Introducing a scalable, smartphone-based treatment program for depression and anxiety that incorporates heart rate variability biofeedback

Marcos Economides, PhD [a]; Kristian Ranta, MSc [a]; Albert Nazander, MSc [a]; Inna Khazan, PhD [b]; Anu Raevuori, MD PhD [a,c]

a. Meru Health Inc. b. Harvard Medical School c. University of Helsinki

Introduction

- Depression is a highly prevalent disorder that severely impacts psychological, physical and social functioning[1].
- Heart rate variability (HRV) describes the time interval between heartbeats and is an important marker of health outcomes[2].
- Individuals with depression have lower HRV, with the extent of reduction correlating with symptom severity[3].
- Less than half of all individuals who require treatment for depression actually receive it[4], and the impact of current treatments on HRV remains largely unknown.
- HRV biofeedback (HRVB) is a form of cardiorespiratory feedback training that is used to increase HRV and treat a variety of disorders[5]. Adding HRVB to the treatment of depression may therefore improve treatment outcomes.

Objective

Here, we introduce a new, widely accessible, smartphone-based treatment program for depression and anxiety that includes HRVB.

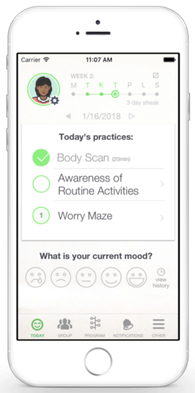
Methods

Design

We conducted a pilot study to test the feasibility of the Meru Health *Ascend* program, and explore pre-post symptom changes in a group of patients (n=36) with depression and/or elevated anxiety symptoms.

Intervention

The 8-week program features daily practices of 10-30 mins, derived from Mindfulness-Based Stress Reduction, Cognitive Behavioral Therapy, and Behavioral Activation Therapy. The program also includes HRVB (via 5-20 mins of daily resonance frequency breathing), anonymous peer support, and 1:1 messaging with a licensed therapist. Content is delivered via the Meru Health app and a Bluetooth-connected heart-rate monitor.

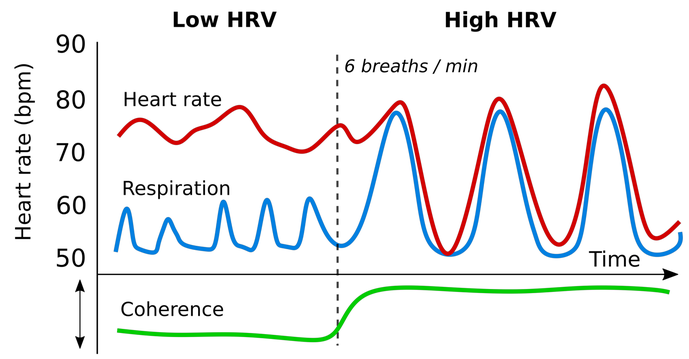


Measures

Depression and anxiety were measured via the PHQ-9 and GAD-7 scales respectively, at baseline and immediately post-intervention.

Heart rate variability biofeedback

Heart rate (HR) increases with inhalation and decreases with exhalation[6]. This effect is maximized at ~6 breaths/min, during which HR and breathing become synchronized, and HRV increases. During HRVB, participants received a visual cue indicating when coherence between HR and breathing was high.



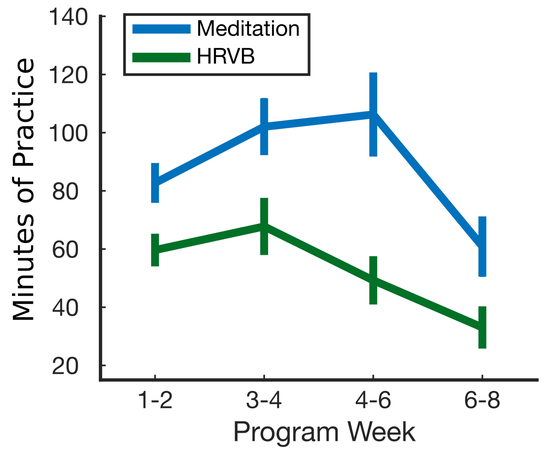
Results

Participants

- Mean age was 36.9 years (SD = 6.41, range = 22 to 50)
- 33 out of 36 participants were female (91.7%)
- 11 out of 36 participants were taking antidepressants (30.6%)

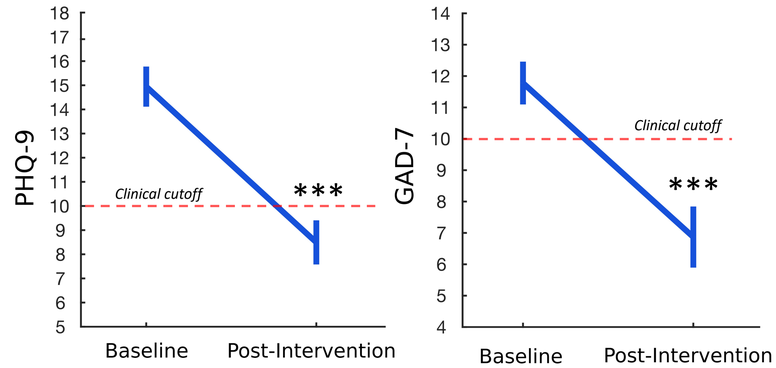
Engagement

31 out of 36 participants completed the program (86.1%), and 5 participants dropped out (13.9%)



Participants engaged with HRVB and meditation practices for a total of **3.5 hrs** (SD = 2.9, range = 0.4 to 11.8) and **5.9 hrs** (SD = 3.7, range = 0.27 to 12.1) respectively. Whilst engagement was generally high, frequency of practice lessened towards the end of the program.

Patient-reported outcomes



**** p < 0.001 (linear mixed effects models). Error bars represent SEM.*

Preliminary evidence suggests that the program is associated with clinically significant reductions in depression & anxiety (≥5 point reduction in PHQ-9 scores[7]; ≥3 point reduction in GAD-7 scores[8]). 63.6% of participants reported ≥ 50% reduction in PHQ-9 scores.

Discussion

- Our pilot results suggest that *Ascend* is feasible and associated with reduced symptoms of depression and anxiety.
- The program completion rate was high (86%) compared to other digital interventions for depression and anxiety.
- Efforts should be made to ensure that engagement with HRVB remains high throughout the program, as frequency of HRVB practice lessened from weeks 4-6 onwards.
- Further analysis will involve determining whether the program features lead to increases in HRV, and whether HRVB specifically contributes to symptom reduction.

References

1. Richards, D. (2011). 31(7), 1117-1125
2. Gorman, JM., et al. (2000). 140:S77-83
3. Kemp, AH., et al. (2010). 67(11), 1067-74
4. Kohn, R., et al. (2004). 82(11), 858-866
5. Lehrer, PM. & Gevirtz, R. (2014). 5, 756
6. Yasuma, F., et al. (2004). 125(2): 683:90
7. Lowe, B., et al. (2004). 42(12), 1194-201
8. Kroenke, MD., et al. (2017). 78(6), 716-27