The StressLess Mobile App Study: Helping carers thrive

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Executive Summary

This report describes the key findings of a randomised controlled trial of an eHealth intervention called StressLess, which was designed to improve stress and broader psychological functioning of informal carers in Australia, drawing on a 3rd wave cognitive behavioural therapy approach.

Carers were recruited via targeted social media (Facebook) campaigns and randomly assigned to use either the StressLess treatment app or a control app for five weeks. The control app simply monitored mood and stress, whereas the treatment app also included treatment modules to reduce stress and improve mood.

To assess for improvements in psychological functioning from using the StressLess app, a range of factors including stress, depressive and anxiety symptoms, subjective wellbeing, positive affect (HPMood), resilience, self-esteem, optimism, coping strategies (primary and secondary) and perceived social support, were measured immediately before and after the intervention. A total of 110 carers (n= 52 in the treatment group and n=58 in the control group) participated in both the pre-intervention and post-intervention components of the study.

There were a number of key findings from the study:

- On average, carers showed high levels of stress, depression and anxiety symptoms as well as low levels of wellbeing and positive mood. Approximately 35-50% of the sample appeared to be at risk of experiencing a psychological disorder. This supports previous findings that the caregiving role may increase vulnerability to mental health difficulties.
- The randomized controlled trial indicated that the StressLess app was effective at reducing stress symptoms and improving resilience. Whilst these findings were evident in the overall treatment sample, they were particularly pronounced amongst the participants experiencing higher levels of distress at the start of the study.
- Improvements in subjective wellbeing and HPMood and increases in the use of primary coping strategies were also more common amongst individuals using the StressLess app who showed signs of poorer psychological functioning at the start of the study.
- Feedback provided during phone calls with participants and in the post-intervention survey showed that end-users found StressLess engaging and easy to use.
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Introduction

It is estimated that there are 2.7 million informal caregivers in Australia, comprising approximately 12% of the population. These carers provide unpaid assistance and support to family members or friends living with a disability, a chronic or terminal medical condition, frailty, mental illness, or substance abuse (Australian Bureau of Statistics, 2015). Around 856,100 of these carers identify as being primary; that is, they are the individuals providing the majority of care to the person in need. In economic terms, the annual cost of replacing the contribution of these carers with paid assistance has been assessed at over $60 billion; which equates to 3.8% of the 2015 Australian gross domestic product (Carers Australia, 2015).

While many carers identify positive aspects to caring, and place a great degree of value on their caregiving role (Schulz et al., 1997), there is also a psychological cost. High levels of stress, and low levels of subjective wellbeing can be expected from their role (Burton-Smith, McVilly, Yazbeck, Parmenter, & Tsutsui, 2009; Cummins et al., 2007; Kenny, King, & Hall, 2014).

Caregivers generally report elevated symptoms of depression and anxiety compared to their non-carer counterparts (Butterworth, Pymont, Rodgers, Windsor, & Anstey, 2010; Colombo, Llena-Nozal, Mercier, & Tjadens, 2011; Cummins et al., 2007; Edwards, Higgins, Gray, Zmijewski, & Kingston, 2008).
Indeed, a large-scale population-based survey in Australia identified carers as having the lowest levels of subjective wellbeing (SWB) relative to a range of other demographic groups and that, on average, they report symptoms indicative of at least moderate levels of stress and depression (Cummins et al., 2007). A common outcome of reporting this level of psychological difficulties is a breakdown in care and the need for formal care arrangements (Joling et al., 2010; Schoenmakers, Buntinx, & Delepeleire, 2010).

“High levels of stress, and low levels of subjective wellbeing are commonly experienced as a result of long-term caregiving”

There is clearly, therefore, a critical need for interventions that reduce stress and promote wellbeing in carers. However, a limitation to many forms of intervention is carers’ ability to access supports in-person. Many are limited by the demands of caregiving, including the time commitment of care-giving and the difficulty of acquiring a short-term alternative caregiver during their absence. Carers may also experience scheduling restrictions if they are also working or studying. (Bennett, Power, Rostain, & Carr, 1996; Morgan et al., 2015; O’Connor, Arizmendi, & Kaszniak, 2014; Stehl et al., 2009). Carers may also have difficulty prioritising their own health- and wellbeing-related needs (Long & Marsland, 2011).

In the light of these difficulties, internet and computer- or phone-based technologies offer novel opportunities for delivering psychological interventions. The potential benefits include reduced costs, increased availability (particularly in geographical locations where services may be limited), convenience of use compared to traditional formats, and greater confidentiality (Christensen & Hickie, 2010; Marzano et al., 2015). However, there is currently a paucity of eHealth interventions that can provide adult carers with an easily accessible ‘toolbox’ of wellbeing strategies that they can use ‘in the moment’; at times they are feeling high levels of stress. Fewer still of these interventions have been empirically tested and validated.

The Centre for Social and Early Emotional Development (SEED) and Australian Centre on Quality of Life (ACQOL) at Deakin University, in partnership with Australian Unity, devised a program to address this gap. The devised program aimed to reduce stress and promote wellbeing by, first, developing, and then evaluating StressLess (freely available on the App Store). StressLess is an eHealth intervention for carers delivered via an iPhone app which provides carers with: (1) a self-paced presentation of strategies based on a third-wave
Cognitive Behavioural Therapy (CBT) approach. This has been found by other authors to be effective at reducing stress and improving mental health and wellbeing (Hofmann, Sawyer, & Fang, 2010); (2) prompts in the form of push notifications that remind carers to monitor their stress levels so that they can engage in protective strategies at times of high stress, and (3) individual feedback in the form of graphs of participants’ stress and mood over time, to help participants gain insight into their functioning over time.

A randomised controlled trial (RCT) was conducted to evaluate the effectiveness of StressLess app at reducing stress, depression and anxiety symptoms, and increasing subjective wellbeing. The method for this study, results, and discussion of the key findings from the trial are presented below.
Method

The StressLess Intervention

StressLess is an iOS app-based intervention designed to reduce stress and improve wellbeing. The intervention program that is nested within the app comprises five modules:

(1) an introduction that includes brief psychoeducation about stress reduction and a description of (third wave) Cognitive Behavioural Therapy (CBT);
(2) clarification of what an individual holds as important in their lives, and goal setting using the knowledge of these key values to provide some balance to their lives and prioritisation of things they hold as important;
(3) mindfulness skills training involving observation of the self and connection with the present moment, acceptance and cognitive diffusion (techniques to encourage the recognition of thoughts simply as thoughts rather than necessarily facts);
(4) wellbeing enhancement through focusing on positive aspects within one’s life and cognitive restructuring (challenging of negative thoughts that might be causing unnecessary distress); and
(5) behavioural activation to increase engagement in and enjoyment of pleasant or valued activities.
Participants are encouraged to work through each module in sequence, and at their own pace. Each module comprises audio-based activities and presentations, and each of these has transcripts available for individuals who would rather read or prefer text for accessibility reasons. There are also self-check and reflective activities to help establish key strategies and practice and reinforce the skills covered within the intervention program to deal more effectively with daily stressors.

In addition to this modularised content, participants also have access to a monitoring component, involving a self-report survey feature. This allows them to enter their current stress levels and mood, as well as key contextual variables, such as the specific coping strategies used in response to specific stressful events, and their confidence at managing these stressors. These stress responses are graphed and fed back to participants so that they can both gain insight into their stress and mood in daily life and also chart progress and improvement in these symptoms as they continue to use the intervention.

Exemplar features of StressLess are presented in Figure 1, below. The left-most panel shows the dashboard. This is the screen that participants are directed to whenever they launch the app is it provides a brief snapshot of their recent mood data (with a smiley face if they have reported positive mood states recently), and a list of tasks to be completed. The task list is kept to a small, manageable number to avoid overwhelming the participant, and shows the upcoming modules based on what the participant has completed already. In the image below, the ‘My Tasks’ list is showing the welcome video as this participant is about to commence the treatment. The second image from the left shows an example of the amount of content for one of the modules (the Values module). The icons for each listing indicate whether it is an audio narration (denoted with a play button), a journaling activity (denoted by the book icon), or a survey to be completed as part of the module (represented with the clipboard icon). The image second from the right shows the mood monitoring survey options. Participants can opt to complete a single item measure of stress, or an elaborated yet brief survey that also asks about contextual influences on their stress. If stress levels are deemed high by the app, participants are notified with a message that indicates the score is high and suggests that now might be an appropriate time to engage with the intervention content. Finally, the image on the far right is a chart of stress scores across the period of participation. This provides a summary for each day of participation that is colour coded to show instances of elevated stress. This is designed to enable participants to gain insights into their mood patterns and to show how they are progressing over time. Pre-testing in the development phase of the app identified this as a key feature that enhances engagement and participant self-awareness.
Figure 1 The StressLess mobile-based intervention

Measures

Participants were administered a measure of carer responsibilities (Young Carers: Questionnaire and Screening Tool; YC-QST20) and demographics (age, gender, family income, working hours per week, etc.) at baseline in addition to the items listed in the table below. Then participants were randomized into the intervention arm (StressLess) or active control group (StressMonitor, described below). Table 1 below provides a list of the measures administered at baseline and post-intervention for all participants to determine change over time.

Procedure

Participants were recruited by a targeted social media (Facebook) advertising program. A series of online campaigns were used to target individuals over 18 years of age who had Facebook profiles which contained carer-related keywords. When a Facebook user clicked on an advertisement, they were redirected to the study website.

There were three components of the study:

1) a baseline (pre-intervention) survey measuring carer demographic information, stress, wellbeing, anxiety and depression symptoms, as well as a
<table>
<thead>
<tr>
<th>Construct</th>
<th>Measure</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HPMood</strong></td>
<td>HPMood measure (Tomyn &amp; Cummins, 2011)</td>
<td>Three items measuring how happy, content, and alert participants feel in general. Higher scores reflect more positive affect (higher HPMood).</td>
</tr>
<tr>
<td><strong>Mental health</strong></td>
<td>Depression, Anxiety, and Stress Scale 21-item version (DASS-21; Lovibond &amp; Lovibond, 1995)</td>
<td>21-item scale comprising 7-item subscales for anxiety, depressive, and stress symptoms. All three subscales were included in this study. Higher scores for subscales reflect greater anxiety, depressive symptoms, and stress, respectively.</td>
</tr>
<tr>
<td><strong>Optimism</strong></td>
<td>Life Orientation Test-Revised (LOT-R; Scheier, Carver, &amp; Bridges, 1994)</td>
<td>10-item scale comprising items for optimism (3 items), pessimism (3 items), and additional items to test for response heuristics (4 items). The 3 items of the optimism subscale were used in the present study. Higher scores indicate greater optimism.</td>
</tr>
<tr>
<td><strong>Perceived control</strong></td>
<td>Primary and Secondary Control Scale (Cousins, 2002)</td>
<td>11 item scale broken into two components: primary control (e.g., ‘When bad things happen, I put lots of time into overcoming it’) and secondary control (‘When bad things happen, I ignore it by thinking about other things’). Higher scores indicate greater level of primary or secondary control, depending on the subscale.</td>
</tr>
<tr>
<td><strong>Resilience</strong></td>
<td>Resilience Scale (Wagnild &amp; Young, 1993)</td>
<td>The present study used 10 items from the original 25 item version of the Resilience Scale. Higher scores reflect greater personal resilience in the face of stressors.</td>
</tr>
<tr>
<td><strong>Self-esteem</strong></td>
<td>Rosenberg Self-Esteem Scale (RSE; Rosenberg, 1965)</td>
<td>10-item scale. Higher scores reflect greater self-esteem.</td>
</tr>
<tr>
<td><strong>Social support</strong></td>
<td>Multidimensional Scale of Perceived Social Support (Zimet et al., 1988)</td>
<td>12-item scale assessing the perceived adequacy of support from family, friends, and significant others. Higher scores reflect greater perceived social support.</td>
</tr>
<tr>
<td><strong>Subjective wellbeing</strong></td>
<td>Australian Unity Personal Wellbeing Index (AU-PWI; International Wellbeing Group, 2013)</td>
<td>7-item measure exploring satisfaction with specific domains of one’s life (standard of living, health, achieving in life, personal relationships, safety, community connectedness, and future security). Items are averaged and rescaled to 0-100 scale. Higher scores reflect more positive subjective wellbeing.</td>
</tr>
</tbody>
</table>
range of variables predicted to influence stress and mood during everyday life that were directly targeted in the intervention modules of the StressLess treatment app (also commonly referred to as change agents because they are thought to be the mechanisms by which the intervention reduces stress and improves mental health): HPMood (stable, positive-activated mood), self-esteem, resilience, optimism and perceived control/coping strategies.

(2) the 5-week StressLess intervention. Participants in the intervention group were given access to the StressLess app, which contained the five intervention modules as well as the monitoring component described above. Participants in the control group were given access to an app called StressMonitor, which only had access to the monitoring component. In both cases, carers were surveyed via smartphone app between 2-4 times per day regarding their current levels of stress, positive and negative momentary affect, as well as the occurrence of any stressful events experienced during the prior 30 minutes. The purpose of this measurement was to isolate potential effects of the intervention content from effects that might rather have been due to the novelty of using an eHealth app and/or self-monitoring of psychological functioning. The provision of a control app (StressMonitor), that asked participants to complete monitoring activities, means that this control is categorised as an “active” control. Comparing an intervention to an active control is considered more stringent than comparing to an “inactive” or “passive” control who receive no form of intervention during the trial period.

(3) an immediate follow up (post-intervention) survey on completion of the 5-week intervention period. This measured stress, depression, and anxiety as well as subjective wellbeing, self-esteem, resilience, optimism, perceived control and HPMood.

In total, 120 carers (n = 63 control group; n = 57 treatment group) participated in the three components of the randomised controlled trial. The data from 10 participants were excluded due to incomplete survey responses on the baseline questionnaire, leaving an effective sample of 110 carers (n = 58 control group; n = 52 treatment group). The study is registered with the Australian New Zealand Clinical Trials Registry (ID: ACTRN12616000996460).
Findings

We conducted analyses to address three sets of questions pertaining to StressLess: (1) what are the key characteristics of participants at baseline?, (2) was the intervention effective in reducing stress and related symptoms?, and (3) did the participants find the app engaging and easy to use? While evaluation of baseline characteristics and their differences between groups (intervention vs control) does not directly inform about the usefulness of StressLess, it helps to work out key features of our sample, and to ascertain whether pre-existing group differences need to be factored into evaluations of the efficacy of the trial. Questions 2 and 3 directly address the usefulness of the app. Each of these questions is discussed separately, below.

Section 1: Participant characteristics and caregiving context at baseline (pre-intervention)

Carer demographics

This section describes the characteristics of the group of 110 informal carers who participated in the StressLess Mobile App Study randomised control trial.

Most carers were female (n=104, 95%). Two males (2%) and one person who identified as transgender (1%) also participated. Participant were aged between 26 and 64 years (M=39.6, SD=5.6).
Caregiving context

Many carers reported that they were providing care to multiple individuals: 42 (38%) were looking after one care recipient, 39 (36%) for two care recipients; and, 24 (22%) were caring for at least three care recipients. Figure 2 provides key words used by participants to describe the health issue of the person they were caring for. Words that were more frequently in the data set are represented with larger text.

Figure 2 Word cloud of diagnoses of care recipients reported at baseline

Most carers identified as the primary carer to at least one care recipient (n=103, 94%). Of the primary carers, most were caring for a family member (n=100, 97%), who was most often a child (n=94, 91%). Nineteen (18%) were providing care to a spouse, seven (6.8%) to a parent, and two (2%) to a sibling. Almost all carers (n=97, 93%) reported spending more than 20 hours providing care per week to their main recipient, with approximately three-quarters of participants (78%) spending more than 40 hours engaged in care related activities. Approximately half (47%) of all carers were participating in the workforce in addition to their caring responsibilities.

“Approximately three-quarters (78%) of carers spent more than 40 hours per week engaged in care-related activities... Nearly half (47%) reported stress symptomatology within the clinical range”
Sample comparison to the Survey of Disability, Ageing and Carers (SDAC)

The characteristics of our sample are different from national averages, according to the Survey of Disability, Ageing and Carers (SDAC) (Australian Bureau of Statistics, 2015). The current sample has higher proportion of younger carers (mean age = 55 years compared against mean age = 39.6 years in our study). The SDAC also recorded a higher number of male informal carers (45%) than were present in our sample (2%). Primary carers in the SDAC were more likely to be providing care to a spouse or partner (40% vs 24.8% in our study). These differences in sample characteristics may reflect the method of recruitment (primarily via social media), but could also reflect that carers with these specific characteristics are more receptive to, or in greater need of, app-based help for their carer role stress. The implications of these differences are detailed in the discussion section below.

Carer mental health symptoms

As shown in Table 2, whilst many (~50-60%) of the participants in our sample reported stress, anxiety or depression scores in the ‘normal’ or ‘mild’ ranges, consistent with relatively few symptoms of distress, there was a large group of participants experiencing at least ‘moderate’ symptomatology, indicating probable cases of mental illness. Nearly half of our participants (47%) reported at least ‘moderate’ stress symptomatology, 39% reported at least ‘moderate’ depressive symptomatology, and 37% reported at least ‘moderate’ anxiety symptomatology. By comparison, in the general population, only 10% typically score within the moderate symptom range or above on these scales (Henry & Crawford, 2005). This highlights the elevated levels of stress, depression and anxiety experienced in our carer sample.

<table>
<thead>
<tr>
<th></th>
<th>Stress N (%)</th>
<th>Depression N (%)</th>
<th>Anxiety N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Normal’</td>
<td>43 (39%)</td>
<td>47 (43%)</td>
<td>58 (53%)</td>
</tr>
<tr>
<td>‘Mild’</td>
<td>17 (16%)</td>
<td>21 (19%)</td>
<td>12 (11%)</td>
</tr>
<tr>
<td>‘Moderate’</td>
<td>28 (26%)</td>
<td>24 (22%)</td>
<td>25 (23%)</td>
</tr>
<tr>
<td>‘Severe’</td>
<td>15 (13%)</td>
<td>12 (11%)</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>‘Extremely Severe’</td>
<td>7 (6%)</td>
<td>6 (6%)</td>
<td>9 (8%)</td>
</tr>
<tr>
<td><strong>Mean (SD)</strong></td>
<td>18.53 (7.94)</td>
<td>11.62 (8.65)</td>
<td>8.02 (6.85)</td>
</tr>
</tbody>
</table>

Consistent with the findings noted above, at baseline, a large number of carers (41%) reported compromised subjective wellbeing, which has been associated with high risk of mental health conditions such as depression (Cummins, 2010; Kenny et al., 2014). Indeed, only 1 in 5 (21.8%) carers in this study scored within the normative range for SWB, whilst nearly 1 in 3 (31.8%) reported scores suggesting their wellbeing was under challenge. The
average subjective wellbeing score (54.1, SD=17.3) for this sample was well below that reported for Australian adults in the general population (Capic et al., 2017) but almost identical to the one reported for a previous sample of carers aged 18-55 years (Cummins et al., 2007). Baseline scores for other change agent variables are available in the Appendix of this report.

We checked for potential differences between the intervention and control group that might have been present at baseline before administering the intervention. The group of intervention participants were found to have higher scores (M=37.7, SD=15.7) than the group of control participants (M=30.5, SD=15.1) on the scale measuring use of secondary control strategies. There were no other significant differences between the groups on the key analysis variables. Thus, overall results suggest the randomization process was successful in ensuring the groups (intervention and control) were equivalent at baseline in key characteristics.

**Figure 3** Proportion of participants with normal, challenged, and high-risk levels of HPMood and Subjective Wellbeing (SWB) at Baseline

![Figure 3](image)

**Section 2: Randomised Controlled Trial Results**

The over-arching aim of the StressLess randomised controlled trial was to evaluate whether the 5-week StressLess intervention reduced symptoms of stress (the primary outcome of interest) and/or wellbeing, depression, and anxiety (secondary outcomes). In addition, we evaluated the role of various ‘change agents’; variables that might account for the effectiveness of StressLess. These variables were self-esteem, resilience, optimism, perceived primary and secondary control, and HPMood.
Differences in average change between the intervention and control groups

To examine this question, we first compared the average change in scores between groups from pre- to post-intervention. There was evidence that the StressLess intervention group showed significantly greater improvement in resilience (one of the proposed change agents) compared to the StressMonitor control group, as shown in Figure 4. Participants in the treatment group reported an average resilience score of 68.3 at baseline, which increased to 74.1 following the intervention – a change of 5.8 points, whilst control participants reported a baseline resilience score of 69.3 that increased to 71.2 – a change of 1.9 points.

A significant effect was also observed for social support, with greater improvement for the StressLess group ($M = 59.1$ vs $64.5$) than the StressMonitor control group ($M = 62.7$ vs $64.5$).

“The resilience of StressLess intervention participants improved significantly over the study, beyond that demonstrated by control participants”

Differences in the average amount of change between the groups in stress, anxiety and depression, and the other proposed change agents, were not found to be statistically significant. However, as shown in Figure 4, whilst not statistically significant, the intervention group showed signs of improvement on many of these factors from pre-intervention (Time 1) to post-intervention (Time 2) compared to the control group.

Differences in proportions of participants in the intervention and control groups achieving clinically meaningful change

The analyses reported above investigate whether the participants using the StressLess app, on average, improved more than those in the control condition. While such an approach can inform about trends for the sample as a whole, it is insensitive to the possibility that the intervention is more effective for some individuals than for others.

Hence, it is also informative to compare the proportion of participants in each group who improve or decline by an amount that is considered to represent a clinically meaningful change. In this study, we defined a clinically

Figure 4 Mean comparisons between StressLess and StressMonitor participants' scores for depression, anxiety, and stress over time
meaningful change as a change in score from pre- to post-intervention that was greater than one standard deviation (SD) on the scale (Tomyn, Fuller-Tyszkiewicz, Richardson, & Colla, 2016). In the present study, that corresponded with a change in scores of 6.85 to 22.7 units, depending on the scale in question. Accordingly, participants in each condition were classified into one of three groups:

1. The **increase** group: Those who experienced a clinically meaningful improvement in symptoms (defined as at least 1 standard deviation improvement in scores by post-intervention);
2. The **decrease** group: Those who experienced a clinically meaningful worsening in symptoms (defined as at least 1 standard deviation worsening in scores by post-intervention); and
3. The **stable** group: Those who demonstrated no meaningful change in either direction (defined as change in scores of less than 1 standard deviation).

As shown in Table 3 and Figure 5 below, the proportion of individuals who experienced *clinically meaningful change* in stress symptoms was found to be significantly greater in the StressLess intervention group than the StressMonitor control group. In the control condition, 47 individuals (81%) remained stable, showing no clinically meaningful change in levels of stress symptoms at post-intervention, 2 (3.4%) reported an increase in stress symptoms, and 9 (15.5%) showed a decrease in stress symptoms. In the intervention condition, 32 individuals (61.5%) showed no change in stress symptoms, whereas 7 individuals (13.5%) recorded an increase in stress symptoms, and 13 individuals (25%) reported a decline in stress symptoms at post-intervention. Significant differences in the proportions of individuals who experienced clinically meaningful change on the other measures were not evident between the StressLess intervention group and the StressMonitor control group when the sample was considered as a whole.

"The proportion of individuals who experienced clinically meaningful change in stress symptoms was found to be significantly greater in the StressLess intervention group than the StressMonitor control group"
<table>
<thead>
<tr>
<th>Variable</th>
<th>Intervention (Count, %)</th>
<th>Control (Count, %)</th>
<th>( p )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>Increase 7 (13.5)</td>
<td>Decrease 13 (25)</td>
<td>.049*</td>
</tr>
<tr>
<td></td>
<td>Stable 32 (61.5)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>Increase 3 (5.8)</td>
<td>Decrease 6 (11.5)</td>
<td>.671</td>
</tr>
<tr>
<td></td>
<td>Stable 43 (82.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>Increase 2 (3.8)</td>
<td>Decrease 3 (5.7)</td>
<td>.672</td>
</tr>
<tr>
<td></td>
<td>Stable 47 (90.4)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subjective Wellbeing</td>
<td>Increase 10 (20)</td>
<td>Decrease 1 (2)</td>
<td>.595</td>
</tr>
<tr>
<td></td>
<td>Stable 39 (78.0)</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Resilience</td>
<td>Increase 10 (19.2)</td>
<td>Decrease 2 (3.8)</td>
<td>.212</td>
</tr>
<tr>
<td></td>
<td>Stable 40 (76.9)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-esteem</td>
<td>Increase 8 (15.4)</td>
<td>Decrease 4 (7.7)</td>
<td>.517</td>
</tr>
<tr>
<td></td>
<td>Stable 40 (76.9)</td>
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</tr>
<tr>
<td>Optimism</td>
<td>Increase 6 (11.5)</td>
<td>Decrease 6 (11.5)</td>
<td>.300</td>
</tr>
<tr>
<td></td>
<td>Stable 40 (76.9)</td>
<td></td>
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<tr>
<td>Social Support</td>
<td>Increase 5 (9.6)</td>
<td>Decrease 3 (5.8)</td>
<td>.984</td>
</tr>
<tr>
<td></td>
<td>Stable 44 (84.6)</td>
<td></td>
<td></td>
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<tr>
<td>Primary Control</td>
<td>Increase 10 (19.2)</td>
<td>Decrease 3 (5.8)</td>
<td>.579</td>
</tr>
<tr>
<td></td>
<td>Stable 39 (75.0)</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Secondary Control</td>
<td>Increase 6 (11.5)</td>
<td>Decrease 3 (5.8)</td>
<td>.077</td>
</tr>
<tr>
<td></td>
<td>Stable 43 (82.7)</td>
<td></td>
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<td></td>
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<tr>
<td>HPMood</td>
<td>Increase 11 (22.0)</td>
<td>Decrease 3 (6.0)</td>
<td>.237</td>
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<tr>
<td></td>
<td>Stable 36 (72.0)</td>
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* \( p \)-value < 0.05

**Figure 5** Distribution of participants across stable, decline and increase groups by variable
Comparison of rates of clinically meaningful change from the intervention in participants at high and low risk of psychological difficulties at baseline

We anticipated that individuals experiencing greater difficulties at baseline might receive greater benefit from the intervention compared to those who were already functioning well. We therefore explored whether the relative effectiveness of the StressLess intervention differed according to whether participants had reported a higher or lower level of distress prior to receiving the intervention. Results generally supported the contention that rates of improvement would be higher amongst individuals experiencing greater difficulties at baseline, with effects for stress, resilience, SWB and HPMood in particular.

As shown in Figure 6, results indicated that almost half of StressLess participants showing elevated stress symptoms at baseline (47%, compared to 27% among the control group) showed signs of clinically meaningful improvement. A similar pattern was seen for resilience; rates of clinically meaningful improvement were highest amongst StressLess treatment participants with lower levels of resilience at baseline - 37% of this subgroup showed signs of such improvement post-intervention (compared to only 15% of control participants).

Results also suggested that improvements in HPMood were particularly pronounced in StressLess treatment participants who had reported low baseline levels of HPMood; more than half of these participants (55%) reported clinically meaningful increases in this measure of positive affect following intervention, compared to 18% of the StressMonitor control group. Likewise, signs of clinically meaningful improvement were evident in nearly 40% of the participants in the StressLess treatment group who had reported low baseline levels of wellbeing, compared to nearly 20% of participants in the StressMonitor control group.

Amongst the subset of participants who reported low usage on primary control strategies (involving active attempts to influence or change objective conditions in the environment) at baseline, nearly 40% of treatment participants showed clinically meaningful increases in reliance on these strategies (compared to approximately 20% of controls). Rates of improvement were much lower for those participants who reported few stress symptoms initially (in the ‘normal’ to ‘mild’ range’), high levels of resilience, wellbeing and HPMood and stronger reliance on primary coping strategies, with most participants rather continuing to maintain these pre-intervention levels of these factors.
Clinically meaningful improvement in wellbeing was found in nearly 40% of the participants in the StressLess treatment group who had reported low baseline levels of wellbeing, compared to nearly 20% of participants in the StressMonitor control group.

In general, rates of pre-to-post-intervention change on measures of depression and optimism were lower, including amongst participants with poorer psychological functioning at baseline. There were still some signs however of the pattern of increased improvement in treatment participants with higher distress on these measures (for example, clinically meaningful improvement in depression was observed in 15% of treatment participants relative to 8% of control participants reporting elevated symptoms at baseline). Whilst rates of improvement in anxiety, self-esteem and social support were higher in participants with reduced psychological functioning at baseline, there was no indication that improvements were more pronounced in the treatment group.

Figure 6: Proportion (%) of participants whose stress levels increased, decreased, or remained stable as a function of baseline stress levels.
Section 3: Participants’ Evaluation of the StressLess Mobile App

Participants provided qualitative feedback about the StressLess app during phone interviews as well as quantitative feedback in the follow-up survey post-intervention.

Qualitative feedback

Most participants were positive about the app, reporting that they found it easy, intuitive, and convenient to use, including while they were ‘on-the-go.’ One participant commented “I’m finding the app very beneficial. I like listening to it in the car on the way to pick up the kids.”

Participants identified the reminders to chart their stress levels and the graphs to track changes over time as helpful features that increased their awareness of how they were feeling and sometimes provided a different perspective on their day. For example, they reported “I’ve found the mood tracking particularly useful,” and “I am loving the app. It has made me more aware of how I’m feeling” and “I noticed that I will think I’ve had a bad day but then realise that only part of the day was hard.”

A number of participants also commented however that it was challenging to find time to use the app. For example, one participant stated “To be honest, I’m not using it as much as I’d like – it takes too much time.” A small number of participants also indicated that in the context of very significant current stress (such as a recent hospitalisation of a family member), they were too overwhelmed and distressed to complete the app activities.

Quantitative feedback

Quantitative feedback was also generally positive, with participants giving the app an average rating of 4/5 stars, as shown in Figure 7. Most participants (80.9%) found the app immediately intuitive or easy to learn to use (with clear instructions provided), almost all participants (91.5%) indicated that they found the visual explanations in the app either mostly or perfectly ‘clear, logical and correct,’ and approximately 70% of participants reported that the content of the app was either moderately or very interesting. More than three-quarters of participants (85%) would recommend it to at least several people that they thought might benefit from it, and many (58%) thought that they would continue to use the app with some regularity (at least 10 times or more in the next 12 months) despite the formal five-week intervention having concluded.
Figure 7 Frequency of participant ratings (very low to very high) of the StressLess Intervention app across four usability factors and overall star rating

Participant ratings: 1 Very low  2 Low  3 Medium  4 High  5 Very High
Discussion

Findings from this randomised controlled trial indicate that the StressLess Mobile App intervention was effective at reducing stress and improving resilience. These findings were present as main effects (seen for the overall sample of StressLess carers) but were particularly pronounced for the subgroup of carers who were experiencing higher levels of distress and reporting reduced capacity to “bounce back” from stressful or challenging experiences at the start of the intervention. This suggests that the StressLess intervention may work best for the group of carers most in need of support.

Indeed, there was also indication that rates of improvement in subjective wellbeing post-intervention were greater amongst the more distressed group of StressLess carers. This group also showed the highest increase in use of active primary control strategies to manage challenges and setbacks.

“The StressLess Mobile App was effective at reducing stress and improving resilience in carers generally, and particularly within carers who were most in need of support”

The findings suggest the StressLess app may be helpful in enhancing certain aspects of psychological functioning in carers, particularly stress reduction.
and resilience. This is important given both the vulnerability of the carer population to mental health difficulties and the major gap in the availability of evidence-based treatment to reduce stress and promote the use of effective psychological skills to manage the day-to-day challenges that many carers face. Indication that treatment effects were greatest for individuals with higher stress symptoms, lower wellbeing, lower HPmood (positive affect), lower resilience and less frequent use of primary coping strategies at baseline suggests that the intervention may potentially be most suited to a targeted intervention rather than universal intervention, and may not be as effective for individuals with milder difficulties. Nonetheless, it is possible that the StressLess intervention may have preventative effects by reducing the likelihood of future difficulties amongst those currently experiencing a low level of difficulties.

It was interesting to note that treatment effects for depression and anxiety, the two mental health outcomes that were included in the current study, were less pronounced. Initial effects of the StressLess intervention seem to be more confined to the underlying psychological factors that contribute to the development of mental illness, such as stress and resilience. It is possible however that improvements in depression and anxiety might emerge over time as a result of decreases in stress and increased capacity to ‘bounce back’ from challenges. This effect might only be evident with a longer follow-up period (which is currently underway).

It is important to note that our sample differs in several ways from national survey data on carers in Australia (collected by the Survey of Disability, Aging and Carers (SDAC); Australian Bureau of Statistics, 2015). The StressLess sample had a higher number of females who were more likely to be providing care to children, and the average age was also lower than the sample from the SDAC study. Differences between our sample and the SDAC sample may indicate that younger women may be more help seeking and have greater familiarity with (or interest in) seeking help through technologies such as social media and eHealth interventions. The high proportion of younger women caring for children in the current sample means that some caution is needed about generalising our findings to carers more broadly. Further research with different subsets of carers (such as male carers, older carers, or those caring for spouses/partners, parents or siblings) will be helpful in clarifying the benefits of the StressLess app for these groups.

Despite these caveats, there are a number of exciting future avenues for research on the StressLess app. First, as noted above, we are currently conducting further follow-up with the StressLess intervention participants to examine whether the treatment gains observed immediately post-intervention are maintained or whether improvements on other factors
emerge 4-months after completing the intervention. Second, we also plan to examine the data collected within the StressLess app itself, including participants’ monitoring of daily stress and mood, and the frequency of participants’ use of different activities or features of the app (patterns of usage). This information may help us to understand which individuals received greater benefit from the app (for example, perhaps those that used the app more often, or completed particular activities). It will also provide us with useful information that could inform personalised tailoring of the app design going forward to provide real-time care when most needed. Finally, the possibility of using this as an adjunct to face-to-face therapy and other support systems for carers warrants further attention. The monitoring functionality of StressLess may enable greater self-awareness of symptoms, as well as providing useful insights for clinicians to help focus therapy sessions. Further, the intervention modules may be useful to embed and practice key therapeutic techniques proposed in therapy sessions.
Conclusion

The results of the current study are consistent with previous studies suggesting that informal carers are a vulnerable group in terms of their mental health and wellbeing. It was therefore encouraging to see preliminary evidence that the StressLess intervention was effective at reducing stress and increasing resilience given these factors that are implicated in mental health difficulties. Additionally, exploratory analyses indicated carers with elevated stress and reduced wellbeing, positive mood, and resilience at baseline appeared to benefit most from the intervention. Further follow up (at 4-months post-intervention) will be useful to clarify potential longer-term benefits of the app.

Importantly, participants’ evaluations of the app highlights that both qualitative and quantitative feedback was overwhelmingly positive about the usability and engaging nature of the StressLess app, which had been purpose-built for the study.

Findings of improved psychological functioning amongst the group of StressLess app users as well as findings suggesting that participants found the app easy and intuitive to use suggests that StressLess may be a valuable resource for carers experiencing high levels of distress. The potential cost-effectiveness of using such an app, as well as increased availability (particularly in geographical locations where available services may be limited), and convenience of use (allowing caregivers to take part in the program in the comfort of their own home and at times that suit them) compared to traditional formats are further reasons that carers may benefit from StressLess.


Kenny, P., King, M. T., & Hall, J. (2014). The physical functioning and mental health of informal carers: Evidence of care-giving impacts from an Australian


Appendix

Glossary

*Standard deviation (SD)*. A standard deviation is the measure of the spread or variation of scores around a mean value.

**Interpretation of measures used in this trial**

<table>
<thead>
<tr>
<th>Measurement Domain</th>
<th>Interpretation (higher scores reflect)</th>
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</thead>
<tbody>
<tr>
<td>Personal wellbeing</td>
<td>More positive wellbeing</td>
</tr>
<tr>
<td>Resilience</td>
<td>Greater resilience</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>Greater self-esteem</td>
</tr>
<tr>
<td>Optimism</td>
<td>Greater optimism</td>
</tr>
<tr>
<td>Perceived social support</td>
<td>Higher levels of perceived support</td>
</tr>
<tr>
<td>Primary control</td>
<td>More frequent use of primary control strategies</td>
</tr>
<tr>
<td>Secondary control</td>
<td>More frequent use of secondary control strategies</td>
</tr>
<tr>
<td>HPMood</td>
<td>More positive affect</td>
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</tbody>
</table>