***Online Supplementary Materials***

***Therapist Guided Internet-Based Treatments for Loneliness: A Randomised Controlled Three-Arm Trial Comparing Cognitive Behavioural Therapy and Interpersonal Psychotherapy***

**Prior research on CBT interventions for loneliness**

CBT has been evaluated in controlled studies, including a treatment study on loneliness in adults aged 65 years or older [1] which incorporated group sessions. Another study based on CBT principles tested the effects of a smartphone app for older adults [2]. Internet-based interventions have the advantage of improving access to underserved groups [3] and have been proposed as a possible solution to the lack of health care options during the COVID-19 pandemic [4]. We previously reported a controlled pilot study of adults experiencing loneliness in which we examined the effects of internet-based CBT (ICBT). The intervention contained elements of cognitive restructuring, behavioural activation, and exposure therapy [5]. Many participants exhibited clinical levels of comorbid psychiatric symptoms and 46 % reported at least one prior psychotherapeutic contact. The results showed a significant reduction in self-reported loneliness and an increased quality of life compared to a waitlist control group. However, there was no active control condition which aids the ability to draw conclusions.

**Interpersonal factors in relation to loneliness**

One aspect to consider in the treatment of frequent and distressing loneliness is the impact of interpersonal events and factors. Interpersonal events and the circumstances in which these are situated have been proposed to play a part in the onset and experience of loneliness [6, 7]. They can be present in the form of a major disruption in the social network, for example in relation to bereavement or a divorce [8, 9]. However, interpersonal factors, other than the development of social skills, have rarely been the focus of interventions for loneliness. Changes in the social network can bring about a decrease in social support, and lower social support following adverse life events has been linked to an increase in loneliness and depressive symptoms [10]. Focusing on reducing the impact of an adverse interpersonal event has been highlighted as a potential way of helping people with distressing forms of loneliness [11].

**Additional details regarding materials and methods**

**Design of the trial and deviations from the initial protocol**

The original plan was to conduct a two-centre trial with parallel recruitment in the United Kingdom and Sweden. Due to unforeseen delays with the ethics application and the subsequent lack of staff in the United Kingdom, the choice was made to limit recruitment to Sweden. to approximate the number of participants to be included in the planned two-centre design. Additionally, we deviated from the initial protocol (Clinicaltrials.gov identifier: NCT03807154) in another way: the follow-up period was changed from three to four months to better account for the Swedish summer vacation schedule with the aim of increasing the response rate.

**Recruitment strategy**

Information about the study was spread through social media, physical posters in Swedish cities, contacts at primary care and student health centres, and two regional newspaper articles. Additionally, three paid advertisements were also published in nationwide Swedish newspapers. The information included a web address where the prospective participant could get information about the study and register interest. All information related to the study during the recruitment specified that the study was aimed at participants experiencing distressing feelings of loneliness.

**Therapists, therapist training, and supervision during the treatment**

Of the eight therapists, five had primarily received CBT training as part of their clinical education, while the other three had primarily received psychodynamic training. All therapists undertook additional IPT training (equivalent to level A-training) before the start of the study. All therapists treated participants in both the IIPT and ICBT conditions. Therapists were encouraged to work with one of the treatments at a time when giving feedback on the assignments included in the modules. Supervision was provided every other week throughout the study. All therapists attended two sessions during these weeks, one for participants in the IIPT condition and one for participants in the ICBT condition. The ICBT supervision was provided by a licensed clinical psychologist (A.K.) with training and clinical experience in conducting CBT. The IIPT supervisor was a licensed psychotherapist (M.Bä) with level D-training in IPT and extensive experience of psychotherapy and supervision in a clinical setting. Therapists also had the option to contact the supervisors between sessions should the need arise.

**Therapist contact and feedback during the treatment**

Contact with the participants was handled using the messaging function of the platform*.* No face-to-face contact took place during the study. On a few occasions participants were contacted by phone for technical troubleshooting (per request of the participants). Interactions with the participants were in line with the observations documented by Paxling et al., [12], such as clarifying information in the modules and prompting the important principles. While some of the behaviours were generic (e.g., providing reminders), there were specific therapist responses in the two conditions. In IIPT the therapist helped the participants to map potential mood-event connections. In ICBT the therapists were instructed to answer and provide support with the functional analytical model in mind and to return to these principles when needed.

**Description of the two interventions**

The main element of the modules was text, but pictures were used to exemplify important information and to make the modules more engaging. The assignments were interactive in the sense that the participants could add their own text and information to the templates contained in the modules (e.g., asking the participant to identify and write down the short and long-term consequences in a chosen situation) that would then be reviewed by the therapist. Two of the IIPT modules also included links to video clips.

The ICBT programme was developed and tested in a previous pilot trial [5]. The modules centred around the concept of valued social contact as a means of counteracting feelings of loneliness. A lack of valued social contact can exist as a function of the quality in existing relationships (e.g., lack of support from one’s significant other), or a lack of quantity (lack of relationships). The first module included psychoeducation about loneliness and introduced a functional behavioural model on how loneliness is maintained over time. The second module instructed the participant on how to identify treatment goals and values. The subsequent modules asked the participant to identify what might constitute valued social contact for them and to use behavioural activation to foster change towards such contacts. Strategies to deal with obstacles such as social anxiety (exposure), maladaptive cognitions (cognitive restructuring and behavioural experiments) or inadequate social skills (social skills training) were introduced in later modules. Compared to the pilot trial, the following changes were made: 1) the order of the modules containing cognitive interventions and those containing behavioural interventions were reversed, meaning that the behavioural elements were introduced during the third and fourth module 2) a new module focusing on social skills was introduced. The changes were made based on a systematic review which identified elements of effective CBT interventions for loneliness [13]. The modules spanned a total of 131 pages.

The IIPT programme was created by the study team under the supervision of the D-level IPT therapist and supervisor. While the materials and the content were developed for the study, the work drew on previous IPT self-help books [14] in contextualising the theory using case examples, asking the participant to complete written assignments, and reflect on the relationship between mood and events. The programme was divided into three phases, the assessment phase (modules 1 through 3), the focus phase (modules 3 through 8) and the end phase (module 9). The assessment phase was standardised for all participants and asked them to identify their unique experiences of loneliness and create an interpersonal team to help with the work during the treatment period. In case the latter was not possible, the participant was informed that the therapist could serve this function. Additionally, this phase focused on mapping feelings of loneliness over time (timeline), the current interpersonal situation (interpersonal inventory) and choosing a focus for the next phase. Based on their assessment, the participants would choose one of the four focus areas: conflict, grief, interpersonal deficits, and role transition. Each focus contained unique, though sometimes overlapping, content related to the focus in question. If a participant was unable to work with the first choice of focus (e.g., the other party of the conflict was unwilling to work to solve the problem), they could change to another focus area. The focus phase continued the work of mapping the mood-event relationship while introducing strategies such as communication analysis and experiential exercises meant to further the emotional processing of feelings related to the loneliness. The modules also made use of the loneliness assessments collected every other week as a tool to reflect on how the experience of loneliness connected to the events occurring during the treatment period. The last module asked the participant to draw up a plan for the continued work to maintain the positive changes. The full programme spanned 333 pages of text, pictures, and assignments. The modules making up each focus area consisting of 59 pages (interpersonal deficits), 61 pages (role transition), 65 pages, (interpersonal conflict), and 81 pages (grief).

**Measuring the participants’ attributions of reductions in loneliness**

Participants in the active treatment groups were asked four questions about factors thought to be potentially relevant for reduced feelings of loneliness. Due to the different components of the intervention and the study, we were interested to what factors participants might attribute their change in loneliness. The four factors were contact with the therapist, actively working with the material of the modules, being part of a study centred around the problem of loneliness, and the increased societal attention that loneliness has received in the past years. The questions were asked at post-treatment to participants in the active treatment conditions. The items instructed the participant to rate how often a certain factor helped them feel less lonely during the treatment period. The items focused on contact with the therapist (*When I have been in contact with my therapist, I have felt less lonely*), working with the modules(*When I have worked with the modules, I have felt less lonely*), being part of the study in general (*Being part of the SOLUS project has made me feel less lonely*), or the fact that loneliness has been addressed as a societal problem (*The fact that loneliness is being addressed as a societal problem has made me feel less lonely*). Responses were given on a seven-point Likert scale with the alternatives being Never (1), Rarely (2), Once in a while (3), Sometimes (4), Often (5), Very often (6), and Always (7). We report the means, standard deviations, and an independent *t*-test for each item in Table 7.

**Power calculation**

The software G\* Power [15] was used to calculate the number of participants needed for the study. The power calculation was one-tailed (as we expected both of the active treatments to outperform the control group), used a Bonferroni-corrected alpha level of 0.016, a power of .80, and a 2:2:1 ratio of assignment to condition. The primary comparison was that between the active treatment groups and the waitlist control group for which we expected a moderate effect size of *d* = 0.70 on the primary outcome measure. The effect size was estimated based on the previous findings for the ICBT condition [5] but was set slightly lower to account for the uncertainty regarding the effects of the IPT condition. Assuming these parameters, 140 participants would be needed. Taking 25 % missing data at post-treatment into consideration, 175 participants would be needed to achieve sufficient power. A post-hoc sensitivity power analysis showed that the recruited sample size (*n* = 170) and the chosen power parameters would be able to detect significance for an effect size of *d* = 0.68.

**Further details on the analysis of the primary outcome**

Estimation made use of non-normality robust maximum likelihood via the MLR option in Mplus. Additional parameters (free/fixed residual variance, linear/quadratic change, correlations between the latent variables) were specified using model indices as a guideline for best fit with the data. Model fit was evaluated using the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the Root Mean Square Error of Approximation (RMSEA). The final model incorporated a linear slope, fixed residual variances, and no covariance between intercept and slope. Significance of model parameters was tested using Wald’s test where the parameter estimate is divided by the standard error and compared against a z-distribution.

**Analyses of secondary outcomes**

For the secondary outcome measures, we examined differences at post-treatment using a robust regression model with the pre-treatment score as a covariate (similar to an ANCOVA), thus controlling for the ratings before treatment began. The contrasts were identical to those used in the primary outcome model. Parameters were estimated using robust full information maximum likelihood (MLR). For the follow-up measurement, we examined differences on the secondary outcome measures at the time point of interest using the same model, but with the follow-up time point as the data source. Condition was entered as a dummy-coded predictor (IPT = 0, CBT = 1). Significance of model parameters are evaluated using a Wald-test. Confidence intervals are reported at 95 %.

**Clinically significant change**

Classification of clinically significant change and deterioration was made using the formula specified by Jacobson and Truax [16], where the observed mean from the baseline measurement is subtracted from the observed mean at follow-up and then divided by the standard error of measurement of the difference for the primary outcome measure. The one-year test-retest coefficient of .73 from the validation study [17] was used. The cut-off was set at ± 11 points on the ULS-3.

**Additional results**

**Participants’ attributions of reductions in loneliness**

Means and standard deviations for each item is shown in table 7. The two groups did not differ significantly on any of the four items (all *p* > .357).

**Attrition, missing data, and activity statistics**

A total of 14 participants (8%) indicated that they wanted to discontinue participation during the treatment period. Dropout rates did not differ significantly between the conditions, χ2(2) = 4.20, *p* = .122. Participants provided data for 81 % of the primary outcome assessments during the treatment period. In total, 130 out of the 170 randomized participants (76 %) provided data at the post-treatment assessment. The groups did not differ significantly in completion rates on the post-treatment assessment, χ2(2) = 5.15, *p* = .076. Participants who provided data at post-treatment did not differ significantly from those who did not at pre-treatment with regards to the outcome measures, range of *p*-values = .060 (GAD-7) to .874 (BBQ). However, when accounting for demographic differences, participants with missing post-treatment values were significantly younger, *t*(168) = 2.59, *p* = .010, then those who completed the assessment. At the four-month follow-up, 82 of the 136 participants (60 %) in the treatment groups provided data for all outcome measures. The proportion of completers of the follow-up assessment did not differ significantly between the conditions, χ2(1) = 0.12, *p* = .726.

There were no significant differences between the groups on the outcome measures at pre-treatment, range of *p*-values = .10 (PHQ-9) to .77 (BBQ). For the demographic variables, the analyses revealed one marginally significant difference between the groups - the control group contained a higher proportion of singles (not reporting a partner) compared to the other groups, χ2(2)= 20.32, *p* = .078.

Average rates of module access and completion along with ratings of treatment related variables are presented in Table 4. There were no significant differences between the active treatment conditions with the exception of the total therapist time for which the time IIPT condition was significantly higher than the ICBT condition overall (*p* = .004), but not per completed module (*p* = .131).

For the IIPT focus areas, 57 % of the participants choose to focus on interpersonal deficits as their primary focus, 26 % on their role transition, 17 % on an interpersonal conflict, and 5 % on grief.

**Results from the analyses of the secondary outcomes at post-treatment**

**Quality of life**

For quality of life ratings, the analysis indicated a significant difference between the ICBT condition and the waitlist at post-treatment favouring the ICBT group, *b* = 16.40 [99 % CI 5.93, 26.88], SE = 4.07, *p >* .0001, *d* = 0.99. The comparison between IIPT and the waitlist was also significant, *b* = 10.70 [99 % CI 2.59, 18.80], SE = 3.15, *p =* .003, *d* = 0.65.

**Social anxiety**

For ratings of social anxiety, the comparison between the ICBT condition and the waitlist did not indicate a significant difference at post-treatment, *b* = -5.95 [99 % CI -12.61, 0.72], *p =* .066, *d* = 0.36. This was also the case for the IIPT condition compared to the waitlist group, *b* = -4.55 [99 % CI -10.26, 1.15], SE = 2.21, *p =* .120, *d* = 0.27.

**Depression**

For ratings of depressive symptoms, the comparison between the ICBT condition and the waitlist showed a significant difference at post-treatment, *b* = -2.93 [99 % CI -6.00, 0.13], SE = 1.19, *p =* .004, *d* = 0.48. For the IIPT and waitlist comparison, the difference was not statistically significant, *b* = -1.61 [99 % CI -3.73, 1.16], SE = 1.08, *p = .*420, *d* = 0.26.

**Generalised anxiety**

On the measure of generalised anxiety, the comparison showed that the ICBT group rated their symptoms at significantly lower levels than the waitlist group, *b* = -2.62 [99 % CI -5.08, -0.15], SE = 0.96, *p =* .018, *d* = 0.51. The comparison between the IIPT condition and the waitlist was not significant at post-treatment, *b* = -1.47 [99 % CI -3.89, 0.95], SE = 0.94, *p* = .348, *d* = 0.29.

**Comparisons between the active treatments**

For quality of life ratings, there was no significant difference between the active conditions at post-treatment, *b* = 5.71 [99 % CI -3.76, 15.17], SE = 3.68, *p* = .360, *d* = 0.35. This was also the case for symptoms of social anxiety at post-treatment, *b* = -1.39 [99 % CI -5.66, 2.87], SE = 2.18, *p* = 1, *d* = 0.08. Similarly, non-significant differences were found for ratings of depressive symptoms, *b* = -1.32 [99 % CI -3.74, 1.10], SE = 0.94, *p* = .480, *d =* 0.22, and symptoms of generalised anxiety disorder, *b = -*1.14 [99% CI -3.15, 0.86], SE = 0.78, *p* = .429, *d* = 0.22.

**Between-group comparisons for the secondary outcome measures at the four month follow-up**

**Quality of life**

For quality of life ratings, there was no significant difference between the conditions at follow-up, *b* = 2.63 [95 % CI -4.15, 9.42], SE = 3.46, *p* = .447, *d* = 0.16.

**Social anxiety**

For symptoms of social anxiety, there was no significant difference between IIPT and ICBT at follow-up, *b* = -1.29 [95 % CI -5.66, 3.07], SE = 2.27, *p* = .561, *d* = 0.08.

**Depressive symptoms**

For ratings of depressive symptoms, the comparison between IIPT and ICBT did not reveal a significant difference between the conditions at follow-up, *b* = 0.46 [95 % CI -1.61, 2.53], SE = 1.06, *p* = .661, *d = -*0.08.

**Generalised anxiety**

For symptoms of generalised anxiety disorder, there was no significant difference at the follow-up timepoint between the IIPT and ICBT condition, *b = -*0.53 [95% CI -2.33, 1.28], SE = 0.92, *p* = .572, *d* = 0.10.

**Reliable change and deterioration**

In the group receiving ICBT, 17 out of the 46 participants (37 %) were classified as clinically significantly improved at post-treatment. No one in this condition was classified as significantly deteriorated. For the IIPT condition, 8 of the 57 participants (14 %) were classified as clinically significantly improved at post-treatment. One participant (2 %) was classified as significantly deteriorated. In the control group, 3 of the 27 participants (11 %) were classified as clinically significantly improved at post-treatment. None of the participants in the control condition were classified as significantly deteriorated.

**Sensitivity analyses**

**Year of intake and the potential impact of Covid-19**

To test out whether year of intake moderated the change in loneliness due to differing circumstances (e.g., the COVID-19 pandemic towards the end of the second intake) during the treatment period we tested a separate model with year as a dummy-coded predictor (2019 = 0, 2020 = 1). The two intakes did not differ significantly in neither intercept, *b* = -0.64 [95 % CI -2.88, 1.61], SE = 1.14, *p* = 0.578, nor change in loneliness during the treatment period, *b* = 0.85 [95 % CI -1.80, 3.50], SE = 1.34, *p* = 0.522.

**Demographic predictors**

Including age and civil status as single yes/no as time-invariant predictors in the analysis of the primary and secondary outcomes did not alter the findings. For the primary outcome model, age was not significantly related to neither intercept, b = -0.02 [95 % CI -0.09, 0.04], SE = 0.03, p = .482, nor change during the treatment period, b = -0.004 [95 % CI -0.002, 0.010], SE = 0.03, p = .191. Single status predicted a significantly higher initial rating of loneliness, b = 3.63 [95 % CI 1.42, 5.85], SE = 1.13, p = .001, but did not predict a significantly different change during the treatment period, b = 0.021 [95 % CI -2.22, 2.24], SE = 1.24, p = .868. For the primary outcome model, inclusion of civil status as single and age as time-invariant predictors increased the effect size of the CBT against wait-list comparison to d = 0.74. The comparison between IPT and the wait-list increased to d = 0.22, though this comparison was still non-significant (p = .292).

**Completer analysis**

To investigate the potential for different trajectories for completers/non-completers of the post-treatment assessment, a separate growth curve model was specified with completion of the post-treatment assessment (coded as 0) or non-completion (coded as 1) entered into the model as a time-invariant dummy predictor of the primary outcome measure, the only measure which was measured during the treatment and thus allowed for estimation of a latent growth factor (i.e. rate of change of loneliness). The results indicated that the estimated change over the course of the treatment on the primary outcome measure did not differ significantly between completers and non-completers of the post-treatment assessment, *b* = 2.53 [95 % CI -1.77, 6.85], SE = 2.20, *p* = .249. This also held true when only analysing the participants in the treatment groups (*n* = 136), *b* = 0.85 [95 % CI -2.98, 4.67], SE = 1.95, *p* = .665.

 The same analysis was conducted for the treatment groups with completion of the follow-up assessment as a time-invariant predictor. This analysis did not indicate a significant difference for estimated change during the treatment for the group completing the follow-up measurement compared to the group that did not, *b* = 0.07 [95 % CI -2.73, 2.86], SE = 1.424, *p* = .913.

 **Psychiatric disorders**

An additional sensitivity analysis was conducted to investigate whether the presence of a mental health disorder (operationalised as a diagnosis on the MINI interview) predicted the effect of the treatments in the treatment conditions. Diagnosis yes/no (coded as 0 = no diagnosis, 1 = one or more diagnosis/diagnoses) as a time invariant predictor did indicate a higher initial level of loneliness, *b* = 3.06 [95 % CI 0.75, 5.37], SE = 1.18, *p* = .009. One or more psychiatric diagnoses also predicted significantly lower change during the treatment period, *b* = 3.83 [95 % CI 1.37, 6.29], SE = 1.26, *p* = .002.

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| Table 1.*Demographic Characteristics of the Recruited Sample (n = 170)* |
|  | IPT (*n* = 68) | CBT (*n* = 68) | Wait-list (*n* = 34) |  |
|  | *M* | SD | *M* | *SD* | *M* | *SD* | *F* |
| Age | 49.68 | 16.40 | 47.18 | 15.94 | 43.91 | 17.08 | 1.43, *p* = .723 |
| Duration of loneliness (years) | 10.47 | 11.98 | 12.27 | 15.58 | 11.00 | 11.80 | 0.31, *p* = 1 |
| Onset of loneliness (age at the time of onset) | 26.51 | 21.63 | 25.43 | 18.54 | 26.88 | 19.31 | 0.08, *p* = 1 |
|  | *n* | % | *n* | % | *n* | % | χ2 |
| Gender |  |  |  |  |  |  |  |
| Female | 57 | 83.8 | 49 | 72 | 23 | 68 | 4.146, *p* = .378 |
| Male | 11 | 16.2 | 19 | 28 | 11 | 32 |
| Marital status |  |  |  |  |  |  |  |
| Single | 30 | 44.1 | 33 | 48.5 | 26 | 76.5 |  |
| Married | 8 | 11.8 | 12 | 17.6 | 1 | 2.9 |  |
| In a relationship (cohabiting) | 6 | 8.8 | 3 | 4.4 | 1 | 2.9 | 20.318, *p* = .078 |
| In a relationship (not cohabiting) | 3 | 4.4 | 7 | 10.3 | 0 | 0 |
| Divorced | 13 | 19.1 | 11 | 16.2 | 5 | 14.7 |  |
| Widow/Widower | 8 | 11.8 | 2 | 2.9 | 1 | 2.9 |  |
| Living with |  |  |  |  |  |  |  |
| Alone | 46 | 67.6 | 38 | 55.9 | 27 | 79.4 |  |
| With family | 11 | 16.2 | 21 | 30.9 | 4 | 11.8 | 9.945, *p* = .807 |
| With friends | 1 | 1.5 | 1 | 1.5 | 1 | 2.9 |
| With partner | 8 | 11.8 | 7 | 10.3 | 1 | 2.9 |
| Other communal living | 2 | 2.9 | 1 | 1.5 | 1 | 2.9 |  |
| Highest attained educational degree |  |  |  |  |  |  |  |
| No completed degree | 0 | 0 | 1 | 1.5 | 0 | 0 |  |
| Primary school | 1 | 1.5 | 0 | 0 | 0 | 0 |  |
| Secondary school | 9 | 13.2 | 16 | 23.5 | 8 | 23.5 | 10.924, *p* = 1 |
| College/University | 47 | 69.1 | 38 | 55.9 | 24 | 70.6 |
| Other vocational education | 8 | 11.8 | 9 | 13.2 | 0 | 0 |  |
| Postgraduate degree | 3 | 4.4 | 4 | 5.9 | 2 | 5.9 |  |

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| Table 1.(*continued)* |
| Primary occupation | *n* | % | *n* | % | *n* | % | χ2 |
| Student | 4 | 5.9 | 7 | 10.3 | 4 | 11.8 |  |
| Employed | 42 | 61.8 | 39 | 57.4 | 20 | 58.8 |  |
| Unemployed | 4 | 5.9 | 6 | 8.8 | 1 | 2.9 |  |
| Internship | 1 | 1.5 | 0 | 0 | 0 | 0 | 9.235, *p* = 1  |
| Retired | 12 | 17.6 | 14 | 20.6 | 7 | 20.6 |
| Short-term sick leave | 2 | 2.9 | 0 | 0 | 0 | 0 |  |
| Long-term sick-leave | 2 | 2.9 | 1 | 1.5 | 2 | 5.9 |  |
| Other | 1 | 1.5 | 1 | 1.5 | 0 | 0 |  |
| Previous treatment for mental health problems: Yes  | 43 | 63.2 | 38 | 55.8 | 15 | 44.1 | 3.386, *p* = .552 |
| Previous/current use of psychotropic medication: Yes | 36 | 52.9 | 27 | 39.7 | 15 | 44.1 | 2.452, *p* = .879 |
| Loneliness attributed to an event: Yes | 36 | 52.9 | 24 | 35.9 | 16 | 47.1 | 4.378, *p* = .336 |
| Psychiatric diagnoses as indicated by MINI 7.0.1 during the screening |
|  | *n* | % yes | *n* | % yes | *n* | % yes | χ2 |
| Major depressive disorder | 23 | 33.8 | 17 | 25.0 | 9 | 26.5 | 1.405, *p* = 1 |
| Panic disorder | 5 | 7.4 | 5 | 7.4 | 5 | 14.7 | 1.828, *p* = 1 |
| Agoraphobia | 3 | 4.4 | 5 | 7.4 | 2 | 5.9 | 0.531, *p* = 1 |
| Social anxiety disorder | 12 | 17.6 | 12 | 17.6 | 8 | 23.5 | 0.616, *p* = 1 |
| Obsessive compulsive disorder | 1 | 1.5 | 4 | 5.9 | 1 | 2.6 | 1.987, *p* = 1 |
| Post-traumatic Stress Disorder | 2 | 2.9 | 4 | 5.9 | 3 | 8.8 | 1.643, *p* = 1 |
| Alcohol Use Disorder | 4 | 5.9 | 5 | 7.4 | 3 | 8.8 | 0.314, *p* = 1 |
| Bulimia Nervosa | 1 | 1.5 | 1 | 1.5 | 0 | 0 | 0.506, *p* = 1 |
| Binge Eating Disorder | 3 | 4.4 | 1 | 1.5 | 1 | 2.9 | 1.030, *p* = 1 |
| Generalized Anxiety Disorder | 11 | 16.2 | 9 | 13.2 | 4 | 11.8 | 0.437, *p* = 1 |

Table 2. *Content of the IPT modules*

|  |
| --- |
| **IPT** |
| **Module 1 – Understanding your loneliness**Introduction to the idea of loneliness as a signal to an unmet relational need and the IPT process. Mapping the symptoms of loneliness that express themselves for the participant. Initial effort to involve others in the participants’ IPT team.  |
| **Module 2 – Understanding your relationships and your history**Mapping the experience of loneliness over time using a timeline, connecting it to specific events. Interpersonal circle and inventory. Investigating interpersonal themes related to the events on the timeline. |
| **Module 3 – Finding your interpersonal focus**Summarizing the earlier findings and choosing an interpersonal focus for the coming weeks. Setting goals for the treatment period and the future.  |
| **Interpersonal conflict** | **Role transition** | **Grief** | **Interpersonal sensitivity** |
| **Module 4 – Our emotions and needs**Mapping needs and emotions and how they relate to the current situation. Introduction to and mapping of relationship behaviours. | **Module 4 – Our emotions and needs**Mapping needs and emotions and how they relate to the current situation. Introduction to and mapping of relationship behaviours. | **Module 4 – Our emotions and needs**Mapping needs and emotions and how they relate to the current situation. Introduction to and mapping of relationship behaviours. | **Module 4 – Our emotions and needs**Mapping needs and emotions and how they relate to the current situation. Introduction to and mapping of relationship behaviours. |
| **Module 5 – Observe your relationship**Observing and reflecting on event related to the interpersonal context, looking at the history of the conflict with the significant other. Introduction to communication analysis. | **Module 5 – Your role transition**Information about the process of role transition from one social role to another and possible obstacles that might interfere with it. Mapping of where in the process the participant is at the moment.  | **Module 5 – Your grief**Exploring the grief process and factors that might affect it. Looking at memories of the relationship and how it affects the participant’s loneliness. | **Module 5 – Your strengths** Identifying positive relationships, current or previous, and the participant’s contributions to them. Looking at positive patterns related to relationship behaviours. Identifying other relevant strengths. Putting together a plan on how to use one’s strengths to help satisfy the identified needs.  |
| **Module 6 – Communication analysis**Practicing applying communication analysis, first to an unrelated video clip, then to situations related to the conflict and the other party. | **Module 6 – Leaving your old role**Reflecting on the old role and processing the emotional impact that the transition has had, creating nuance around the advantages/disadvantages of the old role.  | **Module 6 – The time around the passing**Recalling the time around the death and how it affects the participant’s loneliness. Involving others in the grief process.  | **Module 6 – Your deficits**Identifying relationships generally characterized as negative, and the participant’s contribution to this. Looking at general deficits in terms of relationship behaviours Identifying ways to break maladaptive interpersonal patterns.  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Module 7 – Active negotiation**Mapping the needs that would help the participant feel less lonely and introducing negotiation as a means to reach this stage. Continued communication analysis. | **Module 7 – Managing the change**Reflecting on and processing how the role transition occurred and how it is related to the feeling of loneliness. Mapping potential sources of support that has been helpful up to this point and whether these can be useful in the current situation. Assignment on activating sources of social support. | **Module 7 – Your loss and the relationship**Going over the relationship history in an effort to gain a balanced picture of the lost relationship. Looking at ways of replacing and maintaining the missing social support. | **Module 7 – The art of communicating**Information about effective ways of communicating and obstacles related to this (e.g., lack of assertiveness, dysfunctional habits related to body language). Conducting two communication analyses, first one on a film clip and then one on a real-life situation experienced by the participant. |
| **Module 8 – Your other relationships**Continued communication analysis and exercises related to communication negotiation of unmet need and processing the conflict. Additionally, looking at other relationships as a source of support and belonging. | **Module 8 – Adapting to the new role**Adapting to the new circumstances, identifying emotions connected to the new role. Taking stock of needs and wants related to the feeling of loneliness in the new role. Continued work with activating sources of social support. | **Module 8 – Your new situation**Reflecting on the new situation and factors that might hinder the process of adapting to it. Taking up old positive habits and creating new relationships that might be able to provide the missing social support. | **Module 8 – Honing your communication skills**Continued information on how to improve one’s communication (e.g., by using active listening). Communication analysis of a situation where the participant used one or more of the techniques listed in this or the previous module. |
| **Module 9 – For the future**Evaluating changes during the programme and how they relate to the experience of loneliness, including changes in the social network and the participant’s relationship behaviours. Overlooking the goals set during week three and updating them for the future. Information about setbacks and how to prevent them/deal with them, should they happen. | **Module 9 – For the future**Evaluating changes during the programme and how they relate to the experience of loneliness, including changes in the social network and the participant’s relationship behaviours. Overlooking the goals set during week three and updating them for the future. Information about setbacks and how to prevent them/deal with them, should they happen. | **Module 9 – For the future**Evaluating changes during the programme and how they relate to the experience of loneliness, including changes in the social network and the participant’s relationship behaviours. Overlooking the goals set during week three and updating them for the future. Information about setbacks and how to prevent them/deal with them, should they happen. | **Module 9 – For the future**Evaluating changes during the programme and how they relate to the experience of loneliness, including changes in the social network and the participant’s relationship behaviours. Overlooking the goals set during week three and updating them for the future. Information about setbacks and how to prevent them/deal with them, should they happen. |

Table 3. *Content of the CBT modules*

|  |
| --- |
| **CBT** |
| **Module 1 – Understanding your loneliness**Psychoeducation regarding loneliness and an introduction to a functional behavioural model used throughout the treatment. |
| **Module 2 – Your goals and values**Psychoeducation and assignments regarding goals and values. Additionally, a first behavioural assignment (“take the first step towards your values”). |
| **Module 3 – Your social behaviours**Modified behavioural activation centred around the concept of identifying and finding valued social contact. |
| **Module 4 – Overcoming obstacles**Continued modified behavioural activation and a rationale for exposure with response prevention. |
| **Module 5 – Thoughts and distorted thinking**Psychoeducation and assignments aimed at challenging dysfunctional thoughts and beliefs. |
| **Module 6 – Behavioural experiments**Psychoeducation and assignments based on the principles of behavioural experiments. |
| **Module 7 – Communication and social skills**Psychoeducation and practical assignments related to social skills and communication. |
| **Module 8 – Overview and continued work**Continued modified behavioural activation and evaluation of the prior modules. |
| **Module 9 – Staying the course: relapse prevention**Relapse prevention |

Table 4. *Ratings of Treatment Factors and Activity Statistics.*

|  |  |  |  |
| --- | --- | --- | --- |
|  | IPT | CBT |  |
|  | *M* (SD) | *M* (SD) | *t-*value |
| CEQ | 31.23 (10.12) | 32.04 (11.64) | -0.381, *p* = .704 |
| WAI-12 | 56.28 (15.43) | 56.20 (16.02) | 0.27, *p* = .979 |
| CSQ | 22.25 (5.02) | 23.89 (5.51) | -1.53, *p* = .129 |
| Modules accessed | 6.93 (2.93) | 6.85 (2.99) | 0.15, *p* = .885 |
| Modules completed\* | 6.01 (3.31) | 5.46 (3.33) | 0.98*, p* = .328 |
| Total therapist time (minutes) | 136.68 (75.92) | 103.94 (51.24) | -2.95, *p* = .004 |
| Therapist time per completed module (minutes) | 26.75 (14.54) | 23.10 (12.48) | 1.52, *p* = .131 |
|  | % | % | χ2-value |
| % of participants completing all modules | 61.8 | 55.9 | 0.49, *p* = .486 |

 *Abbreviations. CEQ = Credibility and Expectancy Questionnaire, WAI-12 = Working Alliance Inventory, 12 item version, CSQ = Client Satisfaction Questionnaire*

*\* Completion of modules as indicated by completed assignments*

Table 5. *Observed* *Means for the* *Outcome Measures at the Pre-, Post-, and Follow-up Timepoints*

|  |  |  |  |
| --- | --- | --- | --- |
|   | Pre-treatment | Post-treatment | Four-month follow-up |
| Outcome measure | *M* (SD) | *n* | *M* (SD) | *n* | *M* (SD) | *n* |
| ULS-3 |  |  |  |  |  |  |
| CBT | 57.59 (6.80) | 68 | 48.37 (9.30) | 46 | 50.10 (8.28) | 40 |
| IPT | 58.46 (7.67) | 68 | 53.53 (7.98) | 57 | 52.43 (10.44) | 42 |
| Wait-list | 59.18 (8.00) | 34 | 57.07 (7.53) | 27 | - |  |
| BBQ |  |  |  |  |  |  |
| CBT | 30.72 (17.34) | 68 | 44.67 (22.10) | 46 | 48.13 (17.06) | 40 |
| IPT | 32.69 (16.81) | 68 | 41.07 (17.63) | 57 | 46.00 (20.22) | 42 |
| Wait-list | 32.35 (14.96) | 34 | 30.19 (15.54) | 27 | - |  |
| SIAS |  |  |  |  |  |  |
| CBT | 33.37 (16.09) | 68 | 26.18 (13.20) | 46 | 28.62 (15.63) | 40 |
| IPT | 36.37 (17.69) | 68 | 28.44 (15.10) | 57 | 28.21 (15.07) | 42 |
| Wait-list | 35.71 (15.97) | 34 | 33.07 (17.61) | 27 | - |  |
| PHQ-9 |  |  |  |  |  |  |
| CBT | 9.56 (5.67) | 68 | 5.11 (5.05) | 46 | 5.83 (5.50) | 40 |
| IPT | 11.79 (6.13) | 68 | 7.46 (5.34) | 57 | 7.00 (5.33) | 42 |
| Wait-list | 10.94 (6.76) | 34 | 9.15 (6.19) | 27 | - |  |
| GAD-7 |  |  |  |  |  |  |
| CBT | 6.32 (4.66) | 68 | 3.67 (4.12) | 46 | 4.47 (4.78) | 40 |
| IPT | 7.91 (5.65) | 68 | 5.96 (5.41) | 57 | 4.40 (4.48) | 42 |
| Wait-list | 7.09 (4.89) | 34 | 7.26 (5.14) | 27 | - |  |

*Abbreviations*: ULS-3 = UCLA Loneliness Scale, Version 3; BBQ = Brunnsviken Brief Quality of Life Scale; SIAS = Social Interaction Anxiety Scale; PHQ-9 = Patient Health Questionnaire 9; GAD-7 = Generalized Anxiety Disorder 7-item scale.

Table 6. *Estimates for the Parameters of the Conditional Latent Growth Curve Model for the Treatment Period with Standard Errors, Confidence Intervals, and Model Fit Indices*

|  |
| --- |
| ULS-3 (*n* = 170) |
|  | Estimate | *SE* | 99 % CI |
| Fixed effects |  |  |  |
|  Initial level | 59.25\*\*\* | 1.24 | [56.81, 61.69]  |
|  Condition *Wait-list vs. IPT* *Wait-list vs. CBT* *IPT vs. CBT a* | -1.24-1.32-0.08 | 1.541.481.21 | [-4.25, 1.78][-4.22, 1.58][-2.45, 2.29] |
|  Linear slope | -0.28\* | 0.13 | [-0.53, -0.03] |
|  Condition X Slope *Wait-list vs. IPT* *Wait-list vs. CBT* *IPT vs. CBT a* | -0.14-0.52\*\*-0.39\*\* | 0.140.170.13 | [-0.42, 0.15][-0.86, -0.19][-0.65, -0.13] |
| Random effects |  |  |  |
|  Variance initial level | 43.97\*\*\* | 5.60 | [32.98, 54.95] |
|  Variance linear slope | 0.34\*\*\* | 0.09 | [0.16, 0.51] |
| Fit indices |  |  |  |
| CFI | 0.964 |  |  |
| TLI | 0.967 |  |  |
| RMSEA | 0.074 |  |  |
| *\* p < .05 \*\* p < .01 \*\*\* p < 0.001**Abbreviations. ULS-3 = UCLA Loneliness Scale, Version 3. IPT = Internet-based Interpersonal psychotherapy. CBT = Internet-based Cognitive Behavioural Therapy. CFI = Comparative Fit Index. TLI = Tucker-Lewis Index. RMSEA = Root Mean Square Error of Approximation.**a Estimated in a separate model* |

Table 7. *Means, Standard Deviations, and Test Statistics for the Between-Group Comparison of Attributions of Reductions in Loneliness*

|  |  |  |  |
| --- | --- | --- | --- |
|  | IPT | CBT |  |
|  | *M* (SD) | *M* (SD) | *t-*value |
| Contact with therapist | 3.74 (1.93) | 3.57 (1.93) | 0.442, *p* = .659 |
| Working with modules | 3.67 (1.87) | 3.91 (1.88) | -0.641, *p* = .523 |
| Being part of the project | 3.89 (1.87) | 4.16 (1.86) | -.716, *p* = .475 |
| Loneliness being addressed as a societal problem | 3.80 (2.01) | 4.16 (1.84) | -0.925, *p* = .357 |