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High-Functioning Autism Spectrum Disorder in Adulthood: A Systematic Review of Factors Related to Psychosocial Outcomes

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Short title: Psychosocial Outcomes of Adults with High Functioning Autism Spectrum Disorder

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Abstract

Background: This systematic review aimed to identify the factors related to psychosocial outcomes for adults with high functioning autism spectrum disorder (HFASD). A further aim was to appraise the research methodology and provide recommendations for future research.

Method: Systematic review methodology was used to comprehensively search for peer reviewed articles, assess methodological rigor and summarise the results. Twenty-seven studies published between 1989 and December 2015 met inclusion criteria and included 1398 individuals (*M* age = 28.54 years) with HFASD (IQ $\geq$ 70).

Results: Factors most consistently found to be related to poor psychological, social and adaptive outcomes included: greater symptom severity, lower childhood IQ, impaired non-verbal learning, cognitive shifting deficits, negative thinking styles, and perceptions of low social support.

Conclusions: Overall, key risk factors for poor psychosocial outcomes of adults with HFASD were identified. However, further prospective longitudinal research with large samples is needed to examine the complex, and potentially bi-directional relationships among these factors.

Key words: adults, high-functioning, autism spectrum disorder, psychosocial outcomes

Introduction

Autism spectrum disorder (ASD) is a grouping of neurodevelopmental disorders characterised by deficits in social communication and language as well as a restricted range of behaviours or interests (American Psychiatric Association, 2013). A wealth of studies have investigated the aetiology and characteristics of ASD in children and adolescents (Chiang & Wineman, 2014; Levy & Perry, 2011). Reviews of the empirical literature to date have focused broadly on social and adaptive outcomes of individuals with high and low functioning ASD (e.g., Magiati, Tay, & Howlin, 2014; Tobin, Drager, & Richardson, 2014) and across different developmental phases (e.g., Chiang & Wineman, 2014). Less is known about the psychological, social and adaptive outcomes of adults with ASD who are "high-functioning" in the sense that their intellectual functioning is in the normal range (i.e., ≥ 70), commonly referred to as high functioning ASD (HFASD; see Baron-Cohen, 2000).

Due to the multidimensional nature and complex symptomatology of ASD, no single theory can comprehensively account for the characteristics and outcomes of the disorder (Silva et al., 2013). It has been proposed that diverse factors potentially account for differences in psychological, social and adaptive outcomes. These include demographic characteristics, neurocognitive functioning, severity of ASD symptoms, self-appraisals, emotion regulation and coping skills, and social support (Attwood, 2007). From this perspective, psychosocial outcomes could incorporate both mental health (e.g., depression, anxiety, stress, self-esteem, psychotic symptoms, attention deficit hyperactivity disorder, quality of life) and social and adaptive functioning (e.g., levels of independence, vocational, academic and interpersonal functioning) domains.

A leading neurocognitive developmental account of ASD implicates deficits in social cognition such as theory of mind (ToM), or the ability to evaluate the mental states of others (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Frith & Frith,

2003). A second major neurocognitive developmental account, weak central coherence theory, proposes that individuals with ASD have pervasive difficulties with perceiving the overall meaning or gist in a given situation, which leads to processing information in a fragmented and fine-grained way (Frith & Happé, 1994; Rajendran & Mitchell, 2007). Aspects of ASD symptomatology unaccounted for by ToM and weak central coherence theories have been proposed to arise from deficits in executive functioning such as problems with attentional switching, perseveration and impulse control (Hill, 2004; Kleinhans, Akshoomoff, & Delis, 2005). Despite generally mixed empirical support concerning the profile of executive function impairments in ASD (Hill & Bird, 2006; Pennington & Ozonoff, 1996; Rajendran, Mitchell, & Rickards, 2005; Turner, 1999), there is consistent evidence of difficulties with cognitive shifting (i.e., the ability to engage and disengage actions in the service of predominant goals; Ambery, Russell, Perry, Morris, & Murphy, 2006; Hill & Bird, 2006; Pellicano, 2007). However, the influence of neurocognitive functioning on psychosocial outcomes in adults with HFASD is unclear.

The ways in which individuals perceive themselves and their environment has long been recognised to impact on psychological and social functioning in the context of chronic health conditions (Lauwerier et al., 2010; McCracken, 2005). Research has shown that adolescents with HFASD perceive themselves as different and report lower self-esteem than typically developing peers (Vickerstaff, Heriot, Wong, Lopes, & Dossetor, 2007; Williamson, Craig, & Slinger, 2008). Qualitative studies indicate that some individuals perceive positive effects of being diagnosed with ASD and are motivated to seek out likeminded individuals and community support groups (Haertl, Callahan, Markovics, & Sheppard, 2013). In contrast, others express feeling helpless, estranged, and rejected by society (Haertl et al., 2013; Smith & Sharp, 2013; Townson et al., 2007). Individuals may also value certain skills associated with ASD, such as

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identifying errors quickly and understanding complex mathematics and computers (Smith & Sharp, 2013). Such findings highlight the importance of examining the impact of self-appraisals on psychosocial outcomes for adults with HFASD.

Individuals with ASD are prone to heightened stress and comorbid psychological diagnoses (Baron, Groden, & Groden, 2006; Samson, Huber, & Gross, 2012). Yet, investigations of stress and coping have mainly focused on family members (Baron et al., 2006; Dabrowska & Pisula, 2010; Pottie & Ingram, 2008). Stress is thought to detrimentally influence health outcomes on a number of inter-related levels whereby stressful situations trigger negative appraisals of harm, activate physiological systems and elicit unhelpful coping responses (e.g., avoidance, alcohol and illicit drug use; Cohen, Kessler, & Gordon, 1995; Lazarus & Folkman, 1984). Long-term activation of stress response systems is associated with a heightened risk of developing a range of physical and psychiatric disorders (DeLongis, Folkman, & Lazarus, 1988; Rosengren, Orth-Gomer, Wedel, & Wilhelmsen, 1993).

Related to self-appraisals and coping resources, emotion regulation refers to the capacity to simultaneously attend to internal and external cues in order to respond appropriately in a given situation (Ekman, 1992). Samson and colleagues (2012) found that adults with HFASD were less likely to use reappraisal strategies when regulating emotions in a stressful situation than matched controls. Therefore, self-appraisals, coping and emotion regulation skills are important to examine as personal resources potentially related to psychosocial outcomes of HFASD in adulthood.

In addition to emotion regulation skills, social resources can buffer the detrimental effects of stressful events on well-being (Cohen, 1988). In particular, social support has been found to moderate the impact of high levels of stress on psychological well-being (Cohen, 2004). A fundamental aspect of this buffering effect is the extent to which social support is *perceived* as available or effective by an individual (Cohen,

1988). There is considerable evidence that the perceived availability and quality of social support moderates the influence of high levels of stress on health outcomes in a range of clinical populations (Payne et al., 2012; Steptoe, 2000). However, the influence of perceived social support on psychosocial outcomes of adults with HFASD has received little attention to date.

Broader social environmental factors likely to influence psychological, social adaptive outcomes include the quality of interactions with friends, family and employers (Chiang & Wineman, 2014; Howlin, 2000; Levy & Perry, 2011; Tobin et al., 2014). In particular, the experience of bullying and victimisation during childhood and adolescence, most commonly in the school environment, has been proposed to contribute to poor psychosocial outcomes in adulthood (Cappadocia, Weiss, & Pepler, 2012; Roekel, Didden, & Scholte, 2010). In an unpublished dissertation, Merkler (2007) reported that adults with HFASD were more isolated than matched controls and that isolation from social networks and relationships was associated with psychological distress. Despite their social challenges, individuals with HFASD have been found to report a desire for intimacy and social connectedness and derive satisfaction from contributing to others' welfare (Muller, Schuler, & Yates, 2008). A better understanding of social environmental influences on outcomes of adults with HFASD may guide support interventions.

Rationale and Aims of the Systematic Review

Previous reviews of factors related to psychosocial outcomes of ASD have typically synthesised the findings for children and adults with high and low functioning ASD (Chiang & Wineman, 2014; Howlin & Moss, 2012; Levy & Perry, 2011; Magiati et al., 2014; Nordin & Gillberg, 1998; Tobin et al., 2014; van Heijst & Geurts, 2014). For example, Levy and Perry (2011) found that autism severity, cognitive and language skills, co-morbid psychopathology and access to interventions were consistently related

to outcomes for adolescents and adults with ASD. More recently, Magiati et al. (2014) reviewed 25 longitudinal studies of cognitive, language and behavioural outcomes of adults with ASD. The key findings were that IQ typically remained stable between childhood and adulthood and that early IQ and language skills predicted functional outcomes in adulthood. Improvements were evident between childhood and adulthood for ASD symptoms, language and adaptive functioning; however, social outcomes were generally poor and the majority still met partial criteria for ASD in adulthood.

Overall, given the heterogeneity of study samples encompassing participants with high and low functioning ASD (e.g., Magiati et al., 2014; Tobin et al., 2014) and children and adults (e.g., Chiang & Wineman, 2014), it is unclear to what extent these findings generalise to adults with HFASD. Further, greater emphasis has been placed on neurocognitive predictors than self-appraisals, coping resources and aspects of the social environment which are potentially responsive to intervention (Tobin et al., 2014). To guide future research and support interventions specific to adults with HFASD, it is important to understand both risk factors and protective factors impacting long-term psychosocial outcomes.

Accordingly, the broad aims of this systematic review were to identify studies investigating factors associated with psychosocial outcomes of adults with HFASD and synthesise the key findings. A further aim was to appraise the research methodology, identify gaps in the literature and provide future research recommendations. As mentioned previously, psychosocial outcomes broadly include mental health and social and adaptive functioning.

Method

The current paper adopted systematic review methodology in accordance with relevant guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009). This review

process entailed four stages: 1) searching electronic databases using key terms; 2)

reviewing abstracts with potentially relevant titles and key terms; 3) reviewing the full-

text of articles to determine eligibility (conducted by two authors); and 4) appraising the

methodology of eligible studies and summarising the findings.

Search Strategy

Eligible articles were identified through systematic electronic searches of the

following databases: Ovid (PsycINFO), ProQuest, PubMed, Science Direct, Scopus and

Web of Science from inception to the end of October 2015. Keyword searching (i.e.

searching of title, abstract, keyword and/or subject) was used for the following terms: 1)

autism spectrum disorder or Asperger* or high-functioning autism or high functioning

autism or HFASD; AND 2) outcome* or psychosocial or mental health or depression or

anxiety or self-esteem.

Search terms were chosen based on Diagnostic and Statsitical Manual for

Mental Disorders-Fourth Edition (DSM-IV; 1994), DSM-IV-TR (2000), DSM-5 (2013)

and International Classification of Diseases-Tenth Revision (ICD-10; 1993)

terminology for people with high-functioning autism spectrum disorder (or Asperger's

Syndrome/Disorder) as relevant to the specific focus of our review.

Searches were limited to adults either via limits or through the additional search

terms: AND adult*. In addition, specific autism journals (i.e., Autism Research, Journal

of Autism and Developmental Disorders, Journal of Intellectual and Developmental

Disability and Autism) were screened for articles published online that may not have

been identified through the original database search. Finally, the reference lists of

eligible studies were also manually searched.

Selection Criteria

To identify relevant studies, the following inclusion criteria were applied: peer-

reviewed articles published in English; quantitative studies (i.e., use of statistical

analysis) that investigated factors related to psychosocial outcomes in adults with HFASD; mean age for the HFASD sample was at least 18 years and the minimum age of a participant was 16 years; participants had a formal diagnosis of ASD and/or ASD severity was measured; and participants' IQ was in the normal range (i.e., ≥ 70), or intellectual disability was specified in exclusion criteria.

All abstracts of articles that met these inclusion criteria were reviewed by the primary author. Articles were excluded if they were reviews, commentaries or case studies or if they only employed qualitative methodology. Despite having an empirical basis, the findings of case studies and qualitative studies require a different approach to synthesis that was outside the scope of this review.

Following the initial screening stage, the full-text of each article was independently reviewed by two authors. Level of agreement concerning eligibility for inclusion was quantified using a point-by-point method (i.e., number of agreements/[agreements + disagreements] x 100 = % agreement).

Quality of Methodology

The final stage of the review process involved evaluating the methodological quality of the eligible studies according to a checklist adapted from Ownsworth and McKenna (2004). Articles were scored 0 (does not meet) or 1 (meets) on the following five criteria: 1) prospective and/or retrospective design employed with at least two assessment time points (i.e., collection of data on childhood variables and follow-up of outcomes in adulthood); 2) characteristics of the sample (i.e., age, gender, IQ and ASD status) and the inclusion criteria for the study were clearly stated; 3) analysis of sample representativeness was conducted. For prospective (and retrospective) studies, participants lost at follow-up were described and the reasons for attrition were explained. For cross-sectional studies, a comparison was conducted between individuals who were eligible and participated and those who were eligible but did not participate;

4) an adequate sample size, i.e. comprised of at least 10 participants per predictor/independent variable (Cohen, 2013); and 5) a multivariate statistical approach was used to examine the relationship between the predictor/independent variables and outcomes with examination of, or control for other predictors or covariates. Higher scores (0-5) represented stronger methodological quality. The first author reviewed each study and rated the quality of methodology while the second author checked and confirmed the suitability of these ratings.

Data Synthesis

Due to significant variability in design, sample characteristics, analytic approach and outcome measures, meta-analysis was not used to synthesise the data. Instead, results were synthesized qualitatively.

Results

As shown in Figure 1, the initial search yielded a total of 843 articles, which reduced to 807 once duplicates and studies not published in English were removed. A further 726 articles were excluded on the basis of title or abstract, leaving a total of 67 articles to be screened for eligibility as full-texts by both reviewers. Additionally, a further six articles were identified through reviewing the content pages of specific autism journals and searching the reference lists of eligible articles. This process identified 27 articles eligible for review (see Figure 1). There was 82% agreement between two independent raters concerning the inclusion or exclusion of the 67 studies based on review of the full text. Initial disagreement regarding eligibility of 12 studies was resolved through discussion. Specifically, nine studies were included (Gillberg, Helles, Billstedt, & Gillberg, 2015; Gotham, Bishop, Brunwasser, & Lord, 2014; Gotham, Unruh, & Lord, 2014; Hagberg, Billstedt, Nyden, & Gillberg, 2015; Hagberg, Nyden, Cederlund, & Gillberg, 2013; Hare, Wood, Wastell, & Skirrow, 2014; Maddox & White, 2015; Rinaldi, Jacquet, & Lefebvre, 2015; Shtayermman, 2007), while three

were not deemed eligible (Bejerot, Eriksson, & Mortberg, 2014; Gray et al., 2014; Hare,

Gracey, & Wood, 2015). Two articles (Gotham, Bishop, et al., 2014; Gotham, Unruh, et

al., 2014) employed the same sample, but analysed a different set of variables. A further

two articles (Hagberg et al., 2015; Hagberg et al., 2013) also employed identical

samples that involved analyses of different variables. The results of these four articles

were summarised as two broader studies for the purpose of this review. Table 1 outlines

the design, sample characteristics, correlates/predictors, psychosocial outcomes, quality

of methodology ratings and significant findings of the 27 eligible studies.

Insert TABLE 1 about Here

Participant and Sample Characteristics

A total of 1398 individuals (M age = 28.54 years) with HFASD were involved

across the 27 studies (published between 1989 and December 2015), with sample sizes

of 10-291 (M sample size = 51.8). The cross-sectional study by Khanna, Jariwala-

Parikh, West-Strum, and Mahabaleshwarkar (2014) had the largest sample size ($n =$

291), representing 20.8% of the total participants in this review. Across the 26 studies

that specified participants' gender there were 930 males (71.6%) and 369 females

(28.4%).

Quality of Methodology

As shown in Table 2, the methodological quality was variable across the 27

studies (score range: 1-4). Based on the five criteria specified for this review, the two

studies with the strongest methodological quality were a cross-sectional study ($n = 141$)

by Byers et al. (2013) and a prospective study by Gillberg et al. (2015). The most

common research design was cross-sectional (21/27 studies), whereas five studies

employed a prospective design (Berger, Aerts, van Spaendonck, Cools, & Teunisse,

2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2013; Taylor, Henninger,

& Mailick, 2015) and one study analysed data retrospectively across a time interval of

11-27 years (Szatmari, Bartolucci, Bremner, Bond, & Rich, 1989). The prospective study by Berger et al. (2003) is noteworthy as the only study to employ a uniform follow-up period of three years, whereas the length of follow-up period was variable for Hagberg et al. (2013), Farley et al. (2009), Gillberg et al. (2015) and Taylor et al. (2015), ranging from 9.4-24.4 years.

Most studies (22/27) provided a clear description of the sample characteristics, including age, gender, IQ and ASD status (see Table 2). In terms of sample representativeness, four studies described and compared the characteristics of individuals who were eligible and participated in the study versus those who were eligible but did not participate (Byers, Nichols, Voyer, & Reilly, 2013; Farley et al., 2009; Gillberg et al., 2015; Szatmari et al., 1989). Two prospective and one retrospective study described participants lost at follow-up and reasons for attrition (Farley et al., 2009; Gillberg et al., 2015; Szatmari et al., 1989). Fourteen studies met the criteria for adequate sample size, with at least 10 participants per variable in the analyses (Bishop-Fitzpatrick, Mazefsky, Minshew, & Eack, 2015; Byers et al., 2013; Gillberg et al., 2015; Gotham, Bishop, et al., 2014; Gotham, Unruh, et al., 2014; Hagberg et al., 2013; Hill, Berthoz, & Frith, 2004; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Schmidt et al., 2015; Tani et al., 2012). Finally, eleven studies utilised multivariate statistical approaches to examine the relationship between independent variables and psychosocial outcomes whilst controlling for other variables (Bishop-Fitzpatrick et al., 2015; Byers et al., 2013; Hill et al., 2004; Khanna et al., 2014; Maddox & White, 2015; Montgomery, Stoesz, & McCrimmon, 2013; Renty & Roeyers, 2006, 2007; Schmidt et al., 2015; Taylor et al., 2015; Wallace et al., 2015).

Insert TABLE 2 about Here

As shown in Table 1, psychosocial outcomes were measured using a combination of clinician or researcher-rated instruments (e.g., the Vineland Adaptive Behavior Scales [VABS; Sparrow et al.,1984], Autism Diagnostic Interview-Revised [ADI-R; Lord, 1994] and Structured Clinical Interviews/Global Assessment of Functioning [DSM IV-TR; APA, 2000]) and various self-report questionnaires. The most common self-report measure used was the Beck Depression Inventory (BDI; Beck, Steer, & Brown, 1996).

Factors Associated with Psychosocial Outcomes

Demographics: Age and Gender. Eight studies (Abell & Hare, 2005; Bishop-Fitzpatrick et al., 2015; Byers et al., 2013; Gotham, Unruh, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006; Taylor et al., 2015; Wallace et al., 2015) investigated the relationship between age and/or gender and psychosocial outcomes in adulthood. A cross-sectional study ($n = 46$) by Abell and Hare (2005) found that age was significantly and positively correlated with social anxiety and depression. Further, the cross-sectional study ($n = 38$) by Bishop-Fitzpatrick et al. (2015) noted that older age, and not years of education, was correlated with poorer social and adaptive functioning. However, cross-sectional studies with larger samples sizes ($n = 58$ and $n = 291$) by Renty and Roeyers (2006) and Khanna et al. (2014) found no significant associations between age and gender and quality of life (QoL). Further, cross-sectional research by Gotham, Unruh, et al. (2014) ($n = 50$) and Wallace et al. (2015) (n = 35) identified that age was not significantly related to mental health or social and adaptive outcomes. In a large internet based study on romantic relationships ($n = 141$), Byers et al. (2013) found that males reported significantly better dyadic and solitary sexual well-being than females. Age was not found to be related to sexual well-being. In a prospective study (n = 73) over 12 years, Taylor et al. (2015) reported that after controlling for age, males were more likely to be employed or in post-secondary education than females. Further, females were less

likely than males to maintain employment or post-secondary education over time.

Overall, the findings for the influence of age and gender on psychosocial outcomes of

adults with HFASD were mixed.

Severity of ASD Symptoms. Thirteen studies examined the relationship between

severity of ASD symptoms and psychosocial outcomes (Byers et al., 2013; Gotham,

Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare,

2014; Jantz, 2011; Khanna et al., 2014; Maddox & White, 2015; Renty & Roeyers,

2007; Shtayermman, 2007; Szatmari et al., 1989; Tani et al., 2012; Taylor et al., 2015).

In a small retrospective study ($n = 16$), Szatmari et al. (1989) found that early ASD

symptoms (*M* age = 6 years) were not significantly associated with social and adaptive

functioning in adulthood. Conversely, in the study with the largest sample size ($n =$

291), Khanna et al. (2014) reported that greater ASD symptom severity was associated

with poorer mental health-related QoL. Similarly, cross-sectional research by Gotham,

Bishop, et al. (2014) ($n = 48$) and Jansch and Hare (2014) ($n = 30$) found that higher

levels of ASD impairments were significantly related to greater depressive and anxiety

symptoms. Consistent with these findings, Hirvikoski and Blomqvist (2015) reported in

their cross-sectional study ($n = 25$) that greater ASD symptoms were associated with

higher perceived stress. Further, Maddox and White (2015) reported in their cross-

sectional study that greater ASD related social impairments were significantly

associated with a co-morbid diagnosis of social anxiety disorder ($n = 28$). In a

comparison of adults with Asperger's syndrome (i.e., no early language delays) and

those with high functioning autism with early language delays, Howlin (2003) generally

found no significant differences in psychosocial outcomes. However, adults with

Asperger's syndrome ($n = 42$) achieved a higher level of education than those with high

functioning autism with early language delays ($n = 34$). On the contrary, Taylor et al.

(2015) found in their prospective study (n = 73) that ASD characteristics did not

significantly predict participation in post-secondary vocational and/or educational activities.

In a study assessing self-reported psychosocial outcomes, Jantz (2011) identified that despite access to social interaction, information and advice, adults with HFASD ($n = 35$) attending community social support groups with greater ASD symptoms reported increased loneliness. Similarly, in their large cross-sectional study ($n = 141$), Byers et al. (2013) found that greater ASD symptoms were related to increased sexual anxiety and lower self-esteem. Additionally, cross-sectional research ($n = 99$) by Tani et al. (2012) found that a higher level of circumscribed interests was associated with increased anxiety. As with many correlational findings, the direction of this association is unclear because higher levels of anxiety could also contribute to people developing more specific or restricted interests in activities.

Focusing on males with HFASD ($n = 21$) in a marital relationship, Renty and Roeyers (2007) reported that severity of ASD symptoms was negatively associated with spousal marital satisfaction, but not with the participants' own relationship satisfaction. Finally, Shtayermman (2007) reported a significant negative correlation between severity of ASD symptoms and level of suicidal ideation. Unexpectedly, this finding suggested that people with more severe ASD symptoms experienced lower levels of suicidal ideation. However, caution is needed when interpreting this finding given the small sample size ($n = 10$).

Measures of Neurocognitive Functioning. Eleven studies examined the relationship between measures of neurocognitive functioning and psychosocial outcomes (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Gotham, Unruh, et al., 2014; Hagberg et al., 2015; Hagberg et al., 2013; Jansch & Hare, 2014; Montgomery et al., 2013; Rinaldi et al., 2015; South et al., 2015; Szatmari et al., 1989; Wallace et al., 2015). In a prospective study ($n = 41$) with a mean follow-up of 24 years,

Farley et al. (2009) found that after controlling for age at assessment, childhood full scale IQ (FSIQ) significantly predicted social and adaptive functioning in adulthood, explaining 23% of the variance. Current verbal IQ and non-verbal IQ accounted for significant additional variance (14-27%) in social and adaptive outcomes. Therefore, adults demonstrating greater gains in IQ between childhood and adulthood experienced significantly better social and adaptive outcomes in adulthood.

Consistent with these findings, in a prospective study ($n = 69$) with a mean follow-up of approximately 10 years, Hagberg et al. (2013) reported that adults with persisting non-verbal learning problems from childhood had poorer global outcomes in adulthood than those with improved non-verbal functioning. Additionally, they found that adults with "lifelong non-verbal disability" had poorer social adaptive behaviour than those with no history of non-verbal disability. In the same sample, Hagberg et al. (2015) found that poorer childhood non-verbal IQ was associated with greater ADHD symptoms in adulthood. Similarly, Gillberg et al. (2015) ($n = 50$) reported that males with lower current FSIQ and non-verbal IQ demonstrated greater ADHD symptoms.

Further, Szatmari et al. (1989) found that current FSIQ and cognitive shifting skills (i.e., Wisconsin Card Sort Test; Grant & Berry, 1981) were significantly and positively correlated with adaptive behaviour in adulthood. There were no significant associations between adaptive behaviour and tests of motor coordination, facial recognition and receptive language. Consistent with these findings, the prospective study ($n = 30$) by Berger et al. (2003) found that poor cognitive shifting skills in childhood was predictive of lower social competence in adulthood.

However, cross-sectional research ($n = 50$) by Gotham, Unruh, et al. (2014) reported no significant association between verbal IQ and depressive symptoms. Similarly, in their cross-sectional study ($n = 35$), Wallace et al. (2015) found that FSIQ was not significantly related to adaptive functioning, anxiety or depression. Instead, they found

that poorer executive functioning (i.e., metacognition and behaviour regulation) was related to worse psychosocial outcomes. Specifically, after controlling for age and FSIQ, poorer planning (metacognition subscale) was significantly related to worse adaptive functioning ($sr^2 = .29$) and depression ($sr^2 = .17$), while deficits in shifting (i.e., behaviour regulation subscale) was related to greater anxiety ($sr^2 = .38$). In line with these results, a cross sectional study ($n = 24$) by South et al. (2015) reported that poorer memory (i.e., pattern separation memory) was associated with more negative emotionality.

In a small cross sectional study ($n = 17$), Rinaldi et al. (2015) found that interference control or inhibition, an executive function domain, distinguished between adults with ASD with a co-morbid diagnosis of schizophrenia and those with ASD with no co-morbid diagnosis. Although there was no significant difference between the groups on verbal and non-verbal fluency, individuals without co-occurring psychotic symptoms performed significantly better on a measure of interference control (i.e., Stroop colour naming task). However, in another cross sectional study ($n = 30$), Jansch and Hare (2014) reported no significant associations among data gathering bias (i.e., the tendency to jump to conclusions), mentalisation and paranoid thoughts.

In the only study ($n = 25$) to examine the relationship between social cognition and psychosocial outcomes, Montgomery et al. (2013) reported a significant positive association between self-reported trait emotional intelligence and interpersonal relations. Further, individuals with greater emotional intelligence and ToM had lower social stress. There were no significant associations between FSIQ, executive functioning and interpersonal relations and social stress.

Overall, despite the diversity of neuro-cognitive factors investigated, the findings most consistently indicated significant associations between lower IQ

(especially non-verbal functioning) and executive functions (i.e., cognitive shifting skills, planning and inhibition) and poorer psychosocial outcomes.

Appraisals and Coping Skills. Six studies examined the relationship between self-appraisals and coping skills and psychosocial outcomes (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2014; Hill et al., 2004; Khanna et al., 2014; Renty & Roeyers, 2006). In a large cross-sectional study ($n = 291$), Khanna et al. (2014) reported that maladaptive coping strategies (i.e., behavioural disengagement, denial, self-blame, self-distraction, substance abuse and venting) were significantly related to poorer physical and mental health-related QoL in adulthood. In a small cross-sectional study ($n = 21$), Renty and Roeyers (2007) explored different coping styles employed by males with HFASD using the Ways of Coping Questionnaire (WCQ; Lazarus & Folkman, 1984). They found no significant associations between approach coping strategies (e.g., confronting or seeking social support) and avoidance coping strategies (e.g., distancing or escape avoidance) and marital satisfaction.

Cross-sectional research by Hill et al. (2004) found that adults with HFASD ($n = 27$) reported greater difficulty identifying and describing their feelings (i.e., emotion processing) and were more depressed than matched controls; however, emotion processing was not significantly related to depression. In contrast, Gotham, Bishop, et al. (2014) found that rumination was significantly and positively associated with depressive symptoms, and moderated the relationship between ASD symptoms and depression. In further cross-sectional research ($n = 46$), Abell and Hare (2005) reported that greater delusional beliefs and self-consciousness were significantly related to higher levels of anxiety. Similarly, in a small cross sectional study ($n = 20$), Hare et al. (2014) found that negative thinking styles (i.e., greater self-focus and worrying) and longer periods of rumination were positively associated with anxiety symptoms.

Social and Environmental Factors. Six studies investigated social and environmental factors associated with psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006; Schmidt et al., 2015; Tani et al., 2012; Taylor et al., 2015). In the only prospective study to examine the impact of the familial context on psychosocial outcomes, Taylor et al. (2015) found that adults with HFASD ($n = 73$) who had fathers with higher educational attainment were more likely to obtain and maintain education or employment activities.

Cross-sectional research ($n = 58$) by Renty and Roeyers (2006) identified that perceived informal support was more closely related to QoL than actual received support. Further, levels of perceived and received social support were stronger predictors of QoL than disability characteristics (i.e., severity of ASD symptoms and FSIQ). In a separate study, Renty and Roeyers (2007) identified that perceived informal support was related to better psychological functioning and marital adaptation for men with HFASD ($n = 21$). Similarly, in a large cross-sectional study ($n = 291$), Khanna et al. (2014) reported that greater perceptions of availability and adequacy of social support from friends were related to better physical and mental health-related QoL. Further, cross-sectional research ($n = 50$) by Gotham, Bishop, et al. (2014) reported that lower levels of perceived social support, social motivation and social participation were related to increased depression. In terms of social inclusion, Schmidt et al. (2015) found that participation in society (i.e., taking part in family, social and community activities) was significantly related to overall life satisfaction for adults with HFASD ($n = 43$).

Finally, the long-term psychosocial impact of bullying was investigated in a large cross-sectional study ($n = 99$) by Tani et al. (2012), which identified that bullying during the school years was associated with greater mood swings in adulthood. Overall, low levels of perceived social support were consistently found to be related to poorer psychosocial outcomes.

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Discussion

This systematic review sought to identify factors related to psychosocial outcomes for adults with HFASD. A review of the 27 selected studies indicated that demographic characteristics (i.e., age and gender), ASD symptom severity and indices of neurocognitive functioning were the most frequently investigated factors. Relatively few studies examined self-appraisals, coping strategies and social and environmental factors. Overall, the methodological quality of the studies reviewed was low (i.e., 19/27 received a rating of <3/5) with common limitations including the use of cross-sectional designs, small and non-representative samples, and reliance on univariate analyses that did not control for other relevant predictors or covariates. There was also considerable variability in the design, sampling characteristics, outcome measures and analytic approach of studies included.

Despite these methodological issues, a consistent finding was that severity of ASD symptoms was significantly related to diverse psychosocial outcomes, including: depression, QoL, loneliness, anxiety, stress, sexual well-being, self-esteem, martial satisfaction and suicidal ideation (Byers et al., 2013; Gotham, Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Renty & Roeyers, 2007; Shtayermman, 2007; Tani et al., 2012). An exception to this finding was that ASD symptoms during childhood were not related to social and adaptive functioning in adulthood (Szatmari et al., 1989). However, the small sample size ($n = 13$) and retrospective design limits the ability to draw conclusions from this study. Further, a prospective study by Taylor et al. (2015) identified that ASD characteristics were not related to post-secondary vocational or educational outcomes. Nevertheless, the present findings regarding ASD symptom severity largely concur with those of previous reviews on children and adults with high and low functioning ASD (Chiang & Wineman, 2014; Levy & Perry, 2011), thus

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highlighting that more severe ASD symptomatology represents a risk factor for poor psychosocial outcomes of adults with HFASD.

The findings regarding the influence of age and gender on psychosocial outcomes were largely mixed. In particular, Abell and Hare (2005) reported a robust positive association between age and levels of anxiety and depression. Additionally, Bishop-Fitzpatrick et al. (2015) found that older age was significantly associated with poorer social and adaptive functioning. Conversely, this association was not significant in studies by Gotham, Unruh, et al. (2014) and Wallace et al. (2015) which adopted similar methodology. Controlling for the effects of age, the prospective study by Taylor et al. (2015) reported that males were more likely to be employed or in post-secondary education than females, and that females were less likely than males to maintain employment or post-secondary education over time. Further, Renty and Roeyers (2006) and Khanna et al. (2014) found that age and gender were not related to QoL for adults with HFASD. These results contrast with the review by Chiang and Wineman (2014), who found that increasing age was related to poorer QoL in a combined group of children with high and low functioning ASD. A potential explanation for these inconsistent findings relates to different approaches to measuring QoL and adaptive functioning in the studies selected for review. For example, in the adult HFASD literature, QoL was typically assessed using self-report measures, whereas parental or caregiver ratings were more commonly used for children with ASD. It is likely that perceptions and expectations related to QoL differ for adults with HFASD as compared to parents or caregivers asked to rate a child with high or low functioning ASD.

A further main finding of this review is that neurocognitive functioning was related to various psychosocial outcomes (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2015; Hagberg et al., 2013; Montgomery et al., 2013; Rinaldi et al., 2015; South et al., 2015; Szatmari et al., 1989; Wallace et al.,

2015). It is noteworthy that five of the 11 studies that supported this relationship employed a prospective and/or retrospective design, thus identifying that stronger early cognitive skills (i.e., FSIQ, non-verbal learning and cognitive shifting) were associated with better social and adaptive functioning in adulthood (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2015; Hagberg et al., 2013; Szatmari et al., 1989). This mirrors the results of previous reviews of adults with high or low functioning ASD (Howlin, 2000; Levy & Perry, 2011; Magiati et al., 2014), which is perhaps not surprising given the overlap in studies selected. However, the present review additionally highlights the early prognostic significance of deficits in executive functions, notably cognitive shifting for individuals with an IQ of > 70 (Berger et al., 2003; Szatmari et al., 1989). In line with these findings, a cross sectional study by Wallace et al. (2015) found that deficits in cognitive shifting was related to greater anxiety. Cognitive shifting, also referred to as set-shifting or task switching, supports the ability to manage goals and self-regulate behaviour and has consistently been shown to be impaired for individuals with HFASD (Ambery et al., 2006; Hill & Bird, 2006; Lopez, Lincoln, Ozonoff, & Lai, 2005; Pellicano, 2007).

This review also identified other executive function domains associated with psychosocial outcomes. Specifically, difficulties with interference control (i.e., inhibition), were associated with a co-morbid diagnosis of schizophrenia (Rinaldi et al., 2015). Evidence in the literature suggests an overlap in features between ASD and schizophrenia at the biological (see Burbach & van der Zwaag, 2009 for a review), psychological and psychosocial level (Bölte, Rudolf, & Poustka, 2002; Eack, Bahorik, et al., 2013). In particular, difficulties in some executive processes, such as inhibition and interference control, may act as vulnerability markers for the development of psychotic symptoms (Barneveld, de Sonneville, van Rijn, van Engeland, & Swaab, 2013).

A further noteworthy finding of the present review was the relationship between poorer neuro-cognitive functioning and greater risk of ADHD symptoms in adulthood (Gillberg et al., 2015; Hagberg et al., 2015). The DSM-5 (American Psychiatric Association, 2013) recognises that comorbidity of ASD and ADHD is common, and it is estimated that 30-50% of individuals with ASD manifest ADHD symptoms (Reiersen & Todd, 2008). There is evidence that the profile of executive function deficits for those with ASD and ADHD differs in children and adolescents (Happé, Booth, Charlton, & Hughes, 2006). Overall, the nature of executive function deficits experienced by adults with HFASD and relationship to psychosocial outcomes remains an important area for future research.

Social cognition is often conceptualised as a component of executive function (i.e., hot executive functions; Chan, Shum, Toulopoulou, & Chen, 2008; McDonald, 2013). A novel finding that emerged in a small cross-sectional study ($n = 25$) by Montgomery et al. (2013) is that poorer ToM and lower trait emotional intelligence were associated with higher levels of social stress. Interestingly, trait emotional intelligence was more closely related to quality of interpersonal relations than FSIQ, ToM and executive functioning. Unlike these neuro-cognitive indices, emotional intelligence, social stress and interpersonal relations were assessed using self-report measures. Hence, method variance may have contributed to the significant associations between these constructs. Although discussed in the context of social cognition in this review, emotional intelligence may also reflect coping resource (i.e., the ability to perceive, be guided by and manage one's emotions and those of others; Mayer, Salovey, Caruso, & Sitarenios, 2001). Difficulties with social functioning have long been attributed to socio-cognitive and emotional deficits such as poor joint attention and diminished emotional expressiveness (Baron-Cohen, 1995; Baron-Cohen et al., 2001; Castelli, Frith, Happé, & Frith, 2002; Frith & Frith, 2003). The early influence of social

cognition deficits related to emotional intelligence and ToM on the development of social competency in adults remains an important area for future research.

In relation to self-appraisal and coping variables, there was evidence from several studies that delusional beliefs, perseverative thinking, and maladaptive coping are related to psychosocial outcomes of adults with HFASD (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2015; Khanna et al., 2014). Abell and Hare (2005) identified that delusional beliefs were positively related to anxiety. Consequently, they proposed a cognitive model of the development and maintenance of paranoid and grandiose thinking styles. Similarly, perseverative thinking style was related to increased depression and also moderated the relationship between severity of ASD symptoms and depression (Gotham, Bishop, et al. (2014). Hare et al. (2014) found that thinking styles characterised by worrying and rumination were associated with anxiety. Further, in their large cross-sectional study, Khanna et al. (2014) reported that maladaptive coping strategies were related to poorer physical and mental health domains of QoL. Due to the correlational nature of these findings, it is not possible to infer the direction of relationships. Specifically, although negative thinking styles and unhelpful coping strategies may contribute to poor psychosocial outcomes, it is also plausible that emotional distress and adverse social experiences contribute to, and maintain maladaptive appraisals and coping responses. Prospective studies investigating these potentially bi-directional or reciprocal effects over time could greatly aid intervention efforts for this population. Further, research investigating the existence of cross-domain interactions among risk factors (e.g., the effects of stress and depression on executive functioning) would advance the field.

A further consistent finding of this review was the association between higher levels of perceived social support and better psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). These studies indicated that

subjective appraisal of support (i.e., perceived quality or availability) was more closely related to psychosocial outcomes than actual received support. This finding differs from the results of the review by Levy and Perry (2011) which indicated that access to intervention programs was associated with more positive outcomes for adolescents and adults with ASD. Aside from sampling differences, a key difference is that Levy and Perry (2011) focused on functional outcomes (e.g., cognitive function, language, academic performance and social outcomes), rather than indices of subjective well-being (e.g., QoL and depression) as measured by the studies included in the present review (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). As noted previously, it is possible that perceptions of social support and levels of subjective well-being have reciprocal or mutually enhancing effects. There is considerable evidence in the general clinical literature that perceived social support moderates the impact of high levels of stress on health outcomes in a range of clinical populations (Payne et al., 2012; Steptoe, 2000). However, the stress buffering effects of perceived social support on psychosocial outcomes of adults with HFASD has received little attention to date and represents an important direction for future research.

Finally, only one study by Tani et al. (2012) examined the relationship between bullying and psychosocial outcomes. Based on retrospective reports, bullying during the school years was found to be associated with mood swings in adulthood. This finding is consistent with other ASD literature which cites that the experience of being bullied, victimised or socially isolated, especially during the school years, may contribute to poor psychosocial functioning in adulthood (Cappadocia et al., 2012; Roekel et al., 2010). Interestingly, Hofvander et al. (2009) found that females with HFASD were more likely to be bullied during schooling than males. The factors that contribute to the experience of bullying (e.g., gender, ASD symptom severity, emotional intelligence, aspects of the education system) and potential mediators and/or moderators (e.g.,

appraisals, coping and social support) in the relationship between bullying and psychosocial outcomes in adulthood represents an important area for future research.

Methodological Considerations

The aim of the present review was to identify factors related to psychosocial outcomes of adults with HFASD. For this reason, only group studies that reported statistical analyses were included. It is important to recognise the valuable and often more in-depth accounts provided by case studies and qualitative studies, even though the aim of such studies is not to broadly generalise findings to the ASD population (Giarelli & Fisher, 2013; Haertl et al., 2013; Muller et al., 2008; Smith & Sharp, 2013; Townson et al., 2007). Rather, these studies may provide insight into the lived experience of a health condition within a particular social and cultural context.

In terms of the review methodology, the initial article search and screening (stages 1 and 2) and the assessment of methodological quality was not replicated by an independent researcher. However, the first and second authors independently screened full-text articles for inclusion during stage three and worked collaboratively to assess the quality of methodology of selected studies. The use of independent raters to examine methodological quality and obtain mutual agreement would increase the rigour of future reviews.

In order to achieve extensive coverage of the literature, comprehensive databases (i.e., Ovid (PsycINFO), ProQuest, PubMed, Science Direct, Scopus and Web of Science) were used to identify relevant studies. Further, specific autism journals (i.e., Autism Research, Journal of Autism and Developmental Disorders, Journal of Intellectual and Developmental Disability and Autism) and reference lists of eligible studies were manually screened for articles published online that may not have been identified through the original database search. The search terms that were selected for the present review were based on DSM-IV (1994), DSM-IV-TR (2000), DSM-5 (2013)

and ICD-10 (1993) terminology to identify people with high-functioning autism spectrum disorder (Asperger's Syndrome/Disorder) as relevant to the specific focus of our review. However, it is acknowledged that a different set of search terms, including broader terms such as 'autism' and 'functioning', or indeed a search of other databases, may have yielded additional papers.

Finally, it is important to recognise that the findings of this review are based on a heterogeneous set of studies with varying methodological quality. In particular, there was wide variation with respect to study design and sample characteristics, variables examined and measurement of psychosocial outcomes. This made the process of appraising methodological quality challenging. Thus, an alternative set of criteria may have yielded different ratings of methodological quality.

Conclusions and Future Directions

The findings of this systematic review on the early prognostic significance of ASD symptom severity and neurocognitive functioning (i.e., IQ and non-verbal abilities) were largely consistent with previous reviews of the broader ASD empirical literature. The present review additionally identified that cognitive shifting deficits are an early risk factor for poor psychosocial outcomes of adults with HFASD. However, further prospective research examining the relationship between deficits in executive function and social cognition and psychosocial outcomes for adults with HFASD is warranted. Such research may guide the focus of remedial and/or compensatory strategy training programmes (see Eack, Greenwald, et al., 2013; Hare et al., 2015; Magiati, Tay, & Howlin, 2012; Schmidt et al., 2015).

Although there were fewer studies focusing on self-appraisals and coping, there was evidence that individuals with negative thinking styles and maladaptive coping strategies experience poorer psychosocial outcomes, albeit mainly from cross-sectional research with correlational data. Due to the potentially bi-directional relationships

among these factors, prospective studies are needed to better understand the development and maintenance of psychological and social difficulties over time. In terms of social and environmental factors, there was consistent support for the association between higher levels of perceived social support and better psychosocial outcomes. However, it is presently unknown whether perceived social support functions as a stress buffer between risk factors and psychosocial outcomes. More generally, examining the moderating and/or mediating role of psychological resources (e.g., appraisals, coping and social support) on the relationship between key risk factors (e.g., severity of ASD symptoms, neuro-cognitive deficits) and psychosocial outcomes would advance the field. As highlighted by qualitative research, the experience of being diagnosed with ASD, meeting likeminded people and recognising personal talents can have a positive effect on self-concept (Haertl et al., 2013; Smith & Sharp, 2013). Therefore, it is also important to examine positive self-concept domains that may buffer the stressors associated with ASD.

In future research it is recommended that prospective designs with large and representative samples be employed to improve the generalisability of findings to the broader adult HFASD population. Greater use of multivariate analyses that control for potential covariates would increase confidence in the findings. Greater consistency in research methodology across studies (including measurement of psychosocial outcomes) would also support quantitative synthesis of findings through meta-analysis.

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Step 1: Identification
Electronic databases searched using key terms
(n = 837)

Additional articles identified
through other sources (n = 6)

Excluded based on title (n =36)
- Duplicate (n = 16)
- Not published in English (n = 20)

Step 2: Screening
Abstracts reviewed and articles retained if the content
suggested potential eligibility.
(n = 807)

Excluded based on abstract (n = 726)
- Case studies
- Review or commentary
- Qualitative methodology
- Adults with HFASD were not studied

Step 3: Eligibility
Full-text articles reviewed independently by two
authors to assess for eligibility (n = 67)

Excluded based on full-text (n = 42)
- Methodology not relevant (e.g., mixed
HFASD and autism sample)

Step 4: Inclusion
Final studies included in qualitative synthesis and
appraisal of methodology (n = 27)
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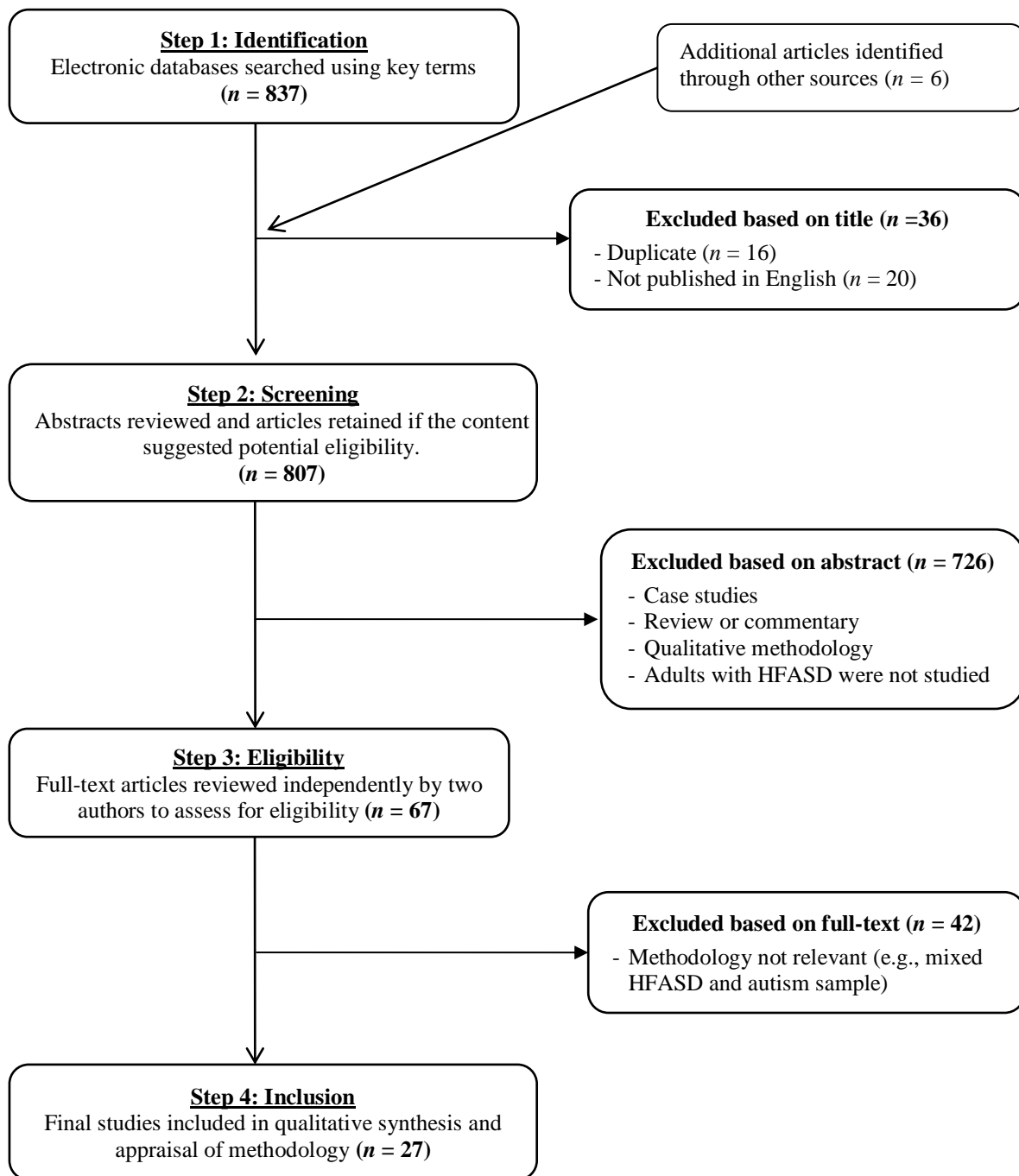
Figure 1. Flow diagram of literature search and study selection

Table 1

Summary of Studies Investigating Factors Related to Psychosocial Outcomes in Adults with HFASD

Authors	Design and Sample (Mean Age)	Correlates/Predictors	Psychosocial Outcomes	Quality of Methodology	Significant Findings
Abell and Hare (2005)	Cross-sectional $n = 46$ (32.5 years)	Age, self-consciousness, executive functioning, delusional beliefs, non-verbal & verbal IQ, FSIQ, theory of mind (ToM), autobiographical memory	Anxiety and depression (HADS)	1	Older age, greater delusional beliefs and self-consciousness correlated with anxiety. Older age was also related to increased depression
Berger, Aerts, van Spaendonck, Cools, and Teunisse (2003)	Prospective $n = 30$ (19.3 years), 3 year follow-up interval	Time 1: central coherence, cognitive shifting; Time 1 & 2: Social functioning (symptom severity, social understanding & competence)	Improvement in social competence (VABS)	2	Cognitive shifting was identified as an early prognostic marker of social competence
Bishop-Fitzpatrick, Mazefsky, Minshew and Eack (2015)	Cross-sectional $n = 38$ (23.1 years)	Age and education	Stress (Brief Psychiatric Rating Scale); Social Functioning (Global Assessment Scale; Social Adjustment Scale-II)	3	Older age, but not education, was related to poorer social functioning (note: associations with stress were not examined)
Byers, Nichols, Voyer, and Reilly (2013)	Cross-sectional $n = 141$ (39.6 years)	Gender, age, relationship status, ASD symptoms, self-esteem,	Sexual well-being (e.g., anxiety, self-esteem)	4	Greater ASD symptoms were related to increased sexual anxiety and lower self-esteem. Males had better sexual well-being
Farley et al. (2009)	Prospective $n = 41$ (32.5 years), mean time interval to follow-up 24.42 years	Social support (vocational rehabilitation, government disabilities support), FSIQ	Social functioning rating (very good-very poor) and adaptive behaviour (VABS)	3	Childhood FSIQ predicted VABS scores in adulthood. Greater gains in intellectual functioning(IQ) were associated with better social and adaptive outcomes
Gillberg, Helles, Billstedt, and Gillberg (2015)	Prospective $n = 50$ (30 years) mean time interval to follow-up 9.4 years	FSIQ, VIQ, PIQ	Depression (BDI), psychiatric disorders (Mini Neuropsychiatric Interview), GAF, ADHD (Adult ADHD Self-Report Scale ; SNAP-	4	Lower current FSIQ and non-verbal IQ was associated with ADHD symptoms.

				IV)		

Study	Design	Predictors	Outcomes	Quality	Findings
Gotham, Unruh, and Lord (2014); Gotham, Bishop, Brunwasser, and Lord (2014)	Cross-sectional $n = 50$ (20.7 years)	Age, gender, FSIQ, ASD related impairments, rumination, perceived social support, social interests and habits	Depression (BDI-II; Self-Report Depression Questionnaire), Anxiety (Spence Children's Anxiety Scale-Parent), adaptive behaviour (VABS)	2	Greater ASD impairments and rumination and lower levels of perceived social-support, motivation and participation were related to increased depression. Rumination moderated the relationship between ASD symptoms and depression.
Hagberg, Nyden, Cederlund, and Gillberg (2013); Hagberg, Billstedt, Nyden, and Gillberg (2015)	Prospective $n = 69$ (22.2 years) mean time interval to follow-up 9.8 years	Childhood ASD diagnosis and interview, cognitive assessment (verbal and non-verbal IQ, executive function, central coherence, memory)	Social adaptive behaviour (VABS); GAF; ADHD (SNAP-IV)	3	Adults with lifelong non-verbal disability had worse GAF than those with childhood only non-verbal disability. Those with lifelong non-verbal disability had worse social adaptive outcomes than those with no history of non-verbal disability; Poorer childhood non-verbal IQ was associated with ADHD symptoms in adulthood
Hare, Wood, Wastell, and Skirrow (2014);	Cross-sectional $n = 20$ (32.1 years)	Thinking characteristics (e.g., self-focus, confusion, worries about everyday events and rumination)	Anxiety and Depression (HADS)	1	Self-focus, worries and longer periods of rumination were positively associated with anxiety
Hill, Berthoz, and Frith (2004)	Cross-sectional $n = 27$ (35.1 years)	Emotion processing on the Toronto Alexithymia Scale	Depression (BDI)	2	Emotion processing was not significantly related to depression
Hirvikoski and Blomqvist (2015)	Cross-sectional $n = 25$ (34.1 years)	ASD symptoms	The Perceived Stress Scale (PSS)	1	Greater ASD symptoms were associated with higher perceived stress
Howlin (2003)	Cross-sectional $n = 76$ (26.1 years)	Autism and Asperger diagnoses, non-verbal IQ, comprehension, vocabulary, parent interview	Social outcomes (Autism Diagnostic Interview) and social functioning	2	The Asperger subgroup achieved higher education attainment than the autism subgroup.
Jansch and Hare (2014)	Cross-sectional $n = 30$ (32.23 years)	ASD symptoms, mentalisation (Reading the Mind in the Eyes Test), data gathering bias (Beads Task)	Depression (PHQ), generalised anxiety (Generalised Anxiety Disorder-7), self-consciousness (Self	2	Greater ASD symptoms were associated with depression and anxiety

			Consciousness Scale), paranoid thoughts (Paranoid Thought Scales)		
Jantz (2011)	Cross-sectional $n = 35$ (45 years)	Age, gender, ASD symptoms	Loneliness (UCLA Loneliness Scale)	1	Greater ASD symptoms were related to increased loneliness
Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014)	Cross-sectional $n = 291$ (30.7 years)	Age, gender, ASD severity, perceived social support, coping	Health-related QoL (HRQoL): Physical and mental (The Medical Outcomes Study Short-Form Health Survey version 2)	2	Poorer perceptions of social support from friends, ASD severity and maladaptive coping strategies were related to poorer physical and mental HRQoL.
Maddox and White (2015)	Cross-sectional $n = 28$ (32.23 years)	ASD symptoms (Social Responsiveness Scale-II)	Social Anxiety Disorder Symptoms (Anxiety Disorders Interview Schedule-DSM-IV [ADIS-IV])	2	Greater ASD related social impairments were associated with social anxiety disorder symptoms.
Montgomery, Stoesz, and McCrimmon (2013)	Cross-sectional $n = 25$ (18.2 years)	HFASD symptoms, Verbal IQ, ToM, executive functions, emotional intelligence	Interpersonal relations and social stress (Behaviour Assessment System for Children-2)	2	Greater emotional intelligence was related to better interpersonal relations. Those with greater emotional intelligence and ToM had lower social stress
Renty and Roeyers (2006)	Cross-sectional $n = 58$ (28.3 years)	Age, gender, ASD symptoms, FSIQ (ASD symptoms + FSIQ = disability characteristics), support characteristics (perceived, received)	Quality of Life Questionnaire	2	Perceived support was significantly related to QoL; perceived and received support characteristics were better predictors of QoL than disability characteristics.
Renty and Roeyers (2007)	Cross-sectional $n = 21$ (43.5 years)	Males with ASD, ASD symptoms, informal social support – spouse and family, received support – spouse and family, formal support, coping strategies	Psychological distress – individual satisfaction (The Symptom Checklist-90), marital satisfaction (Dyadic Adjustment Scale)	1	Informal support was related to psychological functioning and marital adaptation for men with ASD. Severity of ASD symptoms in men was negatively associated with spouse marital satisfaction. Coping was not related to outcomes.
Rinaldi, Jacquet, and	Cross-sectional	Executive function	Development of	1	Interference control distinguished between

Lefebvre (2015)	$n = 17$ (17.88 years)	(interference control)	psychotic symptoms		those with ASD and those with ASD and psychotic symptoms.
Schmidt et al. (2015)	Cross-sectional $n = 43$ (31 years)	Psychological resources and general functioning (WHODAS)	Life satisfaction (German Quality of Life Questionnaire)	3	Self-reported participation in society predicted improved life satisfaction.
Shtayermman (2007)	Cross-sectional $n = 10$ (19.7 years)	HFASD symptoms, peer victimisation, level of stigma	Anxiety, depression (PHQ), suicidal ideation (Suicidal Ideation Questionnaire)	1	Severity of ASD symptoms were negatively correlated with level of suicidal ideation
South et al. (2015)	Cross-sectional $n = 24$ (22.51 years)	Pattern separation memory task	State-Trait anxiety scale; Behavioural inhibition and approach strategies (Behavioural Inhibition and Activation Scales)	2	Poorer pattern separation memory was associated with greater state anxiety and behavioural approach strategies.
Szatmari, Bartolucci, Bremner, Bond, and Rich (1989)	Retrospective $n = 16$ (26.0 years), mean time interval to follow-up 11-27 years	Early ASD symptoms, current FSIQ, visuo-motor skills, facial recognition, receptive language, non-verbal problem solving (cognitive shifting) skills, visual motor integration	Social adaptive functioning (VABS)	3	Current FSIQ and cognitive shifting correlated with social adaptive functioning, whereas early ASD symptoms were weakly associated with these outcomes
Tani et al. (2012)	Cross-sectional $n = 99$ (30.7 years)	ASD symptoms, developmental and social history (structured interview with informant), FSIQ	Psychological and behavioural history (mental health and behavioural symptoms)	2	Adults with poor lifestyle habits had greater depression; Circumscribed interests were related to anxiety; Those bullied at school had less stable emotions and mood swings
Taylor, Henninger, and Mailick (2015)	Prospective $n = 73$ (23.83 years) over a 12 year follow-up	Gender, age, ASD symptoms, maladaptive behaviours, daily activities, parental education, maternal social support, depression, anxiety and pessimism	Employment and study outcome (Vocational Index)	3	Males were more likely to be employed or studying than females after high school; Those with fathers with higher education attainment were more likely to obtain and maintain employment or tertiary education

| Wallace et al. (2015) | Cross-sectional $n = 35$ (21.55 years) | Age, FSIQ, Executive functioning (behaviour regulation and metacognition) | Adaptive functioning (Adaptive Behaviour Assessment System-II); anxiety, depression and ADHD (Adult Behavior CheckList) | 2 | Poorer planning was related to worse adaptive functioning and increased depression, whereas poorer shifting was related to greater anxiety. |

BDI-II = Beck Depression Inventory; GAF = Global Assessment of Functioning; HADS = Hospital Anxiety and Depression Scale; PHQ= Patient Health Questionnaire; SNAP-IV = Swanson, Nolan and Pelham Questionnaire; VABS = Vineland Adaptive Behavior Scale.

Table 2

Ratings of Quality of Methodology of Included Studies

Study	Prospective/Retrospective Design	Sample Characteristics	Sample representativeness	Adequate sample size	Multivariate Analysis	Total (0-5)
Abell and Hare (2005)	✗	✓	✗	✗	✗	1
Berger, Aerts, van Spaendonck, Cools, and Teunisse (2003)	✓	✓	✗	✗	✗	2
Bishop-Fitzpatrick, Mazefsky, Minshew and Eack (2015)	✗	✓	✗	✓	✓	3
Byers, Nichols, Voyer, and Reilly (2013)	✗	✓	✓	✓	✓	4
Farley et al. (2009)	✓	✓	✓	✗	✗	3
Gillberg, Helles, Billstedt, and Gillberg (2015)	✓	✓	✓	✓	✗	4
Gotham, Unruh, and Lord (2014); Gotham, Bishop, Brunwasser, and Lord (2014)	✗	✓	✗	✓	✗	2
Hagberg, Nyden, Cederlund, and Gillberg (2013); Hagberg et al. (2015)	✓	✓	✗	✓	✗	3
Hare, Wood, Wastell, and Skirrow (2014);	✗	✓	✗	✗	✗	1
Hill, Berthoz, and Frith (2004)	✗	✗	✗	✓	✓	2

Hirvikoski and Blomqvist (2015)	✗	✗	✗	✓	✗	1
Howlin (2003)	✗	✓	✗	✓	✗	2
Jansch and Hare (2014)	✗	✓	✗	✓	✗	2
Jantz (2011)	✗	✗	✗	✓	✗	1
Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014)	✗	✗	✗	✓	✓	2
Maddox and White (2015)	✗	✓	✗	✗	✓	2
Montgomery, Stoesz, and McCrimmon (2013)	✗	✓	✗	✗	✓	2
Renty and Roeyers (2006)	✗	✓	✗	✗	✓	2
Renty and Roeyers (2007)	✗	✗	✗	✗	✓	1
Rinaldi, Jacquet, and Lefebvre (2015)	✗	✓	✗	✗	✗	1
Schmidt et al. (2015)	✗	✓	✗	✓	✓	3
Shtayermman (2007)	✗	✓	✗	✗	✗	1
South et al. (2015)	✗	✓	✗	✓	✗	2
Szatmari, Bartolucci, Bremner, Bond, and Rich (1989)	✓	✓	✓	✗	✗	3

Tani et al. (2012)	✘	✔	✘	✔	✘	2
Taylor, Henninger, and Mailick (2015)	✔	✔	✘	✘	✔	3
Wallace et al. (2015)	✘	✔	✘	✘	✔	2