Tailored therapist-guided internet-based cognitive behavioral treatment for psoriasis:

a randomized controlled trial

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Short title: Internet-based treatment for psoriasis

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INTERNET-BASED TREATMENT FOR PSORIASIS

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INTERNET-BASED TREATMENT FOR PSORIASIS

ABSTRACT

Background: Patients with somatic conditions, such as psoriasis, frequently suffer from high burden of their disease in daily life and might benefit from internet-delivered cognitive behavioral treatment (ICBT) tailored to their adjustment problems. The aim of this multicenter randomized controlled trial was to examine the effects of therapist-guided, individually-tailored ICBT in a clinical sample of patients with psoriasis.

Methods: A total of 131 patients with psoriasis, who were screened for a psychological risk profile, were randomized to either care as usual (CAU, n=65) or ICBT in addition to care as usual (n=66). Participants filled out standardized self-report questionnaires assessing physical and psychological functioning, and impact on daily activities, at baseline, post-assessment, and 6-month follow-up.

Results: In covariate-controlled linear mixed models analyses, significantly larger improvements in ICBT compared to CAU were found in the primary outcomes physical functioning ($p=.03$, $d=0.36$) and impact on daily activities ($p=.04$, $d=0.35$), but not in psychological functioning ($p=.32$), up to 6 months after treatment as compared to baseline. In explorative analyses, the working alliance measured at the beginning of ICBT treatment predicted improved physical ($p=.02$) and psychological ($p<.001$) outcomes.

Conclusions: Results underline the promise of therapist-guided, individually-tailored ICBT to improve physical functioning and reduce the impact of psoriasis on daily activities in patients with a psychological risk profile. Establishing a good therapeutic relationship early on may be an important factor that influences treatment outcomes in personalized ICBT interventions. Further research is needed to evaluate ICBT effectiveness in additional samples, and to explore its underlying mechanisms.
INTERNET-BASED TREATMENT FOR PSORIASIS

**KEYWORDS:** cognitive-behavioral treatment, tailored personalized treatment, dermatology, effectiveness, impact of illness, internet-based treatment, intervention, psoriasis, psychodermatology, randomized controlled trial, working alliance.
INTRODUCTION

Psoriasis is one of the most common immune-related chronic dermatological conditions [1] and is known for its high disease burden in daily life [2]. Patients frequently experience problems with mood, distress, and social impairments, in addition to the burden of physical symptoms [e.g., 3-6]. These problems may also negatively impact upon skin status, disease course, adherence, and dermatological treatment success [7-11]. Patients with a psychological profile of elevated levels of distress (an estimated 30 to 40%) are known to be at risk for long-term adjustment problems [e.g., 3, 12] and might benefit from cognitive behavioral therapy (CBT), as it has shown to improve physical and psychological functioning in patients with chronic somatic conditions [13-16], including dermatological conditions [17-20]. Over the last decade, CBT has increasingly been offered online, which may facilitate intervention reach, increase cost-effectiveness and time-efficiency, and reduce possible barriers to follow a psychological intervention [e.g., 21, 22].

While systematic reviews show favorable effects of Internet-based CBT (ICBT) for chronic somatic conditions [e.g., 23-25], research in dermatological conditions is scarce. One randomized controlled trial (RCT) showed positive effects of unguided ICBT on anxiety and quality of life in patients with psoriasis, but was limited by high dropout rates [26]. Therapist guidance may improve adherence [27, 28] and treatment effects [e.g., 29-31], and patients tend to prefer guidance in ICBT [22, 32]. Furthermore, ICBT is usually based on standardized protocols [e.g., 33], whereas recent findings underline the promise of less studied individually-tailored interventions [e.g., 34-36].

Despite the promising effects of therapist-guided, individually-tailored ICBT in other conditions, its effects have not been examined in dermatological conditions. Possible predictors and correlates of treatment outcomes, including the therapeutic relationship [37, 38] and adherence [39], also remain unexplored in this group. Therefore, this study examined...
INTERNET-BASED TREATMENT FOR PSORIASIS

the effectiveness of therapist-guided, individually-tailored ICBT for patients with psoriasis, expecting greater improvements in physical and psychological functioning, and reduced impact on daily activities, in ICBT compared to care as usual (CAU). In addition, socio-demographic, disease-related, and treatment-related predictors and correlates of treatment effects were explored.

METHODS

Participants and procedure

Study participants were recruited through outpatient dermatology departments of one academic and three non-academic hospitals and through the Dutch Psoriasis Association (Figure 1). Inclusion criteria were a diagnosis of psoriasis, age ≥18 years, and a positive psychological risk profile (i.e., Impact of chronic Skin Disease on Daily Life [ISDL] score of ≥5 for anxiety and/or ≥21 on negative mood [40, 41]). Exclusion criteria were psychological (i.e., diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders [DSM; 42]) and/or physical comorbidity interfering with the study protocol, current psychological treatment, current photo(chemo)therapy, pregnancy, lack of access to a computer and/or internet, and illiteracy.

This study had an open-label parallel-group RCT design. An independent person randomized participants (allocation ratio: 1:1) using a computerized program that minimized on age, gender, educational level, recruitment site, self-assessed disease severity, and medication use. Patients were randomized to either care as usual (CAU; i.e., regular dermatological care) or ICBT in addition to CAU. A member of the research team informed
INTERNET-BASED TREATMENT FOR PSORIASIS

participants by phone and letter about treatment assignment. ICBT interventions took place between July 2010 and October 2014. Measurements were collected between June 2010 and April 2015. Study assessments were conducted at baseline, post-treatment (CAU: 6 months after baseline), and 6-month follow-up (CAU: 12 months after baseline). The study was approved by the regional medical ethics committee, registered in the Dutch Trial Registry (NTR2436), and conducted in accordance with the Declaration of Helsinki [43]. All participants provided written informed consent.

ICBT intervention

Patients randomized to the ICBT condition received an internet-based, therapist-guided CBT intervention aimed to reduce the impact of psoriasis on daily life, which was based on previous evidence-based face-to-face interventions [e.g., 41, 44]. The intervention consisted of five flexible treatment modules containing a broad variety of cognitive and behavioral techniques, focused on themes that patients often experience problems with: itch, pain, fatigue, negative mood, and social relationships. Participants started with two face-to-face intake sessions with their therapist (i.e., a psychologist), in which individual treatment goals were discussed. Next, patients received a telephone-based instruction of the intervention website by a researcher to ensure that they were capable of working with the program from home. Patients then started with the individually-tailored ICBT intervention, by logging on to the secure intervention website. Choice of treatment modules and individual assignments within these modules were determined based on individual patient goals, therapist’s judgment, and screening procedures [see also 45]. Patients received personalized written feedback on their assignments from their therapist, approximately once a week. Intervention duration and content varied between participants, depending on treatment goals, with a mean duration of 25
of ICBT modules, therapists, intervention use, and adherence, see Online Supplementary Methods and Results.

**Instruments**

**Primary and secondary outcomes**

The primary outcome was the impact of psoriasis on daily life, measured on three domains, for which total scores were computed (i.e., composite scores: the overall average of normalized (z-)scores of the questionnaires included in each domain): 1) *Psychological functioning*, consisting of negative mood [ISDL; 40], anxiety [ISDL; 40], and depressive symptoms [Beck Depression Inventory; 46, 47]; 2) *Physical functioning*, consisting of itch [ISDL; 40] and fatigue [Checklist Individual Strength; 48]; and 3) *Impact on daily activities*, consisting of role limitations due to physical health problems and role limitations due to emotional problems [RAND-36 Health Status Inventory; 49, 50]. Secondary outcomes consisted of clinician-rated [Psoriasis Area and Severity Index; 51] and self-reported disease severity [Self-Administered Psoriasis Area and Severity Index; 52], and dermatological treatment compliance.

**Predictors and correlates of treatment outcome**

Socio-demographic (i.e., age, sex, educational level, and marital status), disease-related (i.e., disease severity and duration), and treatment-related variables (i.e., working alliance between
INTERNET-BASED TREATMENT FOR PSORIASIS

patient and ICBT therapist [Working Alliance Inventory - Short form; 53, 54], ICBT adherence, website logins) were examined as possible predictors and correlates of treatment outcomes. Further measurement details of all study variables can be found in the Online Supplementary Methods and Results.

Data analysis

Baseline characteristics were compared with t-tests and \( \chi^2 \)-tests. Primary analyses were conducted using linear mixed-effects modeling, which has superior qualities with regard to missing values [56] and makes use of all available data, making this a full-intention-to-treat analysis. Models were fitted with full information maximum likelihood estimation. Between-group effects at post-treatment and follow-up were analyzed with baseline scores of dependent variables as covariates. Time was operationalized as a continuous variable, post-treatment assessment varied across participants as a result of different intervention length. Fixed linear effects of time and condition were included and random effects of intercept. Primary analyses were conducted including all variables included in randomization (i.e., age, sex, educational level, recruitment site, systemic medication use, etanercept use, and disease severity) as covariates [57]. In secondary analyses, results were reported 1) without covariates (see Results) and 2) excluding ICBT dropouts/non-starters (see Online Supplementary Methods and Results).

Between-group Cohen’s \( d \) type of effect size was calculated, dividing the difference in estimated marginal means of primary analyses of the two groups by their pooled pre-treatment SD. Within-group Cohen’s \( d \) effect sizes were calculated by dividing the difference in pre- and post-assessment means by pre-assessment SDs. Effect sizes of 0.2, 0.5, and 0.8 were
INTERNET-BASED TREATMENT FOR PSORIASIS

considered small, moderate, and large [58]. Unstandardized effect sizes were defined as raw mean differences between ICBT and CAU.

Pearson correlation coefficients were calculated between change in primary outcomes (residual gain scores) and selected socio-demographic, disease-related, and treatment-related variables [59]. All analyses were conducted in IBM SPSS v21. A power analysis with 80% power indicated a sample size of two groups of 65 patients was needed, assuming the effect size $d=0.50$ ($\alpha=.05$), based on previous ICBT studies for physical and psychological conditions [61]. Statistical significance was accepted at $p<.05$. In explorative analyses examining correlates of treatment effects, tendencies towards significant effects ($p<.10$) were not reported, for stringency reasons.

RESULTS

Between June 2010 and November 2013, 751 patients were screened and 131 patients were randomized to either ICBT (n=65) or CAU (n=66). Means and SDs of selected socio-demographic and disease-related variables are presented in Table 1 and baseline values on primary outcomes and their subcomponents, and secondary outcomes, are presented in Tables 2 and 3. These values did not differ between groups ($p$-values $\geq.10$), with the exception of a tendency towards higher levels of fatigue ($p=.08$) and higher clinician-rated disease severity ($p=.03$) in ICBT compared to CAU. Disease severity was generally mild to moderate, with 7.6% of patients having severe psoriasis (i.e., PASI $>10$ [62]).
INTERNET-BASED TREATMENT FOR PSORIASIS

Attrition

A total of 73.3% of patients filled out post-treatment measurements and 62.6% completed 6-month follow-up measurements (see Figure 1). ICBT intervention dropout was 26.2%; 10 patients did not start treatment (non-starters; 15.4%), 6 patients dropped out during treatment (non-completers; 9.2%), and 1 patient (1.5%) died during treatment as a result of comorbidity unrelated to the treatment. Reported reasons for ICBT dropout, and differences between completers and dropouts, can be found in the Online Supplementary Methods and Results.

ICBT treatment satisfaction

Patients in the ICBT group who filled out post-treatment evaluation questionnaires (n=41) were satisfied with the ICBT intervention and gave the overall intervention a mean score of 7.64 (±1.71) and user-friendliness a 7.72 (±1.32) out of 10. A majority of 85.3% of patients would recommend the treatment to a friend or relative with a chronic somatic condition and 87.7% of patients believed the treatment would have long-term positive effects (somewhat/probably/certainly). Sixty percent of patients indicated a preference for internet-based treatment over other forms of treatment (phone-based: 5.0%, face to face: 27.5%) for future treatment, and an additional 7.5% gave internet-based treatment a shared first place with one or more other modalities.
Primary outcomes

Results on primary outcomes and their subcomponents, including effect sizes, are presented in Table 2 and Figure 2.

- Insert Table 2 and Figure 2 about here -

Psychological functioning

In linear mixed models analyses controlling for previously specified covariates, no significant differences were found between ICBT and CAU regarding psychological functioning at post-assessment and 6-month follow-up ($p=.32$), nor on its subcomponents negative mood, anxiety, and depressive symptoms (all $p$-values $\geq .20$). The lack of significant main effects of time ($p$-values $\geq .22$) indicated that these outcomes were stable across post-assessment and 6-month follow-up. Similar results were obtained in secondary analysis including no other covariates than baseline values of the dependent variable ($p$-values $\geq .19$).

Physical functioning

Significantly larger improvements in ICBT compared to CAU were found for physical functioning up to 6 months after treatment as compared to baseline ($F(1,76.29)=4.60, p=.03$, $d=0.36$), with significant effects for fatigue ($F(1,74.53)=4.16, p=.04, d=0.37$), but not for itch ($p=.30$). These outcomes were stable across post-assessment and 6-month follow-up, with the exception of fatigue, which tended to be lower at post-assessment than at 6-month follow-up ($p=.09$). In secondary analysis including no other covariates than baseline values of the dependent variable, a tendency towards greater improvement in ICBT compared to CAU was
found for fatigue \( (p=.08) \) and no significant between-group differences for itch or total physical functioning \( (p\text{-values} \geq .16) \).

**Impact on daily activities**

Significantly larger improvements in ICBT compared to CAU were found for impact on daily activities up to 6 months after treatment as compared to baseline \( (F(1,81.48)=4.18, \ p=.04, \ d=0.35) \), with significant effects on both subcomponents: role limitations due to emotional problems \( (F(1,132)=4.36, \ p=.04, \ d=0.33) \) and role limitations due to physical health problems \( (F(1,81.99)=4.25, \ p=.04, \ d=0.32) \). The improvements in role limitations due to emotional problems at post-assessment were further enlarged at follow-up \( (p=.047) \), while other outcomes remained stable. In secondary analysis including no other covariates than baseline values of the dependent variable, no between-group differences were found \( (p\text{-values} \geq .17) \).

**Disease severity and compliance**

Results on self-reported and clinician-assessed disease severity, and dermatological treatment compliance, including effect sizes, are reported in Table 3. No between-group differences were found for any of these outcomes, with or without covariates \( (all \ p\text{-values} \geq .25) \).

- Insert Table 3 about here -

**Within-group improvements**

For primary outcome measures, ICBT within-group improvements were large for physical functioning \( (d=0.81-0.90) \) and moderate for psychological functioning \( (d=0.59-0.61) \) and
INTERNET-BASED TREATMENT FOR PSORIASIS

impact on daily activities ($d=0.48-0.51$). CAU within-group improvements were small to moderate for physical functioning ($d=0.30-0.56$), psychological functioning ($d=0.33-0.47$), and impact on daily activities ($d=0.33-0.43$).

**Predictors and correlates of treatment effects**

To explore which patients benefitted most from treatment, *treatment-related variables* (i.e., working alliance with the therapist, treatment duration, and ICBT adherence including patient-ratings, therapist-ratings, and website logins) were correlated with change in primary outcomes. Results indicated that a better working alliance with the therapist at the beginning of treatment was associated with greater pre-to-post-assessment improvements in psychological ($r=-.66, p<.001$) and physical ($r=-.42, p=.02$) functioning, but not with change in impact on daily activities ($r=18, p=.34$). No significant associations with treatment duration or ICBT adherence were found, nor with the *socio-demographic and disease-related variables* age, sex, educational level, disease duration, and disease severity (all $p$-values $\geq .17$).

**DISCUSSION**

This first trial on the effectiveness of individually-tailored, therapist-guided ICBT for patients with psoriasis who had a psychological risk profile indicated that ICBT as an adjunct to care as usual had more beneficial effects on physical functioning and the impact of psoriasis on daily activities, compared to care as usual alone. When analyzing who benefits most from ICBT, the working alliance between patient and therapist measured at the beginning of treatment was related to improved physical and psychological outcomes, suggesting that the
INTERNET-BASED TREATMENT FOR PSORIASIS

establishment of a good patient-therapist relationship early on is of considerable importance in guided ICBT.

Results on primary outcomes showed significantly larger improvements in ICBT compared to CAU on physical functioning and impact on daily activities. Effects on physical functioning were driven by improvements in fatigue, which is a frequent and disabling symptom in many chronic inflammatory conditions [63]. Patients often characterize fatigue as one of the most burdensome aspects of their condition [63], which was also reflected in the current trial; mean baseline scores were above the cut-off point for extreme fatigue [48], while means on other outcomes were comparable to norm groups of healthy individuals. In addition, the fatigue module was frequently chosen as preferred treatment module in this trial. ICBT patients also improved more on impact on daily activities, indicating that patients who received ICBT felt significantly less limited by their physical health and emotional problems in performing their work or daily activities than patients who received CAU.

In contrast, no significant between-group effects were observed for psychological functioning. This is surprising, considering that patients were screened for elevated levels of distress and that negative mood was a frequently applied treatment module. Despite screening, baseline psychological functioning scores were generally comparable to healthy populations, as many patients scored just above cutoff values and 22% of the sample that scored above cutoff values at screening did not fulfill these criteria anymore at baseline. As meta-analyses suggest that patients with higher distress scores demonstrate larger CBT effects [63, 64], distress levels may have been too low for patients to benefit sufficiently from ICBT. Low baseline scores were also cited as a reason for the small effects found in a recent meta-analysis on (I)CBT for long-term conditions (i.e., effect sizes of 0.20-0.21 for anxiety and depression [66], comparable to an earlier meta-analysis [24]).
INTERNET-BASED TREATMENT FOR PSORIASIS

Moderate-to-large ICBT effects were found for primary outcomes and their subcomponents, that were comparable to similar tailored face-to-face CBT interventions [e.g., 41, 67]. However, between-group effect sizes were small, which was explained by larger than expected CAU-effects. This may also explain why significant effects for physical functioning were found for fatigue but not for itch: post-treatment ICBT effect sizes were similar for itch and fatigue, while CAU-effects were moderate for itch and small to non-existent for fatigue. As high standards of care are generally associated with greater CAU-effects on physical and psychological outcomes [68], the fact that 42% of patients were recruited from a university medical center might have played a role in these findings. Timing of participant recruitment may have also contributed; patients were often recruited when starting dermatological treatment and many patients reported changes in systemic medication during the trial. In future research, differential screening procedures may decrease these confounding effects and possibly optimize treatment effects, by screening patients who experience elevated distress levels despite being on a stable dermatological regimen, for example.

A better therapeutic relationship (i.e., working alliance) measured early in treatment showed moderate to large correlations with improvements in physical and psychological outcomes, supporting the relevance of the therapeutic relationship in ICBT. These findings are in line with evidence in face-to-face CBT [e.g., 69-71] and extend upon scarce evidence from studies on internet-based interventions [38, 72-75]. Associations of early working alliance scores with treatment outcome were somewhat higher than those observed in previous studies, possibly because the therapeutic relationship is of greater importance in highly personalized interventions. Number of logins or treatment length were not associated with treatment outcomes, partially corresponding with previous conflicting evidence [e.g., 39, 76, 77]. While logins and treatment length have advantages in being objective measures, they may not adequately reflect interaction with treatment content and user experiences.
Characteristics of this study differed in some important ways from many previously conducted ICBT studies. ICBT was compared to CAU in a clinical sample, including 6-month follow-up, while most ICBT studies have typically included community-based and self-referred samples, waiting-list comparisons, and post-treatment data only [summarized in 24]. While significant effects were found in this trial, effects were typically small and were not all found in secondary analyses that did not include pre-specified covariates. Consistent with our findings, recent meta-analytic evidence shows that effects of ICBT are typically smaller in studies with a CAU than a waiting-list comparison and in clinical samples than in community-based samples, and often non-significant on the rare occasion that long-term follow-up results are meta-analyzed [78-80], underlining the need for further in-depth research regarding the influence of methodological, sample, and intervention characteristics on trial results.

Both limitations and strengths of the present study have to be considered. Firstly, similar to previous studies [summarized in 24], a substantial proportion of patients did not complete ICBT and/or failed to return questionnaires. Attrition rates were higher in ICBT than in CAU, in line with previous evidence [81]. While dropout rates were somewhat lower than in a study of non-tailored ICBT for psoriasis [26], the fact that they were generally comparable to previous studies does not support the often-cited idea that tailored interventions are associated with less dropout. However, the majority of dropouts were non-starters and therefore not exposed to treatment content. Furthermore, the relatively long ICBT duration (i.e., a mean duration of 25 weeks, compared to 8 weeks in many other interventions [e.g., 24]) may have increased dropout rates, which often increase progressively with intervention duration [82]. Lower baseline disease severity was associated with higher ICBT dropout, possibly because these patients experienced a lower disease burden and were therefore less motivated to adhere to a program aimed to decrease the impact of psoriasis on daily life. Main strengths of the current study include the application of a unique individually-tailored and
INTERNET-BASED TREATMENT FOR PSORIASIS

therapist-guided intervention in a target population that is generally underserved when it comes to psychological support. Methodological strengths include the multicenter RCT design comparing a clinical sample to CAU, including 6-month follow-up.

To conclude, individually-tailored, therapist-guided ICBT led to significantly greater improvements compared to CAU for physical functioning and impact on daily activities in a clinical sample of patients with a psychological risk profile. The therapeutic relationship showed moderate-to-large associations with better treatment effects, illustrating the importance of this relationship in guided ICBT. Results of this trial underline the promise of ICBT for dermatological conditions in a clinical setting, which is supported by previous studies in other conditions showing that ICBT interventions can be transferred to clinical practice with sustained effects and moderate to large effect sizes [83]. Future research should focus on the working mechanisms and provide further evidence on how well these interventions translate into clinical practice. Furthermore, future research in additional samples (e.g., higher levels of distress and disease severity) should extend these findings to be able to draw robust conclusions on the effectiveness of individually-tailored, therapist-guided psychological interventions for dermatological conditions.

CONFLICT OF INTEREST

The authors state no conflict of interest.

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INTERNET-BASED TREATMENT FOR PSORIASIS

manuscript preparation, nor in publication decisions. The authors of this manuscript are not aware of any conflict of interest influencing this work. Prof. dr. Andrea Evers received research grants from ERC (European Research Council), NWO (The Netherlands Organisation for Scientific Research), ZonMw, Pfizer, and the Nierstichting (Dutch Kidney Foundation). Henriët van Middendorp, Sylvia van Beugen, and Maaike Ferwerda are part of the research group conducting research funded by these grants. The authors are grateful to Nina Koch and Milou Looijmans for their help in collecting the data, to Saskia Spillekom-van Kouil, Tamara Bremer, Els Garritsen, Irene Vermeulen, Lieke Wirken, and Alicia Wijnakker for their work as online therapists, and to Marisol Otero, Jessica Terwindt-Slob, and Lisa Jacobs for conducting PASI assessments. The authors would also like to thank IPPZ for collaboration in the design of the online program and for ongoing technical support. Lastly, the authors would like to thank their patient research partners who contributed significantly throughout the development and study of the ICBT intervention: Henk van Duijn, Mariëtte Tomas-Krabbe, Ilse van Ee, and Hen Ros†.
REFERENCES


INTERNET-BASED TREATMENT FOR PSORIASIS


INTERNET-BASED TREATMENT FOR PSORIASIS


27 Andersson G: The promise and pitfalls of the internet for cognitive behavioral therapy. BMC medicine 2010;8:82.


INTERNET-BASED TREATMENT FOR PSORIASIS


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internet-based treatment for psoriasis


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INTERNET-BASED TREATMENT FOR PSORIASIS


INTERNET-BASED TREATMENT FOR PSORIASIS

Table 1. Baseline socio-demographic and disease-related characteristics of internet-based cognitive behavioral treatment (ICBT) and care as usual (CAU) groups.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ICBT+CAU (n=65) 1</th>
<th>CAU (n=66) 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (male)</td>
<td>33 (50.8)</td>
<td>34 (51.5)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>52.69 ± 11.27 (24-73)</td>
<td>53.45 ± 13.81 (19-79)</td>
</tr>
<tr>
<td>Married/ living together</td>
<td>46 (70.8)</td>
<td>53 (80.3)</td>
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</table>

Educational level

<table>
<thead>
<tr>
<th>Level</th>
<th>ICBT+CAU (n=65)</th>
<th>CAU (n=66)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>1 (1.5)</td>
<td>4 (6.1)</td>
</tr>
<tr>
<td>Secondary</td>
<td>44 (67.7)</td>
<td>43 (65.2)</td>
</tr>
<tr>
<td>Tertiary</td>
<td>20 (30.8)</td>
<td>19 (28.8)</td>
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</tbody>
</table>

Disease severity (PASI) 2

<table>
<thead>
<tr>
<th>ICBT+CAU (n=65) 2</th>
<th>CAU (n=66) 2</th>
</tr>
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<tbody>
<tr>
<td>5.99±5.61 (1-31)</td>
<td>4.20±2.87 (0-13)</td>
</tr>
</tbody>
</table>

Disease severity (SAPASI) 2

<table>
<thead>
<tr>
<th>ICBT+CAU (n=65) 2</th>
<th>CAU (n=66) 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.27±3.29 (1-19)</td>
<td>4.48±2.41 (0-12)</td>
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</table>

Disease duration (years)

<table>
<thead>
<tr>
<th>ICBT+CAU (n=65) 2</th>
<th>CAU (n=66) 2</th>
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<tr>
<td>18.03 ± 13.76 (0-59)</td>
<td>15.16 ± 16.35 (0-65)</td>
</tr>
</tbody>
</table>

Systemic treatment 4

<table>
<thead>
<tr>
<th>ICBT+CAU (n=65) 2</th>
<th>CAU (n=66) 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 (44.6)</td>
<td>17 (29.3)</td>
</tr>
</tbody>
</table>

Abbreviations: CAU, care as usual; ICBT, internet-based cognitive behavioral treatment; PASI, Psoriasis Area and Severity Index; SAPASI, Self-assessed PASI.

1 mean ± SD (range) or n (%).

2 n=2-12 missings.

3 Due to unequal distribution of PASI and SAPASI scores, transformed variables were used in analyses (see Methods section). Untransformed scores are displayed in this table.

4 Number of patients reporting use of systemic treatment.
INTERNET-BASED TREATMENT FOR PSORIASIS

**Table 2.** Means and SDs of each measurement point on primary outcome measures (i.e., total scores) and their subcomponents, including results of linear mixed models analyses and accompanying effect sizes.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>ICBT</th>
<th>Care as usual</th>
<th>Standardized effect size</th>
<th>Unstandardized effect size (95% CI)</th>
<th>Linear mixed models</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>n</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Psychological functioning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total score (composite)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre</td>
<td>0.02</td>
<td>0.87</td>
<td>60</td>
<td>-0.01</td>
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<td><strong>Negative mood (ISDL)</strong></td>
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31
### Internet-Based Treatment for Psoriasis

#### Depressive Symptoms (BDI)

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#### Physical Functioning

#### Total Score (Composite)

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#### Fatigue (CIS-f)

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## Itch (ISDL)

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## Impact on daily activities

### Total score (composite)

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### Emotional role functioning (RAND-36)

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### Physical role functioning (RAND-36)

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<th>Post</th>
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<th>Follow-up</th>
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<td>73.94</td>
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</table>
INTERNET-BASED TREATMENT FOR PSORIASIS

| Follow-up | 70.95 | 41.04 | 37 | 70.45 | 40.08 | 44 | 0.32 | 13.34 (0.46-26.22) | Group .04 |

Note. All means and SDs are presented as uncorrected scores. Abbreviations: BDI, Beck Depression Inventory; CI, confidence interval; CIS-f, Checklist Individual Strength – fatigue; ICBT, internet-based cognitive behavioral treatment; ISDL, Impact of Skin Disease on Daily Life; RAND-36, RAND-36 Health Status Inventory.

¹Due to unequal distribution of IHDL negative mood, transformed variables were used in analyses (see Methods section). Untransformed scores are displayed in this table.
INTERNET-BASED TREATMENT FOR PSORIASIS

**Table 3.** Means and SDs of each measurement point on secondary outcome measures, including results of linear mixed models analyses and accompanying effect sizes.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>ICBT</th>
<th>Care as usual</th>
<th>Standardized effect size</th>
<th>Unstandardized effect size (95% CI)</th>
<th>Linear mixed models</th>
<th>Effect</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td><strong>Clinician-assessed disease severity (PASI)</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
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<tr>
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<td>4.20</td>
<td>2.87</td>
<td>56</td>
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<td>Post</td>
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<td>4.59</td>
<td>3.79</td>
<td>2.94</td>
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<td>3.47</td>
<td>3.40</td>
<td>2.63</td>
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<td>.94</td>
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<tr>
<td><strong>Self-assessed disease-severity (SAPASI)</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
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<td>2.41</td>
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<td>3.75</td>
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<td><strong>Dermatological treatment compliance</strong></td>
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INTERNET-BASED TREATMENT FOR PSORIASIS

<p>| | | | | | | | | |</p>
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<td>Follow-up</td>
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<td>31</td>
<td>3.89</td>
<td>1.20</td>
<td>40</td>
<td>-0.11</td>
<td>-0.12 (-0.52-0.28)</td>
</tr>
</tbody>
</table>

Note. All means and SDs are presented as uncorrected scores. Abbreviations: ICBT, internet-based cognitive behavioral treatment; PASI, Psoriasis Area and Severity Index; SAPASI, self-assessed PASI.

¹Due to unequal distribution of PASI and SAPASI scores, transformed variables were used in analyses (see Methods section). Untransformed scores are displayed in this table.
Assessed for eligibility (n=751)
(252 RUMC, 406 RS, 52 PVN, 26 CWZ, 15 ZGT)

Excluded (n=620)
- Did not meet inclusion criteria (n=43)
- Declined to participate (n=59)
- Did not return screening instrument (n=216)
- Did not report elevated distress levels (n=302)

Randomized (n=131)

Allocated to ICBT+CAU (n=65)
- Received allocated intervention (n=55)
- Non-starters (n=10, 15.4%)
- Non-completers (n=6, 9.2%)

Allocated to CAU (n=66)

Baseline
Lost to pre-treatment assessment (n=5)
Analyzed: 60 (92.3%)

Lost to pre-treatment assessment (n=6)
Analyzed: 60 (90.9%)

Post-treatment
Lost to post-treatment assessment (n=21)
Analyzed: 44 (67.7%)

Lost to post-treatment assessment (n=15)
Analyzed: 51 (77.3%)

Follow-up
Lost to 6 month follow-up (n=28)
Analyzed: 37 (56.9%)

Lost to 6 month follow-up (n=21)
Analyzed: 45 (68.2%)
INTERNET-BASED TREATMENT FOR PSORIASIS

Figure 1. CONSORT flow diagram of participants.

*Note.* CAU, Care as usual; CWZ, Canisius-Wilhelmina Hospital, Nijmegen; ICBT, internet-based cognitive behavioral treatment; PVN, Dutch Psoriasis Association; RS, Rijnstate Hospital, Velp; RUMC, Radboud university medical center, Nijmegen; ZGT, Ziekenhuis Groep Twente, Almelo
INTERNET-BASED TREATMENT FOR PSORIASIS

(a) Psychological functioning

(b) Physical functioning
Figure 2. Baseline, post-assessment, and 6-month follow-up scores on primary outcome measures (i.e., total scores of psychological functioning (a), physical functioning (b), and impact on daily activities (c)) for internet-based cognitive behavioral therapy (ICBT) and care as usual (CAU) groups, presented as means ± SEM. Negative scores indicate improved psychological and psychological functioning in (a) and (b), and positive scores indicate reduced impact on daily activities in (c).