Quantifying Virtual Reality Pain Modulation in Healthy Volunteers through Ice Immersion

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Abstract body

Introduction:

Virtual reality (VR) is an emerging tool used to reduce pain and anxiety during medical procedures. While there are several reports of VR's clinical benefits, the literature lacks large RCTs that incorporate biometric data to quantify the effectiveness of VR in increasing pain threshold/tolerance. Our purpose was to use subjective, timelapse, and biometric data to evaluate the effectiveness of VR in modulating pain during an ice immersion exercise.

Methods:

An RCT was conducted at Stanford University. Students, faculty, guests and hospital staff (>18 years) were recruited to participate in the study. Participants were connected to biometric sensors and underwent two ice immersions. Participants were randomized to immerse their dominant or non-dominant hand with VR or control (no VR) for the first ice immersion and then crossed over for the second immersion. Participants were instructed to keep their hand immersed until their maximum pain threshold was reached or until they reached a 4-minute time limit (unknown to participants). The outcomes of interest included ice immersion duration, onset of discomfort and pain, heart rate variability and skin conductance. Paired t-tests and McNemar test were used to compare participants' measures with and without VR.

Results:

The sample included 153 participants (mean age = 29yrs; 54% Female; 47% White). Participants on average were able to keep their hand immersed in the ice bath 25 seconds longer with VR compared to controls (2:39± 1:28 vs 2:14± 1:32, $p < 0.001$). Participants did not report a significantly later onset of discomfort with VR ($p=0.093$). However, participants did report a significantly later onset of pain when using VR (0:57sec ± 00:49 vs 00:46sec ± 00:39 $p=0.011$). McNemar's test showed a significant difference ($p = 0.001$) in the proportion of participants that reached 4 minutes when using VR compared to control. Biometric results are pending further analyses.

Conclusions:

Preliminary results indicate that VR increases the pain threshold and pain tolerance as demonstrated by later onset of pain and longer duration withstanding laboratory induced pain with VR use. Future work will include comparing VR with augmented reality and different VR modalities (active, passive and coaching).