



## Review article

# An examination of the association between anxiety and social functioning in youth with ADHD: A systematic review



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## ABSTRACT

Although up to 50% of children with Attention-Deficit/Hyperactivity Disorder (ADHD) meet criteria for an anxiety disorder, it is unclear how comorbid anxiety influences social functioning for this population. Understanding the factors associated with social functioning in ADHD is important given the limited efficacy of existing social skills interventions for this population. This systematic review aimed to determine the association between anxiety and social functioning (social problems, peer status, and social skills/ competence) in children and adolescents with ADHD. A standardised search protocol was used, identifying 4807 articles for screening with 31 included in the final review. Anxiety symptom severity was associated with lower levels of social skills and higher levels of social problems in young people with ADHD. However, few differences emerged when defining anxiety based on diagnostic measures. Although the results varied considerably amongst studies, a number of key variables emerged that influenced the associations between anxiety and social functioning including the type of reporter and sample characteristics such as age, sex, ADHD subtype and other mental health comorbidities. These findings have implications for social functioning interventions in ADHD given the role of anxiety symptoms in predicting poorer social functioning.

## 1. Introduction

Attention-Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterised by persistent patterns of inattention, hyperactivity and impulsivity. ADHD is highly comorbid with other psychiatric disorders and it is estimated that approximately 25–50% of children with ADHD also have a comorbid anxiety disorder; this rate is significantly higher than the estimated 5% in the general paediatric population (Jarrett and Ollendick, 2008; Jensen et al., 1997; Pfiffner, 2007).

Given the high comorbidity between ADHD and anxiety, explanations have been sought as to why these two disorders frequently co-occur. There is neurobiological evidence that lowered prefrontal cortex inhibition (which has been observed in ADHD) can increase amygdala activity which might explain the high levels of comorbidity (Levy, 2004). Alternatively, anxiety may develop over time as a consequence of the extensive impairments experienced by children with ADHD (Jarrett and Ollendick, 2008; Tannock, 2000). It has also been posited that the comorbidity can be explained by shared psychosocial factors such as biological, family, and social risk factors that have been

aligned with the aetiologies of ADHD and anxiety as separate disorders (Jarrett and Ollendick, 2008). It remains unclear as to which hypothesis offers the best explanation, however, there is a general consensus that the high levels of comorbidity are not solely attributed to the methodological challenges associated with assessing these conditions which can include shared symptom overlap and reporter-biases (Jarrett and Ollendick, 2008).

A small but growing body of literature has examined the impact of anxiety on children with ADHD. Studies have shown that children with ADHD and anxiety have poorer quality of life and daily functioning, more problematic behaviours (Sciberras et al., 2014), reduced academic functioning (Booster et al., 2010; Karutis et al., 2000), and more conflicted familial associations (Biederman et al., 1991; Pfiffner and McBurnett, 2006), when compared with children with ADHD only. The social functioning capabilities of children with ADHD and anxiety have also been studied, however, the results have been less conclusive about the role of anxiety alongside ADHD. Some studies have found that children with ADHD and anxiety have more impaired social skills (Becker et al., 2015; Bowen et al., 2008), experience more social problems and face more challenges navigating peer relationships (Biederman et al., 2013; Lee et al., 2012;

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Pollack et al., 2016). By contrast, other studies have suggested that the co-occurrence of anxiety does not further impede the social functioning capabilities of children with ADHD (Greene et al., 1997; March et al., 2000; Mulraney et al., 2016; Sciberras et al., 2014). It is particularly challenging to synthesise the research and draw conclusions due to many key methodological differences in studies. For example, there is considerable variation in the way anxiety is conceptualised (e.g. clinical diagnoses vs anxiety symptoms), the types of anxiety disorders assessed, and the reporters of anxiety and social functioning abilities (e.g. parent, teacher, child).

Theoretically it is important to understand why anxiety may influence the social functioning of children with ADHD. It has been proposed that when anxiety occurs alongside ADHD, this can intensify common ADHD symptoms such as inattention, and working memory deficits (Pliszka et al., 1999; Schatz and Rostain, 2006; Tannock, 2009). However, anxiety can also decrease impulsive and aggressive behaviours (Newcorn et al., 2001). Whilst the mechanisms underpinning social difficulties in the comorbid population are not well understood it can be hypothesised how the presence of both ADHD and anxiety may influence a child's social functioning capabilities.

For children with ADHD, their social difficulties are believed to result from various factors including: having difficulty reading social cues (Hinshaw and Melnick, 1995), impaired social-information processing abilities (Sibley et al., 2010; Zentall et al., 2001), impulsive behaviour which can manifest as disruptive and aggressive behaviours, inattentive behaviours which can result in difficulties maintaining conversation, and taking turns (Nijmeijer et al., 2008) and having poor insight into appropriate social behaviour (Hoza, 2007). When considering how anxiety may further influence a child with ADHD's social functioning this may result in the child ruminating about their worries during social interactions, being preoccupied with fears of negative social evaluation rather than engaging with the social interaction, or avoiding social encounters altogether (Greco and Morris, 2005; Rapee et al., 2009). Further, a lack of social engagement can serve as a maintaining factor in youth with anxiety and can limit the opportunities for future social interactions consequently preventing children from practicing essential social skills (Jacob et al., 2014). Thus, for a child with ADHD, it may be hypothesised that the added presence of anxiety may further impact the underlying processes necessary for social engagement which could have subsequent implications for the child's social performance (Mikami et al., 2011). By contrast, it also needs to be considered that the presence of anxiety may not further influence social functioning abilities given the extent of social problems already experienced by children with ADHD (Becker et al., 2012), and may even reduce some problematic social behaviours such as impulsivity and aggression (Newcorn et al., 2001).

Whilst the evidence to date has shown that some associations do exist between ADHD, anxiety and social functioning, the nature of the associations between these factors requires further investigation. Understanding how anxiety specifically aligns with social functioning capabilities in children with ADHD has implications for better understanding the impairment experienced by this comorbid group and may have implications for prevention and intervention efforts. To date, there is mixed evidence relating to the effectiveness of social skills interventions for children with ADHD (see Mikami et al., 2017 for a review). Whilst some studies have found improvements in peer functioning at the time of intervention, there is limited evidence to suggest that this results in long-term improvements in social functioning for children with ADHD (Gardner and Gerdes, 2015; Hoza et al., 2005a). As such, a greater understanding about what other factors may influence these treatment outcomes is warranted; it is possible that anxiety could be one of these contributing factors. Investigating how comorbid mental health conditions may impact the social functioning of children with ADHD is important given that there is evidence to suggest that comorbid ADHD results in greater social impairments than ADHD alone (Becker et al., 2012; Becker et al., 2012a). Further, it is important to focus on anxiety specifically, as the way the social impairments present

differs significantly across mental health conditions (Becker et al., 2012) and there is a growing body of literature which has shown that anxiety can result in poorer outcomes for children with ADHD (Booster et al., 2010; Karutsis et al., 2000; Sciberras et al., 2014).

Previous conceptual reviews have been valuable in examining the comorbidity of ADHD and anxiety, however, they have not specifically examined the social functioning of this comorbid group (Jarrett and Ollendick, 2008; Schatz and Rostain, 2006). A recent meta-analysis was conducted that examined the association between ADHD and social functioning, however, this meta-analysis examined the potential moderating role of conduct problems, and did not examine other comorbid conditions that occurred alongside ADHD (Ros and Graziano, 2018). Only one known previous review has explored the association between mental health comorbidities and their associations with peer functioning in children with ADHD (Becker et al., 2012). The focus of Becker et al. (2012) review was to characterise the peer functioning impairments across a range of mental health conditions. This review examined internalising difficulties (anxiety and depression) that occurred alongside ADHD, and included a small number of studies that examined anxiety specifically ( $n = 9$ ). Since this review, there has been a significant increase in the amount of research conducted in the ADHD and anxiety field given the extent of impairment that this population have been shown to experience. This current review aims to update and extend upon this work by providing a more comprehensive examination of anxiety specifically, and by exploring differences in study respondents, measures of anxiety and social functioning, and relevant sample characteristics that may influence this complex association.

### 1.1. Aim

The aim of this systematic review is to evaluate the association between anxiety and social functioning in children and adolescents with ADHD. These associations will be explored as a function of the type of anxiety measure used (e.g. anxiety diagnoses vs anxiety symptoms), across reporter type (e.g. parent, teacher, child) and by exploring the role of other comorbid mental health conditions.

## 2. Methods

### 2.1. Eligibility criteria

This review was conducted in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009) (Table 1, Supplementary Material). Studies were included if they 1) were written in English, 2) were peer reviewed, 3) involved a child or adolescent population <18 years of age, and 4) comprised participants with a diagnosis of ADHD. Participants were required to meet full diagnostic criteria for ADHD according to past or current versions of the DSM or ICD. Diagnostic measures included structured or semi-structured interviews, and/or scoring above a pre-determined threshold on a validated ADHD rating scale. Further, studies must have 5) included a diagnostic anxiety measure or assessed anxiety symptoms, and 6) included a measure of social functioning. Social functioning measures included those designed to assess observable aspects of social functioning including social skills, competence, peer relationships, experiences of bullying or victimisation. Exploring the mechanisms underpinning social functioning abilities (e.g. emotion recognition, theory of mind) was outside the scope of this review.

Articles were excluded on the following grounds: 1) included an adult sample (>18 years of age), 2) were single case studies, supplementary abstracts, conference proceedings, review articles, or thesis dissertations, 3) included an internalising measure assessing both anxiety and depressive symptoms as a single construct, 4) contained no analyses examining associations between ADHD, anxiety and social functioning, 5) were treatment studies with no pre-treatment

**Table 1**  
Social Problems ( $n = 23$ ).

Social Functioning Construct	Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounding Variables Accounted for in Analyses	Findings
Social Problems ( $n = 14$ )	Antshel 2014 USA	Longitudinal <sup>a</sup>	Clinical sample $N = 68$ (ADHD only: $n = 15$ , ADHD + Anxiety: $n = 14$ , ADHD + Depression: $n = 14$ , ADHD + ODD/CD: $n = 25$ ) Aged 14 - 18 ( $M = 16.4$ , $SD = 1.3$ ) 66.2% males ADHD-C = 48.8% ADHD-I = 51.2% 100% of sample medicated	K-SADS-E (DSM-IV criteria) (PR & CR) ADHD Rating Scales (PR & TR)	K-SADS-E (DSM-IV) (PR & CR; GAD and OCD were assessed)	IRS: association with peers subscale (PR & TR)	None	No difference in peer problems when comparing children with ADHD only and ADHD + Anxiety according to PR ( $t(27) = 0.00$ , $p = 1.00$ , 95% CI [-0.44 - 0.44], Cohen's $d = 0.00$ ) and TR ( $t(27) = -0.33$ , $p = 0.74$ , 95% CI [-0.72 - 0.52], Cohen's $d = 0.12$ ).
	Bagwell 2006 USA	Longitudinal <sup>b</sup>	Clinically referred (ADHD group), community (comparison group) $N = 242$ (ADHD: $n = 142$ , Control: $n = 100$ ) Aged 13 - 18 ( $M = 15.2$ , $SD = 1.4$ ) 93.7% male (ADHD group), 95% male (control group) ADHD subtypes not reported. 55% of sample medicated	Childhood diagnosis of ADHD previously made (DSM-III-R or DSM-IV) and adolescence diagnoses DISC 2.3 (PR) DBD, SNAP, IOWA Conners Rating Scale (PR & TR)	DISC (DSM-III) (PR & CR); GAD, avoidant disorder and social anxiety disorder assessed	CBCL Social Problems Scale (PR & TR)	None	Social problems in childhood were significantly associated with any anxiety disorder; social, avoidant or, GAD ( $\chi^2 = 4.1$ , $p < 0.05$ , Cohen's $d = 0.35$ ), and social anxiety disorder in adolescence ( $\chi^2 = 4.80$ , $p < 0.05$ , Cohen's $d = 0.44$ ) for children in the ADHD group. Social problems in childhood were not significantly associated with avoidant disorder ( $\chi^2 = 2.96$ , $p > 0.05$ , Cohen's $d = 0.41$ ) or GAD alone in adolescence ( $\chi^2 = 3.56$ , $p > 0.05$ , Cohen's $d = 0.47$ ) in the ADHD group.
Social Problems ( $n = 9$ )	Biederman 1996 USA	Longitudinal	Clinical and community referred sample $N = 237$ (ADHD & various comorbidities: $n = 128$ ; ADHD + Anxiety: $n = 35$ , Control: $n = 109$ ) Aged 6 - 17: ADHD & various comorbidities, ( $M = 14.4$ , $SD = 3.3$ ) 100% male ADHD subtypes not reported Medication status not reported	Diagnosed by paediatrician or psychiatrist as having ADHD. K-SADS-E (PR & CR if child > 12)	K-SADS-E (PR & CR if child > 12)	SAICA (problems with peers scale) (PR & CR)	Social class, other comorbid disorders, baseline functioning	Children with ADHD + Anxiety did not have significantly more peer problems than children with ADHD only ( $t(94) = -1.22$ , $p = 0.22$ , 95% CI [-0.52 - 0.12], Cohen's $d = 0.26$ ).
	Biederman 2013 USA	Longitudinal <sup>a</sup>	Clinical and community referred sample $N = 501$ (ADHD: $n = 257$ , ADHD + PTSD: $n = 14$ ) Age: ADHD ( $M = 10.9$ , $SD = 3.2$ ) ADHD + PTSD ( $M = 10.5$ , $SD = 3.4$ ) 48.5% male ADHD subtypes not reported Medication status: ADHD only = 30%, ADHD + PTSD = 0%	Diagnosed by paediatrician or child psychiatrist as having ADHD. K-SADS-E (PR & CR if child > 12)	K-SADS-E (PR & CR if child > 12)	SAICA (problems with peers and opposite sex subscales) (PR & CR)	None	Children with ADHD + PTSD had significantly more peer problems than children with ADHD only ( $t(269) = -3.17$ , $p < 0.001$ , 95% CI [-1.14 - 0.27], Cohen's $d = 0.87$ ). No differences with problems with opposite sex when comparing children with ADHD and ADHD + PTSD ( $t(269) = -1.38$ , $p = 0.02$ , 95% CI [-0.74 - 0.14], Cohen's $d = 0.37$ ).
Social Problems ( $n = 4$ )	Bowen 2008 USA	Cross-sectional	Clinical sample $N = 190$ (ADHD only: $n = 15$ , Anxiety only: $n = 54$ , ADHD + Anxiety: $n = 14$ ) Aged 7 - 18 ADHD only ( $M = 12.6$ , $SD = 3.2$ ) ADHD + Anxiety ( $M = 12.4$ , $SD = 3.1$ ) 49% male ADHD-I: 75.8%	ADIS-C (PR)	ADIS-C (PR) SCARED (PR & CR)	Social Competence Scale (PR & CR)	None	There was a significant difference in children's capacity to make friends across comorbidity groups ( $\chi^2(9) = 24.86$ , $p < 0.01$ , Cohen's $d = 0.78$ ). However, there were no significant difference in reported troubles making friends when comparing children with ADHD only (20%) to children with

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Table 1 (continued)

Social Functioning Construct	Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounding Variables Accounted for in Analyses	Findings
ADHD + Anxiety (36%), OR = 0.45, p > 0.05,	Farmer 2015 USA	Longitudinal <sup>a</sup>	ADHD-H: 10.4%	K-SADS-PL (PR & CR)	CASI-4R (PR; generalised anxiety, separation anxiety, anxiety composite subscales used)	CASI-4R (peer conflict scale; PR)	None	Small positive correlations between higher levels of peer conflict and composite anxiety scores ( $r_s = 0.29$ , Cohen's $d = 0.61$ ), and generalised anxiety scores ( $r_s = 0.34$ , Cohen's $d = 0.72$ ) <sup>†</sup> .
			ADHD-C: 13.8%					
ADHD + Anxiety = 43%	Greene 1997 USA	Longitudinal	Medication status: ADHD only = 80%, ADHD + Anxiety = 43%	Diagnosed by paediatrician or child psychiatrist as having ADHD.	K-SADS-E (PR & CR if child > 12)	SAICA (PR & CR is child > 12)	None	59% of boys with ADHD + SD (at baseline) had significantly higher rates of anxiety disorders at 4 year follow up when compared to 29% of boys with ADHD only ( $\chi^2 = 27.99$ , $p < 0.01$ , Cohen's $d = 1.10$ ). Social disability did not uniquely predict multiple anxiety disorders at 4 year follow up (OR = 1.33, $p = 0.74$ , 95% CI = 0.25 – 7.16).
			Clinically referred sample children with ADHD and comorbid DBD N = 168 Aged 6 - 12 (M = 8.9, SD = 2.0) 77% males ADHD subtypes not reported 50% of sample medicated					
ADHD + Anxiety = 43%	Humphrey 2007 USA	Cross-sectional	Clinical and community sample N = 226 (ADHD only; n = 97; ADHD + SD: n = 22)	Diagnosed by psychiatrists as having ADHD.	CBCL Internalising scale (PR) RCMAS (CR)	CBCL & Connor's Social Problems (PR & TR)	None	Higher levels of PR anxiety associated with higher levels of PR social problems on CBCL ( $r = 0.54$ , $p < 0.001$ , Cohen's $d = 1.28$ ), and Connor's subscale ( $r = 0.25$ , $p < 0.05$ , Cohen's $d = 0.52$ ). Higher levels of CR anxiety associated with lower levels of PR social problems ( $r = -0.54$ , $p < 0.05$ , Cohen's $d = 1.28$ ).
			Aged 6–17 ADHD (M = 14.2, SD = 2.9), ADHD + SD (M = 16.1, SD = 2.5), 100% male ADHD subtypes not reported Medication status not reported					
ADHD + Anxiety = 43%	Karstis 2000 USA	Cross-sectional	Clinically referred sample N = 116 Aged 4 - 18 (M = 9.95, SD = 3.5) 78.5% male ADHD-C: 55.2% ADHD-I: 12.9% ADHD-H: 2.6% ADHD-not specified: 2.6% Medication status not reported	DICA-R-P (DSM-III-R; PR) CBCL & TRF Attention Problems Factor (PR & TR) CAP (subtype measure)	RCMAS (CR) Higher severity DSMD (CR)	CBCL Social Problems (PR & TR)	Externalising behaviours	CR anxiety was associated with PR ( $\beta = 0.29$ , $sr = 0.25$ , $R^2$ change = 0.08, $p < 0.01$ ) and TR social problems ( $\beta = 0.15$ , $sr = 0.13$ , $R^2$ change = 0.05, $p < 0.01$ ). PR anxiety was associated with PR social problems ( $\beta = 0.22$ , $sr = 0.18$ , $R^2$ change = 0.21, $p < 0.001$ ) but not TR social problems ( $\beta = 0.31$ , $sr = 0.24$ , $R^2$ change = 0.04, $p > 0.05$ ).
			Clinically and community referred sample N = 125 Aged 7 - 12 (M = 9.2, SD = 1.6) 77.6% male ADHD-C: 62% ADHD-I: 32% ADHD-H: 6% Medication status not reported					
ADHD + Anxiety = 43%	Lee 2012 USA	Cross-sectional	Clinical and community referred sample N = 223 (ADHD: n = 71, ADHD + Anxiety: n = 46) Aged 6 - 9 (M = 7.4, SD = 1.1) 69.5% male ADHD subtypes not reported 15% of sample medicated	DISC-IV (PR) DISC-IV (PR, social phobia, OCD, GAD, PTSD, SAD, specific phobia, agoraphobia, panic disorder assessed)	DISC-IV (PR, social phobia, OCD, GAD, PTSD, SAD, specific phobia, agoraphobia, panic disorder with Peers (PR & TR)	CBCL & TRF Social Problems Scale (PR & TR) IRS: Association with Peers (PR & TR)	Age and sex	Children with ADHD + Anxiety had significantly more social problems than children with ADHD only (PR) ( $\beta = -0.25$ , $SE = 0.09$ , $p < 0.01$ ) but this was not significant for TR (no statistics reported for this pairwise comparison). No difference in social impairment when comparing children with ADHD only and children with ADHD + Anxiety (no statistics reported for these pairwise comparisons).

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Table 1 (continued)

Social Functioning Construct	Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounder Variables Accounted for in Analyses	Findings
Bullying/Aggression (n = 6)	Mulraney 2016 Australia	Longitudinal <sup>a</sup>	Community sample N = 391 (ADHD: n = 179, Control: n = 212) Aged 6 - 8 (M = 7.3, SD = 0.4) 66.2% male ADHD-C: 52.0% ADHD-I: 35.8% ADHD-H: 12.6% 12% of sample medicated	DISC-IV (PR)	DISC-IV (PR); social phobia, GAD, OCD, PTSD, SAD assessed)	SDQ Peer Problems Scale	Adjusted analyses controlled for conduct problems, ADHD presentation, parent psychosocial distress and neighbourhood disadvantage	In unadjusted analyses, PR peer problems were significantly associated with anxiety in children with ADHD (OR = 1.6, p = 0.01, 95% CI [1.1, 2.3]). TR peer problems not associated with anxiety (OR = 1.1, p = 0.44, 95% CI [0.8, 1.6]). In adjusted analyses PR peer problems were not significantly associated with anxiety in children with ADHD (OR = 1.3, p = 0.25, 95% CI [0.8, 1.9]).
	Newcorn 2004 USA	Longitudinal	Clinical sample N = 32 (baseline ADHD + Anxiety diagnosis: n = 9, baseline ADHD + Anxiety + CD diagnosis n = 6) Aged 15 - 18 (initially entered study 7 - 11 (M = 9.1, SD = 1.3) 100% male ADHD subtypes not reported 65% of sample medicated Clinically referred sample N = 107 (ADHD only: n = 19, ADHD + ODD: n = 46, ADHD + ODD + Anxiety: n = 42) Aged 3 - 5 (M = 3.95, SD = 0.71) 76.6% male ADHD subtypes not reported Medication status not reported	DISC-P (PR) CBCL (PR) Iowa Connors Teacher Questionnaire (TR)	DISC-P for childhood anxiety diagnosis (PR); disorder, social phobia, overanxious disorder)	CBCL Social Problems (PR) YSR Social Problems (CR)	Time to follow up, CD diagnosis	Childhood ADHD + Anxiety was significantly associated with adolescent rated social problems ( $\beta = 0.53$ , p = 0.01) but not PR social problems ( $\beta = 0.25$ , p = 0.23). Childhood ADHD + Anxiety + CD diagnosis significantly predicted PR problems ( $\beta = 0.56$ , p = 0.01) but not CR social problems ( $\beta = 0.05$ , p = 0.82). There was a significant difference in the social problems of children with ADHD + ODD + Anxiety, ADHD + ODD and ADHD only (F (2, 104), = 7.73, p = 0.001, partial $\eta^2 = 0.13$ ). Pairwise comparisons indicated that children with ADHD only had fewer social problems than children with ADHD + ODD + Anxiety (p = 0.001, Cohen's d = 1.16).
Bullying/Aggression (n = 6)	Pollack 2016 USA	Cross-sectional	Clinically referred sample N = 370 (ADHD only: n = 132, ADHD + 1 anxiety disorder: n = 95, ADHD + ≥ 2 anxiety comorbidities: n = 143) Aged 5 - 13 ADHD only (M = 9.9, SD = 1.8) ADHD + 1 anxiety diagnosis (M = 10.3, SD = 2.0) ADHD + ≥ 2 anxiety diagnoses (M = 10.4, SD = 1.8) 81% male ADHD-C: 64.9% ADHD-I: 9.8% ADHD-H: 5.4% 85% of sample medicated	DISC-P (PR) CRS (PR & TR)	ADIS-C (PR; SAD, social phobia, GAD, panic disorder, PTSD, OCD assessed)	CRS-R: Social Problems (TR) Observational coding of negative play behaviour	None	None
	Sciberras 2014 Australia	Cross-sectional	Clinically referred sample N = 370 (ADHD only: n = 132, ADHD + 1 anxiety disorder: n = 95, ADHD + ≥ 2 anxiety comorbidities: n = 143) Aged 5 - 13 ADHD only (M = 9.9, SD = 1.8) ADHD + 1 anxiety diagnosis (M = 10.3, SD = 2.0) ADHD + ≥ 2 anxiety diagnoses (M = 10.4, SD = 1.8) 81% male ADHD-C: 64.9% ADHD-I: 9.8% ADHD-H: 5.4% 85% of sample medicated	Paediatrician diagnosis (DSM-IV) ADHD Rating Scale—IV (PR)	ADIS-C (PR; SAD, social phobia, GAD, panic disorder, PTSD, OCD assessed)	SDQ Peer Problems Scale (PR)	Age, gender, ADHD medication, ADHD symptom severity, psychiatric comorbidities (mood externalising, ASD), parent age and education, SEIFA	≥ 2 Anxiety Comorbidities In unadjusted analyses children with ADHD + ≥ 2 anxiety comorbidities had more PR peer problems than children with ADHD only (SMD = 0.05, 95% CI [0.2 - 0.7], p < 0.001) but not for TR peer problems (SMD = 0.2, 95% CI [-0.1 - 0.4], p = 0.23). In adjusted analyses no differences in PR (SMD = 0.02, 95% CI [-0.1 - 0.4], p = 0.13) or TR peer problems (SMD = 0.1, 95% CI [-0.2 to 0.4], p = 0.47) when comparing children with ADHD only and ADHD + Anxiety.
Bullying/Aggression (n = 6)	Abikoff 2002 USA	Cross-Sectional	Clinically referred (ADHD), community (comparison group) N = 1004 (ADHD only: n = 171, ADHD + Anxiety: n = 58,	DISC-P (DSM-IV; PR) Connors Hyperkinesia Index (PR & TR)	DISC-P (PR; overanxious disorder, separation anxiety, or social phobia)	COC (observed in classroom)	None	No difference in aggression ratings between children with ADHD only, children with ADHD + Anxiety or children with ADHD + Anxiety + DBD (continued on next page)

Table 1 (continued)

Social Functioning Construct	Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounders Accounted for in Analyses	Findings
			ADHD + DBD + Anxiety <i>n</i> = 110 Aged 7 - 10 ( <i>M</i> = 8.4, <i>SD</i> = 0.8) 81% male 100% ADHD combined subtype Medication status not reported Clinical sample <i>N</i> = 269 (ADHD only <i>n</i> = 59, ADHD + Anxiety <i>n</i> = 210) ADHD only ( <i>Mage</i> = 10.2, <i>SD</i> = 3.7) ADHD + Anxiety ( <i>Mage</i> = 10.3, <i>SD</i> = 3.2) 70% male ADHD subtype not reported Medication status not reported Clinically and community referred sample: children with ADHD and comorbid Tic Disorder <i>N</i> = 54 (ADHD only: <i>n</i> = 37, ADHD + Anxiety: <i>n</i> = 17) Aged 6 - 12 ADHD Only ( <i>M</i> = 8.9, <i>SD</i> = 1.7) ADHD + Anxiety ( <i>M</i> = 9.5, <i>SD</i> = 1.7) 77% male ADHD subtypes not reported 100% of sample medicated Clinical sample <i>N</i> = 287	Psychiatrists diagnosed children as having ADHD K-SADS (PR)	Psychiatrists diagnosed children K-SADS (PR)	CBCL aggressive behaviour subscale (PR) MOAS (PR) PPRARS (PR)	Age, gender	No difference in CBCL aggression scores, MOAS total, verbal, object or other aggression scores, or PPRARS reactive or proactive aggression when comparing children with ADHD, and ADHD + Anxiety ( <i>ps</i> > 0.05).  No difference in interpersonal peer aggression between children with ADHD only and children with ADHD + Anxiety ( <i>t</i> = 0.6, <i>p</i> = 0.50, Cohen's <i>d</i> = 0.21).
	Gadow 2011	Cross-sectional		Met DSM-III-R or DSM-IV criteria for ADHD Above clinical cut offs on: ATRS/APRS, Iowa Conners TRS/PRS, MOMS, CSI (PR & TR)	DICA-P (PR); GAD, SAD, social phobia assessed)	Peer Conflict Scale (PR & TR)	None	
	Hu 2016 USA	Cross-sectional	Aged 11–18 ( <i>M</i> = 13.1, <i>SD</i> = 2.0) 87.5% male ADHD-C = 77.3% ADHD-I = 22.0% ADHD-H = 0.7% 85% of sample medicated Clinical and community referred sample <i>N</i> = 124 (ADHD: <i>n</i> = 62, Comparison <i>n</i> = 62) Aged 6 - 10 ADHD ( <i>M</i> = 8.26, <i>SD</i> = 1.21) Comparison ( <i>M</i> = 8.23, <i>SD</i> = 1.19) 67.7% male ADHD-C = 74.2% ADHD-I = 25.8% 65% of ADHD sample medicated	Diagnosed by child psychiatrist in accordance with DSM-IV-TR criteria SNAP-IV (PR)	MASC-T (CR)	C-SBEQ (CR)	Age, sex, medication status, ADHD symptom severity, behavioural temperamental traits, ASD status	No significant association between bullying perpetration and anxiety symptoms in adolescents with ADHD ( $\beta = 0.07, t = 1.4, p = 0.16$ ).  Significant negative interaction between anxiety and ADHD status in predicting aggression in comparison children but not for children with ADHD ( $\beta = -0.01, p = 0.91$ ). Anxiety was not associated with aggressive behaviours in children with ADHD ( $\beta = -0.01, p = 0.91$ ).
	Mikami 2011 USA	Cross-sectional		K-SADS-PL (PR) Above clinical cut-offs on CSI (PR & TR)	CBCL and TRF Anxiety Problems Subscale (PR & TR; higher scores indicate greater severity)	Observational coding (observed aggression in classrooms)	Age, sex, parental education, ADHD status and ODD status	
	Yen 2014 Taiwan	Cross-sectional	Clinically referred sample <i>N</i> = 251 Aged 11 - 18 ( <i>M</i> = 13.1, <i>SD</i> = 2.0) 100% male ADHD-C = 79.7%, ADHD-I = 19.5% ADHD-H = 0.8% 85% of sample medicated	Psychiatrist diagnosis (DSM-IV-TR) SNAP-IV (CR & PR)	MASC-T (CR; higher scores indicate greater severity)	CEQ (CR)	Age, sex	Cyberbullying perpetration was not significantly associated with anxiety in children with ADHD ( $\beta = 0.04, p = 0.60$ ).

(continued on next page)

Table 1 (continued)

Social Functioning Construct	Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounder Variables Accounted for in Analyses	Findings
Victimisation (n = 3)	Becker 2016 USA		Community sample N = 131 Aged 11 - 15 (M = 12.6, SD = 1.0) ADHD-C = 47.3% ADHD-I = 52.7% 73.3% male Medication status not reported	P-CHIPS (DSM-IV; PR) DBD (TR)	MASC (CR; higher scores indicate greater severity)	RPEQ (CR)	Sex	Significant positive associations between anxiety and physical (r = 0.39, p < 0.001, Cohen's d = 0.85), relational (r = 0.38, p < 0.001, Cohen's d = 0.82) and reputational victimisation (r = 0.36, p < 0.001, Cohen's d = 0.77) in adolescents with ADHD. Physical and relational victimisation were uniquely associated with higher anxiety symptoms in adolescents with ADHD (β = 0.22, p = 0.04) and (β = 0.01, p > 0.05) respectively. Reputational victimisation was not associated with anxiety symptoms in adolescence (β = 0.01, p > 0.05).
	Hu 2016	All study information reported above						Bullying victimisation was significantly associated with anxiety symptoms in adolescents with ADHD (β = 0.20, t = 4.1, p < 0.001). Cyberbullying victimisation was not significantly associated with anxiety in children with ADHD (β = 0.12, p = 0.10).
	Yen 2014 Taiwan	All study information reported above						

**Abbreviations and references of instruments are in alphabetical order:**

ADHD = Attention Deficit Hyperactivity Disorder, ADHD-C = ADHD Combined Type, ADHD-H = ADHD predominantly hyperactive type, ADHD-I = ADHD predominantly inattentive type, ADIS-C = Anxiety Disorder Interview Schedule - Children, ATRS/ APRS = Abbreviated Teacher/Parent Rating Scale, CAP = Child Attention Profile, CASI-4R = Child & Adolescent Symptom Inventory- 4R, CBCL = Child Behavior Checklist, CD = Conduct Disorder, CEQ = Cyberbullying Experiences Questionnaire, CSBEQ = Chinese version of the School Bullying Experience Questionnaire, COC = Classroom Observation code, CSI = Child Symptom Inventory, Connors Rating Scales-Revised Long Form (CRS-R), DBD = Disruptive Behavior Disorder Rating Scale, DICA = Diagnostic Interview for Children and Adolescents, DISC-P = Diagnostic Interview Schedule for Children Parent-Informant Interview, DSM-D = Devereux Scales of Mental Disorders, DSM = Diagnostic Statistical Manual, GAD = Generalised Anxiety Disorder, Iowa Connors TRS/PRS = Iowa Connors Teacher Rating Scale/Parent Rating Scale, IRS = Impairment Rating Scale, K-SADS-E = Kiddie Schedule for Affective Disorders and Schizophrenia –Epidemiological Version, K-SADS-PI = Kiddie Schedule for Affective Disorders and Schizophrenia - Present and Lifetime Version, MOAS = Modified Overt Aggression Scale, MOMS = Mothers' Objective Method for Subgrouping, MASC = Multidimensional Anxiety Scale for Children, MASC-T = Multidimensional Anxiety Scale for Children-Taiwanese, OCD = Obsessive Compulsive Disorder, P-CHIPS = Children's Interview for Psychiatric Syndromes - Parent Version, PPRARS = Proactive/Reactive Aggression Rating Scale, PTSD = Post Traumatic Stress Disorder, RGMAS = Revised Children's Manifest Anxiety Scale, ODD = Oppositional Defiant Disorder, RPEQ = Revised Peer Experiences Questionnaire, SAD = Separation Anxiety Disorder, SAICA = Social Adjustment Inventory for Children and Adolescents, SDQ = Strengths and Difficulties Questionnaire, SEIFA = Socio-Economic Indexes for Areas, SNAP = Swanson, Nolan and Pelham Version Rating Scale, SNAP-IV (C) = Swanson, Nolan and Pelham Version IV Rating Scale, Chinese version, TRF = Teacher Report Form, YSR Social Problems = Youth Self Report Social Problems.

Note: PR = parent report; TR = teacher report, CR = child report

<sup>a</sup> Longitudinal study design, only baseline (time-point 1) results used

<sup>b</sup> This study followed up children into adolescence, social problems were recorded in childhood

<sup>c</sup> SD = social disability; defined as SAICA scores that were 1.65 standard deviations below the mean for all boys in the sample

<sup>d</sup> No p value provided, only the direction and size of the correlation can be reported.

**Table 2**  
Peer Status ( $n = 4$ ).

Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounders Variables Accounted for in Analyses	Findings
Becker 2013 USA	Cross-sectional	Clinical sample $N = 188$ Aged 7 - 11 ( $M = 8.7$ , $SD = 1.2$ ) 58.5% male 100% ADHD-I 4.5% of sample medicated	K-SADS-PL (PR) CSI-4 and IRS (PR)	RCMAS (CR) BASC - Anxiety scale (PR & TR)	Dishion Social Acceptance Scale (TR)	N/A	No significant associations between CR, PR and TR anxiety with negative social preference <sup>a</sup> ( $r = -0.004$ , $p > 0.05$ , Cohen's $d = 0.01$ ), ( $r = -0.07$ , $p > 0.05$ , Cohen's $d = 0.14$ ) and ( $r = 0.14$ , $p > 0.05$ , Cohen's $d = 0.28$ ) respectively.  Negative social preference was significantly associated with TR anxiety ( $B = 0.24$ , $SE = 0.12$ , $\beta = 0.14$ , $t = 1.99$ , $p < 0.01$ ), but not PR ( $B = 0.20$ , $SE = 0.24$ , $\beta = -0.06$ , $t = -0.83$ , $p > 0.05$ ) or CR anxiety ( $B = 0.03$ , $SE = 0.30$ , $\beta = 0.01$ , $t = 0.09$ , $p > 0.05$ ).  There was a significant negative social preference x sex interaction across CR ( $R^2 = 0.04$ , $p = 0.007$ ) and TR ( $R^2 = 0.02$ , $p = 0.04$ ) for girls, but not for boys.  No significant difference between children with ADHD and children with ADHD + Anxiety when examining peer sociometric variables (e.g. peer status, preference, impact, liking) (statistics not reported).
Hoza 2005 USA	Cross-sectional	Clinical sub-sample from MTA study $N = 165$ (ADHD only): $n = 109$ , ADHD + Anxiety: $n = 56$ ) Aged 7 - 9.9 ( $M = 7.8$ , $SD = 0.8$ ) 80% male ADHD-C: 100% Medication status not reported	DISC-P (DSM-III; PR)	SNAP (PR)	Sociometric assessment: peer status, preference, impact, liking (peer-reported)	Not reported	No difference in peer ratings between children with ADHD only and children with ADHD + Anxiety; they were both negatively regarded by peers to the same extent by PR ( $B = 0.11$ , $SE = 0.14$ , $p = 0.42$ ) and TR (no pairwise comparison statistic reported).  At age 10 (avg) no significant association between anxiety and peer rejection ( $r = 0.11$ , $p > 0.05$ , Cohen's $d = 0.22$ ).  Significant associations between higher levels of anxiety and more experiences of peer rejection at age 16 ( $r = 0.20$ , $p < 0.05$ , Cohen's $d = 0.41$ ) 18 ( $r = 0.12$ , $p < 0.05$ , Cohen's $d = 0.24$ ).  No significant associations between anxiety and friendship at mean ages of 10, ( $r = -0.10$ , Cohen's $d = 0.20$ ), 16 ( $r = -0.11$ , Cohen's $d = 0.22$ ) and 18 ( $r = -0.07$ , Cohen's $d = 0.14$ ).  Peer rejection at age 10 (avg), significantly predicted anxiety at age 16 (avg) ( $\beta = 0.19$ , $p < 0.01$ ), friendship did not significantly predict anxiety ( $\beta = 0.03$ , $p > 0.05$ ).  Neither peer rejection or friendship at age 10 (avg) predicted anxiety at age 18 (avg) ( $\beta = 0.09$ , $p > 0.05$ ) and ( $\beta = 0.00$ , $p > 0.05$ ).
Lee 2012 USA	All study information reported in Table 1.						
Mrug 2012 USA	Longitudinal	Clinical sample $N = 300$ Age: Baseline: 7.0–9.9 years 2 years f/up ( $M = 10.35$ , $SD = 0.84$ ) 6 years f/up ( $M = 16.35$ , $SD = 0.84$ ) 8 years f/up ( $M = 18.35$ , $SD = 0.84$ ) 80% male ADHD-I: 100% Medication status not reported	DISC-P (DSM-III; PR) (CR)	MASC & BAI (CR)	Sociometric assessment, friendship and peer rejection (peer-reported)	MTA site, age, sex, racial/ethnic minority status, family SES, ADHD, ODD and CD symptoms for regression analyses	No difference in peer ratings between children with ADHD only and children with ADHD + Anxiety; they were both negatively regarded by peers to the same extent by PR ( $B = 0.11$ , $SE = 0.14$ , $p = 0.42$ ) and TR (no pairwise comparison statistic reported).  At age 10 (avg) no significant association between anxiety and peer rejection ( $r = 0.11$ , $p > 0.05$ , Cohen's $d = 0.22$ ).  Significant associations between higher levels of anxiety and more experiences of peer rejection at age 16 ( $r = 0.20$ , $p < 0.05$ , Cohen's $d = 0.41$ ) 18 ( $r = 0.12$ , $p < 0.05$ , Cohen's $d = 0.24$ ).  No significant associations between anxiety and friendship at mean ages of 10, ( $r = -0.10$ , Cohen's $d = 0.20$ ), 16 ( $r = -0.11$ , Cohen's $d = 0.22$ ) and 18 ( $r = -0.07$ , Cohen's $d = 0.14$ ).  Peer rejection at age 10 (avg), significantly predicted anxiety at age 16 (avg) ( $\beta = 0.19$ , $p < 0.01$ ), friendship did not significantly predict anxiety ( $\beta = 0.03$ , $p > 0.05$ ).  Neither peer rejection or friendship at age 10 (avg) predicted anxiety at age 18 (avg) ( $\beta = 0.09$ , $p > 0.05$ ) and ( $\beta = 0.00$ , $p > 0.05$ ).

**Abbreviations and references of instruments are in alphabetical order:**

ADHD-I = Attention Deficit Hyperactivity Disorder predominantly inattentive subtype, BAI = Beck Anxiety Inventory, BASC = Behavior Assessment Schedule for Children, CSI-4 = Child Symptom Inventory, DISC-P = Diagnostic Interview Schedule for Children Parent-Informant Interview, K-SADS-PL = Kiddie Schedule for Affective Disorders and Schizophrenia -Present and Lifetime Version, MASC = Multidimensional Anxiety Scale for Children, IRS = Impairment Rating Scale, RCMAS = Revised Children's Manifest Anxiety Scale, SNAP = Swanson, Nolan and Pelham Version Rating Scale.

**Note:** PR = parent report; TR = teacher report, CR = child report

<sup>a</sup> Negative social preference = subtracting the reject = dislike rating from the accept = like rating and then reverse-scoring the scale so that higher scores indicate higher levels of negative social preference.

examination of anxiety and social functioning, and 6) participants had a diagnosed intellectual disability.

## 2.2. Information sources and search

Studies were identified after searching the following psychological and medical electronic databases: CINAHL, Embase Complete, MEDLINE Complete, PsycINFO, and Informit. These were accessed using the EBSCOhost platform (last updated August 3rd 2018). Key concepts for the search included variants of the following: “ADHD”, “Anxiety”, “Child” and “Social Functioning” (Table 2, Supplementary Material). A backwards and forwards citation analysis was also completed which involved manually searching the reference lists of included articles, and reviewing any article that had cited an included study via Google Scholar.

## 2.3. Study selection

The PRISMA flow chart (Fig. 1) describes the systematic review process (Moher et al., 2009). CB and MM independently screened the titles and abstracts to eliminate those studies not relevant to this review. Full text articles were retrieved for all “yes” classifications to determine eligibility for inclusion. Any discrepancies were then discussed in person and a consensus was reached. Where studies were excluded based on more than one criterion, the first exclusion criterion that was met is displayed on the PRISMA diagram. Agreement between authors, for full text screening was Cohen's Kappa ( $\kappa$ ) = 0.85 indicating excellent agreement between authors.

## 2.4. Data extraction

The data were independently extracted by CB and independently cross-referenced by MM for all studies. Any discrepancies between authors were discussed and resolved. The following data were extracted from studies: 1) country where research was conducted, 2) sample characteristics, 3) study aims, 4) methodology, 5) statistical analyses conducted, and 6) study findings that were relevant to the review aims.

## 2.5. Risk of bias in individual studies

The Standard Quality Assessment Criteria for Evaluating Primary Research Papers was used to indicate the study's overall quality (Kmet et al., 2004) (Table 3, Supplementary Material). Items on the checklist assessed study design, methodology, accurate reporting of results, and conclusions made. Studies were scored on 14 items, depending on the extent to which they met the criteria (2 = yes, 1 = partly, 0 = not addressed). A summary score was then made for each study. The authors suggest that a relatively conservative cut off point for article inclusion is 75% (Kmet et al., 2004). Overall the studies were of a high quality, with scores ranging from 77% - 100%.

## 3. Results

### 3.1. Search results

As shown in Fig. 1, 4807 studies were identified through the search, and 31 full texts were eligible for inclusion in this review. Of these 31 studies, four reported data from the same sample (Hoza et al., 2005b; Jensen et al., 2001; March et al., 2000; Mrug et al., 2012). After examining each study, three key domains were identified and included: social problems ( $n = 23$ ; Table 1), peer status ( $n = 4$ ; Table 2), social skills and competence ( $n = 11$ ; Table 3). Two studies explored unique aspects of social functioning that did not fall within these categories and were thus placed in an ‘other’ group other ( $n = 2$ ; Table 4).

In this review, social problems refers to difficulties engaging with peers (e.g. few friends, complaints of loneliness, not interested in

children the same age), as well as other problematic social behaviour such as bullying (perpetration and victimisation), and aggressive behaviours. The term social problems was used as it encompasses both peer problems, as well as more general social difficulties experienced by children. Peer status has been defined as the extent to which children are accepted or rejected by their peers (Coie et al., 1990). Social skills has been conceptualised as the interpersonal processes that are necessary for appropriate social behaviour and interpersonal effectiveness (Beauchamp and Anderson, 2010; Bedell and Lennox, 1997). Social competence involves the use of social skills, and provides an overall indication, of how successfully an individual is able to engage in social settings, display appropriate social behaviours and achieve social goals (Beauchamp and Anderson, 2010; Iarocci et al., 2007). If articles included multiple measures of social functioning (e.g. social problems, and peer status) they were included in both groups. A visual depiction of results is also provided (Fig. 1, Supplementary Material), this illustrates the proportion of effects across studies that found evidence of an effect. This is displayed as a function of anxiety measurement type (diagnostic or symptom) and across raters.

### 3.2. Additional analyses

For studies where there were no analyses between groups of interest but where a mean (M), standard deviation (SD) and sample size were available, a *t*-test was conducted in Stata version 14.0. For studies that did not provide an effect size estimate, Cohen's *d* was calculated, which can be interpreted as follows: 0.2 = small effect, 0.5 = moderate effect, 0.8 = strong effect size (Cohen, 1992).

### 3.3. Social problems ( $n = 23$ )

Overall 23 studies examined social problems. 14 of these explored social problems as a general concept (including peer problems), the remaining studies investigated bullying/ aggressive behaviours ( $n = 6$ ) and victimisation ( $n = 3$ ) and these have been sub-classified as separate groups within the social problems domain.

#### 3.3.1. Studies using a diagnostic measure of anxiety ( $n = 10$ )

Three longitudinal studies highlighted associations between anxiety disorders that co-occur alongside ADHD and social problems (Bagwell et al., 2006; Greene et al., 1997; Newcorn et al., 2004). The results of these studies were shown to vary across reporters and anxiety disorder type. For example a diagnosis of ADHD and anxiety in childhood was significantly associated with child-reported but not parent-reported social problems during adolescence (Newcorn et al., 2004). Interestingly a childhood diagnosis of ADHD, anxiety and conduct disorder (CD) resulted in the opposite; this diagnosis was significantly associated with parent-reported but not child-reported social problems. In the Greene et al. (1997) study, children with ADHD and social problems in adolescence had significantly higher rates of anxiety disorders 4 years later when compared to children with ADHD who did not have social problems according to parent and child-report. The importance of examining specific anxiety disorders was highlighted in Bagwell et al. (2006) study whereby it was shown that parent and teacher-reported social problems in childhood significantly predicted parent- and child-reported social anxiety in adolescence, but not avoidant disorder or generalised anxiety disorder (GAD).

Seven cross-sectional studies examined social and peer problems in children with ADHD and compared them to children with ADHD and anxiety. Of these, five studies found that anxiety did not exacerbate peer problems above and beyond ADHD. It was shown that children and adolescents with ADHD and anxiety did not have any more difficulties making friends according to parent- and child-report (Bowen et al., 2008) nor did they experience more peer problems than others with ADHD alone based on parent- and teacher-reports (Antshel et al., 2014; Mulraney et al., 2016; Sciberras et al., 2014) and parent- and child-

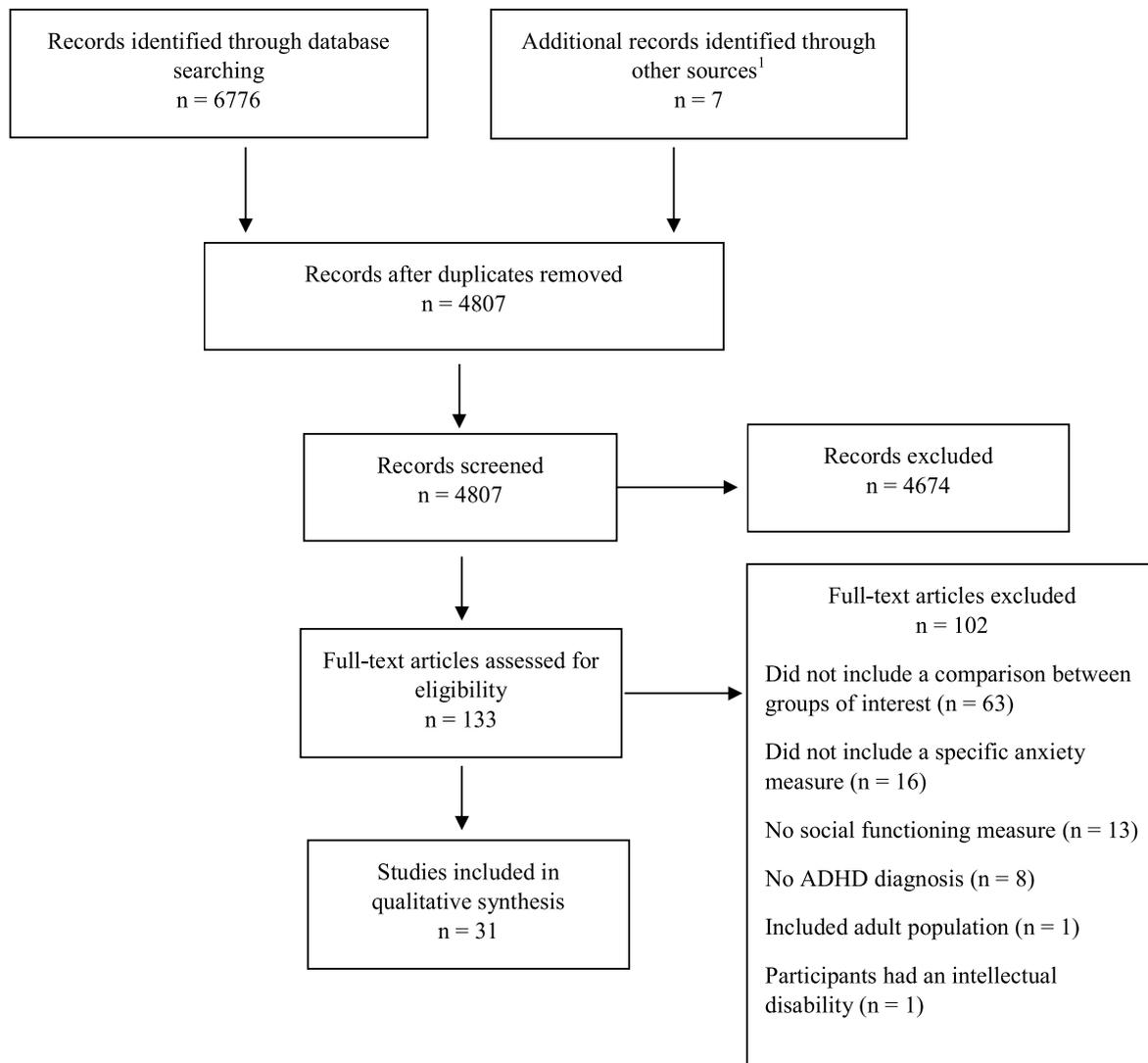


Fig. 1. PRISMA diagram

<sup>1</sup>Other sources include articles found from backwards and forwards citation analysis.

reports (Biederman et al., 1996). Interestingly, two studies revealed that in unadjusted analyses, children with ADHD and anxiety experienced more parent-reported peer problems than children with ADHD (Sciberras et al., 2014) and that parent-reported peer problems were significantly associated with anxiety diagnoses in children with ADHD (Mulraney et al., 2016). These associations were not significant according to teacher-report. However, after accounting for potential confounding variables such as ADHD symptom severity, externalising disorders, mood disorders and Autism Spectrum Disorder (ASD) the previously significant parent-reported results were no longer significant. Only two studies found that children with ADHD and comorbid anxiety disorders experienced more parent- and child-reported peer (Biederman et al., 2013) and social problems (Lee et al., 2012) when compared to children with ADHD alone. This was found to be somewhat dependent on reporter type, with Lee et al. (2012) finding this to only be significant for parent- not teacher-report.

### 3.3.2. Studies using an anxiety symptom measure (n = 4)

Four studies examined the associations between anxiety and social problems, in children with ADHD using a symptom-based measure of anxiety (Farmer et al., 2015; Humphrey et al., 2007; Karutsis et al., 2000; Pollack et al., 2016). All four studies provided evidence that associations exist between anxiety and social problems, however, the pattern of these associations

varied across raters. It was shown that higher levels of parent-reported anxiety were associated with higher levels of parent-reported peer conflict (Farmer et al., 2015) and teacher-reported social problems (Pollack et al., 2016) in children with ADHD who have comorbid externalising problems. Further Humphrey et al. (2007) found associations between higher levels of parent-reported anxiety (but not child-reported anxiety) and parent-reported social problems. Likewise, Karutsis et al. (2000) found that parent-reported child anxiety symptoms were associated with parent-reported social problems but not teacher-reported social problems, whereas child-reported anxiety symptoms aligned with both parent- and teacher-reported social problems. Whilst the exact nature and direction of these associations can change depending on the reporter, it is clear that associations exist between anxiety symptoms, and social problems in children with ADHD. It is interesting to note that patterns emerged to suggest that associations were more likely to exist when the same rater recorded the child's anxiety and social functioning abilities, this was most commonly observed when parents rated both the child's anxiety and social problems

### 3.3.3. Summary

Overall, there were inconsistent associations between anxiety and social problems in children with ADHD. When considered dimensionally, there was convincing evidence that higher levels of anxiety were associated with more social problems in youth with ADHD (Farmer

**Table 3**  
Social Skills/ Competence ( $n = 11$ ).

Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounding Variables Accounted for in Analyses	Findings
Becker 2015 USA	Cross-sectional	Community sample $N = 310$ Aged 10 - 14 ( $M = 12.1$ , $SD = 0.9$ ) 70.7% male ADHD-I: 50.65% ADHD-H: 49.36% Medication status not reported	P-ChIPS (DSM-IV; PR) DBD Rating scale (TR)	P-ChIPS (DSM-IV; PR) MASC (CR)	SSIS (PR & CR) SPPC (Social Acceptance Subscale) (PR & CR)	Youth age, sex and race, parental depressive symptoms	<b>Social Skills</b> Youth with ADHD + Anxiety had poorer PR social skills ( $t = 2.71$ , $p < 0.01$ ) but not poorer CR social skills ( $t = 1.58$ , $p = 0.11$ ) when compared to youth without a comorbid anxiety disorder. Harm avoidance was significantly positively associated with both CR ( $\beta = 0.46$ , $p < 0.001$ ) and PR ( $\beta = 0.18$ , $p < 0.01$ ) social skills. Social anxiety was significantly negatively associated with CR social skills ( $\beta = -0.24$ , $p < 0.001$ ) but not PR social skills (statistics not reported). Global scores of anxiety, physical symptoms, separation/panic symptoms did not align with PR or CR social skills ( $ps > 0.05$ ). <b>Social Acceptance<sup>a</sup></b> Youth with ADHD + Anxiety had lower PR social acceptance ( $t = 2.52$ , $p = 0.01$ ) but not lower CR social acceptance ( $t = 0.56$ , $p = 0.58$ ) than youth without a comorbid anxiety disorder. Social anxiety was negatively associated with CR ( $\beta = -0.38$ , $p < 0.001$ ) and PR social acceptance ( $\beta = -0.16$ , $p < 0.05$ ). Physical symptoms, separation/panic symptoms and harm avoidance did not align with CR or PR social acceptance ( $ps > 0.05$ ). Higher levels of a global anxiety score were associated with lower levels of CR social acceptance ( $t = -0.33$ , $p < 0.001$ , Cohen's $d = -0.70$ ) and PR social acceptance ( $t = -0.14$ , $p < 0.05$ , Cohen's $d = -0.30$ ).
Biederman 2013 USA	All study information reported in <a href="#">Table 1</a> .				SAICA (activities with peers and boy-girl associations subscales; PR & CR)	None	When comparing children with ADHD to children with ADHD + PTSD there were no significant differences in how they engaged in activities with peers ( $t(269) = 0.00$ , $p = 1.00$ , 95% CI [-0.38 - 0.38], Cohen's $d = 0.00$ ) or their boy-girl associations ( $t(269) = 1.82$ , $p = 0.07$ , 95% CI [-0.03 - 0.83], Cohen's $d = 0.50$ ).
Bowen 2008 USA	All study information reported in <a href="#">Table 1</a> .					None	Significant differences amongst children's social competence ratings across comorbidity groups for PR ( $F(3180) = 6.3$ , $p < 0.001$ ) and CR ( $F(3179) = 11.48$ , $p < 0.001$ ). Post hoc comparisons revealed that children with ADHD + Anxiety had lower PR ( $p < 0.05$ , Cohen's $d = 0.60$ ) and CR ( $p < 0.05$ , Cohen's $d = 1.25$ ) social competence when compared to children with ADHD only.

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Table 3 (continued)

Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounding Variables Accounted for in Analyses	Findings
Jensen 2001 USA	Longitudinal (only baseline data used)	Clinical sample N = 579 ADHD only (n = 184), ADHD + Anx (n = 81), ADHD + Anx + ODD/CD (n = 143) Aged 7 - 9 (M = 8.2) 80% male ADHD-C: 100% Medication status not reported	DISC-P (DSM-III; PR)	DISC-P (DSM-III; included overanxious disorder, separation anxiety, or social phobia; PR)	SSRS (PR & TR)	None	Effect of comorbid status on TR (F (8, 570) = 2.15, p < 0.03) and PR social skills (F (8, 514) = 8.01, p < 0.001). Children with ADHD + Anxiety had poorer PR social skills than children with ADHD alone (p < 0.05, effect size provided = - 0.21). No differences in the social skills of children with ADHD only and children with ADHD + Anxiety (TR) (p > 0.05, effect size provided = - 0.07).
Lee 2012 USA	All study information reported in Table 1.				SSRS (PR & TR)	None	No differences in the social skills of children with ADHD only and ADHD + Anxiety according to PR (B = 0.49, SE = 0.39, p < 0.21) or TR (no statistics were reported for this finding).
March 2000 USA	Cross-sectional	Clinical sample N = 579 (ADHD only: n = 365, ADHD + Anxiety: n = 63, ADHD + Anxiety + CD: n = 119) Aged 7 - 9 (M = 8.2) 80% male ADHD-C: 100% Medication status not reported	DISC-P (DSM-III) (PR)	DISC-P (DSM-III; included overanxious disorder, separation anx, or social phobia; PR)	SSRS (PR & TR)	None	The comorbid status of children with ADHD resulted in significantly different PR and TR social skills F (2, 544) = 9.96, p = 0.001. No difference in PR & TR social skills in children with ADHD only and children with ADHD + Anxiety (p > 0.05, Cohen's d = 0.02). Children with ADHD + Anxiety + CD had significantly poorer social skills when compared to children with ADHD + Anxiety (p < 0.05, Cohen's d = 0.15) and ADHD only (p < 0.05, Cohen's d = 0.49).
Mikami 2011 USA	All study information reported in Table 2.				SSRS (PR & TR)		The influence of anxiety symptoms on social skills was stronger for comparison children (β = - 0.56, p < 0.01), than it was for children with ADHD (β = - 0.13, p = 0.12), suggesting anxiety symptoms in children with ADHD did not further influence social skills.
Pollack 2016 USA	All study information reported in Table 1.				SSRS (TR)		Significant difference in the social problems of children with ADHD + ODD + Anxiety, ADHD + ODD and ADHD only (F (2, 94), = 3.51, p = 0.03, partial η <sup>2</sup> = 0.07). Pairwise comparisons indicated that there were no significant differences in the social skills of children with ADHD only and children ADHD + ODD + Anxiety (p > 0.05, Cohen's d = 0.68).
Ray 2017 USA	Cross-sectional	Clinical sample N = 324 Aged 10–14 (M = 12.2) 71% male ADHD-I and ADHD-C (% not reported) Medication status not reported	P-ChIPS (PR) DBD Rating scale (PR & TR)	MASC (PR)	SSRS (PR & CR)	None	No significant difference in PR anxiety symptoms when comparing socially healthy to socially impaired adolescents across both PR t (321) = 1.49, p = 0.14, 95% CI [-0.66 - 4.82], Cohen's d = 0.17 and CR t (319) = 0.19, p = 0.85, 95% CI [-3.14 - 2.60], Cohen's d = - 0.02.

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Table 3 (continued)

Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounding Variables Accounted for in Analyses	Findings
Schneider 2009 USA	Cross-sectional	Clinical sample N = 159 (ADHD: n = 94, ADHD + CMTD: n = 65) Aged 6 - 12 (M = 7.9, SD = 1.5) 100% male ADHD subtypes not reported 12% of sample medicated	Structured psychiatric interviews (PR) Exceeded clinical cut offs: IOWA Connor's Teacher Rating Scale (TR), CSI-4 (PR), MOMS (PR).	DICA-P (PR) CSI-4 (PR)	CBCL (social competence; PR)	None	In the ADHD only group, PR social competence was associated with PR global anxiety ( $\beta = -0.20$ , $p \leq 0.05$ ) and PR social phobia ( $\beta = -0.32$ , $p \leq 0.05$ ). PR social competence was not associated with PR GAD, SAD and OCD. PR social competence was not associated with TR GAD, OCD or social phobia ( $p > 0.05$ ).
Sukhodolsky 2005 USA	Cross-sectional	Clinical sample N = 287 (ADHD: n = 95, ADHD + OCD: n = 43) Aged 7 - 18 (M = 11.5, SD = 2.5) 66.5% male ADHD subtypes not reported Medication status: ADHD = 73%, ADHD + OCD = 77%	K-SADS PL (PR) Connor's Teacher & Parent Rating Scale (PR & TR)	Children's Yale-Brown Obsessive Compulsive Scale (CR & PR)	CBCL (social competence scale ; PR)	None	No significant difference in the social competence of children with OCD + ADHD when compared to children with ADHD only ( $t(136) = 1.47$ , $p = 0.15$ , 95% CI [-0.88 - 5.88], Cohen's $d = 0.27$ ).

**Abbreviations and references of instruments are in alphabetical order:**

ADHD = Attention Deficit Hyperactivity Disorder, ADHD-C = ADHD Combined Type, ADHD-H = ADHD predominantly hyperactive type, ADHD-I = ADHD predominantly inattentive type, ADIS-C = Anxiety Disorder Interview Schedule – Children, CBCL = Child Behavior Checklist, CD = Conduct Disorder, CMTD = Chronic Multiple Tic Disorder, CSI-4 = Child Symptom Inventory - 4, DBD = Disruptive Behavior Disorder Rating Scale, DICA-P = Diagnostic Interview Schedule for Children and Adolescents – Parent Version, DISC-P = Diagnostic Interview Schedule for Children Parent-Informant Interview, DSM = Diagnostic and Statistical Manual of Mental Disorders, GAD = Generalised Anxiety Disorder, K-SADS-PL = Kiddie Schedule for Affective Disorders and Schizophrenia -Present and Lifetime Version, MASC = Multidimensional Anxiety Scale for Children, MOMS = Mothers' Objective Measure of Subgrouping, OCD = Obsessive Compulsive Disorder, ODD = Oppositional Defiance Disorder, P-CHIPS = Children's Interview for Psychiatric Syndromes - Parent Version, PTSD = Post-traumatic Stress Disorder, SAICA = Social Adjustment Inventory for Children and Adolescents, SAD = Separation Anxiety Disorder, SCARED = Screen for Child Anxiety Related Emotional Disorders, SPPC = Self Perception Profile for Children, SSIS = Social Skills Improvement System, SSRS = Social Skills Rating System.

**Note:** PR = parent report; TR = teacher report, CR = child report

<sup>a</sup> Social acceptance = success in the peer domain, being able to make and maintain friendships, popularity.

<sup>b</sup> These results were based on supplementary analyses, M and SD were not provided to calculate effect size.

**Table 4**  
Other studies ( $n = 2$ ).

Study	Design	Sample Description	Measure of ADHD	Measure of Anxiety	Measure of Social Functioning	Confounding Variables Accounted for in Analyses	Findings
Normand 2011 Canada	Cross-sectional	Clinical and community sample $N = 133$ (ADHD only: $n = 45$ , ADHD + Anxiety: $n = 42$ ) Aged 7 - 13 ADHD group: ( $M = 10.3$ , $SD = 1.85$ ) 76% male ADHD subtypes not reported 82% of sample medicated	Diagnosed with ADHD by a qualified health care professional (e.g. psychologists, paediatricians, psychiatrists and family physicians). CRS-R:L ADHD subscales (PR & TR)	CRS-R:L (anxiety subscale, PR & TR)	The Car Race Task and Card-Sharing and Game-Choice Tasks <sup>a</sup>	None	When comparing children with ADHD and ADHD + Anxiety only two differences emerged between the two groups. Children with ADHD only made more self-centred proposals than children with ADHD + Anxiety in the card sharing task ( $p^2$ (127) = 11.06, $p < 0.01$ , Cohen's $d = 0.65$ ) and made more legal manoeuvres in the car-race task ( $p^2$ (127) = 5.68, $p < 0.05$ , Cohen's $d = 0.50$ ).
Pollack 2016 USA	All study information reported in Table 1.				Observational coding of solitary play, parallel play and negative play behaviours		There were no differences in the amount of time children with ADHD only and children with ADHD + Anxiety + ODD spent engaging in solitary play ( $t$ (59) = 1.12, $p = 0.27$ , 95% CI [- 4.25 - 15.03], Cohen's $d = 0.31$ ) or parallel play ( $t$ (59) = 0.28, $p = 0.78$ , 95% CI [- 13.69 - 18.11], Cohen's $d = 0.08$ ). There were also no significant differences in the amount of negative play behaviours when comparing children with ADHD only to children with ADHD + ODD + Anxiety $t$ (59) = - 1.42, $p = 0.16$ , 95% CI [- 4.10 - 0.69], Cohen's $d = 0.39$ .

**Abbreviations and references of instruments are in alphabetical order:**

ADHD = Attention Deficit Hyperactivity Disorder, CRS-R:L = Conners Rating Scale-Revised: Long Form DSM-IV ADHD subscales, ODD = Oppositional Defiant Disorder.

Note: PR = parent report; TR = teacher report, CR = child report

<sup>a</sup> = The Car Race Task assesses a child's conflict resolution skills and compliance with rules, the Card-Sharing and Game-Choice tasks assess negotiation skills.

et al., 2015; Humphrey et al., 2007; Karutsis et al., 2000; Pollack et al., 2016). Furthermore, children with ADHD who experienced social problems in childhood were at increased risk of having an anxiety disorder at a later-time point (Bagwell et al., 2006; Greene et al., 1997; Newcorn et al., 2004). In contrast, there was limited evidence from cross-sectional research that the presence of a comorbid anxiety disorder was associated with more social problems in children with ADHD.

### 3.3.4. Social problems: bullying and aggression (n = 6)

Four studies assessed aggressive behaviours and two studies examined bullying perpetration.

**3.3.4.1. Studies using a diagnostic measure of anxiety (n = 3).** When comparing children with ADHD only to children with ADHD and anxiety, there were no significant differences in classroom observed verbal aggression ratings (Abikoff et al., 2002) or interpersonal peer aggression ratings across parent-report (Danforth et al., 2017) and parent / teacher-report (Gadow and Nolan, 2011). Interestingly in the Abikoff et al. (2002) study, children with ADHD, anxiety and disruptive behavioural disorders (DBD) did display higher rates of aggression when compared to children with ADHD only and ADHD and anxiety suggesting the additional presence of an externalising disorder alongside anxiety, increased aggressive behaviours.

**3.3.4.2. Studies using an anxiety symptom measure (n = 3).** Parent- and teacher-reported symptoms of anxiety in children with ADHD were not associated with aggressive behaviours according to parent- and teacher-reports in children with ADHD (Mikami et al., 2011). Further, child-reported anxiety was not associated with child-reported bullying (Hu, 2016) and cyberbullying perpetration in adolescents with ADHD (Yen et al., 2014). From the limited research in this area, these studies suggest that the presence of anxiety symptoms or diagnoses alongside ADHD does not alter these children's aggressive behaviours or tendency to engage in cyber-bullying.

### 3.3.5. Social problems: peer victimisation (n = 3)

**3.3.5.1. Studies using an anxiety symptom measure (n = 3).** Three studies assessed the associations between ADHD, anxiety and experiences of victimisation and revealed mixed results. In the Becker et al. (2016) study, child-reported physical and relational victimisation were associated with higher levels of child-reported anxiety symptoms in adolescents with ADHD. Likewise child-reported anxiety was also associated with child-reported bullying victimisation in adolescents with ADHD (Hu, 2016). By contrast, in the Yen et al. (2014) study, being a victim of cyber-bullying was not related to anxiety in adolescents with ADHD according to child-reports. Taken together, two studies indicated that there were associations between anxiety and direct experiences of victimisation, however, no associations were found between anxiety and cyberbullying victimisation in adolescents with ADHD.

### 3.3.6. Summary

Overall, there was no evidence to suggest that children with ADHD and anxiety displayed more aggressive behaviours, or engaged in bullying behaviours more often than children with ADHD only (Abikoff et al., 2002; Gadow and Nolan, 2011; Mikami et al., 2011; Yen et al., 2014). In the studies that explored victimisation, associations were reported between anxiety and face-to-face victimisation (Becker et al., 2016; Yen et al., 2014) but not with online victimisation (Yen et al., 2014). Given the differences in the way that experiences of victimisation were explored (e.g. face-to-face vs. online), these studies highlight the importance of considering the setting via which adolescents' experience victimisation.

## 3.4. Peer status (n = 4)

Four studies examined the peer status of children with ADHD and anxiety.

### 3.4.1. Studies using a diagnostic measure of anxiety (n = 2)

Two studies compared children with ADHD and anxiety to children with ADHD only, it was shown that both groups of children were negatively regarded by peers to the same extent according to both parent- and teacher-report (Lee et al., 2012) and peer-rated sociometric assessments (Hoza et al., 2005b). It is important to note that these studies included children aged less than 10 years old, it is possible at this developmental stage, anxiety does not influence how children are being perceived by their peers.

### 3.4.2. Studies using an anxiety symptom measure (n = 2)

Two studies assessed anxiety dimensionally and highlighted the importance of considering the child's age and gender when examining the association between peer status and anxiety in children with ADHD (Becker et al., 2013; Mrug et al., 2012). In the Becker et al. (2013) study, no significant associations were observed between child-, parent- or teacher-reported anxiety and negative social preference (the extent to which participants are negatively regarded by their peers according to teacher-report). However, when sex was entered into the model, negative social preference was significantly positively associated with teacher-reported and child-reported anxiety for girls, but not boys. The second study showed that there was no association between peer rejection (as rated by peers) and child-reported anxiety at age 10 in children with ADHD. By contrast, at age 16 and 18, children with higher levels of anxiety also had higher ratings of peer rejection suggesting that these associations can vary depending on developmental stage (Mrug et al., 2012).

### 3.4.3. Summary

Taken together, findings from this domain indicate that children with ADHD and an anxiety diagnosis are not perceived differently from their peers. Relationships were observed between anxiety symptoms and peer status and this was influenced by the child's age and gender, with girls and older children/ adolescents being more likely to be perceived more negatively by their peers (Becker et al., 2013; Mrug et al., 2012). Given that only four studies were included in this domain, these findings do need to be interpreted with caution.

## 3.5. Social skills and competence (n = 11)

Eleven studies were identified that examined social skills/ competence.

### 3.5.1. Studies using a diagnostic measure of anxiety (n = 7)

The majority of studies (n = 4) did not find any differences in social skills/ competence when comparing children with ADHD and anxiety to children with ADHD only. There were no differences in children's capacity to develop relationships with peers based on parent- and child-reports (Biederman et al., 2013), nor their social skills as outlined by parent- and teacher-reports (Lee et al., 2012) or parent-reported social competence (Sukhodolsky et al., 2005). Whilst March and colleagues (2000) also found no differences in parent- and teacher-reported social skills when comparing children with ADHD only to children with ADHD and anxiety, they found that the added presence of a comorbid externalising disorder alongside anxiety further impeded these children's social skills.

Three studies did find evidence that children with ADHD and

anxiety differed compared to children with ADHD alone when examining their social competence and social skills (Becker et al., 2015; Bowen et al., 2008; Jensen et al., 2001). One study reported that children and adolescents with ADHD and anxiety had lower social competence when compared to children and adolescents with ADHD only according to parent- and child-reports (Bowen et al., 2008). Likewise Becker et al. (2015) found that children and adolescents with ADHD and anxiety had poorer parent-reported (but not child-reported) social skills and social acceptance when compared to children and adolescents with ADHD only. Jensen et al. (2001) reported that children with ADHD and anxiety had poorer social skills according to parent-report, but not to teacher-report when compared to children with ADHD only. These findings further highlight the complexity of interpreting these results which are often dependent on the reporter. For example the majority of these significant findings involved parent-reports of both anxiety and social skills when compared to teacher- or child-report. In summary, the majority of studies indicate that the co-occurrence of ADHD and anxiety does not significantly influence a child's social skills or social competence when compared to children with ADHD without comorbid anxiety.

### 3.5.2. Studies using an anxiety symptom measure ( $n = 4$ )

Of the four studies that assessed anxiety symptoms, two indicated associations between children's anxiety and social skills, however, this was dependent on the type of anxiety being assessed (Becker et al., 2016; Schneider et al., 2009). In Schneider et al. (2009) parent-reported social competence was associated with parent-reported anxiety (global measure) and social anxiety in children with ADHD but not GAD, SAD or OCD. This suggests that social competence aligns with particular types of anxiety; namely social anxiety (Schneider et al., 2009), which is not surprising. Becker et al. (2016) also found associations between social skills and specific symptoms of anxiety in children and adolescents. Higher levels of social anxiety were associated with poorer child-reported social skills and lower child- and parent-reported social acceptance. Physical symptoms of anxiety, separation/panic symptoms were not associated with child- or parent-reported social skills or social acceptance. Unlike the other two studies in this domain, Mikami et al. (2011) found that general symptoms of anxiety in children with ADHD did not further influence children's social skills across parent and teacher-reports. Likewise, Ray and colleagues categorised adolescents with ADHD as being 'socially healthy' or 'socially impaired' and found no differences in general anxiety ratings across these two groups. These findings reinforce the value of examining different facets of anxiety as it appears that certain symptoms of anxiety relate more strongly with social functioning capabilities.

### 3.5.3. Summary

The majority of studies that utilised diagnostic measures found no differences in social skills or competencies between children with ADHD alone and children with ADHD and anxiety disorders. Of the four studies that assessed anxiety symptoms, two indicated associations between children's anxiety and social skills, however, this was dependent on the type of anxiety being assessed (Becker et al., 2016; Schneider et al., 2009). The two studies that did not find evidence of an effect included a more global conceptualisation of anxiety rather than examining specific symptoms which may provide one explanation for the conflicting findings (Mikami et al., 2011; Ray et al., 2017).

### 3.6. Other ( $n = 2$ )

Two articles contained measures of social functioning that could not be placed in previously described categories (Normand et al., 2011; Pollack et al., 2016). In Normand et al. (2011) study, children with ADHD and anxiety were shown to have higher levels of compliance and

better equipped to deal with conflict resolution when compared to children with ADHD only. In Pollack and colleagues (2016) study, play behaviours were observed in children with diagnosed ADHD, anxiety and ODD (symptoms only) and compared to children with ADHD only. It was shown that there was no difference in the type of play or negative play behaviours when comparing the two groups.

## 4. Discussion

The aim of this review was to systematically explore the associations between anxiety and social functioning (social problems, peer status and social skills/ competence) in children and adolescents with ADHD. The observed associations between social functioning and anxiety varied substantially across studies. In regards to social problems, there was evidence of associations between anxiety symptoms and social problems, and associations between anxiety disorders and social problems in longitudinal research. Differentially, there was limited evidence that anxiety disorders were associated with increased social problems in cross-sectional research, nor were anxiety symptoms aligned with increased aggressive behaviours. The results from the peer status domain indicated that for the most part, children with ADHD and anxiety were not perceived differently from children with ADHD only, however, anxiety symptoms were associated with increased experiences of peer rejection. Finally, in a similar pattern to the social problems domain, there was limited evidence of associations between anxiety disorders and more impaired social skills/competence, however, associations were observed more consistently between higher levels of anxiety symptoms and more problematic social skills/competence.

Whilst there were many patterns identified throughout the review, there was also considerable heterogeneity amongst the findings. The importance of considering how anxiety was measured (including what symptoms were assessed), the reporter of both anxiety and social functioning (e.g. parent, child, teacher), the age of the child, and accounting for the role of other comorbid conditions emerged as key factors to consider when evaluating the complex association between anxiety and social functioning in children with ADHD. Given that many of the reported associations varied when considering the aforementioned factors the large majority of the discussion will focus on exploring these factors in greater depth.

### 4.1. Key factors influencing findings

A number of key themes emerged as important factors when synthesising the findings of this review including: anxiety measurement and symptom severity, measurement of social functioning, the use of a cross-sectional or longitudinal design, reporter type and the context of observations.

#### 4.1.1. Anxiety measurement & symptom severity

Across the studies included, there were approximately equal number of studies that used diagnostic measures of anxiety and anxiety symptom measures. One of the most consistent findings from this review was the importance of considering the way anxiety was measured, and what types of anxiety disorders/ symptoms were assessed. In studies that used diagnostic measures, there was little evidence that the presence of an anxiety disorder was associated with poorer social functioning, while in contrast there was compelling evidence of an associations between symptoms of anxiety and higher levels of social problems, and poorer social skills.

The majority of studies in this review examined anxiety as a single construct, and this was the case for studies that used diagnostic measures, and symptom severity measures. For example, in studies that used diagnostic measures, anxiety disorders were either grouped together as a whole, or most authors did not report the specific frequencies of anxiety disorders in the sample. Similarly, in studies that used symptom-based measures, most often anxiety symptoms were

examined as a single construct (e.g. total anxiety), rather than specific symptoms of anxiety (e.g. social, generalised). This approach may be neglecting important underlying associations that exist between specific facets of anxiety and social functioning capabilities. For example, in studies that examined specific anxiety disorders or symptoms of anxiety, patterns emerged which suggested that some types of anxiety may be particularly pertinent to poorer social functioning. Perhaps unsurprisingly, social anxiety emerged as the most consistently reported facet of anxiety (disorder or symptom) that was related to social problems and social skills (Bagwell et al., 2006; Becker et al., 2015; Schneider et al., 2009). This finding does however, need to be interpreted with caution due to the few studies which examined specific anxiety disorders or symptoms. This may provide insight into one of the key drivers of the variability of the findings to date and highlights the importance of future research using both diagnostic and symptom based measures to examine specific facets of anxiety.

The associations between anxiety and social functioning may also vary depending on the severity of anxiety symptoms and the relationship between anxiety and social functioning may not be linear. Examining the severity of symptoms and exploring how this may influence social functioning across anxiety symptom groups (e.g. low, moderate, high levels of anxiety) may glean insight into both the potential protective and impairing role of anxiety on social functioning. It is possible that children with high levels of anxiety may avoid social encounters, or endure them with great distress and over time become more withdrawn (Jacob et al., 2014; Rapee et al., 2009). By contrast, children with low levels of anxiety may be more vulnerable to displaying impulsive and aggressive behaviours in social settings (Newcorn et al., 2001). Perhaps moderate levels of anxiety offer a more protective role in dampening some of the disruptive behaviours, and allow children to participate in social engagements without extreme distress. This is an important avenue for future studies to explore.

#### 4.1.2. Social functioning measurement

Rating scales completed by parents, teachers and occasionally youth were by far the most commonly used method for measuring social functioning abilities. Only two studies used socio-metric peer nominations and three used independent coders in the school environment as a way of measuring peer functioning. It has been well established that assessment methods that use peers as informants represent the gold standard methodology for assessing peer relationships amongst school-aged children (Crowe et al., 2011; Hoza, 2007; McQuade and Hoza, 2008). This is because many interactions occur between children in situations that are inaccessible to adults, and when they are not being closely monitored (Crowe et al., 2011). Whilst this methodology is associated with increased time and cost when compared with rating scales, future research should incorporate more naturalistic methodologies to assess social functioning.

#### 4.1.3. Cross sectional vs longitudinal study design

Only four studies used longitudinal designs to examine the association between anxiety and social problems, and peer status in youth with ADHD, with the vast majority using a cross-sectional design, or including analyses from one time point ( $n = 27$ ). In this review, many studies included samples with a large age range (e.g. 5–18) and as such it is difficult to identify trends in cross-sectional studies about how these associations present at different developmental stages.

Theoretically, this is an important direction for future research as the development of peer associations and overall social functioning capabilities changes significantly through early, middle, late childhood and adolescence (Parker et al., 2006). It may be that the association between anxiety and social functioning is less prominent during the early school years, and becomes more problematic throughout adolescence as the social demands increase and become more complex. It is likely that the association between anxiety and social functioning is bidirectional, whereby children with social problems feel more anxious

during social interactions, which in turn may result in further social difficulties and associated anxiety (Mikami et al., 2011). A more detailed understanding as to how these relationships may change over time could be explored using longitudinal study designs.

#### 4.1.4. Reporter type & context of observation

One of the most significant findings across all domains of social functioning was the extent to which findings varied depending on the reporter of both social functioning and anxiety (parent, teacher, child). Patterns emerged to suggest that associations were more likely to be observed when the same reporter rated both anxiety and social functioning. This was most typically observed when parents were the reporter, however, it also needs to be considered that parents were by far the most frequent reporter included in most studies. Whilst it is well established that use of a multi-informant assessment is gold-standard for understanding children's behaviour across a number of contexts (Achenbach et al., 1987), interpreting the results from multiple informants brings with it many additional challenges, given that multiple reporters often share little variance with each other (Achenbach et al., 1987; De Los Reyes et al., 2015). This was the case in the current review where there was considerable variation amongst the pattern of associations depending on the reporter.

The differences in findings across reporters may be explained by the context in which the child is being observed. For example, it is possible that a child's anxiety and social interactions differ significantly in the school and home environment. It is important to consider that parents primarily observe how their child functions at home and in social interactions with siblings or family members, whereas teachers observe children at school, where they spend significantly more time interacting with peers. This is one explanation for the varied findings across reporters. It has also been shown that reporters are less consistent when the behaviour is difficult to observe, for instance it has been highlighted that there is less correspondence between reporters for a child's internalising problems when compared to externalising (Achenbach et al., 1987; De Los Reyes et al., 2015). It is likely that the same can be said of observing social interactions, many of which are inaccessible of adult observers (Hoza, 2007). Thus, it needs to be considered that these are very difficult aspects of functioning to observe in a child, and likely vary significantly between contexts.

#### 4.1.5. Other confounding factors

Another important consideration relates to wide variability in the sample characteristics in the studies included. The majority of studies did not consider likely important confounding variables. For example, in two studies it was found that children with ADHD and anxiety were found to have more peer problems when compared to children with ADHD only (Mulraney et al., 2016; Sciberras et al., 2014). However, when other factors such as externalising behaviours, ASD, mood disturbances, medication use and ADHD symptom severity were controlled for these associations became non-significant. This suggests that there are various other factors which may be driving the sometimes reported association between anxiety and social functioning in children with ADHD and may explain the variability in the findings to date.

The influence of other comorbid mental health difficulties alongside anxiety is another noteworthy point of discussion. Past research has found that the presence of a comorbid externalising disorder alongside anxiety further impaired social functioning in children with ADHD whilst anxiety alone did not (Abikoff et al., 2002; March et al., 2000). However, another study found a unique effect of anxiety above and beyond externalising difficulties (Mikami et al., 2011). The majority of studies have not examined the results in a way that considers other comorbidities, which is problematic given that children with ADHD are likely to have multiple comorbid conditions (Spencer et al., 2007).

The importance of considering how a child's social behaviour may vary as a function of ADHD presentation is another key consideration. The majority of studies in this review did not report on ADHD

presentation when describing their sample characteristics and as such conclusions have not been made. Past research has shown that children with ADHD-C and ADHD-I differ significantly in their social behaviours. For example, children with ADHD-C are more frequently rejected by their peers, and rated as being more aggressive (e.g. starting fights), whereas children with ADHD-I have been shown to be more socially isolated and labelled by peers as shy (Hinshaw, 2002; Hodgins et al., 2000; McQuade and Hoza, 2008). These findings suggest that children with ADHD-I and ADHD-C display different impairments in the social domain. Understanding how the association between anxiety and social functioning varies as a function of ADHD presentation is an important avenue for future research.

#### 4.2. Methodological limitations

This review has a number of limitations. Firstly, due to the heterogeneous use of social functioning measures, reporters and sample characteristics, the numbers within subgroups were reduced significantly. As a result, a meta-analysis was not able to be completed with the data that was available from included studies. Secondly, this review only focussed on children and adolescents, and did not examine how these associations may persist into adulthood, or how they may change over time. Lastly, the results from individual studies in this review were very nuanced and specific. In order to discuss general patterns and trends some conclusions have been drawn, however, the importance of considering individual study findings when examining this literature cannot be understated.

#### 4.3. Future research and clinical implications

Future studies should seek to use gold-standard anxiety diagnostic measures as well as anxiety symptom severity based measures to understand how these associations function across diagnoses and symptom severity. This will allow for a greater understanding as to which aspects of anxiety offer a more protective or impairing role. Additionally, the use of sociometric nominations and naturalistic methodologies would significantly enhance the current knowledge base and provide a more comprehensive understanding about the social functioning abilities in this comorbid population. Incorporating assessments of social functioning into online games or platforms may provide a more accessible way of assessing a child in a more naturalistic setting. It would be interesting to examine if these associations varied as a function of the type of anxiety disorder (e.g. social anxiety disorder vs separation anxiety disorder), as it may be that certain types of anxiety disorders result in more noticeable impairments amongst peers.

Further, this review highlights the importance of using multiple informants in combination with various methodologies (e.g. self-report, peer-report, naturalistic observations) to form a more comprehensive picture of these relationships. The understanding of these relationships would be significantly enhanced by future studies employing longitudinal study designs. This would provide important insight into the developmental trajectories of anxiety, and social functioning difficulties in youth with ADHD. It would be interesting to observe this as a function of specific types of anxiety, and to examine if these impact social functioning abilities in unique ways throughout childhood to adolescence.

Future research should also begin to explore the mechanisms underpinning social functioning abilities in this population. For example, examining social-cognitive factors such as social-information processing abilities and emotion recognition abilities in children with comorbid ADHD and anxiety may provide important insight into the drivers behind some difficulties in social functioning. This may have subsequent implications for improving the treatments that target social skills and functioning in this population.

This review has a number of key clinical implications. Firstly, it highlights the importance of clinicians carefully assessing for comorbid

anxiety, and subsequent social functioning impairments in youth with ADHD. Further, the importance of considering the likely bidirectional relationship between ADHD and anxiety highlights the need for clinicians to consider both anxiety management, and social skills interventions when working with this population. Whilst traditional social skills treatment programs have shown limited efficacy for this population (see Mikami et al., 2017 for a review), different approaches such as involving peers and parents as coaches, summer holiday programs, and providing reinforcement for appropriate social behaviour in vivo, are promising new directions for social skills interventions for children with ADHD. Investigating how to tailor interventions to meet the specific needs of children with ADHD and anxiety is an important avenue for future research.

## 5. Conclusions

In summary, this review highlighted that some associations exist between anxiety and social functioning in youth with ADHD. More specifically, anxiety symptom severity was associated with lower levels of social skills and higher levels of social problems in young people with ADHD. Few differences emerged when anxiety was defined using diagnostic measures across all domains of social functioning. Although the results varied considerably amongst studies this review highlights the importance of considering the study respondents (e.g. parents, teachers, children), the measure of anxiety being used (e.g. anxiety diagnoses or anxiety symptoms), and sample characteristics (e.g. sex, age, ADHD subtype, comorbidity) when examining the association between anxiety and social functioning. Future research is needed to further clarify the exact nature of these associations and the mechanisms underpinning poor social functioning in children with ADHD.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.psychres.2019.01.039](https://doi.org/10.1016/j.psychres.2019.01.039).

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