, College Station, TX, USA).

3. Results

3.1. Sample characteristics

Participant characteristics are shown in Table 1. There were no differences between ADHD and non-ADHD children in terms of child age, sex, and neighborhood SES or teacher characteristics.

Table 1
Participant characteristics for children with ADHD and controls.

	ADHD ^a	Controls ^b	p -Value ^c
Child characteristics			
Child age	7.3 (0.5)	7.3 (0.4)	0.50
Child sex (boys), n (%)	123 (69.1)	133 (63.6)	0.26
ADHD subtype, n (%)			
Combined	92 (52.0)	–	–
Inattentive	63 (35.6)	–	–
Hyperactive	22 (12.4)	–	–
ADHD medication, n (%)	21 (11.7)	–	–
Emotional (SDQ)	3.4 (2.4)	1.8 (1.6)	<.001
Conduct (SDQ)	4.2 (2.3)	1.3 (1.4)	<.001
Hyperactivity (SDQ)	8.3 (1.6)	2.6 (2.1)	<.001
Peer (SDQ)	3.1 (2.2)	1.1 (1.3)	<.001
Prosocial (SDQ)	6.3 (2.1)	8.3 (1.6)	<.001
Visual processing	45.8 (9.6)	51.6 (10.4)	<.001
Vocabulary	43.9 (9.4)	49.7 (8.6)	<.001
Working memory	8.6 (2.4)	10.2 (2.5)	<.001
Word reading	96.9 (17.7)	111.8 (13.6)	<.001
Math	90.1 (14.7)	102.9 (13.5)	<.001
Primary caregiver characteristics			
Age	37.2 (5.8)	38.9 (5.5)	<.001
Female, n (%)	158 (88.8)	186 (87.7)	0.22
Biological parent, n (%)	161 (90.4)	195 (93.3)	0.53
Did not complete high school, n (%)	62 (34.8)	37 (17.7)	<.001
SES (SEIFA)	1010.3 (41.8)	1014.3 (45.3)	0.37
Teacher characteristics			
Age	36.4 (11.6)	36.9 (12.31)	0.63
Sex (female)	160 (89.9)	178 (85.2)	0.08
Years of teaching experience	11.2 (10.7)	11.4 (10.9)	0.85
Teacher perceived self-efficacy	17.7 (1.70)	17.8 (1.6)	0.62

Note: ^a N ranged from a maximum of 177 to a minimum of 165. ADHD subtype data was only available for children with a diagnosis of ADHD; ^b N ranged from a maximum of 20 to a minimum of 208; ^c $p < .05$; n (%) = number and percentage, SDQ = strengths and difficulties questionnaire–parent rated; SEIFA = socio-economic indexes for areas (population mean = 1000, SD = 100). All characteristics reported as M (SD) unless otherwise specified.

Compared to non-ADHD children, children with ADHD were more likely to have significant behavioral difficulties and lower cognitive and academic achievement, across all domains. Children with ADHD were also more likely to have parents who were younger and who had lower educational attainment. Of the children with ADHD, 63 had predominantly inattentive presentation (ADHD-I), 22 had predominantly hyperactive-impulsive presentation (ADHD-H), 92 had ADHD combined presentation (ADHD-C). Twenty-one children were currently taking ADHD medication at the time parents were surveyed.

3.2. Differences in STRQ between children with and without ADHD

Teachers reported significantly poorer total STRQ scores for children with ADHD compared to non-ADHD children (*mean difference* $MD = -8.9$; 95% $CI: -10.4$ to -7.2 ; $p < .001$; *Cohen’s* $d = -1.11$). This was driven by the large effect of student–teacher conflict and to a lesser extent lower closeness (see Table 2).

3.3. Differences in STRQ in children with different ADHD presentations

Total STRQ scores differed by only two points amongst different ADHD presentations: ADHD-I (STRQ mean score = 59.8, $SD = 9.7$), ADHD-H ($MS = 58.6$, $SD = 9.5$) and ADHD-C ($MS = 57.9$, $SD = 10.0$). Results of a one way ANOVA revealed no significant differences in STRQ between ADHD presentations, $F(2, 174) = .71$, $p = .49$. Further, a comparison of means scores on the parent rated conduct problems $F(2, 162) = .20$, ($p = .14$) and prosocial $F(2, 164) = .09$, ($p = .90$) subscales of the SDQ, showed that there were no significant difference between ADHD presentations.

Table 2
Comparison of student–teacher relationship quality by ADHD and controls in grade one.

STRQ variables	ADHD (N = 177) M (SD)	Controls (N = 208) M (SD)	Cohen's <i>d</i>	95% CI	<i>p</i> -Value ^a
Closeness	32.5 (4.9)	33.9 (4.9)	0.29	.09, .48	0.01
Conflict	15.8 (7.3)	8.4 (2.5)	1.42	1.4, 1.2	<.001
Overall quality	58.7 (9.8)	67.6 (6.1)	1.11	.89, 1.3	<.001

Note: ^a*p* < .05; higher scores on the closeness scale reflect higher teacher–student closeness; higher scores on the conflict scale reflect higher student–teacher conflict; higher scores on overall quality reflect higher quality teacher–student relationships (conflict scores are reversed to obtain this score.).

Table 3
Correlations for study variables for children with and without ADHD.

Variable ^a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. STRQ	–																			
2. Child age	.03	–																		
3. Child sex	–.17**	.06	–																	
4. ADHD subtype	.06	–.08	–.14*	–																
5. ADHD medication	–.21**	.09	.07	–.01	–															
6. Emotional (SDQ)	–.15**	–.02	–.05	.05	.21**	–														
7. Conduct (SDQ)	–.42**	.05	.00	–.10	.29**	.45	–													
8. Hyper (SDQ)	–.42**	–.05	.18**	–.19**	.26**	.38**	.60**	–												
9. Peer (SDQ)	–.31**	.05	.13*	–.16*	.20**	.40**	.50**	.51**	–											
10. Prosocial (SDQ)	.41**	–.04	–.20**	.02	–.26**	–.26**	–.59**	–.53**	–.51**	–										
11. Visual processing	.15*	–.12*	–.08*	.03	–.14*	–.16*	–.28**	–.23**	–.19**	.18	–									
12. Vocabulary	.16*	–.12*	–.06	.06	–.10**	–.22**	–.34**	–.32**	–.29**	.25**	.42**	–								
13. Working memory	.11*	–.11*	–.01	.09	–.09*	–.25**	–.32**	–.28**	–.26**	.16**	.38**	.45**	–							
14. Word reading	.20**	–.25**	–.03	.05	–.19**	–.31**	–.36**	–.40**	–.32**	.20**	.43**	.56**	.52**	–						
15. Math computation	.14**	–.35**	.07	.09	–.22**	–.29**	–.34**	–.33**	–.27**	.21**	.45**	.49**	.42**	.67**	–					
16. Parent education	.21**	–.02	.02	–.02	–.14*	–.20**	–.24**	–.19**	–.19**	.10*	.21**	.17**	.14*	.26**	.20**	–				
17. SES (SEIFA)	.15*	–.05	.06	.05	–.14*	–.12*	–.09	–.11*	–.14*	.01	.03	.17**	.18**	.22**	.16*	.21**	–			
18. Years' experience	.17**	–.02	.06	.04	.06	–.02	.02	–.02	–.09*	–.06	–.03	–.04	–.01	.00	.03	.00	.28**	.14**	–	
19. Teacher sex	.04	.00	–.03	.04	.06	.09*	.08	.04	.01	–.03	–.03	.01	–.05	–.04	–.01	.02	.03	–		
20. Teacher efficacy	.11*	.12*	–.03	–.04	.03	–.04	.01	–.05	–.05	.04	.05	–.01	.00	–.04	–.08	.04	–.02	.03	.19**	–

Note: **p* < .05, ***p* < .01, ****p* < .001; ^aSTRQ = student teacher relationship quality as measured on the STR questionnaire; child sex = boy (1) or girl (0); ADHD subtype = ADHD-inattention, ADHD-combined, ADHD-hyperactive, SDQ = strengths and difficulties questionnaire–parent rated; SEIFA = socio-economic indexes for areas, teacher sex = male (0) or female (1).

3.4. Factors associated with STRQ in children with and without ADHD

A Pearson's correlation matrix (see Table 3) shows variables with a univariate association with STRQ at an alpha level of <0.10 (aim 3) for the whole sample. Child factors including sex (boys), medication use (yes), and behavior (emotional, peer, conduct and hyperactivity) were negatively associated with STRQ, whilst prosocial behavior and better cognitive skills (visual processing, working memory, word reading and math computation) were positively associated with STRQ. Parent education, neighborhood SES, and teacher years of experience and efficacy were also positively correlated with STRQ. Child age, ADHD presentation and teacher sex were not associated with STRQ.

The results from the multivariable linear regression model including all variables associated with STRQ at the bivariate level at *p* < 0.1 are shown in Table 4. The strongest independent factors associated with STRQ for children with ADHD included child sex, conduct problems and prosocial behavior. Results showed a moderate effect for child sex. Grade one boys with ADHD were rated almost half a *SD* (0.47, *p* = 0.02) lower on STRQ in comparison to girls. There was a small negative association between conduct problems and STRQ, while prosocial behavior was associated with better STRQ (small effect). In children without ADHD (controls) prosocial behavior, neighborhood SES and teacher years of experience were positively associated with STRQ. Results also show school and classroom effects on teacher ratings of STRQ (see bottom of Table 4). Findings show that the clustering of schools (*N* = 40–42) had little impact on teacher ratings in both groups. The impact of intra-cluster correlations indicate that there was no significant correlation between schools and teacher ratings for children with

ADHD and that there is appropriate within school teacher variance (ICC = >0.01). Therefore, variance in STRQ is not likely to be as a result of school and teacher clustering for the ADHD group. Teacher ratings within schools for the control children was more homogeneous (ICC = 0.29) suggesting the classroom teacher rated children without ADHD in their class more similarly.

4. Discussion

This study examined STRQ for children in the second formal year of primary school with and without ADHD. Children with ADHD had poorer teacher-reported STRQ compared to non-ADHD controls. Overall, poorer STRQ for children with ADHD was driven by significantly higher student–teacher conflict, and to a smaller degree less close relationships with teachers, in comparison to children without ADHD. In contrast to expectations, there was no evidence that STRQ differed by ADHD presentation (i.e., ADHD-C versus ADHD-I or ADHD-H). The variance in the quality of student–teacher relationships after taking into account school and classroom level effects can be best explained by child sex (boys), conduct problems, prosocial behavior and teacher years of experience in students with ADHD, and prosocial behavior, neighbourhood SES and teacher years of experience for children without ADHD.

Our findings that children with ADHD have poorer quality relationships with their teacher in comparison to classmates are consistent with prior evidence linking ADHD to poorer STRQ (Prino et al., 2016; Rogers & Tannock, 2013; Rogers et al., 2015). For example, our results closely align to findings reported by Prino et al. (2016) who reported that student–teacher relationships in children with high levels of ADHD symptoms were characterized by high levels of conflict and lower warmth than those experienced

Table 4
Factors associated with STRQ in grade one children with and without ADHD: fully adjusted models.

STRQ	ADHD ^a				Controls ^b			
	β	95% CI	SE	p Value	β	95% CI	SE	p Value
Child sex (boys)	-0.46	-0.84, -0.08	0.18	0.01	-0.94	-2.76, 0.88	0.93	0.31
Emotional (SDQ)	0.15	-0.01, 0.14	0.08	0.06	-0.16	-1.36, 1.05	0.61	0.80
Conduct (SDQ)	-0.23	-0.44, -0.03	0.10	0.02	-0.73	-2.34, 0.87	0.82	0.37
Hyperactivity (SDQ)	0.11	-0.25, 0.48	0.17	0.53	1.05	-0.49, 2.60	0.79	0.18
Peer (SDQ)	0.10	-0.08, 0.30	0.09	0.28	0.23	-1.15, 1.61	0.70	0.74
Prosocial (SDQ)	0.24	0.04, 0.43	0.09	0.01	1.54	0.25, 2.8	0.66	0.02
Visual processing	-0.04	-0.26, 0.17	0.10	0.68	-0.05	-0.99, 0.89	0.48	0.92
Vocabulary	-0.01	-0.23, 0.22	0.11	0.94	0.32	-0.75, 1.38	0.54	0.56
Working memory	-0.11	-0.33, 0.10	0.10	0.27	-0.34	-1.34, 0.67	0.51	0.51
Word reading	0.16	-0.05, 0.40	0.11	0.14	-0.04	-1.45, 1.36	0.72	0.95
Math ability	-0.20	-0.45, 0.06	0.12	0.11	-0.66	-1.81, 0.49	0.59	0.26
Parent education	0.24	-0.05, 0.53	0.14	0.08	0.63	-1.21, 2.47	0.94	0.50
SES (SEIFA)	0.08	-0.11, 0.28	0.10	0.41	0.96	0.02, 1.90	0.48	0.05
Years of teaching experience	0.17	-0.01, 0.36	0.09	0.05	1.32	0.31, 2.3	0.51	0.01
Teacher efficacy	0.09	-0.09, 0.27	0.09	0.29	0.35	-0.56, 1.3	0.47	0.45
ADHD medication	-0.31	-0.62, 0.22	0.25	0.22	-	-	-	-

Clusters	Groups	#	Mean	ICC	Groups	#	Mean	ICC
Schools	40	4–10	3.8	>0.01	42	1–11	4.5	>0.01
Teachers/class	111	1–4	1.4	0.05	138	1–3	1.4	0.29

Note: Bolding denotes significance; ^aN = 150, model adjusted for all variables listed; ^bN = 191, model adjusted for all variables listed excluding ADHD medication; all models included variables correlated with STR quality at the p < .10 level and are adjusted for the effect of school and teacher clustering. STR = student–teacher relationship quality as measured on the STR questionnaire; SDQ = strengths and difficulties questionnaire–parent rated; SEIFA = socio-economic indexes for areas, ICC = intra-cluster correlation coefficient; all variables are standardized to M = 0 & SD = 1.

by peers without ADHD symptoms. It is well known that children with ADHD often exhibit problematic behaviors in the classroom, including being disruptive, aggressive, and interrupting other students' learning (Barkley et al., 2006; Loe & Feldman, 2007). Teachers can find these behaviors challenging to manage and it is easy to envisage how interactions between the child and the teacher may be more negative and conflictual in comparison to children who do not exhibit these problems (Klassen & Tze, 2014).

To our knowledge, this is the first study to examine STRQ in relation to ADHD presentation. The fact that we found no difference in STRQ between ADHD presentations was surprising, as children with ADHD-C and ADHD-H are at higher risk for externalizing problems e.g., conduct problems), while children with ADHD-I reportedly display more appropriate behavior (e.g., prosocial skills; (Gaub & Carlson, 1997). However, in this community-based study these presentations did not differ in terms of conduct problems or prosocial behaviors, which may help explain our findings.

4.1. Factors associated with STRQ in children with and without ADHD

Child prosocial behavior was the strongest explanatory variable of STRQ for both children with and without ADHD. Prior research has also pointed to prosocial behavior as an important factor in student–teacher relationships in kindergarten children (Birch & Ladd, 1998) and older children (Obsuth et al., 2017). Our findings that children who are more prosocial in general have better quality relationships with their teacher may suggest that prosocial student behavior may elicit more positive teacher responses, and in turn contribute to a better quality relationship. While we do not have the design to test the directionality of effects within a student–teacher relationship dynamic, it is possible that targeting prosocial behaviors (e.g., working cooperatively with peers) may be beneficial for the STRQ, and this could be tested in future research. Other important factors associated with STRQ in children with ADHD included conduct problems and child sex. Children with ADHD and conduct problems often display oppositional, defiant and disruptive behaviors that are inappropriate in the context of the classroom and learning environment and likely contribute to

greater student–teacher conflict (Crum et al., 2016). Our finding that grade one boys with ADHD had poorer STRQ in comparison to girls fits with our knowledge in the general population that teachers report closer and less conflictual relationships with girls than with boys in their class (Baker, 2006; Hamre & Pianta, 2001). In contrast with expectations, parent-reported hyperactivity, emotional problems and peer problems did not independently contribute to STRQ for either group, which suggests that these factors may be less important in the context of student–teacher relationships.

Although studies in typically developing children have linked STRQ with cognitive functioning and academic achievement (Ahnert et al., 2013; Roorda et al., 2011), we found that cognitive functioning and academic achievement was not associated with STRQ when accounting for co-occurring behavior problems as well as parent and teacher factors. Although we did not find a direct relationship between academic and cognitive abilities and STRQ for children with ADHD, it may be that academic and cognitive difficulties contribute to increased conduct problems. Children who experience academic and cognitive issues are more likely to have difficulty with their school work and as a consequence, this may lead to increased anger and frustration (Loe & Feldman, 2007). Further, studies suggest these early student–teacher relationships may play an important role in promoting better academic achievement as children progress through school (Maldonado-Carreno & Votruba-Drzal, 2011; Whitley, 2010). Future research aimed at investigating the influence of early teacher–student relationships upon later school outcomes of children with ADHD is required in order to clarify the moderating/mediating role of conduct problems.

Importantly, with the exception of prosocial behavior and teacher years of experience, our study showed factors associated with STRQ differed between students with and without ADHD. For example, in children without ADHD, boys did not differ from girls in STRQ. Similarly higher neighborhood SES predicted higher quality student–teacher relationships for children without ADHD, which is consistent with prior research in typically developing students (Mashburn et al., 2006; Hamre & Pianta, 2001), but did not predict STRQ for children with ADHD. Family SES has been well established as a predictor of poorer educational outcomes. Children from

lower SES families do worse across a range of educational outcomes including, achievement, engagement and classroom behavior in comparison to children from higher SES families (Lamb, Jackson, Walstab, & Huo, 2015). Helping children from low SES families to build better quality relationships with their teachers may serve to better protect these at risk children in these important foundation years (McNally & Slutsky, 2018). This may be achieved through specific training for teachers to increase awareness of the higher vulnerability of low SES families, teach relationship building skills and approaches to strengthen student–teacher, teacher–parent and family–school partnerships (Roberts, 2015; Sabol & Pianta, 2012). We found a significant teacher clustering effect for children without ADHD only, which suggests that for this group, children within the same classroom were rated similarly by their teachers, however this was not evident for children with ADHD. It is plausible that classroom environments may be more salient in fostering the relationship between the child and teacher in children without ADHD. In contrast, for students with ADHD, STRQ may be underpinned by more proximal child-level factors including challenging behaviors. The current study did not examine other teacher-related factors that may influence STRQ in both groups, e.g., teacher's perceptions of 'teachability' of the child, which could be explored in future research.

4.2. Strengths and limitations

This study had a number of methodological strengths. A key strength of this study was the study design. Children were recruited from 43 primary schools, comprehensively screened for ADHD using parent and teacher reports, and then carefully assessed for ADHD diagnostic status. Child and teacher factors were measured via detailed teacher and parent surveys and blinded direct child assessments. A limitation of this study was its reliance on teacher report for the measure of STRQ. Independent observational data would have strengthened the findings. In addition, we chose to use parent-ratings of socio-emotional and behavioral functioning and not teacher ratings to limit bias arising from using a common informant data collected as both the outcome and predictor. Teacher-reported data may have provided a more accurate observation of child behavior in the classroom (Youngstrom, Loeber, & Stouthamer-Loeber, 2001). In addition, we were unable to control for children's ethnicity or variance in how long the teacher had known the student. Both of these factors may have influenced the STRQ. The cultural diversity of students may play an important role in STRQ and would be important to consider as well as the cultural match between the teacher and student (Saft & Pianta, 2001). In future waves of data collection, findings may be strengthened by collecting perspectives on STRQ from children themselves, especially as they reach adolescence. Finally, the associations reported here were cross-sectional data drawn from the baseline wave of a longitudinal study. As such, inferences about the direction of influence between variables are not possible. As data become available from subsequent waves, we will be able to examine temporal changes in these measures giving greater confidence in possible causal processes.

4.3. Clinical implications

Our findings show that a child's ability to demonstrate prosocial behaviors, such as engaging, helping and co-operating in the classroom, may facilitate a warmer and less conflictual relationship with their classroom teacher for children with and without ADHD. Future research efforts are needed to explore if there are ways to promote prosocial behaviors in children and classroom settings and if this indeed can have an impact on the quality of student-teacher relationships for children at-risk. Emerging evi-

dence suggests implementing cooperative learning strategies that promote prosocial skills within the classroom may have benefits for all children. In these programs teachers create a classroom culture that encourages students to develop and model empathy, self-regulation and respect for others (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Using concrete and meaningful reward systems (i.e., token economies) may be helpful in reinforcing positive behavioral change, particularly for children with ADHD (Barkley et al., 2006).

A more tailored approach may be necessary to improve STRQ for young children with ADHD, particularly for boys and children with conduct problems. Research indicates that targeting conduct problems and anti-social behavior in early childhood can lead to improved classroom behavior (Beard & Sugai, 2004; Larmar & Gatfield, 2006), however, teachers may need support to implement targeted interventions and parent training may also be necessary to reinforce behavior change. For example, one promising intervention targeting early conduct problems known as the "First Step to Success" program (Beard & Sugai, 2004) incorporates screening, classroom intervention and parent training. Further, a small pilot study of a 12-week joint family–school intervention for kindergarten and first-grade children with ADHD (n = 61) was associated with short-term improvements in STRQ (Mautone et al., 2011). The intervention "Family–School Success-Early Elementary" involved facilitating communication between home and school, daily report cards, improving parent-child interaction and increasing parent involvement in the child's education (Mautone et al., 2011). However, more research is required to determine the longer term efficacy of these programs.

In conclusion, children with ADHD have substantially poorer STRQ compared to non-ADHD controls, due to higher levels of conflict and lower levels of closeness in the relationship. In both groups, the strongest explanatory variables of STRQ were prosocial behavior. Within the ADHD group, poorer STRQ was evident for boys and children with conduct problems. School-based interventions aimed at promoting prosocial behavior and reducing conduct problems in the classroom may be one way of improving STRQ. Prospective research is now needed to examine how STRQ influences longer-term school-based outcomes for children with ADHD.

Conflict of interest

All authors report no conflict of interest in relation to this manuscript.

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