



Effective Health Care Program

Interventions for Adolescents and Young Adults With Autism Spectrum Disorders

Executive Summary

Background

Autism Spectrum Disorders (ASD) are among the most common neurodevelopmental disorders, with an estimated prevalence of 1 in 110 children in the United States having an ASD.¹ ASDs are typically diagnosed in early childhood, often at or before preschool age. The diagnosis is fundamentally behaviorally based (i.e., there is no specific genetic test or clinical/ laboratory procedure for diagnosis) and rests on documented core impairments related to social interaction, communication, as well as restricted and repetitive behavior.

Diagnoses made by clinical providers, often pediatricians, behavioral providers, child neurologists, child psychiatrists, or child psychologists, are based on documented symptom patterns in these domains. Numerous screening and diagnostic tools are available to help document and measure symptoms of autism, with research investigations increasingly utilizing such measures in combination with clinical diagnoses in order to more accurately describe, measure, and analyze the heterogeneity in presentation associated with ASD. In addition to impairments in core symptom areas, many individuals with ASD also have impaired cognitive skills, atypical sensory behaviors, or other complex

Effective Health Care Program

The Effective Health Care Program was initiated in 2005 to provide valid evidence about the comparative effectiveness of different medical interventions. The object is to help consumers, health care providers, and others in making informed choices among treatment alternatives. Through its Comparative Effectiveness Reviews, the program supports systematic appraisals of existing scientific evidence regarding treatments for high-priority health conditions. It also promotes and generates new scientific evidence by identifying gaps in existing scientific evidence and supporting new research. The program puts special emphasis on translating findings into a variety of useful formats for different stakeholders, including consumers.

The full report and this summary are available at www.effectivehealthcare.ahrq.gov/reports/final.cfm.

medical and psychiatric symptoms and conditions, such as seizure disorders, motor impairments, hyperactivity, anxiety, and self-injury/aggression.



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More than 55,000 individuals between the ages of 15 and 17 in the United States likely have an ASD.² For some individuals, core symptoms of ASD (impairments in communication and social interaction and restricted/repetitive behaviors and interests) may improve with intervention and over time;³⁻⁵ however, some degree of impairment typically remains throughout the lifespan.⁶ As children transition to adolescence and young adulthood, developmentally appropriate interventions to ameliorate core deficits may continue, but the focus of treatment often shifts toward promoting adaptive behaviors that can facilitate and enhance independent functioning.⁶ Treatments for some must take into account new emergent symptoms as well as engagement with new developmental challenges (e.g., independent living, vocational engagement, postsecondary education).

There is also evidence to suggest that improvements in symptoms and improvements in problem behaviors may slow down or stop after youth with ASD leave high school.⁷ This change in improvement is likely due, at least in part, to the termination of services received through the secondary school system upon high school exit, as well as the lack of adult services and long waiting lists for many services.^{7,8} This issue of the lack of services available to help young adults with ASD transition to greater independence has been noted by researchers for a number of years and is increasingly a topic in the lay media.⁹

Interventions Used To Treat ASD

Individuals with ASD have significant impairments in social interaction, communication, and repetitive behavior. As noted, some people with ASD also have impaired cognitive skills, atypical sensory behaviors, or other complex medical and psychiatric symptoms and conditions. The expression and severity of ASD symptoms differ widely across individuals and over time. Treatments may include a range of behavioral, psychosocial, educational, medical, and complementary approaches focused on the transitional process and improving outcomes for parents/families of individuals with ASD during adolescence and adulthood.

ASD in Adolescence and Young Adulthood

Current data suggest that attainment of independent living or employment in adulthood for individuals with an ASD is variable, with factors that predict the ability to live and work independently not well elucidated.⁶ Research conducted to date has suggested that most individuals with ASD will require some sort of intervention, often at very intensive levels, throughout adolescence and adulthood,

and the estimated costs of medical and nonmedical care (e.g., special education, daycare) are high. One study estimates that the total yearly societal per capita cost of caring for and treating a person with autism in the United States at \$3.2 million and at about \$35 billion for an entire birth cohort of individuals with autism.¹⁰ A study of health care utilization in a large group health plan revealed increased medication costs in older children with an ASD compared with younger children, as well as similarly aged adolescents without an ASD; other care costs were also higher in this population, including a significantly increased rate of hospitalizations.¹¹

Costs of transitional and employment programs are also high for young adults with ASD. In a recent analysis of U.S. Federal- and State-funded vocational rehabilitation programs, enrolled individuals with ASD were among the most costly of nine disability groups, with costs even higher among those with ASD and another concomitant disability. However, those with ASD had a higher rate of employment (40.8%) at the time of case closure compared with those with other disabilities, though with fewer work hours and lower wages than some other disability groups.¹²

There is no cure for ASD and no global consensus regarding which intervention strategies are most effective. Chronic management, often using multiple treatment approaches, may be required to maximize ultimate functional independence and quality of life by minimizing core ASD features, facilitating development and learning, promoting socialization, reducing maladaptive behaviors, and educating and supporting families. Investigators have noted that less data on therapies for adolescents or young adults exist than for younger children,¹³ and such research is increasingly important as the prevalence of ASD continues to grow and as children with ASD diagnoses reach adolescence.

Objectives

The goal of this review is to examine the effects of available interventions on adolescents and young adults with ASD, focusing on the following outcomes: core symptoms of ASD (impairments in social interaction, communication, and repetitive behavior); medical and mental health comorbidities; functional behaviors and independence; the transition to adulthood; and family outcomes.

Population

We focused this review on therapies for adolescents and young adults (ages 13 to 30) with ASD as well as interventions aimed at family members.

Interventions

Studies assessed interventions falling into the broad categories of behavioral, educational, adaptive/life skills, vocational, medical, and allied health approaches.

Comparators

Comparators included no treatment, placebo, and comparative interventions or combinations of interventions.

Outcomes

Intermediate outcomes included changes in core ASD symptoms and in common medical and mental health comorbidities as well as effects on functional behavior, the transition process, and family outcomes. Long-term outcomes included changes in adaptive/functional independence, academic and occupational attainment or engagement, psychological well-being, and psychosocial adaptation. We also assessed the harms of interventions, defined by the Agency for Healthcare Research and Quality (AHRQ) Effective Health Care program as all possible adverse consequences of an intervention, including adverse events (Figure A).¹⁴

Key Questions

We have synthesized evidence in the published literature to address these Key Questions:

Key Question 1: Among adolescents and young adults with ASD, what are the effects of available interventions on the core symptoms of ASD?

Key Question 2: Among adolescents and young adults with ASD, what are the effects of available interventions on common medical and mental health comorbidities (e.g., epilepsy, sleep disorders, motor impairments, obesity, depression, anxiety, acute and episodic aggression, attention deficit hyperactivity disorder, etc.)?

Key Question 3: Among adolescents and young adults with ASD, what are the effects of available interventions on functional behavior, attainment of goals toward independence, educational attainment, occupational/vocational attainment, life satisfaction, access to health and other services, legal outcomes, and social outcomes?

Key Question 4: Among adolescents and young adults with ASD, what is the effectiveness of interventions designed to support the transitioning process, specifically to affect attainment of goals toward independence, educational attainment, occupational/vocational attainment, life satisfaction, access to health and other services, legal outcomes, and social outcomes?

Key Question 5: Among adolescents and young adults with ASD, what harms are associated with available interventions?

Key Question 6: What are the effects of interventions on family outcomes?

Analytic Framework

The analytic framework summarizes the process by which individuals with ASD and their families/caregivers make and modify treatment choices (Figure A). Treatment choices may target intermediate outcomes including changes in communication skills, academic skill development, or social skills. Interventions lead to long-term outcomes such as adaptive independence and changes in psychosocial well-being. Family outcomes such as parent distress may also be targeted by interventions and may lead in turn to long-term outcomes. Finally, interventions may be associated with harms/adverse effects. Numbers in circles within the diagram indicate the placement of Key Questions in relation to the treatment process.

Methods

Input From Stakeholders

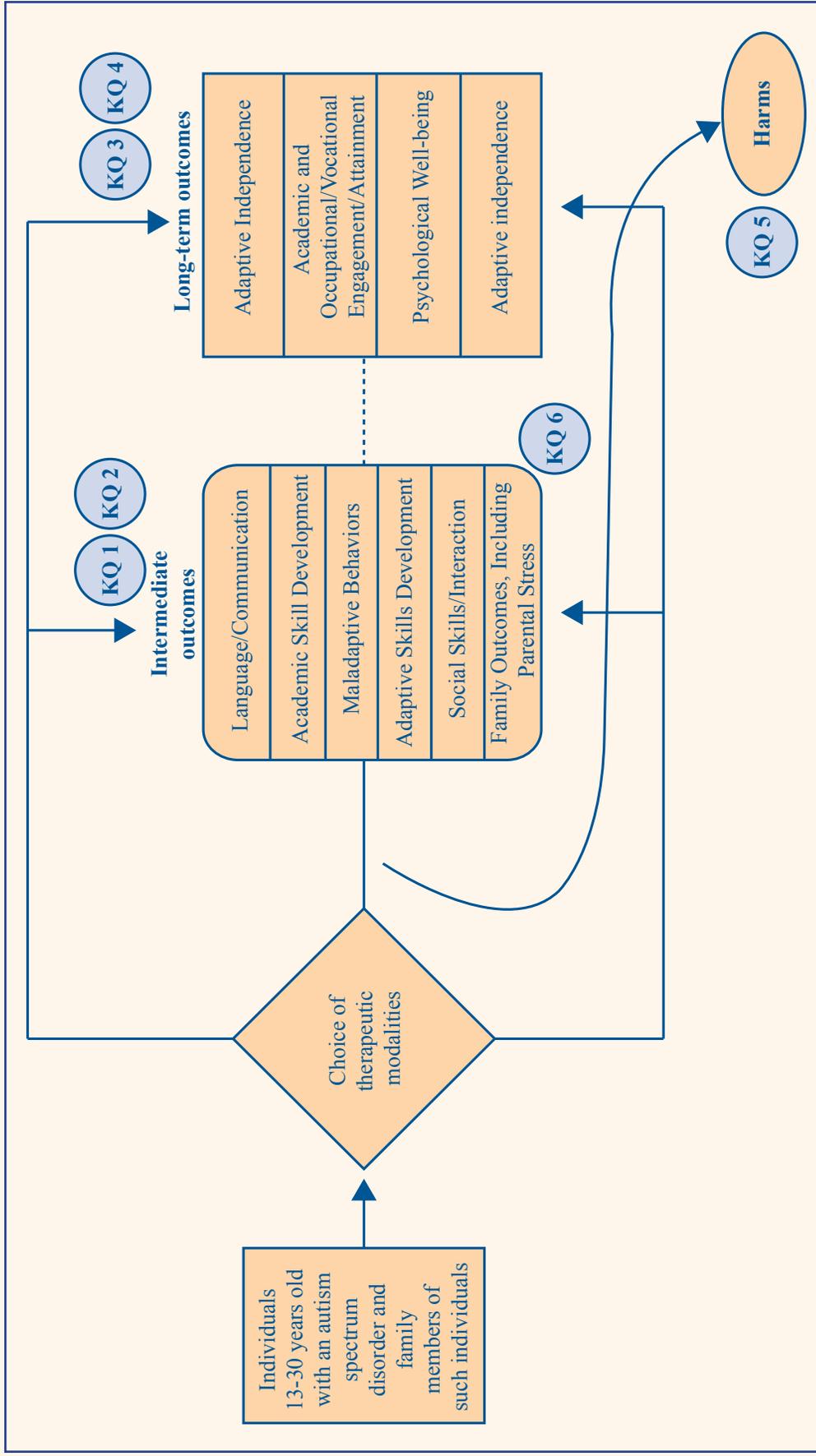
The topic was nominated in a public process. With key informant input, we drafted initial Key Questions, which were reviewed by AHRQ and posted to a public Web site for public comment. Using public input, we drafted final Key Questions, which were reviewed by AHRQ. We convened a Technical Expert Panel to provide input during the project on issues such as setting inclusion/exclusion criteria and assessing study quality. In addition, the draft report was peer reviewed and available for public comment.

Data Sources and Selection

Data Sources

We searched four databases: MEDLINE® via the PubMed interface, PsycINFO® (psychology and psychiatry literature), the Educational Resources Information Clearinghouse, and the Cumulative Index of Nursing and Allied Health Literature database. We used a combination of controlled vocabulary terms appropriate for each database (e.g., MEDLINE vocabulary term autistic disorder) and keywords related to ASD (e.g., Asperger syndrome). Appendix A of the full report details each search strategy. We hand searched reference lists of included articles and recent reviews for additional studies.

Figure A. Analytic framework for interventions for adolescents and young adults with ASD



KQ = Key Question

Inclusion and Exclusion Criteria

We included all study designs except single case reports provided that studies reported on an intervention aimed at individuals with ASD between the ages of 13 and 30 or family members of such individuals. We excluded studies that:

- Were not original research
- Did not report information pertinent to the Key Questions
- Did not address treatment modalities aimed at core symptoms of ASD, common comorbidities, functional/life skills outcomes, family-related outcomes, or assisting with the transition to adulthood
- Did not include aggregate data (i.e., included only individual data for each participant) or data presented only in graphics/figures
- Were single case reports
- Were not published in English
- Were published before 1980 and the publication of autism diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders, Third Edition.

We also excluded studies that included fewer than 20 total participants in the target age range with ASD or family members of such individuals. Our goal was to identify and review the best evidence for assessing the efficacy and effectiveness of therapies for adolescents and young adults with ASD, with an eye toward utility in the treatment setting.

Interventions to address ASDs are frequently behavioral in nature and highly intensive. They are also frequently adapted to be targeted to specific study participants given the significant heterogeneity of individuals with ASD.

In part because this makes behavioral research complex and intensive, study sizes tend to be very small. A cutoff sample size of 20 provides a balance, allowing us to review and comment on adequate literature for the review but with studies large enough to suggest effects of the interventions.

Screening of Studies

Two reviewers separately evaluated each abstract. If one reviewer concluded that the article could be eligible, we retained it. Two reviewers independently read the full text of each included article to determine eligibility, with disagreements resolved via third-party adjudication.

Data Extraction and Quality Assessment

Data Extraction

All team members entered information into the evidence tables. After initial data extraction, a second team member edited entries for accuracy, completeness, and consistency. In addition to outcomes for treatment effectiveness and family outcomes, we extracted data on harms/adverse effects.

Quality Assessment

Two reviewers independently assessed quality (study design, diagnostic approach, participant ascertainment, intervention characteristics, outcomes measurement, and statistical analysis) using a quality assessment methodology adapted from that used in a prior AHRQ review of therapies for children with ASD.¹⁵ We resolved differences through discussion, review of the publications, and consensus with the team. We rated studies as good, fair, or poor quality and retained poor studies as part of the evidence base discussed in this review. More information about our quality assessment methods is in the full report, and Table A describes the quality ratings.

Table A. Description of study quality levels

Quality Level	Description
Good	Good studies are considered to have the least bias and results are considered valid. A good study has a clear description of the population, setting, interventions, and comparison groups; uses a valid approach to allocate patients to treatments; has a low dropout rate; and uses appropriate means to prevent bias; measure outcomes; analyze and report results.
Fair	Fair studies are susceptible to some bias, but probably not sufficient to invalidate the results. A study may be missing information, making it difficult to assess limitations and potential problems. As the “fair quality” category is broad, studies with this rating vary in their strengths and weaknesses. The results of some fair-quality studies are possibly valid, while others are probably valid.
Poor	Poor studies are subject to significant bias that may invalidate the results. These studies have serious errors in design, analysis, or reporting; have large amounts of missing information; or have discrepancies in reporting. The results of a poor-quality study are at least as likely to reflect flaws in the study design as to indicate true differences between the compared interventions.

Data Synthesis and Analysis

Evidence Synthesis

We used summary tables to synthesize studies and summarized the results qualitatively.

Strength of the Evidence

The degree of confidence that the observed effect of an intervention is unlikely to change is presented as strength of evidence. Strength of evidence can be regarded as insufficient, low, moderate, or high. It describes the adequacy of the current research, in quantity and quality, and the degree to which the entire body of current research

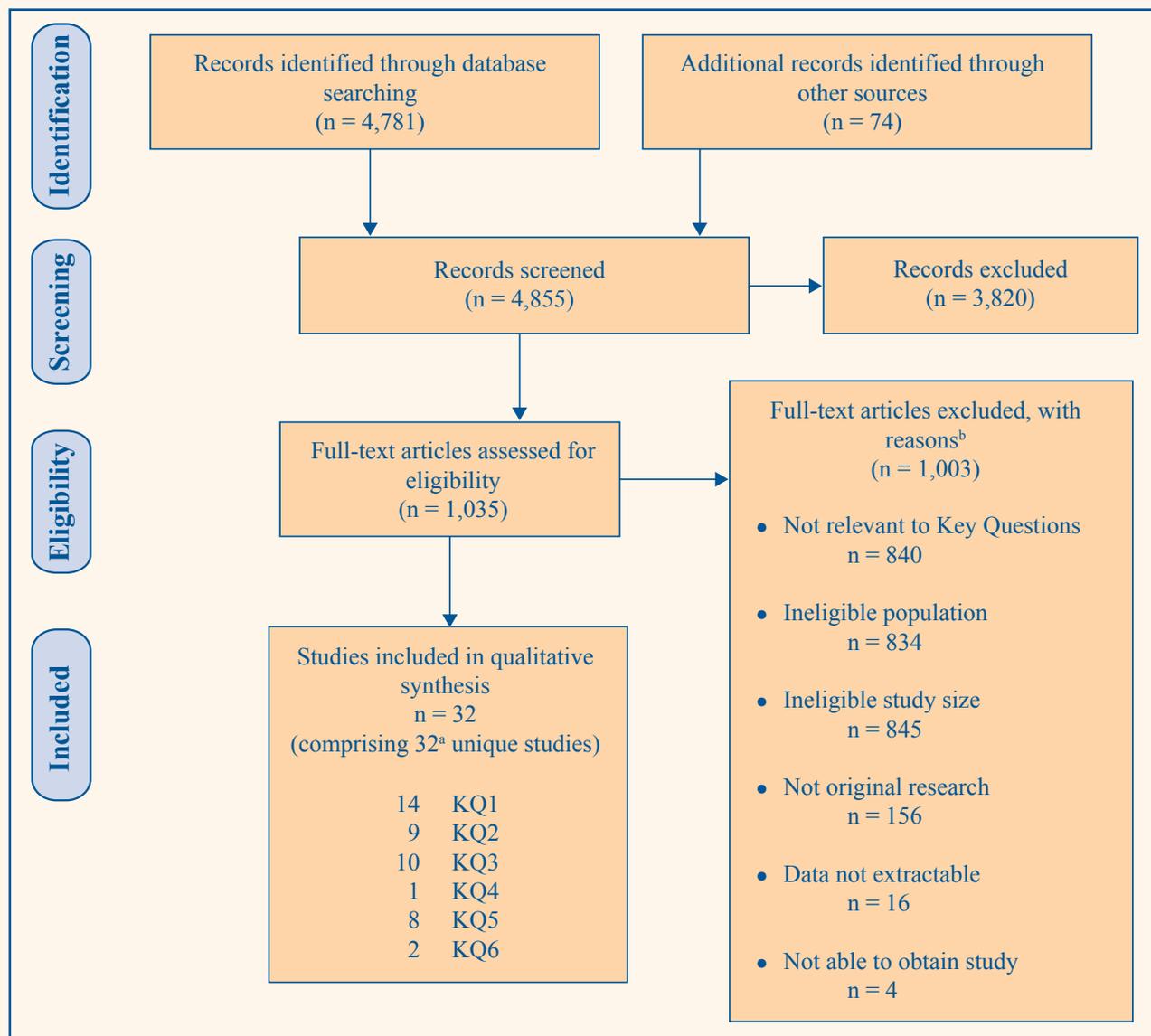
provides a consistent and precise estimate of effect. We established methods for assessing the strength of evidence based on the AHRQ Effective Health Care program's Methods Guide for Effectiveness and Comparative Effectiveness Reviews.¹⁶

Results

Article Selection

Of the entire group of 4,855 citations, 1,035 articles required full-text review (Figure B). Of the 1,035 full-text articles reviewed, we retained 32 papers (comprising 32 unique studies) and excluded 1,003 papers.

Figure B. Disposition of articles



KQ = Key Question; n = number

^aOne paper¹⁷ reports two unique studies.

^bNumbers do not tally, as studies could be excluded for multiple reasons.

Organization of Results

As noted, we classified studies by broad category of intervention (behavioral, educational, vocational, adaptive/life skills, medical, and allied health). With the exceptions of studies of behavioral, medical, and vocational interventions, which included at least two studies addressing the same intervention, the other categories of interventions largely comprised single studies of unique interventions. Most studies (n=14) also targeted core symptoms of ASD (Key Question 1) or functional behavior/independent living skills (n=10) (Key Question 3). Nine studies, eight of which addressed medical interventions, examined comorbidities commonly occurring with ASD, which we defined broadly to encompass associated symptoms such as irritability (Key Question 2). Only studies of medical interventions addressed harms (Key Question 5).

One study addressed interventions targeting the transition process (Key Question 4), and two studies assessed effects of an intervention on family outcomes (Key Question 6). Because questions were addressed by a number of small, single studies of a given intervention, we discuss all studies together in the following sections instead of divided by Key Question. This approach allows us to present the findings of this disparate literature more clearly.

Across all categories of interventions, most studies (n=27) were of poor quality, and none was good quality. Five RCTs were fair quality: four that investigated pharmacologic agents¹⁸⁻²¹ and one allied health study that assessed a leisure/recreation program.²² Although positive results may be reported in individual studies, the poor quality of the studies and the lack of replication of the intervention studies mean that the strength of evidence for the body of evidence around any specific intervention is currently insufficient.

More research is needed to determine a measure of effect associated with any of the interventions described in this body of literature. Therefore, although we describe the results of individual studies in the report, the overall strength of evidence that any given intervention has a specific effect on outcomes is insufficient.

Studies of Behavioral Interventions

We identified eight studies^{17,23-28} of behavioral interventions. One paper¹⁷ reports two unique studies. Studies were conducted in the United States, Europe, and Canada and included a total of 302 participants. Seven studies (with two unique studies reported in one paper¹⁷)

examined individual/group- or computer-based social skills interventions^{17,23-25,27,28} and an additional study assessed an intensive behavioral treatment provided at a semi-residential facility.²⁶ All studies were of poor quality. Individual studies assessing heterogeneous social skills approaches reported some benefits in emotion recognition, social functioning, and participation in social activity over the short term.^{17,23-25,27,28} The study of an intensive approach reported modest improvements in adaptive behavior over a 2-year period.²⁶ This study also assessed parental satisfaction with treatment, noting high levels of satisfaction overall.

Studies of Educational Interventions

Two studies, both poor quality, examined educational interventions.^{29,30} Studies were conducted in the United States and Canada and included fewer than 50 total individuals with ASD. In one study, individuals with ASD and mean mental age scores of 3.3 years received language instruction using two teaching methods, with no significant difference observed between methods.²⁹ In a randomized study assessing strategies to promote reading comprehension,³⁰ scores generally improved overall in the short term.

Studies of Adaptive/Life Skills Interventions

We identified four studies, all of poor quality, of various interventions focused on adaptive behavior.³¹⁻³⁴ Treatment duration varied tremendously from a daylong experiment to a study examining outcomes across a 2-year interval in a residential facility. Overall these studies included a total of 155 individuals with ASD. All studies were conducted in the United States, and at least two explicitly included participants with intellectual disability.^{31,33} Across studies, participants made very specific short-term gains in learning or successfully executing an adaptive or life skills-focused task, including lacing shoes or using a personal digital assistant to help with remembering activities. In one study of a residential facility employing a Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH)-based model, exploratory analyses showed variable results with few significant changes in skills or negative behaviors over time across individuals in the TEACCH program or in institutions, family homes, or group homes.³¹ Parents were significantly more satisfied with the TEACCH program overall.

A final poor-quality case series addressed the transitioning process by assessing effects related to implementing a classroom process—changing rooms throughout the school

day—that individuals would likely encounter as they move to high school or college; the study reported no increase in disruptive behavior after the implementation of classroom rotation.³⁴

Studies of Vocational Interventions

We identified six papers from five unique study populations that addressed the impact of supported employment/vocational interventions.^{8,35-39} Studies were conducted in the United States and Europe and included more than 1,900 individuals with ASD; roughly 1,700 of these were included in an administrative database study assessing use of vocational rehabilitation services. All studies were considered poor quality. Interventions all involved finding and implementing on-the-job supports (broadly defined as services to promote job placement and job retention) for young adults with ASD. Studies comparing supported employment in the community with sheltered workshops reported that participants in supported employment groups experienced reductions in autism symptoms and improvements in quality of life in one study assessing those outcomes,^{37,38} and improvements in measures of cognition in another study.³⁵

In long-term studies of a job-finding program in the United Kingdom,^{8,39} young adults in a supported employment group were significantly more likely to find paid employment than those in the control group (63.3% vs. 25%), with the majority of those employed showing job satisfaction. One final study identified individuals with ASD in a U.S. vocational rehabilitation dataset. These data illustrated that the presence of on-the-job supports was associated with a higher likelihood of employment in the community (competitive or supported).³⁶

Studies of Medical Interventions

Eight studies of pharmacologic agents, four of fair¹⁸⁻²¹ and four of poor quality,⁴⁰⁻⁴³ met our review criteria. The studies included a total of 272 individuals with ASD, and all were conducted in the United States, Canada, or Europe in academic clinics. All studies were funded using institutional and grant sources. Three randomized controlled trials (RCTs), one fair quality²¹ and two poor,^{20,40} addressed the efficacy of antipsychotic medications including risperidone and haloperidol. One fair-quality RCT investigated the opiate antagonist naltrexone.¹⁹ Of five studies examining serotonin reuptake inhibitors (SRIs),^{18,20,41-43} two RCTs were fair quality,^{18,20} and three case series were poor.⁴¹⁻⁴³

All studies of medical interventions addressed outcomes related to comorbid conditions such as irritability or harms of treatments. Studies of antipsychotic medications reported some reductions in repetitive behavior, aggression, hyperactivity, and irritability in treatment groups over time periods of 7 to 24 weeks. Brief treatment with naltrexone (4 weeks) was associated with increases in stereotypy (repetitive or ritualistic behavior or movement) in the treated group. Studies of SRIs reported some improvements in treated participants in measures of irritability, repetitive behavior, and aggression over treatment durations of 7 to 12 weeks. One longer term case series reported improvements in general symptom severity and compulsive behavior in individuals receiving fluoxetine for a mean of 6 months.⁴³

All medical studies reported harms of treatment. Harms or adverse effects reported in studies of antipsychotic medications included sedation, gastrointestinal complaints, weight gain, increased appetite, fatigue, dystonia, and depression.^{21,40,44} Adverse effects described in the study of naltrexone included nausea, fatigue, sedation, and an increase in self-injurious behavior and stereotypy.¹⁹ Harms noted in studies of SRIs included fatigue, tremor, tachycardia, agitation, gastrointestinal complaints, sedation, anxiety, agitation, and insomnia.^{18,20,41-43}

Studies of Allied Health Interventions

We identified five studies of disparate allied health interventions^{22,45-48} including one fair-quality RCT investigating a leisure/recreation program,²² two poor-quality case series addressing music therapy,^{47,48} and two poor case series addressing facilitated communication.^{45,46} Studies included a total of 174 individuals with ASD, and the duration of treatment ranged from 20 hours to 12 months in 4 studies;^{22,45,46,48} one study of music therapy reviewed data from participants who had participated in varying hours of therapy.⁴⁷ Studies of music therapy reported some improvements in social skills using unvalidated measures.^{47,48} Studies assessing facilitated communication noted little communication improvement associated with facilitation and some evidence of facilitator influence on participants' responses.^{45,46} The study examining a recreation program reported improvements in stress-related scores for individuals in the intervention group compared with those in the control group ($p < 0.001$). Overall quality of life scores similarly improved for intervention participants compared with the control group.²²

Discussion

Key Findings

Despite a growing population of adolescents and young adults who have diagnoses of an ASD and the need for effective intervention across the lifespan, very little research is available to help understand the impact of specific intervention approaches for adolescents and young adults with ASD. The available research is lacking in scientific rigor. We identified a total of 32 studies (one paper reported two separate studies), of which 10 were

randomized controlled trials. Although RCTs are often considered the gold standard for assessing intervention effectiveness, particularly in a complex behavioral field with emerging research such as this, observational designs can be rich sources of information. Nonetheless, most studies were of poor quality; only five were fair quality and none were good quality. The strength of the evidence (degree of confidence that the observed effect of an intervention is unlikely to change) across all interventions and outcomes was insufficient as studies were typically of poor quality, addressed disparate interventions and outcomes, and lack replication (Table B).

Table B. Summary of strength of evidence and key outcomes of studies

Intervention	Strength of Evidence	Summary/Conclusions/Comments
Behavioral		
Individual or group-based social skills training ^{23,24,27,28}	Insufficient	<ul style="list-style-type: none"> • 4 poor-quality studies, 2 reporting on manualized (i.e., has a published treatment manual) intervention. • Some gains in social skills on largely parent-reported measures in short-term studies. • 2 studies lacked comparison groups; diagnostic approach, participant characteristics, treatment fidelity not clearly reported.
Computer-based social skills training ^{17,25}	Insufficient	<ul style="list-style-type: none"> • 3 poor-quality, short-term studies (one paper¹⁷ reported 2 separate studies). • Some improvements in emotion recognition in treated participants; no differences in measures of generalization. • Systematic diagnostic approach not reported within studies; concomitant interventions and treatment fidelity not reported.
Intensive behavioral treatment ²⁶	Insufficient	<ul style="list-style-type: none"> • 1 poor-quality case series with diverse participants. • Some gains in adaptive behavior reported. • Intervention not clearly described; treatment fidelity and concomitant interventions not reported; assessors not masked.
Educational		
Vocabulary teaching ²⁹	Insufficient	<ul style="list-style-type: none"> • 1 poor-quality nonrandomized trial. • Neither teaching method significantly more effective in increasing nouns. • Inclusion/exclusion criteria not clearly stated; attrition and differences in concomitant interventions not reported; assessors not masked.
Reading comprehension ³⁰	Insufficient	<ul style="list-style-type: none"> • 1 poor quality RCT; two facilitation methods increased comprehension compared with baseline scores. • Randomization method not clearly reported; assessors not masked and differences in concomitant interventions not reported.

Table B. Summary of strength of evidence and key outcomes of studies (continued)

Intervention	Strength of Evidence	Summary/Conclusions/Comments
Adaptive/Life Skills		
Specific life/transitional skills ³²⁻³⁴	Insufficient	<ul style="list-style-type: none"> • 3 poor-quality, short-term studies assessing highly specific skills and unique interventions (shoe lacing, digital device use, rotating classroom schedule). • Some gains seen in individual studies but most lacked comparison groups. • Systematic diagnostic approach not reported within studies; participants often not clearly characterized; differences in concomitant interventions and treatment fidelity often not reported.
TEACCH ³¹	Insufficient	<ul style="list-style-type: none"> • 1 poor-quality cohort study; desirability of living situation and use of programming rated more highly for TEACCH than other conditions; group homes rated more desirable than institutions. • Nonrandom assignment to groups; systematic diagnostic approach not reported within study; inclusion/exclusion criteria not clearly stated; interventions not fully described; assessors not masked.
Vocational		
On-the-job supports/supported employment ^{8,35-39}	Insufficient	<ul style="list-style-type: none"> • 5 poor-quality studies. • Individual studies of different on-the job supports (broadly defined as services to promote job placement and job retention) reported increased rates of employment in the community relative to those without on-the-job supports. Because the individual studies have not been replicated and are of poor quality, the strength of evidence for the effect seen is insufficient, as more research is needed to quantify the degree to which these interventions are likely to have an effect. • Nonrandom assignment to groups in 3 studies, no comparison group in 2 case series; attrition not always reported and interventions not always fully described; treatment fidelity and differences in concomitant interventions frequently not reported; assessors not masked.
Medical		
Antipsychotics ^{20,21,40}	Insufficient	<ul style="list-style-type: none"> • 2 fair-quality RCTs and 1 poor quality crossover study. • Improvements in aggression, irritability/agitation, repetitive behavior, sensory motor behaviors, and overall behavioral symptoms in participants receiving risperidone. • Treatment adherence not reported in 2 studies; assessors not masked and participants not clearly characterized in 1 study.
Opioid receptor antagonists ¹⁹	Insufficient	<ul style="list-style-type: none"> • 1 poor-quality crossover study. • Significant increase in stereotypy in treated participants. • Participants not clearly characterized; adherence and differences in concomitant interventions not reported.
Serotonin reuptake inhibitors ^{18,20,41-43}	Insufficient	<ul style="list-style-type: none"> • 2 fair-quality RCTs, 3 poor quality case series. • Studies had inconsistent results: RCT of fluvoxamine reported decreases in repetitive behavior, aggression, autistic symptoms, and language usage. Case series addressing sertraline, fluoxetine, and clomipramine reported some benefits, while a crossover study of clomipramine vs. placebo reported no significant differences in autistic symptoms between groups. • Lack of comparison groups in 3 studies; treatment adherence not reported; assessors not masked in some studies.

Table B. Summary of strength of evidence and key outcomes of studies (continued)

Intervention	Strength of Evidence	Summary/Conclusions/Comments
Allied Health		
Facilitated communication ^{45,46}	Insufficient	<ul style="list-style-type: none"> • 2 poor-quality case series. • Facilitated communication did not increase participants' communication or literacy abilities over their independent abilities. • No comparison groups; differences in concomitant interventions not reported; assessors not masked.
Music therapy ^{47,48}	Insufficient	<ul style="list-style-type: none"> • 2 poor-quality case series. • Some gains in social skills reported using unvalidated and largely subjective measures. • No comparison groups or measures of treatment fidelity; participants not clearly characterized; assessors not masked; differences in concomitant interventions not reported.
Leisure/recreation program ²²	Insufficient	<ul style="list-style-type: none"> • 1 fair-quality RCT. • Positive effects on stress and quality of life in leisure group participants compared with controls. • Attrition and treatment fidelity not reported; randomization method not clearly described; differences in concomitant interventions not reported.

RCT = randomized controlled trial; TEACCH = Treatment and Education of Autistic and Communication related Handicapped Children

In the behavioral literature research, social skills interventions utilizing individual/group^{23,24,27,28} and computer-based interventions^{17,25} suggested improvements across a variety of caregiver-reported social skills and emotion recognition capacities respectively. However, each study employed a different approach and paradigm, making comparison across interventions impossible. Likewise, such social skills interventions have yet to demonstrate consistent generalization of skills across settings and often limit interventions to individuals with average to above average verbal and/or cognitive abilities.

Only a single poor-quality case series examined the effects of a more intensive, comprehensive intervention approach. This study suggested improvement in adaptive skills and high levels of family satisfaction with services for 34 adolescents receiving treatment in a residential treatment setting over the course of 2 years. Given the lack of adequate comparison group in this setting, there is very little information surrounding the impact of comprehensive behavioral intervention approaches for this population.

Research into educational approaches for adolescents and young adults with ASD is very limited, with only two small crossover studies identified in this population. These studies^{29,30} focused on the impact of highly specified educational strategies and outcomes (e.g., vocabulary

development) and ultimately provide little evidence to support selection of either specific or various broad-based educational strategies.

Studies of adaptive/life skills-focused interventions meeting our criteria were of poor quality, addressed disparate interventions, and typically included few participants. Individual studies documented specified short-term gains in learning or successfully executing an adaptive or life skills-focused tasks, but the applicability and generalization of these findings is limited by the highly specified approaches utilized.³¹⁻³⁴ Additionally, studies were typically uncontrolled and of short duration.

Among five studies of supported employment/vocational interventions,^{8,35-39} all focused on on-the-job supports as the employment/vocational intervention. No other vocational interventions were reported in the literature meeting our study criteria. Our ability to know the ultimate benefit of supported employment programs is limited given the existing research. No study utilized random assignment, making it difficult to draw conclusions about the effectiveness of the programs, and all studies were poor quality. Three small studies focused on employment as an outcome of interest reported that supported employment interventions increased rates of employment for young adults with ASD.^{8,36,39} Additional studies reported that

supported employment was associated with improvements in quality of life and core symptoms^{37,38} and cognitive functioning³⁵ in supported employment participants relative to young adults with ASD in sheltered work settings.

Supported employment interventions remain understudied. For example, only one study examined rates of employment for programs that lasted 3 years or longer.⁸ Further, this longer term study did not include a control group, making it impossible to determine the rates of employment over time for young adults with ASD who were not participating in the supported employment intervention. Finally, none of the studies examined whether increased employment rates or improvements in other outcomes were sustained after the termination of the supported employment intervention.

The use of medical interventions in adolescents and young adults with ASD is common.⁴⁹ However, there is little evidence that supports the use of medical interventions specifically in this population. Overall, most studies focused on the use of medications to address specific challenging behaviors (i.e., aggression or irritability). Four studies were fair quality,¹⁸⁻²¹ and four were poor.⁴⁰⁻⁴³ The most consistent findings were identified for antipsychotic medications. A fair quality RCT studying risperidone found improvements in aggression, repetitive behavior, sensory motor behaviors, and overall behavioral symptoms.²¹ A crossover study of risperidone also showed a significant reduction of irritability/agitation ratings with risperidone treatment, but the control was indirect.⁴⁰ A placebo-controlled crossover study found that haloperidol significantly improved hyperactivity/defiance ratings, but no significant difference was found for irritability/agitation or other symptoms.²⁰ While limited literature supports the use of risperidone in adolescents or young adults with ASD, the efficacy of risperidone in studies including mostly children has moderate strength of evidence⁵⁰ that is consistent with the results of the one fair RCT and one poor crossover study in adults with ASD. There is therefore no evidence to suggest that the effects of risperidone for irritability/agitation in ASD are specific to a particular age range.

A number of studies of SRIs were identified but with limited consistency across studies as a whole. An RCT of fluvoxamine showed decreases in repetitive behavior, aggression, autistic symptoms, and language usage.¹⁸ In contrast, no significant differences were observed in a crossover study of clomipramine versus placebo.²⁰ Three case series of SRIs were also identified, including sertraline, fluoxetine, and clomipramine, with each study

reporting some benefit to treatment.⁴¹⁻⁴³ A recent study not meeting criteria for this review contributes to the limited data on SRIs: the placebo-controlled RCT⁵¹ of fluoxetine included 37 individuals with ASD with a mean age of 34.31 and reported improvements in repetitive behavior and ASD symptoms in the treatment group and mild harms. This study used a different medication than the one fair quality study in our age range, so it would be unlikely to influence the strength of evidence for a specific medication. It is possible, however, that a systematic review of SRIs in the broader age range of adults with ASD could provide data that might increase our confidence in the effect.

A crossover study of the opioid receptor antagonist naltrexone found no significant improvements in problem behavior and showed worsening of stereotyped behavior with naltrexone treatment compared with placebo.¹⁹

Based upon the published studies in adolescents and adults with ASD, the strength of evidence is insufficient for harms associated with medications tested in this population. As in the case of efficacy, the data on adverse effects associated with risperidone, including sedation and weight gain, are consistent with the high strength of evidence for these adverse effects in children with ASD.⁵⁰ The available evidence therefore appears consistent in supporting our understanding of the risk of these adverse events in ASD without being limited to a specific age range. Of course, this does not mean that other medications tested in ASD are free of adverse effects. It is reasonable to expect that, in contrast to efficacy, which is more likely to be specific to disorder and symptom, adverse effects are more likely to extend across diverse groups of subjects studied. Clinicians evaluating the evidence and sharing information with families routinely take this perspective, as does the Food and Drug Administration in mandating that all adverse events be listed for a drug, rather than just those for a particular indication.

Few studies of allied health interventions met our criteria.⁴⁵⁻⁴⁷ One fair quality RCT assessed a 12-month recreation program²² and reported improved quality of life and lower stress scores in individuals participating in the leisure/recreation program compared with those on a waiting list. Two studies of facilitated communication used approaches designed to assess the effects of facilitation both with and without facilitators' awareness of the word being prompted. Both studies demonstrated some facilitator influence without specific effects on participants' independent ability to communicate. One retrospective study of a music therapy program reported some positive

effects on participants' social skills using largely subjective outcome measures.⁴⁷ One poor-quality case series⁴⁸ included 22 young adults engaged in a music therapy intervention. Nearly all participants reported making friends during the program and were generally satisfied with the program. Both studies assessed outcomes shortly after treatment, so longer term effects of the interventions are not known.

Applicability of the Evidence

Study populations across interventions were highly variable. A number of studies included individuals with ASD and significant intellectual disability or language impairment, while studies assessing vocational and social skills-related behavioral interventions typically included higher functioning individuals. Studies of medical interventions were all conducted in academic clinic settings, which may limit applicability to the general population. Thus there was substantial variability and limited information on developmental, cognitive, and behavioral characteristics of study populations.

Future Research

The period of development representing the transition from adolescence to early adulthood presents numerous challenges for individuals with and without neurodevelopmental challenges. These challenges are compounded for individuals with ASD as they are presented with additional complexities requiring efforts to maximize the possibility of a positive transition and achievement of individual goals for independence. Despite increasing numbers of adolescents facing the transition from adolescence to adulthood, intervention research lags behind. To date, there is not sufficient strength of evidence for documenting the effects of any interventions in this age group on specific outcomes.

Overall, there is a dearth of evidence in all areas of care for adolescents and young adults with autism spectrum disorders and it is urgent that more rigorous studies be developed and conducted. It is unlikely that large scale implementation of interventions will be considered until a stronger evidence base is developed, despite growing numbers of individuals with need, and some small studies demonstrating initial promise. A fruitful area for consideration may be identifying programs/interventions that are appropriate candidates for developing treatment manuals to encourage standardized replication of promising approaches.

Basic understanding of the effects of aging on health, cognitive skills, and other domains of functioning is

absent, and evaluations of interventions are rare. The lack of randomized, controlled trials is notable in all categories of intervention, but especially so in medical interventions, where substantial adverse events may be associated with medication use in adolescence. Only three studies^{8,31,37,38} (one reported in two publications) reported more than 12 months of followup; longer term data are needed in all areas of therapy. Furthermore, although early intervention for individuals with ASD is often delivered in the home or at specialized agencies, behavioral and educational interventions for adolescents and adults with ASD are likely to take place in existing community-based settings such as schools and businesses, with nonspecialists having a key role in implementation. Thus, another critical issue is to design interventions for implementation in such settings.

The behavioral literature generally focuses on a subset of individuals with ASD, often those who are higher functioning, and may not be representative of the range of individuals with ASDs. In particular, more attention is warranted to understand the impact of behavioral interventions in the lives of individuals and how these interventions generalize to real-world impact and outcome.

Few studies addressing educational interventions in the adolescent and young adult population have been conducted, and studies focusing on life skills or adaptive behaviors have included few individuals, typically in short-term studies focused on highly specific short-term intermediate outcomes. More research in both areas and over broader timeframes with more clearly defined populations is critical for helping individuals with ASD transition to greater independence.

In vocational research, studies are needed that illuminate which aspects of multifaceted supported employment programs have the greatest impact. Studies that do show evidence of effectiveness in this area should collect longer term data to describe the degree to which findings, including the duration of employment, continue after the intervention itself is removed. These studies should also broaden the outcomes measured, to include other functional outcomes such as quality of life, educational attainment, residential outcomes, and social outcomes. Similarly, allied health studies are needed to understand best approaches to fostering independent living skills and ways in which improvements in motor skills may affect communication and other domains.

Medical studies conducted in adolescents and young adults have focused largely on problem behaviors, and additional data are needed on medical comorbidities in

adolescents with ASD. Clear evidence from earlier studies of antipsychotics, which included mostly younger children, supports the use of risperidone and aripiprazole in children with ASD.⁵⁰ The only fair-quality study of risperidone in adults is consistent with the findings in children, but the strength of evidence based upon the adult literature alone is insufficient to draw firm conclusions. Population studies may be helpful to empirically group ASD patients by age in a way that fosters more effective studies of treatments. Understanding the age-appropriateness of potential medical treatments as based on social, physiological, pharmacological, and functional characteristics of the population would help to prioritize future research, including the ways in which medical comorbidities arise or increase as children with ASD move into adolescence and adulthood. Increased use of such standardized age groupings would facilitate comparisons of effectiveness within medical intervention categories as well as with nonmedical therapies. One way to support accomplishing this is by developing treatment networks with adequate numbers of patients of varying ages to participate in research.

Thus far, medication research in adolescents and young adults with ASD has been limited to compounds that are already approved for other indications. As targeted treatments for ASD emerge, initial studies will need to study adult populations to establish safety before moving into studies of adolescents and finally children. Study of compounds not yet on the market could be facilitated with partnerships between the academic and pharmaceutical communities. It will be critical to consider the appropriate outcome measures and settings in which to study medication response in adults. The heterogeneity in settings for adults with ASD is a significant impediment to assessing symptom response. Ideally, medications would be combined with an educational or psychosocial intervention that would mirror the school and therapeutic settings in which children with ASD show improvements in social, communication, or behavioral function. Without some level of educational or social challenge, it may be quite difficult to assess medication response.

Across all intervention types, research is needed on which outcomes to use in future studies. The Aberrant Behavior Checklist is the best outcome measure for behavioral symptoms in ASD in terms of both validity and reliability, but it does not directly index anxiety, mood, social, or communication function, nor does it capture broader outcomes such as quality of life. More outcome measures are needed to allow assessment of a broader range of symptoms, particularly in individuals who may be higher

functioning. No studies provide adequate information on longer term outcomes, and particularly on outcomes related to achieving goals for independence and quality of life. To some degree, this reflects a lack of understanding and consensus about optimal outcomes and how to measure them.

We know little about which outcome measures are most appropriate and valid for this population specifically; nor do we have good, empirical evidence about which outcomes are valued by individuals and their families. Furthermore, it is unclear which outcomes are most likely to change as a result of the very different types of interventions assessed in this population. Substantial, foundational research should be done to identify and validate outcome measures in the adolescent and young adult population with ASD.

Research is also necessary to understand how individuals' expression of ASD symptoms and the severity of symptoms may affect treatment over the lifespan. Foundational research is necessary to understand the goals of individuals with autism and their families as future research studies are planned. Similarly, little research addressing the effects of family and caregiver interactions and characteristics on the responses of individuals' with ASD to interventions exists.

Finally, for all research in this area, we encourage greater transparency in reporting, particularly as it relates to reporting of randomization approaches, characterization of study participants, description of the intervention and measures of fidelity and adherence. These are all necessary to correctly understand the potential impact of the interventions being reported.

Conclusions

Given the number of individuals affected by ASD, there is a dramatic lack of evidence on best approaches to therapies for adolescents and young adults with these conditions. In particular, families have little in the way of evidence-based approaches to support interventions capable of optimizing the transition of teens with autism into adulthood. Most of the studies identified were of poor quality; while the five fair-quality studies were primarily of medical interventions. Behavioral, educational, and adaptive/life skills studies were typically small and short term and suggested some improvements in social skills and functional behavior.

Individual studies also suggested that vocational programs may increase employment success, but the studies were small. By the same token, few data address

the effectiveness and harms of medical or allied health interventions in the adolescent and young adult population. Although the studies that have been conducted focused on the use of medications to address specific challenging behaviors, the effectiveness in managing irritability and aggression in this age group remains largely unknown and can at best be inferred from studies including mostly younger children.

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