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Virtual Group–Based Mindfulness Intervention for Autistic Adults: a Feasibility Study

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Abstract

Objectives Although mindfulness-based interventions have been shown to be helpful in reducing psychological distress in autistic adults, limited research has explored virtual delivery in the autism community. We designed an adapted virtual group–based mindfulness intervention, based on input from autistic adults, and evaluated its feasibility in terms of demand, acceptability, implementation, practicality, adaptation, and limited efficacy testing.

Methods Informed by an online needs assessment survey of 77 autistic adults, 37 individuals completed a six-week autism informed manualized course delivered virtually. Participants completed pre, post, and 12-week follow up, and also provided qualitative feedback.

Results There was a demand for the course, adaptations were successful, and participants indicated good acceptability of the intervention. Open-ended feedback highlighted advantages and challenges with the technology, the benefits of connecting with other autistic adults, and unique aspects of the mindfulness instruction. Participants reported reduced levels of distress which were maintained at three-month follow-up, and increased mindfulness, and self-compassion.

Conclusions Autism-informed adaptations to standard mindfulness-based interventions can lead to self-reported improvements in mindfulness, self-compassion, and distress by autistic adults. Continued research with outcome measures tailored toward autistic adults will be important, during and post-pandemic.

Keywords Autism · Adulthood · Mindfulness · Telehealth · Feasibility · COVID-19

It is well recognized that autistic adults experience significant stress in their daily life (Bishop-Fitzpatrick et al., 2015; Gillott & Standen, 2007; Joshi et al., 2013) and that they report higher rates of depression and anxiety than other individuals (Gillott & Standen, 2007; Hollocks et al., 2018; Joshi et al., 2013). There is a paucity of research, however, on psychological interventions to reduce stresses that are autism-specific (Benevides et al., 2020). Of the limited research which has been done, the majority has focused on children as opposed to adults (Kirby & McDonald, 2021).

Mindfulness, defined as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (Kabat-Zinn, 2003, p. 145), has been shown to reduce stress in a number of populations (Chiesa & Serretti, 2011; Singh et al., 2007, 2020; Vøllestad, et al., 2011). Several recent reviews have highlighted the value of mindfulness-based interventions for autistic people (Benevides et al., 2020; Cachia, et al., 2016a, 2016b; Hartley, et al., 2019); however, the majority of studies have focused on mindfulness for parents, as opposed to autistic individuals. Mindfulness may be particularly helpful to autistic people in several ways: Being aware without judgment encourages noticing with curiosity without attaching a value to a somatic experience or a thought. This may help autistic people learn to pause and observe, which could help to prevent someone from becoming overwhelmed. Importantly, it also allows someone to shift their attention in moments of stress from one aspect of the experience to another. Acting mindfully can serve as a warning system

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to someone who is overwhelmed, and lead to actions to protect oneself (Benevides et al., 2020). A person can also learn to be mindful of how another person may be experiencing a situation (Block-Lerner et al., 2007; Pratscher et al., 2018), which can impact their social communication with others.

Of the mindfulness studies that have focused on autistic people, the majority have been delivered to children and youth, either alone (Semple, 2019), or together with their parents (Hwang et al., 2015; Ridderinkhof et al., 2018; Ridderinkhof et al., 2019). Fewer studies have focused on autistic adults. Spek et al. (2013) compared adapted group mindfulness-based cognitive therapy (MBCT) for autistic adults to a waitlist control. Adaptations included removing metaphoric language, reducing cognitive elements, and extending the intervention length by one week. The three-minute breathing space was lengthened to five minutes to accommodate the slower information processing of some participants. Daily homework included 40 to 60 min of formal meditation, similar to MBCT. They reported that depression, anxiety, and rumination were reduced in the mindfulness arm. In a second study, following up on this original group and some others ($N = 50$), Kiep et al. (2014) demonstrated that symptom improvement following the nine-week intervention was maintained at nine-week follow-up. In their final study (Sizoo & Kuiper, 2017), the adapted MBCT group was compared to CBT in an RCT. Both arms proved to be effective at reducing depressive and anxious symptoms. A similar MBCT adaptation was also piloted on an individual basis with young autistic adults and was shown to be feasible and acceptable to participants (Conner & White, 2018). Notably, four of the nine individuals reported symptom improvements with this brief individual intervention (six hours in total).

A more recent feasibility trial targeted autistic adults in the USA and delivered a standard mindfulness-based stress reduction (MBSR) program with two minor adaptations related to how the course was facilitated (Beck et al., 2020); The facilitator provided individuals with questions to discuss prior to the session, in writing, and had people discuss their responses in pairs rather than in the group during the session. Feasibility was assessed through recruitment statistics, retention, participant engagement (rated weekly with the Pittsburgh Rehabilitation and Participation Rating scale), and understanding of constructs (rated weekly using the Understanding of Material scale). Outcome measures included self-reported quality of life, mindfulness, and positive outlook using standardized scales, in addition to qualitative information provided as part of an exit interview. Challenges identified included the length of the sessions, and unanticipated problems related to coming to the groups, such as with traveling to sessions, parking, and the costs of attendance. Challenges during the groups included turn-taking, and participants remaining quiet during formal

meditation practices. The authors concluded that the delivery of standard MBSR was feasible and outcome measures were appropriate.

A recent systematic review of health interventions for autistic adults, which included input from autistic adults, considered mindfulness to be an emerging evidence-based approach to improve mental health outcomes (Benevides et al., 2020). Authors recommended future research on mindfulness-based interventions especially on ease of use, cost, long-term benefits, and consideration of digital delivery using apps. They also recommended that future research involve collaboration with autistic adult research partners to determine what is feasible.

An alternative to in-person mindfulness training is to deliver programs virtually, with the support of technology, where interventions can be delivered synchronously or asynchronously. Asynchronous interventions have the advantage of being available at any time and have been well-studied in a variety of populations. A recent feasibility RCT compared *Be Mindful*, an asynchronous program in the UK, to online asynchronous CBT, and a waitlist control in autistic adults (Gaigg et al., 2020). This study reported that 88% of 14 autistic adults remained in the mindfulness program until completion. The automated weekly reminders were considered helpful to them. Symptoms of self-reported anxiety improved and were maintained at three-month follow-up for 75% of participants, and at six-month follow-up for over 50% of participants.

The limitation of asynchronous virtual mindfulness interventions is that participants cannot benefit from sharing their experience with others or learn from the group inquiry process following each formal practice. A recent systematic review of virtual group-based psychological interventions (Gentry et al., 2019) included 40 studies and concluded that such groups are feasible (e.g., retention, technological aspects) and produce self-reported clinical outcomes similar to in-vivo treatments with high participant satisfaction. Synchronous group-based virtual mindfulness interventions have been tried with different groups including healthy adults (Ma et al., 2018), cancer patients (Campo et al., 2017; Zernicke et al., 2014), and family caregivers (Lunsky et al., 2021; Rayner et al., 2016), but not autistic adults. The Ma et al. (2018) study compared synchronous group-based mindfulness to self-directed mindfulness, a virtual discussion group, and a no treatment control condition and found that the group-based intervention was more effective than the other conditions. A study of synchronous group-based virtual mindfulness for parents of autistic adults found that parents reported reduced stress and depression, and improved mindfulness and self-compassion, maintained at follow-up (Lunsky et al., 2021). Improvements were comparable to what was reported during in-person group interventions.

Given that the few studies of in-person group-based mindfulness for autistic adults have reported benefits (Cachia et al., 2016b), it is important to explore whether virtual synchronous mindfulness groups could also be beneficial. Such an intervention would enable group interactions but not require travel, which is stressful for many autistic individuals, and would make the intervention more accessible to people who live far from an in-person group, or who are not comfortable meeting outside of their home. Technology would have other benefits as well to people with unique sensory needs, or who need to move around or make sounds during in session formal mindfulness practices, which are typically carried out silently, a challenge reported with autistic adults in in-person groups (Beck et al., 2020).

The aims of this study were to describe the process of developing an autism-informed group-based synchronous virtual mindfulness intervention together with autistic advisors and present early results on its feasibility including preliminary outcome data. Given the exploratory nature of the study, and the importance of detailed feedback with an autistic lens on course delivery (Benevides et al., 2020), feasibility was evaluated by combining quantitative results and a qualitative summary of participant feedback (Fletcher-Watson et al., 2018; Goering & Streiner, 1996). Such an approach also recognizes that feasibility may not be sufficiently captured with preconceived quantitative measures alone. The research was conducted prior to and during the first year of the COVID-19 pandemic; therefore, sensitivity analyses were carried out to explore how individuals experienced this intervention during the COVID-19 pandemic compared to prior.

Methods

Participants

Inclusion criteria for the current study were met if participants indicated they (1) were 18 years or older; (2) were proficient in English; (3) Canadian; and (4) self-identified as autistic. To participate, they required access to a computer, tablet, or smartphone. Although 62 individuals registered to participate in mindfulness groups, only 57 individuals provided written informed consent to participate in research evaluating the program which was approved by the Hospital Research Ethics Board. Three of the remaining five registered individuals completed the program. Of the 57 who consented to participate in the research, 50 completed baseline measures (26 women [52%], 22 men [44%], and two individuals who identified as non-binary [4%]). Participants ranged between 18 and 52 years of age, with a mean age of 31 years ($SD = 8.75$) and came from six provinces across

Canada (Ontario, Quebec, Newfoundland, Alberta, British Columbia, and New Brunswick). Of the 37 individuals who completed the intervention, 14 identified as women (38%), 21 as men (57%), and two as non-binary (5%).

Procedure

Needs Assessment to Inform Intervention Development and Feasibility Similar to Spek et al. (2013), prior to designing the adapted virtual mindfulness groups, we reached out to autistic adults in 2018 for input into the intervention design. This provided valuable information regarding perceived demand for the program, practicality, and necessary adaptations to meet the needs of autistic participants. Seventy-seven self-identified autistic adults responded to an anonymous online survey shared via social media and autism organizations, approved by the Hospital Research Ethics Board. Because of the anonymous nature of the survey, respondents reviewed an online consent form and provided implied consent prior to completing the survey. Survey respondents were between the ages of 17 and 64 years ($M = 37.81$; $SD = 11.15$). Approximately 56% identified as women, 30% as men, and 14% non-binary or preferred not to disclose. They were asked questions about whether such a group would be of interest, and if so, what the optimal number of sessions, length of sessions, and time of day would be for such a group.

With regard to perceived demand, survey results suggested that autistic adults had some interest in taking part in virtual mindfulness groups. We asked participants if they had ever participated in any type of mindfulness activities (e.g., yoga, meditation, mindfulness groups). Of those who reported they had (72%), 47% indicated they would be interested in participating in mindfulness activities again, and 26% said they *may* be interested. Of those who had never participated in any type of mindfulness activity (28%), 38% indicated that they would be interested in participating and 19% reported that they may be interested. Half of the participants indicated that would be interested in taking part in a web-based mindfulness research project for autistic adults and responses suggested comparable preferences for in-person and virtual interventions. With regard to practicality, 58% indicated they had access to a computer with a camera, 35% had access to a tablet device (e.g., iPad) with a camera; 46% had access to a smartphone with a camera; and 42% had internet or a mobile phone data plan (note: options were not mutually exclusive). In terms of relevant adaptations, evening (i.e., between 4:00 PM and 8:00 PM) was the most preferred time (49%), followed by afternoon (30%), and the majority (54%) preferred sessions to be 60 min in length with 33% wanting something shorter, and only 13% wanting the class to be 90 min.

Responses to open-ended survey questions also provided information about important elements to include when adapting the intervention, such as autistic leadership, structure, and sensory accommodations. Five respondents expressed concerns about mindfulness if not adapted to the unique needs of autistic people, with one of them stating that it is "extraordinarily harmful for most autistic people and causes anxiety." One individual suggested that leaders need to be prepared how to support someone who was triggered or had a meltdown from the exercises. Three individuals commented on the importance of including mindful movement in the teaching, recognizing that some autistic people may not be able to manage well keeping still. Two people spoke about the importance of making the group fun and allowing for social opportunities given the need for autistic adults to connect with one another. The needs assessment demonstrated perceived demand for the intervention, so long as some adaptations could be made to the more standard mindfulness-based programs, informed by autistic input.

Incorporating this feedback, the authors, including a clinician with over twenty years of experience facilitating MBSR, a clinician scientist with expertise in autism and in mindfulness, and two autistic advisors who both had received mindfulness training previously, mapped out the topics of a four-week trial program, with each session being 60 min in length. The aim of the first pilot group was to test the virtual platform and get early feedback from participants on mindfulness-based practices. Following this initial group, a second pilot group was conducted that was five weeks long, utilizing standardized outcome measures distributed prior to, following the intervention, and at follow-up. These measures were kept brief (only three measures in total, with two of them being the "short-form versions"), and in line with feedback that people may not want to be in a mindfulness study, participation in the research evaluation was considered optional. The five-week course was expanded to six sessions, based on feedback from participants, and was held with four cohorts of adults.

Intervention Description The intervention, based on the Mindfulness-Based Stress Reduction (MBSR) curriculum (Kabat-Zinn, 2003), was modified to make it more accessible for autistic adults ("adaptation"). The essential elements of mindfulness-based programs were maintained as outlined by Crane et al. (2017), but variations were made to the program structure, length, and delivery, tailored to fit the current group, and the online nature of the intervention. Modifications included shorter sessions (60 min as opposed to two and a half hours), shortening the guided meditations in sessions as well as the recordings for home practice, removing the full-day silent meditation retreat, and reducing the total number of sessions from eight to five (cohort one)

or eight to six (cohorts two to five). The curriculum developed for this program was designed with autistic advisors guiding the team on the length of meditations, the language used when giving instructions, and the range of techniques that would be most helpful for autistic adults. The modified curriculum followed the same scaffolding of mindfulness techniques as the original full eight-week MBSR program, beginning with eating meditation, then breathing techniques, the body scan, mindful movement, and metta, or loving-kindness in the same order as MBSR. Each activity was presented as optional, recognizing that some people may find certain silent sensory experiences too distressing. Participants were encouraged when they felt comfortable and safe to do so, to try each activity and notice the sensations in the body as well as their thoughts. Cameras could be on or off. Rather than focusing on one way to do each exercise, multiple options were offered where possible. For example, in week one, Mindful eating, participants could eat a raisin, or they could select a small item of food that they were comfortable with. In week two, which focused on Awareness of the Breath, participants had the opportunity to practice three different breathing strategies: (1) Hoberman Sphere breath (breathing by expanding the chest and releasing at the same time as expanding and contracting a Hoberman Sphere (Nishioka et al., 2016), (2) Figure-Eight Breathing (expanding and releasing the breath while tracing a figure-eight with the finger—breath in on the upward part of the eight and breath out with the lower part (Pagel, 2012), (3) Lotus Breathing (expanding the breath while opening the hand like a lotus and releasing the breath while contracting the hand). Participants could try all three or just pick the one they preferred the most for their home practice. Importantly, each of these three examples of breathing practices included synchronizing the breath with an action with their hand or an object, to help concretize their focus and make it less abstract.

To facilitate home practice, participants had a workbook with session summaries, homework, and links to video and audio practices similar to what was taught that week in session. Novel ingredients to the intervention included the participation of autistic advisors in sessions, promotion of multiple communication options (text and audio, camera on or off), as well as anonymous polling. Recognizing the diverse ways that autistic adults prefer to communicate, individuals could speak or type their comments in a chat box during the sessions. As well, while most people listened and had their cameras operating during the group, some people opted to just listen, and some opted to watch but keep their cameras off. This flexibility meant that a person who needed to move around while listening, for example, could easily do so without disrupting other participants.

Sessions were one hour in length, but individuals could log on 15 min early and chat with facilitators and one another. Before the first group, everyone had a chance to practice using the software one-to-one with the technical support person. Each session began with a group check-in, a brief mindfulness activity (review from the week prior) and a homework discussion. The participant workbook included homework tracking, but participants did not submit documentation of homework completion as part of the study. Next, a new theme was introduced for that week, with longer formal practice and inquiry discussion. Sessions ended with a summary of the session and an outline of the week's homework. Groups were facilitated by the mindfulness instructor together with the technical support facilitator and an autistic advisor. They met before each session to discuss the session content and structure and then debriefed after each session and problem solved. The technical support facilitator was not responsible for the content of the session and could focus strictly on supporting the technology and providing one-to-one support as required, in addition to keeping session notes. With regard to fidelity, all sessions were led by the same mindfulness instructor (SH) and followed the outline in the participant workbook but were not formally measured. There was some variation within each session with regard to timing devoted to each activity, based on participant comments and interests. See Table 1 for a brief outline of the sessions.

Participants were recruited through agencies across Canada that work with autistic people and their families. Flyers advertising the groups were also shared through social media (e.g., Twitter, Facebook). Interested participants contacted the researcher responsible for organizing the groups. Participants who agreed to take part in the research study were sent a consent form via email. Once the consent form was signed and returned to the researcher, they were sent a survey link and a unique ID to complete baseline measures the week prior to the first session. Post measures were completed online in the week after the last session, and follow-up measures were completed 12 weeks after the final session. Online questionnaires were administered through REDCap.

Five cohorts received the intervention between Fall 2018 and Winter 2020, using virtual meeting platforms (Zoom [cohorts one to two], and WebEx [cohorts three to five]). Participants from cohort one ($N = 10$) received a \$15 honorarium as a result of the initial grant funding, which was not available for participants from cohorts 2 to 5. All ten individuals in the first cohort completed at least three of five sessions whereas 27 of 40 individuals in the later cohorts completed four of six sessions.

Measures

Feasibility was assessed across six of the eight key areas of focus outlined in Bowen et al. (2009) framework for conceptualizing feasibility studies. Adaptation was assessed descriptively, based on needs assessment feedback from autistic people, which informed the development of the intervention, and which was assessed post-intervention through qualitative inquiry. Acceptability, or how the people an intervention is designed for respond to it, was assessed via self-reported open-ended responses about experiences with the program. Demand, which can be based on perceived as well as actual demand for an intervention based on uptake data, was measured as part of the needs assessment, and then in terms of the number of people recruited. Practicality, how easily the program could be carried out using existing means, was assessed via qualitative feedback about the program. Implementation, the degree to which the intervention can be delivered as proposed, was assessed by program adherence and study attrition rates. Limited efficacy testing, or whether the new program shows success, considered whether the intervention led to changes in depression, anxiety, and stress, in mindfulness and self-compassion, maintained at six-week follow-up.

DASS-21 The 21-item Depression, Anxiety & Stress Scales (DASS-21; Henry & Crawford, 2005), which included seven depression, seven anxiety, and seven stress items, was used to measure overall psychological distress at each time point. Items were rated using a 4-point Likert scale ranging from 0 ("Did not apply to me at all") to 3 ("Applied to me very much, or most of the time") and were summed to yield a single total score between 0 and 63, with higher scores indicating greater levels of distress. Internal consistency of the

Table 1 Weekly outline of mindfulness group sessions

Week	Content	Home practice
1	How mindfulness can help me: Using my senses to calm myself	Ocean breath, mindful snack
2	Breathing to calm myself	Figure 8 breath or lotus breath and mindful routine activity
3	Being aware of my body	Body scan or progressive relaxation and mindful routine activity
4	Mindfully moving my body and watching my thoughts	Cat Cow, watching my thoughts, and mindful routine activity
5	Being kind to myself and others	Lovingkindness and mindful routine activity
6	Mindfulness, music, and art	N/A

21-item DASS was excellent for the current sample at baseline measures (Cronbach's $\alpha = 0.91$).

FFMQ-SF The 24-item Five-Facet Mindfulness Questionnaire-Short form (FFMQ-SF; Baer et al., 2006) was used to assess five components of mindfulness: observing one's experiences, describing one's experiences, acting with awareness, accepting inner experiences in a nonjudgmental way, and accepting inner experiences without reacting. Participants were asked to rate how generally true each item was for them using a 5-point scale ranging from 1 ("Never or very rarely true") to 5 ("Very often or always true"), with higher total scores suggesting greater mindfulness (total score range from 24 to 120). Internal consistency of the FFMQ-SF was good for the current sample at baseline measures (Cronbach's $\alpha = 0.86$).

SCS-SF The Self-Compassion Scale – Short Form (SCS-SF; Raes et al., 2011) is a 12-item measure that assesses the ability to demonstrate care and kindness toward oneself, and acceptance of one's own imperfections. Self-compassion is often a focus of mindfulness-based interventions because of the interrelatedness with state mindfulness (Neff, 2003). Responses were given using a 5-point Likert scale that ranged from 1 ("Almost never") to 5 ("Almost always"), yielding a total score between 12 and 60, with higher scores indicating greater self-compassion. Internal consistency of the SCS-SF was good for the current sample at baseline measures (Cronbach's $\alpha = 0.86$; McDonald's $\omega = 0.82$).

Intervention Satisfaction Participants provided responses to open-ended questions asking about what they liked best and least about the group, what the biggest challenges they had to attending group meetings, what would make participation easier, and how they would change the group for future participants via an online survey distributed at the end of the course with the post-evaluation measures.

Data Analyses

Several post-intervention metrics of feasibility were assessed. Demand was assessed in terms of numbers recruited, and implementation was assessed with regard to how successfully each session was carried out. Acceptability and practicality were assessed by analyzing answers to open-ended questions in post-group survey using content analysis (Hsieh & Shannon, 2005), an analytic approach considered most suitable for open-ended survey questions that require single-word and short-sentence responses. Analysis followed the three phases outlined by Elo and Kyngäs (2008). These phases are preparation, organizing,

and reporting. During the *preparation phase*, authors (Y.L and B.R) became immersed in the data by reading and re-reading all open-ended responses. During the *organizing phase*, categories were created by grouping alike responses together. These categories were further broken down into subcategories. Categories and subcategories were not finalized until reviewed and agreed upon by all authors. Finally, for the *reporting phase*, detailed quotes were selected to represent each subcategory for the write-up of this article. Trustworthiness was established through prolonged engagement with data, research triangulation, peer debriefing, and documentation of discussions (Lincoln & Guba, 1985).

Limited efficacy testing was carried out through within-subjects repeated-measures analysis of variance (ANOVA), evaluating change in outcome measures across the three time points (pre-intervention, post-intervention, and follow-up). Significant results were followed by pairwise comparisons for pre-intervention to post-intervention, pre-intervention to follow-up, and post-intervention to follow-up. Only data from the 28 participants who completed measures at all three time points were included in these analyses. All participants completed pre-intervention assessments prior to COVID-19 restrictions. Exploratory repeated measures ANOVAs were calculated, with the group as a 2-level within-subject factor (no COVID-19 exposure vs. COVID-19 exposure) and time as a 3-level within-subject factor. Partial eta^2 was used as an estimate of effect size, with 0.01 indicating a small effect, 0.06 indicating a medium effect, and 0.14 indicating a large effect. Finally, we explored whether changes in aspects of mindfulness (i.e., FFMQ-SF and SCS-SF) were associated with changes in mental health variables (i.e., DASS) using Pearson product-moment correlations.

Results

Demand and Implementation

We were able to recruit participants through social media in the allotted time frame. Of these individuals, 57 consented to be part of the evaluation study. Of those, 50 completed baseline measures. Fewer completed post ($n = 34$) and follow up measures ($n = 29$). The technology worked for the most part. When someone had difficulties they could work individually with the technology facilitator during that session, as well as after the session. Adherence was assessed in terms of attendance and program completion. Attendance at three or more sessions out of five was considered complete for the first cohort, and four or more of six sessions for the remaining cohorts. Thirty-seven of 50 individuals completed the program, as shown in Fig. 1.
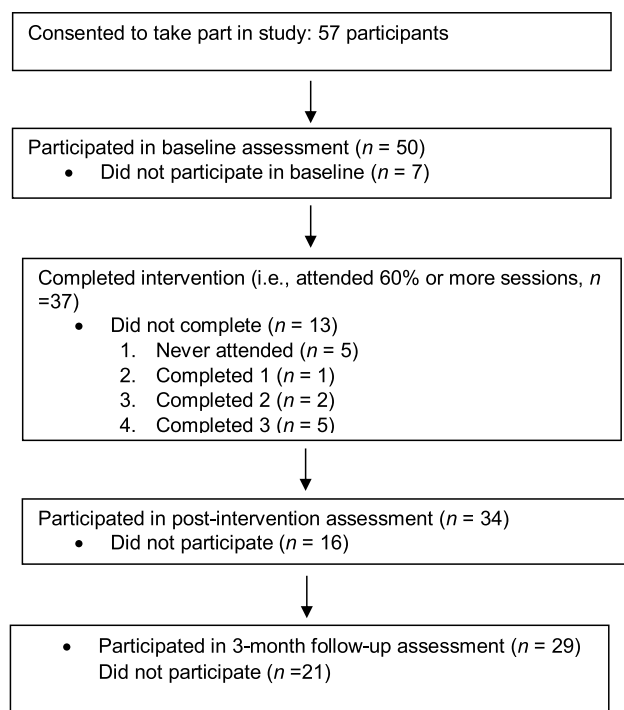
Fig. 1 Recruitment

Participants who completed the program ($n = 37$) did not differ statistically from those who did not complete the program ($n = 13$) on any of the baseline measures (DASS depression, DASS stress, DASS anxiety, DASS total, SCS-SF, and FFMQ-SF). The six sessions were carried out as outlined in the adapted workbook in terms of the core topics covered. Having a consistent person in charge of technology at each session meant that almost all technology problems could be quickly resolved.

Acceptability

Acceptability was evaluated using open-ended feedback from a satisfaction questionnaire completed by participants at the end of the program about what they liked and did not like about the course. Eighteen participants completed this questionnaire and their experiences fell into three categories: challenges and benefits of technology; making connections; and mindfulness elements. These categories were further broken down into subcategories. Participants also offered several recommendations they felt would improve the program.

Challenges and Benefits of Technology

Challenges Participants discussed various challenges they experienced with the technology. Some participants reported

having difficulties with their internet connection, while others encountered difficulties with specific features of the virtual platform. For instance, one participant (P17) felt distracted by seeing all the participants, "I didn't like being able to see everyone. I found it distracting. I would have preferred an option where I could block out the participants and maybe just have audio." Similarly, another participant (P4) wrote, "If you could keep the main screen on the leader and maybe just have the participants in small boxes surrounding her that would be better than flickering between them." Another feature of the virtual program that some participants felt distracted by was the chat function. While one participant (P6) felt distracted by people's comments in the chat, another participant didn't like the "private" function of the chat: "I don't like that people can talk to you privately in chat box." An additional distraction noted by one participant (P1) was the ease of accessibility to browse the internet during session. "I find it easy to get distracted while doing this at a computer…It's too easy to listen in while browsing the internet or otherwise not giving my full attention." The participant recommended that participants put their keyboard away/out of sight so they would not be tempted by online distractions.

Benefits Despite the challenges participants encountered with the technology, participants also benefited from the technology. Participants indicated that they enjoyed the online nature of the group. One participant (P1) quoted, "I could do it from home, and because my face wasn't visible, the stress of doing it was fairly minimal." Another participant (P3) noted:

> To join the group via videoconferencing has been a very positive thing for me, as commuting can be quite stressful and undo the immediate effects of a group session…To interact with the other members through virtual connection has been really beneficial.

Another benefit commonly reported by participants was that the virtual nature of the program allowed them to meet people from all around Canada.

Making Connections

Meeting Other Autistic Adults The majority of participants reported that they enjoyed meeting other autistic adults. For one participant (P15), this gave them a sense of normalcy, "[I] liked hearing other participants' perspectives. Additionally, it was nice to hear other people's various struggles, in life and also with the program itself, as it gave me a sense of normalcy, something I rarely feel." It was also clear that participants felt this contributed to a safe environment where they could express themselves and relate to others.

Sharing Coping Strategies The sessions allowed for discussion among the participants, which was often facilitated by the mindfulness instructor. Discussions mostly concerned the mindfulness practices; however, discussions often led to participants sharing their experiences with stress, anxiety, and depression, and the different strategies they used to cope. It was evident that these discussions not only offered participants a moment to share their experiences, but an opportunity to connect with one another on a deeper level. One participant (P3) described this in the following quote:

> The discussion part during each session was the occasion to share on how we manage our anxiety, but above this, to exchange our experiences as adults on the spectrum. This by itself means so much as many of us feel socially isolated, in a society that doesn't always cater to our uniqueness. Being surrounded by fellow individuals on the spectrum along this project has added a valuable human element… To me, it has a lasting impact on embracing the concept of mindfulness, emotionally and socially as a whole.

Connecting with other autistic adults was powerful and an additional benefit of this program.

Mindfulness Elements

Accessibility of Practices Participants shared aspects of the mindfulness program that were helpful, including the practices. One participant (P4) commented, " [The] Figure 8 and being taught to be mindful on an activity and to give it your full attention. Those really helped." Other participants appreciated that there were a variety of practices and that they were short and could be individualized.

Mindful Style of Facilitation Several participants noted that the facilitation and environment offered them a safe and comfortable place to learn and engage. One participant (P10) commented:

> Somehow her [mindfulness facilitator] being able to relate to our issues of being autistic helped me feel that our issues of a racing mind, especially, were being addressed. We've always been judged as faulty neurotypicals …. I don't know how, but I felt like the sessions had more of what we as autistic people needed.

Other participants emphasized that they were treated with respect by the facilitators and that they were being taught in a "non-dogmatic and non-judgmental way." A participant (P14) further noted, "It was a chill environment, participation was encouraged but not necessary. The amount of engagement was also not enforced."

Practicality

The qualitative analysis also offered valuable information with regard to the practicality of the intervention. Participants offered recommendations to improve the program. Several participants said they would prefer if the sessions were longer than one hour. Some participants also noted that they would appreciate if the sessions had more structure. One participant suggested visually sharing a session agenda on screen with the participants. Another participant (P9) explained the benefit of an agenda:

> i.e. first 10 minutes are used for review etc., next 10 min are for xyz..., that way I understand whether my comments are adding to the conversation or holding up the next segment. I don't mean to prevent flow, I was just not always clear whether it was time to talk or move on.

It was also suggested that dedicating time at the end of each session for a brief overview of the next session would also help participants better prepare.

Finally, the time in which the sessions were offered was a barrier to many participants. The sessions were made available across Canada so there was a four-and-a-half-hour range in terms of time zone, but the goal was to make sessions available in afternoons and evenings. Some participants explained the evening sessions were particularly challenging because they were very tired by the time the session began, or it was during their supper time. One participant suggested a morning group would have been preferred. Some participants who took part in the late afternoon group said they would have preferred if the group was delivered at a later time or on a weekend.

Limited Efficacy Testing

As shown in Table 2, RM ANOVA indicated significant differences between time points on the DASS total score ($F(2, 54) = 8.39$, $p = 0.001$, eta$^2 = 0.24$) and on the DASS stress subscale ($F(2,54) = 14.94$, $p < 0.001$, eta$^2 = 0.36$) and DASS anxiety subscale ($F(2, 54) = 4.25$, $p = 0.02$, eta$^2 = 0.14$), but not the DASS depression subscale ($F(2, 54) = 2.80$, $p = 0.07$, eta$^2 = 0.09$). Planned contrasts revealed that the DASS total, stress, and anxiety scores had significant reductions in symptoms between pre- and post-intervention ($p = 0.002$, $p < 0.001$, $p = 0.02$, respectively) and follow-up ($p = 0.004$, $p < 0.001$, $p = 0.045$, respectively), but no difference between post-intervention and follow-up (all p's > 0.70). Planned comparisons for the DASS depression subscale between pre- and post-intervention ($p = 0.08$) and follow-up ($p = 0.06$) were not significant.

Self-compassion also had a significant main effect for time ($F(2,54) = 5.73$, $p = 0.006$, eta$^2 = 0.18$), as a result of

Table 2 Repeated measures ANOVA comparing self-reported ratings of distress, self-compassion and mindfulness at pre-, post-, and 12-week follow-up

Measure	N	Pre M (SD)	Post M (SD)	Follow-up M (SD)	F (df)	p
DASS Depression	28	10.14 (6.43)	8.28 (6.60)	8.11 (5.55)	2.80 (2)	.070
DASS Stress	28	11.71 (5.29)	8.25 (4.40)	8.21 (4.00)	14.94 (2)	.000
DASS Anxiety	28	6.68 (4.78)	4.64 (3.71)	4.89 (3.67)	4.25 (2)	.019
DASS total	28	28.54 (13.59)	21.18 (12.63)	21.21 (11.70)	8.39 (2)	.001
SCS-SF	28	28.14 (7.50)	32 (10.03)	34 (10.36)	5.73 (2)	.006
FFMQ-SF	26	70.19 (13.93)	75 (13.79)	75.73 (14.92)	3.61 (2)	.034

DASS depression anxiety and stress scale; *SCS-SF* self-compassion scale, short form; *FFMQ-SF* five-factor mindfulness questionnaire, short form

Raw scores were computed for DASS analyses, rather than multiplying by two, which would be required to compute clinical cutoffs

minor improvements from pre to post intervention ($p = 0.06$) and large improvements from pre-intervention to follow-up ($p = 0.005$). Overall mindfulness, as reflected by the total FFMQ score, showed significant differences across time ($F(2,54) = 3.61$, $p = 0.03$, eta$^2 = 0.13$), as a result of minor improvements from pre- to post-intervention ($p = 0.07$) and significant improvements from pre-intervention to follow-up ($p = 0.02$).

Nine of 28 participants completed their post-intervention and follow-up assessment time points after the onset of COVID-19 restrictions (March 2020). Exploratory RM ANOVAs were calculated with Time as a three-level within-subject factor and No COVID/COVID groups as a two-level between subject factors to assess any differential effects as a result of completing post-intervention and follow-up time points after the onset of these restrictions. A violation of sphericity emerged with regard to Self-Compassion ($p = 0.045$) but not with DASS ($p = 0.13$) or FFMQ ($p = 0.20$). An interaction emerged with regard to self-compassion, adjusting for unequal variances using the Huynh–Feldt correction, $F(1.80, 43.38) = 3.94$, $p = 0.03$, eta$^2 = 0.13$, with planned comparisons indicating greater pre-post and pre-follow up changes with the COVID group (M difference = -10.67, SE = 3.18, $p = 0.002$; M difference = -9.22, SE = 3.36, $p = 0.01$, respectively) compared the non-COVID group (M difference = -0.63, SE = 2.19, $p = 0.07$; M difference = -4.26, SE = 2.31, $p = 0.08$). No significant Time x COVID Group interactions emerged with regard to DASS scores or FFMQ score (all $p > 0.05$).

Change scores were calculated in overall changes in mindfulness (FFMQ-SF) and self-compassion (SCS-SF), along with DASS scores. Increases in mindfulness were correlated with reductions in DASS Total scores ($r = -0.57$, $p = 0.002$); specifically, increased mindfulness was related to reduced anxiety ($r = -0.47$, $p = 0.002$) and depression ($r = -0.61$, $p = 0.001$), but not stress ($r = -0.32$, $p = 0.10$). Similarly, increases in self-compassion were correlated with reductions in DASS Total scores ($r = -0.51$, $p = 0.005$); greater change in self-compassion was related to reduced anxiety ($r = -0.39$, $p = 0.04$) and depression ($r = -0.60$, $p = 0.001$), but not stress ($r = -0.24$, $p = 0.22$).

Discussion

This study describes efforts to design and evaluate an autistic-informed synchronous virtual mindfulness-based course. Based on input from autistic adults and our prior experience delivering virtual mindfulness training, the six-week co-designed program demonstrated some initial indicators of success. The course was feasible in terms of demand, acceptability, and implementation, and improvements were reported with regard to overall distress, as well as self-compassion and mindfulness. This work adds to a growing body of literature highlighting the benefits of mindfulness-based interventions for autistic adults, by showing that it can be delivered virtually with many of the in-person group elements retained. Changes were observed and maintained according to self-report, despite the total number of hours of intervention being minimal. There is a need to study more carefully what the contributors are to the changes observed (e.g., hours of at-home mindfulness practice, benefits of being part of a supportive group), with a larger cohort using a more controlled research design.

One unique aspect of this program was its synchronous nature. Many apps are available to individually teach mindfulness skills to this population, and there is early/emerging evidence that such apps in their current form are helpful to autistic adults (Gaigg et al., 2020). Asynchronous apps, while they provide flexibility, do not offer the benefits of learning from others in real time, nor do they allow people who often feel isolated to connect with others in similar situations. Qualitative comments from the current study highlighted the importance of these connections to participants. Recent research has demonstrated the value of peer support for autistic adults (Crane et al., 2021), this may be one important benefit of an autistic-centered group-based mindfulness program, in addition to the adaptations themselves.

Future research could compare the impacts of virtual individual– and virtual group–based synchronous interventions, mindfulness or otherwise, and directly compare synchronous and asynchronous interventions utilizing similar outcome measures. Additionally, it would be important to compare outcomes for those in more standard MBSR programs which may be more accessible locally, to autism informed programs such as the one studied here where people from across the country virtually meet one another. It is important to evaluate whether the additional costs of facilitating synchronous groups offer any added benefits to available asynchronous courses. Ultimately, intervention modalities should be matched toward individual preferences.

With some participants completing this study prior to the pandemic and others impacted by COVID-19 during their participation, this allowed for some exploration of the pandemic impact on participation. Early findings suggest similar changes in mental health outcomes in COVID vs. non-COVID participants, except in the realm of self-compassion, where the COVID participants reported greater changes from pre-intervention to post-intervention and follow-up than did the non-COVID participants. It is important to note that the COVID participants completed the pre-intervention time point prior to COVID restrictions taking place. More work is needed to examine the benefits of similar mindfulness interventions where participants are seeking support as a result of the pandemic, or as we begin pandemic recovery.

This study offers evidence that virtual interventions can be beneficial, which is of particular importance now, when many in-person activities are still on hold. When demand for virtual mindfulness was explored in the 2018 needs assessment, only a subgroup of individuals was interested in online participation and fewer than half of people who completed an online questionnaire had a data plan to support virtual participation. This has likely changed significantly since the pandemic began, meaning that interest in similar interventions may be increasing, and may be acceptable and feasible for more individuals. Several opinion pieces have highlighted the benefits of virtual care at this time for autistic youth and adults (Ameis et al., 2020; Pellicano & Stears, 2020), although there is limited research evaluating group-based virtual interventions (Ameis et al., 2020; Pellicano & Stears, 2020). This work highlights the importance of flexible ways to participate and communicate in sessions as well as the utility of being able to avoid stressful in-person experiences, which are relevant to autistic adults during the pandemic but also in the future.

There are unique challenges to conducting virtual mindfulness groups, which have relevance both to research studies evaluating mindfulness and also clinical practice. Some of the technical issues were frustrating for participants. This can also occur in the general population, but some autistic individuals may find it particularly overwhelming when a problem cannot be corrected either for themselves or for another group member, especially if it leads to an unpleasant sensory experience or it seems to deviate from agreed-upon rules. The inclusion of a facilitator who could focus strictly on the technology was an important adaptation in this regard, to minimize disruption and reduce frustration. While the use of the chat function meant that it provided alternate ways for individuals to communicate who have difficulties speaking in a group, it was also a distraction to some participants. Speaking, typing, listening, and reading puts additional demands on individuals which can be stressful. Removing participant access to the chat function during meditation practices was one adaptation, and having the facilitator regularly review and read comments out loud from the chat box helped individuals who could not read the written text and participate at the same time. In addition to technological challenges, there are also challenges in designing an intervention that provides the appropriate level of detail to each of the autistic participants, whose learning styles and mindfulness backgrounds vary. Although the length of the session (60 min) was what was requested most frequently in the needs assessment survey, some individuals who participated wanted either longer sessions or more sessions. Some individuals wanted more in-depth discussion and longer formal practices. Similar to assessments of suitability for other types of interventions, there is a need for guidance on how to determine who would be most suitable for a group-based virtual synchronous intervention, mindfulness-focused or otherwise. There may be particular participant characteristics (gender, age, familiarity with mindfulness, comfort with group-based activities) that should be considered when recruiting for these types of groups.

Limitations and Future Research

There are important limitations to this exploratory research, which should be taken into consideration when interpreting findings. First, participants self-identified as autistic; a larger trial may wish to confirm the diagnosis or include a standardized measure of autistic symptoms, which would also allow testing the association between clinical outcomes and autism severity/symptom profiles. As well, the number of participants who completed the study measures at all three time points was smaller than the total number of study participants. Study outcome measures were selected based on what was predicted to change through the intervention, but these measures were not designed for autistic people. Future research should consider utilizing autism-specific measures of stress, as well as mindfulness, and also measure additional constructs that emerged as relevant to participants, such as feeling a sense of belonging or connection to other autistic group members. To more fully explore satisfaction with the course, it would be important to add a structured questionnaire, which could

focus on the content areas identified through the open-ended questions. Common methods bias is another limitation as all outcomes were based on self-report (Podsakoff et al., 2012). Future research could weave in additional measures such as biological markers of stress or clinician ratings. Because there were no control groups in this study, it is not possible to know whether the positive impacts reported here were specific to this mindfulness-based intervention itself or to other factors, such as being part of a supportive group of autistic peers. The intervention itself was quite brief (six weeks) and it is not known how much participants completed their homework and practiced the mindfulness skills taught outside of session, or how the number of sessions attended, and amount of home practice impacted outcomes. Although there was some consistency in the delivery of the protocol because it followed a manual and was delivered by the same lead therapist, no fidelity measures were used.

This paper offers some early support for an autistic-informed virtually delivered mindfulness program. It adds to the emerging literature on how to adapt intervention groups, both in-person and virtual, for autistic adults (Benevides et al., 2020; Gaigg et al., 2020), and highlights that this can best be done by working together with them in the design and delivery of such interventions. It also highlights the value of including mixed methods when evaluating feasibility. Traditional teaching is one way to practice mindfulness, but it is vital that we recognize that standard practices may produce increased stress for autistic individuals. Allowing for adaptations and choices for this group is very important to them. It will be important to learn from the various virtually delivered psychological interventions offered during the pandemic to autistic adults and explore who is best suited for such interventions as well as how to improve virtual delivery even after the pandemic is over.

Declarations

Ethics Approval This study was reviewed and approved by the Centre for Addiction and Mental Health Research Ethics Board.

Conflict of Interest The authors declare no competing interests.

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