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ORIGINAL PAPER

Special Education Service Use by Children with Autism Spectrum Disorder

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Abstract

In the last decade, the prevalence of children with autism spectrum disorder (ASD) without intellectual disability (ID) in schools has increased. However, there is a paucity of information on special education placement, service use, and relationships between service use and demographic variables for children with ASD without ID. This study aimed to describe and explore variation in type and amount of special education services provided to ($N=89$) children with ASD. Results indicated that the largest percentage of children received services under the Autism classification (56.2%) and were in partial-inclusion settings (40.4%). The main services received were speech (70.8%) and occupational (56.2%) therapies, while few children received behavior plans (15.7%) or social skills instruction (16.9%). Correlates with service use are described.

Keywords Autism spectrum disorder without intellectual disability · Special education · Service use · School · Correlates

Introduction

Autism spectrum disorder (ASD) is characterized by symptoms of social-interaction/-communication impairments and restricted and repetitive interests and behaviors [American Psychiatric Association (APA) 2013]. Prevalence estimates have documented an increase of 29% in children with ASD that occurred between 2008 and 2010, with the majority of this increase ascribed to the growing number of children with ASD without intellectual disability [ID; Center for Disease Control and Prevention (CDC) 2014, 2016]. For example, the CDC (2016) documented that in 2012, 43.9% of students identified with ASD had average or above average cognitive ability. Given their relative cognitive and language strengths, combined with their clinical symptoms, children with ASD without ID pose a significant challenge in the school setting (Koegel et al. 2012).

Studies have indicated that children with ASD with higher IQs and lower levels of ASD symptoms are likely be placed in full-inclusion classrooms (Sansosti and Sansosti 2012; White et al. 2007). Many studies of the inclusion of students with ASD have reported a positive effect on these students' level of social engagement (Sansosti and Sansosti 2012). For example, many demonstrate increased social interaction in the mainstream classroom (Dahle 2003), have larger networks of friends, or are included in peer activities at the same rate as their same-age peers without disabilities (Chamberlain et al. 2007). However, others argue that despite the recent trend toward full-inclusion of children with ASD without ID (Martins et al. 2014), an inclusive placement alone may be insufficient to improve the social skills of children with ASD without ID (Sansosti 2010). This is important to note, as data from the United States Department of Education (USDOE 2012) has indicated that the number of children with ASD served in public schools doubled between 2004 and 2010, and there was a 244% increase of these students in full-inclusion (e.g., placement in mainstream, general education setting for the entirety of their school day) classrooms from 1992 to 2006 (USDOE 2010). However, placement in a full-inclusion classroom may be counterproductive for children with ASD who are unable to benefit from or model the behavior of typically-developing classmates (White et al. 2007). The social interaction

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demands within the classroom environment often prove difficult for children with ASD without ID, who may fail to identify or appropriately interpret social cues in the classroom (Bauminger-Zviely 2014). This inability to interpret social cues may result in the children appearing insensitive to peers or responding inappropriately to others within the classroom (Thomeer et al. 2017). Bullying is also a concern in general education settings, with children with ASD without ID frequently reporting being bullied and/or feeling isolated (Humphrey and Lewis 2008). Additionally, some children with ASD without ID may exhibit problem behavior that creates difficulties in the classroom (Thomeer et al. 2017). Frequent and/or intense problem behavior can result in the child with ASD being placed in a more restrictive setting (Sansosti and Sansosti 2012) and reduce access to interactions with typically-developing classmates. Although there are arguments for and against inclusive and restrictive settings for children with ASD (Sansosti and Sansosti 2012), little is known regarding what information is used to make placement decisions (White et al. 2007).

Despite a recent trend toward full-inclusion of children with ASD without ID (Martins et al. 2014), most of these students will require special education services, regardless of their strengths (Sansosti and Sansosti 2012). Although these children are characterized by cognitive and language strengths, administrators should not assume that they only require minimal educational support in order to be successful (Sansosti and Sansosti 2012). The latest USDOE (2017) Annual Report indicated that 9.1% of the children, ages 6–21 years in special education were served under the classification of Autism. However, the number served under the special education classification of Autism may be misleading and an underestimate of the number with a clinical diagnosis of ASD served in special education. Many students with ASD may receive special education services under a different classification (CDC 2014; Sansosti 2010; Toomey et al. 2009) such as Other Health Impaired (OHI), Specific Learning Disability (SLD), Speech and Language Impairment (SLI), Emotional Disturbance (ED), and Multiply Disabled (MD; CDC 2014; Toomey et al. 2009). The CDC (2014) reported that between 30 and 69% of functionally-heterogeneous students diagnosed with ASD were receiving special education services under the classification of Autism. Toomey et al. (2009) conducted a survey of special education classifications of children with ASD without ID and found that only 17.6% were classified under the Autism category. Most (41.2%) of the children were classified under OHI, followed by 17.6% as MD, 11.8% as SLD, and 11.8% as SLI. This distribution of special education classifications indicates that school personnel should review the unique features of students within special education, and not rely on the specific special education category to guide appropriate social and behavioral interventions (Toomey et al. 2009).

There is currently a paucity of information regarding special education services received by students with ASD with heterogeneous functional levels, and how these services may differ based on age, level of symptomology, and other demographic variables (Wei et al. 2014). Wei et al. (2014) examined three national datasets of functionally-heterogeneous students with ASD and found that for elementary school students, the two most common therapies were speech and language therapy (84.6%) and occupational therapy (50.0%). In contrast, a relatively lower percentage (34.6–44.6%) of students received a behavior management program. While these results are consistent with prior research (White et al. 2007), Wei et al. (2014) noted the widespread social and behavioral impairments experienced by students with ASD and lack of social/behavioral services delivered in schools. They also found that 3.4% of elementary/middle school children with ASD did not receive any of the three services (i.e., speech and language therapy, occupational therapy, behavior management program) thought to directly address ASD symptoms. Finally, Wei et al. (2014) found that students with ASD and higher levels of ASD symptoms were more likely to receive more special education services and that service use generally declined with increasing age.

Although there is limited information regarding special education services for children with ASD and heterogeneous functional levels, even less is known regarding the correlates of special education service use with children with ASD without ID (White et al. 2007). In a study of 101 children with ASD without ID, White et al. (2007) examined relationships between child demographic factors and special education, and found that children with ASD without ID with lower cognitive and language abilities (relative to the group) were more apt to receive special education services. White et al. (2007) did not find that the children's average level of social ability (as measured by the Vineland Adaptive Behavior Scales; Sparrow et al. 1984) was associated with special education use. This is concerning, given the overarching suppression of social ability among children with ASD without ID (White et al. 2007) and how their social deficits affect performance in the classroom setting (Thomeer et al. 2017). Finally, most students with ASD without ID received special services, with the majority receiving speech therapy, followed by physical/occupational therapies (White et al. 2007). Social skills instruction was much less frequently reported, with none of the parents of older children (grades 7 and 8) reporting that their children received this service. Given the potential benefits of social skills instruction in the schools (Thomeer et al. 2017), this continues to be an area of unmet need (White et al. 2007).

Regardless of their strengths, if students with ASD without ID are to integrate successfully with their typically-developing peers, special supports and services are necessary in schools (White et al. 2007). This need is especially clear as children with ASD without ID do not typically remain on the same developmental trajectory as their same-age peers over time (McDonald et al. 2016). At present, little is known regarding what special education services these children receive, as well as the amounts and types of special education services accessed and their relationship to the children's demographic variables (e.g., age, IQ, level of ASD symptoms, adaptive behavior). Documenting service use is important as it may inform the types of training necessary for school personnel working with children with ASD, as well as inform families as to what special education services a child with ASD without ID typically receives (Wei et al. 2014). This study aimed to document the special education services accessed by a group of children with ASD without ID, as well as investigate relationships between service use and various child demographic characteristics.

Methods

Participants

The sample consisted of 89 children diagnosed with ASD (without concomitant ID). These children, ages 6–11 years ($M = 8.77$; $SD = 1.37$), had been enrolled in a large randomized controlled trial of a school-based psychosocial intervention in western New York. Inclusion criteria for the clinical trial were: a prior clinical diagnosis of ASD; a Wechsler Intelligence Scale for Children-4th Edition (WISC-IV; Wechsler 2003) short-form IQ > 70; and Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk 1999) short-form Expressive or Receptive language score > 75. Children were excluded if there was a history of psychosis (per prior clinical or parent report). All children had their diagnosis confirmed using the Autism Diagnostic Interview-Revised (Rutter et al. 2003). Table 1 provides summary descriptive statistics for the sample including gender, ethnicity, age, and scores on the measures of cognitive and behavioral characteristics [WISC-IV, CASL, ADI-R, and Adaptive Behavior Assessment System, Third Edition (ABAS-3)]. Most of the children were male (91%) and Caucasian (96%). The mean age was 8.8 years with a range of 6–11 years. The mean WISC-IV short-form full-scale IQ was 101.35 with a range of 71–135.

Table 1 Demographic, cognitive, language, and behavioral characteristics of sample

Characteristic	Participants $N = 89$
	n (% of total)
Gender	
Male	81 (91%)
Female	8 (9%)
Ethnicity	
Caucasian	85 (95.5%)
Latina/Hispanic	3 (3.4%)
African American	1 (1.1%)
	Mean (*SD*)
Age in years	8.77 (1.37)
WISC-IV Short-Form Full Scale IQ	101.35 (13.36)
CASL	
Expressive language	95.12 (14.65)
Receptive language	100.39 (16.69)
ADI-R	
Social interaction	18.71 (5.85)
Communication	15.06 (4.77)
Repetitive behavior	6.08 (2.05)
Total	39.84 (10.34)
ABAS-3	
Conceptual	83.88 (10.37)
Social	80.55 (10.88)
Practical	82.74 (11.70)
GAC	81.02 (10.46)

WISC-IV Wechsler Intelligence Scale for Children-4th Edition, *CASL* Comprehensive Assessment of Spoken Language, *ADI-R* Autism Diagnostic Interview-Revised, *ABAS-3* Adaptive Behavior Assessment System-Third Edition

Measures

Adaptive Behavior Assessment System, Third Edition (ABAS-3)

The ABAS-3 (Harrison and Oakland 2015) is a norm-referenced comprehensive measure used to assess the adaptive functioning of individuals from birth to 89 years of age in a variety of settings. The ABAS-3 Parent Form (ages 5–21) was used to assess adaptive behavior of the current sample. The form for this age range consists of nine adaptive skill areas used to generate three adaptive domain scores including the Practical, Social, and Conceptual domains, as well as an overall General Adaptive Composite (GAC). The GAC serves as an indicator of overall adaptive functioning. For the domain scores, internal consistency estimates range from .94 to .98 for parent forms for children ages 6–12 years, and .98 for the GAC. Validity of the ABAS-3 is supported in moderate-to-high correlations with other established measures of adaptive behaviors (e.g., VABS-2; Sparrow et al. 2005).

Autism Diagnostic Interview-Revised (ADI-R)

The ADI-R (Rutter et al. 2003) is a 93-item standardized diagnostic interview administered to a caregiver familiar with the developmental history and current behavior of the person being evaluated. The interview focuses on three domains (i.e., Reciprocal Social Interactions, Language/Communication, and Restricted, Repetitive, and Stereotyped Behaviors and Interests). Validity evidence indicates that the ADI-R accurately discriminates between ASD and non-ASD samples (Rutter et al. 2003).

Comprehensive Assessment of Spoken Language (CASL)

A four-subtest short-form of the CASL (Carrow-Woolfolk 1999) was used as a screening measure of receptive and expressive language including the Antonyms, Synonyms, Syntax Construction, and Paragraph Comprehension subtests. For the ages under consideration, subtest internal consistency reliabilities ranged from .76 to .90 and short-form composite reliability was .94. Composite reliability was calculated using the formula provided by Tellegen and Briggs (1967).

Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV)

IQ was evaluated using a 4-subtest short-form of the WISC-IV (Wechsler 2003) consisting of Block Design, Similarities, Vocabulary, and Matrix Reasoning subtests. Methods provided by Tellegen and Briggs (1967) were used to calculate reliability and validity coefficients based on standardization information in the technical manual. The short-form composite yielded an internal consistency estimate of .95 and correlated .92 with the full-scale IQ.

Procedure

As noted, children in the current sample were participants in a prior clinical trial. The study protocol for the school-based treatment trial that generated the data used in this study was approved by the Institutional Review Board and conducted in compliance with the approved procedures (including attainment of written parental consent and written child assent). Screening measures (i.e., ADI-R, WISC-IV, CASL) were administered prior to inclusion in the clinical trial. Parents reported use of psychotropic medication via a demographic form. A parent-completed ABAS-3 was collected 6 weeks into the school year (prior to the start of the clinical trial). Each rating scale was reviewed for any omitted items and raters were immediately contacted for corrections as needed. Each protocol was scored using the affiliated computer-scoring program. To further ensure accuracy, scores from all measures were entered into the study database by a research assistant and then independently checked by a second research assistant. A third research assistant resolved any discrepancies in the data entry. All demographic and study-related data were entered into the study database following this same procedure. Finally, each parent provided a copy of his or her child's current Individualized Educational Program (IEP). Each IEP was evaluated for special education classification, type of service received (e.g., social skills instruction, speech therapy, counseling, occupational therapy, physical therapy, individualized behavior support plan, 1:1 aide), duration of service, and type of placement (i.e., full inclusion, partial inclusion, self-contained classroom). Full inclusion was defined as the placement for a child who remained in the mainstream, general education setting for the entirety of the school day. Partial inclusion was defined as the placement for children who attended general education for the majority of their school day, but less than 100% in the general education setting. (Partial inclusion typically encompassed those students who were removed from the general education setting for more intensive instruction in a specific subject area, such as math and/or reading.) Finally, a self-contained classroom was defined as the placement for children who primarily remained in this more restrictive special education classroom and only were included into the general education setting for a maximum of two academic classes. The lead author independently logged all data regarding services and placement into the study's database. The third author then independently checked the data for any errors or discrepancies. Any discrepancy was resolved via discussion between the two raters until agreement was established. Overall interscorer reliability for the IEP data was > .99.

Overview of Data Analysis

Data analysis procedures were chosen based on the descriptive and exploratory aims of the study as well as characteristics of the measures and data distributions. Analysis steps included examination of distribution characteristics, descriptive statistics, and additional exploratory analyses. The distributions of the dependent variable (service time) and the test scores were examined for normality, outliers and missing data. The test scores (ABAS-3, ADI-R, CASL, and WISC-IV) were normally distributed without significant kurtosis. In terms of outliers, one case included a score that was 3.09 SD above the mean on ABAS-3 Practical subscale. The score was valid and retained in the correlation analysis. All other scores were less than 3 SD from the mean. The number of minutes of service was positively skewed (skew = .72, *SE* = .26), primarily as a result of 12 cases with 60 min of service (the modal score) at the low end of the distribution. Numerous alternative procedures are available when assumptions such as normal distributions are not tenable (e.g., Fox 2016; Sprent and Smeeton 2007; Wilcox 2017). In this study, statistical estimation procedures included nonparametric Spearman rank correlations and Chi square. Regression with bootstrapped standard errors was also utilized in a limited exploratory analysis of interactions

(Stata 15.1). Exact *p*-values and effect sizes were reported for all tests. Since no hypotheses were prespecified, null hypothesis testing was not used. Similarly, as the study was retrospective as well as exploratory, power analysis was not appropriate. Complete data was available for all variables in each case.

Results

Classification, Placement, and Services

Table 2 presents summary descriptive statistics for the participants on IEP classification, placement, medication status, and special services provided. Over half of the sample ($n = 50$, 56%) was classified under Autism, followed by OHI (27%) as the second largest category of special education. Partial inclusion was the most frequent placement (40%), followed by full inclusion (34%) and self-contained classroom (26%). The most frequently provided services included speech therapy (71%), occupational therapy (56%), and counseling (44%). Social skills instruction and behavior support plans were the least common (17% and 16%, respectively). Most participants received at least one special service (94%). The average number of services received was 2.6 ($SD = 1.3$), with a range of 0–6. The average number of minutes of services per week was just over three hours ($M = 194.9$ min), with a range of 0–570 min per week.

Special Education Classification and Services

The relationship between classification status and services provided was examined in a series of Chi Square tests comparing children classified under the category of Autism ($n = 50$) versus other ($n = 39$) by whether they received the service or not. Table 3 presents the results as well as effect sizes (ψ). Seven of the nine comparisons reflected similar proportions between the two groups. Two comparisons marginally deviated from this pattern. Children classified under Autism were about twice as likely to receive 1:1 aide service as other children (40% vs. 21%, $p = .05$, $\psi = -.21$). Medication was similar in terms of p value and effect size ($p = .05$, $\psi = .21$), but children classified under Autism were about half as likely to receive medication (24% vs. 44%). Social skills instruction and behavior support plans were provided less frequently to both groups than most other services. The relationship of classroom placement was also examined in relation to Autism classification. Similar proportions of students with Autism and those with other classifications were found across the three levels of placement ($\chi^2 = 3.54$, $p = .17$, $\psi = .19$).

Table 2 Student classification, placement and service use

Characteristic	Participants $N = 89$
	n (% of total)
IEP classification	
Autism	50 (56.2%)
Other health impairment	24 (27.0%)
Multiply disabled	9 (10.1%)
Speech and language impaired	5 (5.6%)
Specific learning disability	1 (1.1%)
Placement	
Full inclusion	30 (33.7%)
Partial inclusion	36 (40.4%)
Self-contained	23 (25.8%)
Prescribed psychotropic medications	
Yes	29 (32.6%)
No	60 (67.4%)
Special services[a]	
Speech therapy	63 (70.8%)
Occupational therapy	50 (56.2%)
Counseling	39 (43.8%)
Physical therapy	25 (28.1%)
Social skills instruction	15 (16.9%)
1:1 aide	28 (31.5%)
Individualized behavior support plan	14 (15.7%)
Any special service	84 (94.4%)
	Mean *(SD)*
Average # of services used	2.63 (1.33)
Total average # of minutes for all services	194.89 (134.99)
Average # of minutes of therapies per week[b]	109.94 (63.99)
Average # of minutes of 1:1 aide	56.63 (84.06)
Average # of minutes for behavior support plan	28.31 (65.91)

Percentages reflect number of students placed or accessing services in a given category

IEP Individualized Education Program

[a] Special Services received as reported on the student's IEP

[b] Average # of minutes of therapies per week excludes minutes for 1:1 aide and behavior support plan

Service Time and Child Characteristics

The relationship between total service time and child characteristics, including age and test scores, was examined with Spearman rank correlations (Table 4). Gender and ethnicity were not examined because variability was very limited. The coefficients are consistent in showing little or no relationship between service time and child characteristics. In order to explore the possibility that bivariate interactions may account for variance in service time beyond individual variables, regression analysis was conducted with three plausible interactions. These included interactions of age with IQ and ADI-R as well as IQ with ADI-R. Of the three

Table 3 Services/therapies provided by autism versus other classification (N = 89)

Service/therapy	Classification				
	Autism (n = 50)	Other (n = 39)			
	n (%)	n (%)	χ^2	p	ψ
Social skills instruction	7 (14)	8 (21)	.66	.42	.09
Speech therapy	36 (72)	27 (69)	.08	.78	− .03
Counseling	25 (50)	14 (36)	1.77	.18	− .14
Occupational therapy	25 (50)	25 (64)	1.77	.18	.14
Physical therapy	10 (20)	15 (39)	3.70	.06	.20
1:1 aide	20 (40)	8 (21)	3.86	.05	− .21
Behavior support plan	7 (14)	7 (18)	.26	.61	.05
Any service	47 (94)	37 (95)	.03	.86	.02
Medication	12 (24)	17 (44)	3.83	.05	.21

Table 4 Spearman rank correlations of child characteristics with services (N = 89)

Characteristic	Total service min/week	
	r_s	p
Age in years	− .22	.04
WISC-IV Short-Form Full-Scale IQ	.21	.05
CASL		
Expressive language	.11	.29
Receptive language	.13	.20
ADI-R		
Social interaction	.14	.20
Communication	.18	.09
Repetitive behavior	− .08	.44
Total	.15	.16
ABAS-3		
Conceptual	.02	.89
Social	− .09	.41
Practical	.10	.34
GAC	.05	.63

WISC-IV Wechsler Intelligence Scale for Children-4th Edition, *CASL* Comprehensive Assessment of Spoken Language, *ADI-R* Autism Diagnostic Interview-Revised, *ABAS-3* Adaptive Behavior Assessment System-Third Edition

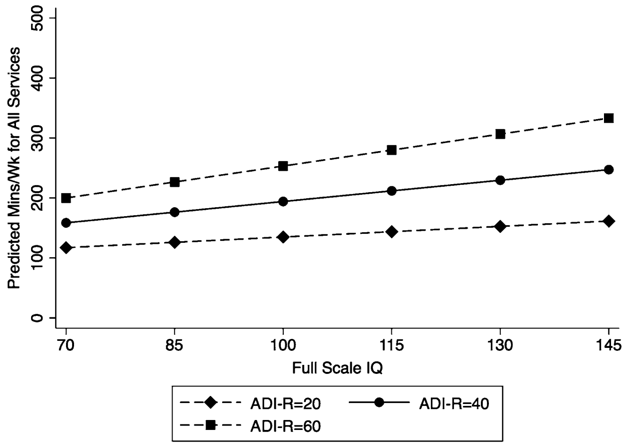

Fig. 1 Predicted total minutes per week of service as a function of interaction of full-scale IQ with ADI-R total score

interaction terms tested, only the combination of IQ and ADI-R produced a non-negligible result (b = .03, SE = .01, z = 2.43, p = .02). As noted, standard errors were estimated via bootstrapping (the SE changed < .001 between 50 and 3000 replications). The regression model of the interaction between IQ and ADI-R was used to produce the plot in Fig. 1 by calculating predicted values of the total number of minutes of service per week at fixed levels of IQ and ADI-R. To facilitate practical interpretation, the levels of the two predictors were set by the means and standard deviations (ADI-R M = 40, SD = 20; IQ M = 100, SD = 15). As an example, we can see that the estimated total number of minutes of service for a child with an ADI-R score of 60 and an IQ of 130 would be approximately 300 min per week. In contrast, a child with the same IQ of 130 and an ADI-R score of 20 would receive about half as many minutes of service per week, approximately 150.

Discussion

Prior research in the area of special education service use by children with ASD and its relationships with child and placement variables is limited (Wei et al. 2014; White et al. 2007). Most research has examined the service use of functionally-heterogeneous samples of children with ASD. There are no other known studies examining the correlates of special education service use in a well-characterized sample of students with ASD without ID. The goals of this study were to describe and explore variation in the type and amount of special education services provided to a sample of children with ASD without ID. The descriptive analysis provided an overview of characteristics of children and the special education services received in school. The exploratory analysis attempted to identify sources of variation in the services as a function of demographic, cognitive and behavioral characteristics of the children, including tests of plausible interactions.

The descriptive analysis showed that the IEPs of participants included a wide variety of classifications, special services and classroom placements. The majority of children with ASD without ID were classified under Autism (56%), followed by OHI (27%) as the second largest category of classification. This is in contrast to the findings of Toomey et al. (2009), who found that children with ASD without ID were most frequently classified under OHI. Overall, participants in the current study received an average of more than three hours of special services per week. Speech therapy and occupational therapy were provided to more than half of the children each week. This result is similar to that documented by Wei et al. (2014) who examined data of functionally-heterogeneous students with ASD. However, 44% of children in the current study also received counseling services in the school. This is noteworthy, as counseling has not been widely examined within the broader literature on special education services for children with ASD, even though evidence for the use of cognitive-behavioral strategies with children with ASD without ID is increasing (Ho et al. 2018).

The examination of individual types of therapies in relation to Autism classification showed that children with this classification were about twice as likely to receive 1:1 aide support (40% vs. 21%), and about half as likely to receive psychotropic medication (24% vs. 44%) as those who receive special education services under a different classification. Social skills instruction and behavior support plans were relatively infrequent across classifications. This finding may be surprising, especially for children classified under Autism who rarely received either service (14%). However, this result is similar to Wei et al.'s (2014) work with a sample of students with ASD and heterogeneous functional levels. Although Wei et al. (2014) found a larger percentage (34.6–46.6%) of students had BIPs than the current sample, the researchers' reported percentages of students with BIPs were relatively lower than expected, especially given the widely recognized level of social and behavioral impairment among children with ASD. White et al. (2007) also asserted that social and behavioral dysfunction is an area of unmet need in the school systems. The distributions of other specific services were generally similar by Autism versus other classifications.

Overall variation in the amount and kind of services was examined in relation to a number of characteristics of the children, including their age, special education classification, placement, and scores on cognitive and behavioral measures. These analyses showed a small negative relationship between age and the number of prescribed minutes of related services provided. There was a small positive correlation between service time and IQ ($r_s = .21$). The measures of language (CASL), autism symptoms (ADI-R), and adaptive behavior (ABAS-3) showed little to no relationship to amount of service time in the correlation analysis. This is in contrast to research with heterogeneous-functioning samples of children with ASD (Wei et al. 2014) or a diagnostically-heterogeneous higher-functioning sample of students with Pervasive Developmental Disorders (PDDs; White et al. 2007), where results indicated that greater language impairment and/or ASD symptoms had a positive relationship with special education service use. One possible explanation for the discrepancy in results may be related to potential differences in functioning and/or symptom severity levels between overall samples of children with ASD or PDDs used in previous studies. While this study included a diagnostically- and relatively functionally-homogenous sample of children with ASD without ID, prior studies' samples have generally been functionally- or diagnostically-heterogeneous [i.e., participants included according to diagnostic parameters of PDDs as set in the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition, Text Revision (DSM-IV-TR); APA, 2000]. In addition, it is possible that there could be qualitative differences in language impairment experienced by the current study's homogenous sample of children with ASD without ID. For example, the current sample may display language deficits that are more pragmatic in nature (as evidenced by the mean CASL expressive and receptive language scores in the average range), versus the language deficits in functionally-heterogeneous samples of children with ASD that may include more severe receptive or expressive language delays.

The robust regression analysis of three plausible bivariate interactions indicated that the interaction of the ADI-R total score with IQ was related to service time. While this reflects previous findings with functionally-heterogeneous samples of students with ASD in regard to symptoms (Wei et al. 2014), the interaction with cognition is new. One possible explanation of this interaction is that children with higher symptoms as well as higher IQ may have greater awareness of their needs and perhaps are more able to advocate for assistance. Alternatively, given the child's potential to succeed academically, parents or other parties may advocate for increased services, in order to assist the child to reach his or her potential.

Given the disparities between level of social/behavior services provided in schools and the social/behavioral needs of children with ASD highlighted by multiple researchers (Wei et al. 2014; White et al. 2007) and the current study's results, families and school staff of students with ASD should advocate for appropriate social and behavioral interventions in schools. Thomeer et al. (2017) described how the social-interaction/-communication deficits, restricted and repetitive behaviors, and possible problem behavior of students with ASD without ID affects the student and the environments in which they learn including the classroom and district levels. While there remains a critical need for research on the implementation of evidence-based practices (EBPs) in schools (Kasari and Smith 2013), Thomeer et al. (2017) recommend the use of evidence-based techniques, such as video modeling, peer mediation, self-management techniques and social skill groups (SSGs), to teach social-cognition and social skills/behaviors to children with ASD without ID in the schools. In addition, Thomeer et al. (2017)

summarized results of meta-analyses (Whalon et al. 2015; de Bruin et al. 2013) supporting the use of behaviorally-based interventions (i.e., functionally relevant antecedent-, consequence-, and video-based strategies) to improve the adaptive and academic functioning of students with ASD. The authors noted that these social and behavioral techniques should not be implemented in isolation, but combined as part of a comprehensive intervention (Thomeer et al. 2017). One example of a comprehensive school-based intervention (CSBI) that targets social and behavioral deficits of children with ASD without ID is schoolMAX (Lopata et al. 2012, 2013, 2018). schoolMAX incorporates five active treatment components including SSGs, in vivo practice of learned social skills in naturalistic play activities, face and voice emotion recognition instruction, a behavioral reinforcement system, and parent training. Results from a recent large-scale RCT by Lopata et al. (2018) indicated that students with ASD without ID who received schoolMAX exhibited significantly greater improvements in emotion-recognition skills and parent–teacher ratings of ASD symptoms and social/social-communication skills compared to students with ASD without ID who received their typical school interventions. These findings demonstrate the potential benefit of CSBIs for improving the social competence and ASD symptoms of students with ASD without ID, and highlight the need for special education services that directly target the social and behavioral needs of these students in the special education system.

Although this study provides important information on the special education services of children with ASD without ID, there are several limitations. These limitations are related to generalizability due to the sample characteristics, use of a retrospective study design and existing IEPs, and the exploratory nature of some of the analyses. The participants in this study were largely male and Caucasian and all were elementary-school age in western New York. In addition, these participants were all enrolled in prior treatment trials; this may limit generalization to the broader population of children with ASD without ID whose parents do not self-select or advocate to be included in treatment research. As such, future studies would benefit from more diverse and larger samples including those not involved in a treatment trial. In addition to these limitations, the severity of disability was assessed via a parent-report measure (ADI-R). Future studies may benefit from use of the Autism Diagnostic Observation Schedule—Second Edition (Lord et al. 2012) in order to assess the impact of researcher-observed symptoms, rather than parent-reported symptoms. Results also suggested that greater service delivery occurred for younger children. Whether this pattern represents an attempt at early intervention, decreased need as a result of successful therapies, or other factors, is unknown but is worthy of ongoing study. The relatively limited delivery of social skills instruction and individual behavior plans for children with ASD without ID is also deserving of further study (Wei et al. 2014; White et al. 2007) as these address the core features of the disorder. Additionally, the small but plausible relationship between services and autism symptoms and IQ found in this study warrants further investigation with a larger sample. Finally, this study focused primarily on related-services in special education. Further information on the specific academic support services received by students with ASD without ID receive is needed. Given the inconsistency in how academic support service information was reported in the IEPs examined in this study, future prospective studies may want to collect that information through direct means (e.g., observations in schools, interviews of all the school team members), rather than rely on retrospective review of IEPs. This study was a retrospective, exploratory study and it provided important initial information on the special education service use of children with ASD without ID. Future studies using large samples are needed to better understand service use and to ensure these children receive services that address their unique needs.

Author Contributions CAM participated in the design of the study and led its coordination, interpreted the data, and drafted the manuscript; JPD participated in the design, performed the statistical analysis, and assisted in drafting the manuscript; ALF participated in the design and coordination of the study and contributed to the manuscript; CL conceived of the design of the study, participated in the interpretation of the data and helped to draft the manuscript; JDR participated in the study's design and coordination and helped to draft the manuscript. MLT participated in the study's design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders: DSM-IV-TR*. Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington: American Psychiatric Association.

Bauminger-Zviely, N. (2014). School-age children with ASD. In F. R. Volkmar, S. J. Rogers, R. Paul, & K. A. Pelfrey (Eds.), *Handbook of autism and pervasive developmental disorders: Vol 2: Assessment, interventions, and policy* (4th ed., pp. 1029–1042). New York: Wiley.

Carrow-Woolfolk, E. (1999). *Comprehensive assessment of spoken language*. Circle Pines: American Guidance Service.

Center for Disease Control and Prevention (CDC). (2014). Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 states, United States, 2010. *MMWR*, *63* (SS-2), 1–21.

Center for Disease Control and Prevention (CDC). (2016). Prevalence and characteristics of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 states, United States, 2012. *MMWR*, *65* (SS-3), 1–23.

Chamberlain, B., Kasari, C., & Rotherman-Fuller, E. (2007). Involvement or Isolation? The social networks of children with autism in regular classrooms. *Journal of Autism and Developmental Disorders, 37,* 230–242. https://doi.org/10.1007/s10803-006-0164-4.

Dahle, K. B. (2003). Services to include young children with autism in the general classroom. *Early Childhood Education Journal, 31,* 65–70. https://doi.org/10.1023/A:1025193020415.

de Bruin, C. L., Deppeler, J. M., Moore, D. W., & Diamond, N. T. (2013). Public school-based interventions for adolescents and young adults with an autism spectrum disorder: A meta-analysis. *Review of Educational Research, 83*(4), 521–550. https://doi.org/10.3102/0034654313498621.

Fox, J. (2016). *Applied regression analysis and generalized linear models* (3rd ed.). Thousand Oaks: Sage.

Harrison, P. L., & Oakland, T. (2015). *Adaptive behavior assessment system* (3rd ed.). Los Angeles, CA: Western Psychological Services.

Ho, B. P. V., Stephenson, J., & Carter, M. (2018). Cognitive-behavioral approaches for children with autism spectrum disorder: A trend analysis. *Research in Autism Spectrum Disorders, 45,* 27–41. https://doi.org/10.1016/j.rasd.2017.10.003.

Humphrey, N., & Lewis, S. (2008). 'Make me normal': The views and experiences of pupils on the autistic spectrum in mainstream secondary schools. *Autism, 12*(1), 23–46. https://doi.org/10.1177/1362361307085267.

Kasari, C., & Smith, T. (2013). Interventions in schools for children with autism spectrum disorder: Methods and recommendations. *Autism, 17*(3), 254–267. https://doi.org/10.1177/1362361312470496.

Koegel, L., Matos-Freeden, R., Lang, R., & Koegel, R. (2012). Interventions for children with autism spectrum disorders in inclusive school settings. *Cognitive and Behavioral Practice., 19*(3), 401–412. https://doi.org/10.1016/j.cbpra.2010.11.003.

Lopata, C., Thomeer, M. L., Rodgers, J. D., Donnelly, J. P., McDonald, C. A., Volker, M. A., et al. (2018). Cluster randomized trial of a school intervention for children with autism spectrum disorder. *Journal of Clinical Child & Adolescent Psychology*. https://doi.org/10.1080/15374416.2018.1520121.

Lopata, C., Thomeer, M. L., Volker, M. A., Lee, G. K., Smith, T. H., Rodgers, J. D., et al. (2013). Open-trial pilot study of a comprehensive school-based intervention for high-functioning autism spectrum disorders. *Remedial and Special Education, 34*(5), 269–281. https://doi.org/10.1177/0741932512450518.

Lopata, C., Thomeer, M. L., Volker, M. A., Lee, G. K., Smith, T. H., Smith, R. A., et al. (2012). Feasibility and initial efficacy of a comprehensive school-based intervention for HFASDs. *Psychology in the Schools, 49*(10), 963–974. https://doi.org/10.1002/pits.21649.

Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., & Bishop, S. (2012). *Autism diagnostic observation schedule* (2nd ed.). Torrance, CA: Western Psychological Services.

Martins, M., Harris, S. L., & Handelman, J. S. (2014). Support inclusive education. In F. R. Volkmar, S. J. Rogers, R. Paul, & K. A. Pelfrey (Eds.), *Handbook of autism and pervasive developmental disorders. Vol 2: Assessment, interventions, and policy* (4th ed., pp. 858–870). New York: Wiley.

McDonald, C. A., Lopata, C., Nasca, B. C., Donnelly, J. P., Thomeer, M. L., & Rodgers, J. D. (2016). ABAS-II adaptive profiles and correlates in samples of children with HFASD or LFASD. *Journal of Developmental and Physical Disabilities, 28*(5), 769–783. https://doi.org/10.1007/s10882-016-9508-y.

Rutter, M., LeCouteur, A., & Lord, C. (2003). *Autism diagnostic interview—revised*. Los Angeles: Western Psychological Services.

Sansosti, F. J. (2010). Teaching social skills to children with autism spectrum disorders using tiers of support: A guide for school-based practitioners. *Psychology in the Schools, 47,* 257–281. https://doi.org/10.1002/pits.20469.

Sansosti, J. M., & Sansosti, F. J. (2012). Inclusion for students with high-functioning Autism Spectrum Disorders: Definitions and decision making. *Psychology in the Schools, 49*(10), 917–931. https://doi.org/10.1002/pits.

Sparrow, S. S., Balla, D., & Cicchetti, D. A. (1984). *Vineland adaptive behavior scales (Survey ed.)*. Circle Pines, MN: American Guidance Service.

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *Vineland adaptive behavior scales* (2nd ed.). Circle Pines, MN: American Guidance Service.

Sprent, P., & Smeeton, N. C. (2007). *Applied nonparametric statistical models* (4th ed.). Boca Raton: Chapman & Hall.

Tellegen, A., & Briggs, P. F. (1967). Old wine in new skins: grouping Wechsler subtests into new scales. *Journal of Consulting Psychology, 31,* 499–506.

Thomeer, M. L., McDonald, C. A., Rodgers, J. D., & Lopata, C. (2017). High-functioning autism spectrum disorder: A framework for evidence-based practice. *School Mental Health.*. https://doi.org/10.1007/s12310-017-9236-1.

Toomey, J. A., Lopata, C., Volker, M. A., & Thomeer, M. L. (2009). Comprehensive intervention for high-functioning autism spectrum disorders: An in-depth case study. In M. T. Burton (Ed.), *Special education in the 21st century* (pp. 95–118). Hauppauge, NY: Nova Science.

United States Department of Education. (2010). *32nd annual report to congress on the implementation of the individuals with disabilities education act.* Retrieved June 24, 2018 from https://www2.ed.gov/about/reports/annual/osep/2010/parts-b-c/32nd-idea-arc.pdf.

United States Department of Education. (2017). *39th annual report to congress on the implementation of the individuals with disabilities education act.* Retrieved June 24, 2018 from https://www2.ed.gov/about/reports/annual/osep/2017/parts-b-c/39th-arc-for-idea.pdf.

United States Department of Education, National Center for Education Statistics. (2012). *Digest of education statistics, 2011* (NCES 2012-001). Chapter 2.

Wechsler, D. (2003). *Wechsler intelligence scale for children* (4th ed.). San Antonio, TX: The Psychological Corporation.

Wei, W., Wagner, M., Christiano, E. R. A., Shattuck, P., & Yu, J. W. (2014). Special education services received by students with autism spectrum disorders from preschool through high school. *The Journal of Special Education, 48*(3), 167–179. https://doi.org/10.1177/0022466913483576.

Whalon, K. J., Conroy, M. A., Martinez, J. R., & Werch, B. L. (2015). School-based peer-related social competence interventions for children with autism spectrum disorder: A meta-analysis and descriptive review of single case research design studies. *Journal of Autism and Developmental Disorders, 45*(6), 1513–1531. https://doi.org/10.1007/s10803-015-2373-1.

White, S. W., Scahill, L., Klin, A., Koenig, K., & Volkmar, F. R. (2007). Educational placements and service use patterns of individuals with autism spectrum disorders. *Journal of Autism and Developmental Disabilities, 37,* 1403–1412. https://doi.org/10.1007/s10803-006-0281-0.

Wilcox, R. R. (2017). *Introduction to robust estimation and hypothesis testing* (4th ed.). London: Academic Press.