The efficacy and feasibility of a fully automated, web-based acceptance-enhanced behavioral treatment for trichotillomania in adults: A randomized waitlist-controlled trial

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**Abstract**

Treatment access for those with trichotillomania is limited by several issues including professionals’ lack of knowledge of the disorder, proximity to providers, and financial constraints. Acceptance-enhanced behavioral therapy (AEBT) has been implemented in groups and using telehealth to reach a larger population. However, these methods still require therapist time and incur notable costs. This study aimed to address the gap in trichotillomania treatment accessibility by examining the feasibility and efficacy of a self-guided, web-based AEBT treatment for adults with trichotillomania across the United States. Participants completed an eight-module asynchronous program over eight weeks. The effects of the website were tested with 81 adults with trichotillomania randomized into a treatment and waitlist condition. Results demonstrated statistically stronger decreases in the treatment condition over the waitlist condition across outcomes including trichotillomania symptoms severity, trichotillomania-related psychological flexibility, well-being, total distress, depression, and stress. Treatment effects were maintained at one month follow-up. Anxiety did not significantly decrease between conditions, but a significant decrease was found across time. Of participants in the treatment condition, 52.8% (vs 15% for waitlist) met treatment responder status from pre- to post-treatment and 30.5% (vs 10% for waitlist) met responder status from pre-treatment to follow-up. Implications of these preliminary findings are discussed.

*Keywords:* acceptance and commitment therapy, AEBT, treatment, website, adults, trichotillomania

**Introduction**

Trichotillomania is characterized by hair pulling that is repetitive, leads to notable hair loss, and causes clinically significant distress and impairments across social and functional domains (American Psychiatric Association [APA], 2013). The social impairment caused by trichotillomania includes negative impact on close relationships, reduced likelihood of pursuing occupational changes or advancement, and interference with schooling (Grant et al., 2017; Woods, et al., 2006). Despite prevalence rates between 1-2% of the population in the United States (Duke et al., 2010) and associated impacts across physical, social and functional domains, treatment is not widely available or understood. There also is a lack of widespread knowledge of resources for referral if needed (Marcks et al., 2006). As such, research on efficacious treatments is vital.

A combined treatment of acceptance and commitment therapy (ACT) and habit reversal training (HRT), also known as acceptance-enhanced behavior therapy (AEBT), is gaining empirical support (e.g., Woods, Ely, Bauer, et al., 2022;Twohig et al., 2021; Lee, Haeger, et al., 2018, Lee, Homan, et al, 2018). A key component of AEBT, that is not included in HRT alone, is a focus on psychological inflexibility. Psychological inflexibility refers to when thoughts, urges and other internal experiences excessively govern an individuals’ behavior, rather than one’s values (Hayes et al., 2006). Higher trichotillomania symptom severity is related to greater psychological inflexibility (Begotka et al., 2004; Houghton et al., 2014), may be a risk factor for higher levels of impairment (Alexander et al., 2017; Houghton et al., 2014), and is correlated with treatment outcomes (Houghton et al., 2017). Psychological inflexibility may also mediate the relationship between hair pulling severity and affect (e.g., anxiety and depression; Houghton et al., 2014). As psychological inflexibility is a primary focus of AEBT, these findings suggest that AEBT may be a logical treatment focus for individuals with trichotillomania. The standard course of AEBT is 10 sessions and begins with HRT and general stimulus control procedures before transitioning to ACT-focused sessions. This treatment is equipped to target automatic pulling using HRT and stimulus control, and ACT targets focused pulling by reducing psychological inflexibility and increasing valued living (Woods & Twohig, 2008). Valued living refers to engaging in activities that are moving toward the individuals’ values (Hayes et al., 2006). At this time, there are nine studies examining AEBT and one study examining ACT as a standalone treatment for trichotillomania.

The effectiveness of AEBT was first shown in a multiple baseline design with six participants (Twohig & Woods, 2004). Four were treatment responders at posttreatment and three were responders at follow-up. This study was followed by a small randomized clinical trial (RCT) where AEBT was compared to a waitlist with 25 participants with trichotillomania (Woods et al., 2006). Results of this 10 session in-person study showed that 66% of those in AEBT condition were considered treatment responders versus 6% in the waitlist. One effectiveness study examined 10 sessions of ACT without combined behavioral treatment for mixed adolescents and adults (N=39; Lee et al., 2018). It was found that the treatment group saw a 47% decrease in pulling versus no change in the waitlist (Cohen’s *d = 0.92;* Lee et al., 2018). In a Finnish study, 53 participants with trichotillomania were placed into AEBT groups of 3-7 that met for three hours weekly over the course of 10 weeks. Results showed clinically significant reduction in symptom severity, with 87.5% of participants no longer meeting criteria for trichotillomania after treatment. These results were maintained by 60% of participants at one year follow-up (Cohen’s *d=* 1.03- 1.43; Haaland, 2017). The largest AEBT study do date was recently published with 78 adults with trichotillomania. The study compared AEBT to psychoeducation and supportive therapy. AEBT showed moderate effect size differences from the control condition on trichotillomania severity (Woods et al,. 2022).

To help address the concerns related to treatment access, two studies assessed AEBT over telehealth (Lee et al., 2018; Twohig et al., 2021). In the first study, 22 adults were randomized to waitlist or AEBT via telehealth. The results showed a significant decrease in hair pulling severity from pre-to post treatment (42.2% decrease) in the treatment condition and an increase in the waitlist condition (17.7%; Lee et al., 2018). Psychological inflexibility also significantly decreased in the treatment condition (71.9%) compared to the waitlist condition which showed a decrease (3.4%; Lee et al., 2018). In the most recent study of AEBT delivered through telehealth, 28 adolescents with trichotillomania were randomized into treatment and waitlist conditions. Pulling severity decreased significantly through treatment (Hedge’s *g* = .85) accompanied by a moderate decrease in psychological inflexibility from pre-to post-treatment (Hedge’s *g* = -.53; Twohig et al., 2021).

In summary, AEBT has shown efficacy in a variety of formats, group and individual, in the USA and internationally, as well as delivered in-person and through telehealth for adults and adolescents. Furthermore, psychological inflexibility has preliminary support as a process of change. However, treatment accessibility through these formats can be difficult, particularly given that AEBT is a specialized treatment and clinicians generally report limited knowledge of trichotillomania and its treatment (Marcks et al., 2006). ACT has been found to be acceptable and effective when delivered in a self-guided (i.e., automated, asynchronous) web-based format with a variety of populations (Lappalainen & Lappalainen, 2020). This treatment modality addresses barriers to treatment accessibility including availability of trained clinicians, travel, and financial concerns. Thousands of people can access a website at any given time to learn evidence-based skills from expert clinicians at their own pace and in the privacy of their own home. Only one study to date has examined a website as part of trichotillomania treatment; Rogers and colleagues (2014) incorporated a web-based platform into a study utilizing a stepped care model for trichotillomania with promising results. Thus, given the promising benefits for treatment access, there is a need to explore more web-based and self-guided programs for trichotillomania treatment.

The present study aimed to preliminarily assess the efficacy and feasibility of a self-guided website delivering AEBT to adults with trichotillomania. We predicted that the website would be feasible as indicated by high self-report ratings of program acceptability and usability by participants as well as high adherence rates to completing the assigned web-based modules. We also predicted that hair pulling severity, trichotillomania related psychological inflexibility, well-being, overall distress, depression, anxiety, and stress would decrease over time in the treatment condition more so than in the waitlist.

**Methods**

**Participants**

 Participant demographics are described in Table 1. The sample was primarily White, non-Hispanic, identifying as women, and had a mean age of approximately 30 years old. Participants were recruited through advertising on Google ads, Facebook trichotillomania groups, and Reddit trichotillomania subreddits (i.e., pages). Participants were included in the study if they (a) met the DSM-5 criteria for trichotillomania, (b) were searching for trichotillomania-based treatment, (c) were at least 18 years old at intake, and (d) were fluent English speakers. Participants were excluded from the study if they (a) were modifying or starting psychotropic medication, (b) were living outside the United States, (c) were under the age of 18, and/or (d) did not, at time of intake session, meet DSM-5 diagnostic criteria for trichotillomania.

 To determine the number of participants to include in the study, a power analysis using G\*Power software was conducted (Faul et al., 2007). This study is the first to examine a web-based treatment for trichotillomania on its own; a between group effect size (*d* = *.*40*)* was assumed, power was set at .80, and alpha was set at .05, specifying a sample of 80. However, it is difficult to complete an accurate power analysis for multilevel models because of the nuances involved in estimating these different values, which was the type of analysis used in the present study (Hox, Moerbeek, van de Schoot, 2017). See Figure 1 for the participant flowchart.

**Procedures**

 The current study was reviewed by the [removed for masked review] Institutional Review Board. Participants completed a screener assessing eligibility and, if they met eligibility requirements, were contacted via email to schedule an intake session. An intake interview was held over Zoom where participants completed the informed consent, and baseline assessment. A diagnostic interview was also conducted using the Diagnostic Interview for Anxiety, Mood and Obsessive-Compulsive and Related Neuropsychiatric Disorders (DIAMOND) to assess if participants met diagnostic criteria for trichotillomania. Participants were then randomized into the treatment or delayed treatment waitlist condition of eight weeks. Participants had an equal chance of being assigned to either group and were assigned through a random number generator. Participants placed in the treatment group then completed the eight-module web-based treatment program over an eight-week intervention period (described in the *intervention* section). Participants in both conditions completed online assessments through Qualtrics at the end of the fourth week following their intake session (mid-treatment assessment point), after the eighth week (post-treatment assessment point), and after the 12th week (follow-up assessment point). After the final assessment point, the waitlist group was given access to the website.

**Intervention**

 This web-based intervention was created by the Utah State University ACT Research lab, co-directed by Drs. Michael Twohig and Levin. Although it was developed as a research prototype, it might be adapted and delivered as a publicly available program for a small fee in the future as part of the ACT Guide service suite hosted at Utah State University The intervention consisted of eight, 20–30-minute modules developed from the empirically supported acceptance-enhanced behavior therapy manual (Woods & Twohig, 2008). Module 1 was an introduction to the program and psychoeducation. Module 2 introduced stimulus control. Module 3 addressed competing responses and habit reversal techniques to manage pulling. Module 4 introduced values as motivation for change. Modules 5 and 6 introduced acceptance and defusion skills. Module 7 built upon values, acceptance, and defusion strategies. Module 8 provided a reviewed treatment and relapse prevention. The program was developed and deployed through Qualtrics, a research platform that our research team has successfully used to deliver online ACT programs in several prior clinical trials (e.g., Levin, Petersen, et al., 2021). Participants completed treatment on their home computers, other available computers, or using their tablets or smartphones.

Participants received weekly check-ins via telephone with a graduate student researcher to assess module progress and establish plans for completing consecutive modules. Participants were asked if they had completed a session that week. If they hadn’t, they were asked when they planned to complete one to ensure a module was completed that week. Participants were asked when they planned to complete the next module for the following week. Finally, they were asked if they had run into any technical issues to ensure this was not a barrier to adherence. These check-ins were between two and five minutes long. All treatment, excluding phone-based weekly check-ins, utilized the automated web-based treatment site.

**Measures**

 ***Diagnostic Interview for Anxiety, Mood, and Obsessive-Compulsive and Related Neuropsychiatric Disorders* (**DIAMOND; Tolin et al., 2016).The DIAMOND is a semi-structured diagnostic interview designed to assess for DSM-V psychiatric disorders in adults (ages 18 and above). The interview is administered in approximately one hour. For this study, only the trichotillomania section was administered and took approximately 20 minutes per participant. The DIAMOND has good inter-rater reliability, test-retest reliability, and convergent and divergent validity (Tolin et al., 2018)

***Massachusetts General Hospital Hair Pulling Scale*** (MGH-HPS; Keuthen et al., 1995).The MGH-HPS assesses urges to pull, pulling behavior, and the distress caused by pulling through a seven-item self-report measure. An example item is “On an average day, how often did you feel the urge to pull your hair?” Items are rated individually on a scale from 0-4 and then the total scale is summed, with total scores ranging from 0–28. Higher scores indicate greater hair pulling severity. Treatment response is indicated by a seven-point reduction in score (Houghton et al., 2015). The MGH-HPS demonstrates good internal consistency (Keuthen et al., 1995), test-retest reliability and convergent and divergent validity (O’Sullivan et al., 1995). In the present sample, internal consistency was good (*α* = 0.79).

***Acceptance and Action Questionnaire for Trichotillomania*** (AAQ- TTM; Houghton et al., 2014). The AAQ-TTM assesses psychological flexibility through a nine-item self-report measure designed for individuals with trichotillomania. An example item is “when I feel the urge to pull, I am unbable to take care of my responsibilities.” Each item is rated from 1 (*never true*) to 7 (*always true*) and totals range from 7-63 points; higher scores indicate less trichotillomania-specific psychological flexibility. The AAQ-TTM has good internal consistency (Houghton et al., 2015) and good convergent and divergent validity (Bond et al., 2011). In the present sample, the internal consistency at pre-treatment was considered unacceptable (*α* = 0.66). However, at all other time-points, the internal consistency was good (*α* = 0.79).

***Mental Health Continuum Short Form*** (MHC-SF; Lamers et al., 2011) The MHC-SF is a 14-item self-report questionnaire assessing emotional, psychological, and social well-being. An example item is “During the past month, how often did you feel happy?” Items are rated on a Likert type scale from 0 (*never*) to 5 (*every day*). Higher scores indicate greater well-being across these domains. The MHC-SF has demonstrated excellent validity and reliability (Lamers et al., 2011). In the present sample, internal consistency was excellent (*α* = 0.90).

***Depression, Anxiety, Stress Scale- 21 Items*** (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 is a shortened version of the DASS, a 42-item self-report questionnaire. The DASS-21 measures negative emotional states, specifically depression, anxiety, and stress. An example item is “I found it hard to wind down.” Each item is rated on a Likert-type scale of 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). The DASS-21 demonstrates good validity and reliability (Henry & Crawford, 2005). In the present sample, internal consistency was good (*α* = 0.87)

 ***System Usability Scale*** (SUS; Tullis & Albert, 2008)The SUS measures the usability of technology-based systems using a 10-item self-report measure. Items are rated from 1 (*strongly disagree*) to 5 (*strongly agree*). An example item is “I think that I would like to use this system frequently.” Items are modified to refer to self-help website for trichotillomania. The SUS demonstrates good reliability and validity (Tullis & Albert, 2008). This measure was administered only to participants who use the website. In the present sample, internal consistency was excellent (*α* = 0.91).

***Treatment Evaluation Inventory-Short Form* (**TEI-SF; Kelley et al., 1989) The TEI-SF assesses treatment acceptability using a 9-item self-report measure. However, the 7-item version is used in this study. An example item is "I believe this treatment is likely to be effective.” One of the seven items was modified to refer to “hair pulling” rather than “anxiety” and is specifically worded “I find this treatment to be an acceptable way of dealing with my hair pulling.” This version of the TEI-SF has been used in previous research (Twohig et al., 2010). Each item is rated from 1 (strongly disagree) to 5 (strongly agree). The TEI-SF demonstrates good reliability and validity (Kelley et al., 1989). This measure was administered only to participants who used the website. In the present sample, internal consistency was good (*α* = 0.80).

**Statistical Analyses**

Analyses for the present study were conducted in R version 3.6.3 (R Core Team, 2020) in R Studio (R. Team, 2020) using the following packages: tidyverse (Wickham, 2017), lme4 (Bates et al., 2015), texreg (Leifeld, 2013), cowplot (Wilke, 2018), effects (Fox & Weisberg, 2019), effsize (Torchiano, 2017), psych (Revelle, 2018), and furniture (Barrett & Brignone, 2017).

 To assess within and between-group differences over time, multilevel models (MLM) were used for seven outcomes: trichotillomania severity (MGH-HPS), trichotillomania related psychological inflexibility (AAQ-TTM), well-being (MHC-SF), distress (DASS-21 Total), stress (DASS-21 Stress), depression (DASS-21 Depression), and anxiety (DASS-21 Anxiety). MLM was selected because of the longitudinal and hierarchical nature of the data and because it can accommodate missing data without removing participants as is the case with repeated measures analysis of variance (Hox, Moerbeek, & van de Schoot, 2017). The primary outcome of this study was trichotillomania symptom severity in terms of treatment efficacy, but the other outcomes are important in understanding treatment outcomes and moderators of change in treatment.

 For each primary and secondary outcome, we compared four nested models to each other to find the best fitting model. Each outcome was individually fitted starting with a model that only looked at random intercepts based on individual participants (i.e., null model). Then we added additional fixed effects to each subsequent model. We added a fixed effect of time only in the second model, condition only in the third model, and then an interaction of time and condition in the fourth model. The purpose of this method is to see if the data is a best fit for a model with time only (i.e., no effect of the intervention), condition-only (i.e., no effect of time), or the interaction between them (i.e., change in condition over time). If the model including the interaction between time and condition is the best fitting model, it indicates effect of the intervention compared to waitlist.

When comparing models to identify the best fitting model, each model was compared to the last model (e.g., null model to time only) using likelihood ratio tests with a significance level of *p*<.05. Maximum likelihood criterion was used to estimate the final models and unstandardized coefficients are reported for each best-fitting model.

 Hedges’ *g* effect sizes were calculated for between-group differences from pre- to post- treatment and pre-treatment to follow-up. Additionally, we assessed within-group change in the treatment group from pre- to post-treatment and pre-treatment to follow-up to assess treatment response. The following values were used as benchmarks: 0.2 is a small effect, 0.5 is a medium effect, and 0.8 is a large effect.

 Percentage change in pulling was used to assess responder status on hair pulling severity in the treatment group. Therefore, if pulling was reduced by 45% (Houghton et al., 2015), that benchmark was considered significant change and responder status. Treatment adherence was assessed by number of modules completed by all participants, therefore if 65% or more of participants complete all modules, this is considered good treatment adherence. To assess treatment feasibility and usability, descriptive statistics were used.

 One participant was not included in the data analyses due to completing the pre-treatment survey and then contacting the research team to be removed from the study at the request of their medical doctor. All other participants were included in the data analyses in an intent-to-treat approach (see Figure 1 for CONSORT diagram).

**Results**

Recruitment was completed within three weeks, and all participants were actively enrolled in the treatment within a month and a half from the date we launched the study. Notably, this study was conducted during the COVID-19 pandemic which may have impacted recruitment by increasing the number of people seeking remote treatment options. Testing baseline equivalency between conditions found no significant differences between conditions across all outcomes and demographics. In terms of general demographics, descriptive statistics were used and the participants were primarily White, non-Hispanic, and female. See Table 1 for participant demographics.

Engagement and adherence to the questionnaires was assessed. Questionnaire completion was based on the total sample; 100% of participants completed the baseline assessment, 96% of participants completed the mid assessment, 96% completed the post assessment, and 91% of participants completed the follow-up assessment (see Figure 2). Again, this indicates strong adherence and engagement in the study.

See Table 2 for means and standard deviations. See Table 3 for within-group and between group effect sizes. Within- group effect sizes were calculated for the treatment condition only and this accounts for the larger effect sizes seen in within group compared to between group. For the best fitting models of all outcomes, the regression coefficients and 95% confidence intervals are reported in Table 4.

**Feasibility and Adherence**

Acceptable scores were based on pre-determined benchmarks (21 or higher on the TEI-SF and 72 or higher on the SUS; Bangor et al., 2008; Twohig et al., 2006). In this study, the mean score on the TEI-SF was 26.50 (SD = 4.60). This indicates that the treatment was acceptable. In this study, the mean score of the SUS was 84.9 (SD = 14.90) indicating a good to excellent score for usability of the website.

Based on previous trials of trichotillomania, attrition rates range from 0-35% (e.g., Lee, Haeger et al., 2018; Twohig et al., 2021). Therefore, good treatment adherence and engagement were indicated if 65% of participants completed all modules. Of the participants in the treatment group, thirty-four participants (85%) completed all eight modules, three participants (7.50%) completed three of the eight modules, and three participants (7.50%) completed one or fewer modules. These completion rates support strong adherence and engagement with the treatment.

After completing the website, participants were asked after the completion of the treatment to provide brief responses to questions regarding their experience of the program. These responses indicated that participants overall found the website to be helpful and easy to use. Several participants reported that they felt understood and validated by the language used in the website, particularly because it accurately reflected the lived experience of pulling. Similarly, participants noted that the website was clear and concise, making it more accessible. Additionally, participants reported that scenarios or examples of when urges might show up helped to make the information easily applicable.

As previously described, phone check-ins were used to enhance treatment adherence and engagement. Participants in the treatment condition completed 85% of the weekly phone check-ins. All eight weekly check-ins were completed by 47.50% of participants. Seven of the eight check-ins were completed by 25% of participants. Six of eight check-ins were completed by 15% of participants. Finally, 12.50% completed five or fewer check-ins.

**Trichotillomania severity**

For trichotillomania severity (MGH-HPS), a significant time and condition interaction was found, indicating a greater decrease in severity in the treatment condition than in the waitlist condition over time (*β* = 0.42). The within group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were large (Hedges’ *g* = -1.19 to -1.38). The between group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were small (Hedges’ *g =* -0.27- -0.34). See Figure 2 for estimated marginal means.

***Responder status.*** To be considered a treatment responder, participants needed a 45% or seven-point reduction on the MGH-HPS (Houghton et al., 2015). In the treatment condition, from pre-treatment to post-treatment, 52.78% of participants had clinically significant reduction in symptoms and met responder status criteria compared to 15% of participants in the waitlist condition. From pre-treatment to follow-up, 30.50% of participants had clinically significant reduction in symptoms or met responder status criteria compared to 8% of participants in waitlist condition.

**Trichotillomania-related psychological inflexibility**

For trichotillomania related psychological inflexibility (AAQ-TTM), a significant time and condition interaction was found, indicating a greater decrease in psychological inflexibility in the treatment condition than the waitlist condition over time (*β* = 0.49). The within group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were large (Hedges’ *g* = -1.26 to -1.39) The between group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were small (Hedges’ *g* = -0.32 to 0.32). See figure 2 for estimated marginal means.

**Well-being**

For well-being (MHC-SF), a significant time and condition interaction was found which indicates that there was a greater increase in quality of life in the treatment condition than in the waitlist condition over time (*β* = -6.04). The within group effect size from pre-treatment to post-treatment was negligible (Hedges’ *g* = 0.18). The within group effect size from pre-treatment to follow-up was small (Hedges’ *g* = 0.37). The between group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were small (Hedges’ *g* = -0.29 to -0.33).

**Distress**

For distress (DASS-21), a significant time and condition interaction was found which indicates that there was a greater decrease in distress in the treatment condition than in the waitlist condition over time (*β* = 0.45). The within group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were medium (Hedges’ *g* =-0.61 to 0.67). The between group effect sizes from pre-treatment to post-treatment and post-treatment to follow-up were small (Hedges’ g= -0.23 to -0.27).

***Stress***. For stress (DASS-21 Stress subscale), a significant time and condition interaction was found which indicates that there was a greater decrease in stress in the treatment condition than in the waitlist condition over time (*β* = 0.27). The within group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were medium (Hedges’ *g* = -0.68 to -0.70) The between group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were negligible (Hedges’ *g* = -0.12 to -0.19).

***Depression***. For depression (DASS-21 Depression subscale), a significant time and condition interaction was found which indicates that there was a greater decrease in depressed mood in the treatment condition than in the waitlist condition over time (*β* = 0.06). The within group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were small (Hedges’ *g =* 0.22 to -0.31) The between group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were medium (Hedges’ *g* = -0.52 to -0.58).

***Anxiety***. For anxiety (DASS-21 Anxiety subscale), a significant time and condition interaction was not found. A significant fixed effect of time was found which indicates that there was no difference in anxiety based on condition, but over time anxiety symptoms decreased (*β* = -0.10). The within group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were medium (Hedges’ *g* = -0.55 to -0.59). The between group effect sizes from pre-treatment to post-treatment and pre-treatment to follow-up were negligible (Hedges’ *g* = 0.03 to 0.12).

**Discussion**

 The present study examined the preliminary efficacy and feasibility of implementing a fully automated AEBT website for adults with trichotillomania through a randomized waitlist-controlled trial. Participants reported high intervention acceptability and usability, as well as demonstrated a high level of adherence to completing the web-based modules. Participants in the AEBT condition improved significantly more than waitlist over time on trichotillomania symptom severity, trichotillomania specific psychological inflexibility, well-being, distress, depression, and stress. There was a significant effect of time on anxiety but not condition. Overall, these results suggest AEBT can be feasibly delivered in a self-guided, web-based format for individuals with trichotillomania to effectively improve this undertreated condition.

Feasibility and usability of the website were in the good to excellent range, indicating strong engagement and retention throughout the treatment program. Most participants (85%) completed all modules and a small portion completed half of the modules or less (15% of participants). These adherence rates are notably high compared to other web-based trials (e.g., Levin et al., 2014). This study also provides preliminary evidence for the feasibility of AEBT delivered through a website. Technology-based research has increased over the last decade across a variety of disorders and has been efficacious for many clinical issues (e.g., Firth et al., 2017). However, prior to the present study, an AEBT website had never been tested as a standalone treatment modality for trichotillomania. The findings of this study provide a strong contribution to technology-based research and preliminary evidence that this is a feasible modality of treatment delivery.

Trichotillomania symptom severity decreased in the treatment condition significantly more than the waitlist condition. Of participants who completed the treatment, 52.78% met treatment responder status from pre- to post-treatment and 30.50% met treatment responder status from pre-treatment to follow-up. In the waitlist condition, 15% of participants met responder status from pre- to post-treatment and 8% met responder status from pre-treatment to follow-up which is explained by changes in symptom severity over time. Previous in-person research has similar findings to the present study (between 53-63%; e.g., Lee, Haeger, et al., 2018; Haaland et al, 2017) despite the online and automated delivery of this treatment. In the trial by Lee et al. (2018), symptom severity decreased significantly through treatment delivered via telehealth and 58% met responder status (Lee et al, 2018). Similarly, Haaland (2017) found that 60% of participants met treatment responder status following AEBT (Haaland, 2017). In the trial by Twohig and colleagues (2021) that was delivered through telehealth, there was a significant decrease in symptom severity for adolescents and 52-63% of participants met responder status. In all three trials, gains were maintained at follow-up (Twohig et al, 2021; Lee et al., 2018; Haaland, 2017). These findings are also comparable to trials of other combined interventions like DBT and HRT (e.g., 35%; Keuthen et al., 2012). In the present study, gains were maintained at follow-up; however, there was a small increase in pulling between post-treatment and follow-up. Based on reports from participants, many did not revisit the website between ending treatment and the follow-up assessment—this gap may explain the increase in pulling symptoms at follow-up. Additionally, several participants contacted the research team requesting access to the treatment again following study completion to review and/ or complete the program for a second time, further highlighting a potential need for follow-up and/or booster resources. Given the interest in gaining access to the treatment again, it is interesting that many participants did not revisit the website between post-treatment and follow-up despite having access for the full study period. This could be due to several reasons but the most likely, given continued interest in access to the treatment at other times, is that participants were not aware that they could revisit the website over that time. While this information was shared with participants at various points during the study, it is possible that this was forgotten or overlooked. Additionally, without the weekly check-ins, it is possible that the adherence may not be as high as seen during this study. However, further research is needed to assess this.

Trichotillomania-related psychological inflexibility decreased in the treatment condition significantly more than the waitlist condition. Trichotillomania specific psychological inflexibility is associated with trichotillomania symptom severity, so this finding was not surprising given the reported decrease in trichotillomania severity by participants. Previous research has suggested that trichotillomania-specific psychological inflexibility may also be correlated with higher levels of impairment and symptom severity, making changes in the AAQ-TTM especially clinically useful (Houghton et al., 2014). Previous research also has mixed findings for the effect of AEBT on psychological inflexibility. For example, in a trial by Woods and colleagues (2006) examining AEBT for adults in an in-person trial, experiential avoidance (which is the process that prevents an individual from being psychologically flexible by avoiding internal sensations or discomfort) decreased by 13% from pre- to post-treatment (Woods et al., 2006). In the trial by Lee et al. (2018), examining AEBT for adults in a telehealth trial, the effect of treatment on psychological inflexibility over time was significant (24.5% decrease pre- to post-treatment) which is consistent with the findings in this study. However, in a trial by Twohig and colleagues (2021) examining AEBT for adolescents in a telehealth trial, there was not a significant effect of psychological inflexibility. The variation in results could be due to small sample size in the Twohig and colleagues (2021) study or the fact that the AAQ-TTM has not been validated with youth.

Overall well-being increased in the treatment condition significantly more than the waitlist condition. This finding is consistent with our prediction but differs from previous studies. Previous studies used measures assessing Quality of Life broadly (e.g., Lee, Haeger et al., 2018) and the present study measured well-being. While related concepts, well-being focuses more on positive psychology and engagement in meaningful activities. Quality of life, on the other hand, focuses on the importance of certain aspects of a quality of life and to what extent they are being engaged in. The benefit of using a scale measuring well-being rather than quality of life, is that progress is measurable in shorter periods of time (e.g., months rather than years). Total distress, stress, and depression decreased in the treatment condition significantly more than the waitlist condition. For anxiety, condition was not a significant predictor of change, however, over time anxiety decreased. These outcomes are important to assess given the high rates of co-morbid anxiety and depressive disorders with trichotillomania. The findings for total distress, stress, and depression are consistent with our prediction but the finding of anxiety is not what we expected. However, because of the high comorbidity rates of anxiety disorders with trichotillomania and the targeted nature of this treatment, it is logical that these symptoms were not directly impacted by the treatment. It is also possible that due to the sample size, there was not enough power to detect the change. Additionally, previous research suggested that comorbid conditions may impact treatment outcomes (Grant et al., 2017), but these studies on AEBT have not examined the effect of treatment on comorbid conditions.

 Overall, the clinical utility of this web-delivered treatment for trichotillomania is significant. First, this treatment could be used as a first step before more intensive treatment (e.g., Rogers et al., 2014). If a client’s willingness to engage in treatment in low, a website like this one may help to increase their willingness by providing a first look at treatment that is less of a financial burden and time commitment. Further, if a client is seeking in-person or telehealth services and the waitlists for trichotillomania-experienced providers are long, this website could be recommended in the interim. Finally, this website could be used as a standalone treatment and does not need to be used in conjunction with in-person or telehealth services, depending on client need and readiness for change. Finally, it would also be helpful for maintenance for those who participated in in-person treatment.

 This study had several limitations. First, the sample is primarily female. Recent research suggested that prevalence rates are equal across sex, but more females seek services than males (Grant et al., 2020). Future research should seek a more evenly distributed sample. Additionally, this sample was primarily White and future research should focus on obtaining a more heterogenous sample. Previous research has indicated that treatment seeking samples of trichotillomania tend to be homogeneous and primarily White (Grant et al., 2020). Research to suggest if these prevalence rates are representative of trichotillomania prevalence in the population is limited. A study that is more heterogeneous would increase our understanding of prevalence of trichotillomania in the population at large and help to eliminate health disparities. Additionally, in terms of treatment adaptations, a more diverse sample would inform cultural adaptations for trichotillomania and OCRD treatment more generally. Finally, a more diverse sample would increase our understanding of what treatments work and for whom which could increase access and reach.

 Another limitation of this study is that recruitment occurred quickly (within three weeks of launching the study) and entirely through trichotillomania-specific pages on Reddit and Facebook. The sample was recruited almost exclusively from those two platforms, limiting the people who may have seen the study advertised. This also limits participants to a help-seeking sample who were already utilizing online support forums and who may have been able to easily use a website compared to someone calling into a clinic. Future research should seek to recruit through a variety of forums to ensure more groups are reached.

 In conclusion, this study provides evidence for the efficacy and feasibility of implementing a website delivering AEBT for adults with trichotillomania. Participants in the treatment condition reported significant improvement in hair pulling symptoms, psychological flexibility, quality of life, total distress, stress, and depression as compared to the waitlist group. This study adds to the literature supporting AEBT as a potential treatment for trichotillomania and is the first study to provide preliminary evidence supporting its efficacy when delivered through a website. These findings have a variety of compelling research and clinical implications, which include providing treatment that is accessible across rural and urban areas and is not limited by finances or proximity to a providing clinician.

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Figure 1

*CONSORT Diagram for Participant Flow in the Full Sample*

Assessed for eligibility via Zoom-intake (n= 85)

Residing outside U.S. (n=3)

Trichotillomania symptoms not present (n=1)

Randomized (n=81)

Allocated waitlist condition (n= 40)

Allocated ACT condition (n= 41)

Withdrew (n=1)

Mid-treatment assessment (n= 38)

Mid-waitlist assessment (n= 39)

Post-treatment assessment (n= 37)

Post-waitlist assessment (n=39)

Follow-up assessment (n=34)

Follow-up assessment (n=39)

Figure 2

Estimated Marginal Means and Standard Error Ribbons from Best-Fitting Model for AAQ-TTM and MGH-HPS Scores at p < .05



*Note.* Condition 1 indicates the treatment condition and condition 2 indicates the waitlist condition.

Table 1

Demographics for the Entire Sample and by Condition.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Entire Sample(N = 81) | Group ACT(n = 41) | Waitlist(n = 40) |
| Age (SD) | 30.62 (7.87) | 30.53 (7.36) | 30.55 (8.46) |
| Gender (%) |  |  |  |
| ManWomanAgenderNon-binary | 7 (8.64)70 (86.42) 1 (1.23)3 (3.70) | 6 (14.63)33 (80.49)0 (0)2(4.88) | 1 (2.50) 37 (92.50) 1 (2.50)1 (2.50) |
| Sex at birth (%)MaleFemale | 7 (7.41)74 (92.59) | 7 (12.20)35 (87.80) | 1 (2.50) (39) 97.50 |
| Race (%) |  |  |  |
| White or CaucasianHispanicBlackBiracialAsian | 67 (82.72)1 (1.23)1 (1.23)3 (3.70)9(11.11) | 36 (87.80)1 (2.44)1 (2.44)3 (7.32)0 (0) | 31 (77.50)0 (0)0 (0)0 (0)9 (22.5) |
| Ethnicity (%) |  |  |  |
| White/Non-HispanicHispanic/LatinxBlackBiracialAsianPrefer Not to AnswerDemography (%)Rural Urban | 63 (77.78)4 (4.94)1 (1.23)1 (1.23)10 (12.35)2 (2.47)17 (21)63 (78) | 37 (90.24)1 (2.44)1 (2.44)1 (2.44)1 (2.44)0 (0) | 25 (62.50)3 (7.50)0 (0)0 (0)9 (22.50)0 (0) |
|  |  |  |  |

Table 2

Means and Standard Deviations of Outcome Measures for Full Sample

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   | Treatment |  |  | Waitlist |  |  |
|   | Pre-treatment(n =41) | Mid-treatment(n = 38) | Post-treatment(n = 37) | One monthFollow-up(n = 34) | Pre-treatment(n = 40) | Mid-treatment(n = 39) | Post-treatment(n = 39) | One monthFollow-up(n= 39) |
| AAQ-TTM | 45.2 (7.5) | 38.2 (7.2) | 35.2 (8.1) | 34.7 (7.4) | 45.2 (6.3) | 42.8 (7.1) | 40.9 (8.1) | 40.8 (8.0) |
| MGH-HPS1 | 17.9 (4.4) | 12.5(5.5) | 10.9 (5.5) | 11.9 (5.6) | 18.2 (3.8) | 17.8 (5.1) | 17.1 (5.6) | 17.4 (5.1) |
| MHC-SF | 50.3 (13.0) | 53.7 (13.3) | 54.2 (14.8) | 55.7 (14.7) | 51.6 (12.6) | 51.8 (14.2) | 51.8 (14.1) | 51.1 (14.5) |
| DASS-211 | 20.1 (9.2) | 18.1 (8.4) | 14.2 (9.6)) | 14.4 (9.0) | 20.9 (10.1) | 21.9 (8.5) | 19.6 (10.7) | 20.8 (10.6) |
| DASS-21 S1 | 9.5 (4.4) | 8.6 (4.0) | 6.7 (4.2) | 6.7 (3.9) | 9.5 (4.5) | 10.0 (4.0) | 9.6 (4.5) | 9.8 (4.7) |
| DASS-21 D1 | 5.8 (4.3) | 5.2 (4.0) | 4.6 (4.4) | 4.8 (4.3) | 6.6 (4.0) | 6.8 (3.9) | 6.2 (4.2) | 6.4 (4.7) |
| DASS-21 A1 | 4.8 (3.4) | 4.3 (3.4) | 2.9 (2.8) | 3.0 (2.9) | 4.8 (4.1) | 5.0 (3.5) | 3.8 (3.5) | 4.5 (4.0) |

1 Higher scores indicate greater severity

*Note.* AAQ-TTM = Acceptance and Action Questionnaire- Trichotillomania, MGH-HPS = Massachusetts General Hospital- Hair Pulling Scale, MHC-SF= Mental Health Continuum Short Form, DASS-21 = Depression, Anxiety, Stress Scale- 21 Items, DASS-21 S = DASS-21 Stress subscale, DASS-21 D= DASS-21 Depression subscale, DASS-21 A= DASS-21 Anxiety subscale

Table 3

Hedges’ *g* Effect Sizes Within AEBT Condition and Between Groups Across Timepoints for Full Sample

|  |  |  |
| --- | --- | --- |
|  | Pre- to post-treatment | Pre-treatment to follow-up |
|   | Within-group1 | Between-groups | Within-group1 | Between-groups |
| AAQ-TTM | -1.26 | -0.32 | -1.39 | -0.32 |
| MGH-HPS | -1.38 | -0.27 | -1.19 | -0.34 |
| MHC-SF | 0.18 | -0.29 | 0.37 | -0.33 |
| DASS-21 | -0.67 | -0.23 | -0.61 | -0.27 |
| DASS-21 Stress | -0.70 | -0.12 | -0.67 | 0.19 |
| DASS-21 DepressionDASS-21 Anxiety | -0.31-.59 | -0.580.03 | -0.22-.55 | -0.520.12 |

1 Effect sizes calculated within treatment condition only.

*Note.* AAQ-TTM = Acceptance and Action Questionnaire- Trichotillomania, MGH-HPS = Massachusetts General Hospital- Hair Pulling Scale, MHC-SF= Mental Health Continuum Short Form, DASS-21 = Depression, Anxiety, Stress Scale- 21 Items, DASS-21 Stress = DASS-21 Stress subscale, DASS-21 Depression= DASS-21 Depression subscale, DASS-21 Anxiety= DASS-21 Anxiety subscale

Table 4

Estimated Marginal Means and 95% Confidence Intervals from Best-Fitting Multilevel Models

|  |
| --- |
|  | **AAQ-TTM** | **MGH-HPS** | **MHC-SF** | **DASS-21 Total** | **DASS-21 Stress** | **DASS-21 Depression** | **DASS-21 Anxiety** |
| Intercept | 43.65 [41.44; 45.85]\* | 16.35 [14.88; 17.82]\* | 874.98 [815.95; 934.02]\* | 19.86 [17.05; 22.67]\* | 9.44 [ 8.18; 10.70]\* | 5.65 [ 4.42; 6.89]\* | 4.80 [ 4.07; 5.52]\* |
| Week | -0.86 [-1.03; -0.69]\* | -0.50 [-0.65; -0.36]\* | 5.34 [ 2.07; 8.60]\* | -0.50 [-0.72; -0.28]\* | -0.25 [-0.35; -0.15]\* | -0.08 [-0.19; 0.02] | -0.10 [-0.16; -0.05]\* |
| Condition | 1.04 [-2.07; 4.16] | 1.82 [-0.25; 3.89] | 16.31 [-67.11; 99.73] | 1.35 [-2.61; 5.32] | 0.23 [-1.55; 2.01] | 1.03 [-0.71; 2.77] |   |
| Week x Condition | 0.49 [ 0.25; 0.72]\* | 0.42 [ 0.22; 0.62]\* | -6.04 [-10.56; -1.51]\* | 0.45 [ 0.15; 0.75]\* | 0.27 [ 0.14; 0.40]\* | 0.06 [-0.09; 0.20] |   |
| BIC | 1999.13 | 1853.45 | 3740.67 | 2149.04 | 1657.09 | 1684.50 | 1523.70 |
| Number of observations | 306 | 306 | 298 | 306 | 306 | 306 | 306 |
| Number of participants | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| \* Null hypothesis value outside the confidence interval. |