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Association Between Therapeutic Interventions and Quality of Life in People With Autism

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Abstract

Research exploring the association of autism interventions with the quality of life (QoL) of adults with autism spectrum disorders was scarce. Although a multitude of interventions are used to target a specific challenge facing the individual with autism, their correlation with achieving a better QoL is largely unknown. We conducted a cross-sectional, correlational survey study to determine the association between seven interventions—behavioral, social, mental health, daily living skills (DLS), vocational, mindfulness, and medications—and the QoL of adults 18 years and older with autism with no intellectual disability (ID) living in Canada. A national sample of 182 autistic adults or proxy reports completed the survey that used the WHOQOL-BREF to measure subjective QoL. Behavioral, mental health, and medications were the most frequently used interventions (67%, 71.4%, and 82.4%, respectively). QoL was lower across all domains of the WHOQOL-BREF compared with the general population. Hierarchical multiple regression analysis showed that characteristics, such as autism severity, being female, and older age negatively predicted QoL across all domains except for the physical domain, whereas being in a relationship positively predicted social QoL explaining 35.2% of the variance. Of the seven interventions used, behavioral therapies and receiving mental health support consistently predicted a better QoL across all domains, except for the environment domain where only mental health support was a significant predictor. Our findings suggest prioritizing provision of behavioral and mental health interventions to adults with autism and inform future research to evaluate their effectiveness in QoL outcomes as an end goal.

Introduction

Autism spectrum disorders (ASD) are a group of neurodevelopmental conditions characterized by difficulties in social communication, interaction, and sensory disturbances accompanied by repetitive and restrictive behaviors and interests, which limit the person's ability to achieve full integration into the community (American Psychiatric Association [APA], 2013). The current prevalence of ASD is estimated at 1%–2%, although there is a trend toward increasing numbers being diagnosed (Xu et al., 2018), with current estimated rates of 1 in 54 children having the disorder compared with 1 in 89 in 2015 (Baio et al., 2018). ASD occurs among all racial, ethnic, and socioeconomic groups with a higher prevalence in males than females with a 3:1 ratio (Baio et al., 2018).

The World Health Organization (WHO, 1995) defined QoL as

> The individual's perception of their position in life, in the context of culture and value systems in which they live, and in relation to their goals, expectations, standard and concerns as they relate to the individual's physical and psychological health, personal beliefs, social relationships, level of independence, and salient features of the environment (p. 1405).

Individuals with ASD experience a significantly poorer quality of life (QoL) and burden of mental health disorders compared with the general population and even those with other disabilities (Ayres et al., 2018; Kamio et al., 2013; Khanna et al., 2014; Knüppel et al., 2018; Lawson et al., 2020; van Heijst & Geurts, 2015). This is true across all age groups and QoL domains, although social QoL appears to be most impacted (Jennes-Coussens et al., 2006; Kamio et al., 2013; Kamp-Becker et al., 2010; Lin, 2014). Several factors, including communication and social difficulties, cognitive functioning, atypical behaviors, and sensory disturbances, limit the ability of these individuals to participate in their community and live independent, fulfilling lives. Van Heijst and Geurts (2015) found that people with autism had a much lower QoL compared with those without autism across the lifespan, regardless of age. Another large study investigating QoL in 370 autistic adults in the UK found a diminished QoL in all domains of the WHOQOL-BREF questionnaire compared with the general population, with younger participants reporting a higher QoL compared with older ones in the psychological and environment domains (Mason et al., 2018). Factors such as psychiatric disorders, intellectual disability (ID), autism symptomology, and sleeping difficulty have been associated with poor QoL in this population (Knüppel et al., 2018), whereas perceived adequacy of social support from family and friends and ability to cope have been positive predictors of QoL (Khanna et al., 2014). Of note, challenges in social participation, communication, and daily living skills (DLS) have been shown to negatively affect QoL.

Although a range of therapeutic interventions are offered to people with ASD to target specific gaps in functioning, behaviors, and communication, their impact on improving QoL and well-being is not well understood. In fact, there is a gap in understanding what a "good" QoL means from the autistic person's perspective and which interventions are deemed most effective in achieving this goal (Ayres et al., 2018; Pfeiffer et al., 2017). Most studies focus on evaluating outcomes related to the specific intervention strategy being tested and the challenges it is meant to address. Moreover, effectiveness studies often use small sample sizes and lack a longitudinal perspective. As such, the true impact of therapeutic interventions in improving QoL is often not a key objective nor an end goal for such programs. Several studies have assessed the association between a given intervention and health-related outcome measures in people with ASD (Ekman & Hiltunen, 2015; Gal et al., 2015; McVey et al., 2016; Siew et al., 2017; Sizoo & Kuiper, 2017; Spek et al., 2013). Intervention types have included cognitive behavioral therapy (CBT), social skills, medical, peer mentoring, vocational, and complementary/integrative interventions, but many of the interventions did not have sufficient evidence supporting their use in autistic adults and were not perceived as important by the autistic community (Benevides et al., 2020, Pfeiffer et al., 2017). Indeed, findings from a recent systematic review showed that only two interventions, namely CBT and complementary/integrative mindfulness interventions,

were considered as emerging evidence-based approaches that assessed health outcomes of the autistic population (Benevides et al., 2020).

Given the current research and awareness related to the predictors of QoL in people with autism, targeted interventions should focus on approaches that help improve QoL outcomes in this population. However, the outcomes of various interventions offered to children and adults with ASD rarely relate to QoL, nor are they always consistent with the end goals and needs of people with ASD and their caregivers (Pfeiffer et al., 2017). As such, there is a gap to better understand the outcomes of interventions that are meaningful and important to the autistic population. Based on these gaps in existing research, we aimed to identify the most used interventions by people with ASD residing in Canada, and more importantly, to ascertain whether a relationship exists between the use of these interventions and their QoL. Specifically, our cross-sectional correlational survey study captured the use of autism interventions including social skills, mental health, medications, adaptive/DLS, behavioral therapies, mindfulness, and vocational therapies, and their association with the QoL of individuals with autism 18 years and older without ID. Our cross-sectional design allowed us to investigate the population of interest at a single point in time without manipulation of the variables being studied (Salazar et al., 2015), while the correlational aspect explored the relationship between the predictor and outcome variables, although a causal relationship cannot be established (Asamoha, 2014; Frankfort-Nachmias & Leon-Guerrero, 2018).

Our current research highlights a few important points: (a) the need to integrate measures of QoL in interventional studies, (b) the lack of data regarding which therapeutic interventions matter most to the autistic community, and (c) the voice of the autistic community as an integral part of the intervention process to ensure a client-centered approach.

Theoretical Foundation

The theoretical basis for our research was the precede-proceed model (PPM) for program health planning and evaluation (Green & Kreuter, 1991). The model is used to guide the development and evaluation of evidence-based interventions that meet the needs of the target population, and the model has been used in autism research (Hatfield et al., 2016). The precede framework is based on predisposing, reinforcing, and enabling factors in educational and environmental diagnosis and evaluation, whereas proceed comprises the policy, regulatory, and organizational constructs in educational and environmental development. Specifically, phases 6–8 of the proceed framework revolve around the process, impact, and outcome evaluations of the intervention where impact evaluation considers whether the intervention is having the desired impact on the targeted behavioral change, and outcome evaluation assesses whether the intervention is achieving the desired outcome, an improved QoL (Green & Kreuter, 2005). Therefore, the latter construct relates to the nature of our study.

In addition, two of the five pillars posited by Green and Kreuter that ground the PPM are relevant here (Porter, 2016). First, its participatory nature is community-based and involves key stakeholders and members of the target population in the identification, planning, and evaluation of community health and QoL issues. Second, its QoL focus is the end goal rather than changing behavior. In this context, the participatory nature of the PPM involves the autistic community as the target population and the QoL aspect focuses on evaluating this concept as the outcome of interest.

Methods

Participants

The sample population for our study comprised individuals with autism, without ID, aged 18 years and older residing in Canada or the parents/caregivers of these individuals as proxy-reports (i.e., how the parent thinks the child would respond to questions). The reason for allowing parents to complete the study survey was to ensure that adults with autism, without ID, who did not have access to the survey or whose autism severity may have interfered with their ability to complete the survey were not excluded from the study. This approach ascertained a more inclusive sample, which captured the views of individuals with all levels of autism as well as mitigated the potential risk of not achieving the desired sample size.

The severity and ID status was based on self-reports or proxy reports rather than a clinician's formal diagnosis. We asked participants in the study survey: "What is your level of autism?" The option of three levels, with associated brief descriptions, were provided, ranging from "requiring support" to "requiring very substantial support." Moreover, "mild," "moderate," and "severe" were included as additional descriptors to further distinguish the three levels of severity. We used a nonprobability convenience sampling technique and invited participants from targeted autism service centers, provincial ASD organizations, and social media groups to take part in the survey using an electronic flyer outlining details of the study. A small token of appreciation in the form of a $10 gift card was provided to participants who completed the study survey. The university's Ethics Review Board approved the study (11-05-21-0981565). The study survey was administered using the Survey Monkey platform.

Measures

Measurements of demographic variables and interventions use. The demographic questionnaire of the survey captured variables including participants' age, gender, autism severity, relationship status, living status, education level, employment status, support status, and physical and mental health status. All variables were included in the descriptive statistics of the analysis and eight were tested as potential covariates in the statistical model. Age was captured as a continuous variable, while all other variables were dichotomous categorical. We included seven autism interventions—social skills, mental health, behavioral therapies, adaptive/DLS, vocational/employment, mindfulness, and medications—on the study survey and asked the following question: "Please indicate which of the following autism interventions you have ever used (in the past or present) to help manage your needs" *(Please choose all that apply).* The use of each intervention was captured as a dichotomous variable *Yes/No.*

QoL measurement: WHOQOL-BREF. To assess the QoL of individuals with autism in this study, the WHOQOL-BREF instrument was used (Harper et al., 1998). The WHOQOL-BREF assessment is an abbreviated version of the WHOQOL-100 tool developed by the WHOQOL Group in 15 international field centers across different cultures (WHOQOL Group, 1994) and has been validated in the adult autistic population (McConachie et al., 2018). It consists of 26 items with two global questions and four QoL domains: physical (seven items, e.g., activities of daily living, work capacity, sleep), social (three items, e.g., relationships, social support), psychological (six items, e.g., self-esteem, positive feelings, memory), and environment (eight items, e.g., safety, transport). Respondents are asked to rate each question on a 5-point Likert scale with higher scores signifying a higher QoL (WHOQOL-BREF Manual, 1996). Each total domain score is calculated by taking the mean score of all items within each domain, then raw scores are transformed by multiplying by four to make them comparable with the scores used in the WHOQOL-100. As such, the converted scores range between 4 and 20. Finally, the second transformation converts the domain scores into standardized scores ranging between 0 and 100. All domain scores were quantitative and measured on a continuous scale. Permission to use the WHOQOL-BREF was obtained and granted from the WHO National Field Center prior to its use.

Statistical Procedures. We used four hierarchical multiple regression (HMR) models to predict each of the WHOQOL-BREF domains. In each instance, a set of potential covariates were entered as blocks into the model to investigate their association with the outcome variable. Model 1/Block 1 comprised the demographic variables: age, gender, and autism severity; Model 2/Block 2 included additional covariates including employment status, relationship status, education level, support status, and having a mental health diagnosis. These covariates were chosen based on a review of the literature, which revealed statistically significant associations between these factors and the WHOQOL-BREF or other measures of QoL (Khanna et al., 2014; Mason et al., 2018). Model 3/Block 3 included all seven therapeutic interventions to determine whether any significant associations exist with the criterion variables.

Prior to conducting the HMR analysis, we tested key assumptions of the HMR model. This included normality of residuals, multicollinearity, independence of residuals, undue influence, linearity, and homoscedasticity. In addition, we used point-biserial correlations for *diagnostic* purposes to ascertain correlations between the predictor/covariate and outcome variables. We created a correlation matrix to evaluate correlations between each covariate (age, gender, autism severity, relationship status, employment, mental health status, social support status, and education level) and each WHOQOL-BREF domain. Furthermore, we repeated bivariate analyses to determine correlations between each of the seven autism interventions and respective outcome variables. We considered correlation coefficients ranging from 0.1 to 0.39, 0.4 to 0.69, and 0.7 and above as small, moderate, and high, respectively (Hinkle et al., 2003).

We conducted a series of data screening and cleaning procedures to handle missing data and outliers in accordance with the WHOQOL-BREF Manual (1996). To handle missingness, we discarded domains with more than 20% of the data missing from the assessment. In this dataset, one individual did not complete the full WHOQOL-BREF questionnaire and was, therefore, excluded from the analysis. We conducted model checks by assessing the F value and the adjusted coefficient of determination (R^2) with associated p values for each of the WHOQOL-BREF domains. The R^2 served as an indicator of the effect size denoting the proportion of the variance in the criterion variables explained by the predictor variables. Moreover, the change in R^2 (ΔR^2) and associated p value between the three models were reported to show the magnitude and significance of the additional variance explained by each additional model. Standardized β coefficients and associated p values were reported for each predictor variable to compare the strength, direction, and significance of each in relation to the outcome variable. The SPSS 28.0 statistical software was used for analyses and p values <.05 indicated significance.

Results

Study collection and participant recruitment for the study lasted from November 2021 through February 2022. We exported study data from the Survey Monkey platform to the SPSS 28.0 software. A total of 192 participants completed the study survey, although 10 responses were removed for the following reasons: seven participants were under the age of 18 and three only completed the demographic section of the survey. As such, the final complete dataset comprised 182 participants.

Participant Demographics

Descriptive statistics were performed for the 182 participants in the study (Table 1). All participant demographics reflected those of the adult child with autism rather than the parent/caregiver completing the survey, hence those receiving the intervention. Of the survey respondents, 71.4% (*n* = 130) were autistic individuals and 28% (*n* = 51) were proxy reports (the parent or caregiver of the person with autism). One person did not answer the question of who completed the survey. Most respondents were male (59.3%, *n* = 108) and 63.7% (*n* = 116) self-reported a Level-1 (requiring support) ASD diagnosis followed by Level 2 (requiring substantial support) and Level 3 (requiring very substantial support) (23.1%, *n* = 42; 13.2%, *n* = 24,

respectively) (American Psychiatric Association, 2013). The mean age of participants was 29.1 years (SD = 10.6) with a range of 18–72 years. About half of respondents (51.1%, n = 93) had completed postsecondary level education, such a college or university, the majority (69.8%, n =127) were single, and 66.5% (n = 121) lived with family or caregivers. Regarding employment status, approximately one third (32.4%, n = 59) of the respondents were employed, whereas the majority (80.8%, n = 147) received support from family, friends, or social groups. A lower proportion of participants (30.2%, n = 55) were currently ill or in poor health whereas 36.8% (n = 67) self-reported having a mental health condition diagnosis.

Table 1. *Participants' Demographic Information*

Characteristic	N	%	Mean	SD
Age (years)	181		29.1	10.6
Person completing survey				
Person with autism	130	71.4		
Parent/caregivers	51	28.0		
Gender				
Female	74	40.7		
Male	108	59.3		
Level of autism				
Level 1	116	63.7		
Level 2	42	23.1		
Level 3	24	13.2		
Highest level of education				
High school or less	89	48.9		
Postsecondary	93	51.1		
Current relationship status				
Single	127	69.8		
In a relationship	54	29.7		
Current living status				
Lives on own	61	33.5		
Lives with family/caregiver	121	66.5		
Current employment status				
Employed (full or part time)	59	32.4		
Unemployed	71	39		
Student	52	28.6		
Current level of support				
Receives support from family	147	80.8		
Does not receive support	35	19.2		
Currently ill or in poor health				
Yes	55	30.2		
No	127	69.8		
Current mental health condition diagnosis				
Yes	67	36.8		
No	114	62.6		

Note. For each characteristic where percentages do not add up to 100%, the remaining percentage was not reported.

To ascertain the degree of QoL impairment in this cohort, the WHOQOL-BREF mean subscale domain scores for physical, social, psychological, and environment were compared to other reported population norms. In the absence of normative WHOQOL-BREF data for healthy Canadians, we used UK norms from the study by Skevington and McCrate (2012) for participants who ranked their health status as *well*, rather than those with various illnesses. The QoL scores from this study were consistently lower across all domains than UK norms (Table 2). Since primary data were not available from the UK study, Cohen's *d* was computed for each QoL subscale showing moderate to large effect sizes between the two populations.

Table 2. *WHOQOL-BREF Subscales and Normative Data for UK Cohort*

Study	Mean physical (*SD*)	Mean psychological (*SD*)	Mean social (*SD*)	Mean environment (*SD*)
Social skills	57.9 (17.9)	58.1 (19.8)	54.4 (22.2)	60.4 (16.1)
UK norms[a]	76.5 (16.2)	67.8 (15.6)	70.5 (20.7)	68.2 (13.8)
Cohen's *d*	1.1	0.6	0.8	0.5

Note. [a]Taken from Skevington & McCrate (2012) normative data for "well" participants (*n* = 1324–1328). Cohen's *d*: 0.2 = small effect, 0.5 = medium effect, and 0.8 = large effect.

Autism Interventions

Table 3 displays the frequencies of the seven therapeutic interventions used by the cohort of autistic individuals in this study. The following interventions were used by more than 60% of participants: social skills (63.2%), mental health support (71.4%), and behavioral therapies (67%); and medications were used by the largest proportion of participants (82.4%). On the other hand, approximately half of participants used adaptive learning skills, employment support, and mindfulness therapies (48.4%, 55.5%, and 54.9%, respectively).

Table 3. *Frequencies and Percentages of Autism Therapeutic Interventions Used by Participants*

Intervention	N (182)	%
Social skills	115	63.2
Mental health	130	71.4
Behavioral	122	67.0
Adaptive learning	88	48.4
Employment support	101	55.5
Mindfulness	100	54.9
Medications	150	82.4

Predictors of QoL

HMR analysis was used to explore the relationship between a set of covariates/predictors and the QoL of people with autism. Block 1 (Model 1) included three covariates: namely, age, gender, and autism severity. Next, five additional covariates including level of education, current relationship status, current level of support, employment status, and having a mental health condition were entered into the second block (Model 2). Finally, the seven predictors or interventions of interest including social skills, behavioral therapies, mental health support, employment support, adaptive/DLS, mindfulness therapies, and medications were entered as Block 3 (Model 3). Results of the HMR models for each of the WHOQOL-BREF domains (physical, psychological, social, and environment) are displayed in Table 4.

Table 4. *HMR Models for Each Subscale of the WHOQOL-BREF*

Subscale	Adjusted R^2	p	Positive predictors	β	Negative Predictors	β
Physical						
Model 1[a]	.169	< .001	-		Autism severity	-.370***
Model 2[b]	.205	< .001	Being employed	.186*	Autism severity	-.319***
Model 3[c]	.275	< .001	Mental health support	.219**	Autism severity	-.325***
			Behavioral therapies	.161*		
Psychological						
Model 1[a]	.095	< .001			Autism severity	-.196**
					Gender (female)	-.151*
			-		Age	-.201**
Model 2[b]	.117	.007	-		Age	-.249**
Model 3[c]	.269	<.001	Being employed	.194*	Autism severity	-.166*
			Mental health support	.313**	Gender (female)	-.205**
			Behavioral therapies	.283*	Age	-.206**
Social						
Model 1[a]	.104	< .001	-		Autism severity	-.204**
			-		Gender (female)	-.174*
			-		Age	-.197**
Model 2[b]	.199	< .001	Being in a relationship	.299**	Autism severity	-.147*
					Gender (female)	-.147*
					Age	-.293***
Model 3[c]	.290	< .001	Being in a relationship	.352***	Autism severity	-.151*
			Mental health support	.215**	Gender (female)	-.221**
			Behavioral therapies	.167*	Age	-.239**

Subscale	Adjusted R^2	p	Positive predictors	β	Negative Predictors	β
Environment						
Model 1[a]	.130	< .001	-		Autism severity	-.216**
			-		Gender (female)	-.251**
			-		Age	-.153*
Model 2[b]	.163	< .001	Being employed	.209*	Autism severity	-.178*
					Gender (female)	-.219**
					Age	-.183*
Model 3[c]	.237	< .001	Being employed	.235*	Autism severity	-.187*
			Mental health support	.240**	Gender (female)	-.226**
					Age	-.176*

Note. [a]Predictors: autism severity, gender, and age; [b]Predictors: education level, employment status, relationship status, support status, and having a mental health condition diagnosis; [c]Predictors: social skills, mental health support, adaptive/DLS, mindfulness, employment status, behavioral therapies, and medications.

*p < .05, **p < .01, ***p < .001

For the physical domain, all three HMR models were significant with each model predicting an increasingly higher proportion of the variance in the dependent variable. Model 1 predicted 16.9% of the variance, while Models 2 and 3 predicted 20.5% and 27.5% of the variance, respectively (Model 1: R^2 = .169, F (3, 172) = 11.7, p < .001; Model 2: R^2 = .205, F (8, 167) = 5.4, p < .001; and Model 3: R^2 = .275, F (15, 160) = 4.1, p < .001). Of note, the change in variance from Model 1 to Model 2 was not significant (ΔR^2: p = .2), although it was significant from Model 2 to Model 3 (ΔR^2: p = .035). When evaluating the significance of each covariate/predictor variable, autism severity remained the strongest negative predictor of physical QoL across all three models (β = -.37, β = -.32, and β = -.33, all p < .001, respectively). Additionally, in Model 3, predictors which were significantly associated with physical QoL included being employed (β = .19, p = .047), receiving mental health support (β = .22, p = .004), and behavioral therapies (β =.16, p = .045).

For the psychological domain, all three HMR models were significant with each model predicting an increasingly higher proportion of the variance in the dependent variable. Model 1 predicted 9.5% of the variance, while Models 2 and 3 predicted 11.7% and 26.9% of the variance, respectively (Model 1: R^2 = .095, F (3, 172) = 6.0, p = .001; Model 2: R^2 = .117, F (8, 167) = 2.76, p = .007; and Model 3: R^2 = .269, F (15, 160) = 3.92, p < .001). Of note, the change in variance from Model 1 to Model 2 was not significant (ΔR^2: p = .523), although it was significant from Model 2 to Model 3 (ΔR^2: p < .001). When evaluating the significance of each covariate/predictor variable, autism severity, gender (being female), and age (older age) were significant predictors of psychological QoL in Model 1 (β = -.20, p = .008; β = -.15, p = .043; and β = -.20, p = 0.007, respectively). In Model 2, age remained the only significant predictor of psychological QoL (β = -.25, p = .002). In Model 3, autism severity, gender, and age remained significant negative predictors of psychological QoL as in Model 1 (β = -.17, p = .023; β = -.21, p = .008; and β = -.21, p = .009, respectively), while the strongest positive predictor of psychological QoL was receiving mental health support (β = .31, p < .001), followed by behavioral therapies (β = .28, p = .001) and being employed (β = .19, p = .038).

For the social QoL domain, all three HMR models were significant, and each model predicted an increasingly higher proportion of the variance in the dependent variable. Model 1 predicted 10.4% of the variance, while Models 2 and 3 predicted 19.9% and 29.0% of the variance, respectively (Model 1: R^2 = .104, F (3, 172) = 6.64, p < .001; Model 2: R^2 = .199, F (8, 167) = 5.19, p < .001; and Model 3: R^2 = .290, F (15, 160) = 4.35, p < .001). The changes in variance from Model 1 to Model 2 and from Model 2 to Model 3 were both statistically significant (ΔR^2: p = .002 and .007, respectively). In Model 1, autism severity, gender (being female), and age (older age) were all significant negative predictors of social QoL (β = -.20, p =.006; β = -.17, p = .019; and β = -.20, p = 0.008, respectively). In Model 2, all three covariates remained statistically significant, although the strongest predictor of social QoL was being in a relationship (β = .30, p = .002). In Model 3, autism severity, gender, and age remained significant predictors of social QoL (β = -.15, p = .036; β = -.22, p = .004; and β = -.24, p = .002, respectively). In addition, being in a relationship predicted the highest proportion (35.2%, p < .001) of the variance for social QoL, followed by receiving mental health support (β = .22, p = .004) and behavioral therapies (β = .17, p = .035).

Finally, for the environment QoL domain, all three HMR models were significant, and each model predicted an increasingly higher proportion of the variance in the dependent variable. Model 1 predicted 13.0% of the variance, while Models 2 and 3 predicted 16.3% and 23.7% of the variance, respectively (Model 1: R^2 = .130, F (3, 172) = 8.53, p < .001; Model 2: R^2 = .163, F (8, 167) = 4.06, p < .001; and Model 3: R^2 = .237, F (15, 160) = 3.32, p < .001). The change in variance from Model 1 to Model 2 was not statistically significant (p = .257), but it was significant from Model 2 to Model 3 (ΔR^2: p = .034). In Model 1, autism severity, gender, and age were all significant predictors of environment QoL (β = -.22, p = .003; β = -.25, p = .001; and β = -.15, p= 0.036, respectively). In Model 2, all three covariates remained statistically significant, while employment status was also a significant positive predictor of environment QoL (β = .21, p =.03). In Model 3, autism severity, gender, age, and employment status all remained significant predictors of environment QoL as in model 2 (β = -.19, p = .013; β = -.23, p = .004; β = -.18, p = .03, and β = .24, p = .002, respectively). In addition, receiving mental

health support intervention (β = .24, p = .002) significantly predicted environment QoL.

Discussion

To our knowledge, ours is the first quantitative, cross-sectional, correlational study to evaluate the association between a variety of interventions used by people with autism throughout their lifespan and their QoL. Key findings from our study suggest that receiving mental health support and behavioral therapies as therapeutic interventions are significantly associated with achieving a better QoL for adults with autism. Our study confirms findings from previous research in several ways. First, it is in line with the results of numerous studies that have consistently reported a lower QoL in people with autism across all domains of the WHOQOL-BREF as compared with normative samples (Bishop-Fitzpatrick et al., 2018; Hong et al., 2016; Ikeda et al., 2014; Kamio et al., 2013; Katz et al., 2015; Khanna et al., 2014; Knüppel et al., 2018; Lawson et al., 2020; Mason et al., 2018; van Heijst & Geurts, 2015). For example, van Heijst and Greuts (2015) used a combined sample size of 486 people with ASD and 17,776 controls and found a significantly lower QoL in people with autism compared with controls with a quite large mean effect size (Cohen's d = 0.96). Similarly, in this study, moderate to large effect sizes between 0.5 and 1.1 were seen for the four QoL domains.

Second, several characteristics of this sample resembled those of recent studies conducted in the United States and Europe. In our study, most participants (71.4%) could fill out the study survey independently rather than by a proxy report (28%). This is similar to the study by Mason et al. (2018) where 78.4% of respondents did not need help to complete the study questionnaires. The latter finding may reflect the large proportion of adults in the current study with Level 1 ASD (63.7%) and without an ID who are relatively able and can be generalizable to the broader population of autistic adults who can self-report. Next, the proportion of autistic adults in this sample who were employed either full time or part time (32.4%) is similar to those reported by other researchers at 40% and 36.5% (Helles et al., 2017; Mason et al., 2018). Of note, the percentage of adults in the current study who had completed postsecondary education was slightly higher (51.1%) than those reported by Gotham et al. (2015) and Mason et al. (2018), who reported rates of 42% and 41.6%, respectively. The latter finding may again be reflective of the higher proportion of participants with Level 1 ASD and no ID in this cohort who are capable of higher educational achievement.

Despite epidemiological data reporting a high male-to-female ratio of four to one for the autistic population, our study had a large proportion of females (40.7%, n = 74). This is similar to the study by Mason et al. (2018), who also reported a high proportion of females (42.7%) in their study. Moreover, the proportion of autistic adults living with their family or caregiver in our study was quite high (66.5%), although lower than the rate reported in the National Longitudinal Transition Study-2 (Roux et al., 2015) where 87% of young adults with autism were living with a parent after leaving high school compared with 21% of neurotypical young adults living in the United States. Finally, in our study, the proportion of subjects reporting a mental health condition diagnosis was substantially lower (36.8%) compared with other studies (Mason et al., 2018; Helles et al., 2017; Gotham et al., 2015), which reported much higher rates. For example, Mason et al. (2018) reported a rate of 70.8% in their cohort of autistic adults who had at least one mental health condition, whereas Helles et al. (2017) and Gotham et al. (2015) reported 50% and 86%, respectively. The lower proportion of mental health condition diagnosis in our study may be due to several factors including the absence of having sought a formal mental health diagnosis, the lack of self-awareness that one may have a mental health condition, and the high variability in rates of mental health conditions reported by different studies. For example, a recent systematic review and meta-analysis using a large sample of studies and participants found current and lifetime prevalence rates of 27% and 42% for any anxiety disorder and depressive disorder, respectively (Hollocks et al., 2019). The high variability in prevalence rates of mental disorders in the literature reflects a high degree of heterogeneity in methodology, diagnostic tools, and clinical samples used, which underscores the importance of well-defined study samples, representation by nonclinical

samples, and the use of validated diagnostic tools to reduce bias and heterogeneity (Hollocks et al., 2019; Wigham et al., 2017).

Demographic Predictors of QoL

In our study, characteristics such as older age, being female, and autism severity were negative predictors of QoL across almost all domains except for physical QoL, which was only associated with autism severity. Conversely, several factors, including being employed and in a relationship, positively predicted QoL. Several studies have reported similar findings. For example, in a large study of 370 adults with autism, being female, older, and with more severe levels of autism were negative predictors of QoL (Mason et al., 2018). Although the effect of aging on lower QoL may not be specific to only those with autism (Skevington & McCrate, 2012), it may reflect inadequate access and provision of appropriate services to older autistics compared with children and adolescents, as well as the inability of those services to meet their unmet needs. Further, both social isolation and the loss of perceived informal support (having someone to spend time with and/or do things with) experienced in older age may be associated with the lower QoL of adults with autism (Happé & Charlton, 2012). Of note, the negative effects of ageism are likely further exacerbated in individuals with higher autism severity as they may be less flexible and reluctant to try new things. In contrast to these findings, researchers like van Heijst and Greuts (2015) did not find a significant association between age, IQ, and ASD severity and QoL in a cohort of 486 people with autism across the lifespan, which highlight differences in the various subpopulations of autistics. But being in a relationship was a significant predictor of social QoL in our study, which further underscores the importance of social supports in this population.

Our study also showed lower QoL across all domains (except for physical) related to gender. Several studies have found autistic females to have a significantly lower QoL compared with their male counterparts (Kamio et al., 2013; Mason et al., 2018). This contrasts with Bargiela et al. (2016), who found a higher QoL in autistic females compared with males. Though the latter may be related to the higher motivation levels and ability of females to better initiate and maintain friendships than males, it may also reflect the notion of "camouflaging" by autistic people, which results in long-term negative effects (Hull et al., 2021).

Findings around the association between autism severity and QoL of people with autism have been inconsistent. Our study found a significant association between autism severity and QoL across all three models and domains. This is in line with the results of several studies (Khanna et al., 2014; Chiang & Wineman, 2014; Knuppel et al., 2018; Lawson et al., 2020) where autism severity was significantly correlated with the QoL of both children and adults with autism. On the other hand, several studies have not found a significant association between autism severity and QoL (Kim & Bottema-Beutel, 2019; van Heijst & Greuts, 2015). The discordance in findings may reflect the difference in how autism severity was captured in these studies (formal diagnosis vs. self-reported), the different QoL instruments used, the levels of support available and accessed, and the presence of confounders.

Employment is a known mediator of a range of QoL components, including family and life satisfaction, economic self-sufficiency, mental health, and social inclusion in the general population (Walsh et al., 2014). This is an important consideration when assessing the QoL of people with autism since over half are unemployed or underemployed (Hirvikoski & Blomqvist, 2015). Poor employment has been associated with low independence, higher rates of physical and mental problems, and poor community engagement, all of which negatively impact QoL (van Rijn et al., 2016). The current finding that being employed was a significant positive predictor of psychological and environment QoL is, therefore, not surprising. The psychological domain's questions ask about mental health, happiness, self-satisfaction, and having a meaningful life, while the environment domain asks about transport, access to health services, and living arrangements (WHOQOL-BREF, 1996). However, as noted previously, these positive associations should not be interpreted as causal or directional since it may well be that those with a higher QoL are better able to seek and secure employment

compared with autistic individuals with a lower QoL.

Finally, we found that being in a relationship was a positive significant predictor of social QoL. This corroborates the results of several studies that have shown the importance of social support, forming relationships, engaging in social interactions, and communication in achieving better mental health and well-being (Knuppel et al., 2018; van Heijst & Greuts, 2015; Khanna et al., 2014; Mason et al., 2018). Indeed, social isolation, the absence of someone to talk to and do things with, and the lack of supportive people around can all have a significant impact on QoL and mental health of people with autism (Happé & Charlton, 2012).

Our findings provide evidence-based information related to specific individual characteristics that should be considered for provision of supports and services to improve QoL of people with ASD. For example, older autistic women who are unemployed or single may represent a particularly vulnerable group requiring attention and support to achieve and sustain a better QoL. However, it is important to note that these findings are cross-sectional and directional associations should not be interpreted as causal relationships between the predictor and QoL variables. For example, those with a higher QoL may be more able to initiate and maintain a relationship with a partner and/or seek and maintain employment.

Finally, our results from this study are consistent with several but not all findings from other research. As in other studies (Jennes-Coussens et al., 2006; Kamio et al., 2013; Kamp-Becker et al., 2010; Lin, 2014), social QoL was the most affected and the lowest of the four QoL domains in the current study (M = 54.4, SD = 22.2). Difficulties with social skills are a core characteristic of people with ASD and impaired social skills and low social cognition, in general, have been associated with poor QoL outcomes as they often result in social isolation, anxiety, and depression (Lieb & Bohnert, 2017). These social challenges typically arise from the inability to process nonverbal cues, delays in the acquisition of verbal communication skills, repetitive behaviors, and sensory issues. As such, provision of social skills interventions to people with autism should be prioritized as they support and encourage their integration and inclusion into society.

Therapeutic Interventions Predicting QoL

Of the seven interventions studied, only two, receiving mental health support and behavioral therapies, were significant predictors of a better QoL in this cohort of individuals with autism. These results corroborate several studies that have evaluated the association between single interventions using psychological interventions and health and health-related outcomes (physical, mental health, and well-being) (Ekman & Hiltunen, 2015; Hesselmark et al., 2014; McGillivray & Evert, 2014; Russell et al., 2013; Sizoo & Kuiper, 2017; Weiss & Lunsky, 2010). Specifically, these studies have evaluated the association between psychological interventions using CBT and health and health-related outcomes. Deemed as the "current gold standard of psychotherapy" in the general adult population, the National Institute for Health and Care Excellence Clinical Guidelines (2011) recommend psychological therapy, in particular CBT, as first line treatment in mild to moderate presentations. In a systematic review conducted by Benevides et al. (2020), CBT interventions were considered an *emerging evidence-based approach* in improving self-reported mood and anxiety in autistic adults, although not significantly better than anxiety management or recreational groups as alternative interventions. For example, Sizoo and Kuiper (2017) reported improvements in self-reported anxiety and depression scores, rumination, and global mood in those who underwent CBT. Further, a Canadian study by Weiss and Lunsky (2010) using group CBT showed positive outcomes related to self-reported depression and anxiety symptoms. Of note, our study did not identify the specific approaches used for the delivery of mental health interventions, although CBT was included as an example in this intervention type on the study survey. Given the high prevalence of comorbid mental health disorders in the autistic population, with depression and anxiety being the most common (Croen et al., 2015; Joshi et al., 2013), the empirical evidence generated from our study suggests that provision of mental health interventions may be associated with a better QoL in autistic adults. As such, as part of evidence-based interventions, mental health support should be prioritized

as an effective therapeutic option to help achieve better long-term outcomes, satisfaction, and well-being for people with autism across the lifespan.

The second intervention type that was significantly associated with a better QoL in our study was behavioral therapies. All domains of QoL except for environment appeared to have benefited from this intervention. Applied behavior analysis (ABA) is a widely accepted and well-established approach used to strengthen and improve a broad range of skills and deficits in individuals with ASD, including communication skills; behavioral, physical, and social skills; among others (Yu et al., 2020). There is strong evidence to support its use in children with ASD, although data is scarce in the adult population (Roth et al., 2014). The findings from this research are aligned with previous research that confirm the effectiveness of ABA as a valid and evidence-based intervention to help improve a variety of skills in people with autism. For example, a meta-analysis by Roth et al. (2014), evaluating the effectiveness of behavioral interventions in various areas, such as academic skills, phobic avoidance, vocational skills, problem behaviors, adaptive skills, and social skills, showed medium to large improvements.

Similarly, a recent literature review conducted by Marcotte et al. (2020) found that behavioral interventions, which comprised the majority (40%) of the articles reviewed, were among the seven effective interventions identified. These interventions significantly improved activities of DLS, such as food and meals, shopping, and travelling in the community.

While research evaluating the long term, sustained effects of ABA specifically around improving QoL of adults with autism is scarce, the significant associations found in our study may suggest a sustained overall positive impact of this intervention on the QoL and well-being of people with ASD. Indeed, researchers have suggested incorporating long-term follow-up of ABA interventions a priori in future studies to ascertain their true effectiveness in addressing the core deficits of ASD. Given that behavioral interventions are used overtly to target a broad range of impairments in people with autism, it is plausible that this intervention alone may have compensated for the other types of interventions used in our study resulting in the spurious associations observed between the remaining therapies and QoL.

In contrast to the findings in our study, the systematic review by Benevides et al. (2020) found that mindfulness-based interventions were emerging evidence-based approaches in the adult autistic population. Mindfulness interventions focus on modifying the way a person perceives and processes their thoughts and emotions with the goal of achieving a better state of self-awareness and emotional regulation (Conner & White, 2018). Of note, this finding was based on two high-quality studies including a RCT and a pretest-posttest quasi-experimental design (Sizoo & Kuiper, 2017; Spek et al., 2013). Both studies showed small to large effect sizes between .07 and .78 for self-reported depression and anxiety symptoms, suggesting the beneficial effects of mindfulness therapies. In our study, mindfulness interventions were used by 55% of participants and were defined as yoga, meditation, breathing exercises, and physical exercise.

This contrasts with how mindfulness interventions are implemented in the research setting, which include complementary/integrative medicine administered at various frequencies, duration, and intensity. Therefore, they are not implemented in the same manner as those defined in our research study, which may explain the discrepant results. On the other hand, findings from our study are consistent with those reported in previous research that did not find sufficient evidence to support their effectiveness in addressing health and health-related outcomes in the autistic population (Benevides et al., 2020; Enticott et al., 2011; Gal et al., 2015; McVey et al., 2016; Nilsson & Ekselius, 2009; Roser et al., 2009; Wachtel et al., 2010). These interventions included social skills, vocational, prescription medications, and DLS interventions. As such, the consistency of the findings from our study with those of previous research with more rigorous designs and methods is reassuring and further strengthens the validity of these findings.

Strengths and Limitations of the Study

This study had several strengths and some limitations. We recruited a relatively large sample size of autistic participants with a nationwide sampling frame that gave us the power to undertake the HMR analysis with multiple covariate and predictor variables. This also increased the generalizability of the findings. Next, the study used the WHOQOL-BREF questionnaire, which has been validated in the ASD population (McConachie et al., 2018). In addition, the questionnaire had an excellent completion rate of 95%, likely due to the various sources where the study was advertised.

However, the study had some limitations. The data captured pertaining to the use of autism interventions was dichotomous (*Yes/No*) and lacked specificity. For example, the duration, administration, or completion status of the interventions used were not captured in the study survey. This may have confounded the effectiveness of the interventions used due to the heterogeneity among participants who responded *Yes* to this question. For instance, if the intervention was used for a short duration, the intended outcome may have not been achieved even though the participant indicated using the intervention. The latter may have resulted in an underestimation of a potential significant association between the intervention used and QoL.

Next, the data were self-reported and not cross-validated against formal diagnoses for variables such as autism, ASD severity, ID, or having a mental health condition. Further, the geographic residence of participants was not captured in the survey. It is possible that regional differences in access and availability of interventions to people with ASD may have impacted their QoL, although the nationwide sampling frame should have mitigated this limitation. Another limitation of the study involved its cross-sectional design, limiting interpretation of causal relationships. It is feasible that those with a higher QoL had a higher likelihood of seeking employment, being in relationships, or using autism interventions. Self-selection bias may have been another limitation, since autistic individuals who chose to participate in the survey may have been more involved in online platforms, sought and used autism interventions, and been more comfortable completing the survey. These factors may have impacted the representativeness of the sample, although the large, nationwide participation may have, in part, mitigated these limitations and increased the generalizability of the findings (Althubaiti, 2016). Finally, the inclusion of proxy reports (28%) may not have accurately reflected first person ratings given the subjective nature of QoL. Several studies, however, have shown a high correlation between autistic adult self-reports and parental proxy reports around QoL outcomes, which gives reassurance to the consistency of responses between the two groups (Hong et al., 2016; Sheldrick et al., 2012).

Future Directions

Our study has underscored an important gap in autism research related to the ways in which therapeutic interventions are associated with QoL in individuals with ASD. While a multitude of interventions are available and offered to people with ASD, they often do not consider QoL as an outcome and a long-term goal for this population (Benevides et al., 2020, Pfeiffer et al., 2017; Mason et al., 2018). As noted by Pfeiffer et al. (2017), autism interventions are not always coherent with the end goals and needs of people with ASD and the relationship between interventions and QoL is not well understood. Our study sought to determine the association between a set of commonly used therapeutic interventions by adults with ASD and their QoL. The findings from our study should catalyze future research to focus on improving QoL as an end goal, especially across the lifespan. Researchers should include well-defined measures of QoL, health, and well-being as desirable outcomes for interventions. In addition, researchers should adopt a longitudinal approach in their studies to identify how current interventions meet the identified needs of people with ASD as they age into adulthood. Intervention methods should be guided by the meaningfulness of interventions to the individual with autism rather than solely focusing on short-term goals that aim to improve the specific gap or challenge experienced by the person. While the latter is an important first and obvious step in supporting individuals with ASD, the long-term outcomes of ASD interventions are often not considered and evaluated with a

longitudinal perspective. Finally, given the significant decline in provision of services in adulthood known as the "service cliff" (Anderson et al., 2018) as well as the paucity of data around the use of interventions among the adult autistic population (van Heijst & Guerts, 2015), future research should identify the most commonly used interventions that are most suited to address the unmet needs of adults with ASD.

Our study found that behavioral and mental health support interventions were significantly associated with a better QoL in adults with ASD without an ID. This provides guidance for future studies to directly evaluate the effectiveness of these interventions in improving QoL and well-being. Moreover, it suggests the importance of involving community-stakeholder partnerships when evaluating the effectiveness of autism interventions to ensure that they are accepted and are meaningful in improving QoL over time.

Implications

Findings from our study have practical importance and positive implications for social change. First, we have helped identify two types of therapeutic interventions that are most relevant to improving QoL in adults with autism. Of note, behavioral and mental health interventions are evidence-based approaches that have shown effectiveness in addressing the various needs of people with autism. Second, results from our study have raised awareness about the importance of intervening early with subgroups of autistic individuals, such as those with higher ASD severity, women, and the elderly, as they are particularly vulnerable to a lower QoL. Third, findings from our study can raise awareness and guide decision making among policy makers and agencies regarding the allocation and prioritization of scarce resources and funding to those interventions and services that optimize long-term outcomes for people with ASD. Finally, findings from our study may bring about positive social change by helping inform multiple stakeholders involved in the management, care, and delivery of services to people with autism to support advocacy and client-centered approaches that are associated with better QoL outcomes and overall well-being.

Conclusion

To our knowledge, this is the first study to evaluate the association of a set of commonly used therapeutic interventions in adults with autism and their QoL. Rooted in the PPM theoretical framework, which posits that all interventions and programs should start with the end goal in mind (i.e., to improve QoL), we found that behavioral-based therapies and mental health interventions were significantly associated with a better QoL in adults with autism without an ID. Additionally, individual characteristics including older age, ASD severity, and being female were negatively associated with a better QoL. These findings are important since, while a multitude of studies have evaluated the effectiveness of various autism interventions in improving a target behavior or psychosocial gap, they do not consider the impact of these interventions on QoL, and their long-term sustained effect is not well known. Given that both behavioral and mental health interventions are evidence-based approaches well studied in the literature, our findings are reassuring and should instigate further research to evaluate the direct effectiveness of these interventions on the QoL and well-being of people with autism, especially as they age.

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