Research in Developmental Disabilities

Mindfulness-based therapy in adults with an autism spectrum disorder: A randomized controlled trial

Annelies A. Spek [a,*], Nadia C. van Ham [a,1], Ivan Nyklíček [b,2]

[a] P.O. Box BD 6232, Postbus 909, 5600 AX Eindhoven, The Netherlands
[b] Center of Research on Psychology in Somatic Disease (CoRPS), Department of Medical and Clinical Psychology, Tilburg University, The Netherlands

A R T I C L E   I N F O

A B S T R A C T

Research shows that depression and anxiety disorders are the most common psychiatric concern in autism spectrum disorders (ASD). Mindfulness-based therapy (MBT) has been found effective in reducing anxiety and depression symptoms, however research in autism is limited. Therefore, we examined the effects of a modified MBT protocol (MBT-AS) in high-functioning adults with ASD. 42 participants were randomized into a 9-week MBT-AS training or a wait-list control group. Results showed a significant reduction in depression, anxiety and rumination in the intervention group, as opposed to the control group. Furthermore, positive affect increased in the intervention group, but not in the control group. Concluding, the present study is the first controlled trial to demonstrate that adults with ASD can benefit from MBT-AS.

© 2012 Published by Elsevier Ltd.

1. Introduction

Autism is a lifelong developmental disorder that affects an individual's functioning in multiple areas. As people with ASD mature, they often obtain a better understanding of their strengths and weaknesses (Frith & Happé, 1999). However, growing self-awareness and an increasingly complex social world may enhance the risk of developing co-morbid mood and anxiety disorders through lifespan (Tantam, 2003). Depression and anxiety disorders appear to be the most common psychiatric concern in ASD, especially in higher functioning adults and adolescents (Hofvander et al., 2009; Lecavalier, 2006; Rumsey, Rapoport, & Sceery, 1985; Shtayermman, 2007; Skokauskas & Gallagher, 2010). This stresses the need for effective interventions.

Various interventions have been developed to alleviate comorbid symptoms in adults with ASD, however, evidence for their efficacy is limited. Non-medical treatments for comorbid depression and anxiety in ASD have mainly been focused on the application of cognitive behavioral therapy (CBT). With regard to adults with ASD, two $N = 1$ studies and one $N = 3$ study described positive effects of CBT on symptoms of depression and anxiety (Cardaciotto & Herbert, 2004; Hare, 1997; Weiss & Lunsky, 2010). However, the researchers also described limitations of CBT for individuals with ASD. Firstly, it generally took a long time for the individuals to grasp the concept of cognitive restructuring. Secondly, it was questionable whether the gains were of a lasting nature. Thirdly, generalization of the cognitive-behavioral techniques to real-life situations appeared to be

* Corresponding author. Tel.: +31 040 2613900; fax: +31 040 2613943.
E-mail address: aa.spek@ggze.nl (A.A. Spek).
[1] Tel.: +31 040 2613900; fax: +31 040 2613943.
[2] Tel.: +31 013 4662391.

limited. These constraints stress the importance to examine other techniques in the treatment of comorbid depression and anxiety in individuals with ASD.

Mindfulness-based therapy (MBT) constitutes a relatively new form of treatment that has been found particularly effective in treating mood disorders in clinical populations (Hofmann, Sawyer, Witt, & Oh, 2010; Teasdale, Segal, & Williams, 1995). Mindfulness has been defined as paying attention to experiences in the present moment in a nonjudgmental and accepting way (Kabat-Zinn, 1990). These experiences include ones thoughts and feelings, which are accepted as just temporary mental phenomena without the need to analyze their content and change them, such as in CBT. The concept of mindfulness is closely related to the concept of acceptance, which is fundamental in Acceptance and Commitment Therapy (ACT) (Hayes, 2004). These relatively new methods based on mindfulness have also been called the "Third wave of cognitive and behavioral therapies" (Hayes, 2004). It is conceptualized that by teaching people to accept thoughts and feelings as they appear, avoidance strategies can be countered effectively (Hayes, 2004), which reduces ruminative thinking and consequently also anxiety and negative mood (e.g. Jain et al., 2007; Nyklíček & Kuijpers, 2008).

Thus, although both MBT and CBT both aim at reducing symptoms of depression and anxiety, the underlying mechanisms differ. In CBT, thoughts and feelings are identified and analyzed in order to examine whether they are beneficial and realistic (Beck, 1993), whereas, in MBT, analysis of the contents of thoughts and feelings is unnecessary (Kabat-Zinn, 1982). The acceptance without analysis is accomplished mainly by simple experiential exercises during which patients are learned to identify phenomena occurring in the present moment (e.g., bodily sensations, thoughts, feelings) and accept them just as they appear. In light of the deficits in theory of mind and communication of many patients with ASD (Baron-Cohen, Leslie, & Frith, 1985; Tager-Flusberg, Paul, & Lord, 2005), such emphasis on simple experiential exercises without the need to analyze and discuss thoughts seems highly suitable for these individuals.

Research into the effects of MBT in individuals with ASD is limited to three small adolescent studies without control groups. One study examined adolescents with externalizing disorders and their parents (Bögels, Hoogstad, van Dun, de Schutter, & Restifo, 2008). Fourteen adolescents participated, of which four were diagnosed with an autism spectrum disorder, combined with externalizing behavior. Results showed improvements in social interaction, concentration, awareness, impulsive behavior and happiness. Unfortunately, the effects of the ASD subgroup were not investigated separately and there was no randomized control group. The other two studies were conducted by Singh, Lancioni, Manikam, et al. (2011) and Singh, Lancioni, Singh, et al. (2011), in which adolescents with either the autistic disorder or Asperger syndrome received an intervention that was based on mindfulness; their mothers taught them to shift their attention from their emotion (e.g. anger, frustration), to the soles of their feet. Results of these studies showed a decrease in aggression. Despite the promising results, final conclusions about the effectiveness of mindfulness could not be drawn, given the small group sizes with 3 individuals in each group, and considering the narrow focus of the intervention. Finally, the fact that all three studies did not use a control group is an important methodological limitation, and questions the assumption that the intervention itself was responsible for the changes obtained.

Further research is important to examine in more detail whether and how individuals with ASD can benefit from MBT, using a randomized controlled protocol. Therefore, we aim to investigate whether a modified MBT protocol may be beneficial for adults with ASD in treating comorbid affective symptoms, by means of a randomized controlled trial (RCT). This modified protocol will further be named MBT-AS (mindfulness-based-therapy for autism spectrum disorders). We hypothesize that MBT-AS will reduce symptoms of depression and anxiety in these individuals. A relevant variable when examining the effects of mindfulness on symptoms of depression and anxiety is the tendency to ruminate, which has been described as the tendency to think repetitively about the causes, situational factors and consequences of one's emotional experience (Nolen-Hoeksema, 1991). Rumination has been hypothesized to be an important factor in both the etiology and maintenance of depression and anxiety disorders (McLaughlin & Nolen-Hoeksema, 2010; Nolen-Hoeksema, 2000). Furthermore, previous studies showed evidence to suggest that mindfulness may decrease rumination (Borders, Earleywine, & Jajodia, 2010; Burg & Michalak, 2011; Chambers, Chuen Yee Lo, & Allen, 2008; Jain et al., 2007). Thus, rumination may be hypothesized to be a mechanism (partially) responsible for any decrease in symptoms of mood disturbance. Therefore, rumination was also included in our study. It was examined whether and how any improvement in depression and anxiety is related to a decrease in rumination tendencies. We hypothesized (i) a decrease in symptoms of depression and anxiety and of rumination tendencies, as well as an increase in positive affect after the intervention, and (ii) statistical mediation of the changes in affect by a change in rumination.

2. Material and methods

2.1. Participants and procedure

The participants were recruited from the Adult Autism Center of Eindhoven, The Netherlands. All participants had undergone a standardized diagnostic process. The autism spectrum disorder was diagnosed by means of evaluation of historic and current symptomatology by an experienced and trained psychologist. Parents were interviewed to gather developmental information, using the Dutch version of the Autism Diagnostic Interview, Revised version (ADI-R, Lord, Rutter, & Le Couteur, 1994). When parental information was not available, an older sibling was interviewed. In this manner, additional information about early childhood was gathered. Also, a semi-structured interview was conducted with all participants in order to assess the ASD criteria of the DSM-IV-TR (APA, 2000). For each diagnostic criterion, a standard
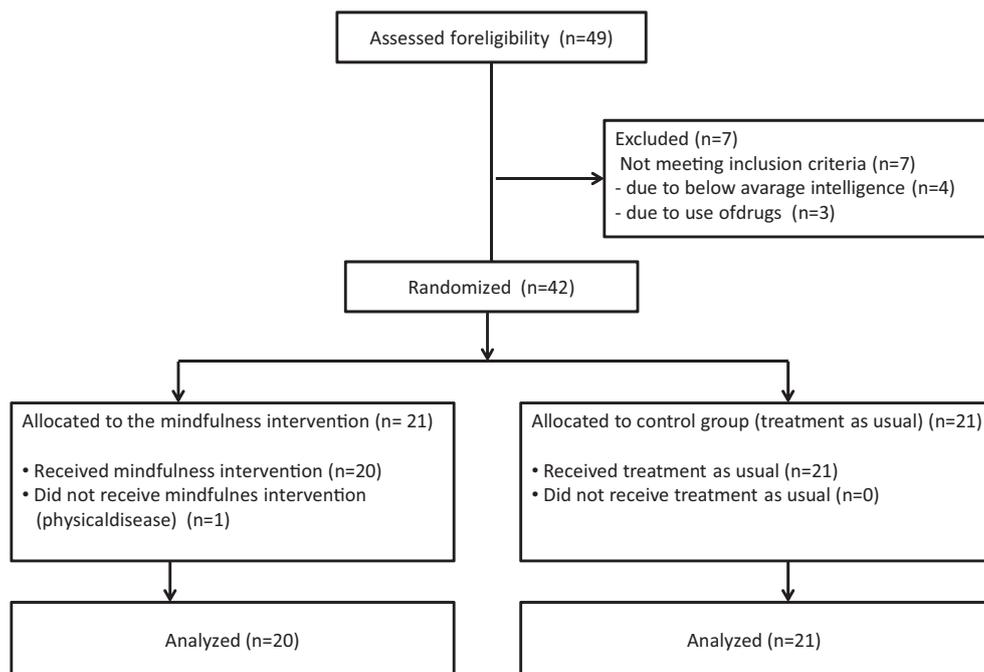
Fig. 1. Flow chart research process.

primary question was asked, followed by questions to clarify whether the participant met the criteria of the given item. This semi-structured interview has been used for diagnostic classification in previous studies (e.g. Spek, Scholte, & Van Berckelaer-Onnes, 2008, 2009). Only those participants who met DSM-IV-TR criteria of the autistic disorder, Asperger syndrome or pervasive developmental disorder, not otherwise specified (PDD-NOS), were included in the present study. We decided to include all individuals with a diagnosis on the autism spectrum, based on the recent notion that there is insufficient evidence for a valid distinction between the diagnostic subtypes within the autism spectrum (Witwer & Lecavalier, 2008). This is in line with recent developments in DSM-5 criteria of neurodevelopmental disorders that describe that autism is best represented as a single diagnostic category (APA, 2011). Participants were eligible to participate if they met the following criteria: (1) experiencing symptoms of depression, anxiety and/or rumination, as identified by their clinicians, who referred the participants to the mindfulness training; (2) age between 18 and 65 years; (3) a diagnosed autism spectrum disorder. Exclusion criteria included: (1) genetic conditions or other neurodevelopmental disorders than autism (e.g. Tourette syndrome); (2) being institutionalized; (3) having a below-average intelligence and verbal ability (scoring 85 or less in full scale intelligence and the verbal comprehension index, as measured by the WAIS-III, Wechsler, 1997); (4) use of drugs and/or problematic use of alcohol; (5) a change in medication during the research study.

From the 49 patients who were referred, 7 did not meet inclusion criteria due to a below-average intelligence (four individuals) and use of drugs (three individuals). 42 met inclusion criteria and were randomized: 21 to the experimental group and 21 to the wait-list control group. Randomization of participants represented as only numbers occurred via a computer program and was sealed in envelopes by a research assistant. The researchers and therapists were blind to the randomization process, but obviously not to the outcome of the randomization. The participants in the control group received the MBT-AS intervention at a later date, after this research study was completed.

Before and after the MBT-AS intervention, both groups completed relevant questionnaires. In the experimental group, one participant dropped out after two sessions because of unexpected serious physical illness, bringing the number participants within the experimental group to 20 (see Fig. 1). Because of this early drop out as a result of the serious illness, no post-treatment data from this patient were obtained. Besides that patient, there were no individuals who missed more than one treatment session.

All participants agreed to take part in the survey and signed informed consent forms prior to their inclusion in the study. The study was approved by the Ethics Committee of the participating health center.

2.2. Treatment procedure

The participants followed a group training of 10 or 11 patients, led by two trained and experienced therapists (a psychologist and a clinical psychologist). The two therapists had followed an 8-day MBCT Educational Program for Therapists in the Netherlands in which they both received and delivered the mindfulness training. After this initial training, the therapists practiced MBT-AS individually in adults with ASD during a period of 8 months, meanwhile adjusting the existing MBCT program to an MBT-AS protocol suitable for this patient group.

Specifically, the MBCT protocol of Segal, Williams, and Teasdale (2002) was used, but because of the information processing deficits that characterize autism, the cognitive elements were omitted. For example, exercises examining the content of ones thoughts were omitted. Also, the information processing deficits that characterize autism were taken into account. For example, because individuals with autism have the tendency to take language literally, the use of metaphors was avoided. Further, words or sentences that are ambiguous or that require imagination skills were avoided. In addition, the eight-week protocol was extended by one week, due to the relatively slow information processing in adults with ASD (Spek et al., 2008). For the same reason, the three-minute breathing exercise was changed into a five-minute breathing exercise. The final MBT-AS protocol comprised nine weekly sessions of two and a half hours each. The participants were instructed to practice 40–60 minutes of meditation daily, six days a week. All meditation exercises were available as mp3 (audio) files on the internet. Furthermore, impairment in executive functioning was accounted for: for example, special attention was paid to planning the home practice program (a program of exercises to do at home) which was devised to help incorporation of the mindfulness skills into the home environment and into the daily routine. For instance, the exercises to do at home were always noted down by the participants and, if necessary, planning issues were discussed individually. The participants were encouraged to explore which meditation exercises were most helpful to them. They were also encouraged to investigate the best time and place for them to practice meditation. The program content week-by-week was as follows:

Week 1. Rationale and program content were presented. Participants were led through a mindful eating exercise and a body scan, during which patients directed their attention to sensations in various parts of their body in an accepting way. This was followed by an evaluation of individual experiences. Home practice (exercises to do at home) was explained and planned for the coming week.

Week 2. The body scan was practiced. Home practice (difficulties) was discussed. A five-minute mindful breathing meditation was performed, during which attention was directed to sensations accompanying breathing while any thoughts and feelings were noticed and accepted as they appeared. Home practice was explained and planned, with special attention to when and where the five-minute breathing exercise may be of most benefit in reducing symptoms of stress and (work)strain. The session ended with another short meditation focused on breathing.

Week 3. Home practice was discussed. Information was given about physical reactions to stress. The participants were taken through a mindful walking exercise. The five-minute breathing exercise was performed, followed by an introduction of mindful movements (a Yoga exercise). The session ended with planning of home practice and a short breathing meditation.

Week 4. A sitting meditation was introduced, focusing on breathing and on bodily sensations. A five-minute breathing exercise was practiced. After discussing home practice, participants were taught to do a listening meditation, in which attention was paid to sounds as they naturally occurred. This was followed by an evaluation. The session ended with planning home practice and a mindful movements exercise.

Week 5. A sitting meditation was taught, which focused attention on breathing, the body and sounds. Home practice was discussed, followed by a five-minute breathing exercise. The usefulness of meditation techniques in stressful situations was explored and discussed. Home practice was planned and the session ended with a short movement exercise.

Week 6. The session started with a sitting meditation, focusing on breathing and bodily sensations. Psycho-education was given about ruminative thoughts and the relationship with autism. A meditation exercise was practiced, focusing on observing thoughts from a detached perspective. Homework was discussed, followed by a five-minuted breathing exercise, home practice planning and a short movement exercise.

Week 7. A sitting meditation focusing on breathing and bodily sensations was performed. Home practice was discussed, followed by a five-minute breathing exercise, mindful observing thoughts and home practice planning. The session ended with a short breathing meditation and a movement exercise.

Week 8. The session started with a sitting meditation, followed by a movement exercise. Home practice was discussed, a body scan was performed and home practice for the following week was planned. Finally, a short movement exercise was practiced.

Week 9. This session opened with the body scan or a sitting meditation, depending on the preference of the participants, followed by a movement exercise. Home practice was evaluated. The participants were asked about their experiences with mindfulness in the past nine weeks. After a meditation chosen by the participants, each individual wrote down whether and how they wanted to incorporate mindfulness in their lives.

More details of the procedure have been described in an instruction book for adults with ASD and their clinicians (Spek, 2010).

2.3. Measures

Three self-report questionnaires were used in order to investigate the effects of the training. The measures were administered by psychology students who had experience in the assessment of autism spectrum disorders and who were not involved in the treatment procedure. The self-reports were administered at the Autism center in Eindhoven. During the completion of the self-reports, the participants were encouraged to ask the psychology students for help when necessary.

After the participants filled in the questionnaires, the student checked whether all items were filled in correctly in order to prevent the presence of missing values. This procedure was identical for the experimental group and for the control group.

2.3.1. SCL-90-R

The Symptom Checklist-90-revised (Derogatis, 1994) is a 90-item self-report symptom inventory. It is a measure of psychological distress, using nine symptom dimensions and a global severity index. Scores for anxiety (16 items, Cronbach's α = .90) and depression (10 items, Cronbach's α = .86) were used in this study. Reliability and construct validity of the original SCL-90-R and of the Dutch version have been described as excellent (Arrindell & Ettema, 2003; Buckelew, Burk, Bownelee-Duffeck, Frank, & DeGood, 1988).

2.3.2. RRQ

The Rumination-Reflection Questionnaire (RRQ, Trapnell & Campbell, 1999) was used to measure rumination tendencies. Rumination has been described by Trapnell and Campbell as 'recurrent thinking' or 'self-related, recurrent, negative thoughts'. The subscale Rumination contains 12 items. Responses are given on a 5-point Likert scale. A Cronbach's α of .90 has been reported for the Rumination subscale of both the original version and the Dutch version, while correlations with related and unrelated constructs showed its discriminant and concurrent validity (Nyklíček & Denollet, 2009; Trapnell & Campbell, 1999).

2.3.3. GMS

To measure positive general affect, the Dutch Global Mood Scale (GMS) was used (Denollet, 1993). This questionnaire consists of 10 items that measure positive affect and 10 items that measure negative affect. In order to avoid too much overlap with the SCL-90, only the subscale Positive Affect was used in the present study. This subscale is positively associated with quality of life and with the ability to initiate activities, resulting in a pleasant mood. This indicates the construct and predictive validity (Denollet, 1993; Watson & Pennebaker, 1989). In addition, the subscale Positive Affect has a high internal reliability (Cronbach's α of .94) (Denollet, 1993).

2.3.4. Assessment of verbal comprehension

The two groups were matched on verbal ability using the verbal comprehension index scale of the WAIS-III (Wechsler, 1997). Compared to WAIS-II, significant modifications and structural changes were made. The WAIS-III has a new factor structure that gives the best representation of the factors underlying intelligence (Arnou & Thompson, 2000; Ryan & Paolo, 2001). WAIS-III has excellent psychometric properties. The test–retest reliability of the verbal comprehension index scale is 0.92. Further, this index scale has a high internal reliability (Cronbach's α of .96) (Sattler & Ryan, 1999). The WAIS-III has been validated for the Dutch population (Wechsler, 1997).

3. Results

Analyses were on intention-to-treat basis, except that for one patient who dropped out early as a result of a serious illness no post-intervention data were available. This patient was omitted from the analyses. Analyses were conducted using SPSS version 17. An independent samples *t*-test and two Chi-Square tests were performed to examine whether the experimental and control group differed in age, gender distribution and diagnosis. The results showed no significant differences in these three variables (see Table 1), nor did the groups differ regarding pre-intervention values on the outcome variables ($p > .10$). For this reason, these variables were not included as covariates in the following analyses.

Repeated measures multivariate analyses of variance (MANOVA) on all four dependent variables together, showed both a significant omnibus main effect of Time ($F(4, 36) = 4.83$, $p = .003$, partial $\eta^2 = 0.35$) and an omnibus Time by Group interaction effect ($F(4, 36) = 5.59$, $p = .001$, partial $\eta^2 = 0.38$), showing differential omnibus group effects between pre- and post-intervention. For each outcome measure, these analyses showed both significant Time main effects ($F(1, 39) > 4.22$, $p < .05$, partial $\eta^2 > 0.97$) and significant Time by Group interactions: depressive symptoms ($F(1, 39) = 6.15$, $p = .02$, partial $\eta^2 = 0.14$), symptoms of anxiety ($F(1, 39) = 5.50$, $p = .02$, partial $\eta^2 = 0.12$), positive affect ($F(1, 39) = 6.32$, $p = .02$, partial $\eta^2 = 0.14$), and rumination ($F(1, 39) = 15.73$, $p < .001$, partial $\eta^2 = 0.29$). Inspection of the means showed that the MBT-AS group decreased more on depressive symptoms, symptoms of anxiety, and rumination, and increased more on positive affect compared to the

Table 1
Gender, age and diagnoses.

	Experimental group	Control group	*p*-Value
Gender (M:F)	20 (13:7)	21 (14:7)	.91
Mean age (SD)	44.4 (11.1)	40.1 (11)	.21
Diagnosis			
Autism	11	10	.89
Asperger	5	6	
PDD-NOS	4	5	

Table 2
Means and standard deviations of symptoms of depression, anxiety, positive affect and rumination before and after the intervention period.

	Before		After		F-Statistic	Cohen's d
	MBSR ($N=20$)	Control ($N=21$)	MBSR ($N=20$)	Control ($N=21$)		
Depression	36.6 (11.6)	39.5 (9.7)	28.3 (8.6)	37.7 (11.6)	6.15[*]	0.78
Anxiety	20.9 (8.4)	21.8 (6.3)	16.6 (4.9)	21.4 (6.1)	5.50[*]	0.76
Positive affect	16.1 (8.4)	16.5 (7.8)	20.9 (7.7)	16.0 (7.1)	6.32[*]	0.79
Rumination	42.3 (7.0)	42.3 (8.8)	36.7 (5.5)	43.2 (7.8)	15.73[**]	1.25

Note. F-statistic is of Group by Time interaction effect. Cohen's d statistic of effect size reflects differences between groups on changes scores.
  [*] $p < .05$.
  [**] $p < .001$.

control group, with Cohen's d effect sizes of differences between groups between 0.76 (medium to large effect) for anxiety to 1.25 (large effect) for rumination (see Table 2).

To examine associations between changes in rumination and changes in anxiety, depression, and positive affect, new variables were constructed. This was done by subtracting post-intervention values from pre-intervention values for all variables except positive affect, for which the opposite was done, to reflect the amount of improvement from pre- to post-intervention for all variables. Correlations between changes in rumination between pre- and post-intervention and changes in symptoms in the same period across groups showed significant associations between change in rumination and change in depressive symptoms ($r = .34$, $p = .03$), and symptoms of anxiety ($r = .43$, $p = .005$), but not positive affect ($r = .16$, $p > .10$).

Therefore, conditions were met for a potential mediation effect of change in rumination in the differential effects found on symptoms of anxiety and depression. A final repeated measures MANOVA including anxiety and depression as outcomes and change in rumination as covariate, showed that the Time by Group interaction effect was no longer significant for both depressive symptoms ($F(1, 38) = 2.25$, $p > .10$, partial $\eta^2 = 0.06$) and symptoms of anxiety ($F(1, 38) = 0.99$, $p > .10$, partial $\eta^2 = 0.03$). However, the bootstrap procedure with 5000 resamples for the test of mediation showed that the indirect effect was significant for anxiety symptoms only (coefficient $= -1.93$, 95% Confidence Intervals $= -3.90$ to -0.15), but not for depressive symptoms (coefficient $= -1.72$, 95% Confidence Intervals $= -4.94$ to $+2.11$).

4. Discussion

The present study aimed to examine the effects of MBT-AS on co-morbid symptoms of anxiety and depression in adults with ASD. The results showed a reduction in anxiety, depression and rumination in the intervention group that was not present in the control group. Furthermore, an increase in positive affect was found in the intervention group as opposed to the control group. The magnitude of effects was medium to large. To our knowledge, our study is the first controlled trial to demonstrate that adults with ASD can benefit from an MBT-AS training. Although the outcome of this study needs replication by studies using larger samples and different assessment methods, our results suggest that adults with ASD can acquire meditation skills and generalize these into their private life in a way that alleviates comorbid symptoms and improves their wellbeing. Whereas in the past it was thought that problems associated with ASD could only be diminished by changing the environment, this study gives rise to the hypothesis that adults with ASD may be able to acquire skills that actively help them to tackle problem situations and increase their wellbeing. This may ultimately improve perceived control over negative or unpleasant events, which has been proved beneficial for wellbeing (Frala, Leen-Feldner, Blumenthan, & Barreto, 2010).

We also examined whether and how any improvement in depression and anxiety was related to rumination tendencies. The results suggested that the decline in symptoms of anxiety may be attributed to the reduction in rumination and the decrease in symptoms of depression may partly be due to the reduction in rumination tendencies. This is in line with previous research, in which rumination was found to mediate the relationship between mindfulness and depression and anxiety in patients with a history of depression (Ramel, Goldin, Carmona, & McQuaid, 2004). Furthermore, a study in healthy students indicated rumination as an intermediate factor between mindfulness and reduced distress (Jain et al., 2007). These findings stress the putative importance of rumination with regard to the effectiveness of mindfulness, which can be considered a confirmation of the theoretical background of mindfulness as described by Segal and colleagues (2002). They hypothesized that mindfulness can prevent relapse and recurrence of depression by enabling patients to disengage from ruminative processes. Moreover, paying nonjudgmental attention to the present moment has been theorized to be inversely related to repetitive thought and worry (Lord et al., 1994).

Interestingly, while a reduction in symptoms of anxiety and depression appeared to be related to an increase of positive affect in our intervention group, no relation was found between the reduction in rumination and the increase in positive affect. This may suggest that for individuals with autism, rumination may partially also have a positive side. In this respect, the contents of specific items of the rumination reflection questionnaire are noteworthy. Examples of items are: 'Often I'm playing back over in my mind how I acted in a past situation' and 'I often find myself re-evaluating something I've done'. These items encompass repeatedly evaluating past actions. In individuals with ASD, this often happens in an attempt to interpret ambiguous situations, especially those encompassing social elements. Because individuals with ASD do not have an intuitive theory of mind, they need to interpret social situations by the use of cognitive, conscious reasoning mechanisms,

while non-autistic individuals have an effortless automatic theory of mind (Frith & Happé, 1999). Furthermore, as sarcasm and jokes are difficult to interpret by individuals with ASD, they tend to rethink and analyze conversations repeatedly (Tager-Flusberg et al., 2005). Thinking along this line, rumination may be a necessary strategy in an attempt to better understand their social environment. They may perceive rumination as positive when it helps them to understand the social world around them.

Alternatively, or additionally, it may be hypothesized that MBT-AS may have exerted two independent effects in these patients: reducing negative affect, at least partially by decreasing rumination, and increasing positive mood. This is in line with empirical data demonstrating that negative affect and positive affect are partially independent dimensions of emotional well-being (Watson, 1988). Concluding, the present study presents evidence for the effectiveness of MBT-AS in reducing comorbid symptoms of anxiety and depression in adults with ASD. Rumination appears a potentially important mediating factor.

4.1. Limitations

The present study was undertaken in adults with average to high verbal abilities. Therefore, the results deriving from this study cannot be generalized to ASD populations with below average verbal abilities. The relatively small sample size reduced power to find effects and may have increased Type I error. In addition, one should be aware of the fact that, because of the possibility of joint regression to the mean effects of related outcome and mediator variables, the performed mediation analyses do not provide firm evidence for mechanistic mediation by rumination. Further, we only used self-report measures. Although the use of self-reports in individuals is controversial in ASD populations, adolescents and adults with average verbal ability and a relatively high level of functioning seem able to describe their strengths and weaknesses adequately (Hobson, 2005; Frith & Happé, 1999). Nevertheless, future studies should incorporate measures other than self-reports to extend our understanding of the effects of mindfulness in individuals with ASD.

Acknowledgements

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: American Psychiatric Association.
American Psychiatric Association. (2011). *DSM-5 development* Retrieved from http://www.dsm5.org.
Arnou, R. C., & Thompson, B. (2000). Second order confirmatory factor analysis of the WAIS-III. *Assessment, 7*, 237–246.
Arrindell, W. A., & Ettema, J. H. M. (2003). *Handleiding bij een multidimensionele psychopathologie-indicator.* [Manual of a multidimensional indicator of psychopathology]. Lisse, The Netherlands: Swets.
Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a theory of mind? *Cognition, 21*, 37–46.
Beck, A. (1993). *Cognitive therapy and the emotional disorders.* New York: Pinguin.
Bögels, S., Hoogstad, B., van Dun, L., de Schutter, S., & Restifo, K. (2008). Mindfulness training for adolescents with externalizing disorders and their parents. *Behavioral and Cognitive Therapy, 36*, 193–209.
Borders, A., Earleywine, M., & Jajodia, A. (2010). Could mindfulness decrease anger, hostility and aggression by decreasing rumination? *Aggressive Behavior, 36*, 28–44.
Buckelew, S. P., Burk, J. P., Brownlee-Duffeck, M., Frank, R. G., & DeGood, D. (1988). Cognitive and somatic aspects of depression among a rehabilitation sample: Reliability and validity of the SCL-90-R research subscales. *Rehabilitation Psychology, 33*, 67–75.
Burg, J. M., & Michalak, J. (2011). The healthy quality of mindful breathing: Associations with rumination and depression. *Cognitive Therapy and Research, 35*, 179–185.
Cardaciotto, L., & Herbert, J. D. (2004). Cognitive behavior therapy for social anxiety disorder in the context of Asperger's syndrome: A single-subject report. *Cognitive and Behavioral Practice, 11*, 75–81.
Chambers, R., Chuen Yee Lo B., & Allen, N. B. (2008). The impact of intensive mindfulness training on attentional control, cognitive style, and affect. *Cognitive Therapy and Research, 32*, 303–322.
Denollet, J. (1993). Emotional distress and fatigue in coronary heart disease: The Global Mood Scale (GMS). *Psychological Medicine, 23*, 111–121.
Derogatis, L. R. (1994). *SCL-90-R administration, scoring, and procedures manual* (3rd ed.). Minneapolis: National Computer Systems.
Frala, J. L., Leen-Feldner, E. W., Blumenthal, H., & Barreto, C. C. (2010). Relations among perceived control over anxiety-related events, worry, and generalized anxiety disorder in a sample of adolescents. *Journal of Abnormal Child Psychology, 38*, 237–247.
Frith, U., & Happé, F. (1999). Theory of mind and self-consciousness: What is it like to be autistic? *Mind and Language, 14*, 1–22.
Hare, D. J. (1997). The use of cognitive-behavioral therapy with people with Asperger syndrome: A case study. *Autism, 1*, 215–225.
Hayes, S. C. (2004). Acceptance and Commitment Therapy, relational frame theory, and the third wave of behavior therapy. *Behavior Therapy, 35*, 639–665.
Hobson, P. (2005). Autism and emotion. In F. R. Volkmar, P. Rhea, A. Klin, & D. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders* (pp. 406–422). NJ: John Wiley & Sons.
Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*, 169–183.
Hofvander, B., Delorme, R., Chaste, P., Nyden, A., Wentz, E., Stahlberg, O., et al. (2009). Psychiatric and psychosocial problems in adults with normal-intelligence autism spectrum disorders. *BMC Psychiatry, 9*, 1–35.
Jain, S., Shapiro, S. L., Swaninck, S., Roesch, S. C., Mills, P. J., Bell, I., et al. (2007). A randomized controlled trial of mindfulness meditation versus relaxation training: Effects on distress, positive states of mind, rumination and distraction. *Annals of Behavioral Medicine, 33*, 11–21.
Kabat-Zinn, J. (1982). An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General Hospital Psychiatry, 4*, 33–47.
Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness.* New York: Delacourt.

Lecavalier, L. (2006). Behavioral and emotional problems in young people with pervasive developmental disorders: Relative prevalence, effects of subject characteristics, and empirical classification. *Journal of Autism and Developmental Disorders, 24*, 1101–1114.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism diagnostic interview-Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*, 659–685.

McLaughlin, K. A., & Nolen-Hoeksema, S. (2010). Rumination as transdiagnostic factor in depression and anxiety. *Behaviour Research and Therapy, 49*, 186–193.

Nolen-Hoeksema, S. (1991). Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology, 100*, 569–582.

Nolen-Hoeksema, S. (2000). The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology, 3*, 504–511.

Nyklíček, I., & Denollet, J. (2009). Development and evaluation of the Balanced Index of Psychological Mindedness (BIPM). *Psychological Assessment, 21*, 32–44.

Nyklíček, I., & Kuijpers, K. F. (2008). Effects of mindfulness-based stress reduction intervention on psychological well-being and quality of life: Is increased mindfulness indeed the mechanism? *Annals of Behavioral Medicine, 35*, 331–340.

Ramel, W., Goldin, P. R., Carmona, P. E., & McQuaid, J. R. (2004). The effects of mindfulness meditation on cognitive processes and affect in patients with past depression. *Cognitive Therapy and Research, 28*, 433–455.

Rumsey, J. M., Rapoport, J. L., & Sceery, W. R. (1985). Autistic children as adults: Psychiatric, social, and behavioral outcomes. *Journal of the American Academy of Child Psychiatry, 24*, 465–473.

Ryan, J. J., & Paolo, A. M. (2001). Exploratory factor analysis of the WAIS-III in a mixed patient sample. *Archives of Clinical Neuropsychology, 16*, 151–156.

Sattler, J. M., & Ryan, J. J. (1999). *WAIS III supplement*. LeMesa, CA: Jerome Sattler Publishing.

Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse*. New York: Guilford Press.

Shtayermman, O. (2007). Peer victimization in adolescents and young adults diagnosed with Asperger's syndrome: A link to depressive symptomatology, anxiety symptomatology and suicidal ideation. *Issues in Comprehensive Pediatric Nursing, 30*, 87–107.

Singh, N. N., Lancioni, G. E., Manikam, R., Winton, A. S. W., Singh, A. N. A., Singh, J., et al. (2011). A mindfulness-based strategy for self-management of aggressive behavior in adolescents with autism. *Research in Autism Spectrum Disorders, 5*, 1153–1158.

Singh, N. N., Lancioni, G. E., Singh, A. D. A., Winton, A. S. W., Singh, A. N. A., & Singh, J. (2011). Adolescents with Asperger syndrome can use a mindfulness-based strategy to control their aggressive behavior. *Research in Autism Spectrum Disorders, 5*, 1103–1109.

Skokauskas, N., & Gallagher, L. (2010). Psychosis, affective disorders and anxiety in autistic spectrum disorder: Prevalence and nosological considerations. *Psychopathology, 8*–16.

Spek, A. A. (2010). *Mindfulness bij volwassenen met autisme*. [Mindfulness in adults with autism]. Amsterdam: Hogrefe.

Spek, A. A., Scholte, E. M., & van Berckelaer-Onnes, I. A. (2008). The use of WAIS III in adults with HFA and Asperger syndrome. *Journal of Autism and Developmental Disorders, 38*, 1573–3432.

Spek, A. A., Scholte, E. M., & van Berckelaer-Onnes, I. A. (2009). Theory of mind in adults with HFA and Asperger syndrome. *Journal of Autism and Developmental Disorders, 40*, 280–289.

Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication. In F. R. Volkmar, R. Paul, A. Klin, & D. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders* (pp. 335–364). NJ: John Wiley & Sons.

Tantam, D. (2003). The challenge of adolescents and adults with Asperger syndrome. *Child and Adolescent Psychiatric Clinics of North America, 12*, 143–163.

Teasdale, J. D., Segal, Z. V., & Williams, M. G. (1995). How does cognitive therapy prevent depressive relapse and why should attentional control (mindfulness training) help? *Behavior Research and Therapy, 33*, 25–39.

Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five factor model of personality: Distinguishing rumination from reflection. *Journal of Personality and Social Psychology, 76*, 284–304.

Watson, D. (1988). Intraindividual and interindividual analyses of positive and negative affect: Their relation to health complaints, perceived stress, and daily activities. *Journal of Personality and Social Psychology, 54*, 1020–1030.

Watson, D., & Pennebaker, J. W. (1989). Health complaints, stress, and distress: Exploring the central role of negative affectivity. *Psychological Review, 96*, 234–254.

Wechsler, D. (1997). *WAIS-III administration and scoring manual*. San Antonio, TX: The Psychological Corporation.

Weiss, J. A., & Lunsky, Y. (2010). Group cognitive behaviour therapy for adults with Asperger syndrome and anxiety or mood disorder: A case series. *Clinical Psychology and Psychotherapy, 17*, 438–446.

Witwer, A. N., & Lecavalier, L. (2008). Examining the validity of autism spectrum disorder subtypes. *Journal of Autism and Developmental Disorders, 38*, 1611–1624.