



Universiteit
Leiden
The Netherlands

Evaluation of completely online psychotherapy with app-support versus therapy as usual for clients with depression or anxiety disorder: a retrospective matched cohort study investigating the effectiveness, efficiency, client satisfaction, and costs

Willemsen, R.F.; Versluis, A.; Aardoom, J.J.; Petrus, A.H.J.; Silven, A.V.; Chavannes, N.H.; Dijke, A. van

Citation

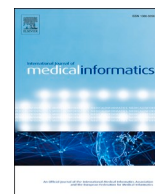
Willemsen, R. F., Versluis, A., Aardoom, J. J., Petrus, A. H. J., Silven, A. V., Chavannes, N. H., & Dijke, A. van. (2024). Evaluation of completely online psychotherapy with app-support versus therapy as usual for clients with depression or anxiety disorder: a retrospective matched cohort study investigating the effectiveness, efficiency, client satisfaction, and costs. *International Journal Of Medical Informatics*, 189. doi:10.1016/j.ijmedinf.2024.105485

Version: Publisher's Version

License: [Creative Commons CC BY-NC 4.0 license](#)

Downloaded from: <https://hdl.handle.net/1887/4266747>

Note: To cite this publication please use the final published version (if applicable).



Evaluation of completely online psychotherapy with app-support versus therapy as usual for clients with depression or anxiety disorder: A retrospective matched cohort study investigating the effectiveness, efficiency, client satisfaction, and costs

Romy Fleur Willemsen^{a,b,*}, Anke Versluis^{a,b}, Jiska Joëlle Aardoom^{a,b}, Annelieke Hermina Josephina Petrus^{a,b}, Anna Veronica Silven^{a,b}, Niels Henrik Chavannes^{a,b}, Annemiek van Dijke^{a,c}

^a Leiden University Medical Center, The Netherlands, National eHealth Living Lab, Leiden 2333 ZA, the Netherlands

^b Leiden University Medical Center, The Netherlands, Department of Public Health and Primary Care, 2333 ZA the Netherlands

^c Parnassia Psychiatric Institute, The Netherlands, PsyQ online, The Hague 2553 RJ, the Netherlands

ARTICLE INFO

Keywords:

Psychotherapy
Anxiety disorder
Depressive disorder
Online psychotherapy
Specialized mental health care
Personalized care

ABSTRACT

Introduction: Depressive and anxiety disorders are common mental disorders ranking among the leading causes of global disease burden. Not all clients currently benefit from therapy and clients are looking for modern ways of therapy. Online psychotherapy is a promising option for better meeting clients' needs. Recently, a new psychotherapy concept has emerged that combines videoconferencing sessions with support through a mobile application. The latter allows for ecological momentary assessments and interventions, facilitates communication between patients and therapists in between sessions through chat, and allows for incorporating feedback-informed treatment principles.

Material and methods: The study was a retrospective observational matched cohort study, comparing online psychotherapy with Therapy As Usual (TAU) for clients with depressive or anxiety disorders. Data were obtained via questionnaires, which are part of standard clinical care. Primary outcomes included general mental functioning, and symptoms of depression and anxiety. Secondary outcomes were efficiency, client satisfaction, and therapy costs. Primary endpoints were analyzed using linear mixed models analysis, with an interaction term between time and group. Secondary outcomes were analyzed using linear regression.

Results: Larger improvements were observed in the online compared to the TAU group for general mental functioning and depressive disorder (i.e., General mental functioning: $B = -8.50$, 95% CI: $-15.01 - -1.97$, $p = 0.011$; Depressive disorder: $B = -3.66$, 95% CI: $-5.79 - -1.54$, $p < 0.01$). No significant differences in change over time between the two groups were observed for anxiety disorder ($B = -3.64$, 95% CI: $-13.10 - 5.82$, $p = 0.447$). The total number of sessions was significantly higher in the online psychotherapy group than in TAU ($B = 3.71$, $p < 0.01$), although clients were matched on treatment time in weeks. Treatment session duration in minutes was comparable across the groups.

Discussion: Online psychotherapy with app support showed to be a promising alternative to TAU for depressive and anxiety disorders. More research is needed to evaluate the effectiveness, cost-effectiveness and client satisfaction of online psychotherapy compared to TAU, such as randomized controlled trials or studies multiple baseline series designs, and in-depth qualitative research.

* Corresponding author.

E-mail addresses: r.f.willemsen@lumc.nl (R.F. Willemsen), a.versluis@lumc.nl (A. Versluis), j.j.aardoom@lumc.nl (J.J. Aardoom), a.h.j.petrus@lumc.nl (A.H.J. Petrus), a.v.silven@lumc.nl (A.V. Silven), n.h.chavannes@lumc.nl (N.H. Chavannes), a.vanDijke@psyq.nl (A. van Dijke).

<https://doi.org/10.1016/j.ijmedinf.2024.105485>

Received 25 January 2024; Received in revised form 8 May 2024; Accepted 13 May 2024

Available online 14 May 2024

1386-5056/© 2024 Published by Elsevier B.V.

1. Introduction

Depressive and anxiety disorders are common mental disorders ranking among the leading causes of global disease burden [1], and are associated with high healthcare and societal costs [2,3]. The prevalence of these disorders is increasing, especially among individuals aged 18 to 34 [3,4]. Current therapy consists of individual or group therapy with evidence-based protocols including cognitive behaviour therapy (CBT), interpersonal therapy (IPT), and behavioural activation (BA) [5]. Although these therapies are effective, not all clients benefit [5–7]. A meta-analysis of the effect of psychotherapy on major depression showed that approximately 60 % of adults improved after psychotherapy [7].

Digital technology is proposed to revolutionize the delivery, efficacy, and accessibility of psychological treatment [8,9]. Moreover, digital technologies have the potential to personalize therapy [10] and personalization of therapy has been shown effective in improving treatment outcomes, suiting a larger variety of clients, and reducing therapy dropout [11]. The possibilities for online psychotherapy increased massively over the last years [8,12]. In most cases, such therapy involves therapist-delivered video-conferencing sessions without additional digital tools such as apps to support the client outside of the sessions [13–16]. Blended therapy, however, combines face-to-face therapy sessions with online modules or digital tools (e.g., text messaging programs or smartphone apps) providing support outside of the therapy session [17–23]. These digital tools mainly consist of psycho-education and homework exercises [17–23].

Recently, a new psychotherapy concept has emerged aiming to improve therapy effectiveness and efficiency. The therapy concept combines videoconferencing sessions with support by means of a mobile application, aiming to better support clients outside of therapy sessions [24–26] and to facilitate the therapeutic alliance [24]. More specifically, evidence-based therapy sessions are delivered via video-conferencing, and are complemented by: 1) ecological momentary assessments (EMAs) of symptoms, 2) ecological momentary interventions (EMIs) 3) communication between client and therapists in-between sessions through chat, and 4) feedback-informed treatment principles. In recent years, the utilization of mobile-based EMA and EMI has increased and proven beneficial for users by enabling real-time intervention in therapy [27,28], which can aid in personalizing therapy [27,29]. EMA involves patients actively monitoring their symptoms, feelings and behaviors in the app throughout the day. Based on this real-life record, client and therapist can decide timely on tailored psychoeducation and interventions in the context of a person's daily life [30–32]. The third element of treatment, involving communication between client and therapist in between sessions through chat, enables need-driven contact initiated by the client, facilitating therapy that better fits into the daily life of the client [24] and allows therapists to encourage clients' in completing assignments, or supporting them while doing so [25]. Feedback-informed treatment involves the frequent evaluation of the therapeutic relationship and treatment progress. Therapists and clients can utilize these data to tailor treatment to clients' specific needs and goals [33–35]. The literature shows that using progress feedback can improve outcomes, reduce dropout, and increase treatment efficiency [33–35], while being cost-effective compared to therapy as usual (TAU) [36,37]. Despite its potential, progress feedback is not yet often used in clinical practice [38,39].

Currently, evidence of this new psychotherapy concept for depressive- and anxiety disorders in specialized mental healthcare is scarce. van Orden, Kraaijeveld [24] investigated this psychotherapy concept and they found that in patients with anxiety- or depressive disorders, the psychotherapy concept had comparable levels of satisfaction and effectiveness in terms of general mental functioning compared to TAU. The current study aims to evaluate 1) the effectiveness of psychotherapy on general mental functioning and disorder-specific symptoms, 2) the efficiency of the psychotherapy process, 3) client satisfaction, and 4) the therapy-related costs of an online psychotherapy concept with app

support that combines EMA, EMI, online communication between client and therapist outside of regular therapy sessions, and feedback-informed therapy (further referred to as online psychotherapy).

2. Material and methods

2.1. Design and setting

The study was a retrospective observational cohort study, comparing online psychotherapy with TAU for clients with depressive or anxiety disorders. Existing Routine Outcome Monitoring (ROM) data, obtained between September 2018 and February 2020 from the Electronic Client File (ECF) at PsyQ, were used. PsyQ Parnassia Groep is a specialized mental health institution in the Netherlands, treating clients referred by their general practitioner or other specialized mental healthcare institutions for specialized mental healthcare. Data were obtained via questionnaires at the start and end of therapy by e-mail as part of standard clinical care [40]. Ethical approval was waived by the Medical Ethics Committee of Leiden – Delft – Den Haag (G20.200). Clients consenting during intake allowed their data to be used for research, adhering to the Declaration of Helsinki.

2.2. Intervention

The online psychotherapy with app support is comprised of evidence-based treatment for depressive or anxiety disorders and is provided completely online via the NiceDay software (<https://niceday.app/>) [41]. It consists of an app for clients and a web portal for both clients and CBT-trained psychologists supervised by psychotherapists. The app and web portal are accessible at any time and place. Niceday is developed according to the NEN 7510 and ISO 27001 standards for information security. Synchronous contact takes place via video conferencing sessions, whereas asynchronous contact takes place via chat. Moreover, the therapist regularly monitors the therapy-related activities of the client and responds or initiates contact by chatting when necessary. Therapist and client reflect together on therapy progress (feedback-informed therapy). Therapy-related activities include personal registrations (a diary), a feelings and thoughts record, and tasks and events (EMA/EMI). The therapy is provided by the therapist in the client's personal environment. Therapy contact varied in frequency and duration according to the treatment progress.

2.3. Therapy as usual (TAU)

The TAU consists of the standard therapy provided by CBT-trained psychologists supervised by psychotherapists for depressive- or anxiety disorders following national treatment guidelines. Medication is prescribed in both the intervention and TAU groups according to national treatment guidelines. Additional information can be found in [Appendix A](#).

2.4. Study population

All clients who initiated and completed online psychotherapy in the study period at PsyQ Parnassia Groep were included and matched to clients receiving TAU in the same period. Inclusion criteria encompassed clients diagnosed according to the Diagnostic and Statistical Manual, fifth edition with a depressive disorder (DSM-V; codes 296.20 – 296.36) or with an anxiety disorder (codes 300.29, 300.23, 300.01, 300.22, 300.02, 300.09, 300.3 and 300.7). Additional inclusion criteria were: (a) age ≥ 18 years, (b) IQ > 80 , (c) proficiency in the Dutch language, (d) completed treatment, (e) completed ROM at the start and end of treatment, (f) total number of sessions between ≥ 2 and ≤ 60 . Exclusion criteria comprised diagnosis of psychotic disorders, bipolar disorder, severe eating disorder, severe addiction, serious suicidal tendencies, or brain damage that might interfere with psychological treatment. The

exclusion criteria were checked by a psychiatrist or clinical psychologist during the intake. Additionally, cases with 0 days of treatment time (i.e., indicating data errors) were removed ($n = 8$).

2.5. Study endpoints

2.5.1. Primary endpoints

Primary outcomes were general mental functioning, depressive symptoms in clients with a depressive disorder, and symptoms of anxiety in clients with an anxiety disorder.

General mental functioning was measured with the validated Outcome Questionnaire – 45 items (i.e., OQ-45 [version 2]) [42]. All items are scored on a 5-point Likert scale, ranging from 0 (never) to 4 (almost always). It provides a total score ranging from 0 to 180. A higher score indicates heavier general symptoms [43]. The psychometric properties of the Dutch OQ-45 were adequate and comparable to the original OQ-45 [42].

Depressive symptoms were assessed with the 16-item Quick Inventory of Depressive Symptomatology – Self Report (QIDS-SR₁₆) [44]. All items are scored on a 4-point Likert scale, and the total score ranges from 0 to 27. General guidelines for interpreting scores are as follows: no depression, less than 5; mild depression, 6 to 10; moderate depression, 11 to 15; severe depression, 16 to 20; and very severe depression, 21 or greater [44]. The QIDS-SR₁₆ has highly acceptable psychometric properties and is therefore useful for assessing depressive symptom severity [44].

Anxiety symptoms were assessed with the 36-item Groninger Angst Schaal (GAS) [45]. These items are scored on a 5-point Likert Scale, ranging from 1 (never) to 5 (always). The total score ranges from 36 to 180, with a lower score indicating less anxiety [45]. The psychometric properties of the GAS are acceptable [45,46].

2.5.2. Secondary endpoints

The efficiency of both therapies was evaluated using the duration of treatment in weeks (i.e., time between the first and last session), the total number of therapy sessions, and the total minutes of treatment time in sessions. Data were obtained from the EPFs. Client satisfaction was evaluated using the 4-item KLANT questionnaire administered at the end of the treatment [47]. The therapy costs were the diagnosis-treatment invoicing costs.

2.5.3. Baseline and clinical characteristics

Other obtained study endpoints were baseline characteristics, e.g., sex, age, primary diagnosis, education status, marital status) from the client's ECF.

2.6. Statistical analysis

Descriptive analyses (means, SDs, N , and percentages) were used to describe the socio-demographic and clinical characteristics of the study population. A p -value < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS statistical software version 20.0 (IBM Corp., Armonk, NY, USA).

Clients from the online group were matched one-on-one to clients from the TAU group on age, sex, diagnosis, and treatment time in days (see Appendix A for details). The matching was conducted for four different samples, namely 1) the total sample (to compare secondary outcomes), 2) the sample who filled in the general mental functioning questionnaire (i.e., OQ-45), 3) + 4) the samples who filled in the disorder-specific questionnaire (i.e., QIDS-SR and GAS). While data on secondary outcomes were available for all clients, not all clients completed the questionnaires for general mental functioning and disorder-specific outcomes. To maximize the sample sizes per outcome, clients were matched on each of the outcomes separately.

The primary endpoints were analyzed using linear mixed models analysis, with time (i.e., baseline and end measurement) as a within-

subject factor, group (i.e., online psychotherapy and TAU) as a between-subject factor, and an interaction term between time and group. Age, sex, diagnosis, and treatment time in weeks were included in a multivariable linear mixed model analysis to adjust for confounding. Standardized mean differences (effect sizes) for general mental functioning and disorder-specific outcomes were calculated using Cohen's d . Additionally, change scores in general mental functioning were calculated in both groups to identify whether the change was considered reliable. A reliable change score (RCI) indicates a clinically significant change. For the OQ-45, a change from pre- to post-intervention of 14 in the Dutch population is considered reliable [42]. The frequency of clients with a reliable change was calculated.

The secondary endpoints: therapy efficiency, client satisfaction and costs were compared between the online and TAU groups using linear regression analysis. Baseline characteristics, namely age, sex, diagnosis and treatment time in weeks, were included in the linear regression analysis to adjust for confounding.

3. Results

In total, 241 clients received online psychotherapy in the study period. Of these, 71 were excluded (see Fig. 1). The final population consisted of 170 clients, who had either unipolar depression or anxiety disorder as their primary diagnosis.

3.1. Baseline and clinical characteristics

In total, 170 clients received online psychotherapy (see Table 1) and were matched with 170 clients from the TAU group from a population of 5223 clients. In both groups, the majority were female (71.18 %) and the mean age was 34 years ($SD = 11.70$). Approximately half of the participants were treated for a depressive disorder (48.24 %) and half for an anxiety disorder (51.76 %).

3.2. Primary endpoints

Both the online and TAU groups showed improved outcomes in general mental functioning (See Table 2), with a significantly larger improvement in the online group (i.e., $B = -8.50$, 95 CI: $(-15.01 - -1.97)$, $p = 0.011$). In the online group, 62 clients (54 %), versus 48 clients in the TAU group (42 %) showed reliable change. The effect size indicated a moderate effect between the groups, favouring online psychotherapy (Cohen's $d = 0.34$).

Both the online and TAU group showed improved depressive outcomes (See Table 2), with a significantly larger improvement in the online group ($B = -3.66$, 95 % CI: $(-5.79 - -1.54)$ $p < 0.01$). The effect size indicated a moderate effect, favouring the online psychotherapy (Cohen's $d = 0.77$).

Both groups improved on anxiety outcomes (See Table 2), with no significant difference between the groups ($B = -3.64$, 95 % CI: $(-13.10 - 5.82)$ $p = 0.447$). The effect size was small, slightly favouring online psychotherapy (Cohen's $d = 0.14$).

3.3. Secondary endpoints

Since clients were matched on treatment time, the average total treatment time in weeks was comparable: approximately 21 weeks (see Table 3). The total treatment time in minutes was also comparable between the groups; approximately: 690 min in the online group and 642 in the TAU group ($p = 0.286$). The total number of sessions was significantly higher in the online group ($M = 15.26$, $SD = 10.40$) than in the TAU group ($M = 11.66$, $SD = 9.68$; $p < 0.01$).

Costs were comparable between the groups; approximately 3300,- euros in the online group and 2980,- in the TAU group ($p = 0.054$).

The results for client satisfaction are shown in Table 3. Overall, clients in both groups scored sufficient to good satisfaction on all four

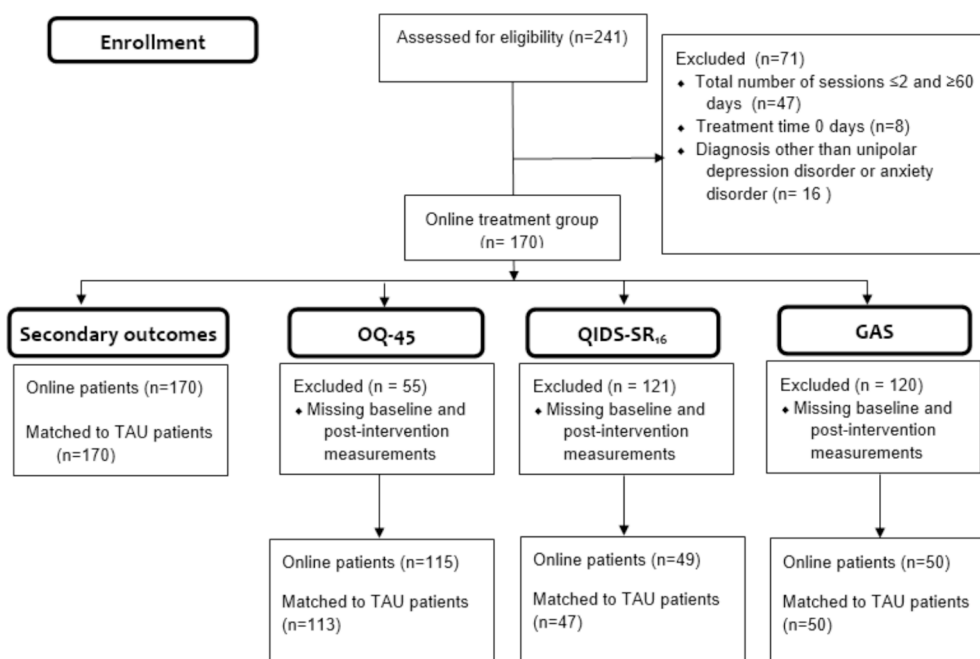


Fig. 1. Flow chart of the inclusion and matching per outcome measure.

Table 1

Baseline and clinical characteristics for all four samples.

	Total sample		OQ-45 sample		QIDS sample		GAS sample	
	Online psychotherapy (N;%)	TAU ¹ (N;%)	Online (N;%)	TAU (N;%)	Online (N;%)	TAU (N;%)	Online (N;%)	TAU (N;%)
Population	170	170	115	113	49	47	50	50
Sex								
Male	49 (28.82)	49 (28.82)	33 (19.41)	31 (19.41)	12 (24.49)	10 (21.28)	15 (30.0)	15 (30.0)
Female	121 (71.18)	121 (71.18)	82 (71.30)	82 (71.30)	37 (75.51)	37 (78.72)	35 (70.0)	35 (70.0)
Age (M ± SD)	34.46 (11.70)	34.36 (11.70)	34.03 (11.74)	34.12 (11.61)	35.84 (13.59)	35.47 (12.98)	32.50 (9.77)	32.34 (9.92)
Primary diagnosis								
Unipolar depressive disorder	82(48.24)	82 (48.24)	55 (47.83)	53 (46.90)	49 (100.0)	47 (100.0)	0	0
Anxiety disorder	88 (51.76)	88 (51.76)	60 (52.17)	60 (53.10)	0	0	50 (100.0)	50 (100.0)
Education status								
Low	8 (4.71)	23 (13.53)	5 (4.35)	12 (10.62)	1 (2.04)	5 (10.64)	4 (8.0)	5 (10.0)
Middle	38 (22.35)	45 (26.47)	23 (20.0)	37 (32.74)	11 (22.45)	14 (29.78)	7 (14.0)	20 (40.0)
High	17 (10.0)	35 (20.59)	10 (8.70)	26 (23.01)	4 (8.16)	9 (19.15)	4 (8.0)	9 (18.0)
Missing	107 (62.94)	67 (39.41)	77 (66.96)	38 (33.63)	33 (67.35)	21 (44.68)	35 (70.0)	16 (32.0)
Marital status								
Married	20 (11.76)	40 (23.53)	14 (12.17)	22 (19.47)	9 (18.37)	11 (23.40)	4 (8.0)	12 (24.0)
Divorced	10 (5.88)	8 (4.71)	5 (4.35)	5 (4.42)	2 (1.77)	2 (4.26)	2 (4.0)	1 (2.0)
Not married	110 (64.71)	92 (54.12)	78 (67.83)	63 (55.75)	32 (28.3)	23 (48.94)	34 (68.0)	25 (50.0)
Partner	3 (1.76)	1 (0.59)	0 (0.0)	3 (2.65)	0 (0.0)	1 (0.59)	0 (0.0)	2 (4.0)
Widowed	5 (2.94)	3 (1.76)	1 (0.87)	1 (0.88)	1 (2.04)	0 (0.0)	0 (0.0)	0 (0.0)
Missing	22 (12.94)	26 (15.29)	17 (14.78)	36 (31.86)	5 (10.20)	10 (21.28)	10 (20.0)	10 (20.0)

¹ Treatment as usual.

subscales, with no significant differences between the two groups.

4. Discussion

This study compared online psychotherapy with TAU for clients with depressive- or anxiety disorders in terms of effectiveness, efficiency, client satisfaction, and costs. Results showed that online psychotherapy was more effective than TAU in terms of improving general mental functioning and symptoms of depression, but no significant difference

was observed for outcomes related to symptoms of anxiety. While the total number of sessions was significantly higher in the online psychotherapy group, treatment session duration in minutes was comparable across the groups. This suggests that online clients had more frequent, but shorter sessions per week than TAU clients. Finally, no significant differences in costs and client satisfaction were found between the two groups.

Table 2
Mean (and SD) of general mental and disorder-specific symptoms at pre- and post-intervention, and the outcomes of the mixed model analysis.

	Online psychotherapy	TAU ¹	Basic model (95 % CI) ²	Adjusted model ³	Effect size ⁴ (Cohen D)
General mental functioning total score	M ± SD n = 115	M ± SD n = 113			
Baseline	88.42 (22.61)	83.18 (27.09)			
Post	66.50(27.93)	69.76 (28.79)			
Change	−21.91 (27.50)	−13.42 (22.15)	−8.50 (−15.01 – −1.97) p = 0.011	−8.50 (−15.01 – −1.97) p = 0.011	0.340
Disorder-specific questionnaire – Depressive disorder	n = 49	n = 47			
Baseline	14.94 (4.44)	13.81 (5.02)			
Post	8.51 (6.09)	11.04 (4.77)			
Change	−6.43 (5.92)	−2.77 (4.42)	−3.66 (−5.79 – −1.54) p < 0.01	−3.66 (−5.79 – −1.54) p < 0.01	0.772
Disorder-specific questionnaire – Anxiety disorder	n = 50	n = 50			
Baseline	102.90 (26.94)	95.72 (25.97)			
Post	87.74 (32.51)	84.20 (25.37)			
Change	−15.16 (29.70)	−11.52 (16.89)	−3.64 (−13.10 – 5.82) p = 0.447	−3.64 (−13.10 – 5.82) p = 0.447	0.138

¹ Treatment as usual.
² The basic model contains time (baseline and post-intervention measurement), group (online or TAU), interaction between time and group, and treatment time in weeks.
³ In addition to the basic model, the adjusted model contains age, sex and diagnosis in case of general mental functioning. The models for the disorder-specific outcomes were adjusted for age and sex.
⁴ Cohen D effect sizes.

4.1. Comparison to literature

We first compare the results to a study that also investigated the online psychotherapy offered by NiceDay, followed by studies that combined online sessions with digital tools allowing for interaction between sessions. As limited studies have been conducted on such forms of therapy, we also compare the findings to studies using blended therapy (i.e., face-to-face therapy combined with digital tools), which also provides the opportunity for interaction between sessions.

In line with our study, van Orden, Kraaijeveld [24], who also investigated online psychotherapy using NiceDay, showed comparable levels of satisfaction between the online and TAU group. In contrast to our study, where online psychotherapy was more effective on general mental functioning than TAU and treatment duration in weeks was matched, van Orden, Kraaijeveld [24] showed equal effectiveness on general mental functioning and significantly lower treatment duration in weeks with online psychotherapy. These differences may be attributable to differences in the analysis methods, as van Orden, Kraaijeveld [24] did not match the groups and compared the total online client group with the total TAU group. Moreover, no adjustments were made for confounding factors in the analysis. Therefore, in van Orden, Kraaijeveld [24] the results may have been influenced by differences in socio-demographic characteristics.

In line with our study, previous studies that investigated online sessions combined with app support showed significant improvements in anxiety and depression symptoms over time [25,26]. It is worth noting that these studies focused on individuals with elevated levels of anxiety and depression, rather than specific diagnosed mental disorders in psychiatric patients as in our study. Additionally, studies on blended therapy consistently reported reductions in anxiety- and depression symptoms over time [17–23]. Furthermore, findings from numerous randomized controlled trials indicate that blended therapies are equally effective as TAU [17,18,21–23].

Our study showed a significantly higher decrease in depression outcomes in online psychotherapy with app support compared to TAU in

psychiatric patients, however, no significant difference was found for anxiety. This can be due to our small subgroups for depression (n = 49) and anxiety (n = 50). Other studies also show comparable effectiveness of online or blended therapy compared to TAU for anxiety outcomes [23,48,49].

However, in our study, larger improvements were shown in depressive disorders with online psychotherapy compared to TAU. The larger effects could be because, the current online psychotherapy combined experience sampling (i.e., EMA, EMI) with feedback-informed therapy. Although these treatment strategies have separately been proven effective, they are rarely used in practice, let alone in combination [27,33,35,38,50].

Our study was, to our knowledge, the first to study the treatment efficiency of online psychotherapy with app support. The number of sessions was higher in the online psychotherapy group than in TAU, although clients were matched on treatment time in weeks. Treatment session duration in minutes, however, was comparable across the two groups. This can be due to the flexibility in duration and frequency of the online psychotherapy. To explain, patients in the online group may have had more frequent contact with their therapist but the contact may have been of shorter duration. This is in line with the vision of the way online psychotherapy with app support is to be administered.

In line with our study, Mathiasen, Andersen [18] showed comparable satisfaction in blended therapy compared to TAU. In addition, a qualitative study by Månsson, Skagius Ruiz [20] showed clients appreciated the blended therapy, such as receiving feedback in between face-to-face sessions. Overall, client satisfaction with online or blended therapy appears to be comparable to TAU.

4.2. Strengths and limitations

The investigated therapy concept is the first to combine online psychotherapy sessions with app support including innovative EMA/EMI and feedback-informed treatment principles, targeting psychiatric clients with an anxiety- or depression disorder. Another strength of this

Table 3

Secondary outcomes: Efficiency and client satisfaction outcomes per group (online versus TAU), and the corresponding linear regression analysis outcome.

	Online psychotherapy	TAU ¹	Basic model	Adjusted model ²
	n; M ± SD	n; M ± SD	β, SE	
Total treatment time in weeks ³	21.43 (12.80)	21.62 (13.08)		
Depressive disorders	20.72 (12.73)	20.75 (13.14)		
Anxiety disorders	22.09 (12.92)	22.43 (13.04)		
Total number of sessions (video consults)	15.26 (10.40)	11.66 (9.68)	3.59 (1.09)	3.71 (1.09)
Depressive disorders	15.12 (9.40)	11.18 (9.83)	$p < 0.01$	$p < 0.01$
Anxiety disorders	15.39 (11.30)	12.11 (9.58)		
Total treatment session duration (minutes, incl need-driven time)	689.76 (588.53)	642.18 (444.42)	47.58 (56.56)	51.47 (48.21)
Depressive disorders	677.02 (500.61)	625.49 (452.39)	$p = 0.401$	$p = 0.286$
Anxiety disorders	701.63 (662.72)	657.73 (438.88)		
Costs	3302.82 (2057.77)	2979.99 (2002.01)	322.83 (220.19)	340.06 (176.06)
Depressive disorders	3135.99 (1838.55)	2900.04 (1999.42)	$p = 0.144$	$p = 0.054$
Anxiety disorders	3458.28 (2242.25)	3054.50 (2012.98)		
Client satisfaction Score recommending to others	104;	84;	−0.28 (0.25)	−0.24 (0.25)
Score therapist	8.19 (1.71)	8.48 (1.72)	$p = 0.260$	$p = 0.350$
	105;	85;	−0.14 (0.22)	−0.12 (0.22)
	8.14 (1.44)	8.28 (1.52)	$p = 0.518$	$p = 0.581$
Score effect therapy	101;	81;	−0.12 (0.29)	−0.101 (0.29)
	7.02 (1.88)	7.14 (1.99)	$p = 0.688$	$p = 0.730$
Score coping with problems	113;	88;	−0.33 (0.23)	−0.242 (0.23)
	7.55 (1.54)	7.88 (1.65)	$p = 0.150$	$p = 0.284$

¹ Treatment as usual.

² Adjusted model contains treatment time (not in the model with outcome treatment time), age, sex, diagnosis.

³ Clients were matched on treatment time, therefore no analysis was performed.

study is that it offers valuable insights into the effectiveness of online psychotherapy in a naturalistic setting, considering both general mental functioning- and disorder-specific outcomes. Next to this, the study's design allowed for the matching of clients receiving online psychotherapy with those undergoing TAU, thereby enabling the examination of therapy responses while controlling for potential sociodemographic confounders such as age, sex, diagnosis, and treatment duration.

A limitation of our study was that the online population was predominantly young (i.e., mean age of 34 years) and female (i.e., 71 %). Therefore, it remains unclear whether the results can be generalized to older individuals or males. During enrollment in the online group of the current study, no waiting list was present for the online psychotherapy, while there was a waiting list for TAU. This could have influenced the choice of the client, for example, clients with more severe symptoms choosing online psychotherapy. The statistical models were not controlled for medication use. It is unclear whether there are differences in medication use across the groups and how this is associated with the

observed improvements in treatment outcomes.

5. Conclusions

Online psychotherapy with app support showed to be a promising alternative to TAU for depressive- and anxiety disorders. More research is needed to evaluate the effectiveness, cost-effectiveness and client satisfaction of online psychotherapy compared to TAU. Future studies should further evaluate the effectiveness of fully online or blended therapy with app support, using (three-armed: online, blended, TAU) randomized controlled or multiple baseline series designs. Such designs can help to overcome biases present in the currently available studies [24–26]. Moreover, such RCT studies can study the level of engagement with the app in relation to treatment outcomes. Additionally, it is recommended to perform an extensive economic evaluation, including costs such as onsite location and online equipment. Finally, qualitative research is important to gain in-depth insight into the experiences of clients and therapists with online psychotherapy, shedding light on its impact on therapeutic alliance and identifying areas for improvement, ultimately contributing to the development of more effective and efficient online psychotherapy approaches.

CRediT authorship contribution statement

Romy Fleur Willemsen: Writing – original draft, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Anke Versluis:** Writing – review & editing, Supervision, Project administration, Methodology, Formal analysis, Conceptualization. **Jiska Joëlle Aardoom:** Writing – review & editing, Supervision. **Annelieke Hermina Josephina Petrus:** Writing – review & editing, Project administration, Conceptualization. **Anna Veronica Silven:** Writing – review & editing. **Niels Henrik Chavannes:** Writing – review & editing, Supervision. **Annemiek van Dijke:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors thank Jorge Luis Reyes Ortiz, and Gisela Lijde for their contributions in the data cleaning process and Annet Spijker for making it possible to conduct this study within PsyQ – Parnassia Group.

Summary table

What was already known on the topic:

- Depressive and anxiety disorders are common mental disorders ranking among the leading causes of global disease burden.
- Therapies are effective, however not all clients benefit.
- Digital technology is proposed to revolutionize psychological treatment.
- Digital technology allows for personalizing treatment, which has been shown effective in improving treatment outcomes.

What this study added to our knowledge.

- Online psychotherapy is shown to be a valuable alternative to TAU in terms of treatment outcomes, costs and client satisfaction.
- Online clients had more frequent, but shorter sessions than TAU clients.

Data availability statement

The data that support the findings of this study are available upon reasonable request from the last author. The data are not publicly available due to privacy or ethical restrictions.

Funding statement

No funding was obtained for this research.

Ethics approval statement

Due to the nature of the study, the need for ethical approval was waived by the Medical Ethics Committee of Leiden – Delft – Den Haag (G20.200 dd 19 Feb 2021).

Patient consent statement

During the intake session to enter therapy provided by PsyQ – Parnassia Group, clients can indicate whether their data can be used for research. Only data of clients who consented were used for this study and all data was handled according to the Declaration of Helsinki

Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijmedinf.2024.105485>.

References

- [1] D.F. Santomauro, et al., Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic, *Lancet* 398 (10312) (2021) 1700–1712.
- [2] D. Chisholm, et al., Scaling-up treatment of depression and anxiety: a global return on investment analysis, *Lancet Psychiatry* 3 (5) (2016) 415–424.
- [3] Proudman, D., P. Greenberg, and D. Nellesen, *The growing burden of major depressive disorders (MDD): implications for researchers and policy makers*. 2021, Springer. p. 619-625.
- [4] P.E. Greenberg, et al., The economic burden of adults with major depressive disorder in the United States (2010 and 2018), *Pharmacoeconomics* 39 (6) (2021) 653–665.
- [5] D. Pauley, et al., Two decades of digital interventions for anxiety disorders: a systematic review and meta-analysis of treatment effectiveness, *Psychol. Med.* (2021) 1–13.
- [6] P. Cuijpers, A. Stringaris, M. Wolpert, Treatment outcomes for depression: challenges and opportunities, *Lancet Psychiatry* 7 (11) (2020) 925–927.
- [7] P. Cuijpers, et al., The effects of psychotherapies for major depression in adults on remission, recovery and improvement: a meta-analysis, *J. Affect. Disord.* 159 (2014) 118–126.
- [8] D. Bhugra, et al., The WPA-lancet psychiatry commission on the future of psychiatry, *Lancet Psychiatry* 4 (10) (2017) 775–818.
- [9] E.A. Holmes, et al., The Lancet Psychiatry Commission on psychological treatments research in tomorrow's science, *Lancet Psychiatry* 5 (3) (2018) 237–286.
- [10] S. Hornstein, et al., Personalization strategies in digital mental health interventions: a systematic review and conceptual framework for depressive symptoms, *Front. Digital Health* 5 (2023) 1170002.
- [11] J.K. Swift, et al., The impact of accommodating client preference in psychotherapy: a meta-analysis, *J. Clin. Psychol.* 74 (11) (2018) 1924–1937.
- [12] P. Gooding, Mapping the rise of digital mental health technologies: Emerging issues for law and society, *Int. J. Law Psychiatry* 67 (2019) 101498.
- [13] M. Bounthavong, et al., Economic evaluation of in-home telehealth compared to in-person treatment delivery for managing depression, *Value Health* 19 (3) (2016) A189.
- [14] L.E. Egede, et al., Psychotherapy for depression in older veterans via telemedicine: a randomised, open-label, non-inferiority trial, *Lancet Psychiatry* 2 (8) (2015) 693–701.
- [15] L.E. Egede, et al., Psychotherapy for depression in older veterans via telemedicine: effect on quality of life, satisfaction, treatment credibility, and service delivery perception, *J. Clin. Psychiatry* 77 (12) (2016) 16304.
- [16] D.D. Luxton, et al., Home-based telebehavioral health for US military personnel and veterans with depression: a randomized controlled trial, *J. Consult. Clin. Psychol.* 84 (11) (2016) 923.
- [17] L.C. Kooistra, et al., Cost and effectiveness of blended versus standard cognitive behavioral therapy for outpatients with depression in routine specialized mental health care: pilot randomized controlled trial, *J. Med. Internet Res.* 21 (10) (2019) e14261.
- [18] K. Mathiasen, et al., The clinical effectiveness of blended cognitive behavioral therapy compared with face-to-face cognitive behavioral therapy for adult depression: randomized controlled noninferiority trial, *J. Med. Internet Res.* 24 (9) (2022) e36577.
- [19] K.H. Ly, et al., Smartphone-supported versus full behavioural activation for depression: a randomised controlled trial, *PLoS One* 10 (5) (2015) e0126559.
- [20] K.N. Månsson, et al., Development and initial evaluation of an Internet-based support system for face-to-face cognitive behavior therapy: a proof of concept study, *J. Med. Internet Res.* 15 (12) (2013) e280.
- [21] S. Nakao, et al., Web-based cognitive behavioral therapy blended with face-to-face sessions for major depression: randomized controlled trial, *J. Med. Internet Res.* 20 (9) (2018) e10743.
- [22] J.C. Pérez, et al., An adjunctive internet-based intervention to enhance treatment for depression in adults: randomized controlled trial, *JMIR Mental Health* 8 (12) (2021) e26814.
- [23] G. Romijn, et al., Acceptability, effectiveness and cost-effectiveness of blended cognitive-behavioural therapy (bCBT) versus face-to-face CBT (fCBT) for anxiety disorders in specialised mental health care: a 15-week randomised controlled trial with 1-year follow-up, *PLoS One* 16 (11) (2021) e0259493.
- [24] M.L. van Orden, et al., Evaluating the first results of a need-driven digital mental health intervention for depression and anxiety: an exploratory study, *Clinical eHealth* 5 (2022) 44–51.
- [25] A. Lungu, et al., Blended care-cognitive behavioral therapy for depression and anxiety in real-world settings: pragmatic retrospective study, *J. Med. Internet Res.* 22 (7) (2020) e18723.
- [26] J.T. Owusu, et al., Real-world evaluation of a large-scale blended care-cognitive behavioral therapy program for symptoms of anxiety and depression, *Telemedicine and e-Health* 28 (10) (2022) 1412–1420.
- [27] K.P. Dao, et al., Smartphone-delivered ecological momentary interventions based on ecological momentary assessments to promote health behaviors: systematic review and adapted checklist for reporting ecological momentary assessment and intervention studies, *JMIR Mhealth Uhealth* 9 (11) (2021) e22890.
- [28] H. Yin, et al., Mobile-based ecological momentary assessment and intervention: bibliometric analysis, *Front. Psych.* 15 (2024) 1300739.
- [29] K.E. Heron, J.M. Smyth, Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments, *Br. J. Health Psychol.* 15 (1) (2010) 1–39.
- [30] E. Frank, et al., Personalized digital intervention for depression based on social rhythm principles adds significantly to outpatient treatment, *Frontiers in Digital Health* 4 (2022) 870522.
- [31] A. Versluis, et al., Changing mental health and positive psychological well-being using ecological momentary interventions: a systematic review and meta-analysis, *J. Med. Internet Res.* 18 (6) (2016) e5642.
- [32] D. Colombo, et al., Current state and future directions of technology-based ecological momentary assessment and intervention for major depressive disorder: a systematic review, *J. Clin. Med.* 8 (4) (2019) 465.
- [33] B. Bovendeerd, et al., Enhancing the effect of psychotherapy through systematic client feedback in outpatient mental healthcare: a cluster randomized trial, *Psychother. Res.* 32 (6) (2022) 710–722.
- [34] P.D. Janse, et al., The effect of feedback-informed cognitive behavioral therapy on treatment outcome: a randomized controlled trial, *J. Consult. Clin. Psychol.* 88 (9) (2020) 818.
- [35] K. de Jong, et al., Using progress feedback to improve outcomes and reduce drop-out, treatment duration, and deterioration: a multilevel meta-analysis, *Clin. Psychol. Rev.* 85 (2021) 102002.
- [36] C.J. Simons, et al., Economic evaluation of an experience sampling method intervention in depression compared with treatment as usual using data from a randomized controlled trial, *BMC Psychiatry* 17 (1) (2017) 1–14.
- [37] M.J. Lambert, et al., The effects of providing therapists with feedback on patient progress during psychotherapy: are outcomes enhanced? *Psychother. Res.* 11 (1) (2001) 49–68.
- [38] A. Jensen-Doss, et al., Monitoring treatment progress and providing feedback is viewed favorably but rarely used in practice, *Adm. Policy Ment. Health Ment. Health Serv. Res.* 45 (2018) 48–61.
- [39] M. Barkham, et al., Routine outcome monitoring (ROM) and feedback: research review and recommendations, *Psychother. Res.* 33 (7) (2023) 841–855.
- [40] E. de Beurs, et al., Routine outcome monitoring in the Netherlands: practical experiences with a web-based strategy for the assessment of treatment outcome in clinical practice, *Clin. Psychol. Psychother.* 18 (1) (2011) 1–12.
- [41] *NiceDay*. [cited 2023 22-03-2023]; Available from: <https://niceday.app/>.
- [42] K. de Jong, et al., The Outcome Questionnaire (OQ-45) in a Dutch population: a cross-cultural validation, *Clin. Psychol. Psychotherapy: an Int. J. Theory Pract.* 14 (4) (2007) 288–301.
- [43] De Jong, K., et al., *Handleiding voor afname en scoring van de Outcome Questionnaire OQ-45.2*. Salt Lake City, UT, OQ Measures LLC, 2009.
- [44] A.J. Rush, et al., The 16-Item Quick Inventory of Depressive Symptomatology (QIDS), clinician rating (QIDS-C), and self-report (QIDS-SR): a psychometric evaluation in patients with chronic major depression, *Biol. Psychiatry* 54 (5) (2003) 573–583.
- [45] A. Scholing, P.M. Emmelkamp, Self report assessment of anxiety: a cross validation of the Lehrer-Woolfolk Anxiety Symptom Questionnaire in three populations, *Behav. Res. Ther.* 30 (5) (1992) 521–531.
- [46] V. Peerbooms, et al., Measuring Anxiety Symptoms-Psychometric Properties of the Dutch Version of the Lehrer-Woolfolk Anxiety Scale Questionnaire, *Psychological Test Adaptation and Development*, 2024.

- [47] I. Huijbrechts, et al., Routine Outcome Measurement binnen PsyQ: normering van de 4 K's, *Dir. Ther.* 29 (4) (2009) 243–253.
- [48] S. Guo, et al., The efficacy of internet-based cognitive behavioural therapy for social anxiety disorder: a systematic review and meta-analysis, *Clin. Psychol. Psychother.* 28 (3) (2021) 656–668.
- [49] Komariah, M., et al. *Efficacy of Internet-Based Cognitive Behavioral Therapy for Depression and Anxiety among Global Population during the COVID-19 Pandemic: A Systematic Review and Meta-Analysis of a Randomized Controlled Trial Study.* in *Healthcare*. 2022. MDPI.
- [50] L.C. Walz, M.H. Nauta, M. aan het Rot, Experience sampling and ecological momentary assessment for studying the daily lives of patients with anxiety disorders: a systematic review, *J. Anxiety Disord.* 28 (8) (2014) 925–937.