International journal of child development and mental health
ISSN: 2286 - 7481; E-ISSN: 2586-887X
Vol. 10 No. 2 July – December 2022 (27-35)

Features of Autism in Children with Visual Impairments: A Brief Report

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How to Cite: Robin L. Dodds, Yuanxi Ye. (2022). Features of Autism in Children with Visual Impairments: A Brief Report. *International Journal of Child Development and Mental Health, 10*(2), 27-35.

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Article Info:
Received: 14 September 2022
1st Revision: 5 October 2022
Accepted: 30 November 2022

Keywords:
Autism spectrum disorder, Children, Parent report, Visual impairment.

Abstract

Children with visual impairments (VI) display challenges in social interaction, may have elevated repetitive behaviors, and sensory features similar to children diagnosed with autism spectrum disorder (ASD). ASD is frequently diagnosed comorbidly in children with VI, making it important for educators to better understand the behavioral similarities and differences between ASD and VI. For this study, the researchers compared 27 children with VI between the ages of 5 and 12 with 177 children with ASD using parent reports of ASD symptomology. Statistical means comparisons were conducted between these two groups on items related to social communication, repetitive behaviors and sensory features. Results: The children with VI displayed similar overall levels of autism symptoms but had better social interaction skills and less behavior and sensory problems. This pilot investigation may help educators better understand the unique needs of children with visual impairments and develop more targeted supports for children with VI who exhibit sensory differences or social communication impairments. Future research should include observational assessments and validated measures.

Introduction

World-wide, there are about 19 million children diagnosed with visual impairments, and 1.4 million of them are considered blind (Ghaderi et al., 2018). Visual impairment can occur at birth, under different circumstances such as hereditary conditions, accidents, and disease. An individual with a visual acuity of 20/70 to 20/200 is considered as low vision, and visual acuity below 20/200 is considered legally blind (Li, 2009). Children with profound visual impairments whose visual acuity is 20/800 or worse experience early challenges in social cognitive development similar to children with Autism Spectrum Disorder (ASD), such as in the ability to understand other people's thoughts or "theory of mind", which may influence their social interaction skills (Pring, 2005; Minter et al., 1998). Children with VI often display impairment in social interaction (Hobson & Lee, 2010) which is similar to children who are diagnosed with ASD (Mukaddes et al., 2007). Although there are few studies that directly compare the behavior of children with VI and ASD, researchers report an overlap in symptoms between these groups (Absoud et al., 2011). Children with ASD can also display repetitive motor movements and may be inflexible about new routines (Hay et al., 2020). Children with ASD present with restricted interests or perseverative behaviors, which interfere with their ability to interact and learn. Additionally, they can also have hyperreactive responses, causing

them to avoid sensory input or, conversely, they can have unusual interests in sensory experiences such as sight, touch, and hearing that lead them to seek out such stimuli (Centers for Disease Control and Prevention, 2020). These symptoms are comparable to "blindisms" reported in children with congenital VI which frequently manifest as body rocking, stereotypical finger movements, eye-pressing, and repetitive jumping (Fazzi et al., 1999). Because VI is a low-incidence disability, much of the literature focused on ASD-like traits in children with VI has been in the form of case descriptions or small-scale screening studies, so it remains unclear whether patterns of ASD traits are expressed similarly in children with diagnoses of VI (Absoud et al., 2011).

According to several studies, ASD is frequently diagnosed comorbidly in children with visual impairments (Jure et al., 2016; Mukaddes et al., 2007). Children with ASD experience similar difficulties in communication, sensory impairments, and intellectual disabilities as children with VI (Absoud et al., 2011; Bellomo, 2016). However, the degree and patterns of impairments might differ between children with VI and ASD. As a result, it is difficult to determine whether children with VI have similar autistic features as children with ASD and should receive a dual diagnosis, or if the symptoms are best attributed to their visual deficit. Additionally, research has indicated that children with VI and comorbid ASD may show marked improvements in ASD symptoms and seemingly "outgrow" their ASD diagnosis (Jure et al., 2016). Thus, it is necessary to investigate the behavioral similarities and differences presented by children with VI and ASD (Hobson et al., 1999).

Objectives

The purpose of this causal-comparative study is to compare ASD symptomatology in school-age children with congenital visual impairments with school-age children with an autism diagnosis as described by their parents.

Methods

Participant Eligibility

The participants for this study included parents or primary caregivers of a school-aged child with either a congenital visual impairment or autism spectrum disorder in the Greater Los Angeles metro region. Participants were recruited through flyers sent by email to public and private school administrators and educational support programs that serve children with VI, ASD or children with disabilities in general. Parents were selected as informants because they would be able to report on the impact of their child's disability now and historically across multiple contexts including; school, home and community. Participants also had to meet the following criteria: (a) their child was between 4 and 12 years old; (b) if their child had a visual impairment, it was considered to be moderate to severe, or profound; and (c) they could read and respond to surveys in English. Children reported to have a dual diagnosis of ASD and VI were excluded from participation to allow for direct comparisons. All procedures described in this paper were approved by the Institutional Review Board (IRB) on Human Subjects of California State University, Los Angeles prior to the recruitment of participants and collection of data.

Recruitment

The research team sent out the flyers for the study to Cal State LA faculty, Special Education classroom teachers attending Cal State LA and enrolled in credential and/or graduate programs, and community organizations who serve children with disabilities in general. Recruitment flyers were also posted to Facebook sites for parent support and special education-focused groups. Additionally, the researchers also contacted organizations who serve people with VI or ASD directly using addresses found on publicly available websites (administrator and/or coordinator of research) and sent an email message with the recruitment flyer attached for distribution. Community organizations could choose to forward the flyer to potential participants or post the flyer to their website and/or social media accounts. Participants could then respond to the online survey by following the hyperlink on the flyer. The research team also visited and distributed physical flyers to

parent support groups for children with disabilities near the University. Potential participants could contact the researchers directly by using the email address listed on the flyer if they had any questions or concerns.

Measures

Demographic information was collected for each parent through the online survey, which included child's grade in school, child's age in years, child's age when first referred to early intervention or special education, parent ethnicity, language spoken at home, current services child receives, mother's highest education level, father's highest education level, child's diagnosis/es, and the severity of child visual impairments for children with VI. Parents were not asked to describe their child's visual impairment beyond this basic information. ASD traits were measured by using the Childhood Autism Rating Scale Questionnaire for Parents and Caregivers (CARS-QPC) (Schopler et al., 2010), which is a tool used in clinical settings to assist professionals in measuring the likelihood of an autism spectrum disorder diagnosis in children two years and older. Although the CARS-QPC is not a diagnostic instrument, it broadly covers all topics addressed on the Autism Diagnostic Interview, Revised ADI-R, Rutter et al. (2003), is written in parent -friendly terms, can be completed by a caregiver in about ten minutes, and parent scores on CARS-QPC items have been shown to correlate with similar constructs on the ADI-R and address most items on the CARS2 (Haebig et al., 2014; Schopler et al., 2010). Additionally, the measure is being used more often in research to assess the severity of ASD symptoms by parent report (Schlosseret al., 2020).

The CARS-QPC elicits parent input to support information traditionally gathered through observational assessments and has been used in research to validate a diagnosis of ASD for inclusion in research studies (Khabazkhoob, M., 2018). The prevalence and causes of visual impairment in seven-year-old children. (Golshan et al., 2019). Thirty-one items from the questionnaire related to children's com} munication, social interaction, motor, play, routines, and sensory skills were rated by parents on a four-point Likert scale: 0 = Not a problem, 1= Not a problem now but was in the past, 2= Mild to moderate problem, or 3=severe problem. Total scores for the CARS-QPC could therefore range from 0 to 93. Although the authors of the questionnaire do not provide reliability and validity information for the CARS-QPC, its utility in survey research or in situations where direct observation is not feasible is an open question (Li, 2012; Haebig et al., 2014). Subscale scores were calculated by adding responses for all items included in the subscale, and total scores were calculated by adding all subscale values for the CARS-QPC. The communication subscale included 5 items, social interaction included 9 items, motor included 5 items, play included 3 items, routines included 5 items, and sensory included 4 items. The internal reliability of the CARS-QPC in the current study sample was investigated using Cronbach's alpha. Results indicated that the alpha for the total scale was very good (α= .92), and alpha values for subscales ranged between .47 and .80.

Data Analysis

An independent samples t-test was performed to compare VI and ASD samples on child age, and no significant difference was found. MedCalc online statistical software's comparison of proportions calculator (Schoonjans, 2019) was utilized to compare the percentages of different racial/ethnic backgrounds between participants who had children with VI and those with ASD. The results of all comparisons are shown in table 1. Because demographics for VI and ASD samples were very similar, the researchers made the decision to forgo participant matching and compared the groups directly to make use of all available data.

Table 1: Comparison of Child Age and Racial/Ethnic Categories for Participants with Visual Impairments (VI) v. Autism Spectrum Disorder (ASD)

	VI (n=27)	ASD (n=177)	95% CI		*t*	*p*	*Chi Square*
	$\bar{x}$ (%)	$\bar{x}$ (%)	Lower	Upper			
Child Age	8.33(1.96)	8.34(1.81)	-.75	.74	-.02	.99	
White/Non-Hispanic	66.6	63.8	-17.20	19.22		.78	.08
African American/Black	11.1	8.4	-6.12	19.95		.64	.21
Hispanic/Latino	11.1	10.2	-8.11	18.23		.89	.02
Native American/Alaskan	7.4	8.5	-15.19	8.45		.85	.04
Asian/Pacific Islander	3.7	6.7	-11.85	8.58		.55	.36

**p<.05*

Prior to analysis, the assumption of normality was assessed for total CARS-QPC score and kurtosis and skewness statistics, are reported in Table 2. According to Joanes and Gill (1998), skewness, a measure of the symmetry of data, which is between -1/2 and +1/2 represents a distribution that is approximately symmetric. And kurtosis (a measure of the sharpness of the peak of the distribution) values between -2 and +2 can be treated as normal according to Westfall (2014). As most values examined fell within these ranges, the data was treated as normal, and therefore no corrections were applied.

Table 2: Descriptive Information of Total Score on the CARS-QPC

			VI (n=27)	ASD (n=177)
Mean	–	–	51.05	55.89
SD			15.99	16.01
Skewness			.10	-.76
Kurtosis			-1.53	-.45

A series of independent t-tests were then performed to determine whether significant differences on CARS-QPC scores existed between school age children with VI and those with ASD at the total score and subscale levels (Martin & Bridgmon, 2012). Item level CARS-QPC data was compared between groups (VI and ASD) using the nonparametric Mann-Whitney test which tests for differences in the overall distribution across groups rather than differences in the mean. For total score and subscale analyses, imputation of the individual participant means of CARS-QPC responses was used to account for any missing data prior to analyses (all included participants completed at least 80% of items), whereas for item level comparisons, only complete data was included, so the number of participants will vary by item. Cohen's ***d*** is reported as a measure of effect size for significant findings in parametric analyses, whereas ***r*** is reported for non-parametric tests.

Results

Participant and family characteristics

The final sample included 27 parents of children with VI and 177 parents of children with ASD based on meeting all eligibility criteria as listed above, and the completeness of participant data. On average, children with VI were 8.33 years-old, and their parents were mostly White non-Hispanic (66.6%) and college-educated (96.3% of both mothers and fathers). Children with ASD had a mean age of 8.34, and their parents were mostly White non-Hispanic (63.8%) and college-educated (99.7% of mothers and 99.3% of fathers). Both groups included

children ranging between four and twelve years old. The students with VI were all described as being in the moderate to profound range of congenital visual impairment by parent report, meaning they were diagnosed at a very young age (or birth) and the impairments have had a significant impact on the child's development. Two children with VI had an additional special education eligibility of Specific Learning Disability, one was considered Deaf/Hard of Hearing, one had an additional eligibility of Other Health Impairment, and one qualified as a student with Emotional or Behavioral Disorder. One student with ASD had additional eligibility as a student with a Speech or Language Impairment and one had eligibility as a student with Emotional or Behavioral Disorder in addition to their diagnosis of ASD. Severity of ASD-related impairments were not assessed in this study, however children with ASD received an average of 2.40 (1.31) Individualized Education Program services, fewer than children with VI who received an average of 3.46 (2.06), which is a statistically significant difference $t(201)=3.54$, $p<.01$. This is likely due to the specialized supports and services such as a teacher of the visually impaired and assistive technology specialist, required for students with VI. As the survey was anonymous, no verification of diagnosis was performed and all data is by parent report.

ASD Symptoms

On average, children with VI scored lower on total CARS-QPC score (M=51.05, SD=15.99) than children with ASD (M=55.89, SD=16.91) $t(201) = -1.39$, $p=.17$, indicating lower levels of autism symptoms, however this relationship was not statistically significant. Children with VI also scored lower on 5 of the 6 subscales than children with ASD, but the only difference that reached significance was the social interaction subscale $t(202) = -2.486$, $p=.01$. This means that students with VI had significantly fewer challenges in social interaction skills than students with ASD. This difference displayed a moderate effect size (d= -.51). Children with VI generally scored lower than children with ASD on most CARS-QPC items. However, the VI group scored higher than the ASD group on the sensory subscale and all items related to sensory seeking (i.e., visual inspection, reflections light, sounds and smell, and texture and touch), meaning that children with VI engaged in more sensory seeking behaviors than children with ASD. However, these differences did not reach significance.

Table 3: Comparing Students with VI and ASD on the CARS-QPC Scales

	VI (n=27)		ASD (n=177)		*t*	*p*	*d*
Scale/Subscale	**M**	**SD**	**M**	**SD**			
Communication	8.26	3.01	8.80	2.77	-.927	.36	
Social Interaction	15.34	5.28	18.02	5.20	-2.48	.01*	-.51
Motor	6.44	2.70	6.47	3.01	-.04	.97	
Play	5.89	3.74	7.36	2.95	-1.94	.06	
Routine	7.92	3.12	8.76	3.16	-1.28	.20	
Sensory	7.19	2.04	6.46	2.62	1.37	.17	

**p<.05*
Note. CARS-QPC=Childhood Autism Rating Scale Questionnaire for Parents and Caregivers

Although children with VI and ASD had similar scores on some social interaction items, children with VI were significantly better able to make and keep friends, show a range of emotions and understand and respond to others' thoughts and feelings appropriately with small effect sizes (r =-.19, -.18, -.21). The VI and ASD groups had similar scores on most play items, but children with VI performed significantly better in their imaginary role-playing skills. This difference displayed a small to moderate effect size (r =-.26). Moreover, children with VI and ASD had similar scores on many of the routines subscale items, but the VI group displayed significantly lower levels of special interests, referred

to as "Highly restricted, fixated interests" in the DSM-V as one of the criteria for ASD (American Psychiatric Association, 2013). This difference displayed a small effect size (r=-.17). Results of subscale comparisons can be viewed in table 3 and results of all item comparisons are shown in table 4.

Table 4: Results Comparing Students with VI and ASD on CARS-QPC Items

	VI			ASD			*U*	*z*	*r*
Item	**N**	**Mean Rank**	**Rank Sum**	**N**	**Mean Rank**	**Rank Sum**			
Imitate Words	25	86.42	2160.50	176	103.07	18140.50	1835.50	-1.39	
Responds Facial	27	104.11	2811.00	176	101.68	17895.00	2319.00	-.21	
Responds Name	26	93.15	2422.00	176	102.73	18081.00	2071.00	-.83	
Directs Facial	26	95.12	2473.00	175	101.87	17828.00	2122.00	-.59	
Gestures	26	111.52	2899.50	173	98.27	17000.50	1949.50	-1.17	
Eye Contact	23	91.20	2097.50	149	85.78	12780.50	1605.50	-.52	
Point/Share	22	94.89	2087.50	138	78.21	10792.50	1201.50	-1.69	-.
Follow Gaze	23	94.91	2183.00	140	79.88	11183.00	1313.00	-1.51	
Responsive Social	21	76.14	1599.00	144	84.00	12096.00	1368.00	-.78	
Initiates Social	22	69.70	1533.50	145	86.17	12494.50	1280.50	-1.59	
Sustains Interaction	24	79.21	1901.00	153	90.54	13852.00	1601.00	-1.13	
Makes Friends	22	65.09	1432.00	151	90.19	13619.00	1179.00	-2.49*	-.19
Range Emotion	22	66.27	1458.00	150	89.47	13420.00	1205.00	-2.35*	-.18
Others Thinking	23	63.15	1452.50	151	91.21	13772.50	1176.50	-2.74**	-.21
Moving Fingers	27	94.83	2560.50	175	102.53	17942.50	2182.50	-.66	
Self-Injury	27	92.96	2510.00	175	102.82	17993.00	2132.00	-.85	
Clumsy	27	107.91	2913.50	175	100.51	17589.50	2189.50	-.64	
Fine-Motor	26	111.46	2898.00	173	98.28	17002.00	1951.00	-1.14	
Parts Toys	22	80.00	1760.00	153	89.15	13640.00	1507.00	-.85	
Repetitive Play	21	78.86	1656.00	151	87.56	13222.00	1425.00	-.81	
Imaginative Play-Objects	22	77.59	1707.00	141	82.69	11659.00	1454.00	-.51	
Imaginative Play-Roles	23	54.87	1262.00	140	86.46	12104.00	986.00	-3.27***	-.26
Anxiety Face/Body	27	93.31	2519.50	175	102.76	17983.50	2141.50	-.84	
Repetitive Worry	27	86.28	2329.50	176	104.41	18376.50	1951.50	-1.58	
Coping	27	111.87	3020.50	176	100.49	17685.50	2109.50	-.98	
Rigidity	26	111.85	2908.00	175	99.39	17393.00	1993.00	-1.07	
Special Interest	25	76.36	1909.00	177	105.05	18594.00	1584.00	-2.38*	-.17
Visual Inspection	24	107.83	2588.00	175	98.93	17312.00	1912.00	-.75	
Reflections	24	108.94	2614.50	174	98.20	17086.50	1861.50	-.90	
Sound/Smells	26	111.77	2906.00	173	98.23	16994.00	1943.00	-1.17	
Texture/Touch	27	116.74	3152.00	176	99.74	17554.00	1978.00	-1.53	

**p≤.05, **p≤.01, *** p≤.001, U=Mann-Whitney U statistic, r=Z/(√N) effect size*

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Discussion

The study found no statistically significant differences between elementary students with VI and those with ASD on the CARS Questionnaire for Parent Concerns total score, although mean scores for children with VI were lower than those with ASD. This finding is somewhat inconsistent with previous literature where children with VI were reported to exhibit significantly lower levels of autism symptoms compared to children with ASD (Butler et al., 2018; Pring & Ockelford, 2005). It is possible that the lack of s ignificance in total autism symptoms as measured by the CARS-QPC in this study is due to the small sample size of children with VI, their relatively young age, additional confounding participant characteristics, or the specific choice of ASD measure. In regard to challenges in the communication subscale, there was no significant difference in scores between children with ASD and VI. However, as some items were vision-related (i.e. making eye-contact when speaking or listening) differences may have been obscured. Parents of children with VI may have interpreted the question differently than parents of children with ASD because they hold different concepts regarding the purpose of making eye contact. Additionally, much of the literature does emphasize that both children with VI and ASD display challenges in social communication (Gordon-Pershey et al., 2019). Tadic´, Pring, & Dale (2009) demonstrated that lack of access to visual information will impact children's overall language and communication development, preventing them from distinguishing facial expressions, leading to challenges in understanding other people's intentions. Interestingly, recent findings from Hay and associates (2020) suggest that for children with ASD who have significant fine and gross motor challenges, visual processing dysfunction may be a factor, even in those with normal visual acuity. In this study, there were no significant differences in the sensory subscale between children with VI and ASD, however students with VI did display higher mean scores on this subscale and on each sensory item, indicating greater challenges. This finding is consistent with previous research showing that sensory differences are more apparent in children with VI than children with ASD. The results may not have reached significance because of inadequate power or differences in measurement of sensory challenges. In this study, only a few parent-report items related to sensory issues were included in the CARS-QPC sensory subscale, whereas other research has utilized trained clinicians to code observations in a controlled laboratory environment (Cuevas et al., 2009; Li, 2009; Ramsamy-Iranah et al., 2016).

Children with VI in this study scored significantly lower on the social interaction subscale than their peers with ASD, as rated by their parent or caregiver. This means that children with VI were better able to make and keep friends, show a range of emotions and understand and respond to others' thoughts and feelings appropriately. This supported previous findings that children with VI were better able to maintain a conversation and establish friendships, whereas children with ASD displayed greater challenges in developing peer relationships (Hobson & Lee, 2010). Importantly, Hobson & Lee (2010) also found that children in their study with VI were able to overcome ASD symptoms related to social interaction over time, while those with an ASD diagnosis did not. Together, these findings may indicate that greater emphasis be placed by educators on sensory-related skills development in students with VI, and social skills interventions in students with ASD.

Limitations and Future Directions

This was a small, brief study that relied on parents to report their child's disability status, service use and ASD symptoms using a single instrument not originally designed for research or diagnostic purposes. Therefore, there are several limitations to report and suggestions for more robust future research. First, future studies should make use of observational measures as well as student and health records to produce more nuanced and reliable data. Additionally, measures of disability severity for ASD, and type of visual impairment (i.e. cerebral or peripheral) should be included in future analyses to better understand their differential impact on social and sensory symptoms (Fazzi et al., 2019). Finally, as new autism symptomology assessments specifically designed (Absoud et al., 2011) or

modified for the VI population (Williams et al., 2014) become available and show strong reliability and validity, these measures can provide better understanding of which children should receive a dual diagnosis of ASD and VI, and which children are likely to outgrow some of their ASD symptoms.

This pilot study found that school age children with VI displayed fewer challenges in social interaction as compared to children with ASD, and potentially greater sensory needs. It is important for educators and researchers to understand the similarities and differences in presentation so that they can create interventions suited to the unique needs of children with VI who display ASD-like traits. Future studies comparing ASD symptoms in individuals with VI should consider the impact of maturity on social interaction skills and implement longitudinal designs to better understand the trajectories of this difference. Additionally, research exploring the efficacy of specific instructional practices for learners with comorbid diagnoses of VI and ASD or other sensory differences is warranted as this population grows (Banda et al., 2014; Probst & Walker, 2017).

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