A MOBILE APPLICATION INTERVENTION FOR PERFECTIONISM

IN UNIVERSITY STUDENTS: A RANDOMIZED

CONTROLLED TRIAL

by

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# I. INTRODUCTION

The prevalence rate of mental health disorders is of growing concern as psychological disorders have continued to increase over the past decades (Twenge et al., 2019). Of particular concern is the significant increase in psychopathology among college students. In a study commissioned by the World Health Organization (WHO), Auerbach and colleagues (2016) used the World Mental Health Survey (WMH) to examine lifetime and 12-month prevalence rates of Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) mental health disorders in college students ($n = 1,572$) and non-college students ($n = 4,178$) of similar ages in 21 countries. The 12-month prevalence rate of any DSM-IV disorder was 20% among college students and 21% among non-students, with anxiety disorders, mood disorders, and substance use disorders being the most prevalent.

More recent research indicates that there has been a consistent increase in mental health problems among college students over the past decade (Lattie et al., 2019). Indeed, Lipson and colleagues (2019) conducted a large epidemiological study ($n = 155,026$) consisting of college students from 196 campuses in the United States (U.S.) and demonstrated that rates of psychological disorders have increased from 22% in 2007 to 36% in 2017. The authors also found that among college students depression diagnoses alone increased from 43% to 56% in 2016-2017 (Lipson et al., 2019). One reason for the increase in mental health problems may be due to the increase in academic pressure and responsibilities that students face while attending college (Pedrelli et al., 2015). Additionally, the COVID-19 pandemic has brought into focus the mental health status of various affected populations, including college students. Since the onset of COVID-19, several studies have shown that college students have faced increases in anxiety, feelings

of loneliness, and depression (Chen & Lucock, 2022; Lee et al., 2021; Li et al., 2021).

Another study focused on a period of 4 months during the peak of the COVID-19

pandemic (C. Wang et al., 2020; X. Wang et al., 2020). In this study, the authors

administered an online survey to the student population at the Texas A&M. Among the

2,031 participants, 48% showed moderate-to severe levels of depression, and 38% of

students showed mild-to-severe levels of anxiety. Further, 71% of participants indicated

that their stress and anxiety levels had increased during the pandemic and less than half

(43%) indicated that they were able to cope adequately with the stress (X. Wang et al.,

2020).

Psychological stress is defined as the interaction between perceived demand,

perceived ability to cope, and the perception of the importance of being able to cope with

the demand (Staal, 2004). In other words, stress is related to the occurrence of

environmental events that are perceived as demanding, or individual responses to events

that are indicative of this overload which is related to negative affect (Cohen & Janicki-

Deverts, 2012). Stress is a reality in most people's lives, but perhaps more so among

college students. In a study carried out by the WHO's World Mental Health International

College Student Initiative (WMH-ICS), sources of stress were assessed as well as their

associations with mental health disorders in a sample of first-year college students from

24 universities across nine countries (Karyotaki et al., 2020). Of the 20,842 student

respondents, 94% had experienced at least one type of stress in the past year with at least

mild severity in the following six life categories: health, romantic relationships, financial

situations, relationships with family, relationships with people at school/work, and

problems experienced by loved ones. Additionally, the study found that stress involving

relationships at work/school significantly predicted major depressive disorder (MDD), bipolar disorder, and generalized anxiety disorder (GAD), with GAD being the strongest correlate (20%) of this category (Karyotaki et al., 2020). Notably, people differ greatly in their stress proneness and coping styles, both of which were found to be heavily influenced by several personality traits (Leszko et al., 2019).

## II. PERFECTIONISIM AND MEASURES OF PERFECTIONISM

**Perfectionism**

One personality trait that influences how individuals experience stress is perfectionism. Perfectionism is defined as "*a personality disposition characterized by striving for flawlessness and setting exceedingly high stands of performance of one's behavior*" (Stoeber et al., 2015, p.1). This disposition affects all aspects of one's life, particularly in the vocational and academic domains (Stoeber et al., 2016). Historically, early psychological conceptualization regarded perfectionism as a unidimensional personality trait (e.g., Burns, 1980). This conceptualization exclusively captured the neurotic and dysfunctional aspects of perfectionism (Burns, 1980). As research continued beyond the 1980s, new views of perfectionism emerged in the 1990s that conceptualized perfectionism as a multidimensional personality disposition. Along these lines, Frost and colleagues (1990) and Hewitt and Flett (1991) offered different multidimensional conceptualizations of perfectionism, and each group developed a corresponding multidimension scale.

**Multidimensional conceptualizations of perfectionism.** The Frost Multidimensional Perfectionism Model (FMPS; Frost et al., 1990) is a heterogeneous construct comprised of six sub-constructs: *personal standards* (*PS*) *concern over mistakes* (*CM*), *doubts about actions* (*DA*), *parental expectations* (*PE*), *parental criticism* (*PC*)*, and organization* (*O*). Personal standards reflect the exceedingly high standards held for oneself. Concern over mistakes captures the fear of making mistakes and the negative consequences from mistakes, whereas doubts about actions capture the uncertainty of decisions and indecisiveness. Parental expectations and parental criticism

refer to the perception of parents setting high standards and being critical if standards were not met. Finally, the organization construct captures the tendency to be neat and value order (Frost et al., 1990).

Another approach to defining and measuring perfectionism was developed by Hewitt and Flett (1991). Their conceptualization of perfectionism focused on interindividual and intraindividual personality dynamics that contribute to overall perfectionistic behavior (Hewitt & Flett, 1991). Given this, The Multidimensional Perfectionism conceptualization by Hewitt and Flett (HMPS; Hewitt & Flett, 1991) defined perfectionism as a construct comprised of three sub-constructs: *self-oriented, other-oriented, and socially prescribed perfectionism*. Self-oriented perfectionism comprises the internally motivated beliefs about the importance of striving for perfection for oneself. Other-oriented perfectionism comprises the internally motivated belief that others should strive for perfection and be perfect. Lastly, socially prescribed perfectionism comprises externally motivated beliefs that being perfect is important to others.

With the increasing popularity and extensive overlap between the two constructs, the FMPS was quickly adopted by researchers and clinical practices (Stöber, 1998). Additionally, after extensive study of both conceptualizations and measures and findings from Frost and colleagues (1993), a bifactor model of perfectionism emerged (Frost et al., 1993). The bifactor model of perfectionism is comprised of *perfectionistic strivings* (*PS*) *and perfectionistic concerns* (*PC*). Perfectionistic striving, also referred to as personal standards perfectionism, captures aspects of perfectionism related to personal standards, order, and organization, and setting unrealistic standards for others and oneself (Gäde et

al., 2017; Stoeber et al., 2016). The *personal standards* and *organization* subscales from the FMPS and the self-oriented perfectionism and other-oriented perfectionism subscales from the HMPS load onto the personal standards factor. This dimension is said to be associated with positive characteristics and is commonly referred to as *adaptive perfectionism* because of its relationship to adaptive outcomes (e.g., greater self-efficacy, positive affect; Stoeber et al., 2020). The perfectionistic concerns (also referred to as evaluative concerns) dimension captures facets of perfectionism associated with doubts about actions, evaluative concern, and perceived pressure from others (Stoeber et al., 2016). *Concern over mistakes, parental criticism, parental expectations, doubts about actions* from the FMPS, and socially- prescribed perfectionism from the HMPS load onto the perfectionistic concerns factor. This dimension has been found to be associated with negative characteristics such as negative affect, a greater indicator of psychopathology, fear of failure, and passive coping and is therefore called *maladaptive perfectionism* (Gäde et al., 2017; Stoeber et al., 2016; Stoeber et al., 2020). Across several studies, the findings are consistent in that the *perfectionistic concerns* domain consistently shows maladaptive effects and is significantly higher in individuals with clinical disorders like Obsessive-compulsive disorder (OCD; Antony et al., 1998; Frost & Steketee, 1997; Maia et al., 2009) and Anorexia nervosa (AN; Bardone-Cone et al., 2007; Maia et al., 2009). However, according to several other studies, college (Miller-Day & Marks, 2006; Welch et al., 2009) and clinical populations (Sassaroli et al., 2008) with eating disorders such as AN and bulimia nervosa have both *perfectionistic strivings* (adaptive) and *perfectionistic concerns* (maladaptive) traits. Similar patterns emerged when Bieling et al. (2004) found that although maladaptive perfectionism was a better indicator of psychopathology, both

maladaptive and adaptive perfectionism contribute to anxiety, stress, depression, and test-taking anxiety in undergraduate students.

Whether the construct of perfectionism indeed consist of an adaptive component is an open and controversial question because on one hand, research contends that there are two conceptions of perfectionism- adaptive and maladaptive- and that adaptive perfectionism is associated with positive characteristics (e.g., positive affect, satisfaction) and low levels of evaluative concerns (Stoeber & Otto, 2006). On the other hand, some studies have found that although adaptive perfectionism is associated with more positive characteristics, it is also associated with elevated clinical-level symptoms of stress, anxiety, and depression (Robinson & Abramovitch, 2020). Further, adaptive perfectionism is also associated with suicidal ideation (Smith et al., 2018 ), eating disorders, and reduced health (Molnar et al., 2012). In a more recent study conducted by Robinson and Abramovitch (2019), 98 university students completed neuropsychological assessments to assess the neuropsychological correlates of perfectionism among high negative perfectionism (HNP) and low negative perfectionism (LNP) groups. The results revealed that while maladaptive and adaptive perfectionism was not found to be associated with different cognitive functions (or dysfunction) or grade point averages, both groups experienced substantial psychopathological burden, including anxiety, depression, and stress. Given these findings, it seems that adaptive perfectionism extends beyond adaptive achievement strivings and is not necessarily synonymous with positive, healthy, or functional outcomes.

Motivated by developing an effective intervention, Shafran and colleagues (2002) offered a more contemporary unidimensional conceptualization of perfectionism. This

new unidimensional approach proposed a new definition and cognitive behavioral conceptualization of *clinical perfectionism* that is often utilized in cognitive behavioral therapy (CBT) for clinical perfectionism (Riley et al., 2007). Clinical perfectionism is defined as, "*the overdependence of self-evaluation on the determined pursuit of personally demanding, self-imposed, standards in at least one highly salient domain, despite adverse consequences*" (Shafran et al., 2002, p. 778). With this new definition, Shafran and colleagues (2002) provided a cognitive behavioral analysis of perfectionism that focused on self-oriented perfectionism. In this model, it is suggested that perfectionism is maintained by cognitive biases such as selective attention to failure and dichotomous thinking. As a result, according to this model, people with elevated clinical perfectionism react to failure with significant self-criticism, counter-productive behaviors, increased anxiety, and excessive checking behavior as well as a reappraisal of their standards (Shafran et al., 2002).

The cognitive behavioral model of clinical perfectionism proposed by Shafran and colleagues (2002), included four main elements of perfectionism: rigid standards, negative self-evaluations based on high standards, self-criticism, and fear of failure. According to this model, people with clinical perfectionism will set inflexible standards kept in place by cognitive biases and dichotomous thinking that will eventually lead to counter-productive behaviors or reappraisal and raising of standards.

**Clinical correlates of perfectionism.** Perfectionism is implicated in the maintenance and etiology of several DSM disorders (Egan et al., 2011; Shafran & Mansell, 2001) and regardless of the conceptualization, the scales designed to measure perfectionism demonstrate how perfectionism plays a central role in OCD (Antony et al.,

1998; Sassaroli et al., 2008), obsessive-compulsive personality disorder (OCPD; Halmi et al., 2005), and anorexia and bulimia nervosa (Bardone-Cone et al., 2007). High levels of perfectionism is also found among individuals diagnosed with anxiety and affective disorders such as major depressive disorder (MDD; Limburg et al., 2017; Sassaroli et al., 2008; Stoeber, 2018), panic disorder (Antony et al., 1998), GAD (Handley et al., 2015; Klibert et al., 2015; Santanello & Gardner, 2007), and post-traumatic stress disorder (Egan, Hattaway, et al., 2014). Indeed, in a study examining the relationship between perfectionism and Axis I disorders, Bieling and colleagues (2004) found that higher scores on the maladaptive evaluative concerns index were strongly associated with anxiety, depression, and stress. This study highlighted the role of perfectionism across a variety of disorders and the importance of targeting perfectionism in treatment. Also, consistent with previous research showing that perfectionism is associated with increased psychological burden (Patterson et al., 2021; Robinson & Abramovitch, 2020), Park and Jeong (2015) showed that college students who struggle with perfectionism often report decreased psychological health and well-being, life satisfaction, and self-esteem as well as higher levels of depression.

**Perfectionism in College Students**

Along with the documented increase in psychopathology among college students, there is growing evidence that the increase in mental health problems among young people may stem from excessive standards they hold for themselves and the harsh self-criticism they engage in (Curran & Hill, 2019). Further, unrealistic expectations for academic and professional achievement, increasing societal pressure, and a preoccupation with receiving validation from peers are among the reasons why the prevalence of

perfectionism has increased among college students (Curran & Hill, 2019). Upon further investigation, Self-Oriented, Socially Prescribed, and Other-Oriented Perfectionism has increased by 10%, 33%, and 16% respectively in students in the past few decades (Curran & Hill, 2019). Socially prescribed perfectionism, characterized by the belief that others have high demands, has had the largest increase, this is especially concerning because this dimension of perfectionism has been shown to be positively related to a range of psychological disorders and symptoms, such as body dissatisfaction, bulimia nervosa, suicide, depression, and anxiety (Limburg et al., 2017). Nevertheless, among students, perfectionism was perceived as socially desirable (Stoeber & Hotham, 2013) and many individuals may continue to embrace it despite the negative consequences. In fact, perfectionism is a transdiagnostic process in that it is elevated in anxiety disorders, OCD, eating disorders, depression, OCPD, and somatoform disorders in students (Egan et al., 2012).

In a novel approach to extract profiles of perfectionism using data from multiple questionnaires, Newman and colleagues identified four distinct profiles of perfectionism (obsessive, constructive, motivated, and non-perfectionist). Obsessive expressions of perfectionism were characterized by high levels of rumination, planning, and moderate academic management. Students who identified with the obsessive expression displayed significantly higher levels of anxiety and depression compared to those who expressed perfectionism as constructive and motivated. Motivated expressions were characterized by high intrinsic motivation, exhibited less depression, and anxiety, and greater happiness and academic involvement over non-perfectionist expressions. Similarly, individuals who displayed a constructive expression of perfectionism experienced significantly less

anxiety and depression symptoms and reported greater subjective well-being. In contrast, non-perfectionists did not possess adequate skills to manage academic demands and exhibited high levels of rumination as well as greater anxiety and depressive symptoms compared to motivated and constrictive profiles. These findings exemplify the phenomenological and phenotypic complexity of perfectionism in college students and the need for further research in this population. It is also consistent with research findings from Madigan (2019), that demonstrated that perfectionism is a highly variable trait in academic settings.

Therefore, given the current knowledge about the associated burden and the role of perfectionism in a variety of disorders, it is important to develop and test treatment for perfectionism directly, and particularly in college student populations.

## III. TREATMENTS FOR PERFECTIONISM AND LOW-INTENSITY INTERVENTIONS

CBT is the primary recommended treatment for perfectionism given the growing evidence of its effectiveness (Shafran et al., 2018). CBT is a psychological therapy that explores the relationships between thoughts, emotions and behaviors and works to dismantle maladaptive thoughts and beliefs, and related behaviors, with the goal of developing more adaptive cognitions and behaviors to help improve psychological and physical well-being (Fenn & Byrne, 2013). Several studies have demonstrated the dominant role of cognitive biases and dichotomous thinking in the maintenance of perfectionism, thus, CBT for perfectionism emphasizes cognition-based interventions more than behavioral interventions (Shafran et al., 2016). Therefore, CBT treatment typically focuses on mechanism that maintain perfectionism, as well as self-evaluation and behavior change (Shafran et al., 2016). Given the importance of cognitive processes in perfectionism (Flett et al., 2018) CBT is an effective evidence-based treatment (Abdollahi et al., 2019; Egan, Hattaway, et al., 2014; Shafran et al., 2017). It may reduce negative cognitions (DiBartolo et al., 2001), evaluative concerns, and comorbid depression and anxiety symptoms (Lloyd et al., 2014). It has also demonstrated its effectiveness in disorders where perfectionism is a central symptom including OCD (Öst et al., 2015), OCPD (Halmi et al., 2005), and AN (Lloyd et al., 2014). Meta-analytic reviews also demonstrate its effectiveness for anxiety (Cuijpers et al., 2014; von Brachel et al., 2019) and trauma-related disorders (Egan, van Noort, et al., 2014).

One of the first studies to evaluate the effectiveness of cognitive restructuring (a common technique used in CBT) for treating perfectionism found that following a brief cognitive restructuring intervention, participants reported lower negative cognitions and affect as well as decreased anxiety ratings (DiBartolo et al., 2001). In another study, twenty participants received 10 sessions of CBT for perfectionism over a period of eight weeks with a treatment protocol that consisted of two cognitive elements and behavioral elements (Riley et al., 2007). Post-treatment results revealed that 75% of participants had clinically improved perfectionism scores with a very large effect size (Cohen's $d = 1.83$). Further, treatment gains continued to significantly improve at 8 and 16-week follow-ups, lending support to the efficaciousness of CBT for perfectionism.

**Low Intensity Interventions**

Low-intensity CBT interventions are interventions that are suggested for mild to moderate presentations of psychological disorders (Papworth & Marrinan, 2019) and for individuals that do not have access to traditional modes of therapy. These interventions utilize a stepped care approach, meaning that the intervention intensity gradually increases until the patients' treatment goals are met (Papworth & Marrinan, 2019). The primary purpose of low-intensity treatments is to increase access to mental health services to enhance mental health and well-being (Bennett-Levy et al., 2010), all while being brief and requiring less adjunct therapeutic input (Shafran et al., 2021). This is greatly important because it increases service flexibility and capacity, access to evidence-based treatments, and it is also cost-effective (Bennett-Levy et al., 2010). Indeed, developing low-intensity psychological intervention is essential given that approximately

95% of adults in the US report at least one barrier to healthcare access (Coombs et al., 2021).

Given the support for CBT as an efficacious treatment for perfectionism, several authors have since then developed and tested similar self-help, web-based applications, and computerized approaches that utilize variations with and without adjunctive coaching by therapists (Egan, van Noort, et al., 2014; Pleva & Wade, 2007; Radhu et al., 2012). In general, low-intensity CBT has been found to be efficacious although a meta-analysis showed that small effect sizes are typically reported for low-intensity CBT-based interventions (Kaddour et al., 2018). For instance, effect sizes of Hedges' $g = 0.35$ (95% CI 0.20 to 0.50) and $g = 0.27$ (95% CI 0.15 to 0.39) were reported for anxiety and depression, respectively, after low-intensity CBT interventions were delivered.

**Low-intensity interventions for perfectionism.** Given the recent surge of novel low-intensity interventions for multiple disorders (Sijbrandij et al., 2020), there has been a growing interest in the development and use of low-intensity CBT for perfectionism including self-help and web and computerized-based approaches (Shafran et al., 2016).

*Self-Help*. Low-intensity CBT for perfectionism has proven to be effective when delivered in several formats. Pleva and Wade (2007) found that in a non-clinical sample anxiety, depression, and perfectionism were significantly reduced via self-help books and guided self-help sessions. While both groups saw improvement in perfectionism measures, the guided self-help group experienced clinically significant improvement in personal standards, attitudes about responsibility, and measures of obsessive and compulsive symptomatology. In a similar study, Egan and colleagues (2014) investigated the efficacy of two formats of CBT for perfectionism in a RCT, face-to-face and pure

online self-help, in reducing perfectionism and related symptoms of stress, anxiety, and depression. The pure online self-help group that received book chapters to read, showed significant reductions (medium-large effects; Cohen's *d* = .73, .74) in concern over mistakes and personal standards, but they did not demonstrate significant changes in symptoms of depression, anxiety, and stress. In comparison to the online group, the traditional CBT group (face-to-face delivery) showed significant pre-post reductions in concern over mistakes, personal standards, depression, anxiety, and stress symptoms (large effect sizes; *d* = 1.16- 2.20; Egan et al., 2014).

  ***Computerized and web-based CBT***. Given the increased need for online interventions, computerized and web-based CBT are other forms of low intensity treatments available for perfectionism. A web-based CBT intervention for perfectionism resulted in significant decreases in perfectionism, depression, anxiety, and stress after 12 weeks (Radhu et al., 2012). Another clinical trial that assessed the effectiveness of web-based CBT in reducing perfectionism and psychological distress in students, supported the effectiveness of self-directed web-based interventions for perfectionism (Arpin-Cribbie et al., 2012). These results lend further support to the effectiveness of low-intensity CBT for treating perfectionism. More recently, in an 8-week clinical trial with 70 participants, Zetterberg and colleagues (2019) compared two methods of delivering internet-CBT (ICBT), namely, ICBT-request (i.e., possibility of requesting support from a therapist) or ICBT- support (i.e., regular support from a therapist). The results revealed significant improvements on the *FMPS concern over mistakes, personal standards*, and *doubts about actions* subscales from pre- to post-treatment assessments with small to large effect sizes (*d* = .03-1.4). Further, the level of support did not differentiate the two

conditions in terms of treatment outcome or attrition rates, which implied that ICBT was beneficial to participants regardless of regular support or support upon request (Zetterberg et al., 2019).

  ***Mobile application interventions.*** Given the simplicity, accessibility, and low-cost, app-related mental health treatments are one of the fastest-growing categories of apps (Marshall et al., 2019), with over 318,000 health-related mobile apps available in 2019 (Weisel et al., 2019). These app-based interventions are promising. Indeed, a recent meta-analysis of six app-based low-intensity intervention studies for depression found a significant albeit small effect size of ($g = 0.33$; Weisel et al., 2019). In addition, when anxiety was assessed as an outcome measure, smartphone app treatments were superior to controls with a pooled effect of 0.43 (Weisel et al., 2019). However, given the prevalence of perfectionism and the data regarding the effectiveness of app-related treatments for psychopathologies, it is surprising that there are no mobile apps that specifically target perfectionism.

  ***GGtude mobile applications.*** The GGtude app platform is among the few available apps that are based on a CBT model that has also demonstrated its efficacy in randomized control trials (RCTs; Aboody et al., 2020; Akin-Sari et al., 2022; Ben-Zeev et al., 2021; Cerea et al., 2020; Cerea et al., 2021; Pascual-Vera et al., 2018; Roncero et al., 2019 ).This app platform focuses on the cognitive aspect of CBT and was created for the primary purpose of improving mental health by reducing maladaptive beliefs and utilizing a healthy inner monologue, as suggested by cognitive therapy models (Knapp & Beck, 2008). Further, maladaptive beliefs are reinforced by negative automatic thoughts, these are the thoughts that appear in our minds without conscious effort and are believed

to influence our core beliefs (Knapp & Beck, 2008). These are the cognitive frameworks that help organize and store new information into meaningful categories. Therefore, core beliefs embedded in maladaptive cognitions shape an individual's thinking style and behavior in a way that fosters cognitive errors commonly seen in disorders such as anorexia or bulimia nervosa, OCD, anxiety, as well as in the context of elevated perfectionism (Knapp & Beck, 2008). Further, CBT for perfectionism emphasizes targeting dysfunctional thoughts and core beliefs given that classic exposure may be less effective than belief testing in this population (Shafran et al., 2018).

GG OCD, one of the apps provided by the GGtude platform, is based on principles of CBT, and focuses on dismantling maladaptive thoughts and beliefs in relation to OCD, anxiety, depression, body image, perfectionism and more. This app works to target maladaptive cognitions by exposing users to contrasting adaptive statements of specific maladaptive beliefs. For instance, an example statement that challenges perfectionism may include, "*Mistakes teach me to overcome my fears.*" Users interact with the statements by pulling blocks of positive statements from the top of the screen toward themselves and throwing (moving statements towards the top of the screen, away from themselves) away negative statements such as "*My mistakes are horrible.*" Fifteen days of consistent app use for approximately three minutes a day resulted in significant reductions in maladaptive OCD beliefs with medium to large effects between the intervention and control group ($d = .42-.84$; Roncero et al., 2019 ). Given that perfectionism has domains related to checking and order similar to OCD, an interactive app such as GG OCD might prove to be effective in reducing perfectionistic beliefs and behaviors in university students.

**Need for Mobile Based Interventions in Students**

Psychological disorders are prevalent and on the rise among college students (Czyz et al., 2013). Unfortunately, there are several barriers that may hinder access to treatment among including socioeconomic background, being unaware of services, being Asian or Pacific Islander, and lack of perceived need (Eisenberg et al., 2007). Similarly, Czyz and his colleagues (2013) reported that barriers to receiving treatment include the inconveniences associated with mental health services, lack of time, and perceived cost and benefits. Moreover, the demand for student mental health services on college campuses has increased by 29% over the last 5 academic years between 2009-2010 and 2014-2015 (*Center for collegiate mental Health*, 2016). Thus, counseling services are often overwhelmed and left without commensurate increases in resources, therefore, providing responsive mental health services for students has also become a challenge for many institutions (Center for collegiate mental Health, 2016). Given the increases in perfectionism, overwhelmed counseling services, and barriers related to receiving treatment, there is an increased need for low-intensity interventions for students.

A meta-analysis of RCTs for the efficacy of mental health app interventions demonstrated that smartphone interventions significantly outperformed control conditions in improving depressive symptoms ($g = .28$), GAD ($g = .30$), stress levels ($g = .35$), and symptoms of social anxiety ($g = .58$; Linardon et al., 2019). Despite such promising results from mental health apps to our knowledge there are currently no available CBT-based apps that directly target perfectionism.

## IV. PURPOSE

Perfectionism is a multidimensional personality disposition that pervades all areas of life, and it is associated with substantial psychological burden in university attending individuals (Robinson & Abramovitch, 2019). Given that low-intensity treatment options, such as mobile applications, have demonstrated promising results in regard to improving symptoms of several psychopathologies (Linardon et al., 2019) with small effect sizes, it is of interest to investigate the efficacy of a mHealth CBT based low-intensity app treatment for perfectionism among university students given that there are currently no available app interventions for perfectionism.

The current study utilized a low intensity app-based mobile delivered CBT-based self-help training application for perfectionism and evaluate improvement in symptoms of perfectionism and associated symptoms of stress, depression, and anxiety. A RCT was conducted to compare university students using GG OCD-Anxiety & Depression for two weeks with a control group of students not using the app. I hypothesized that compared to participants who did not use the app, participants using the app would exhibit a greater reduction in symptoms of perfectionism, and present with lower associated symptoms of anxiety and stress after two weeks of consistent app use.

## V. METHODOLOGY

**Participants**

Recruitment of participants occurred in two phases. To obtain a large sample of participants with clinical level of perfectionism, the first phase of the study entailed an initial screening phase. Phase 1 recruitment email was sent to a random sample of 8,937 college students. At the end of this stage 1,404 participants completed the Concerns Over Mistakes (CM) subscale from the Frost Multidimensional Perfectionism Scale (FMPS; Frost et al., 1990). Inclusion criteria included basic English proficiency, being between the ages of 18-65, and having a smart mobile device with IOS or Android operating system. The mean CM subscale score of 1,404 participants was 28.43 ($SD = 6.67$). In the second stage of recruitment, individuals who scored 1 standard deviation above the mean on the CM subscale ($n = 407$) were randomized and contacted by email and invited in batches to meet with me. This CM cut-off criterion was used due to the fact that perfectionism is not a disorder but a trait and this dimensional cutoff is frequently utilized in perfectionism studies and randomized trials (Egan, van Noort, et al., 2014; Rozental et al., 2017). Eligible participants were contacted in batches in order to minimize cancellations and 'no-shows' and to ascertain that the desired sample size for each group was met. Participants who were contacted by email were randomly assigned to a treatment group.

**Procedure**

In the first stage of the study, a random sample of undergraduate students ($n = 8,937$) was contacted via bulk email at Texas State University inviting participants to complete a brief self-report measure voluntarily. Participants were asked to complete the

CM subscale from the FMPS and provide their email addresses if they were interested in being invited to participate in a paid follow-up study. From the total sample, 1,404 students who provided their informed consent, completed the CM screening survey, and agreed to be invited to participate in the paid study. Of those students, 407 met the screening criteria, set at $> 1SD$ than the mean. Following the screening procedure, participants were randomly assigned to the App ($n = 35$) and Control ($n = 35$) groups. The randomization procedure was carried out using a research randomization tool from randomizer.org (n.d.) to allocate participants to a treatment group. Subsequently, participants scheduled an online video call and subsequently individually met with me via Zoom. In these individual Zoom sessions participants assigned to the App group were informed about the GGtude app and asked to complete three levels a day (approximately 3 minutes a day) for 14 days. During the video call participants were asked to download the 'GG Research' app, formally referred to as GG OCD-Anxiety & Depression, from the Apple App Store or Google Play. Participants in the App group received a step-by-step instruction on how to use the app and provided additional verbal consent for participation. To monitor compliance regarding app use, participants in the App group were asked to share a screenshot of their current level every day via email or via text message. In the individual video calls with the Control group, participants were informed that they were participating in a study that would assess common symptoms experienced by college students and were asked to complete online surveys at three different time points. All video calls were conducted remotely due to the COVID-19 pandemic.

Following the video meeting, participants received an email with a link to the secured Qualtrics system to complete the pre-treatment (baseline; T1) evaluation and sign

an informed consent. Emails with the corresponding survey links were sent to participants 14 days after T1 (i.e., post-treatment; T2), and again 30 days after T2 (follow-up; T3). Participants who completed the T3 survey were compensated for their time with $10 Amazon e-gift cards. In addition, all participants were entered into a raffle to win three $100 Amazon e-gift cards.

**Intervention**

GG OCD - Anxiety & Depression (Fig. 1) consists of short training exercises intended to help users cope with mental challenges by increasing accessibility self-statements that facilitate adaptive interpretations of thoughts, emotions, and events associated with perfectionism. The app contains 9 categories (B*eating self-criticism, Dealing with perfectionism, Reducing vulnerabilities, Fear of mistakes, Perfectionism and worry, Perfectionism and self-criticism, Feeling safe I, II, and III*), which contain concepts related to the category and related maladaptive beliefs (3-6 per belief). Levels are comprised of several statements that are either consistent with their maladaptive belief or challenge this belief. For example, statements consistent with perfectionism include "*I must think negatively about my work*" or "*Always focus on your flaws.*" Users respond to these statements by either embracing them (i.e., pulling the phrase downwards toward themselves) or rejecting them (i.e., throwing the phrase upward away from themselves). Following the completion of each level users will either receive a memory-evaluation screen that will ask them to recall statements that recently appeared in the level completed or receive an encouraging statement such as "Excellent!" Now you've learned how to better deal with your thoughts and to better recognize the way you overestimate threat.
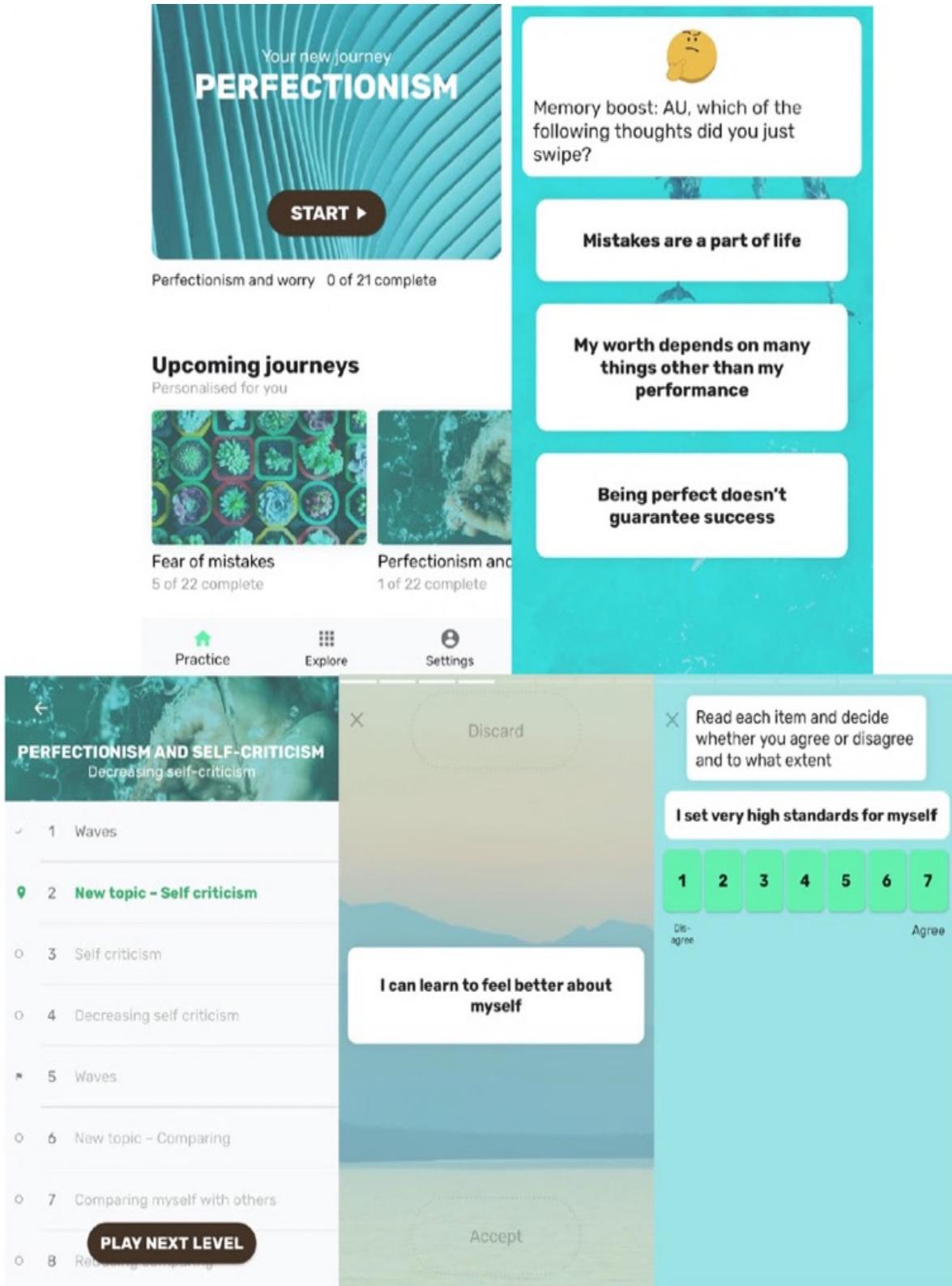
**Figure 1.** GG Research Screenshots

**Measures**

The demographic questionnaire was completed only in T1, and all other measures were

completed at each of the three time points: baseline (T1), at the end of the intervention

after 14 days (T2), and at follow-up after 30 days (T3).

**General Demographic Questionnaire**

The demographic questions consisted of items related to gender, sex, race, ethnicity, age,

relationship status, academic year, and GPA.

**Covid Stress Scale** (CSS; Taylor et al., 2020) The CSS is a 36-item self-report

questionnaire that assesses COVID-19 related fears and stress symptoms about the

pandemic (e.g., intrusive thoughts, nightmares). The scale is comprised of five

subscales: danger and contamination, socioeconomic consequences, xenophobia,

traumatic stress, and compulsive checking. Items were rated on a Likert scale ranging

from 0 (*not at all*) to 4 (*extremely*). The scale's total score ranges from 0-144, with

higher scores entailing elevated COVID-19-related stress. The CSS questionnaire

demonstrated good to excellent internal consistency in the general population ( $\alpha = .86$-

.95; Taylor et al., 2020). In the present study, excellent psychometric properties

(Cronbach's $\alpha = .92$) were observed.

**Clinical Measures**

**Frost Multidimensional Perfectionism Scale** (FMPS; Frost et al., 1990). The FMPS is

a 35-item self-report multidimensional measure of perfectionism. Traditionally, the

FMPS consist of six subscales (Concerns over Mistakes, Doubts about Actions, High

Standards, Parental Concern, Parental Evaluations, and Organization), however

exploratory factor analysis have identified four underlying components, combining

Concerns over Mistakes with Doubts about Actions and Parental Concerns with

Parental Expectations (Stöber, 1998). Therefore, the scale version we used will exemplify this and thus consisted of four subscales of perfectionism: Concern over Mistakes and Doubts about Actions (CM; 13-items), Parental Expectations and Concerns (PE; 9-items), High Standards (HS; 7-items), and Organization (O; 6-items). Items were rated on a Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The total score ranged from 35-175, with higher scores indicating a greater tendency towards perfectionism. The FMPS demonstrated acceptable to excellent internal consistency of subscales in a student sample (α= 0.77 to 0.90; Dorevitch et al., 2020). In the present study, The FMPS demonstrated good psychometric properties (α = .88).

**Depression Anxiety Stress Scale-21** (DASS-21; Osman et al., 2012). The DASS-21 is a 21-item self-report questionnaire that consists of 3 subscales that contain 7 items each. Responses are scored on a 4-point Likert scale from 0 (*did not apply to me at all*) to 3 (*applied to me most of the time*). The total score ranged from 0-120, with higher scores indicating more severe symptoms. In the general population good to excellent internal consistency was found in the general population (α = .91, .80, and .84 for depression, anxiety, and stress, respectively; Sinclair et al., 2011). In the present study, the DASS-21 questionnaire demonstrated good internal consistency (α = .88, .84, and .78 for depression, anxiety, and stress, respectively).

**Obsessive-Compulsive Inventory 12** (OCI-12; Abramovitch et al., 2021). The OCI-12 is a 12-item self-report measure of OCD. The scale consisted of four subscales of OCD: Checking (3-items), Ordering (3-items), Washing (3-items), and Obsessing (3-items). Responses were scored on a 5-point Likert scale from 0 (*Not at all*) to 4 (*Extremely*).

The total score ranged from 0-48, with higher scores indicating more OCD symptoms. The OCI-12 demonstrated good psychometric properties including very good test-retest reliability ($\alpha$ = .85) in a clinical sample, and acceptable to very good internal consistency in obsessive-compulsive disorder samples ($\alpha$= 0.79), anxiety realted disorders ($\alpha$ = 0.89) , and non-clinical controls ($\alpha$ = 0.71; Abramovitch et al., 2021).

**Single Item Self-esteem Scale** (SISE; Robins et al., 2001). The SISE is a one-item self-report measure of global self-esteem. The single item, "*I have high self-esteem*," was scored on a 5-point Likert scale, ranging from 1(*not very true of me*) to 5 (*very true of me*). The SISE demonstrated an acceptable reliability estimate in an undergraduate student sample ($\alpha$ = 0.75; Robins et al., 2001) using the Heise procedure of autocorrelations over three time points for a single-item scale.

**Barkley Functional Impairment Scale-Long Form** (BFIS-LF; Barkley, 2011). The BFIS is a 15-item self-report measure that assessed psychosocial impairments in 15 domains of major life activities. The 15 scale items were evaluated according to a 10-point Likert scale, with possible ratings of 0 (*Not at all*), 1–2 (*Somewhat*), 3-4 (*Mild*), 5-7 (*Moderate*) and 8-9 (*Severe*). In the general population the BFIS-LF demonstrated excellent internal consistency ($\alpha$ = 0.97; Barkley, 2011). In the present study, the BFIS demonstrated good internal consistency ($\alpha$ = .84). Due to technical error, one item was omitted from the BFIS questionnaire. However, as per the measure's manual, BFIS items were designed as stand-alone items representing a domain of everyday functions, and thus each of the 15 domains can be scored individually to obtain individual domain ratings, mean impairment scores, and 'percent impaired' scores (Barkley, 2011). Therefore, all analyses were conducted with 14-items/ domains from the BFIS-LF.

However, the BFIS Quick Screen is a 6-item self-report measure that can be used to
rapidly assess impairment in six life activity domains: self-care, home-chores, home-
family, social-friends, education, and work. Thus, this was used as a functional screener
in the present study. In the general population the BFIS Quick Screen demonstrated
excellent internal consistency ($\alpha$ = 0.91; Barkley, 2011). In the present study, the BFIS
Quick Screen demonstrated acceptable internal consistency ($\alpha$ = .73).

**Subjective VAS Functional and Emotional Items.** The subjective and functional
items were two visual analogue scales that assessed the degree to which perfectionism
has impacted emotional burden and functioning in school, work, or relationships. The
two visual analogue scales ranged from 0 (*I do not feel that perfectionism has caused
any burden or distress in the past week* or *I do not feel that perfectionism has had any
negative impact on my level of functioning in the past week*) to 100 (*Perfectionism has
caused a very extreme degree of burden and distress in the past week* or *Perfectionism
has had an extreme degree of negative impact on my level of functioning in the past
week*). The two items included were, "To what degree has perfectionism caused an
emotional burden or distress in the past week?" and "To what degree has perfectionism
negatively impacted your level of functioning in school, work, or in terms of your
relationship with other people in the past week?"

**Statistical Analysis**

Statistical analyses were conducted using IBM SPSS version 25 (2017). Pearson's
Chi-squared tests were used to analyze nominal variables, and analysis of variance
(ANOVA) were performed to analyze between-group differences on continuous
demographic variables and outcome measures at baseline (CSS, FMPS, DASS-21, CPQ,

OCI-12 SISE, BFIS, and emotional and functional items). To investigate the impact of the GGtude app on all outcome measures, a series of repeated mixed two-way ANOVAs with Time as the within-subject factor (T1, T2, T3), and Group as the between-subject factor (App, Control), were conducted to analyze the differences between groups and outcome measures. Cohen's $d$, where $d$ equals 0.2, 0.5, and 0.8 indicates small, medium and large effect sizes, respectively (Cohen, 2013).

Correlation analysis was performed to assess the relationship of outcome variables. Before testing the efficacy of GGtude app, an intention to treat analysis was applied. When considering all variables in the study across the two samples there was 12% missing data. All missing data in this state were due to participant dropouts. However, results of Little's missing completely at random test ($X^2 = 77.528$, DF = 72, Sig. = .307); Little & Rubin, 2020 ), suggests that the missing data in the present study is missing completely at random. Thus, multiple imputations procedure is not required (Little & Rubin, 2020). However, to avoid the limitations of simple single imputations such as last observation carried forward, we opted to use the regression imputation method, and particularly stochastic regression. Stochastic regression adds additional error variance to the predicted values, and thus avoids the known problem of underestimation of variance typical of conventional single imputation methods such as unconditional mean imputation and simple regression imputation (Little & Rubin, 2020).

# VI. RESULTS

## Demographic Characteristics of Control and App Groups

Table 1 presents demographic information for the entire study sample, and separately for the Control and App groups. Group comparisons indicated that there was no significant difference in age ($F[1, 69] = 0.37$, $p = .54$), ethnicity ($X^2[3] = 1.48$, $p = .68$), or race ($X^2[4] = 3.42$, $p = .49$). In addition, no group differences were found on sex ($X^2[1] = 0.00$, $p = 1.00$), gender ($X^2[2] = 2.30$, $p = .32$), relationship status ($X^2[1] = .00$, $p = 1.00$), and grade level ($X^2[2] = 0.25$, $p = .88$). Lastly, no significant difference was found for GPA between the groups ($F[1, 69] = 0.03$, $p = .86$).

**Table 1.** Demographic characteristics of the Control and App groups

| | Control | App | | | Entire Sample (n=70) |
|---|---|---|---|---|---|
| | Mean/% (n) [SD] | Mean/% (n) [SD] | $F/X^2$ | $p$ | Mean/% [SD] |
| Age (years) | 18.85 [1.03] | 18.71 [0.92] | .37 | .54 | 18.78 [0.97] |
| Ethnicity | | | 1.45 | 0.68 | |
|   Hispanic | 42.90% (15) | 40.00% (14) | | | 51.40% |
|   Non-Hispanic | 51.40% (18) | 45.70% (16) | | | 48.60% |
|   Multiple ethnicities | 2.90% (1) | 8.60% (3) | | | 5.70% |
|   Other | 2.90% (1) | 5.70% (2) | | | 4.30% |
| Race | | | 3.42 | .49 | |
|   White | 42.90% (15) | 57.10% (20) | | | 50.00% |
|   Black | 34.30% (12) | 31.40% (11) | | | 8.60% |
|   Hispanic or Latino | 14.30% (5) | 2.90% (1) | | | 32.90% |
|   Asian | 5.70% (2) | 5.72% (2) | | | 5.70% |
|   Hawaiian/Pacific Islander | 2.90% (1) | 2.90% (1) | | | 2.90% |
| Sex | | | 0.00 | 1.00 | |
|   % Females | 85.70% (30) | 85.70% (30) | | | 85.70% |
| Gender | | | 2.30 | .32 | |
|   Female | 80% (28) | 68.60% (24) | | | 74.30% |
|   Male | 14.30% (5) | 14.30% (5) | | | 14.30% |

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| | Control | App | F | p | Total |
|---|---|---|---|---|---|
| Other | 5.70% (2) | 17.10% (6) | | | 11.40% |
| Relationship status | | | 0.00 | 1.00 | |
|   Single | 60.00% (21) | 60.00% (21) | | | 60.00% |
|   Dating/Serious relationship | 40.00% (14) | 40.00% (14) | | | 40.00% |
| Grade level | | | 0.25 | .88 | |
|   Freshman | 62.90% (22) | 57.1% (20) | | | 60.00% |
|   Sophomore | 34.30% (12) | 40.00% (14) | | | 37.10% |
|   Junior | 2.90% (1) | 2.90% (1) | | | 2.90% |
| GPA | 3.24 [0.62] | 3.21 [0.62] | 0.03 | .86 | 3.22 [0.62] |

**Clinical and functional measures at baseline**

One-way ANOVAs were conducted to compare the Control and App groups on clinical and functional measures at baseline (see Table 2). No significant differences were found between the groups on all clinical or functional variables. In terms of the primary outcome measure the mean FMPS for the entire study sample ($M = 133.81$, $SD = 15.37$) corresponds to elevated or 'clinical perfectionism'. For example, in a clinical population with anxiety disorders, the FMPS-Total scores ranging from 70 to 87.7 were considered a cutoff range for clinical perfectionism scores (Egan & Hine, 2008). In another study, participants with a history of Anorexia Nervosa presented with clinically high FMPS-Total scores ranging from 97.38 to 102.29 (Halmi et al., 2000), indeed higher than the scores found in the present study. Similarly, the DASS-21 subscale severity ratings suggested that at baseline the App group total scores on the DASS-Depression were on the upper range of moderate depression symptom severity, whereas the Control group presented with total scores on the lower range of severe depression symptom severity. For the DASS-Anxiety scale, both groups' total scores indicated severe level of anxiety symptom. In terms of severity of stress, the two groups presented with moderate stress symptom severity at baseline on the DASS-Stress scale (see Fig. 2). In terms of

obsessive-compulsive symptoms, severity benchmarks for the OCI-12 indicate that the total scores at baseline are on the upper range of moderate OC symptom severity (Abramovitch et al., 2021). Similarly, all BFIS domain scores did not significantly differ between the Control and App groups (see Table 3). However, according to the BFIS norms and benchmarks (Barkley, 2011), both groups demonstrated some degree of clinically meaningful impairment in everyday function. Indeed, percentile ranks ranged between 82 (expected levels) to 98 (moderately impaired levels) indicating an overall borderline level of impairment (Barkley, 2011).

**Table 2.** Clinical variables at baseline (T1) for the combined study sample

| | Control | | App | | | |
|---|---|---|---|---|---|---|
| | **Mean** | *SD* | **Mean** | *SD* | *F*(1,69) | *p* |
| **Perfectionism Indices** | | | | | | |
| FMPS-Total | 133.65 | 15.03 | 133.97 | 15.93 | 0.01 | 0.93 |
| FMPS-CM | 50.74 | 6.65 | 51.71 | 7.01 | 0.35 | 0.55 |
| FPMS-EC | 32.00 | 6.27 | 32.49 | 8.13 | 0.08 | 0.78 |
| FMPS-HS | 28.09 | 4.80 | 28.23 | 4.08 | 0.02 | 0.89 |
| FMPS-O | 22.83 | 4.28 | 21.54 | 5.45 | 1.20 | 0.28 |
| **Functional Indices** | | | | | | |
| BFIS Mean | 5.28 | 1.80 | 5.54 | 1.59 | 0.40 | 0.53 |
| VAS Functioning | 52.49 | 27.23 | 48.78 | 23.60 | 0.37 | 0.54 |
| **Symptomatic/clinical Indices** | | | | | | |
| OCI-12 | | | | | | |
| Total Score | 19.00 | 7.17 | 20.45 | 8.31 | 0.61 | 0.44 |
| Checking | 3.86 | 2.07 | 4.98 | 2.93 | 3.41 | 0.07 |
| Ordering | 5.66 | 2.60 | 5.30 | 3.33 | 0.25 | 0.62 |
| Washing | 3.17 | 2.64 | 2.97 | 3.13 | 0.08 | 0.77 |
| Obsessing | 6.31 | 3.07 | 6.95 | 3.26 | 0.71 | 0.40 |
| DASS-21 | | | | | | |
| DASS-D | 10.77 | 5.84 | 9.02 | 4.85 | 1.96 | 0.17 |
| DASS-A | 9.77 | 5.30 | 8.55 | 4.45 | 1.08 | 0.30 |

| | | | | | | |
|---|---|---|---|---|---|---|
| DASS-S | 11.34 | 4.62 | 11.29 | 3.78 | 0.00 | 0.96 |
| VAS Emotional burden | 58.26 | 28.21 | 57.46 | 22.97 | 0.02 | 0.90 |
| CSS | 33.60 | 15.88 | 40.34 | 22.53 | 2.10 | 0.15 |
| SISE | 2.43 | 1.22 | 2.45 | 1.14 | 0.00 | 0.95 |

*Note.* FMPS Total: Frost Multidimensional Perfectionism Total Scale; FMPS-CM: FMPS, Concern over Mistakes Subscale; FMPS-EC: FMPS, Excessive Concern Subscale; FMPS-HS: FMPS, High Standards Subscale; FMPS- O: FMPS, Order and Organization Subscale; BFIS: Barkley Functional Impairment Scale; VAS Perfectionism- related functional impairment item (VAS-PFI): (To what degree has perfectionism negatively impacted your level of functioning in school, work, or in terms of your relationship with other people in the past week?); OCI-12 Total: The Obsessive-Compulsive Inventory-12 Item Scale; DASS-21 D: The Depression, Anxiety, Stress Scale-21, Depression Subscale; DASS-21 A: Anxiety Subscale; DASS-21 S: Stress Subscale; VAS Perfectionism-related emotional burden (VAS-PEB): (To what degree has perfectionism caused an emotional burden or distress in the past week?); CSS: Covid Stress Scale; SISES: Single Item Self-esteem Scale.



*Note.* Degree of symptom severity categories as defined by the scores on the DASS-21 multiplied by 2. Error bars represent standard error.

**Figure 2.** Comparison of DASS-21 symptom severity at baseline for the Control and App groups

**Table 3.** BFIS domains at baseline (T1)

| Item | Control | | | App | | | F(1,69) | p |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Percentile | Mean | SD | Percentile | | |
| 1. Home-family | 5.40 | 3.07 | 92.00 | 5.35 | 2.25 | 92.00 | 0.01 | 0.94 |
| 2. Home-chores | 5.29 | 2.70 | 91.00 | 5.91 | 2.18 | 95.00 | 1.12 | 0.29 |
| 3. Work | 6.14 | 3.34 | 95.00 | 6.27 | 3.56 | 96.00 | 0.02 | 0.88 |
| 4. Social strangers | 5.77 | 2.89 | 94.00 | 6.00 | 2.89 | 95.00 | 0.11 | 0.75 |
| 5. Social friends | 5.40 | 2.97 | 92.00 | 5.30 | 2.39 | 92.00 | 0.02 | 0.88 |
| 6.Community activities | 5.97 | 3.24 | 95.00 | 6.69 | 3.42 | 96.00 | 0.81 | 0.37 |
| 7. Education | 6.31 | 2.74 | 96.00 | 6.01 | 2.60 | 95.00 | 0.22 | 0.64 |
| 8. Marriage/dating | 6.24 | 3.95 | 96.00 | 6.92 | 3.93 | 98.00 | 0.52 | 0.48 |
| 9.       Money management | 5.93 | 2.60 | 95.00 | 6.44 | 2.88 | 96.00 | 0.61 | 0.44 |
| 10. Driving | 4.11 | 3.54 | 82.00 | 5.18 | 4.12 | 91.00 | 1.36 | 0.25 |
| 11.       Sexual relations | 5.55 | 3.89 | 93.00 | 6.08 | 4.37 | 95.00 | 0.28 | 0.60 |
| 12.Daily responsibilities | 6.16 | 2.57 | 95.00 | 6.01 | 2.32 | 95.00 | 0.07 | 0.79 |
| 13.       Self-care routines | 5.05 | 2.93 | 89.00 | 5.75 | 2.63 | 94.00 | 1.11 | 0.30 |
| 14.       Health maintenance | 6.65 | 2.16 | 97.00 | 6.60 | 2.18 | 96.00 | 0.01 | 0.91 |
| *BFIS    Quick Screen* | | | | | | | | |
| Mean impairment | 5.59 | 2.10 | | 5.76 | 1.49 | | | |
| Percent Domains Impaired | 92.00% | | | 93.00% | | | | |

**Note.** BFIS: Barkly Functional Impairment Scale

## Primary Outcomes from Baseline (T1) to Post- Treatment (T2)

To examine changes on primary outcomes during the treatment period (T1-T2), a series of within repeated measures ANOVAs were conducted separately for the App (Table 4) and Control (Tables 5) groups. Within the App group significant reduction in symptoms between T1 and T2 were found on the FMPS-Total score ($p$ = .00, $d$ = -0.80), FMPS-CM ($p$ = .00, $d$ = -1.24), and FMPS-HS ($p$ = .00, $d$ = -0.68). No significant differences were found within the App group on the FMPS-EC ($d$ = -.22) and FMPS-O ($d$

= 0.18) subscales, therefore indicating that there were no significant reductions on these primary outcome measures within the App group. Within the Control Group, no significant change between T1 and T2 were found across all primary outcome measures.

To examine changes across time and between treatment groups during the treatment trial (T1-T2), a series of two-way mixed repeated measures ANOVAs were conducted examining main (time, group) and interaction effects of Group X Time. Mauchly's Test of Sphericity showed that the sphericity assumption was not met for all of the comparisons below ($X^2[2] = .00$, $p < .05$). Therefore, Greenhouse-Geisser and Huynh Feldt corrections were applied. In terms of the primary perfectionism outcomes analysis of the FMPS-Total Score revealed significant main effect of time ($F[1, 68] = 8.52$, $p = .00$) and group ($F[1.38, 94.40] = 7.72$, $p = .00$), as well as a significant Group X Time interaction ($F[1.43, 97.16] = 7.10$, $p = .04$), where the App group reported a significant reduction on this outcome post-treatment over and above the Control group, with a medium effect size ($\eta^2 = 0.11$; see Fig. 3a). Similarly, results revealed significant main effects of time ($F[1.57,106.98] = 11.66$, $p = .00$) and group ($F[1, 68] = 14.05$, $p = .00$) on the FMPS Concerns Over Mistakes subscale (FMPS-CM), as well as a significant Group X Time interaction effect ($F[1.57, 106.98] = 14.71$, $p = .00$), where the App group reported significantly reduced scores on FMPS-CM post-treatment over and above the Control group, with a large effect size ($\eta^2 = 0.17$; see Fig. 3b). For the FMPS Excessive Concerns (FMPS-EC), there was a significant main effect of time ($F[1.42, 96.56] = 6.00$, $p = .01$), but no significant main effect of group ($F[1, 68] = 0.47$, $p = .05$). However, a significant Group X Time interaction was found on the FMPS-EC ($F[1.42, 95.67] = 4.30$, $p = .01$), where the App group demonstrated a significant reduction in severity scores for

excessive concerns post-treatment, with a medium effect size ($\eta^2 = 0.06$; see Fig. 3c). In terms of the FMPS High Standards (FMPH-HS) subscale, although results indicated a significant main effect of time ($F[1.57, 107.37] = 5.18$, $p = .01$), there were no significant group ($F[1, 68] = 3.14$, $p = .08$), or interaction ($F[1.57, 107.37] = 2.35$, $p = .11$, $\eta^2 = 0.03$) effects (see Fig. 3d). Further, there were no significant main effects for time ($F[1.29, 88.28] = 1.31$, $p = .26$), group ($F[1, 68] = 2.13$, $p = .15$), or Group X Time ($F[1.29, 88.28] = 0.30$, $p = .64$, $\eta^2 = 0.00$) on the FMPS Ordering (FMPS-O) subscale post-treatment (see Fig. 3e).

**Primary Outcomes at 1-Month Follow-up**

Further analyses were conducted to determine whether significant pre-post changes were maintained at 1-month follow-up (T3). Within the App group, a significant reduction in symptoms between T2 and T3 were found on the FMPS-EC ($p = .00$, $d = -0.33$), where the App group exhibited significantly lower scores at follow-up compared to post treatment, with a small effect size (Table 4 and Fig 3c). No significant changes between T2 and T3 were observed for the FMPS-Total score ($p = 1.00$, $d = -0.04$), FMPS-CM ($p = .60$, $d = 0.16$), FMPS-HS ($p = 1.00$, $d = 0.08$), or FMPS-O ($p = 1.00$, $d = -0.07$) at 1-month follow-up.

Further, a series of two-way mixed repeated measures ANOVAs were conducted examining main (time, group) and interaction effects of Group X Time between T2 and T3. The FMPS-Total Score revealed that there was a significant effect of group ($F[1, 68] = 12.92$, $p = .00$), but no significant main effects for time ($F[1, 68] = 0.69$, $p = .80$), or Group X Time interaction ($F[1, 68] = 0.71$, $p = .40$, $\eta^2 = 0.01$), indicating that treatment effects were maintained at follow-up. On the FMPS-CM here was no significant main

effect of time ($F$[1, 68] = 1.40, $p$ = .24) or Group X Time interaction ($F$[1, 68] = 0.74, $p$ =

.40, $\eta^2$ = 0.01), indicating that treatment effects were maintained at follow-up, but there

was a significant effect of group ($F$[1, 68] = 22.36, $p$ = .00). However, on the FMPS-EC

there was a non-significant main effect of group ($F$[1, 68] = 1.18, $p$ = .28) and significant

main effect of time ($F$[1, 68] = 4.37, $p$ = .04) and Group X Time interaction ($F$[1, 68] =

13.71, $p$ = .00), where the App group reported a significant reduction on this outcome at

1-month follow-up and demonstrated that treatment effects continued to improve over the

Control group, with a large effect size ($\eta^2$ = 0.17; see Fig. 3c). In terms of the FMPS

High Standards (FMPH-HS) subscale, there was a significant group effect ($F$[1, 68] =

5.27, $p$ = .03), but no significant main effect of time ($F$[1, 68] = 0.13, $p$ = .72) or

interaction effect ($F$[1, 68] = 0.03, $p$ = .60, $d$ = 0.68, $\eta^2$ = 0.00) effect. Further, there were

no significant main effects for time ($F$[1, 68] = 0.07, $p$ = .80), group ($F$[1, 68] = 1.72, $p$ =

.20), or Group X Time ($F$[1,68] = 2.07, $p$ = .15, $d$ = -0.07, $\eta^2$ = 0.03) on the FMPS

Ordering (FMPS-O) subscale at 1-month follow-up, thus indicating that treatment effects

were maintained at follow-up (see Fig. 3e).

**Secondary Clinical Outcomes from Baseline (T1) to Post-treatment (T2)**

To examine changes on secondary outcomes during the treatment period (T1-T2),

a series of within-group repeated measures ANOVAs were conducted separately for the

App (Table 4) and Control (Tables 5) groups. Within the App group significant reduction

in symptoms between T1 and T2 were found on the VAS Perfectionism-related emotional

burden (VAS-PEB; $p$ = .00, $d$ = -0.82), DASS-Stress ($p$ = .02, $d$ = -0.52), and on the CSS

($p$ = .00, $d$ = -0.96). No significant differences were found within the App group on the

OCI-12 Total Score ($d$ = -0.42), OCI-12 Checking ($d$ = -0.51), OCI-12 Ordering ($d$ = -

0.20), OCI-12 Washing ($d = 0.00$), OCI-12 Obsessing ($d = -0.43$), DASS-Anxiety ($d = -0.40$), DASS-Depression ($d = -0.21$), or SISES ($d = 0.10$), indicating that there were no significant reductions on these secondary outcome measures within the App group. Within the Control Group, no significant change between T1 and T2 were found across all outcome measures.

To examine changes across time and between treatment groups during the treatment trial (T1-T2) on secondary clinical outcome measures, a series of two-way mixed repeated measures ANOVAs were conducted examining main and interaction effects (group X time). Mauchly's Test of Sphericity demonstrated that the sphericity assumption was not met for all of the comparisons below ($X^2[2] = .00$, $p < .05$). Hence, Greenhouse-Geisser and Huynh Feldt corrections were used to analyze secondary outcome measures. First a series of two-way mixed repeated measures ANOVAs were conducted to examine changes in emotional affect. To assess changes in subjective reporting on the emotional burden stemming directly from perfectionism, a series of two-way mixed repeated measures ANOVAs were conducted on the VAS-PEB, there were significant main effects of time ($F[1.80, 122.89] = 7.24$, $p = .01$) and group ($F[1, 68] = 5.06$, $p = .03$), but no significant Group X Time interaction effect was found ($F[1.80, 122.89] = 1.87$, $p = .16$, $\eta^2 = 0.10$), see Fig 3i. Similarly, the DASS-Anxiety measure indicated a significant main effect of time ($F[1.78, 121.28] = 5.28$, $p = .01$) and group ($F[1, 68] = 4.55$, $p = .04$), but no significant Group X Time interaction was found ($F[1.78, 121.28] = 0.87$, $p = .41$, $\eta^2 = 0.07$), see Fig. 3g. A significant main effect of group was found for the DASS-Depression subscale ($F[1, 68] = 4.44$, $p = .04$) but no significant main effect of time ($F[1.90, 129.73] = 1.00$, $p = .36$) and Group X Time

interaction ($F[1.90, 129.73] = 0.21$, $p = .80$, $\eta^2 = 0.05$), were found see Fig. 3f. There was a significant main effect of time ($F[2, 136] = 3.53$, $p = .03$) but no significant main effect of group ($F[1, 68] = 1.67$, $p = .20$) and Group X Time interaction ($F[2, 136] = 1.38$, $p = .25$, $\eta^2 = 0.04$) were found on the DASS-Stress subscale; see Fig. 3h.

In terms of the OCI-12 Total score no significant main group effect was found ($F[1, 68] = 1.47$, $p = .23$), but there was a significant main effect of time ($F[1.72, 112.81] = 6.25$, $p = .00$), and Group X Time interaction ($F[1.72, 112.81] = 4.95$, $p = .01$) where the App group exhibited a greater reduction on this outcome measure with medium effect size ($\eta^2 = 0.07$)see Fig. 3j. Similarly, there was no significant main effect of group ($F[1, 68] = 0.12$, $p = .72$) on checking scores from the OCI-12 Checking subscale, but a significant main effect of time ($F[1.93, 131.54] = 6.74$, $p = .00$) and Group X Time interaction effect were found ($F[1.93, 131.54] = 7.03$, $p = .00$; $\eta^2 = 0.09$), see Fig. 3k. These results indicated that the App group demonstrated a significantly greater reduction on this measure with a medium effect size ($\eta^2 = 0.09$). There were no significant main effects of time, group, or Group X Time interactions found for the OCI-12 Ordering subscale ($F[1.88, 125.40] = 3.32$, $p = .05$; $F[1, 68] = 3.62$, $p = .06$; $F[1.88, 125.40] = 1.20$, $p = .30$, $\eta^2 = 0.0$, respectively; see Fig. 3l), OCI-12 Washing subscale ($F[1.97, 134.48] = 2.20$, $p = .11$; $F[1, 68] = 1.28$, $p = .26$; $F[1.97, 134.48] = 1.08$, $p = .34$, $\eta^2 = 0.02$, respectively; see Fig. 3m) or for the Obsessing subscale ($F[1.97, 134.48] = 2.20$, $p = .11$; $F[1, 68] = 1.28$, $p = .26$; $F[1.97, 134.48] = 1.08$, $p = .34$, $\eta^2 = 0.04$, respectively; see Fig. 3n).

Further, in evaluating change over time in stress related to COVID-19, a significant main effect of time was observed ($F[1.42, 98.07] = 31.91$, $p = .00$) with a non-

significant main effect on group ($F$[1, 68] = 0.11, $p$ = .74,). However, there was a significant Group X Time interaction (CSS: $F$[1.48, 101.10] = 5.40, $p$ = .01), where the App group reported a significantly greater reduction in COVID-19 stress symptoms, associated with a medium effect size ($\eta^2$ = 0.07), see Fig. 3p. Finally, there were no significant main effects of time ($F$[1.42, 98.07] = 31.91, $p$ = .00) and group ($F$[1.71, 116.92] = 0.11, $p$ = .86) or Group X Time interaction ($F$[1.71, 116.92] = 0.62, $p$ = .51, $\eta^2$ = 0.02) on the SISES; see Fig 3o.

**Secondary Outcomes at 1-month Follow-up**

At 1-month follow-up there were no significant reductions found on the OCI-12 Total ($d$ = -0.31), OCI-12 Checking ($d$ = -0.40), OCI-12 Ordering ($d$ = -0.30), OCI-12 Washing ($d$ = -0.34), or OCI-12 Obsessing ($d$ = -0.05), subscales, Table 4. There were no significant follow-up scores on the VAS Emotional item ($d$ = -0.03) or for the DASS-Anxiety ($d$ = -0.13), Depression ($d$ = 0.07), and Stress ($d$ = -0.07) scales. A significant reduction was found on the CSS ($p$ = .01, $d$ = -.40), where the App group exhibited significantly lower scores at follow-up compared to post treatment, with a small effect size (Table 4 and Fig. 3p). Lastly, there was a non-significant 1-month follow-up reduction on SISE scores ($d$= 0.03).

Further, a series of two-way mixed repeated measures ANOVAs were conducted examining main (time, group) and interaction effects of Group X Time on secondary outcome measures. There was a significant main effect of group ($F$[1, 68] = 7.31, $p$ = .01), and no significant main effect of time ($F$[1, 68] = 0.06, $p$ = .81) or Group X Time interaction effect ($F$[1, 68] = 0.22, $p$ = .64, $\eta^2$ = 0.07), indicating that the treatment effects were maintained at follow-up on the VAS-PEB, see Fig 3i. Similarly, the DASS-Anxiety

measure had a significant main effect of group ($F[1, 68] = 5.46$, $p = .02$), but no

significant main effect of time ($F[1, 68] = 0.30$,  $p = .60$) or Group X Time interaction

($F[1, 68] = 0.63$, $p = .43$, $\eta^2 = 0.01$), see Fig. 3g. The DASS-Depression measure had a

significant main effect of group ($F[1, 68] = 3.94$, $p = .00$), but no a significant main effect

of time ($F[1, 68] = 1.50$, $p = .22$) or Group X Time interaction ($F[1.90, 129.73] = 0.30$, $p$

$= .60$, $\eta^2 = 0.00$), indicating that the treatment effects were maintained at follow-up, see

Fig. 3f. There was no significant main effect of time ($F[1,68] = 1.56$, $p = .21$), group

($F[1, 68] = 2.79$, $p = .09$), or Group X Time interaction ($F[1,68] = 0.33$, $p = .56$, $\eta^2 =$

$0.02$) on the DASS-Stress subscale; see Fig. 3h.

In terms of the OCI-12 Total score there was a significant main effect of group

($F[1, 68] = 3.91$, $p = .05$) and time ($F[1, 68] = 6.83$, $p = .01$), but no significant Group X

Time interaction ($F[1, 68] = 1.53$, $p = .22$, $\eta^2 = 0.02$), indicating that the treatment effects

were maintained at follow-up, see Fig. 3j. There was a no significant main effect of group

($F[1, 68] = 3.112$, $p = .08$), but significant main effect of time ($F[1, 68] = 3.96$,  $p = .05$)

and Group X Time interaction effect were found ($F[1, 68] = 2.20$, $p = .14$, $\eta^2 = 0.03$) on

OCI-12 Checking subscale, indicating that scores on this measure continued to improve,

see Fig. 3k. OCI-12 Ordering subscale had a significant main effect of group ($F[1, 68] =$

$5.00$, $p = .03$) and time ($F[1, 68] = 5.38$, $p = .02$), but no significant Group X Time

interaction ($F[1, 68] = 0.06$, $p = .80$, $\eta^2 = 0.00$), see Fig. 3l. On the OCI-12 Washing

subscale there was a significant main effect of time ($F[1, 68] = 5.26$, $p = .02$), and no

significant group ($F[1, 68] = 2.12$, $p = .15$) or interaction effects ($F[1, 68] = 1.35$, $p = .25$,

$\eta^2 = 0.02$), see Fig. 3m. Lastly, there were no significant time ($F[1, 68] = 0.00$, $p = .98$),

group ($F[1, 68] = 1.68$, $p = .20$), and interaction ($F[1, 68] = 0.56$, $p = .46$, $\eta^2 = 0.00$) on the OCI-12 Obsessing subscale, see Fig. 3n.

Further, in evaluating the effect of COVID-19 on perfectionism and stress, there was a significant main effect of time ($F[1, 68] = 9.76$, $p = .00$) and group ($F[1, 68] = 2.80$, $p = .01$). However, there was not a significant Group X Time interaction (CSS: $F[1, 68] = 0.42$, $p = .52$, $\eta^2 = 0.01$), indicating that treatment effects were maintained at follow-up, see Fig. 3p. Finally, there were no significant main effects of time ($F[1, 68] = 0.40$, $p = .53$), group ($F[1, 68] = 1.04$, $p = .31$) or Group X Time interaction ($F[1, 68] = 0.93$, $p = .33$, $\eta^2 = 0.01$) on the SISES; see Fig 3o.

**Table 4.** Means, standard deviations, and within group effects of outcome variables overtime for the App group

| | T1 | T2 | T3 | *F* | *p* | Post-hoc |
|---|---|---|---|---|---|---|
| | *M(SD)* | *M(SD)* | *M(SD)* | | | |
| **FMPS Total** | 133.97 (15.93) | 120.64 (17.34) | 119.94 (16.53) | $F(1.56,53.15) = 17.81$ | .00 | T1 vs T2, $p = .00$, $d = -.80$<br>T2 vs T3, $p = 1.00$, $d = -.04$<br>T1 vs T3, $p = .00$, $d = -.86$ |
| **FMPS-CM** | 51.71 (7.00) | 42.23 (8.13) | 43.64 (8.77) | $F(2,68) = 26.57$ | .00 | T1 vs T2, $p = .00$, $d = -1.24$<br>T2 vs T3, $p = .60$, $d = .16$<br>T1 vs T3, $p = .00$, $d = -1.01$ |
| **FPMS-EC** | 32.48 (8.12) | 30.64 (8.23) | 28.05 (7.38) | $F(1.51,51.41) = 12.08$ | .00 | T1 vs T2, $p = .14$, $d = -.22$<br>T2 vs T3, $p = .00$, $d = -.33$<br>T1 vs T3, $p = .00$, $d = -.57$ |
| **FMPS-HS** | 28.22 (4.08) | 25.33 (4.39) | 25.68 (3.60) | $F(2,68) = 9.98$ | .00 | T1 vs T2, $p = .00$, $d = -.68$<br>T2 vs T3, $p = 1.00$, $d = .08$<br>T1 vs T3, $p = .00$, $d = -.66$ |
| **FMPS-O** | 21.54 (5.45) | 22.46 (4.27) | 22.14 (4.28) | $F(1.37,45.13) = 1.01$ | .34 | T1 vs T2, $p = .75$, $d = .18$<br>T2 vs T3, $p = 1.00$, $d = -.07$<br>T1 vs T3, $p = 1.00$, $d = .12$ |
| **BFIS** | 5.41 (1.69) | 4.61 (1.61) | 4.76 (1.86) | $F(1,58) = 8.92$ | .00 | T1 vs T2, $p = .00$, $d = -.48$<br>T2 vs T3, $p = .93$, $d = .08$<br>T1 vs T3, $p = .02$, $d = -.36$ |
| **BFIS-QS** | 5.68 (1.81) | 5.08 (2.00) | 4.93 (1.71) | $F(1,58) = 5.27$ | .02 | T1 vs T2, $p = .00$, $d = -.31$<br>T2 vs T3, $p = .93$, $d = -.08$<br>T1 vs T3, $p = .02$, $d = -.42$ |
| **VAS-PFI** | 48.78 (23.60) | 37.22 (22.84) | 36.91 (22.74) | $F(2,68) = 4.34$ | .02 | T1 vs T2, $p = .03$, $d = -.49$<br>T2 vs T3, $p = 1.00$, $d = -.01$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **OCI-12 Total** | 20.44 (8.30) | 16.76 (9.05) | 14.03 (8.25) | $F(2,68) = 8.76$ | .00 | T1 vs T2, *p* = .11, *d* = -.42<br>T2 vs T3, *p* = .07, *d* = -.31<br>T1 vs T3, *p* = .00, *d* = -.77 |
| **OCI-12 Checking** | 4.97 (2.93) | 3.61 (2.37) | 2.69 (2.23) | $F(2,68) = 9.57$ | .00 | T1 vs T2, *p* = .07, *d* = -.51<br>T2 vs T3, *p* = .11, *d* = -.40<br>T1 vs T3, *p* = .00, *d* = -.87 |
| **Oci-12 Order** | 5.30 (3.33) | 4.63 (3.10) | 3.82 (2.21) | $F(2,68) = 3.32$ | .04 | T1 vs T2, *p* = .77, *d* = -.20<br>T2 vs T3, *p* = .26, *d* = -.30<br>T1 vs T3, *p* = .10, *d* = -.52 |
| **OCI-12 Wash** | 2.97 (3.12) | 3.00 (3.08) | 2.04 (2.36) | $F(2,68) = 2.92$ | .06 | T1 vs T2, *p* = 1.00, *d* = .00<br>T2 vs T3, *p* = .09, *d* = -.34<br>T1 vs T3, *p* = .13, *d* = -.33 |
| **OCI-12 Obsessing** | 6.94 (3.25) | 5.47 (3.56) | 5.27 (3.72) | $F(1.60,54.66) = 5.17$ | .01 | T1 vs T2, *p* = .11, *d* = -.43<br>T2 vs T3, *p* = 1.00, *d* = -.05<br>T1 vs T3, *p* = .02, *d* = -.48 |
| **VAS-PEB** | 57.46 (22.96) | 39.69 (20.02) | 39.03 (19.92) | $F(2,68) = 9.02$ | .00 | T1 vs T2, *p* = .00, *d* = -.82<br>T2 vs T3, *p* = 1.00, *d* = -.03<br>T1 vs T3, *p* = .01, *d* = -.85 |
| **DASS-Anxiety** | 8.55 (4.45) | 6.75 (4.50) | 6.17 (4.24) | $F(2,68) = 6.34$ | .00 | T1 vs T2, *p* = .11, *d* = -.40<br>T2 vs T3, *p* = .89, *d* = -.13<br>T1 vs T3, *p* = .00, *d* = -.54 |
| **DASS-Depression** | 9.02 (4.53) | 7.96 (4.98) | 8.38 (5.68) | $F(2,68) = 39.88$ | .82 | T1 vs T2, *p* = .59, *d* = -.21<br>T2 vs T3, *p* =1.00, *d* = .07<br>T1 vs T3, *p* = 1.00, *d* = -.12 |
| **DASS-Stress** | 11.29 (3.78) | 9.18 (4.25) | 9.52 (4.96) | $F(2,68) = 4.47$ | .01 | T1 vs T2, *p* =. 02, *d* = -.52<br>T2 vs T3, *p* = 1.00, *d* = .07<br>T1 vs T3, *p* = .10, *d* = -.40 |

| | T1 | T2 | T3 | F | p | Post-hoc |
|---|---|---|---|---|---|---|
| **CSS** | 40.34 (22.52) | 23.20 (11.21) | 18.44 (12.12) | $F(1.27,43.36) = 31.81$ | .00 | T1 vs T2, $p = .00$, $d = -.96$<br>T2 vs T3, $p = .01$, $d = -.40$<br>T1 vs T3, $p = .00$, $d = -1.21$ |
| **SISES** | 2.45 (1.14) | 2.57 (1.25) | 2.61 (1.27) | $F(2,68) = .27$ | .76 | T1 vs T2, $p = 1.00$, $d = .10$<br>T2 vs T3, $p = 1.00$, $d = .03$<br>T1 vs T3, $p = 1.00$, $d = .13$ |

**Note.** FMPS Total: Frost Multidimensional Perfectionism Total Scale; FMPS-CM: FMPS, Concern over Mistakes Subscale; FMPS-EC: FMPS, Excessive Concern Subscale; FMPS-HS: FMPS, High Standards Subscale; FMPS- O: FMPS, Order and Organization Subscale; BFIS: Barkley Functional Impairment Scale; VAS Perfectionism- related functional impairment item (VAS-PFI): (To what degree has perfectionism negatively impacted your level of functioning in school, work, or in terms of your relationship with other people in the past week?); OCI-12 Total: The Obsessive-Compulsive Inventory-12 Item Scale; DASS-21 D: The Depression, Anxiety, Stress Scale-21, Depression Subscale; DASS-21 A: Anxiety Subscale; DASS-21 S: Stress Subscale; VAS Perfectionism-related emotional burden (VAS-PEB): (To what degree has perfectionism caused an emotional burden or distress in the past week?); CSS: Covid Stress Scale; SISES: Single Item Self-esteem Scale.

**Table 5**. Means, standard deviations, and within group effects of outcome variables overtime for the Control group

| | T1 | T2 | T3 | F | p | Post-hoc |
|---|---|---|---|---|---|---|
| | *M(SD)* | *M(SD)* | *M(SD)* | | | |
| **FMPS Total** | 133.65 (15.03) | 132.64 (14.75) | 133.98 (15.12) | $F(1.28,43.54) = 0.09$ | .82 | T1 vs T2, $p = 1.00$, $d = -.06$<br>T2 vs T3, $p = 1.00$, $d = .09$<br>T1 vs T3, $p = 1.00$, $d = .02$ |
| **FMPS-CM** | 50.74 (6.65) | 51.17 (7.18) | 51.39 (7.51) | $F(1.40,47.87) = 0.11$ | .82 | T1 vs T2, $p = 1.00$, $d = .06$<br>T2 vs T3, $p = 1.00$, $d = .02$<br>T1 vs T3, $p = 1.00$, $d = .09$ |
| **FPMS-EC** | 32.00 (6.27) | 30.77 (6.10) | 31.49 (6.59) | $F(1.35,46.21) = 0.60$ | .48 | T1 vs T2, $p = 1.00$, $d = -.19$<br>T2 vs T3, $p = .78$, $d = .11$<br>T1 vs T3, $p = 1.00$, $d = -.07$ |
| **FMPS-HS** | 28.08 (4.80) | 27.57 (4.08) | 27.51 (4.09) | $F(1.28,43.55) = 0.22$ | .69 | T1 vs T2, $p = 1.00$, $d = -.11$<br>T2 vs T3, $p = 1.00$, $d = -.01$<br>T1 vs T3, $p = 1.00$, $d = -.12$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **FMPS-O** | 22.82 (4.28) | 23.28 (4.21) | 23.75 (3.35) | $F(1.27,43.42) = 0.66$ | .45 | T1 vs T2, $p = 1.00$, $d = .10$<br>T2 vs T3, $p = .81$, $d = .12$<br>T1 vs T3, $p = .89$, $d = .24$ |
| **BFIS** | 5.60 (2.10) | 5.50 (1.89) | 5.35 (1.85) | $F(1.62,45.50) = 0.16$ | .81 | T1 vs T2, $p = 1.00$, $d = -.05$<br>T2 vs T3, $p = 1.00$, $d = -.08$<br>T1 vs T3, $p = 1.00$, $d = -.12$ |
| **BFIS QS** | 5.28 (1.79) | 5.11 (1.68) | 5.13 (1.80) | $F(1.59,44.67) = 0.24$ | .74 | T1 vs T2, $p = 1.00$, $d = -.09$<br>T2 vs T3, $p = 1.00$, $d = .01$<br>T1 vs T3, $p = 1.00$, $d = -.08$ |
| **VAS-PFI** | 52.49 (27.23) | 45.54 (27.85) | 50.50 (27.70) | $F(2,68) = 0.74$ | .48 | T1 vs T2, $p = .92$, $d = -.25$<br>T2 vs T3, $p = .75$, $d = .17$<br>T1 vs T3, $p = 1.00$, $d = -.07$ |
| **OCI-12 Total** | 19.00 (7.17) | 19.42 (7.93) | 18.45 (6.75) | $F(2,68) = 0.36$ | .69 | T1 vs T2, $p = 1.00$, $d = .05$<br>T2 vs T3, $p = .73$, $d = -.13$<br>T1 vs T3, $p = 1.00$, $d = -.07$ |
| **OCI-12 Checking** | 3.85 (2.07) | 3.99 (2.07) | 3.86 (1.88) | $F(2,68) = 0.11$ | .89 | T1 vs T2, $p = 1.00$, $d = .06$<br>T2 vs T3, $p = 1.00$, $d = -.06$<br>T1 vs T3, $p = 1.00$, $d = .00$ |
| **Oci-12 Ordering** | 5.65 (2.60) | 5.93 (3.11) | 5.27 (3.01) | $F(2,68) = 0.87$ | .42 | T1 vs T2, $p = 1.00$, $d = .09$<br>T2 vs T3, $p = .41$, $d = -.21$<br>T1 vs T3, $p = 1.00$, $d = -.13$ |
| **OCI-12 Washing** | 3.17 (2.64) | 3.45 (2.30) | 3.14 (2.19) | $F(2,68) = 0.30$ | .73 | T1 vs T2, $p = 1.00$, $d = .11$<br>T2 vs T3, $p = 1.00$, $d = -.10$<br>T1 vs T3, $p = 1.00$, $d = -.01$ |
| **OCI-12 Obsessing** | 6.31 (3.06) | 6.29 (3.37) | 6.48 (3.11) | $F(1.45,49.30) = 0.07$ | .87 | T1 vs T2, $p = 1.00$, $d = -.00$<br>T2 vs T3, $p = 1.00$, $d = .05$<br>T1 vs T3, $p = 1.00$, $d = .05$ |

| | | | | | |
|---|---|---|---|---|---|
| **VAS-PEB** | 58.26 (28.21) | 51.19 (28.17) | 53.25 (24.22) | $F(1.42, 48.34) = 0.90$ | .38 | T1 vs T2, $p = .82$, $d = -.25$<br>T2 vs T3, $p = 1.00$, $d = .07$<br>T1 vs T3, $p = 1.00$, $d = -.19$ |
| **DASS-Anxiety** | 9.77 (5.30) | 8.73 (4.50) | 8.84 (4.88) | $F(1.57, 53.54) = 0.89$ | .39 | T1 vs T2, $p = .56$, $d = -.21$<br>T2 vs T3, $p = 1.00$, $d = .02$<br>T1 vs T3, $p = 1.00$, $d = -.18$ |
| **DASS-Depression** | 10.77 (5.58) | 9.95 (5.62) | 11.01 (11.22) | $F(2, 68) = 0.48$ | .61 | T1 vs T2, $p = 1.00$, $d = -.14$<br>T2 vs T3, $p = .66$, $d = .18$<br>T1 vs T3, $p = 1.00$, $d = .04$ |
| **DASS-Stress** | 11.34 (4.62) | 10.47 (4.45) | 11.40 (4.27) | $F(2, 68) = 0.78$ | .46 | T1 vs T2, $p = .93$, $d = -.19$<br>T2 vs T3, $p = .59$, $d = .21$<br>T1 vs T3, $p = 1.00$, $d = .01$ |
| **CSS** | 33.60 (15.87) | 27.19 (13.73) | 24.07 (15.16) | $F(2, 68) = 5.60$ | .01 | T1 vs T2, $p = .15$, $d = -.43$<br>T2 vs T3, $p = .42$, $d = -.21$<br>T1 vs T3, $p = .01$, $d = -.61$ |
| **SISES** | 2.43 (1.22) | 2.42 (1.35) | 2.20 (1.21) | $F(1.64, 55.78) = 0.44$ | .60 | T1 vs T2, $p = 1.00$, $d = -.00$<br>T2 vs T3, $p = .81$, $d = -.17$<br>T1 vs T3, $p = 1.00$, $d = -.18$ |

*Note.* FMPS Total: Frost Multidimensional Perfectionism Total Scale; FMPS-CM: FMPS, Concern over Mistakes Subscale; FMPS-EC: FMPS, Excessive Concern Subscale; FMPS-HS: FMPS, High Standards Subscale; FMPS- O: FMPS, Order and Organization Subscale; BFIS: Barkley Functional Impairment Scale; VAS Perfectionism- related functional impairment item (VAS-PFI): (To what degree has perfectionism negatively impacted your level of functioning in school, work, or in terms of your relationship with other people in the past week?); OCI-12 Total: The Obsessive-Compulsive Inventory-12 Item Scale; DASS-21 D: The Depression, Anxiety, Stress Scale-21, Depression Subscale; DASS-21 A: Anxiety Subscale; DASS-21 S: Stress Subscale; VAS Perfectionism-related emotional burden (VAS-PEB): (To what degree has perfectionism caused an emotional burden or distress in the past week?); CSS: Covid Stress Scale; SISES: Single Item Self-esteem Scale.

**Functional Outcomes from Baseline (T1) to Post-treatment (T2)**

To examine changes on functional outcomes during the treatment period (T1-T2), a series of within repeated measures ANOVAs were conducted separately for the App (Table 4) and Control (Table 5) groups on the BFIS and VAS Perfectionism- related functional impairment item (VAS-PFI). Within the App group significant reduction in symptoms between T1 and T2 were found on the BFIS Mean of 14 items ($p = .00$, $d = -0.48$) and specifically for the following domain items: Home-family ($p = .00$, $d = .61$), Home-chores ($p = .00$, $d = .80$), Money-management ($p = .01$, $d = 0.51$), Daily responsibilities ($p = .06$, $d = 0.65$), and Health maintenance ($p = .02$, $d = 0.66$), see Table 6. No significant differences were found within the App group on the Work ($d = 0.35$), Social strangers ($d = 0.43$), Social friends ($d = 0.40$), Community activities ($d = 0.03$), Education ($d = 0.14$), Marriage/ dating ($d = 0.28$), Driving ($d = 0.36$), Sexual relations ($d = 0.09$), and Self-care routines ($d = 0.41$). Further significant reductions between T1 and T2 were found on the BFIS-QS ($p = .00$, $d = -0.31$), and on the VAS-PFI ($p = .03$, $d = -0.49$).

A series of two-way mixed repeated measures ANOVAs were conducted examining main and interaction effects (Group X Time) of functional impairment assessed by the BFIS and VAS-PFI. A significant main effect of time ($F[1.63, 91.55] = 5.78$, $p = .01$), but a non-significant main effect of group ($F[1, 56] = 2.30$, $p = .13$) was found for the mean of the 14-items on the BFIS. However, there was a significant Group X Time interaction ($F[1.63, 91.55] = 3.34$, $p = .05$), where the App group reported a significantly improvement in terms of overall functional impairments, with a small effect size ($\eta^2 = 0.04$), see Fig. 3q. No significant Group X Time interactions were observed for

the following BFIS items: Home-family ($F$[2, 112] = 0.90, $p$ = .41), Work ($F$[2, 112] = 1.26, $p$ =.25), Social-strangers ($F$[2, 112] = 1.08, $p$ = .34), Social-friends ($F$[2, 112] = 1.58, $p$ = .21), Education ($F$[2, 112] = 0.21, $p$ =.80), Marriage/dating ($F$[2, 112] = 1.21, $p$ = .30), Money management ($F$[2, 112] = 2.82, $p$ = .06), Driving ($F$[1.81, 101.70] = 0.31, $p$ = .71), Sexual relations ($F$[2, 112] = 0.27, $p$ = .76), or Self-care routines ($F$[2, 112] = 0.99, $p$ = .37). Significant Group X Time interactions were found for Home-chores ($F$[2, 112] = 5.60, $p$ = .00), Community activities ($F$[2, 112] = 4.95, $p$ = .01), Daily responsibilities ($F$[2, 112] = 4.19, $p$ = .02), and Health maintenance ($F$[2, 112] = 1.54, $p$ = .22). On the BFIS-QS, there was a significant main effect of time ($F$[1.68, 94.40] = 4.15, $p$ = .02) and a non-significant main effect of group ($F$[1, 56] = 2.33, $p$ = 13) and Group X Time interaction ($F$[1.68, 94.40] = 1.96, $p$ = .15, $\eta^2$ = 0.08), see Fig. 3r. The VAS-PFI revealed a significant main effect of time ($F$[1.89, 128.64] = 3.34, $p$ = .04), a non-significant group effect ($F$[1, 68] = 3.93, $p$ = .05), and interaction effect $F$[1.68, 94.40] = 0.88, $p$ = .41, $\eta^2$ = 0.00), see Fig. 3s.

**Functional Indices at 1-Month Follow-up**

A series of within-group repeated measures were conducted at follow-up between T2 and T3. At 1-month follow-up there were no further significant reductions found for the mean of the 14-items on the BFIS ($d$ = 0.08). No significant changes were found at follow-up for the following BFIS items: Home-family ($d$ = -0.39), Home-chores ($d$ = -0.03), Work ($d$ = 0.02), Social strangers ($d$ = -0.16), Social friends ($d$ = 0.00), Education ($d$ = 0.00), Marriage/ dating ($d$ = -0.43), Money management ($d$ = -0.16), Driving ($d$ = -0.26), Sexual relations ($d$ = -0.20), Daily responsibilities ($d$ = 0.01), Self-care routines ($d$ = -0.16), or Health maintenance ($d$ = -0.06), see Table 6. A significant reduction was

found however for Community activities ($p = .05$, $d = .38$), where the App group exhibited significantly lower scores, indicating further improvement at follow-up compared to post treatment, with a small effect size (Table 4). Finally, there were no significant reductions at follow-up on the BFIS-QS ($d = -0.08$) and the VAS-PFI item ($d = -0.01$).

Finally at follow-up, a series of two-way mixed repeated measures ANOVAs were conducted examining main and interaction effects (Group X Time) of functional impairment as measured by BFIS and VAS Perfectionism- related functional impairment item. The BFIS mean of 14 items revealed a non-significant main effect of time ($F[1, 56] = 0.33$, $p = .56$), a significant group effect ($F[1, 56] = 4.56$, $p = .04$), and a non-significant interaction effect $F[1, 56] = 0.17$, $p = .68$, $\eta^2 = 0.00$), see Fig. 3q. Specifically, no significant Group X Time interactions were observed for the following BFIS items: Home-family ($F[1, 56] = 2.38$, $p = .13$), Home-chores ($F[1, 56] = 0.00$, $p = .57$), Work ($F[1, 56] = 1.21$, $p = .27$), Social-strangers ($F[1, 56] = 0.50$, $p = .48$), Social-friends ($F[1, 56] = 0.89$, $p = .35$), Education ($F[1, 56] = 0.23$, $p = .63$), Marriage/dating ($F[1, 56] = 0.44$, $p = .51$), Money management ($F[1, 56] = 1.08$, $p = .30$), Driving ($F[1,56] = 0.14$, $p = .70$), Sexual relations ($F[1,56] = 0.28$, $p = .60$), Daily responsibilities ($F[1,56] = 1.35$, $p = .25$), Self-care routines ($F[1, 56] = 0.86$, $p = .35$), or Health maintenance ($F[1, 56] = 0.09$, $p = .76$). A significant Group X Time interaction was found for Community activities ($F[1, 56] = 7.93$, $p = .01$). These results indicated that the App group demonstrated a significantly greater reduction on this measure with a medium effect size ($\eta^2 = 0.12$). On the BFIS-QS, there was not a significant main effect of time ($F[1, 56] = 0.33$, $p = .56$), but a significant main effect of group ($F[1, 56] = 3.97$, $p = .05$), and no

significant Group X Time interaction ($F$[1, 56] = 0.05, $p$ = .81, $\eta^2$ = 0.00), see Fig. 3r.

The VAS single item of functioning revealed a non-significant main effect of time ($F$[1, 68] = 0.57, $p$ = .45), a significant group effect ($F$[1, 68] = 4.37, $p$ = .04), and a non-significant interaction effect $F$[1, 68] = 0.73, $p$ = .40, $\eta^2$ = 0.02), see Fig. 3s.

**Table 6**. Comparisons across assessments for BFIS items for App and Control groups

| | T1 M(SD) | T2 M(SD) | T3 M(SD) | F | p | Post-hoc |
|---|---|---|---|---|---|---|
| **1. Home-family** | | | | | | |
| App | 5.48 (3.10) | 3.66 (2.86) | 4.69 (2.33) | $F(2,56) = 5.73$ | .00 | T1 vs T2, $p = .00$, $d = -.61$<br>T2 vs T3, $p = .49$, $d = .39$<br>T1 vs T3, $p = .60$, $d = -.30$ |
| Control | 5.14 (2.35) | 3.90 (2.54) | 3.93 (2.65) | $F(2,56) = 3.68$ | .03 | T1 vs T2, $p = .09$, $d = -.50$<br>T2 vs T3, $p = 1.00$, $d = .01$<br>T1 vs T3, $p = .14$, $d = -.48$ |
| **2. Home-chores** | | | | | | |
| App | 5.76 (2.35) | 3.93 (2.20) | 4.00 (2.50) | $F(2,56) = 7.43$ | .00 | T1 vs T2, $p = .00$, $d = -.80$<br>T2 vs T3, $p = 1.00$, $d = .03$<br>T1 vs T3, $p = .02$, $d = -.72$ |
| Control | 5.21 (2.55) | 5.48 (2.58) | 5.59 (2.41) | $F(2,56) = 0.31$ | .73 | T1 vs T2, $p = 1.00$, $d = .10$<br>T2 vs T3, $p = 1.00$, $d = .04$<br>T1 vs T3, $p = 1.00$, $d = .15$ |
| **3. Work** | | | | | | |
| App | 6.31 (3.71) | 5.00 (3.63) | 4.90 (3.58) | $F(2,56) = 2.48$ | .09 | T1 vs T2, $p = .22$, $d = -.35$<br>T2 vs T3, $p = 1.00$, $d = -.02$<br>T1 vs T3, $p = .20$, $d = -.38$ |
| Control | 6.17 (3.35) | 5.59 (3.39) | 6.55 (3.62) | $F(2,56) = 0.60$ | .55 | T1 vs T2, $p = 1.00$, $d = -.17$<br>T2 vs T3, $p = .53$, $d = .27$<br>T1 vs T3, $p = 1.00$, $d = .11$ |
| **4. Social strangers** | | | | | | |
| App | 5.76 (2.89) | 4.55 (2.74) | 5.00 (2.65) | $F(2,56) = 2.23$ | .12 | T1 vs T2, $p = .18$, $d = -.43$<br>T2 vs T3, $p = 1.00$, $d = .16$<br>T1 vs T3, $p = .71$, $d = -.27$ |
| Control | 6.00 (2.76) | 6.00 (2.73) | 6.03 (2.33) | $F(1.40,39.41) = 0.00$ | .98 | T1 vs T2, $p = 1.00$, $d = 0$<br>T2 vs T3, $p = 1.00$, $d = .01$<br>T1 vs T3, $p = 1.00$, $d = .01$ |
| **5. Social friends** | | | | | | |
| App | 5.14 (2.43) | 4.10 (2.73) | 4.10 (2.54) | $F(2,56) = 2.21$ | .12 | T1 vs T2, $p = .28$, $d = -.40$<br>T2 vs T3, $p = 1.00$, $d = 0$<br>T1 vs T3, $p = .36$, $d = -.41$ |
| Control | 5.41 (2.74) | 5.59 (2.47) | 5.07 (2.21) | $F(1.44,40.39) = 0.48$ | .56 | T1 vs T2, $p = 1.00$, $d = .06$ |

T2 vs T3, $p = .40$, $d = -.22$
T1 vs T3, $p = 1.00$, $d = -.13$

**6. Community activities**

| | | | | | | |
|---|---|---|---|---|---|---|
| App | 6.52 (3.47) | 6.41 (4.14) | 4.93 (3.52) | $F(2,56) = 3.08$ | .05 | T1 vs T2, $p = 1.00$, $d = -.03$<br>T2 vs T3, $p = .05$, $d = -.38$<br>T1 vs T3, $p = 1.00$, $d = -.45$ |
| Control | 5.97 (2.92) | 6.10 (3.22) | 7.14 (3.29) | $F(1.68,47.02) = 1.89$ | .16 | T1 vs T2, $p = 1.00$, $d = .04$<br>T2 vs T3, $p = .40$, $d = .31$<br>T1 vs T3, $p = .09$, $d = .37$ |

**7. Education**

| | | | | | | |
|---|---|---|---|---|---|---|
| App | 5.93 (2.57) | 5.55 (2.81) | 5.55 (3.08) | $F(2,56) = 0.23$ | .80 | T1 vs T2, $p = 1.00$, $d = -.14$<br>T2 vs T3, $p = 1.00$, $d = 0$<br>T1 vs T3, $p = 1.00$, $d = -.13$ |
| Control | 6.38 (2.69) | 6.59 (2.83) | 6.24 (2.68) | $F(2,56) = 0.15$ | .86 | T1 vs T2, $p = 1.00$, $d = .07$<br>T2 vs T3, $p = 1.00$, $d = -.12$<br>T1 vs T3, $p = 1.00$, $d = -.05$ |

**8. Marriage/dating**

| | | | | | | |
|---|---|---|---|---|---|---|
| App | 6.69 (3.91) | 5.59 (3.85) | 6.24 (3.80) | $F(2,56) = 1.06$ | .35 | T1 vs T2, $p = .44$, $d = -.28$<br>T2 vs T3, $p = 1.00$, $d = .43$<br>T1 vs T3, $p = 1.00$, $d = .14$ |
| Control | 5.97 (4.06) | 5.93 (3.74) | 7.24 (3.83) | $F(2,56) = 1.66$ | .20 | T1 vs T2, $p = 1.00$, $d = -.01$<br>T2 vs T3, $p = .14$, $d = .34$<br>T1 vs T3, $p = .43$, $d = .32$ |

**9. Money management**

| | | | | | | |
|---|---|---|---|---|---|---|
| App | 6.17 (2.67) | 4.52 (2.97) | 5.03 (3.34) | $F(2,56) = 4.23$ | .02 | T1 vs T2, $p = .01$, $d = -.58$<br>T2 vs T3, $p = 1.00$, $d = .16$<br>T1 vs T3, $p = .27$, $d = -.37$ |
| Control | 5.45 (2.57) | 5.86 (3.15) | 5.55 (3.00) | $F(2,56) = 0.21$ | .80 | T1 vs T2, $p = 1.00$, $d = .14$<br>T2 vs T3, $p = 1.00$, $d = -.10$<br>T1 vs T3, $p = 1.00$, $d = .03$ |

**10. Driving**

| | | | | | | |
|---|---|---|---|---|---|---|
| App | 4.62 (3.93) | 3.21 (3.76) | 4.24 (4.07) | $F(1.73,48.56) = 2.14$ | .134 | T1 vs T2, $p = .12$, $d = -.36$<br>T2 vs T3, $p = .26$, $d = .26$<br>T1 vs T3, $p = 1.00$, $d = -.09$ |
| Control | 3.93 (3.44) | 3.31 (3.39) | 4.00 (4.29) | $F(2,56) = 0.55$ | .57 | T1 vs T2, $p = .96$, $d = -.18$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | T2 vs T3, $p$ = .98, $d$ = .17 |
| | | | | | | T1 vs T3, $p$ = 1.00, $d$ = -.01 |
| **11. Sexual relations** | | | | | | |
| App | 5.90 (4.44) | 5.48 (4.03) | 6.34 (4.36) | $F(2,56) = 0.43$ | .65 | T1 vs T2, $p$ = 1.00, $d$ = -.09 |
| | | | | | | T2 vs T3, $p$ = .97, $d$ = .20 |
| | | | | | | T1 vs T3, $p$ = 1.00, $d$ = .09 |
| Control | 5.21 (3.88) | 5.66 (4.10) | 5.93 (3.81) | $F(2,56) = 0.46$ | .63 | T1 vs T2, $p$ = 1.00, $d$ = .11 |
| | | | | | | T2 vs T3, $p$ = 1.00, $d$ = .06 |
| | | | | | | T1 vs T3, $p$ = 1.00, $d$ = .18 |
| **12. Daily responsibilities** | | | | | | |
| App | 6.10 (2.27) | 4.69 (2.71) | 4.66 (2.30) | $F(2,56) = 6.00$ | .00 | T1 vs T2, $p$ = .02, $d$ = -.65 |
| | | | | | | T2 vs T3, $p$ = 1.00, $d$ = -.01 |
| | | | | | | T1 vs T3, $p$ = .03, $d$ = -.63 |
| Control | 5.93 (2.70) | 6.41 (2.04) | 5.79 (2.58) | $F(1.60,44.91) = 0.96$ | .37 | T1 vs T2, $p$ = 1.00, $d$ = .20 |
| | | | | | | T2 vs T3, $p$ = .77, $d$ = -.26 |
| | | | | | | T1 vs T3, $p$ = 1.00, $d$ = -.05 |
| **13. Self-care routines** | | | | | | |
| App | 5.48 (2.74) | 4.41 (2.40) | 4.83 (2.85) | $F(2,56) = 1.54$ | .22 | T1 vs T2, $p$ = .24, $d$ = -.41 |
| | | | | | | T2 vs T3, $p$ = 1.00, $d$ = .16 |
| | | | | | | T1 vs T3, $p$ = 1.00, $d$ = -.23 |
| Control | 4.90 (2.80) | 4.97 (3.30) | 4.69 (2.83) | $F(2,56) = 0.14$ | .86 | T1 vs T2, $p$ = 1.00, $d$ = .02 |
| | | | | | | T2 vs T3, $p$ = 1.00, $d$ = -.09 |
| | | | | | | T1 vs T3, $p$ = 1.00, $d$ = -.07 |
| **14. Health maintenance** | | | | | | |
| App | 6.59 (2.26) | 5.03 (2.41) | 4.86 (2.64) | $F(2,56) = 7.69$ | .00 | T1 vs T2, $p$ = .02, $d$ = -.66 |
| | | | | | | T2 vs T3, $p$ = 1.00, $d$ = -.06 |
| | | | | | | T1 vs T3, $p$ = .01, $d$ = -.70 |
| Control | 6.55 (2.06) | 5.97 (2.71) | 5.97 (2.71) | $F(2,56) = 0.90$ | .41 | T1 vs T2, $p$ = .80, $d$ = -.24 |
| | | | | | | T2 vs T3, $p$ = 1.00, $d$ = 0 |
| | | | | | | T1 vs T3, $p$ = .87, $d$ = -.24 |

**i.**



VAS Emotional Burden

**j.**



OCI-12-Total

**k.**



OCI-12 Checking

**l.**



OCI-12 Ordering

**m.**



OCI-12 Washing

**n.**



OCI-12 Obsessing

**o.**

**SISE**



**p.**

**CSS**



**q.**

**Mean BFIS**



**r.**

**BFIS-QS**



**s.**

**VAS Functioning Item**
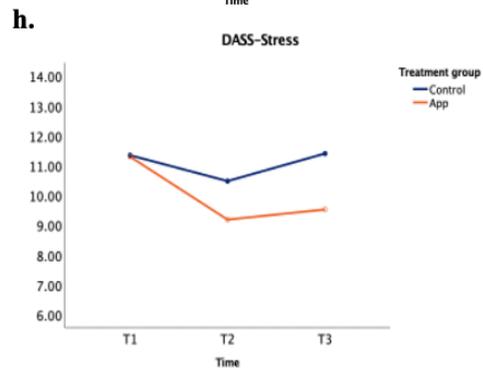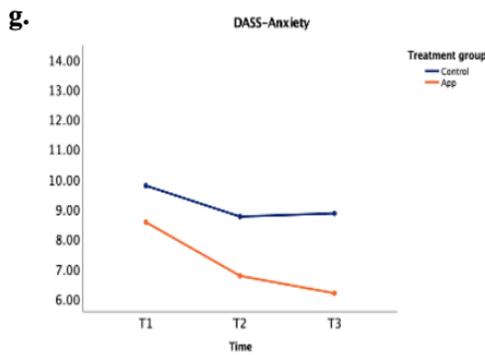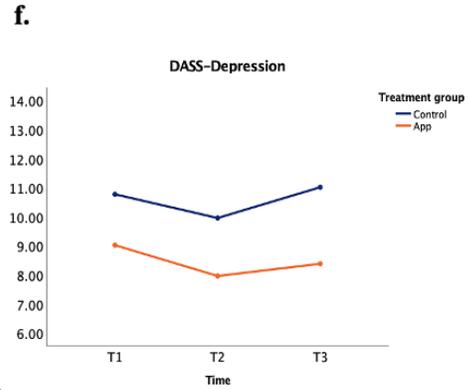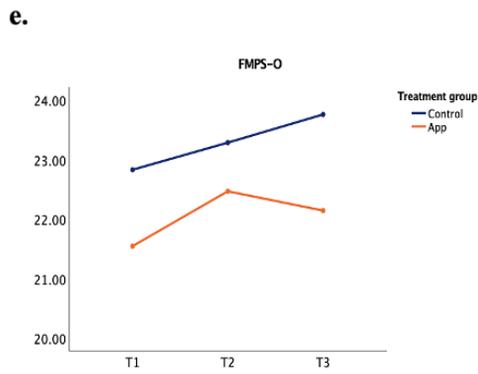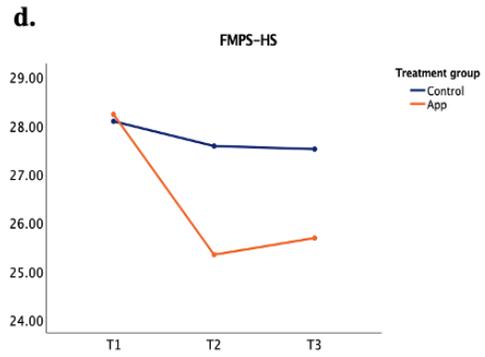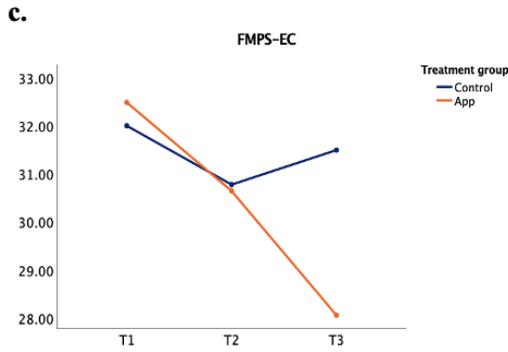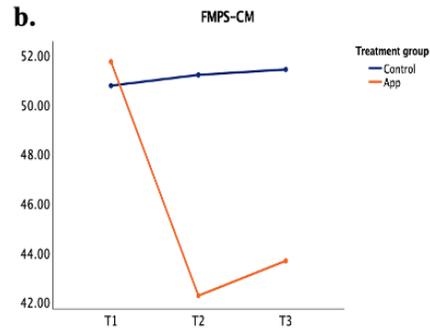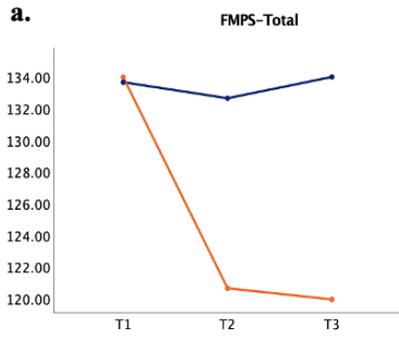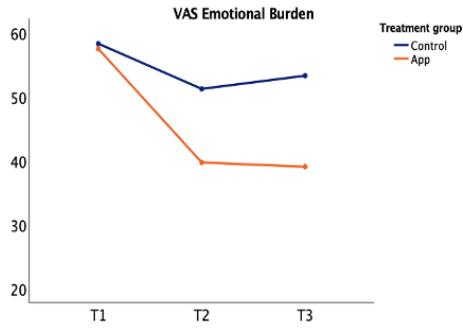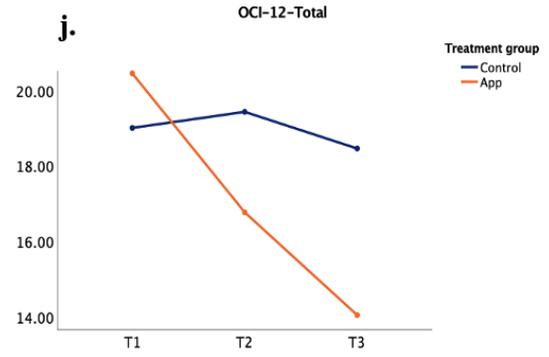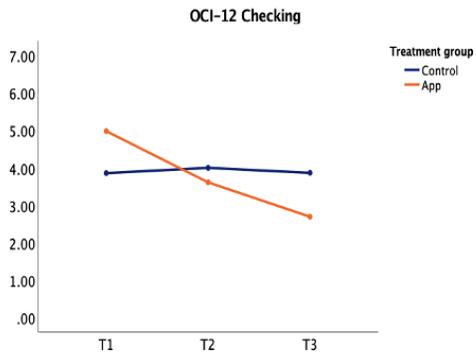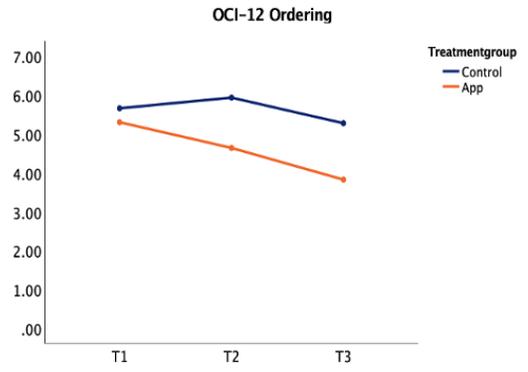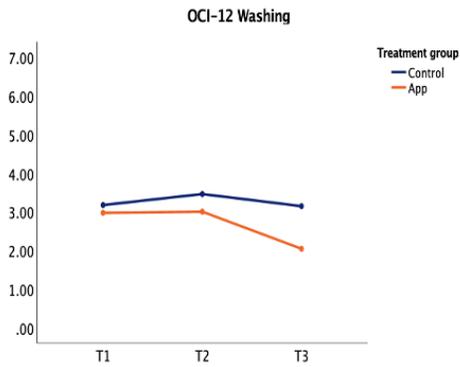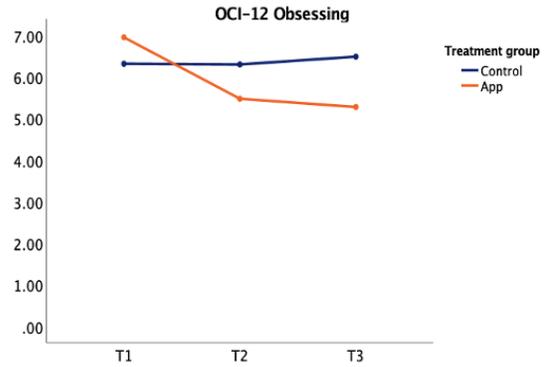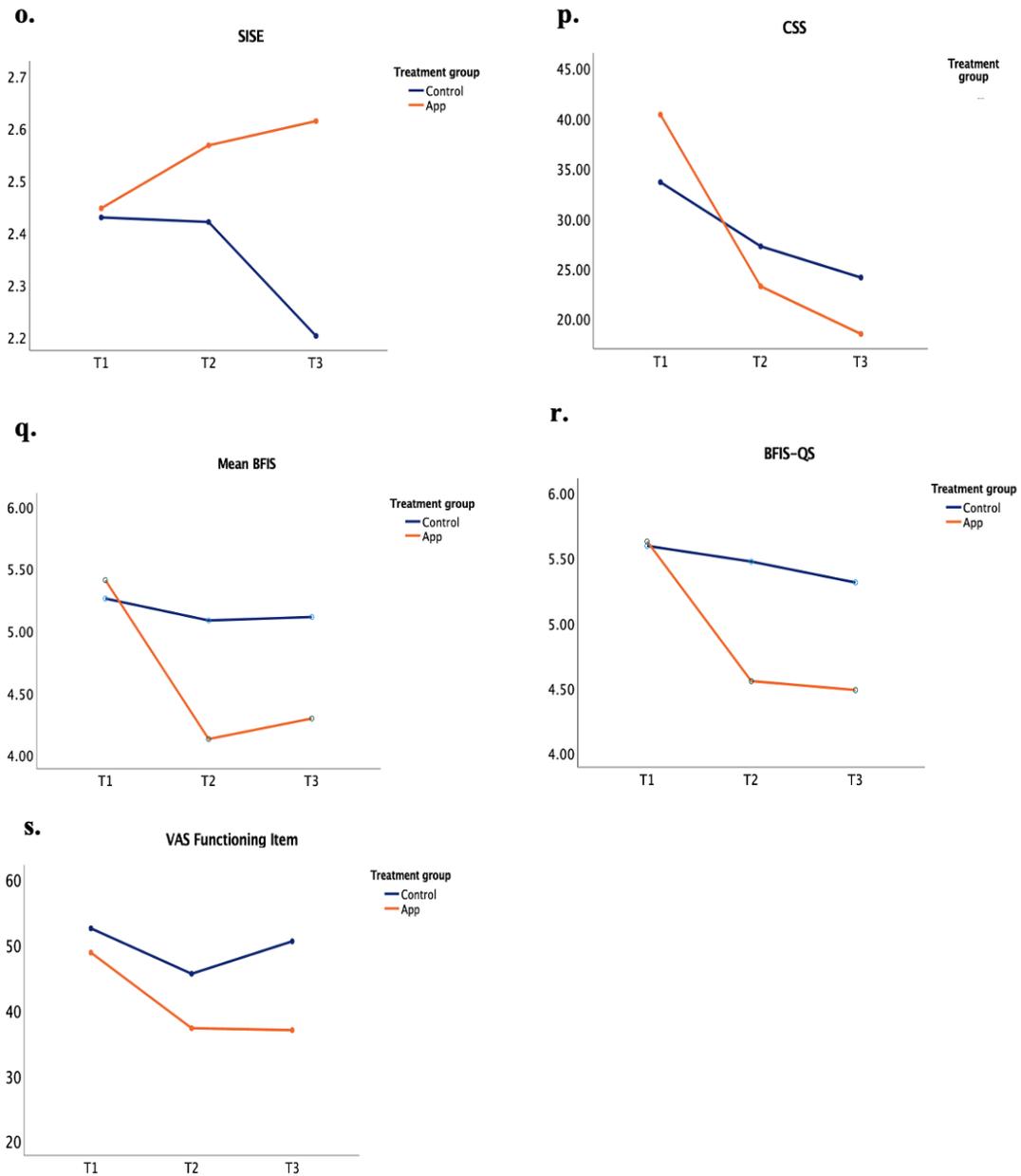


**Figure 3.** Graphs of the measures across T1, T2, and T3 for App and Control groups

**Correlations Between Primary and Secondary Outcome Measures**

Table 7 shows the Pearson's zero order bivariate correlations between the FMPS, BFIS, VAS Perfectionism- related functional impairment item (VAS-PFI) and VAS Perfectionism-related emotional burden (VAS-PEB), OCI-12, -21, CSS, and SISE outcome variables for the entire study sample at baseline.

In terms of functional impairment, the FMPS total score was significantly and positively correlated with overall functional impairment from the mean of the 14 items on the BFIS ($r = 0.34$, $p = .00$) and was significantly positively correlated with VAS-PFI ($r = 0.53$, $p < .00$), such that overall perfectionism severity is positively associated with greater overall functional impairments. In terms of the FMPS subscales, the FMPS-CM and FMPS-EC were significantly and positively correlated with the BFIS mean impairment ($r = 0.51$, $p = .03$ and $r = 0.48$, $p < .00$, respectively), and the VAS-PEB was significantly and positively correlated with the FMPS subscales with the exception of the FMPS-O (ranging from $r = .39$-51), see Table 7.

In terms of the association between perfectionism and OCD symptom severity and, there was a significant and positive correlation between the OCI-12 Total score and the FMPS-Total score ($r = 0.28$, $p = .01$). In terms of OCI-12 subscales the OCI-12 Ordering subscale was the only OCI-12 subscale that was significantly positively correlated with the FMPS-total score ($r = 0.26$, $p = .02$), indicating that overall perfectionism severity was positively associated with a greater likelihood to engage in ordering behaviors. In terms of the FMPS subscales, the OCI-12 total score was significantly positively correlated the FMPS-CM ($r = 0.23$, $p = .04$) and the FMPS-HS subscale ($r = 0.24$, $p = .04$), such that higher levels of OCD symptoms were associated with increased concerns over mistakes and high standards.

Finally, correlations between general symptoms of anxiety, stress and depression and perfectionism were assessed. A significant correlation was found between the DASS-Anxiety subscale and the FMPS-CM subscale ($r = 0.35$, $p < .00$), indicating. DASS-Depression subscale score was found to be significantly positively correlated with the

FMPS total score ($r = 0.28$, $p = .01$), FMPS-CM ($r = 0.47$, $p < .00$), and FMPS-EC ($r = 0.29$, $p = .01$), indicating that overall perfectionism severity, Concerns Over Mistakes, and High Standards were positively associated with greater symptoms of depression. The DASS-Stress subscale was significantly positively correlated with the FMPS-total score, the FMPS-CM, and the FMPS-EC subscales ($r$'s ranging from 0.24-0.36), but not with the FMPS-HS and FMPS-O. Similarly, VAS-PEB was significantly and positively correlated with the FMPS total score and subscales, except for the FMPS-O ($r$'s ranging from 0.28-0.47). Finally, a significant correlation was observed between the CSS and the FMPS total score ($r = 0.25$, $p = .03$).

**Table 7.** Correlation matrix for all dependent variables at baseline (T1)

| | FMPS Total | FMPS-CM | FMPS-EC | FMPS-HS | FMPS-O | BFIS Mean | VAS-PFI | OCI-12 Total | OCI-12 Checking | Oci-12 Ordering | OCI-12 Washing | OCI-12 Obsessing | DASS-Depression | DASS-Anxiety | DASS-Stress | VAS-PEB | CSS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FMPS-CM** | 0.76** | | | | | | | | | | | | | | | | |
| **FPMS-EC** | 0.78** | 0.51** | | | | | | | | | | | | | | | |
| **FMPS-HS** | 0.70** | 0.30* | 0.33** | | | | | | | | | | | | | | |
| **FMPS-O** | 0.36** | -0.13 | -0.03 | 0.38** | | | | | | | | | | | | | |
| **BFIS Mean** | 0.34** | 0.26* | 0.46** | 0.13 | -0.07 | | | | | | | | | | | | |
| **VAS-PFI** | 0.53** | 0.51** | 0.48** | 0.39** | -0.1 | 0.55** | | | | | | | | | | | |
| **OCI-12 Total** | 0.28* | 0.23* | 0.12 | 0.24* | 0.15 | 0.35** | 0.25* | | | | | | | | | | |
| **OCI-12 Checking** | 0.17 | 0.21 | -0.02 | 0.27* | 0.06 | 0.16 | 0.19 | 0.64** | | | | | | | | | |
| **Oci-12 Ordering** | 0.26* | 0.17 | 0.11 | 0.21 | 0.24* | 0.24* | 0.07 | 0.68** | 0.32** | | | | | | | | |
| **OCI-12 Washing** | 0.12 | -0.08 | 0.04 | 0.14 | 0.31** | 0.16 | 0.11 | 0.67** | 0.29* | 0.35** | | | | | | | |

| | C1 | C2 | C3 | C4 | C5 | C6 | C7 | C8 | C9 | C10 | C11 | C12 | C13 | C14 | C15 | C16 | C17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **OCI-12 Obsessing** | 0.18 | 0.27* | 0.15 | 0.09 | -0.12 | 0.36** | 0.30* | 0.63** | 0.19 | 0.17 | 0.22 | | | | | | |
| **DASS-Depression** | 0.28* | 0.47** | 0.29* | -0.01 | -0.16 | 0.49** | 0.47** | 0.23 | 0.09 | 0.04 | -0.03 | 0.47** | | | | | |
| **DASS-Anxiety** | 0.23* | 0.35** | 0.23 | 0.09 | -0.17 | 0.44** | 0.48** | 0.31** | 0.14 | 0.00 | 0.09 | 0.53** | 0.57** | | | | |
| **DASS-Stress** | 0.30* | 0.36** | 0.24* | 0.17 | -0.06 | 0.33** | 0.38** | 0.25* | 0.1 | 0.02 | -0.01 | 0.53** | 0.49** | 0.77** | | | |
| **VAS-PEB** | 0.44** | 0.28* | 0.29* | 0.47** | 0.12 | 0.30* | 0.67** | 0.23 | 0.11 | 0.15 | 0.28 | 0.13 | 0.11 | 0.28* | 0.18 | | |
| **CSS** | 0.25* | 0.21 | 0.22 | 0.16 | 0.04 | 0.30* | 0.16 | 0.56** | 0.28* | 0.26* | .52** | 0.28* | 0.09 | 0.29* | 0.17 | 0.159 | |
| **SISE** | -0.11 | -0.25* | -0.17 | 0.07 | 0.19 | -0.26* | -0.21 | -0.04 | 0.1 | 0.07 | 0.04 | -0.28* | -0.46** | -0.32* | -0.28* | -0.11 | 0.02 |

**Note.** FMPS Total: Frost Multidimensional Perfectionism Total Scale; FMPS-CM: FMPS, Concern over Mistakes Subscale; FMPS-EC: FMPS, Excessive Concern Subscale; FMPS-HS: FMPS, High Standards Subscale; FMPS- O: FMPS, Order and Organization Subscale; BFIS: Barkley Functional Impairment Scale; VAS Perfectionism- related functional impairment item (VAS-PFI): (To what degree has perfectionism negatively impacted your level of functioning in school, work, or in terms of your relationship with other people in the past week?); OCI-12 Total: The Obsessive-Compulsive Inventory-12 Item Scale; DASS-21 D: The Depression, Anxiety, Stress Scale-21, Depression Subscale; DASS-21 A: Anxiety Subscale; DASS-21 S: Stress Subscale; VAS Perfectionism-related emotional burden (VAS-PEB): (To what degree has perfectionism caused an emotional burden or distress in the past week?); CSS: Covid Stress Scale; SISES: Single Item Self-esteem Scale. * p < .05, ** p < .01

# VII. DISCUSSION

The aim of the present research was to evaluate a low-intensity mobile app, 'GG OCD - Anxiety & Depression (GG OCD) by GGtude (GGtude, 2020), designed to improve symptoms of perfectionism and related maladaptive thinking by challenging perfectionistic maladaptive beliefs among university students. The intervention, rooted in principals of cognitive therapy, involved the use of short (a few minutes), daily game-like app for a period of two weeks, where participants accepted (pulling down) or rejected (pushing up) blocks containing adaptive and maladaptive statements related to perfectionism. Overall, the results of the present randomized clinical trial are in support of the efficacy of this app-based low intensity treatment in reducing severity of symptoms of perfectionisms, as well as in improving related symptoms of depression, anxiety, and stress, and general everyday functioning.

## Primary Perfectionistic Outcomes

The Frost Multidimensional Perfectionism Scale was chosen as the main perfectionism outcome measure of this study. The scale includes four subscales that were used as primary outcome measures: 1) Concerns over mistakes and doubts about actions; 2) Excessive concern with parental expectations/ criticism; 3) Excessively high personal standards; and 4) Concern with order and organization. At baseline there were no significant differences observed between App and Control groups on the Frost Multidimensional Perfectionism Scale and subscales. Notably, in terms of severity of perfectionism, the study sample was characterized by an elevated degree of perfectionism as Concerns Over Mistakes scores, that were exceptionally high and greater than

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suggested cut-off scores that indicate elevated levels of perfectionism (Buhrman et al., 2020; Egan, van Noort, et al., 2014; Steele et al., 2013).

Compared to participants in the Control group, App users exhibited significant improvements in High Standards and Concerns Over Mistakes (CM and HS) post-treatment, associated with small and large effect sizes ($\eta^2$ = 0.03 and 0.17), respectively. This is analogous to the results found in classic CBT intervention for perfectionism where small to large effect sizes are frequently reported ($d$ = 0.64 to 1.23) and identified for individuals receiving traditional therapy (Egan, van Noort, et al., 2014). Although, somewhat of a broader range, similar effect sizes were found in internet-based CBT (ICBT) studies (Egan, van Noort, et al., 2014; Rozental et al., 2017). The fact that the effect sizes found in the present study were similar to those in which therapy is administered normally and remotely with adjunct self-help tools, further highlights the efficacy of this brief low-intensity treatment that is delivered in game-like application.

Significant post-treatment reductions were not found for domains related to Excessive Concerns with Parental Expectations or Order and Organization. These results are in line with findings that indicate that the FMPS Concerns Over Mistakes and High Standards are core domains of perfectionism (Frost et al., 1990; Rozental et al., 2017; Shafran et al., 2018; Shafran & Mansell, 2001). Indeed, across studies examining perfectionism Concerns over Mistakes and the total FMPS are commonly used for screening and treatment outcomes in perfectionism (Buhrman et al., 2020; Handley et al., 2015; James & Rimes, 2018; Steele et al., 2013). On the other hand Excessive Concerns due to Parental Expectation/Criticisms and Organization are secondary factors related to perfectionism and more so related to its cause (Rozental et al., 2017). In fact as indicated

by Frost and colleagues (1990) Organization is a correlate of perfectionism, but not a central characteristic.

Similar to an internet-based CBT intervention (Zetterberg et al., 2019), the present study did not detect significant changes at 1 month follow-up on measures of Concerns over Mistakes, High Standards, and Organization. These findings suggest that treatment effects were maintained at 1-month follow-up on these domains. Interestingly, a significant reduction for Excessive Concerns with Parental Expectations/Criticisms were observed at follow-up, with a small effect size.

Nonetheless, these results add to the literature that has demonstrated internet-based CBT interventions to be effective in maintaining post-treatment gains and reducing Concerns over Mistakes, Excessive Concern from Parental Criticism, and Excessive High Standards (Egan, van Noort, et al., 2014; Radhu et al., 2012), with the exception of FMPS-Organization.

GG OCD is a unique app given that short, daily interactive exercises are delivered on a mobile game-like platform that only requires use for a few minutes a day. There have been several other applications related to GG OCD that use the GGtude platform that have been demonstrated to improve a number of types of symptoms including body image concerns, OCD, Major Depressive Disorder (MDD), self-esteem (Aboody et al., 2020; Ben-Zeev et al., 2021; Cerea et al., 2021; Pascual-Vera et al., 2018; Roncero et al., 2019). This app platform has also proven to be effective in reducing the severity of mental health disorders, including schizophrenia and bipolar disorder (Ben-Zeev et al., 2021). Further, GG OCD has several advantages that help to overcome barriers in terms of access to treatment. One being reducing physical barriers to treatment, as applications

can be readily downloaded and implemented irrespective of restraints of space and time (Domhardt et al., 2021). Secondly, this application may benefit individuals who may not be comfortable with sharing their feelings with other people or who are biased towards psychotherapy (Kajitani et al., 2020). Finally, being a low intensity intervention, the app is effective without involvement of mental health care professional.

**Secondary Outcome Measures**

**Obsessive-compulsive symptoms.** Perfectionism is a prominent symptom of OCD (Sadri et al., 2017) and is constantly found to be highly correlated with obsessive-compulsive symptoms in the general population (Antony et al., 1998), and college students (Hemmati et al., 2020). The Obsessive Compulsive Cognitions Working Group identified perfectionism as one of the six key cognitive factors in OCD (Egan et al., 2011). Therefore, it was of interest to see if symptoms of OCD would improve in individuals with elevated perfectionism. Indeed, the App group demonstrated significant improvements in overall OCD symptoms post-treatment compared to the control group. This finding was analogous with a CBT intervention for clinical perfectionism in OCD (Sadri et al., 2017), that demonstrated significant reductions in OCD symptoms after an 8-week group CBT intervention. Specifically, there was a significant reduction in checking behaviors compared to the control group post-treatment. Further, at 1-month follow-up treatment gains were maintained. Gershuny and Sher (1995) found higher perfectionism scores among a group of subclinical compulsive checkers compared to non-checkers and suggested that greater perfectionism may lead people to exert control over situations through checking rituals.

Although not significant, there were reductions in ordering and obsessions post-treatment. At 1-month follow up, reductions continued in both groups, such that there was an overall significant reduction in obsessing. Perfectionism has been linked to obsessions (Tolin et al., 2008), checking (Gershuny & Sher, 1995; Wu & Cortesi, 2009), and ordering behaviors (Tolin et al., 2008; Wu & Cortesi, 2009). It has also been reported that patients with OCD display the need to have things flawless, certain, and exact and possess an inner drive for perfection (Shafran & Mansell, 2001), this dimension of perfectionism is also referred to as no just right experiences (NJRE; Coles et al., 2005). Further, despite the small treatment effect, perfectionism was not associated with washing. However, some studies suggest that perfectionism may be associated with washing among students (Wu & Cortesi, 2009), although there is no indication that washing is related to changes in perfectionism.

**Anxiety, stress, and mood**. Symptoms of depression, anxiety, and stress are known to be closely related to perfectionism (Dorevitch et al., 2020; Handley et al., 2015). Our results revealed that several minutes a day of using the GG OCD resulted in significant reductions in subjective ratings of emotional burden stemming directly from perfectionism via a VAS, that was associated with a medium effect size ($\eta^2 = 0.10$). In addition, this effect was maintained at one month follow-up. These finding are in accordance with research indicating that CBT for perfectionism alleviates overall psychopathological burden, including a significantly greater pre-post increase in quality of life, as well as significantly greater improvement in emotional regulation (Barlow et al., 2017; Mahmoodi et al., 2020).

Further, there were no significant improvements in depression, stress, or anxiety symptoms in the App group post-treatment. Similar to our findings, a RCT of guided iCBT for perfectionism did not find significant improvement on depression, stress and anxiety post-intervention (Shafran et al., 2017). However, post-intervention small treatment effects continued at follow-up which resulted in an overall significant decrease in anxiety symptoms between baseline to follow-up, associated with a small effect size, ($\eta2 = 0.01$). Although past studies have demonstrated significant follow-up reductions in anxiety, depression, and stress (Arana et al., 2017; Lloyd et al., 2015; Riley et al., 2007; Steele et al., 2013) it is important to mention that the aforementioned studies consisted of a variety of CBT-based interventions including: individual, guided self-help, web-based, and group.

To assess self-esteem a single item measure was administered across the three times points. Inconsistent with previous RCTs of CBT for perfectionism showing increases in self-esteem (Egan, Hattaway, et al., 2014; Steele & Wade, 2008), our study did not find significant effects for self-esteem in the App or Control group. One possible explanation for this may be due to the fact that our study used a single item measure of self-esteem, whereas the previous RCTs (Egan, Hattaway, et al., 2014; Steele & Wade, 2008) used The Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965), a 10-item measure of self-esteem. Additionally, individuals with high levels of perfectionism are more likely to be highly sensitive to social sanctions for failure and more likely to experience low self-esteem (Preusser et al., 1994). Thus, it would be especially important to specifically target and focus on negative self-evaluations as a maintaining factor in

perfectionism during treatment in order to witness significant changes in self-esteem overtime.

**COVID-19 symptoms.** The present study was conducted during the COVID-19 pandemic. Therefore, we included the COVID-19 Stress Scale (Taylor et al., 2020) to assess the COVID-19 related distress. At baseline there were no significant differences in stress due to COVID-19. In addition, both groups demonstrated a significant reduction on this measure. This was expected since the study took place after the Delta variant surge had abated and before the Omicron variant was known. However, post-treatment (T2) there was greater reduction in levels of distress due to the pandemic in the App group compared to the Control group. Given that the two groups did not differ on COVID related stress at baseline, and that both groups exhibited consistent reduction at post treatment and at follow-up, the greater reduction on this measure in the App group can be speculatively explained by the fact that the App groups demonstrated a significant reduction in perfectionism and related symptoms that may indirectly alleviate the extend of distress experienced due to the pandemic.

**Everyday functioning.** The present study included an in-depth examination of everyday functional impairments across fourteen life domains. At baseline there were no differences observed between the groups on all individual domains as well as when compared on the brief BFIS scale (i.e., BFIS Quick Screen) of functional impairment across six domains. However, according the BFIS norms, both groups had elevated levels of impairment (overall determined as 'borderline impairment level') (Barkley, 2011). Post- intervention the App group demonstrated a significant reduction in functional impairment. Specifically, there were significant improvements in functional impairment

across Home-family, Home-chores, Money management, Daily responsibilities, and Health maintenance domains were observed. In some respect, these domains have considerable overlap given that they have to do with performance, whether that be managing money, preforming chores, etc. Perfectionism is a performance-based construct (Frost et al., 1990; Sirois & Molnar, 2016), therefore it is not surprising that significant reductions were found across these domains. Perfectionists often impose high standards on themselves and exhibit procrastination because they believe that they cannot meet those standards (Çapan, 2010). Thus, functional improvement may to a meaningful extent improve due to less procrastination and avoidance. There were no improvements in functioning in the romantic relationships and sexual activities, Education and Work, Social -Strangers and Friends, Driving, and Self-Care Routines. Given that perfectionism is a personality trait defined by setting high standards for performance, critical self-evaluations, and concerns about negative evaluations (Flett & Hewitt, 2002), it stands to reason that there would not be significant reductions in these domains. In terms of the Education domains, the short time span of this study did not permit meaningful changes in grades. In terms of Work, many students work in less demanding jobs so that a meaningful improvement in functioning domain is not likely, especially within two weeks. Similarly Driving (e.g., citations), romantic relationships, sexual activities and social activities would not be expected to improve significantly.

Our findings on a subjective measure of functional burden directly related to perfectionism (via VAS) was analogous to our findings of overall functional impairment as measured by the BFIS. These findings were nearly identical, with small effect sizes post- treatment, where the App group demonstrated a significant reduction in functional

impairment. Similarly, at 1-month follow up treatment gains were also maintained. Indeed, clinical perfectionism interferes with functioning and causes significant distress (Shafran & Mansell, 2001). These findings cement the beneficial impact of the GG OCD app for perfectionism on functional impairments that stem from perfectionism. Moreover, these findings are of importance since despite the substantial impact of perfectionism on functional impairments, there is limited empirical support for functional improvement following treatment for perfectionism.

**Implications**

The present study demonstrates that clinically significant perfectionism, resulting in significant functional impairments is prevalent among college students, and that the use of low intensity app designed to target perfectionism, is efficacious in reducing perfectionism symptoms, related clinical symptoms, and functional impairments. One of the main implications resulting from this study is the need to identify and disseminate low intensity treatment for perfectionism to university students. Elevated levels of perfectionism cause direct emotional and functional burden, as well as may lead to increase in symptoms of eating disorders (Steele et al., 2007; Vohs et al., 1999), suicidal ideation (Hewitt et al., 2006; Rasmussen et al., 2008), and increases in depressive symptoms (Egan et al., 2012). Thus, providing resources and treatment for perfectionism may transcend the beneficial effect on symptom of perfectionism and would help to decrease the likelihood of related disorders and symptoms.

Out of the 1,404 participants who completed the initial screening phase in the present study, 30% scored above the study's perfectionism cutoff, entailing clinical levels of perfectionism. This alarming rate suggests that there is a need for universities to play

an active role in preventing difficulties with perfectionism before they arise by disseminating proper resources to help students combat their need for perfection. This is particularly important given the clinical correlates and functional impairments associated with perfectionism. Further, counseling centers should offer training to their staff related to treatment of perfectionism and offer this specific service to support students who have perfectionistic tendencies. That said, as the need for mental health resources and counseling services continues to grow across college campuses and providers continue to become increasingly overwhelmed (*Center for Collegiate Mental Health*, 2018), there is an urgent need for easily accessible resources for treating perfectionism that are made readily available to students. Indeed, GG OCD- Anxiety and Depression (GGtude, 2020) is a low intensity, low cost solution that was proven efficacious, and nearly as effective as traditional CBT treatment.

**Limitations**

This study has a number of strengths, including its methodology (i.e., randomized controlled trial), and being the first study to examine the efficacy of a mobile application specifically designed to address maladaptive thinking/behaviors in perfectionism. However, the study is not free of limitations. First, the study had a plurality of female participants (85.7%), which may hinder generalizability. Thus, future studies would benefit from including a more sex/gender balanced sample. Second, our study did not include a traditional wait-list control group in that participants in the control group were not informed that they are participating in a clinical trial. Although control group participants were offered the app after the study had concluded, not informing control participants that they are taking part in a clinical trial may theoretically impact the study's

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results given lack of expectancy effect in the control group. However, it has been demonstrated that waitlist control conditions typically display minimal changes in results, even when informed of their condition (Smits & Hofmann, 2009). Further, RCTs have reported negligible effects of classic waitlist control conditions. For example, waitlist control groups included in a RCT of CBT for clinical perfectionism exhibited a small effect size (Riley et al., 2007), and similar results were reported for waitlist samples in RCTs for other anxiety disorders such as social anxiety disorder that exhibited an effect size of 0.10. In addition, a recent meta-analysis of CBT for perfectionism demonstrated that the aggregated effect size across studies for the FMPS-CM was found to be 0.9 after controlling for waitlist effect, which is similar to the results of the present study (Steinert et al., 2017). Another limitation of this study is that one item from the BFIS was not included due to technical error. Therefore, only 14 out of the 15 items were presented to participants. However, the measure was designed for items to represent standalone domains and can be computed individually to obtain individual domain scores, including itemized norms (Barkley, 2011). Finally, the current study was conducted during COVID-19 and may have impacted results across our study. However, utilization of a psychometrically valid COVID Stress Scale (Taylor et al., 2020) in order to assess the relative impact of the pandemic related stress, that ultimately appeared not to affect the result of this study in any meaningful way.

**Conclusion**

With the increasing use of mobile devices and internet availability, low-cost, and accessibility, alternative psychological interventions have become increasingly attractive among university students (Borghouts et al., 2021). The current study suggests that a

brief, daily app-based game-like intervention that targets maladaptive perfectionistic beliefs in students is associated with significant improvements in symptoms related to perfectionism, functioning, obsessive-compulsive symptoms, anxiety, and stress. In addition, it shows that this type of low intensity intervention may be a viable low-cost alternative to traditional CBT treatments for vulnerable populations on college campuses.

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