



Guided internet-based cognitive behavioral therapy for adolescent anxiety: Predictors of treatment response



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ABSTRACT

Background: Guided internet-based cognitive behavioral therapy (ICBT) has been found efficacious in reducing symptoms of anxiety in adolescents with anxiety disorders, but not all respond equally well.

Objective: In this study, we explored candidate predictors of ICBT treatment response within the frame of a randomized controlled trial.

Methods: Sixty-five adolescents (13–17 years) with anxiety disorders according to DSM-IV received 14 weeks of therapist-guided ICBT. Outcome was evaluated as improvement (continuous change score) from pre-treatment to 12-month follow-up according to self-reported anxiety symptoms and clinician-rated diagnostic severity. Clinical predictors included baseline self- and parent-reported anxiety symptom levels, baseline clinician-rated severity of primary diagnosis, summed baseline clinician-rated severity of all anxiety diagnoses, baseline self-rated depressive symptoms, age of onset, and primary diagnosis of social phobia. Demographic predictors included age, gender and computer comfortability. Therapy process-related predictors included number of completed modules and therapist phone calls, summed duration of therapist phone calls, degree of parent support, and therapeutic alliance. Multi-level models were used to test the prediction effects over time.

Results: Higher levels of self- and clinician-rated baseline anxiety and self-rated depressive symptoms, female gender, and higher levels of computer comfortability were associated with increased treatment response. None of the proposed therapy process-related predictors significantly predicted treatment response.

Conclusion: The present findings indicate that ICBT may be an acceptable choice of treatment for youths, even those with relative high levels of anxiety and depressive symptoms.

1. Introduction

Anxiety is one of the most common mental health disorders affecting 5–12% of youths from western cultures (Beesdo et al., 2009; Costello et al., 2011). When left untreated, anxiety disorders are associated with persistent difficulties and long-term consequences interfering with general development (Langley et al., 2004), social functioning (La Greca and Harrison, 2005; Wood and McLeod, 2008) and academic achievements (Essau et al., 2000). Treatment studies of adolescents with anxiety disorders have proven face-to-face cognitive behavioral therapy (CBT) to be highly effective in reducing anxiety symptoms (Cartwright-Hatton et al., 2004; James et al., 2013; Reynolds et al., 2012). However, it has been estimated that only around 25% of clinically anxious youths receive treatment (Essau et al., 2000; Wang et al., 2007) as their access to health care services is often limited (Gulliver et al., 2010; Stallard et al., 2007). Adolescents may be

especially reluctant to seek professional help for mental health issues due to a variety of health care barriers such as concerns about confidentiality, fear of social stigma, and worries concerning costs and transportation (Booth et al., 2004; Elliott and Larson, 2004; Gulliver et al., 2010; Rickwood et al., 2007).

As means to increase access to and reduce costs of psychological interventions, internet-based CBT (ICBT) has been proposed, and research shows promising results for the ICBT treatment of adolescents with anxiety disorders (Ebert et al., 2015; Pennant et al., 2015; Podina et al., 2016; Stjerneklar et al., submitted for publication).

However, a considerable proportion of anxious adolescents receiving ICBT do not, or only partially, respond to treatment; and non-response at follow-up (FU) from recent randomized controlled trials (RCTs) range from 38 to 68% (Lenhard et al., 2017; Spence et al., 2011; Stjerneklar et al., submitted for publication; Tillfors et al., 2011), mirroring results reported from regular CBT of 40–50% non-responders

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(James et al., 2015; Silverman et al., 2008). Knowledge of predictors of treatment response may help clinicians identify adolescents at risk of low response before they commend therapy and guide the development and refinement of more effective interventions (Hudson et al., 2015a; Rapee, 2000; Steketee and Chambless, 1992).

Few pre-treatment patient predictors in face-to-face CBT with children and adolescents with anxiety disorders have been consistently demonstrated (Knight et al., 2014; Lundkvist-Houndoumadi et al., 2014). Pre-treatment predictors most consistently associated with poorer response are higher baseline symptom severity, social phobia (SoP) as primary anxiety disorder, comorbid externalizing and/or depressive symptoms, and parental psychopathology (Hudson et al., 2015a; Knight et al., 2014; Lundkvist-Houndoumadi et al., 2014; Rapee et al., 2009). Although an association between higher age and outcome has been documented (Reynolds et al., 2012), a large meta-analysis with individual patient data found no age effects (Bennett et al., 2013).

Despite the assumption that the therapeutic mechanisms underlying regular CBT and ICBT are the same, there are important differences between the two therapy formats possibly influencing both the kind, strength and direction of factors predicting treatment response. For example, adolescents receiving ICBT typically have less therapist guidance than those receiving regular CBT and the modality in which this guidance is offered differs (i.e., physical presence versus telephone calls or emails). Given the physical absence of a therapist, ICBT most likely demands more self-discipline from the adolescents as well as greater responsibility for the implementation of learned techniques than CBT. It is therefore relevant to investigate factors that may predict treatment response specifically in ICBT.

Research within ICBT for adults with anxiety disorders has consistently demonstrated higher baseline symptom severity (El Alaoui et al., 2013; Hadjistavropoulos et al., 2016; Hedman et al., 2012; Hedman et al., 2013) and higher adherence (i.e. number of completed modules) (Berger et al., 2014; El Alaoui et al., 2015; Hadjistavropoulos et al., 2016; Hedman et al., 2012; Hedman et al., 2013), to predict better treatment response. Mixed results have been found when investigating the predictive effect of baseline depressive symptoms. Two trials (Hedman et al., 2012; Hedman et al., 2013) have reported significant negative associations with outcome, whereas one trial (El Alaoui et al., 2015) reported no association. Similarly, mixed results have been demonstrated for computer comfortability with two studies (Hedman et al., 2012; Hedman et al., 2013) demonstrating level of computer skills not to be associated with outcome, and one study (Hadjistavropoulos et al., 2016) demonstrating ‘comfortability with written communication’ to be positively associated with treatment response.

Within adult face-to-face psychotherapy research, the therapeutic alliance is the most studied process variable with a mean correlation with outcome of 0.28 in a large meta-analysis (Horvath et al., 2011). Alliance-outcome associations among youths have generally lead to somewhat smaller correlations as shown by two meta-analyses that also both found lower correlations for adolescents (0.10 and 0.19) than for children (McLeod, 2011; Shirk et al., 2011). The therapeutic alliance has been investigated within ICBT for adults suggesting that even minimal therapist contact is sufficient to establish an adequate alliance (Andersson et al., 2012; Cuijpers et al., 2010). Although a recent narrative review of the alliance in internet-based psychotherapy reported client-rated alliance scores roughly equivalent to those found in face-to-face therapy, mixed results have been found for alliance-outcome associations (Berger, 2017).

Gender (Berger et al., 2014; El Alaoui et al., 2013; El Alaoui et al., 2015; Hadjistavropoulos et al., 2016; Hedman et al., 2012; Hedman et al., 2013) and age of onset (El Alaoui et al., 2013; El Alaoui et al., 2015; Hedman et al., 2012) have previously failed to predict outcome in ICBT for adults. Despite that therapist involvement has generally been shown to substantially increase program usage and improve the efficacy of ICBT with adults when compared with self-help

interventions with no therapist support (Christensen et al., 2009; Spek et al., 2007), previous studies of various degrees of therapist support (i.e., number of telephone calls, number of messages sent by therapist and patient, and therapist time) as predictors has failed so far to demonstrate significant associations (Berger et al., 2014; El Alaoui et al., 2015; Hadjistavropoulos et al., 2016).

Only few studies have investigated pre-treatment patient predictors of treatment response within ICBT for adolescents with anxiety disorders. Three meta-analyses of ICBT for children, adolescents and younger adults (age range 5–25) with anxiety disorders (Ebert et al., 2015; Pennant et al., 2015; Podina et al., 2016) concurrently found superior results for older youths compared to younger indicating age to predict treatment response. Furthermore, (Ebert et al., 2015) investigated parental involvement (‘yes/no’) and did not find support for a predictive relationship. Anderson et al. (2012) studied the role of working alliance in predicting treatment outcome for children and adolescents (age 7–18) with anxiety disorders and found adolescents, but not children, to improve significantly more in overall functioning when alliance was higher (beta = 0.22, $t_{79} = 2.21$, $P = 0.03$). Of two more recent studies, Lenhard et al. (2017) examined the effect of an ICBT program for adolescents (age 12–17) with OCD and found no association between number of completed modules and outcome while Spence et al. (2017) in their study on generic versus disorder specific ICBT for youths (age 8–17) with social anxiety disorder found a significant positive association between number of completed sessions and reductions in anxiety symptoms and improvements in functioning. However, this association was only significant for children – not for adolescents.

To the best of our knowledge, no previous studies of ICBT has looked at the predictive value of primary diagnosis within anxiety disorders, e.g. whether having been diagnosed with SoP as primary diagnosis significantly predicts treatment outcome compared to other anxiety diagnoses.

1.1. Aim and hypotheses

The aim of the present study was to explore a range of candidate predictors of treatment response within ICBT for adolescents. More specifically, we investigated clinical (baseline anxiety symptom severity, baseline depressive symptoms, a primary diagnosis of SoP, and age of onset), demographic (age, gender and computer comfortability), and therapy process-related predictors (number of completed modules, number of therapist calls, total call duration, degree of parental support, and therapeutic alliance). Based on previous results, we hypothesized that higher baseline symptom severity, higher age (within the range 13 to 17), more completed modules, as well as higher therapeutic alliance scores would predict larger improvements, while more baseline depressive symptoms, a primary diagnosis of SoP, and low computer comfortability would predict less improvement. Due to the limited research on age of onset, gender, and degree of parent- and therapist support as candidate predictors, these analyses were considered exploratory.

2. Methods

2.1. Participants and recruitment

The study took place at the Centre for Psychological Treatment of Children and Adolescents (CEBU), a research and teaching facility at the Department of Psychology and Behavioral Sciences, Aarhus University, Denmark. Participants in the study were 65 adolescents who received ICBT treatment within the context of a previous randomized controlled trial (Stjerneklar et al., submitted for publication; ClinicalTrials.gov: NCT02535403). Inclusion criteria were as follows: (a) age between 13 and 17 years; (b) a primary anxiety diagnosis according to the *Diagnostic and Statistical Manual of Mental Disorders, 4th*

ed. (DSM-IV; American Psychiatric Association, 1994); (c) access to a home computer with internet; and (d) ability to write and read in Danish. Criteria of exclusion were: (a) severe comorbid depression ($CSR > 5$); (b) substance abuse; (c) severe self-harm or suicidal ideation; (d) pervasive developmental disorder; (e) intellectual disability; (f) learning disorder; and (f) psychotic symptoms. A detailed description of RCT study procedures are found elsewhere (Stjerneklar, Hougaard, McLellan, & Thastum, submitted for publication). Upon the return of a signed consent form, 70 families were included in the previous RCT and randomly allocated to 14 weeks of ICBT treatment ($n = 35$) or a WL group ($n = 35$). Having waited for 14 weeks, families in the WL group recompleted questionnaires, took part in a second diagnostic interview, and were offered ICBT treatment identical to the one participants in the ICBT group had completed. Four participants from WL declined treatment and dropped out before their second assessment (the baseline assessment of the present study); additionally, one had improved during the WL period and did not meet criteria for any diagnoses at baseline. This participant decided to complete treatment, but was excluded from the present study. The study was approved by the local Ethics Committee of Central Denmark Region (1-10-72-98-15) and by the Danish Data Protection Agency.

2.2. Measures

2.2.1. Outcome measures

2.2.1.1. The Anxiety Disorders Interview Schedule. Type and severity of anxiety disorders was assessed using the Anxiety Disorders Interview Schedule for DSM-IV: Child and Parent Version (ADIS-IV C/P; Silverman and Albano, 1996). ADIS-IV is a semi-structured diagnostic interview, which in this study was conducted by graduate psychology students with the adolescent and one parent (usually the mother) separately to evaluate the diagnostic criteria of anxiety disorders in accordance with DSM-IV (American Psychiatric Association, 1994). Assembling information from both informants, the severity of diagnoses - the Clinical Severity Rating (CSR) - was assessed by a clinical psychologist on a nine-point Likert scale (0 = not at all disturbing; 8 = severely disturbing). A CSR of \geq four represent clinical level of impairment, whereas scores below four are considered subclinical. Where symptom criteria for several diagnoses were met, the one with the highest CSR or judged most disturbing by the assessor was considered the primary diagnosis. The ADIS-IV has well-established psychometric properties (Silverman et al., 2001; Wood et al., 2002). High inter-rater reliability and validity of the ADIS-IV administered over the telephone has been demonstrated, comparable to those administered face-to-face (Lyneham and Rapee, 2005). Interrater-reliability (Cohen's Kappa), as calculated in the RCT (Stjerneklar et al., submitted for publication), for primary anxiety diagnoses was excellent, $K = 0.80$. The intra-class correlation coefficient (ICC; two-way random for individual raters, consistency) was fair, $ICC = 0.419$ (95% CI: -0.121–0.768; $p = 0.060$), for the CSR of primary anxiety diagnosis (CSR_{prim}), and good, $ICC = 0.73$ (95% CI: 0.348–0.905; $p = 0.001$) for the summed CSR of all anxiety diagnoses (CSR_{all}) when calculated in the RCT (Stjerneklar et al., submitted for publication). Please note that only the summed CSR of all anxiety diagnoses was used as outcome measure in the present study.

2.2.1.2. The Spence Children's Anxiety Scale. Adolescent- and parent-reported anxiety symptoms were assessed using the Spence Children's Anxiety Scale: Child and Parent Version (SCAS-C/P; Spence, 1998). The SCAS contains 38 items rated on a four-point Likert scale from zero to three, with higher scores indicating higher anxiety symptom levels. The questionnaire is administered separately to the adolescent (SCAS-C) and to parents (SCAS-P). The Danish version of SCAS has demonstrated good to excellent internal consistency and good test-retest reliability (Arendt et al., 2014). Internal consistency (Cronbach's alpha) in the current study was excellent for both the adolescent ($\alpha = 0.90$) and

parent version ($\alpha = 0.90$). Please note that only the SCAS-C and not the SCAS-P was used as outcome measure.

2.2.2. Measures of predictors

The CSR_{prim} and CSR_{all} were assessed with the ADIS-IV. Self-rated depressive symptoms were measured with *The Short version of the Moods and Feelings Questionnaire* (S-MFQ; Angold et al., 1995). The S-MFQ measures depressive symptoms within the last two weeks through 13 items rated on a three-point Likert scale (0 = not true; 2 = true). The S-MFQ has demonstrated good psychometric properties (Angold et al., 1995). In the present study, internal consistency was excellent ($\alpha = 0.92$). Age of onset of anxiety symptoms was derived from the mother pre-treatment questionnaire with the question: *At what age did you first notice your child being more anxious than other children?*

Demographic data were collected through the online pre-treatment questionnaires. Participants' computer comfortability was measured with the question: *How comfortable do you feel using the computer and the internet?* rated on a four-point Likert scale (1 = not comfortable at all; 4 = very comfortable).

A module was defined as complete when 80% or above of the core module components (i.e., instructions, example-videos and practice tasks excluding worksheets) had been activated according to website server logs. Number and duration of therapist phone calls was calculated from participant records. Only actual conversations (i.e., no missing calls) were included in the analyses. Degree of parent support was derived from the mother post-treatment questionnaire with the question: *On average, how much time have you spent weekly helping your teen complete the program?*

Therapeutic alliance was assessed with *The Working Alliance Inventory-Short Form* (WAI-S; Tracey and Kokotovic, 1989). The WAI-S is a 12-item version of the original 36-item WAI (Horvath and Greenberg, 1989) measuring the therapeutic alliance between therapist and adolescent as reported by the adolescent. Items are rated on a seven-point Likert scale (1 = never; 7 = all the time). The questionnaire contains three subscales in agreement with Bordin's (1979) alliance concept: therapeutic bond, agreement on therapeutic goals, and agreement on therapeutic tasks. In the present study, only the total scale was used. The scale has demonstrated good psychometric properties, with a Cronbach's alpha of $\alpha = 0.93$ for the total scale (Tracey and Kokotovic, 1989). Internal consistency in the present study was α (week four) = 0.92; α (week eight) = 0.94; α (post) = 0.94.

Diagnostic status was assessed at baseline (pre), after the intervention (post), and at three-month FU. All diagnostic interviews were recorded using Crystal Gears® Ver. 2.00 RTM. Fourteen (20%) of the 35 ICBT pre-interviews were re-assessed for inter-rater reliability purposes. The 14 interviews were selected from the top of a random list of all pre-interviews, created with an online list randomizer using atmospheric noise. Adolescents and their parents received the online self-report questionnaires at pre, post, three- and twelve-month FU. For the purpose of the present study, only the adolescents' and mothers' responses were used. The therapeutic alliance questionnaire (WAI-S) was administered at week four and eight of treatment as well as at post-treatment. All questionnaires were administered through an electronic data collection platform, SurveyXact.

2.3. Treatment

ChilledOut Online is based on the *Cool Kids* and *Chilled* treatment programs developed at Macquarie University, Sydney, Australia (Lyneham et al., 2014). The program teaches CBT inspired anxiety management strategies for adolescents through eight online modules of approximately 30 min each, with a focus on psychoeducation, cognitive restructuring, goal setting, and graded exposure. Program content is provided through a combination of multimedia formats such as text, audio, illustrations, and video vignettes. Within each module, adolescents are presented with different worksheets and homework practice

tasks that they are encouraged to keep working on when they are not in front of the computer. Adolescents were advised to complete all modules within the intervention period of 14 weeks, after which they would have another three months of web site access.

Adolescents received a weekly phone call from a trained graduate student therapist focusing on problem solving, technical assistance, feedback about homework tasks, and encouragement. At three-month FU, adolescents received a booster phone call from the therapist mainly addressing motivation and consolidation of previously learned skills. Parents received the *ChilledOut Parent Companion* handout before treatment start describing the program's core treatment strategies and advising them on how to best support their teenager throughout the intervention. Additionally, parents received an introductory phone call from the therapist within the first two weeks of treatment. Further treatment details are provided elsewhere (Stjerneklar et al., submitted for publication; Stjerneklar et al., 2018).

2.4. Statistical analyses

The present study employed a repeated measurements design examining the following predictors of treatment response: Clinical characteristics including baseline self- and parent-reported anxiety symptom levels (SCAS-C/P), baseline CSR_{prim}, summed baseline CSR_{all}, baseline self-rated depressive symptoms, age of onset, and primary diagnosis of SoP. Demographic characteristics including age, gender and computer comfortability. Therapy process-related variables including number of completed modules, number of therapist phone calls, summed duration of therapist phone calls, degree of parent support, and therapeutic alliance. Predicted outcome was evaluated as (a) change score in summed severity of all anxiety diagnoses (CSR_{all}) from pre to 3-month FU, and (b) change in self-reported anxiety symptoms (SCAS-C) from pre to 12-month FU. Analyses that included the same variable as both predictor and outcome/criterion (i.e., CSR_{all}/CSR_{all}, CSR_{prim}/CSR_{all}, and SCAS-C/SCAS-C) were omitted from the study to prevent overlap.

Mixed linear models (MLMs) were used to test candidate predictors over time, i.e. time × predictor with all measuring points included in the analyses. As MLMs tolerate missing values without compromising power, all analyses were based on the intention-to-treat sample (N = 65) without imputations of missing values; a method recommended over other procedures in longitudinal clinical trials (Chakraborty and Gu, 2009). Data were hierarchically arranged in two levels, with time at Level 1 nested within individuals at Level 2. MLMs were estimated with the full maximum likelihood method, and dependent variables were treated as continuous. Models included a random intercept, and the slope was specified as random if it significantly improved model fit as evaluated by a change in the -2LL fit statistics (Heck et al., 2014). A candidate variable was considered a predictor if the two-way interaction term was statistically significant. As suggested when assessing single predictors using multiple measurement tools (Knight et al., 2014), Bonferroni adjustments were used to correct for family-wise analysis error. Candidate predictors were analyzed with two different outcome measures, thus statistical significance was defined as $p \leq 0.025$ (0.05/2) with a two-tailed significance level. Effect sizes were expressed as Cohen's *d* derived from the F-test, calculated as $d = 2 \times \sqrt{F/df}$. All analyses were carried out using IBM® SPSS® statistics, v.24.0 (Armonk, NY: IBM Corp.).

All candidate predictors were included in the analyses as continuous variables. For illustration purposes, variables found to significantly predict treatment response were dichotomized according to the median when graphically depicted.

Although in the original RCT, modest symptom improvements were observed among WL participants while on waitlist (as reported in Stjerneklar et al., submitted for publication), no significant differences in treatment effect over time were found between the two conditions on any of the included outcome measures ($p = 0.326$ – 0.954). Thus, all

Table 1
Sample characteristics.

Continuous variables	N	Mean	SD
Age (years)	65	15.2	1.33
Age of onset	65	8.6	4.32
SCAS-C total	64	43.8	17.01
SCAS-P total	65	44.7	16.94
CSR primary diagnosis	65	6.4	0.86
CSR all anxiety diagnoses	65	12.0	5.62
S-MFQ	64	9.3	6.86
Number of anxiety diagnoses	65	2.1	1.01
Number of completed modules	65	6.4	2.02
Number of therapist calls	65	10.4	2.80
Summed call duration (hours)	65	3.1	1.33
Computer comfortability	65	3.5	0.59

Dichotomous variables	N	Frequency	Percentage
Gender (female)	65	51	78
Primary diagnosis			
Social phobia	65	27	42
Generalized anxiety disorder	65	9	14
Separation anxiety disorder	65	7	11
Specific phobia	65	6	9
Obsessive compulsive disorder	65	6	9
Agoraphobia without a history of panic disorder	65	4	6
Panic disorder without agoraphobia	65	3	5
Panic disorder with agoraphobia	65	3	5
Comorbid mood disorder	65	4	6
Degree of parental assistance ^a			
No time	61	7	11
0–10 min	61	17	28
10–30 min	61	13	21
30–60 min	61	16	26
1–2 h	61	4	7
2–5 h	61	3	5
> 10 h	61	1	2

Note: SCAS-C: Spence Children's Anxiety Scale, Child version; SCAS-P: Spence Children's Anxiety Scale, Parent version; CSR: Clinical Severity Rating; S-MFQ: Short version of the Mood and Feelings Questionnaire.

^a Weekly average.

predictor analyses were conducted using data from the pooled sample of 65 participants. Post hoc power calculations based on ANOVA (repeated measures) indicated that a sample size of 65 and an error probability of $\alpha = 0.05$ (two-tailed) would have sufficient power (0.80) to detect an effect size of $d = 0.70$.

3. Results

3.1. Study flow and sample characteristics

The degree of missing data (intention-to-treat sample, N = 65) was as follows: ADIS (pre = 0; post = 2; 3-month FU = 9); SCAS-C (pre = 1; post = 9; 3-month FU = 16; 12-month FU = 18), and SCAS-P (pre = 0; post = 4; 3-month FU = 6; 12-month FU = 14). Reasons for non-completion are largely unknown, as most non-completers could not be reached.

Baseline sample characteristics are presented in Table 1. The 65 participants (78% females) had a mean age of 15.2 (SD = 1.33; range 13–17). The most common primary diagnosis was SoP (42%), followed by GAD (14%), separation anxiety disorder (11%), specific phobia (9%), and obsessive-compulsive disorder (OCD) (9%). The remaining participants met criteria for panic disorder, with (5%) or without (5%) agoraphobia, or agoraphobia without a history of panic disorder (6%). Mean number of anxiety diagnoses per adolescent was 2.1 (SD = 1.01). Regarding participants' computer comfortability, thirty-four (52%) reported feeling 'very comfortable' using computer and internet, 28 (43%) reported feeling 'fairly comfortable', two (5%) reported feeling only 'a little comfortable', and none reported 'not at all comfortable',

Table 2
Results from predictor analyses.

	SCAS-C			CSR _{all}		
	F	p	d	F	p	d
Clinical predictors						
Baseline SCAS-C	–	–	–	5.53	0.020*	0.42
Baseline SCAS-P	1.75	0.187	0.21	2.16	0.144	0.26
Baseline CSR _{prim}	2.07	0.152	0.23	–	–	–
Baseline CSR _{all}	7.57	0.007*	0.44	–	–	–
Baseline S-MFQ	8.02	0.005*	0.44	1.08	0.300	0.19
Anxiety symptoms onset	4.21	0.042	0.32	2.30	0.132	0.27
Primary diagnosis of SoP	0.68	0.410	0.13	0.54	0.466	0.13
Demographic predictors						
Age	0.62	0.433	0.12	1.31	0.255	0.21
Gender	5.79	0.017*	0.38	8.62	0.004*	0.52
Computer comfortability	9.57	0.002*	–0.49	0.98	0.323	–0.18
Therapy process-related predictors						
Number of completed modules	0.00	0.972	0.00	0.06	0.806	0.04
Number of therapist calls	2.55	0.112	0.24	0.98	0.325	0.17
Summed duration of therapist calls	0.03	0.870	0.03	0.26	0.608	0.09
Parent support	0.81	0.369	0.14	2.67	0.105	0.30
WAI-S week 4	0.82	0.368	0.15	4.11	0.045	0.39
WAI-S week 8	4.45	0.037	0.36	4.42	0.038	0.41
WAI-S post-treatment	4.17	0.043	0.33	1.42	0.236	0.23

Note. SCAS-C/P: Spence Children's Anxiety Scale: Child and Parent Version; CSR_{prim}: Clinical Severity Rating of primary diagnosis; CSR_{all}: summed Clinical Severity Ratings of all anxiety diagnoses; S-MFQ: Short version of the Moods and Feelings Questionnaire; SoP: social phobia; WAI-S: Working Alliance Inventory-Short Form. Positive effect sizes indicate improvement.

* Indicates statistically significant at the Bonferroni-corrected 0.025 level.

resulting in a mean rating of $M = 3.5$ ($SD = 0.59$). Participants (intention-to-treat, $N = 65$) completed a mean of 4.6 modules ($SD = 2.67$) and received a mean of 10.4 therapist calls ($SD = 2.80$) with an average summed call duration of 3.1 h ($SD = 1.33$).

3.2. Clinical predictors

Results are presented in Table 2. Higher self-reported baseline anxiety symptoms (SCAS-C) predicted larger improvement ($d = 0.42$; $p = 0.020$) on clinician-rated summed severity of all anxiety diagnoses (CSR_{all}). In addition, higher clinician-rated baseline severity of all anxiety diagnoses (CSR_{all}) predicted larger treatment response ($d = 0.44$; $p = 0.007$) in self-reported anxiety symptoms (SCAS-C). Change in variables for significant predictors is depicted in Fig. 1a–b.

Baseline depressive symptoms (S-MFQ) significantly predicted treatment response ($d = 0.44$; $p = 0.005$) when using self-reported anxiety symptoms (SCAS-C) as outcome variable. As seen in Fig. 2, higher levels of baseline depressive symptoms were associated with larger improvements over time compared with lower levels of baseline depressive symptoms.

Age of onset did not significantly predict treatment response after Bonferroni-correction. However, a numerical trend ($p < 0.05$) was found associating later age of onset with larger improvements in self-reported anxiety symptoms (SCAS-C).

3.3. Demographic predictors

A significant effect of gender was found both on change in self-reported anxiety symptoms (SCAS-C; $d = 0.38$; $p = 0.017$) and on change in summed severity of all anxiety diagnoses (CSR_{all}; $d = 0.52$; $p = 0.004$), indicating larger improvement for girls than for boys (depicted Fig. 3a–b).

Participants' computer comfortability significantly predicted treatment response ($d = -0.49$; $p = 0.002$) when measured as self-reported anxiety symptoms (SCAS-C). As depicted in Fig. 4, higher levels of

computer comfortability were associated with less improvement over time compared to lower levels of computer comfortability.

3.4. Therapy process-related predictors

None of the proposed therapy process-related variables significantly predicted treatment outcome after Bonferroni-correction (see Table 2). Trends ($p < 0.05$) were, however, found for four of the investigated six associations between alliance and outcome with small to moderate effect sizes ($d = 0.33$ – 0.41), i.e. better alliance scores associated with increased treatment response. WAI-S scores in week 4 ranged from 3.3 to 7.0 ($M = 5.9$; $SD = 0.81$), in week 8 from 2.4 to 7.0 ($M = 5.9$; $SD = 0.89$), and post-treatment from 2.0 to 7.0 ($M = 5.7$; $SD = 1.22$).

4. Discussion

As hypothesized, higher levels of self-reported baseline anxiety symptoms (SCAS-C) predicted larger improvements in clinician-rated summed severity of all anxiety diagnoses (CSR_{all}) over time. Also, higher clinician-rated summed baseline severity of all anxiety diagnoses (CSR_{all}) predicted larger improvements in self-reported anxiety symptoms (SCAS-C) over time. These results are in line with previous ICBT research in adults with anxiety disorders (Hadjistavropoulos et al., 2016; Hedman et al., 2013), suggesting that adolescents who suffer from relatively severe anxiety symptoms may obtain greater reductions in symptom severity from ICBT interventions compared to adolescents with less severe anxiety. Results should be interpreted in light of the symptom severity of the present sample. The average baseline scores on clinician-rated diagnostic severity (CSR_{prim}: $M = 6.4$, $SD = 0.86$), and on self- and parent-reported anxiety symptoms (SCAS-C: $M = 43.8$, $SD = 17.01$; SCAS-P: $M = 44.7$, $SD = 16.94$) of the present sample were generally similar to or higher than those of other adolescent studies using similar outcome measures, e.g. Spence et al. (2011) (CRS_{prim}: $M = 5.7$ – 6.3 , $SD = 0.13$ – 0.16 ; SCAS-C: $M = 36.3$ – 41.9 , $SD = 2.62$ – 3.34 ; SCAS-P: $M = 27.2$ – 33.9 , $SD = 1.95$ – 2.49) and Wuthrich et al. (2012) (CRS_{prim}: $M = 6.9$ – 7.0 , $SD = 0.25$ – 0.29 ; SCAS-C: $M = 34.0$ – 39.0 , $SD = 3.63$ – 3.99 ; SCAS-P: $M = 34.2$ – 39.3 , $SD = 3.79$ – 4.14). Self- and parent rated baseline anxiety symptom levels of the present sample were also generally similar to or moderately higher than those of adolescents from a gender differentiated clinical Danish norm population (SCAS-C_{females}: $M = 46.0$, $SD = 14.42$; SCAS-C_{males}: $M = 34.1$, $SD = 18.34$; SCAS-P_{females}: $M = 44.7$, $SD = 16.65$; SCAS-P_{males}: $M = 34.6$, $SD = 17.54$). Since not all measures of anxiety symptom severity predicted greater improvement (CSR_{prim} and SCAS-P were not significantly correlated with treatment response) it is hard to draw any firm conclusions about baseline symptom severity in general and interpretations should be done with caution. Furthermore, it should be notes.

Also in line with previous ICBT research in adults with anxiety disorders (El Alaoui et al., 2013; El Alaoui et al., 2015; Hedman et al., 2012), age of onset did not predict improvement. Contrary to our hypotheses, higher levels of baseline depressive symptoms predicted larger improvements in self-reported anxiety symptoms over time. This is in contrast to previous ICBT research with adults and to research within regular CBT for youth with anxiety disorders, both typically demonstrating higher levels of depressive symptoms to predict smaller improvements in anxiety. Similar to the average baseline anxiety symptom levels of the present sample, the baseline levels of depressive symptoms were relatively high in this study (S-MFQ: $M = 9.3$, $SD = 6.86$), compared to those of a Danish sample of clinically anxious youths (aged 7–16) assessed with the same measure ($M = 6.5$ – 6.7 , $SD = 5.00$ – 6.02) (Arendt et al., 2015). It is possible, that the demonstrated associations between baseline severity and degree of change are influenced by simple regression towards the mean, since participants with higher scores have more room for improvement. However, although participants with higher anxiety and depressive symptom scores

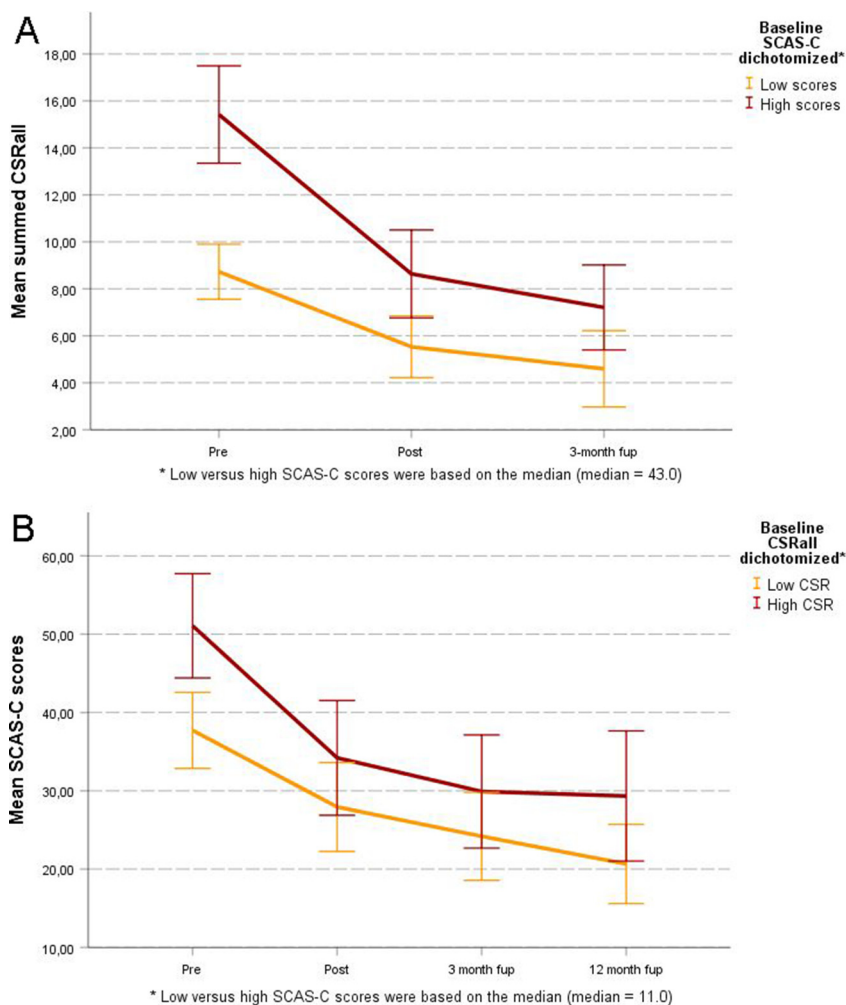


Fig. 1. a. Baseline self-reported anxiety symptoms on summed severity of all anxiety diagnoses
 b. Baseline summed severity of all anxiety diagnoses on self-reported anxiety symptoms.

obtained greater reductions in symptom severity over time, this does not mean that those with lower scores did not also improve. Finally, contrary to our expectations, a primary diagnosis of SoP did not predict less anxiety symptoms improvement compared to other anxiety diagnoses, thus contrasting previous results within CBT with children and adolescents (Compton et al., 2014; Hudson et al., 2015a, 2015b; Knight

et al., 2014; Lundkvist-Houndoumadi et al., 2014). Although it is a small-scale study, almost half of participants fulfilled criteria for a primary diagnosis of SoP. Future studies may provide more insight into the possibilities of treating SoP in adolescents with generic ICBT programs like ChilledOut Online.

Surprisingly, higher levels of computer comfortability predicted less

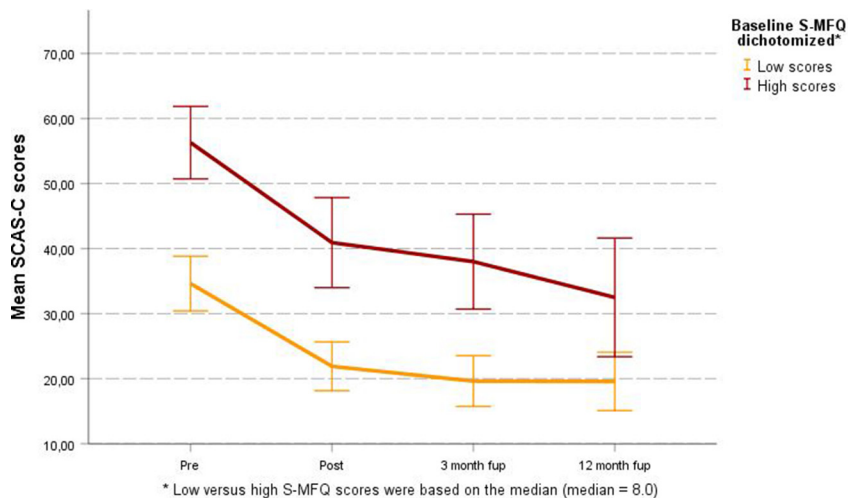


Fig. 2. Baseline depressive symptoms on self-reported anxiety symptoms.

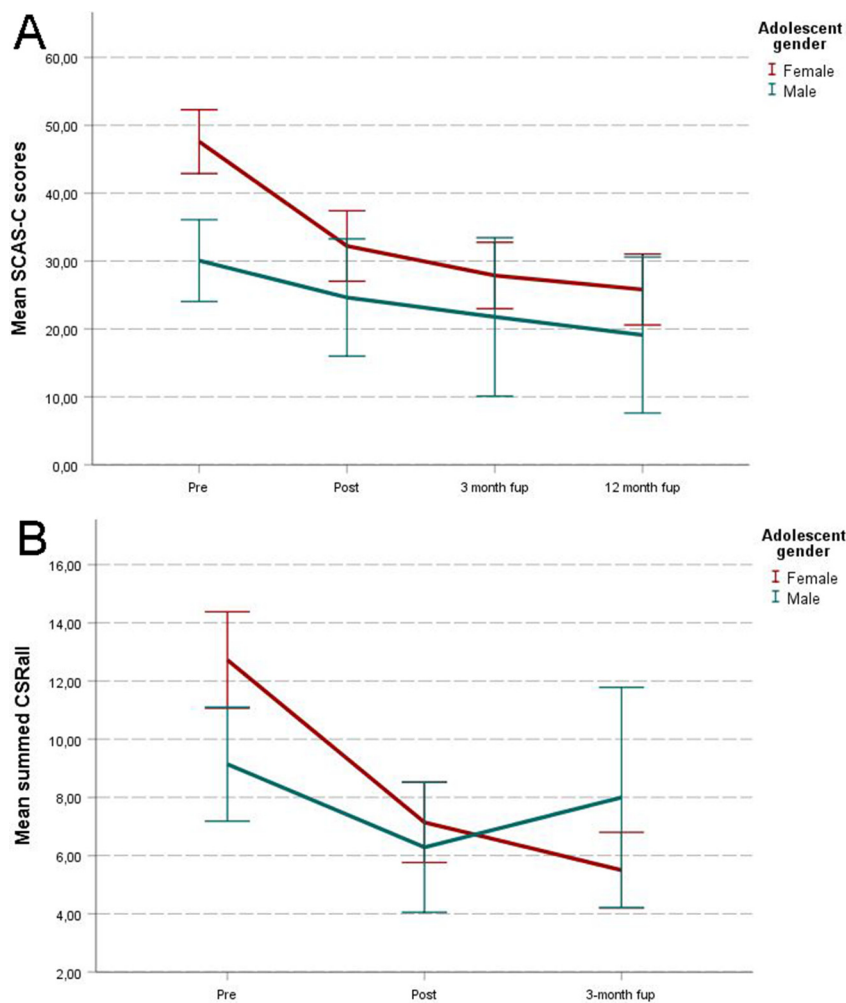


Fig. 3. a. Gender on self-rated anxiety symptoms
b. Gender on summed severity of all anxiety diagnoses.

improvement in self-reported anxiety symptoms over time. To our knowledge, this has not previously been tested within an adolescent population, and only few adult studies have investigated this variable with inconsistent results (Hadjistavropoulos et al., 2016; Hedman et al., 2012; Hedman et al., 2013). Although the adolescents' comfortability ratings were generally high with little variability (i.e., 95% reported feeling either 'fairly' or 'very' comfortable using computer and internet), it appears as if the adolescents' perception of their idiosyncratic

technological capabilities may be important to their overall treatment gains. Gender predicted both self-reported and clinician-rated reduction in symptom severity, suggesting that females show larger improvements over time compared to males. To our knowledge, this is the first study to include gender as a candidate predictor of ICBT for adolescents with anxiety disorders. The vast majority of studies of face-to-face CBT for children and adolescents, however, finds no gender differences in outcome (see reviews by Knight et al., 2014; Lundkvist-Houndoumadi

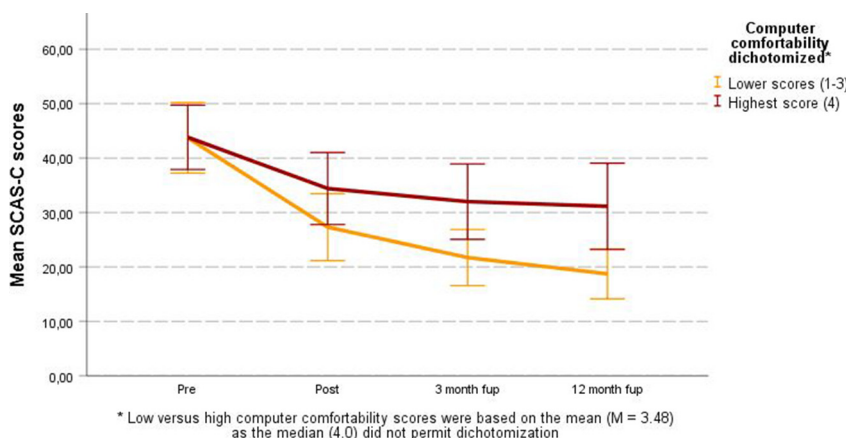


Fig. 4. Computer comfortability on self-reported anxiety symptoms.

et al., 2014; Rapee et al., 2009). Results of this study should be considered within the limits of a relatively small sample with few males represented ($n = 14$) and with females scoring markedly higher baseline anxiety on both outcome measures compared to males; baseline severity also predicted higher degree of change (SCAS-C: $M_{\text{females}} = 47.6$ (SD = 16.57), $M_{\text{males}} = 30.1$ (SD = 10.44); CSR_{all}: $M_{\text{females}} = 12.7$ (SD = 5.89), $M_{\text{males}} = 9.1$ (SD = 3.39)). Age did not predict outcome, in contrast to previous research within ICBT for children and adolescents typically associating higher age with better outcome (Ebert et al., 2015; Pennant et al., 2015; Podina et al., 2016). Our results may be explained by the small age range of the present study sample (i.e., 13–17 years) which is considerably narrower than those of previous studies demonstrating significant findings (6–25, 5–25, and 7–18, respectively).

Concerning process-related predictors, module completion did not predict treatment response contrasting previous research within ICBT for adults (Berger et al., 2014; El Alaoui et al., 2015; Hadjistavropoulos et al., 2016; Hedman et al., 2012; Hedman et al., 2013). It is, however, in line with the study by Lenhard et al. (2017) showing no predictive effect of module completion among anxious adolescents and with the study by Spence et al. (2017) who demonstrated a positive association between module completion and improvement accounting only for children – not for adolescents. Degree of parent support also did not predict treatment response, which may be explained by the need for autonomy and an ability to receive appropriate amounts of support from the adolescents' surroundings. However, as parent support has not previously been investigated as a continuous variable within ICBT for adolescents, these results must be interpreted with caution.

The therapeutic alliance was not a significant predictor of treatment response after Bonferroni-correction, although there was a positive trend ($p < 0.05$) in four of the six examined associations. Disregarding the post-therapy alliance ratings (which cannot influence later therapy outcome) the mean effect size of the association between alliance and outcome was $d = 0.33$, corresponding to $r = 0.16$ (Rosenthal, 1991), roughly equivalent to those found in the two meta-analyses of face-to-face psychotherapy with adolescents (McLeod, 2011; Shirk et al., 2011). The level of alliance ratings on WAI-S in the present study ($M = 5.7$ – 5.9 out of max 7.0) are high, corresponding to those reported in a previous study by Anderson et al. (2012) on ICBT for adolescents with anxiety disorders ($M = 5.6$). Thus, current research seems to support a prior conclusion from the adult literature (Berger, 2017) that level of alliance ratings in ICBT are roughly equivalent to those reported for face-to-face psychotherapy.

The most important clinical implication of the present study is that adolescents suffering from more severe baseline anxiety symptoms show greater reductions in clinician-rated summed severity of all diagnoses and in anxiety symptom severity, possibly suggesting that adolescents with more severe anxiety symptoms may benefit as much (if not more) from ICBT as those with less severe anxiety; hence, clinicians and researchers should be mindful not to exclude these individuals from ICBT interventions due to the assumption that ICBT as a low intensity treatment is suitable only for adolescents with mild anxiety. Also, levels of depressive symptoms may not per se impair the beneficial effects of ICBT on anxiety. However, it should be kept in mind that comorbid severe depression was excluded from the study. The finding of gender should be taken with caution due to the low number (14) of males in the sample and marked gender differences in pre-treatment anxiety severity that also predicted outcome.

4.1. Limitations

The study has several limitations. The primary study was an RCT, and the predictor analyses were secondary. As in most RCTs, exclusion criteria (e.g. not allowing comorbid severe depression) might have limited the variability in relevant clinical pre-treatment variables. The study had only acceptable power to detect moderate to large effects

($d \geq 0.7$). The lack of control group makes it impossible to determine if pre-treatment predictors interacted with treatment (i.e. were moderators) or just might indicate positive prognoses even without treatment. Alliance-outcome associations were correlational in nature without taking account of timelines of change in alliance and outcome. As effect sizes of predictors identified in the present study ranged from small to moderate, the clinical impact is probably limited and results should be viewed in this perspective.

The study also has several strengths, for instance the use of psychometrically strong and validated assessment instruments, low attrition rates, and one-year FU. To the best of our knowledge, it is the first trial specifically aimed at identifying predictors of ICBT treatment response for adolescents with anxiety disorders.

5. Conclusion

Most importantly, results from this study suggest that baseline severity of anxiety and depressive symptoms were positive predictors of treatment response. This finding lends support to the use of ICBT for youths with anxiety disorders, even those with relatively severe symptom levels. As a first study within the area, results may contribute to enlarge the knowledge base within predictors of treatment response in ICBT for youth anxiety disorders.

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Declaration of interests

The authors declare no conflicting interests.

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