

Research

Mixed-Methods Exploratory Study on the Feasibility of a Yoga-Based Intervention for Adolescents with Autism Spectrum Disorder and Their Parents

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Abstract

Autism spectrum disorder (ASD) is often accompanied by emotional and behavioral difficulties in adolescents. In turn, the well-being of adolescents with ASD, as well as that of their parents, can be affected. Yoga is a practice that may positively influence these difficulties. The present study aimed to explore the feasibility of yoga practice among adolescents with ASD and their parents. Six families (adolescents with ASD $n = 6$; mothers $n = 5$; fathers $n = 3$) participated in the Yoga Bali ASD program over an 8-week period. Feasibility was explored by measuring implementation, social acceptability, and potential effects of the program. Direct behavioral observations were conducted, and pre- and postintervention measures of anxiety levels and attention capacities in adolescents with ASD were collected. A semistructured group interview was conducted with all participants at the end of the program. The results suggest that the Yoga Bali ASD program is feasible for adolescents with ASD and their parents. A significant improvement in the attention abilities of adolescents was observed, along with a marginally significant reduction in anxiety symptoms. Qualitative analyses highlighted themes such as a sense of social support, group belonging during sessions, parental stress, school-related stress in adolescents with ASD, and appreciation of relaxation. Yoga practice appears to be an effective approach to supporting adolescents with ASD and their parents in addressing challenges such as reducing perceived stress and anxiety or improving attention abilities. Future research should investigate the potential moderating role of interpersonal relationships during yoga practice on anxiety and replicate these findings in a larger sample. *Beaudoin et al. Int J Yoga Therapy 2026(36). doi: 10.17761/2026-D-25-00016.*

Keywords: yoga, autism spectrum disorder, anxiety, attention, parental stress, feasibility study

Abbreviations Used

ADHD = attention-deficit/hyperactivity disorder

ASD = autism spectrum disorder

DSM-5-TR = *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed., text rev.

MASC-2 = Multidimensional Anxiety Scale for Children, 2nd ed.

TARF-R = Treatment Acceptability Rating Form Revised

TEA-Ch = Test of Everyday Attention for Children

UQAM = Université du Québec à Montréal

YBP-A-ASD = Yoga Bali ASD [program]

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by a high prevalence of emotional challenges (e.g., anxiety, depression) and behavioral difficulties (e.g., inattention, aggression, impulsivity).¹ Among these, anxiety and attention-related issues are particularly common, with prevalence reaching up to 82.2% and 95.5% respectively.²⁻⁴ These challenges can be associated with difficulties in daily functioning,⁵ cognition,⁶ and interpersonal relationships^{7,8} among adolescents with ASD, and they may further increase parental stress.⁹⁻¹¹

Previous studies suggest that yoga-based interventions hold potential benefits for adolescents with ASD and their parents, including reductions in emotional and behavioral difficulties as well as decreases in parental stress.¹² Despite these positive preliminary findings, the evaluation of the feasibility of yoga-based interventions specifically tailored for adolescents with ASD and their parents remains an area requiring further investigation.¹²

Originally rooted in Indian philosophical and spiritual practices, yoga has increasingly been integrated into Western healthcare as a complementary intervention aimed at supporting

mental and physical well-being.^{13,14} Empirical studies have highlighted the practice's benefits for mental health, including reduced stress and anxiety, improved emotional regulation, and enhanced life satisfaction.^{15–17} These outcomes align with the 2014 theoretical framework of Gard et al.,¹⁸ which proposed that yoga promotes psychological and physical well-being through the engagement of high- and low-level brain networks involved in self-regulation. The engagement of these networks may enhance attentional control, which in turn could help regulate neural circuits associated with maladaptive cognitive, emotional, and behavioral outputs, leading to a reduction in anxiety-related responses and improvements in attentional abilities. This engagement is particularly relevant for individuals with ASD, who often exhibit challenges in attentional and emotional regulation,^{2,3} suggesting that yoga may offer a unique pathway to address these core challenges.¹⁴

Ramanathan and Bhavanani¹⁴ suggested that yoga practice must be adapted to the specific needs of adolescents with ASD to be effective. They suggested that the benefits of yoga may be maximized by using postures tailored to youths' abilities, incorporating breathing exercises, and building a strong instructor-youth relationship. Additional factors, such as the physical environment of the class, sequencing and pacing of movements, type of meditation used, and age-appropriate session duration, should also be considered when designing yoga-based interventions for adolescents with ASD.¹⁹ Guidelines from Kaley-Isley et al.¹⁹ advise that sessions should not exceed 90 minutes and should incorporate breathing exercises throughout, as well as guided relaxation at the end. Additionally, creating a low-stimulation environment by minimizing auditory and visual input may be beneficial to support the management of emotional and behavioral challenges in adolescents with ASD.²⁰ Prior studies have also highlighted the potential value of integrating person-centered approaches within interventions such as yoga designed for youth with ASD.^{21,22}

Most studies on yoga and ASD have focused on children, with few evaluating the feasibility of a yoga-based intervention for adolescents with ASD and their parents.¹² To our knowledge, the only program that has been developed for both adolescents with ASD and their parents is the MYmind program, which primarily focuses on mindfulness and includes yoga-based exercises.²³ The program's efficacy has been evaluated in subsequent studies.^{23–25} Using a quantitative nonrandomized design with self-reported questionnaires, de Bruin et al.²³ highlighted the benefits of yoga on anxiety symptoms in adolescents with ASD and on parental feelings of competence. Garcia et al.²⁶ conducted a qualitative feasibility study on a yoga program delivered separately to children with ASD and to their parents. Although the intervention appeared feasible and was associated with reduced parental stress and improved family relationships, it assessed only one construct of feasibility: implementation fidelity. Parents also reported that joint parent-child sessions might have strengthened their ability to use yoga-based intervention techniques at home to further support their child.²⁶ According to Yarımkaya and Esentürk,²⁷ family-based interventions, in which parents and

adolescents with ASD actively participate together (e.g., joint yoga programs), may improve intervention outcomes. To our knowledge, few studies have explored the feasibility of family- and yoga-based interventions in the context of ASD.¹²

Present Study

The present study adopted the framework of Gadke et al.²⁸ to explore the feasibility of a yoga-based intervention program for adolescents with ASD and their parents. The yoga program evaluated in this study was based on the *Yoga Bali Method*, a practice that combines yoga postures, visualization exercises, and relaxation techniques.²⁹ For our study, the Yoga Bali Method was adapted to meet the unique needs of adolescents with ASD. Prior studies have reported the feasibility and benefits of the Yoga Bali Method for children with attention-deficit/hyperactivity disorder (ADHD), adult women undergoing chemotherapy for breast cancer, young circus athletes, and children with ASD.^{30–33}

In sum, the present study aimed to explore the feasibility of the Yoga Bali ASD program for adolescents (YBP-A-ASD). Specifically, we sought to assess the following feasibility constructs from Gadke et al.'s²⁸ framework.

- Implementation: participant engagement in the sessions in person and at home, program overall adherence, participant attentiveness during sessions
- Social acceptability: perceived relevance of the intervention, participant satisfaction, meeting participant needs, and participant responses to the intervention
- Effectiveness: potential effects on emotional and behavioral problems in adolescents with ASD

Methods

Participants and Procedure

Six families were enrolled in the study, with a total of 14 participants (adolescents with ASD $n = 6$; parents $n = 8$). Participants were recruited through a call for participation distributed in high schools and psychological clinics across the greater Montréal region, and on social-media platforms. The inclusion criteria required participants to comprehend French, and for the adolescents to have no medical contraindications to yoga practice, to have a confirmed ASD diagnosis, attend a mainstream school, and be between the ages of 12 and 17. In Québec's school system, students with ASD who attend mainstream school typically fall within levels 1 and 2 of support needs, as defined by the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5-TR)*.³⁴ Attending mainstream school therefore increased the likelihood that the program would be suitable for the targeted population.

Parents provided evaluation reports to confirm their children's diagnosis and to document comorbidities and verbal abilities. The evaluation reports provided by parents confirmed

that all adolescents met the criteria for ASD as outlined in the *DSM-5-TR*.³⁴ All evaluations were completed before the commencement of the study, and the age at which diagnoses had been made ranged from 2–12. The assessments had been conducted by mental health professionals, including psychologists, neuropsychologists, and/or psychiatrists. These evaluations followed established best practices for ASD assessment, including the use of the Autism Diagnostic Observation Schedule–2 and Autism Diagnostic Interview–Revised tools, evaluations of adaptive behaviors using standardized questionnaires (e.g., Adaptive Behavior Assessment System II, Vineland Adaptive Behavior Scale) and ASD screening measures. In addition to clinical report confirmation, parents also completed the French version of the Autism Spectrum Rating Scales.³⁵ Based on the Autism Spectrum Rating Scales Total Score subscale results, all parents reported that their adolescent exhibited clinically significant ASD-related symptoms.

A mixed-methods design integrating qualitative and quantitative data was used to evaluate the feasibility of the YBP-A-ASD program. The study lasted 10 weeks. During the first week, baseline assessments (pretest) were conducted and an introductory session was held with each participating family to visit the yoga space, review the program content, ask questions, and receive the program materials. Weeks 2–9 comprised the 8-week yoga intervention. In the final week, postintervention assessments (posttest) and a semistructured group interview were completed. The interview was conducted in person at the Université du Québec à Montréal (UQAM). Questionnaires were completed either in person or online, depending on participants' availability. Adolescents who required assistance to complete the questionnaires were supported by the principal investigator (M.-J. B.) either in person or virtually. The principal investigator also conducted the in-person group interview.

In-person yoga sessions were held at the university in a space equipped for yoga practice, with mats arranged on the floor, dimmed lighting, and blankets and yoga blocks provided for each participant. At-home yoga sessions were completed independently by participants, with yoga materials supplied if needed. A prerecorded video tutorial, available on the study's website, guided participants through the home sessions. This video was led by the yoga instructor and recorded prior to the study. The yoga instructor held a bachelor's degree in kinesiology and had completed 500 hours of training with the International Yoga Alliance in India and Europe, as well as with the Fédération Francophone de Yoga and International Yoga Federation. Before the beginning of the program, the instructor also received specific training in the Yoga Bali method.

Before the start of the study, ethical approval was obtained from the Research Ethics Committee for Student Projects at UQAM (approval No. 4414). The study was conducted between autumn 2021 and spring 2022. All participants signed a consent form prior to the study.

Intervention

The YBP-A-ASD program is an 8-week intervention designed for adolescents with ASD and their parents. Participants were invited

to attend one in-person yoga session per week (a total of eight sessions) and encouraged to complete two to three additional sessions at home using a prerecorded video tutorial. The program is based on the Yoga Bali method developed by Madan Bali, PhD,²⁹ which draws from Patañjali's eight limbs of yoga and is designed to promote stress reduction and overall well-being. Unlike approaches focused on mastering physical postures, the Yoga Bali method emphasizes enhancing self-awareness, achieving calm through relaxation, reducing perceived stress, and improving attentiveness through visualization exercises. To meet the specific needs of adolescents with ASD and their parents, adjustments to the original Yoga Bali method were made, leading to the development of the current YBP-A-ASD program. These adaptations included the selection of postures based on their potential beneficial effects and relevance to ASD-related challenges (Supplement A), as well as the adjustment of communication and teaching strategies to ensure greater clarity and concreteness. Educational themes are integrated into the sessions to support participants' understanding of the mechanisms and benefits of yoga. Visual support materials are also available to aid comprehension and reinforce a sense of predictability. The program places particular emphasis on creating a sensory-friendly and structured environment that aligns with the needs of adolescents with ASD. Sessions are designed to follow a consistent routine, with a predictable setting maintained throughout the program.

The design of the YBP-A-ASD program is informed by several frameworks and recommendations, including Gard et al.'s¹⁸ model of self-regulation, Kaley-Isley et al.'s¹⁹ yoga guidelines, the Training and Education of Autistic and related Communication Handicapped Children program,³⁶ and principles from both person-centered³⁷ and strengths-based intervention approaches.³⁸

The in-person yoga sessions are designed as a family activity for both adolescents and their parents, who take part in the same intervention. The goal is for parents to share the experience with their child and benefit equally from the practice. In-person yoga sessions are 60 minutes long and divided into three segments: (1) group discussion centered on an educational theme, (2) a sequence of yoga poses, and (3) guided relaxation. These sessions are meant to be conducted in a room designed for yoga practice, where lights can be dimmed, yoga materials are available for participants, and the environment maintains a calming atmosphere. The educational themes are (1) anxiety and attention, (2) the effects of yoga on various aspects of life, (3) learning abdominal breathing and its benefits, (4) focusing on the present moment, and (5) integrating the practice and the discussed themes. For the sessions at home, participants are given access to a 20-minute video tutorial. So they have a basis regarding yoga practice, participants are encouraged to start the yoga practice after the first week of the program. The home practice is meant to foster autonomous practice, with professional guidance provided by the accessible video. During the first session, participants are asked to complete a brief questionnaire to

plan their at-home practice (e.g., when and where they would practice, potential constraints they might face).

Measures

Implementation Measures

Direct and systematic observations of the behaviors of adolescents and parents were recorded during each yoga session. The frequencies of task-focused/attentional behaviors (e.g., performing poses) and inattentive behaviors (e.g., moving around, verbal comments) were tracked using the Behavioral Observation Grid for Children and Adolescents with ASD.³⁹ Direct observations were conducted by two trained research assistants. An interrater reliability agreement of 95% was achieved between the two observers. Additionally, adherence levels were measured by calculating retention, dropout, and attendance rates. These measures included tracking the number of participants before and after the program and the total number of in-person sessions completed by each participant. In addition, to monitor the number of at-home sessions completed and assess participants' satisfaction, a questionnaire was made available on the study's website for participants to complete after each practice.

Social Acceptability Measures

The Treatment Acceptability Rating Form Revised (TARF-R) questionnaire was used to evaluate social acceptability.⁴⁰ This questionnaire was completed by all participants (adolescents with ASD and their parents). The questions addressed key aspects of social validity, including participants' understanding of the intervention, their perception of the program's effectiveness in managing difficulties (e.g., anxiety, psychological well-being, attention problems), perceptions of financial and time investment, and the extent to which the program met their needs. The TARF-R's internal consistency is 0.92.⁴⁰ In addition, a 60-minute semistructured group interview was conducted to further understand participants' responsiveness and satisfaction. During the group interview, adolescents and parents were invited to describe their appreciation of the program and the effects they perceived in their daily lives, as well as to provide feedback on

elements they liked or disliked. An open-ended question was first posed to participants (e.g., "What effects from your yoga practice have you noticed in your daily life?" "What did you most enjoy during the yoga session?"). The facilitator then asked additional questions to clarify responses or encourage participants to elaborate. Qualitative notes were taken during the group interview.

Potential Effects on Adolescent Anxiety

The Multidimensional Anxiety Scale for Children, 2nd Edition (MASC-2), both self-report and proxy report, was used to assess anxiety symptoms in the adolescents participating in the study.⁴¹ Results are categorized into a total scale (MASC-2 total) and nine subscales. Interpretation is based on *T* scores, where higher scores indicate a greater likelihood that the reported symptoms reflect an anxiety disorder. For the parent questionnaire, the test-retest reliability index is 0.93, and the internal validity index is 0.89.⁴¹ For the self-reported questionnaire, the test-retest reliability index is 0.89, and the internal validity index is 0.92.⁴¹

Potential Effects on Adolescent Attention

The d2-R Test of Attention and the "Score!" subtest of the Test of Everyday Attention for Children (TEA-Ch) were used to assess adolescents' attention abilities.^{42,43} The d2-R is a paper-and-pencil task designed for individuals aged 9–60 that involves crossing out specific symbols within a time limit. Results are reported as indices of quantitative, global, and concentration performance. Higher scores indicate better attentional and concentration abilities. The test-retest reliability index of the d2-R ranges from 0.89–0.90, and the internal validity index ranges from 0.94–0.98.⁴² The TEA-Ch is a battery of tests for assessing attention in children and adolescents aged 6–16. The Score! subtest measures sustained auditory attention. This task requires adolescents to count the number of sounds they hear on a recording. Higher scores indicate better sustained attention abilities (range 0–10). The test-retest reliability coefficients are 0.92 and 0.91, respectively.⁴³ Table 1 describes the measures used to explore the feasibility of the YBP-A-ASD program and details the constructs from Gadke et al.'s²⁸ protocol framework.

Table 1. Feasibility Study Elements and Measures

Feasibility Study Element	Description	Measures
Implementation	Participant adherence and engagement levels in the program Participant responses to interventions during the program	Adherence measured using retention, dropout, and attendance rates Direct and systematic observations of participant behaviors during sessions
Social acceptability	Degree to which the program meets participant needs Participant perceptions of the program's potential effectiveness	Social acceptability questionnaire Semistructured interviews
Potential effects	Potential effects on anxiety levels in adolescents with ASD Potential effects on attention difficulties in adolescents with ASD	Self-reported and parent-reported anxiety symptom questionnaires Cognitive tests assessing attention skills

ASD = autism spectrum disorder.

Statistical Analyses

Descriptive analyses were conducted to describe the characteristics of the participants. To evaluate program implementation, dropout and attendance rates were calculated based on data collected on the number of sessions completed at the university and at home, as well as on the number of participants who completed the program. Additionally, nonparametric Friedman tests were conducted on the direct observation results to measure variability in the frequency of task-focused behaviors in adolescents and parents during the sessions. Observation results from session 8 were excluded from the analyses due to a high volume of missing data.

To assess social acceptability, frequency analyses of the TARF-R responses for each item were performed. Additionally, a thematic analysis was conducted on the qualitative notes taken during the semistructured group interview to identify elements related to the perceived social acceptability of the yoga program among adolescents with ASD and their parents. The analysis followed an intuitive, inductive approach. First, the data were read carefully to gain a comprehensive understanding and generate initial insights. Next, recurring ideas were coded, and similar data were grouped into preliminary themes. These groupings were then reviewed and refined in collaboration with a research assistant to identify the final themes. Finally, the selected themes were used to structure the written analysis of the results. The qualitative notes from adolescents were analyzed separately from those of parents.

To explore the potential effects of the program on ASD-related challenges, Wilcoxon signed-rank tests were conducted using pre- and posttest results from the MASC-2 and the attention tasks. The results from the two MASC-2 questionnaires (self-report and proxy report) were analyzed separately. Given that yoga is not identified in the scientific literature as a potentially harmful intervention for the target population,¹² a β/α ratio of 2 (0.20/0.10) was selected instead of the

conventional ratio of 4 (0.20/0.05). The two-tailed significance level was thus set at 0.10. Power analysis using G*Power showed that a sample size of eight participants yields 80% power at $p = 0.10$. Based on Cohen's coefficients, rank-biserial correlation coefficients (r_c) were calculated to analyze effect sizes (small ± 0.15 ; medium ± 0.25 ; large ± 0.5). Given the small sample size, to maximize statistical rigor we interpreted the results considering the p value significance level and calculated effect sizes using rank-biserial correlation coefficients.⁴⁴ Quantitative statistical analyses were performed using RStudio and JASP software.

Results

Participant Characteristics

The adolescents were aged between 13 and 17 years (mean 15.17 ± 1.84 years). The parents were aged between 42 and 50 years (mean 47.5 ± 2.78 years). All adolescents attended a mainstream school ($n = 4$ in nonspecialized classes, $n = 2$ in specialized classes). All adolescents who participated in the study were verbal. Five of the six participants had at least one neurodevelopmental disorder associated with their ASD. None of the adolescents were engaged in other physical activities during the study. Half of the parents reported having health issues themselves. Table 2 provides a detailed description of the participants' characteristics.

Implementation

A zero-dropout rate and an attendance rate of 88% were calculated. Of the 14 participants, 8 completed at least one home session during the program. On average, participants missed only one in-person session at the university out of the eight offered during the program. Friedman analyses did not show significant changes in the frequency of participants' task-focused behaviors during yoga sessions ($\chi^2(6) = 9.94$, $p = 0.13$). Figure 1 graphically illustrates the variability of task-focused behaviors.

Table 2. Participant Characteristics

	<i>n</i>	Mean
Adolescents		
Girls/boys	1/5	
Age (years)		15.17 ± 1.84
Comorbidities	5	
Language and communication disorders	3	
ADHD	3	
Intellectual development disorder	1	
Parents		
Mother/father	5/3	
Age (years)		47.50 ± 2.78
Full-time work	6	
Health issues	4	

ADHD = attention-deficit/hyperactivity disorder.

Social Acceptability

Frequency analysis of the TARF-R scores showed that 10 out of 14 participants perceived that practicing yoga helped them manage their anxiety and that the program met their needs in anxiety management. Of the 14 participants, 8 mentioned that practicing yoga improved their concentration and that the program addressed their attention-management needs. Most participants (11 out of 14) considered the Yoga Bali method effective in helping them. Regarding program appreciation, 9 out of 14 participants stated that they liked the procedures employed,

and 9 participants indicated that the program fit well into their routine. No participants reported adverse effects from the program, although 1 participant experienced discomfort during the sessions, and 8 participants believed that the yoga program could lead to lasting improvements. In terms of engagement, 11 participants planned to continue practicing yoga; however, only 4 participants expressed a willingness to make time in their schedules to continue practicing yoga after the program. Only 1 participant mentioned that practicing yoga outside of a research protocol was too expensive. Figure 2 shows the response count for each TARF-R item by participants (parents or adolescents).

Figure 1. Variability in Task-Focused Behaviors During Yoga Sessions

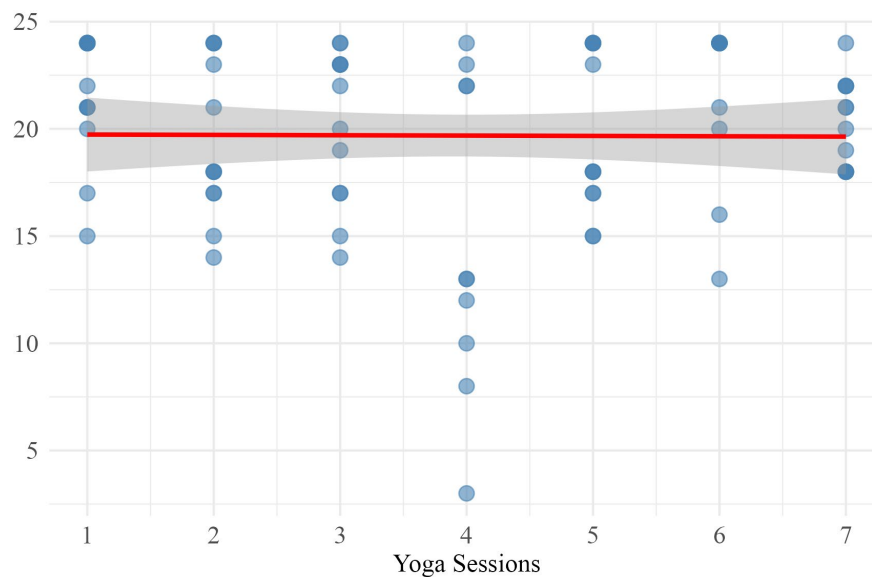
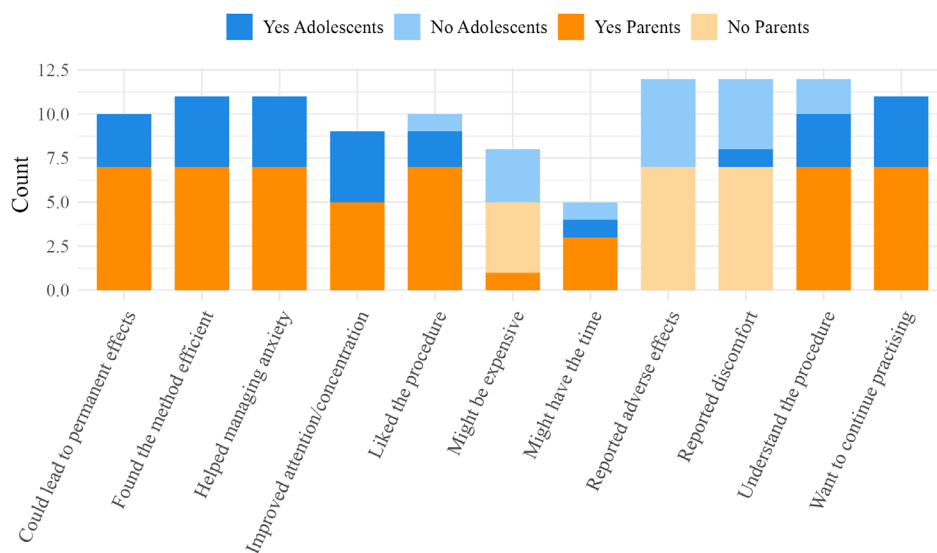


Figure 2. Frequencies of Responses to the TARF-R Questionnaire Evaluating Social Acceptability Among Adolescents with ASD and Their Parents^a



^aFrequencies are reported only for Yes and No responses; participants who abstained from answering are not included in the figure.

ASD = autism spectrum disorder; TARF-R = Treatment Acceptability Rating Form Revised.

Qualitative analysis highlighted three central themes among parents: (1) a lack of professional resources, (2) parental stress, and (3) perceived social support during the program. In summary, parents explained that the yoga program was a good alternative to the lack of interventions available in public networks (e.g., health, social, education). Additionally, they used several techniques learned during the program to manage and reduce their stress at home and work. Finally, the in-person sessions allowed them to exchange information about their respective realities with other parents, which provided a sense of perceived social support. For adolescents, qualitative analysis revealed three main themes: (1) appreciation of relaxation, (2) school-related stress, and (3) social connectedness. Adolescents mentioned during the interview that relaxation helped them unwind, particularly when they felt stressed at school during the week. They also expressed looking forward to the in-person yoga sessions because they could talk with other

participants their age. Finally, all participants reported experiencing a sense of belonging. A more detailed description of the qualitative notes is available in Supplement B.

Potential Effects on Anxiety

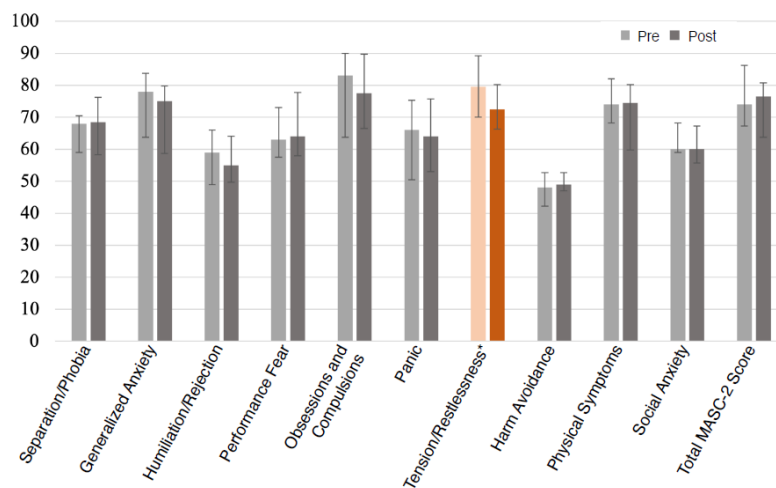
A significant decrease in tension/restlessness subscale scores was observed in the parent-reported assessments of the anxiety symptoms of the adolescents with ASD following the yoga program, with a large effect size (pretest 25th percentile = 72.0, median = 79.5, 75th percentile = 87.8; posttest 25th percentile = 68.8, median = 72.5, 75th percentile = 78.8) ($W(8) = 18.5$, $p = 0.05$, $rc = 0.76$). No other significant changes were observed between pre- and posttest median scores for the MASC-2 subscales completed by parents. Table 3 and Figure 3 summarize the results of the Wilcoxon signed-rank test analyses.

Table 3. Results of Wilcoxon Signed-Rank Test for Each Subscale of the MASC-2 Proxy Report Anxiety Questionnaire Completed by Parents Pre- and Postprogram

MASC-2 Subscale	<i>W</i>	<i>z</i>	<i>p</i>	<i>rc</i>
Separation/phobia	6.5	−1.26	0.91	−0.53
Generalized anxiety	8.5	0.27	0.44	0.13
Humiliation/rejection	18.5	0.76	0.24	0.32
Performance fear	7.5	−1.47	0.94	−0.58
Obsessions and compulsions	12.0	0.31	0.41	0.14
Panic	4.5	−0.18	0.64	−0.10
Tension/restlessness	18.5	1.67	0.05	0.76↓
Harm avoidance	7.0	−0.73	0.79	−0.33
Physical symptoms	16.0	1.15	0.14	0.52
Social anxiety	13.5	−0.08	0.56	−0.03
Total MASC-2 score	17.0	−0.14	0.58	−0.05

MASC-2 = Multidimensional Anxiety Scale for Children, 2nd ed.; *p* = statistical significance threshold set at ≤ 0.05 ; *rc* = rank biserial correlation coefficient; *W* = Wilcoxon signed-rank test statistic; *z* = critical value; ↓ = statistically significant decrease in anxiety level per *p* and *rc* coefficients.

Figure 3. Median Results and Representations of the 25th and 75th Percentiles for Each Subscale of the MASC-2 Proxy Report Completed by Parents Across Measurement Time Points^a



* $p = 0.05$.

^aError bars represent the 25th and 75th percentiles.

MASC-2 = Multidimensional Anxiety Scale for Children, 2nd ed.

Wilcoxon signed-rank test analyses revealed a marginally significant decrease, with a large effect size, in the humiliation/rejection subscale scores reported by adolescents from before the yoga program (25th percentile = 49.5, median = 60.0, 75th percentile = 70.5) compared to after the yoga program (25th percentile = 43.8, median = 46.0, 75th percentile = 50.5)

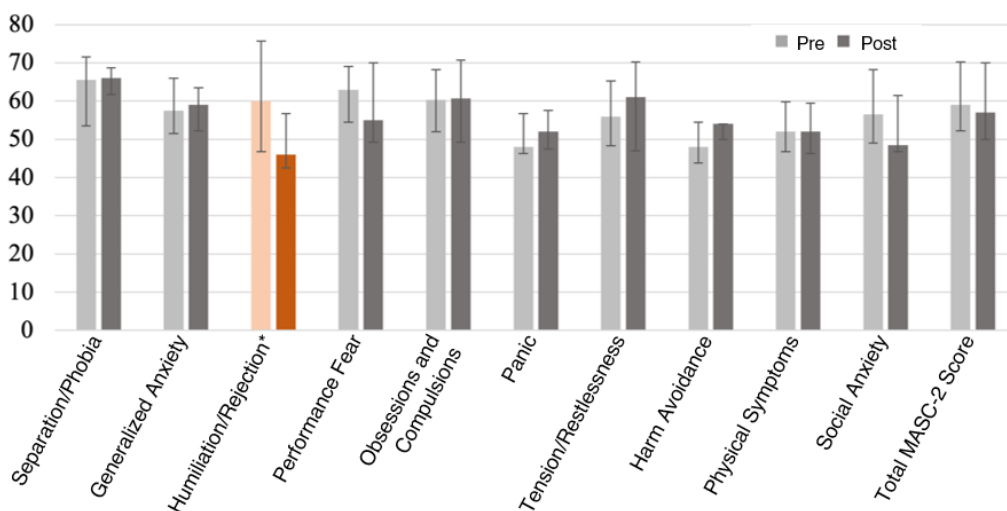
($W(6) = 13.5$, $p = 0.06$, $rc = 0.80$). No other significant changes were observed between pre- and posttest median scores for the MASC-2 subscales completed by the adolescents in the sample. Table 4 and Figure 4 summarize the results for the self-reported MASC-2 subscales and Wilcoxon analyses.

Table 4. Results of Wilcoxon Signed-Rank Test for Each Subscale of the MASC-2 Self-Report Anxiety Questionnaire Completed by Adolescents Pre- and Postprogram

MASC-2 Subscale	<i>W</i>	<i>z</i>	<i>p</i>	<i>rc</i>
Separation/phobia	3.0	0.00	0.60	0.00
Generalized anxiety	6.5	-0.27	0.65	-0.13
Humiliation/rejection	13.5	1.61	0.06	0.80↓
Performance fear	7.5	0.91	0.23	0.50
Obsessions and compulsions	7.5	0.00	0.55	0.00
Panic	4.5	-0.80	0.83	-0.40
Tension/restlessness	6.0	-0.40	0.70	-0.20
Harm avoidance	5.0	-1.15	0.89	-0.52
Physical symptoms	9.0	0.40	0.39	0.20
Social anxiety	11.0	0.94	0.20	0.46
Total MASC-2 score	8.0	0.13	0.50	0.06

MASC-2 = Multidimensional Anxiety Scale for Children, 2nd ed.; *p* = statistical significance threshold set at < 0.10; *rc* = rank biserial correlation coefficient; *W* = Wilcoxon signed-rank test statistic; *z* = critical value; ↓ = statistically significant decrease in anxiety level per *p* and *rc* coefficients.

Figure 4. Median Results and Representations of the 25th and 75th Percentiles for Each Subscale of the MASC-2 Self-Report Completed by Adolescents Across Measurement Time Points^a



* $p = 0.06$.

^aError bars represent the 25th and 75th percentiles.

MASC-2 = Multidimensional Anxiety Scale for Children, 2nd ed.

Potential Effects on Attention

For overall concentration performance on the d2-R, Wilcoxon signed-rank test analyses indicated a significant improvement in concentration scores from before the intervention (25th percentile = 82.25, median = 89.50, 75th percentile = 93.00) compared to after the intervention (25th percentile = 88.00, median = 95.00, 75th percentile = 97.50) ($W(6) = 1$, $p < 0.05$, $rc = -0.90$). Figure 5 illustrates the results. No significant differences were found in the quantitative performance or global performance indices. On the Score! subtest of the TEA-Ch Wilcoxon signed-rank analyses showed no differences between performance before the intervention (25th percentile = 5.50, median = 8.00, 75th percentile = 9.75) and after the intervention (25th percentile = 4.25, median = 6.00, 75th percentile = 9.25) ($W(6) = 9.5$, $p = 0.75$, $rc = 0.26$). Tables 5 and 6 summarize the results of the Wilcoxon signed-rank test analyses.

Discussion

The objective of the present study was to explore the feasibility of the YBP-A-ASD program adapted for adolescents with ASD and

their parents. Based on the feasibility framework of Gadke et al.,²⁸ the results suggest that this yoga program is feasible for both adolescents with ASD and their parents. In terms of implementation, no participants withdrew from the study, attendance to in-person sessions reached nearly 90%, and participants remained attentive for most sessions. In terms of social acceptability, most participants expressed a liking for the procedures used and an interest in continuing their yoga practice. However, few participants were willing to dedicate significant time to continuing yoga practice after the program. Furthermore, no adverse effects from yoga practice were reported, and several participants believed the YBP-A-ASD program could lead to lasting improvements. Finally, most participants stated that the program met their needs and helped them in at least one domain (e.g., anxiety, attention/concentration, stress management). Findings suggest that the YBP-A-ASD had beneficial effects on the adolescents' anxiety levels and concentration abilities. Our findings align with those of studies conducted with children with ASD^{12,26} and with adolescents with ASD and their parents.²³

Table 5. Descriptive Results for the d2-R Test of Attention Subscales and the Score! Subtest of the TEA-Ch

Subscale	Mean	Range	25th Percentile	Median	75th Percentile
d2-R					
Quantitative performance pre	85.00	70–95	82.50	84.00	92.25
Quantitative performance post	88.00	77–101	82.00	89.50	91.00
Global performance pre	85.16	72–96	84.25	85.50	87.50
Global performance post	89.00	75–103	81.75	91.50	93.75
Concentration pre	87.83	77–97	82.25	89.50	93.00
Concentration post	92.16	75–104	88.00	95.00	97.50
TEA-Ch					
Score! pre	7.0	1–10	5.50	8.00	9.75
Score! post	6.5	3–10	4.25	6.00	9.25

TEA-Ch = Test of Everyday Attention for Children.

Table 6. Comparison of Pre- and Posttest Median Results for the d2-R Test of Attention Subscales and the Score! Subtest of the TEA-Ch

Subscale	<i>W</i>	<i>z</i>	<i>p</i>	<i>rc</i>
Quantitative performance	6.0	−0.94	0.19	−0.42
Global performance	6.0	−0.94	0.19	−0.42
Concentration	1.0	−1.99	0.02	−0.90↑
Score!	9.5	0.53	0.75	0.26

p = statistical significance threshold set at < 0.10 ; *rc* = rank biserial correlation coefficient; TEA-Ch = Test of Everyday Attention for Children; *W* = Wilcoxon signed-rank test statistic; *z* = critical value; ↑ = statistically significant increase in attention abilities per *p* and *rc* coefficients.

Implementation

According to Gadke et al.,²⁸ high levels of adherence, engagement, and attentiveness during an intervention are key indicators of adequate implementation. Findings from the present study align with this definition. Adherence to the intervention was high, particularly for in-person group sessions, whereas adherence to the asynchronous at-home practice was lower. In contrast, Garcia et al.²⁶ observed higher levels of adherence to at-home sessions than ours, which they attributed to sustained contact with participants through follow-up communications after each session. Their study also highlighted that group sessions facilitated adherence among parents by allowing them to socialize and connect. These findings may help contextualize the current study's pattern of adherence. Higher engagement with in-person sessions compared to at-home practice may reflect the sense of belonging and social support that participants described during the interview. Prior studies among adults without ASD have suggested that these feelings can promote adherence to physical and relaxation activities, including yoga.^{45,46} Moreover, a qualitative study among adolescents without ASD reported an association between social support and engagement in physical activity.⁴⁷

Results from the nonparametric analysis of the behavioral observations indicate that both adolescents with ASD and their parents were attentive during most sessions. This finding reflects a high level of engagement in yoga practice and attentiveness during the intervention, consistent with the implementation indicators described in Gadke et al.'s framework.²⁸ These findings suggest that parents primarily focused on the yoga sessions and were less inclined to intervene with their child. For some parents, the program was one of the first times they could enjoy an activity with their adolescent with ASD without feeling the need to intervene. These findings align with those of Laughlin and Chun,⁴⁸ who suggested that mothers of children with ASD find valuable personal time through yoga practice, which in turn supports their own emotional well-being. Previous studies also reported potential positive effects of shared parent-child activities on the psychological well-being of parents of adolescents with ASD.⁴⁹

Social Acceptability

The TARF-R results and the qualitative interview support a high level of confidence among participants in the program's potential effectiveness and perceived well-being benefits. In general, most participants felt that the yoga program addressed their needs related to the management of anxiety and attention difficulties. These findings are consistent with studies conducted with adolescents and adults without ASD that suggest that yoga-based interventions reduced anxiety and enhanced attention.^{15–17}

Although two adolescents in the current study reported not liking the procedure, this may reflect a general preference for the relaxation component of the sessions over other elements, as reported during the group interview. To our knowledge, few

studies have explored how children or adolescents with ASD perceive the specific components of mind-body programs.¹² In their qualitative study on participants' experiences with the MYmind program, Ridderinkhof et al.²⁵ reported that children with ASD particularly enjoyed the breathing exercises and yoga components of the mindfulness-based intervention.

During the group interview, parents indicated that the program served as a valuable alternative to the limited resources available in public services. Many mentioned experiencing reduced stress levels over the course of the program. Similar findings were observed in previous studies, where parents of children with ASD reported decreased perceived stress after taking part in a yoga program.^{26,50} TARF-R results further suggested that parents perceived the intervention as effective. Taken together, these findings echo previous research suggesting that parental stress tends to be lower when parents have access to person-centered interventions tailored to their needs and those of their adolescents with ASD.^{51,52}

Certain program elements in our study may have contributed to the participants' perceived benefits of yoga practice on well-being (e.g., reducing stress and anxiety). For example, some participants noted that they felt a sense of calm as soon as they entered the yoga room, describing the environment as quiet and visually soothing. A low-stimulation environment may benefit adolescents with ASD, as sensory sensitivities are often associated with anxiety.⁵³ A study by Marwati et al.²⁰ supports this notion, suggesting that quiet, dimly lit environments, such as those in yoga classes, can reduce stress and behavioral problems. Based on our qualitative results, the predictability of the yoga environment (e.g., systematic room arrangement) may have contributed to a sense of well-being. For adolescents with ASD, intolerance to uncertainty can exacerbate emotional and behavioral challenges.^{54,55} Establishing a stable and predictable environment for yoga sessions may have positively influenced the management of anxiety symptoms in adolescents with ASD. Parental stress levels may decrease as a result of the positive effects of predictability on behavioral and emotional problems in adolescents with ASD.¹⁰ Additionally, access to tailored interventions that parents positively evaluate may further reduce parental stress.⁵²

Perceived social support is another potentially beneficial element associated with the reduction in stress reported by parents. Social support has been found to be a protective factor for parental stress and family functioning.^{52,56,57} Robinson and Weiss⁵⁷ found that the positive impact of social support on mitigating stress is more pronounced when parents of children with ASD perceive the support as sufficient and readily available. Our qualitative results align with this finding, as most parents in the current sample reported that the yoga program provided them with social support tailored to their needs. Similar to Garcia et al.,²⁶ in the present study, parents discussed their shared experiences during yoga sessions and exchanged useful information, such as where to access specific resources. Sharing common realities (e.g., challenges, daily struggles, emotions) can

enhance perceived social support among parents of adolescents with ASD and help them manage stress.⁵⁸ The yoga instructor's attitude may offer another relational explanation for the program's perceived benefits as reported by the participants. During the postprogram interview, several parents reported appreciating the openness of the instructor, and most adolescents mentioned that they had developed a positive connection with him. These elements, according to Ramanathan and Bhavanani,¹⁴ enhance the benefits of a yoga program.

Potential Effects of the Practice

We observed a marginally significant change in the level of anxiety symptoms reported by adolescents in the humiliation/rejection subscale of the MASC-2 before and after their participation in the program. According to the rank biserial coefficient, this change had a large effect size, suggesting that yoga may have beneficial effects on the anxiety-related symptoms of social rejection experienced by adolescents with ASD. Our findings are consistent with previous studies on the MYmind program, which documented reductions in anxiety-related symptoms such as rumination²³ and worry²² among adolescents with ASD.

Bellini's⁷ explanatory model of social anxiety in adolescents with ASD may help contextualize these results. According to this model, repeated positive social experiences can mitigate anxiety symptoms by reducing the sense of social isolation. Social connectedness, friendships, and a sense of belonging, fostered by positive social experiences, are further protective factors promoting psychological well-being in adolescents with ASD.^{59,60} Qualitative findings from our study highlight that many adolescents experienced at least one positive social interaction during the program (e.g., forming a friendship, developing a bond with a parent, or connecting with the yoga instructor). These results suggest that group yoga sessions may provide an opportunity for adolescents with ASD to build friendships, engage in positive interpersonal experiences, and develop social connectedness, which could help reduce feelings of rejection. Future research could evaluate the mediating role of interpersonal experiences during yoga sessions on the anxiety experienced by adolescents with ASD following their participation in the program.

Some of our findings align with Gard et al.'s¹⁸ self-regulation model. Analysis of the MASC-2 subscales completed by parents revealed a marginally significant difference in pre- and posttest levels of physical symptoms of anxiety (e.g., tension/restlessness) in adolescents with ASD. Parents noted a decrease in signs of physical tension (e.g., startle reactions, muscle tension, trembling) in their child after the 8-week program. According to Gard et al., yoga may reduce muscle tension by influencing stress-regulation mechanisms. We also observed a significant improvement in the concentration/attention abilities of adolescents with ASD. Based on Gard et al.'s 2014 self-regulation model, the engagement of attention during yoga sessions may have contributed to improved concentration/attention abilities in other contexts. Among the

adolescents included in our study, 50% had a concurrent ADHD diagnosis. This prevalence is similar to the median rate identified in a 2023 systematic review.² Our results suggest that yoga may be a beneficial intervention for adolescents with ASD and concurrent ADHD, given the observed improvements in attentional abilities. Previous studies have reported beneficial effects of yoga among youth with ADHD without ASD.⁶¹

Program Improvements

Despite the high level of social acceptability, our results reveal low motivation among participants to continue practicing yoga after the end of the program. The program may act as a facilitator by providing structured guidance within a set schedule. Mentorship to support participants in using the tools available on the program's website could be a viable solution to improve continuity of practice after the program ends. Additionally, incorporating a collective dimension into the home sessions could further strengthen the effects of social support on motivation.⁴⁷ One potential solution would be to offer planned remote group sessions instead of videos to be followed autonomously.⁶² Furthermore, as Garcia et al.²⁶ did in their study, it might be useful to implement email follow-ups after each at-home session to provide additional guidance and support for the practice.

Contributions, Limitations, and Future Directions

We observed a certain degree of discrepancy between the perceptions reported by adolescents via the self-report questionnaire and those expressed during the group interview. During the interview, adolescents reported that yoga helped them manage their emotional problems, whereas we did not find significant changes in many MASC-2 subscales. It is worth noting that some adolescents' response styles on the TARS-R tended to be neutral, suggesting that these participants did not hold strong opinions regarding aspects of social acceptability when responding by questionnaire. However, they did express their perceptions during the group interview. One potential explanation for these differences lies in the effectiveness of the method used to gather impressions from adolescents with ASD. Qualitative interviews may be more conducive to sharing experiences among this population. Indeed, the adolescents may have found it difficult to relate their experiences to the statements and response options in a questionnaire.⁶³ A semistructured interview format could allow them greater flexibility to articulate their thoughts in their own words while providing support to reflect on and share their experiences.⁶⁴ Social desirability bias may also have influenced the responses provided by adolescents in the sample during the group interview. Additionally, the small sample size may have reduced the statistical power of the analysis. Nevertheless, feedback from adolescents with ASD is a significant contribution to an exploratory study on intervention feasibility, as the participants are best positioned to identify their own needs.⁶³

According to Lancaster and Thabane's⁶⁵ guidelines, feasibility studies should employ mixed-methods designs to

gather detailed participant feedback. Although the mixed-methods design is a strength of the present study, as it allows for detailed information on participants' experiences, quantitative data analyses should be interpreted with caution. Indeed, the small sample size somewhat limits the interpretation of the quantitative data. The encouraging results regarding the benefits of yoga on anxiety symptoms and attentional capacities in adolescents with ASD warrant verification in a subsequent pilot study that includes a control group, a convenience sample, and the proposed program improvements. Despite the small sample size, our study highlights the active participation of adolescents with ASD and represents an important step in research initiatives aimed at ensuring this clinical population's voice in addressing their challenges.⁶³

Furthermore, our sample reflects the heterogeneity of ASD reasonably well, enabling conclusions that address a broader range of ASD-related challenges. This study adds valuable data to the growing body of research on therapeutic yoga practice, an emerging field.¹² The findings emphasize the importance of offering family-based interventions, as these benefit both parents and adolescents with ASD. Additionally, the data highlight the significant role of social support in engagement and adherence to practice. Future research should further explore the group dynamic in yoga practice and its effects on participants' well-being.

Conclusions

This study contributes valuable data on the feasibility of yoga practice as an intervention for adolescents with ASD and their parents. Overall, the results indicate that yoga practice is a feasible intervention for this population. Group sessions were particularly effective in promoting adherence to the practice and reducing dropouts. During these sessions, participants benefited from social support. Furthermore, yoga practice appeared to decrease anxiety in adolescents with ASD and to reduce parental stress. Finally, as suggested by Gard et al.'s¹⁸ theoretical model, yoga practice contributed to the improvement of concentration abilities in adolescents with ASD. The findings of our study, alongside conclusions from prior research, can serve as a guide for professionals seeking to implement yoga-based interventions for adolescents with ASD and their parents.

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Conflict-of-Interest Statement

The authors declare no conflicts of interest related to this study.

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Supplement A. Components of the YBP-A-ASD

Session	Posture Sequence	Educational Themes
1	1. Seated posture	Sessions 1 and 2: Anxiety and attention Effects of yoga on various aspects of life Objectives: Providing foundational knowledge on anxiety and attention and explaining how yoga may influence various aspects of life including anxiety symptoms and attention abilities
	2. Seated butterfly	
	3. Forward bend	
	4. Static bridge	
	5. Knees to chest	
	6. Crocodile/cobra	
	7. Child's pose	
	8. Relaxation	
2	Repetition of Session 1 postures 1–6	
	7. Candle pose (shoulderstand)	
	8. Cat-cow	
	9. Downward dog	
	10. Mountain	
	11. Tree	
	12. Warrior II	
	13. Child's pose	
	14. Relaxation	
3 and 4	Repetition of Session 2 postures 1–12	Sessions 3 and 4: Learning abdominal breathing and its effects Objectives: Teaching abdominal breathing techniques and briefly explaining their physiological, neurological, and psychological benefits
	13. Goddess (temple) pose	
	14. Seated twist	
	15. Seated figure-4	
	16. Plough	
	17. Happy baby	
	18. Kneeling thunderbolt	
	19. Child's pose	
	20. Relaxation	
5–8	Repetition of the Session 3 sequence	Sessions 5 and 6: Focusing on the present moment Objectives: Learning about the concepts of concentration and encouraging mindfulness of one's current state and thoughts Sessions 7 and 8: Integrate all components of the practice to foster autonomy

YBP-A-ASD = Yoga Bali Autism Spectrum Disorder Program.

Supplement B. Qualitative Notes on Participant Comments During Interviews and Group Discussions^a

Family 1. Patricia (mother) explained that she had to take out a loan from the bank to provide professional support for her son due to a lack of public-sector resources. Additionally, she mentioned that during the program she felt at peace for the first time during an activity with her son because she knew he was being taken care of. She felt that the open-minded approach during the yoga session regarding her son's behaviors reassured her and helped reduce her stress. She added that the program met her needs as the mother of a teenager with ASD. Finally, she explained that she talked with other mothers about similar experiences and felt supported.

Family 2. Alexandra (mother) reported that there were simply no services available for her 14-year-old child with ASD. She mentioned that for the first time she interacted with other parents who shared similar realities. She felt social support when she realized that other parents were facing the same challenges. Mathew (son) said he enjoyed the relaxation.

Family 3. Georges (father) used the breathing technique he learned during the program in several stressful situations. He explained that this technique helped him regulate his stress. France (mother) felt acceptance toward herself and her family during the yoga classes. She appreciated that the instructor had a flexible approach based on the participants' needs. She added that this activity was the first one to benefit every family member. Steve (son) enjoyed the relaxation. He felt comfortable talking to the other participants and reported looking forward each week to seeing his new friends. He also mentioned that he liked the yoga instructor.

Family 4. Jane (mother) tried to incorporate yoga into her family routine but found it sometimes difficult. She observed a decrease in her son's inattention during the program. She also reported that her son requested to do breathing exercises at home to calm down. Oliver (son) appreciated the relaxation because he was able to use it at school when he felt stressed. He also enjoyed talking to Steve (another participant) before and after the yoga sessions. Jane added that her son and Steve exchanged numbers to meet outside of the yoga classes.

Family 5. Louis (father) said he did breathing exercises at work. During the program, he felt less irritable and less stressed. When he started yoga, he felt that his body and mind were more relaxed thanks to the classroom environment. He explained that, during the sessions, as soon as he entered the room, he felt less stressed because the environment seemed calming. Eleanor (daughter) mentioned that yoga helped her manage her anxiety and stress at school.

Family 6. Chantal (mother) explained that the program opened her eyes to the benefits of yoga. She said she felt stressed all the time before the program. She believes that the program met her needs and wished she had access to yoga classes beyond the study. She explained that she might not be able to afford yoga classes at a studio. Philippe (father) did yoga at work to stretch and calm down. Both Chantal and Philippe agreed with Louis's comment about the calming environment of the room and the way the yoga sessions were conducted. Peter (son) reported that he was stressed because of school and that he enjoyed the relaxation.

^aFictitious names used to ensure confidentiality.