Adherence to a 6-Week Study of Wearable Digital Mood and Cognitive Assessments in Depressive Episode(s) Presenting with Distress: Qualitative Insights

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Background
Digital technology has promise in delivering insights into psychiatric conditions such as depression by way of adherence to mood and cognitive tests in a patient’s daily life. The utility of these methods may be limited by patient adherence with frequent testing or wearing of sensing technology. Here we describe qualitative data that aimed to enhance our understanding of participants’ experiences of longer term use of digital cognitive assessments with wearable technology. We explored why participants choose to engage with digital health assessments and motivations and factors influencing adherence to a daily testing regimen over 6 weeks.

Methods
Participants: Thirty adults aged 19-63 with mild-to-moderate single or recurrent major depressive episode(s) prescribed antidepressant monotherapy were enrolled (baseline assessment). Participants were asked to engage with digital health assessments through a novel method for assessing mood and cognitive in participants with major depressive disorder. A schematic of the study procedures and assessments is shown in Figure 1. Daily Assessments: Brief cognitive (Cognition Kit n-back) and mood assessments were administered through the Cognition Kit application on Apple Watch (Figure 2).

Full-length Assessments:
- **Weekly (weeks 1, 3, and 6):** Cognitive performance measured with CANTAB working memory (SWM) and attention (AT) battery. Patient-reported outcomes (PRO) included measures of depression symptom severity (Patient Health Questionnaire - PHQ-9), social function (UCLA Loneliness Scale), and perceived cognitive difficulties (Perceived Difficulties Questionnaire).

Qualitative Interviews:
- **On-site (week 1) and home-based (week 6):** Semi-structured interview examined participants’ experiences of wearable assessments, why they chose to engage with the study, and motivations and factors influencing adherence and engagement.

Data Analysis:
- **Thematic analysis:** completed in three stages using an interpretative phenomenological analysis (IPA) framework: (1) data familiarization; (2) identification of key issues and concepts; (3) clustering and organizing themes, defining the main concepts and mapping the ways in which different parts of the data relate to each other.

Results
Patient Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>30</td>
<td>37.2</td>
<td>10.4</td>
<td>19</td>
<td>63</td>
</tr>
<tr>
<td>PHQ-9 score</td>
<td>30</td>
<td>9.1</td>
<td>3.1</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Comorbid anxiety</td>
<td>30</td>
<td>66.7%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time on medication (months)</td>
<td>30</td>
<td>9</td>
<td>9.5</td>
<td>0.4</td>
<td>94</td>
</tr>
</tbody>
</table>

Previous antidepressant medication washout

<table>
<thead>
<tr>
<th>Medication Type</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serotonin antagonist and noradrenergic inhibitor (SSNRI)</td>
<td>1</td>
<td>3.30%</td>
</tr>
<tr>
<td>Serotonin noradrenergic reuptake inhibitor (SNRI)</td>
<td>5</td>
<td>16.70%</td>
</tr>
<tr>
<td>Selective serotonin reuptake inhibitor (SSRI)</td>
<td>20</td>
<td>66.70%</td>
</tr>
<tr>
<td>Tricyclic antidepressants (TCA)</td>
<td>4</td>
<td>13.33%</td>
</tr>
</tbody>
</table>

Compliance With Daily Assessment
Compliance results are shown in Figures 3 and 4, plotting individual participants (y-axis) by daily compliance during the 6-week study period (x-axis). Yellow squares show days with completed assessments, black squares show where participants missed.

Daily Mood Assessments:
- **Self-reported mood** was available to complete once per day.
- **50% of participants achieved 100% compliance, completing all assessments; overall compliance was 94.6%.

Daily Cognitive Assessments:
- **Participants completed up to three Cognition Kit n-back sessions per day.** A median of two assessments were completed daily.
- **70% of participants achieved 100% compliance. Overall, cognitive assessment was completed on 96% of study days.
- In week 5, compliance reached 100%, with all study participants completing at least one n-back session daily.

Compliance With Full-length Assessments

<table>
<thead>
<tr>
<th>Assessments</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition Kit</td>
<td>30</td>
<td>100%</td>
</tr>
<tr>
<td>Mood assessment</td>
<td>29</td>
<td>96.7%</td>
</tr>
</tbody>
</table>

Qualitative Insights
- **Adherence to the testing regimen with varying degrees of ease, enjoyment, and perceived benefit.** We identified four main themes contributing to participants’ continued adherence: **Theme 1: Continued use of technology;** **Theme 2: Motivation;** **Theme 3: Feasibility;** and **Theme 4: Impact (Figure 5).**
- **Adherence was influenced by contextual factors including moods, daily routines, and social and physical environment.**
- **Many patients expressed personal motivations of enhancing knowledge of depression or gaining self-insight.** The in-app feedback functionality, which displayed scores after each cognitive assessment, supported this aim of self-insight and served as a motivator.
- **Participants were motivated by the luxury status of the device, although short battery life was an obstacle to adherence.** The technology was experienced as discreet, quick, and easy to use.
- **Assessment burden was deemed acceptable over the 6-week time-frame, helped by the brevity of each individual assessment.**
- **Study participation had diverse effects on participant well-being, with some feeling increased anxiety, whereas others report a sense of accomplishment.** The extent to which people reported a benefit was overall linked to their expectations for self-insight, behavior change, and their personal use of the trial data.

Conclusions
- **Our study suggests good acceptance of wearable cognitive and mood assessment technology using the Apple Watch.**
- **The qualitative themes identified show some overlap with previous research in smartphone-based digital health assessments, with discretion of the wearable technology as well as desirability of the smartphone providing additional motivation in the current study.**
- **Usability of health technology has been noted as a major contributor to engagement, and a primary predictor of drop-outs. Optimizing the balance between assessment burden and a monitoring schedule that captures the measures and processes of interest is of importance for supporting adherence in high-frequency assessment studies.** The current results have implications for digital health development and design, identifying factors and features supporting patient adoption, motivation, and engagement.

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