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Internet-Delivered Cognitive Behavior Therapy for Anxiety and Insomnia in a Higher Education Context

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ICBT FOR ANXIETY AND INSOMNIA IN UNDERGRADUATES

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Internet-Delivered Cognitive Behavior Therapy for Anxiety and Insomnia in a Higher
Education Context

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Disclosure statement

At the time this research was undertaken, the corresponding author an employee of Ultrasis UK Ltd., which makes the products ‘Anxiety Relief’ and ‘Insomnia Relief’. The corresponding author is a minor shareholder in this company.

Abstract

Background: Anxiety and insomnia can be treated with internet-delivered Cognitive Behavioural Therapy (iCBT). ICBT may be well-suited to students, who are known to be poor help-seekers and suffer these symptoms. ICBT can offer easy access to treatment and increase service availability. The aim of this study was to evaluate the efficacy of anxiety and insomnia iCBT programs in students.

Design: A randomized, controlled study.

Methods: Students were randomly allocated to intervention (‘Anxiety Relief’: $n=43$; ‘Insomnia Relief’: $n=48$; control: $n=47$). Interventions lasted 6 weeks. Outcome measures were the State-Trait Anxiety Inventory and the Pittsburgh Sleep Quality Index.

Results: Significant within-group reductions in anxiety ($t(31) = 2.00, p=.03$) with moderate between-group (compared to control) effect size ($d=.64$) and increases in sleep quality ($t(31) = 3.46, p=.002$) with a moderate between-group effect size ($d=.55$) were found for completers of the anxiety program from pre- to post- intervention. Significant within-group increases in sleep quality were found for completers of the insomnia program from pre- to post- intervention ($t(35) = 4.28, p >.001$) with a moderate between-group effect size ($d=.51$).

Conclusions: Findings support the use of iCBT for anxiety and insomnia in students, and

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indicate that further research is needed.

Keywords: Internet-delivered Cognitive Behavior Therapy, CCBT, student mental health, undergraduates, anxiety, insomnia

Introduction

Student mental ill-health is an increasingly large problem in the UK (Cooke, Bewick, Barkham, Bradley, & Audin, 2006). Two recent UK student surveys have highlighted that i) more than 50% reported poor sleep/insomnia; and ii) up to 55% reported anxiety (Kerr, 2013; StudentBeans.com, 2011). Indeed, insomnia and anxiety are common manifestations of student psychological distress (Webb, Ashton, Kelly, & Kamali, 1996). Anxiety and insomnia are frequently comorbid, have a bidirectional predictive relationship, and are also both predictors of later depression (Jansson-Fröjmark & Lindblom 2008). Both problems have academic, as well as mental health implications.

Erratic sleep patterns are common among students (Brown, Buboltz, & Soper, 2002), and poor sleep quality is a global problem, with a large proportion of students meeting the commonly used criteria for poor sleep, scoring >5 on the Pittsburgh Sleep Quality Index (PSQI - Buysse Reynolds, Monk, Berman, & Kupfer, 1989). While rates vary across countries, the proportion of students with poor sleep according to the PSQI criteria is generally concerning, with rates as high as 60% in the US (Lund, Reider, Whiting, & Pritchard, 2010). To the best of our knowledge no published data exist on the prevalence of poor sleep in UK students according to the PSQI criteria, but rates of UK students reporting sleep problems in surveys are comparable, ranging from 24% (Webb et al., 1996) to 61% (studentbeans.com; Kerr, 2013).

Sleep problems are related to academic performance, and students with sleep

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problems are over-represented among students at risk of academic failure (Gaultney, 2010). Insomnia is also linked with other mental health problems. Sleep problems are prevalent in individuals with anxiety and depression throughout the adult lifespan (Taylor, Lichstein, Durrence, Reidel, & Bush 2005) but also represent an increased risk for the subsequent development of these disorders (Baglioni et al., 2011). Associations between poor sleep quality and depression have also been found in student samples (Moo-Estrella, Perez-Benitez, Solis-Rodriguez & Arankowsky-Sandoval, 2005), and poor sleep, anxiety, and depression are frequently comorbid and bi-directional (Jansson-Frojmark & Lindblom 2008). Student sleep problems may therefore not only be threatening to academic performance but could also be a risk factor for the development of mental health problems.

Like insomnia, anxiety among students is common and potentially academically damaging. In UK undergraduates, Andrews & Wilding (2004) found that 20% of previously symptom-free students became clinically anxious between one month prior to starting university and midway through their course. Furthermore McKaskill (2012) found that 97% of UK undergraduates who met clinical caseness criteria on the General Health Questionnaire (Goldberg & Williams, 1991), did so for anxiety. Anxiety is a known risk factor for depression onset (Parker et al., 1999) and often temporally precedes depression (de Graaf, Bijl, Spijker, Beekman, & Vollebergh, 2003). Among students, test anxiety, a situation-specific anxiety (Eysenck Derakshan, Santos, & Calvo, 2007), has deleterious effects on academic performance, with those high in test anxiety performing worse than those who are low in test anxiety (Cassady & Johnson, 2002; Chapell et al., 2005). There is a clear need for widely available, affordable student mental health service provision to tackle insomnia and anxiety.

Internet-Delivered-Cognitive Behavioural Therapy (iCBT) for Anxiety and Insomnia

Classical Cognitive Behavior Therapy (CBT, Beck, 1967; 1987) is a widely used

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therapeutic approach effective in the treatment of common mental health problems (Butler, Chapman, Forman & Beck, 2006). Meta-analyses have found CBT to be effective at treating anxiety (Norton & Price, 2007; Morin et al., 2006) and insomnia (Harvey & Tang, 2003; Okajima, Komada, & Yuichi, 2011) in a range of populations. Over the past decade, the Internet has increasingly been used to deploy CBT based self-help for common mental health problems including anxiety (Paxling et al., 2011) and insomnia (Ritterband et al., 2009). Such treatments are referred to as 'internet-delivered CBT' (iCBT). The nature of iCBT means that interventions can be made widely available, all of the time, without waiting lists (Andersson, 2010; Cavanagh & Millings, 2013).

Researchers have found iCBT effective at reducing anxiety. Titov et al. (2009) found that participants receiving therapist-assisted iCBT for anxiety improved significantly relative to control. Kiropoulos et al. (2008) found that iCBT for panic yielded comparable effectiveness to face-to-face CBT, and Klein, Richards and Austin (2006) found that iCBT with email contact had superior effects on panic over a CBT manual with therapist assistance. Furthermore, Cuijpers et al.'s (2009) meta-analysis found that computer-assisted psychotherapy was as effective for anxiety disorders as face-to-face psychotherapy, but there was a negative association between the amount of therapist time that was 'replaced' by the computer and the effect size of improvements. Despite this caution, the evidence base broadly supports the use of iCBT for anxiety disorders. As yet, it is unknown whether these findings will extend to a student population, where so far, tested programs have been for a single, situation-specific anxiety (Orbach et al., 2007) rather than more generalized anxiety symptoms.

Similar successes are described for iCBT for insomnia. Ritterband, et al. (2009) found that an internet delivered program was effective at reducing insomnia in a US community sample of insomnia sufferers. Ström, Pettersson & Andersson (2004) found that an iCBT

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program for insomnia was effective at improving sleep time, total wake time in bed, and sleep efficiency in a Swedish community sample of insomnia sufferers, albeit with small effect sizes. Furthermore, Vincent and Lewycky, (2009) found an online insomnia program to be effective for patients undergoing treatment for chronic insomnia, while in a randomised placebo controlled trial, Espie et al. (2012) found improvements in sleep efficiency, sleep diary outcomes, daytime outcomes, and sleep-wake functioning among adults with insomnia disorder using web-provided CBT versus imagery relief therapy. Similarly, in a comparison between internet and pen and paper self-help CBT, Lancee et al. (2012) found that both formats were effective compared to a wait-list control at improving daily sleep, insomnia, depression, and anxiety. Finally, among students, Trockel et al. (2011) found that emailed PDFs containing CBT self-help reading material for insomnia was effective at reducing symptoms among those who had sleep problems. However, the extent to which commercially available, fully-automated and online self-help programs can improve sleep quality in a student population is yet to be examined.

The potential benefits of iCBT for improving access to treatment among students specifically is vast because despite high levels of need, up to 85% of students with mental health problems do not seek help from available services (Eisenberg, Golberstein & Gollust, 2007). The use of internet-delivered interventions can help to address access convenience and confidentiality concerns, both of which have been cited as barriers to help-seeking among medical students (Givens & Tija, 2002). Preliminary research has found that although more distressed students are less likely to seek help, such students reported greater intentions to use a hypothetical online program for students than did those who were less psychologically distressed (Ryan, Shochet, & Stallman, 2010). This suggests that online interventions have the potential to 'scoop up' students in need of mental health services who may otherwise not receive them. Poor help-seeking in the student population might therefore be addressed by

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offering services universally, rather selectively to students who have identified themselves, or have been identified (or indicated to be) at-risk or symptomatic. While the distinction between ‘universal’ versus ‘selective’ or ‘indicated’ approaches usually applies to prevention rather than treatment (Muñoz, Cuijpers, Smit, Barrera, & Leykin, 2010), in a population where prevalence of symptoms is widespread and help-seeking is low, universal approaches to the availability of treatment might be appropriate.

The Current Study

Given the Royal College of Psychiatrists’ (2011) recommendation to increase the availability of iCBT in the UK student population, it is important to examine the effectiveness of this mode of treatment for common student mental health complaints. In this paper we describe an initial efficacy study examining the potential of two commercially available iCBT programs separately targeting insomnia and anxiety for use in a UK student sample. We examined commercially available products in order to emulate what might occur in student mental health services, where providers are likely to first turn to an ‘off-the-shelf’ program.

We hypothesised that (1) anxious symptoms would be reduced by iCBT for anxiety compared to control; and (2) sleep quality would be increased by iCBT for insomnia compared to control. Because of the known correlational and predictive relationships between anxiety, insomnia, and depression (Jansson-Fröjmark & Lindblom 2008) as well as the potential for transfer gains from CBT targeting one set of symptoms to also improve a related set of symptoms (e.g. Trockel et al., 2011, found that emailed CBT for insomnia improved both insomnia and depression) we also assess depression, and additionally hypothesize that (3) sleep quality might be increased by iCBT for anxiety; (4) anxious symptoms might be reduced by iCBT for insomnia; and (5) depressive symptoms might be reduced by either

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iCBT for anxiety or iCBT for insomnia.

Method

Participants

This study, which was not registered as a trial, received ethical approval from the University of Bristol Human Research Ethics Committee prior to participant recruitment. Participants were recruited by an email campaign, posters, and flyers, circulated at the University of Bristol prior to the summer examination revision period, inviting undergraduate students who were experiencing stress to take part in the study and learn techniques used to manage stress. Inclusion criteria were: interest and self-referral to the study (participants had to contact us in response to our advertising); being a native or advanced English reader, having Internet access, and being willing to attend a one-hour introductory session.

Power Analysis

A power analysis was conducted a priori for ANOVA repeated measures between factors (3 groups and 2 time points), using an effect size of $f = .25$ (a medium ES), which was selected because although studies have shown that iCBT can yield large effect sizes, these tend to be found with clinical populations (Titov, 2009; Vincent and Lewycky, 2009), or when targeting examination anxiety specifically in a student population (Orbach et al., 2007). We anticipated that in our non-clinical population, using more general programs, any effects would be more conservative. The power analysis revealed that a sample size of 147 would be required to detect a medium effect size. This number was increased to 180, to account for attrition rates of between 4-35% found in previous research using iCBT (Orbach, et al., 2007, Ritterband et al., 2009; Stöm et al., 2004; Trockel et al., 2011; Vincent & Lewycky; 2009). Of the original 180 students who contacted the experimenters, 138 ($n = 93$ women, mean age of 20.5 years, $SD = 1.95$, range = 18-34 years) attended the introductory session and were included in the study.

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Measures**State-Trait Anxiety Inventory-State (STAI-S).**

The STAI-S (Spielberger, Gorsuch, & Lushene, 1970) is a 20 item questionnaire, measuring feelings of tension, worry and apprehension. Participants rate each item on a 4 point scale, based on how much they agree with the statement, ranging from 1 'not at all' to 4 'very much', for example "I am worried." All items are summed to provide a total score ranging from 20-80. Higher scores indicate greater anxiety. Previous research has found a test-retest reliability of $r=0.54$ and an internal reliability of $\alpha = .92$ (Spielberger, 1983). The STAI-S can be used to evaluate how respondents feel in the present moment, or how they have been feeling recently, in relation to a specific stressor. This is done by revising the instructions (Spielberger et al., 1970). In the current study participants were asked to indicate how they had been feeling in the last week about their end of year examinations.

The Pittsburgh Sleep Quality Index (PSQI).

The PSQI (Buysse et al., 1989) consists of 19 items assessing sleep quality over the preceding month. These form seven components (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction) which are summed to generate a global sleep score (0-21). Higher scores indicate poorer sleep quality (Buysse et al., 1989). The PSQI has good test-retest reliability $r = 0.85$ and internal reliability $\alpha = 0.83$ (Baker & Sederer, 2002). Due to the brief intervention period, instructions for the PSQI were revised and participants were asked to report on events from the last two weeks.

The Beck Depression Inventory – Second Edition (BDI-II).

The BDI-II (Beck, Steer & Brown, 1996) is a 21-item questionnaire which measures depressive symptoms like prolonged sadness, self-criticism and suicidal thoughts in the preceding two weeks. Items are rated on a 4 point scale, based on how much participants

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agree with the statement, ranging from 0 'not at all' to 3 'very much' (e.g. "I am not discouraged about my future" and "I feel my future is hopeless and will only get worse") and scores range from 0-63. This inventory also has good test-retest reliability $r=.93$ and internal reliability $\alpha=.91$ (Beck et al., 1996).

ICBT Interventions

The interventions used were commercially available programs - 'Insomnia Relief' and 'Anxiety Relief', both retailed by Ultrasis UK Ltd. Both programs are unguided internet-delivered self-help programs featuring CBT components broken into 7 and 6 modules respectively (detailed in Figure 1), and contained monitoring tools depicting graphical feedback. Both programs were designed with subclinical symptoms in mind (Ultrasis, personal communication). Bulk site licenses are currently provided to universities and colleges (as part of a package which includes other programs for different symptoms) for less than £0.5 per student, per year. Both programs are designed for flexible, 'on demand' use. However in order to standardize the delivery of the treatment for the purposes of this study, participants were provided with instructions regarding the areas of the program to be completed, and completion order during the six week intervention period. Because evidence suggests that the outcomes for iCBT are improved by support provision in some form (Gellatly et al., 2007; Newman, Erickson, Przeworski, & Dzus, 2003), each participant received low intensity support in the form of standardised texts and emails that were manually sent each week, to remind them what module(s) they should have completed that week and provide encouragement.¹

[Insert Figure 1 here]

Procedure

Participants were enrolled seven weeks prior to the start of their examination period. Participants gave fully informed consent to take part in the study and subsequently completed

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the pre-intervention measures. Participants were then informed of the group to which they had been randomly allocated. Randomization was carried out using a random number generator in Excel, operated by the first two authors. This was done in blocks of 30 participants, to maximize the probability that groups would be largely comparable in sample size. Participants allocated to the intervention groups (either Insomnia Relief or Anxiety Relief) received the appropriate instructions and were then sent an email confirming their online access details for the program. Participants allocated to the control group were informed that they would be able to have access to the programs six weeks later, after the post-intervention session.

Six weeks later, all participants completed the post-intervention measures, followed by an open ended feedback questionnaire about the programs (data to be presented elsewhere).

Participants were compensated for their time at a rate of £10 per hour if they completed all aspects of the study. Those in the control condition were required to complete all pre- and post- measures resulting in a compensation of £10, while those in the intervention conditions were also required to engage with their allocated iCBT program for a minimum of 20 minutes per week, resulting in a compensation of £50. Usage data stored by the program enabled the identification of individuals who did not meet these criteria².

Data analysis

In order to examine whether the target symptoms (anxiety and insomnia) were reduced by the interventions, separate 3 (group: control, anxiety, insomnia) by 2 (time: pre-intervention, post-intervention) mixed ANOVAs were conducted with each target symptom score as the dependent variable, with repeated measures pre- to post-intervention. Where time X group interactions were significant, paired sample t-tests were used to examine the interaction. To explore the possibility of transfer gains in depressive symptoms, the same

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analysis was conducted for depression scores. Because the CONSORT checklist has dropped the requirement for intention-to-treat (ITT) analyses in favour of a clear description of the inclusion criteria for each analysis conducted (Moher et al., 2010), and following guidance by Armijo-Olivo, Warren and Magee (2009) regarding the evaluation of treatment efficacy, we first undertook Completer Only analyses, and then supplemented this with intention-to-treat (ITT) analyses for the sake of comparison. We conducted ITT using multiple imputations in SPSS version 20, which uses a Fully Conditional Specification (FCS, van Buuren, Brands, Groothuis-Oudshoorn, & Rubin, 2006) method using an iterative Markov chain Monte Carlo (MCMC) procedure. In this approach, multiple imputations of the data are generated and analysed and the pooled results are used to compare against the original data set. Finally, we conducted additional analyses featuring comorbidity and symptomology severity to ascertain whether the pattern of results differed according to severity and comorbidity of symptomology, and whether our results were driven by only a subgroup of comorbid participants with more severe symptomology.

Results

Sample Characteristics

Forty-three (31.2%) participants were allocated to receive 'Anxiety Relief', 48 (34.1%) participants were allocated to receive 'Insomnia Relief' and 47 (34.8%) participants were allocated to the control group. The gender distribution is detailed in Table 1, and the participant flow through the study is detailed in Figure 2.

[Insert Figure 2 here]

A chi square showed that the groups did not differ in gender distribution, $X^2(2, N = 138) = 1.67, p = .44$. One-way analysis of variances (ANOVA) showed that the groups were comparable in age ($F(2, 135) = .490, p = .62$), and did not differ on anxiety, sleep quality, or depression at baseline (STAI-S: $F(2, 135) = .83, p = .44$; PSQI: $F(2, 135) = .65, p = .53$;

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BDI-II: $F(2, 135) = .45, p = .64$ (Table 1).

[Insert Table 1 here]

Adherence and Attrition

Most participants ($n = 112, 81.2\%$) completed the study. In the intervention groups, 7 (5.1%) formally withdrew and 8 (5.8%) did not complete enough of the iCBT to meet the study criteria of engaging with their allocated program for 20 minutes per week and 8 (5.8%) participants failed to complete the post-intervention measures. Independent t-tests indicated that non-completers were comparable to those who completed the study on the self-report measures at the pre-intervention session (STAI-S: $t(136) = .12, p = .91$, PSQI: $t(136) = -.50, p = .62$, BDI-II: $t(136) = -.46, p = .65$) (Table 1).

Change in Self-Reported Anxiety as a Function of Intervention Group

For anxiety, the main effects of time ($F(1, 109) = .24, p = .627$) and group ($F(2, 109) = 2.98, p = .055$) were non-significant but the time X group interaction was significant ($F(2, 109) = 3.41, p = .037$). Post hoc paired sample t-tests were conducted on the pre-intervention versus post-intervention anxiety scores. These revealed that students in the Anxiety Relief group had lower anxiety symptom scores at post-intervention ($t(31) = 2.00, p = .03$, one tailed), with moderate within-group ($d = .51$), and between-group ($d = .64$) effect sizes³. No significant reduction in anxiety symptoms was found for those in the Insomnia Relief group ($t(35) = -.62, p = .54$) nor for those in the control group ($t(43) = -1.92, p = .06$) (Figure 3). In these analyses, there were two noteworthy trend results: i) the main effect of group, indicating that the control group had higher STAI scores to begin with ($p = .055$), and ii) the post-hoc paired sample t-test for the control group ($p = .06$), indicating that increase in STAI score for this group was almost significant (compared to the non-significant increase in the Insomnia Relief group and the significant decrease in the Anxiety Relief group). The imputed data demonstrated similar patterns, with *increases* in anxiety for both the control condition,

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$t(1711) = -2.066, p = .039$ and insomnia condition, $t(229) = -.595, p = .552$. In comparison there was a reduction in anxiety in the anxiety condition, $t(1987) = 1.352, p = .177$, however this failed to reach statistical significance.

These results indicate that while anxiety scores differed pre-intervention, they were reduced in the Anxiety Relief group, while they increased in the other two groups. Anxiety Relief therefore worked as a condition-specific intervention program, and no transfer gains occurred for the insomnia intervention program.

[Insert Figure 3]

Change in Self-Reported Sleep-Quality as a Function of Intervention Group

For sleep quality, there was a main effect of time ($F(1,109) = 23.86, p < .001$) and a significant time X group interaction ($F(2, 109) = 5.01, p = .008$) but no main effect of group ($F(2,109) = .98, p = .38$). The main effect demonstrates that sleep quality improved from pre-intervention ($M 6.95, SD 2.92$) to post-intervention ($M 5.76, SD 2.82$) (higher scores indicate more sleep problems) for all groups. To explore the interaction, paired sample t-tests were conducted on the pre-intervention versus post-intervention sleep quality scores. These revealed that students who completed Insomnia Relief had significantly higher sleep quality (represented by lower PSQI score) at post-intervention ($t(35) = 4.28, p < .001$), with a large within-group effect size ($d = 1.04$) and a moderate between-group effect size ($d = .51$). Similarly, those who completed Anxiety Relief also had higher sleep quality at post-intervention ($t(31) = 3.46, p = .002$), with a large within-group effect size ($d = 0.87$) and a moderate between-group effect size ($d = .55$). There was no significant improvement for those in the control group ($t(43) = .39, p = .70$) (Figure 4). The imputed data demonstrated similar patterns, with the insomnia condition demonstrating the largest significant improvement in sleep quality, $t(79) = 4.615, p < .001$. There was a smaller, yet still significant improvement in sleep quality in the anxiety condition, $t(755) = 3.192, p = .001$. No significant change in

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sleep quality was evident in the control condition, $t(13526) = .742, p = .458$.

[Insert Figure 4 here]

Change in Self-Reported Depression as a Function of Intervention Group

For depression, there was a significant effect of time ($F(1, 109) = 13.32, p = .001$) but no significant effects were found for group ($F(2, 109) = 2.59, p = .079$) nor the time X group interaction ($F(2, 109) = 1.36, p = .261$). A main effect of time shows that depression scores were generally lower post-intervention ($M 10.31, SD 6.90$) when compared to pre-intervention ($M 12.34, SD 7.52$) for all groups. The imputed data demonstrated similar patterns, with both treatment conditions demonstrating a reduction in depression (anxiety condition, $t(128) = 2.54, p = .012$; insomnia condition, $t(69) = 2.48, p = .016$), yet no effect for the control condition, $t(4292) = .991, p = .322$.

Change in Self-Reported Anxiety or Insomnia as a Function of Comorbidity or Symptom Severity

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We also conducted for the same analysis for individuals ($n = 55$) who had high stress symptomology, defined as comorbid high anxiety (STAI scores >38 , Spielberger et al., 1970) and poor sleep quality (PSQI scores >5 , Buysse et al., 1989). These cut-offs reflect scores that were higher than the average reported for female students, due to the majority female composition of our sample. We found a significant time \times group interaction using repeated measures 2 \times 3 mixed ANOVA for the STAI ($p = .039$) and PSQI ($p = .024$) scores, representing the same pattern of results as the main findings, for these comorbid participants. Post hoc paired-sample t-tests showed that Anxiety Relief produced a trend reduction in anxiety levels ($p = .058$, $d = .41$) as well improving sleep quality ($p < .001$, $d = 1.57$), whereas, Insomnia Relief only improved sleep quality ($p = .001$, $d = 1.12$).

To determine whether individuals with high symptomology might be driving our main results, we also conducted 2 (high and comorbid symptomology status: the group identified for the above analysis, and those not in that group (all other participants) \times 2 (Time: pre- and post- intervention) \times 3 (Group: Anxiety Relief, Insomnia Relief & Control) ANOVAs for both the STAI and PSQI. We found non-significant 3 way interactions for both the STAI ($p = .478$) and PSQI ($p = .358$), which indicates that high symptomology status does not affect the effectiveness of the interventions. Together, these analyses indicate that our results were not moderated by severity of symptomology, or symptom comorbidity.

Discussion

The main aim of this study was to examine the efficacy of two iCBT programs, Anxiety Relief and Insomnia Relief, compared to a wait-list control group, in treating self-reported anxiety and insomnia symptoms in students at a particularly stressful time in the academic calendar. We hypothesized that each program would be effective at reducing their target symptoms (H1 and H2). A secondary aim was to identify whether either program lead

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to transfer gains from one set of targeted symptoms (anxiety or insomnia) to the other (H3 and H4), or to depression (H5). We found evidence supporting the effectiveness of both programs at reducing their target symptoms, thus supporting H1 and H2. We also found evidence of transfer gains from Anxiety Relief, which improved sleep quality, thus supporting H3. H4 (that Insomnia Relief might improve anxiety), and H5 (that either program might improve depression), were not supported. Regarding depression, all three groups improved over time. We discuss each of these findings in turn, followed by a discussion of the limitations of our study design, and the implications of our findings both for future research and for mental health services in the Higher Education sector.

Participants allocated to the Anxiety Relief program had lower STAI scores at post-intervention compared with pre-intervention (6 weeks previously), suggesting that the program helped to alleviate symptoms during a time associated with significant stress in the student population. While this finding is in keeping with Cuijpers et al.'s (2009) meta-analysis, which found that iCBT for anxiety disorders is effective, the effect size compared to control for our study was moderate while that found in the meta-analysis was large. Cuijpers et al. (2009) found that the reduction in time spent with therapist in computer-aided therapies as compared to face-to-face therapies was negatively associated with effect size. Our smaller effect size might therefore reflect the 'light touch' nature of the support we provided to participants, which came in the form of texted reminders to persevere with the program, rather than any direct contact or therapeutic content.

Another explanation is that previous studies have examined clinical anxiety, rather than situation-specific anxiety around examinations. A more dramatic reduction can be expected in a clinical sample, because the anxiety level is higher to start off with and without treatment would remain high over time. However, the current study focusses on situation-specific anxiety, 7 weeks prior to the exam period. As exams get closer anxiety levels would

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be expected to rise. It is therefore not surprising that our effect sizes were more conservative because of this.

Participants allocated to the Insomnia Relief program improved in sleep quality from pre-intervention to post intervention (6 weeks later), indicating that the program was effective at alleviating its target symptom. This finding is in line with Okajima et al.'s (2011) meta-analysis, which found moderate-large effect sizes for CBT (rather than iCBT) for insomnia. Our effect size compared to control was moderate, and tallies with studies finding that iCBT can be effective for reducing insomnia in both community (Ritterband, et al., 2009; Ström et al., 2004) and patient (Vincent & Lewycky, 2009) populations, with effect sizes ranging from small to moderate (Ström et al., 2004) and small to large (Vincent and Lewycky, 2009). Among students, Trockel et al. (2011) found that emailed PDFs containing self-help CBT for insomnia was effective against a control treatment comprising a relaxation intervention delivered in the same format. Our findings suggest that a commercially available, interactive, fully automated online program accessed via secure login, and supported by brief text messages, is also effective at improving sleep quality among students.

Moreover the significant results were not driven by individuals with high symptomology or comorbidity. This suggests that a universal approach was an appropriate method to recruitment and that all individuals, even those with low symptom levels could benefit from using these iCBT programs. With regard to transfer gains, we found that Anxiety Relief had a moderate effect reducing insomnia symptoms. Given that anxious symptoms such as worry can interfere with sleep quality (Watts, Coyle, & East, 1994), our Anxiety Relief effects on insomnia are unsurprising. Indeed, they tally with Bélanger, Morin, Langlois, and Ladoceur's (2004) finding that group CBT for Generalised Anxiety Disorder significantly reduced insomnia severity among anxiety patients. To the best of our knowledge, our study is the first to report this similar effect for iCBT in a student population.

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We did not find transfer gains from Insomnia Relief to anxious symptoms. Our rationale for hypothesizing this possible effect was that CBT for anxiety and insomnia both feature cognitive restructuring, which is a core component of CBT. In line with transdiagnostic approaches (Barlow, Allen, & Choate, 2004) we therefore anticipated that iCBT for insomnia might also help anxiety. A possible reason why this transfer gain was not observed may be the specificity of some of the components in Insomnia Relief. For instance, the components of stimulus control therapy and sleep restriction therapy, are directly related to sleep, and do not offer transferrable skills that might target anxiety. Other components of Insomnia Relief, such as cognitive restructuring, relaxation, and guided imagery, while common across programs targeted for both insomnia and anxiety, may not have been potent enough to elicit transfer gains without more specifically anxiety-focused components. That is to say, while there are a common set of techniques that comprise CBT, perhaps those present in Insomnia Relief are not sufficiently foregrounded to be potent.

Our final hypothesis (H5) was that either Anxiety Relief or Insomnia Relief might evidence transfer gains on depressive symptoms, but we found no such effects. Again, this lack of transfer gains could indicate that the skills learned in these programs were not generalizable to depression. Additionally, some researchers have proposed that certain psychological problems, such as depression, are particular challenges to engagement with iCBT, due to the characteristic symptoms of hopelessness and poor concentration (Cavanagh & Millings, 2013). Such challenges may mean that programs intended for a different target disorder are even less likely to invoke transfer gains.

We found that depression generally improved over time, regardless of intervention group. This finding may relate to the time of year in which we conducted the study – the pre-examination period. Conceivably, as the examination period drew nearer, individuals' perceived control, a factor known to be protective against depression in students (Ruthig,

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Haynes, Stupnisky & Perry, 2009), may have increased, along with the knowledge that this stressful period would soon be over. Alternatively, we may have simply observed Hawthorne effects, whereby knowledge of research participation results in improvements in symptoms (De Amici, Klersy, Ramajoli, Brustia, & Politi, 2000).

While novel in its approach and topic, our study is not without limitations. For pragmatic reasons, participants were paid for taking part, and the intervention groups received more money than the control group. This may have had an impact on treatment adherence, such that in our sample, those in the intervention groups may have adhered better than an unpaid sample. Additionally, one could argue that the greater payment of those in the intervention groups compared to the control group may have resulted in their superior treatment effects. However, specific programs were effective for specific symptoms, and not universally effective. That is to say, we found differential effects of the programs we tested, which cannot be accounted for by the fact that participants received payments because payments were equivalent across intervention conditions. That said, future research should seek to replicate our findings without incentivizing research participation.

A further limitation of our study was that following the exclusion of participants who either withdrew, failed to engage with the iCBT programs for the minimum duration specified or complete the post intervention measures, based on our expectation of finding a medium effect size, the study was underpowered (a post-hoc analysis showed that power was .68). Additionally, with hindsight, a power calculation based on a small effect size may have been more appropriate, due to the iCBT being unguided (no therapist input beyond reminder text messages). Unguided iCBT consistently produces small, rather than medium effect sizes (Johansson & Andersson, 2012). That we found significant results despite the study being significantly underpowered suggests that conducting a full, adequately powered trial with the interventions we tested, preferably in more ‘real-world’ conditions, is warranted and should

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be addressed in future studies.

Another aspect of our study which may be viewed as a limitation is that we did not employ a screening procedure to identify and include only those individuals who were symptomatic. However, this reflects our decision to emulate a model of universal treatment availability. Because mental health problems are common, and help-seeking is poor among students, we would contend that universal approaches are more appropriate than indicated or selective approaches. Furthermore, given that we did not select students who were symptomatic, effect sizes may have been lower than in a selected sample. Indeed, our significant results in a non-selective sample of students indicate that the benefits of universal approaches to treatment availability in this population could be widespread.

Our study is limited by not having follow ups. While we found that at the end of the intervention period, those in the Anxiety Relief group had significantly reduced in both anxiety and insomnia symptoms and that those in the Insomnia Relief group had significantly reduced in insomnia symptoms, we do not know what happened to symptom levels in the post-intervention period. Cuijpers et al.'s (2009) meta-analysis of computer aided psychotherapy for anxiety found evidence of stability in anxiety from post-intervention to between 1 and 12 months follow up. Okajima et al.'s (2011) meta-analysis of CBT for insomnia indicates that improvements in sleep at post-intervention and at follow up were moderate-large, also suggesting stability over the post-intervention period (between 1 and 12 months). Further studies could examine whether this holds true with Anxiety Relief and Insomnia Relief applied to a student population. Future studies could also test for the emergence of transfer gains over time as practice over prolonged periods could increase the generalizability of the specific skills learned, to potentially reduce related sets of symptoms.

Future research can seek to build upon this study by employing a naturalistic design which makes iCBT programs available to the entire student body from within a participating

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university's webpages, without requiring students to contact the research team for access, and without offering payment for participation. Multiple follow-ups would allow for tracking the extent to which improvements in symptomology last over time, as well as whether some improvements versus others take longer to materialize (e.g. transfer gains on depression might be observable over a longer time frame). Such a trial would enable analytic approaches include to intention-to-treat and economic evaluations, which were beyond the scope of the current study.

In conclusion our findings suggest that commercially available iCBT programs are effective at reducing the symptoms of anxiety and insomnia in a student population during what is widely viewed as the most stressful period in the academic calendar. Following Ryan et al.'s (2010) study reporting a positive relationship between level of student distress and likelihood of using online interventions, and the Royal College of Psychiatrists' (2011) recommendation to increase the availability of iCBT in the UK student population, our study confirms the potential utility of two such programs, for anxiety and insomnia specifically. We hope that our study paves the way for a larger trial of iCBT for common mental health problems in student services both in the UK and internationally.

Footnotes

¹ Approximately 20% of these texts received a reply, mainly to confirm continued engagement with the program.

² Usage data detailed the pages accessed, but not the length of time spent on the last page accessed in an individual session. As such, it was possible to distinguish between those who cannot have spent 20 minutes engaging, from those who probably did. Precise usage data was

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not stored by the programme, due to the exit time only being recorded if users logged out rather than simply closed their browser.

³ Between-group effect sizes are between the intervention group in question and the control group.

Note

The corresponding author is a minor shareholder in Ultrasis UK Ltd, producers of Anxiety Relief and Insomnia Relief.

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Figure titles and captions

Figure 1

Content and structure of interventions

Figure 2

Participant and procedure flow

Figure 3

Changes in anxiety scores from pre- to post-intervention as a function of group

Note: Figure depicts pre- and post-intervention STAI-S (State-Trait Anxiety Inventory-State) scores for each group with error bars showing 2 SE

Figure 4

Changes in sleep quality scores from pre- to post-intervention as a function of group

Note: Figure depicts pre- and post-intervention PSQI (Pittsburgh Sleep Quality Index) scores for each group with error bars showing 2 SE.

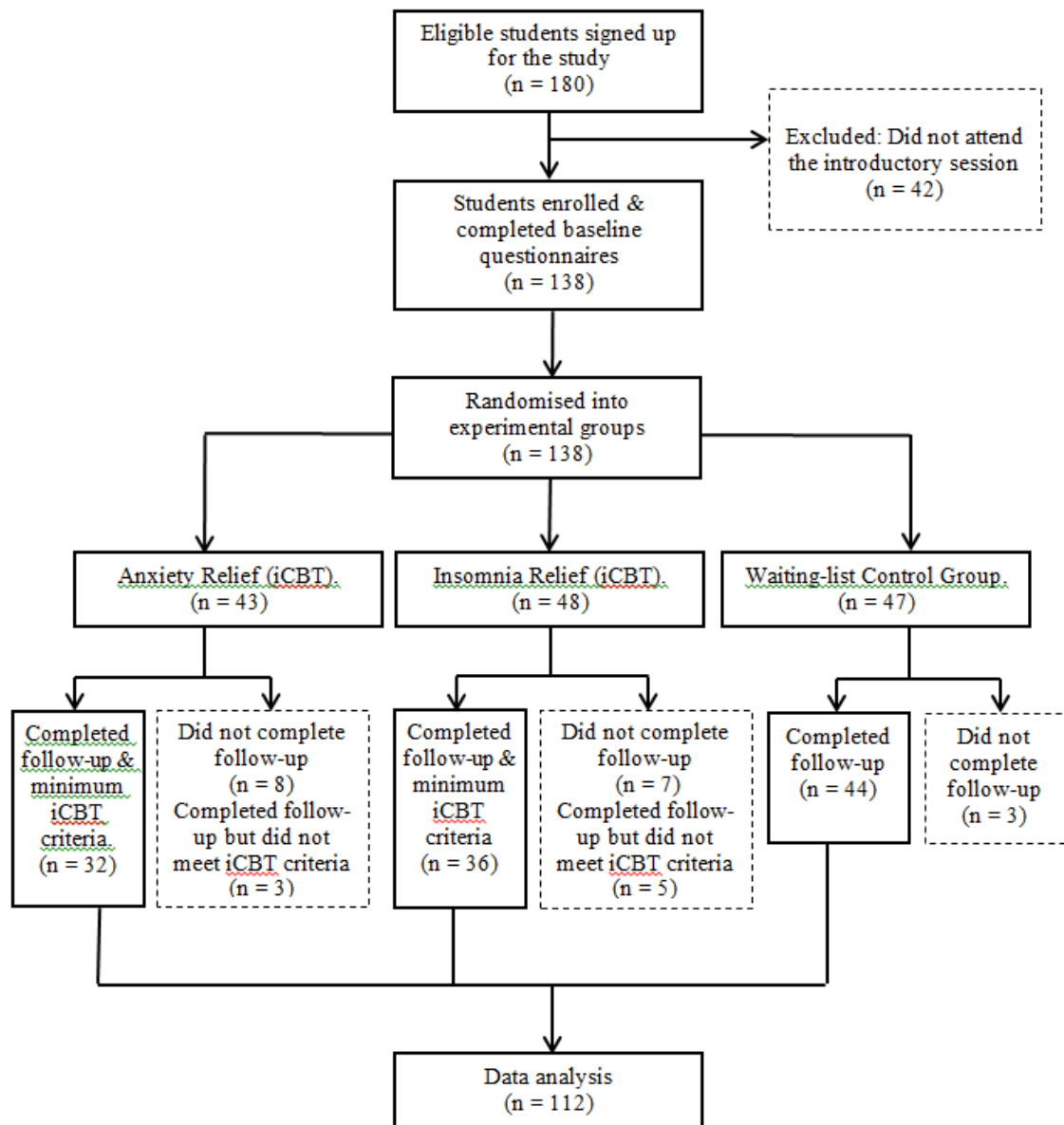
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Figure 1:

Insomnia Relief	
Module	Contents/techniques
About Insomnia	Psychoeducation
Visualisation	Cognitive/guided imagery
Calming Yourself	Relaxation techniques
Better Habits	Sleep hygiene, stimulus control therapy, sleep restriction
Clear Your Mind	Relaxation techniques
Welcoming Sleep	Progressive muscle relaxation
Information & Tips	Additional material
Anxiety Relief	
Module	Contents/techniques
About Anxiety	Psychoeducation
You are Not Alone	Psychoeducation
Tackling Your Fears	Self-monitoring and graded exposure
Thinking	Cognitive restructuring
Challenging your thoughts	Cognitive restructuring
Information & Tips	Additional material

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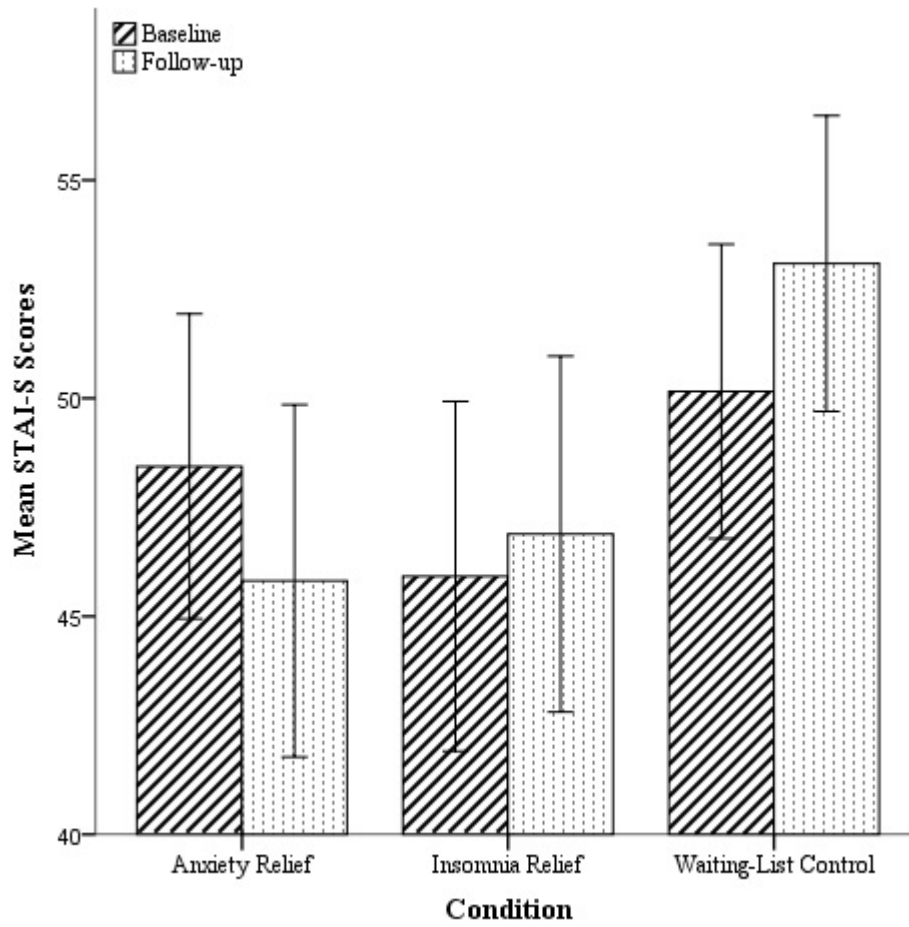
Figure 2:



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Figure 3:

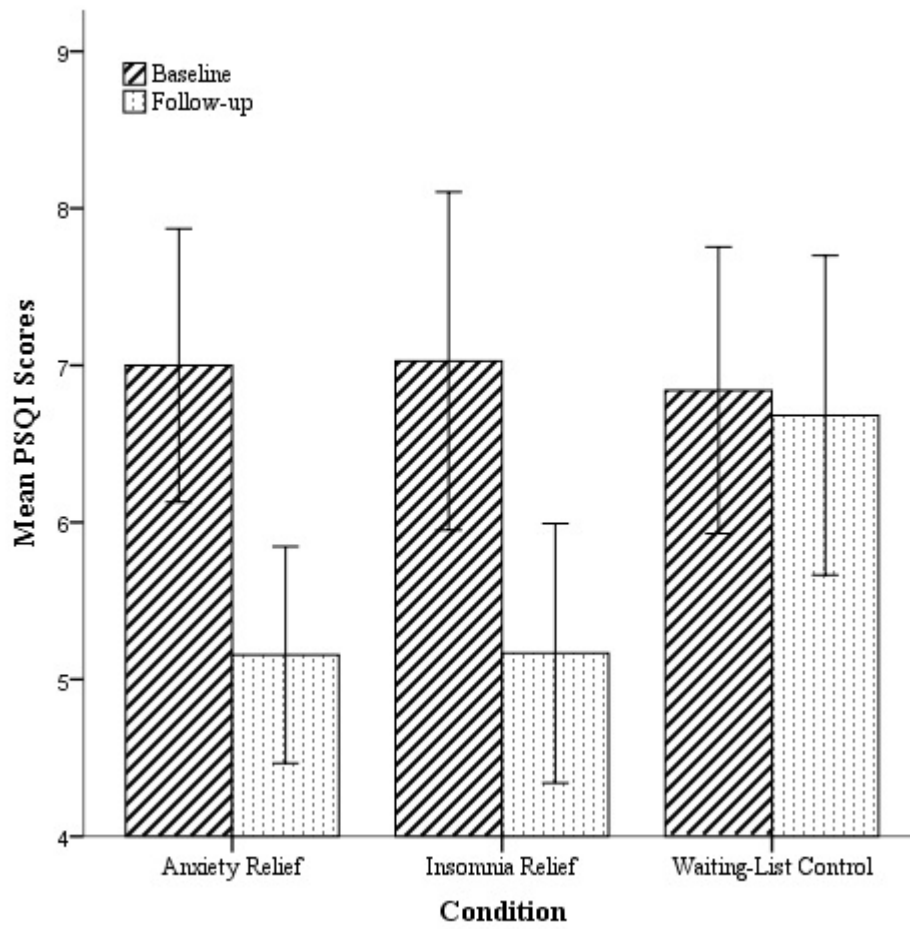


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Figure 4:



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Inventory II; α , Internal Reliability. * $p < .05$

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