EXPLORING VIRTUAL REALITY (VR) EXPERIENCES AS AN ADJUNCTIVE PAIN MANAGEMENT STRATEGY IN CHRONIC CANCER PAIN

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Background & Objectives

- Prior research on VR as a non-pharmacological interventions (NPI) for pain demonstrates significant work for acute pain applications, but little work in the chronic pain and palliative care fields. [1,2,3,4]
- Prior exploratory work using VR for chronic pain found moderate evidence for pain reduction and functional impairment following VR therapy[1,3]

Methods

- An RCT to test VR as a NPI was implemented with a diagnosis of ongoing chronic cancer pain (N=100).
- Participants were split into one of two blinded groups (50/50) and undertook either a VR experience of 30 minutes daily for 6 days a week using a computer and VR head mounted display, or the same applications on a laptop computer with a 2D screen .
- Four different applications were used, two providing cognitive distraction, Carpe Lucem (CL) and Obduction (OB), and two offering meditative relaxation, the Virtual Meditative Walk (VMW) and Wildflowers/The Witness (WF/WN).

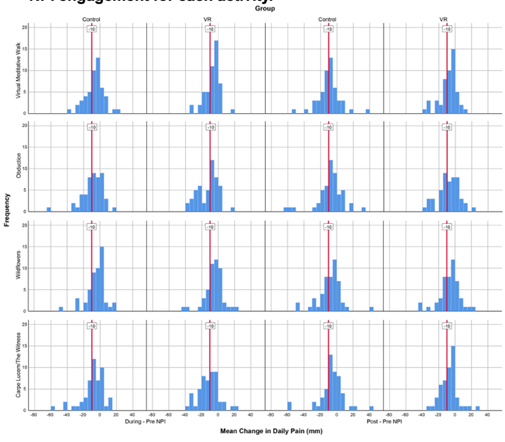
Instruments

- Participants completed
  - Daily: pre, during and post exposure pain-scores using the Visual Analogue Scale (VAS).
  - Weekly: a) McGill Shot Form Pain Questionnaire (SF-MPQ), b) SF-12 quality of life (QoL) questionnaire, and c) the Pittsburgh sleep quality index (PSQI).
  - Baseline observations were recorded at the start for all instruments.

Results

1) Confirmatory Linear mixed effects modelling was used to establish whether there were differences in the outcomes of interest between the VR and control groups.

Figure 1. Weekly distributions of mean Daily VAS change between before and during, and between before and after NPI engagement for each activity.



Note: Vertical red line indicates decrease of -10mm identified as a clinically meaningful change.

Table 1. Number of participants who showed a mean decrease of VAS of ≥ 10mm in a given week.

	VR	Control	Total
Marginal response	7	13	20
Meditative only	6	8	14
Cognitive only	19	7	26
Mixed response	10	14	24
All activities	8	8	16
Total	50	50	100

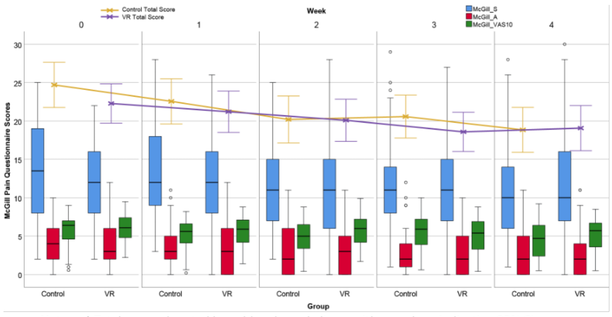
Notes: a) Marginal response indicates participants experienced <10mm VAS decrease in any activity. b) Meditative only indicates ≥ 10mm VAS decrease in one or both meditative activities only, c) Cognitive only indicates ≥ 10mm VAS decrease in one or both cognitive activities only, d) Mixed response indicates ≥ 10mm decrease in at least one of both meditative and cognitive activities.

2) VAS responses were mixed between poor and significant by all participants in both arms for both cognitive & meditative applications (Figure1 & Table 1).

3) Cognitive and meditative applications in both the VR and control arms demonstrated clinically important pain reduction (Table 2).

4) Cognitive applications demonstrated better during-exposure responses, and meditative applications better post-exposure responses (Table 2).

Figure 2. Boxplots of SF-MPQ Components distributions per week.



Notes: a) Total scores denoted by gold and purple lines, with error bars indicating 95% CI.
b) Sub-components were summed to a total out of a potential maximum score of 55.

Table 2: Differential daily mean VAS score parameter estimates for pre-during and pre-post exposure reported pain scores between the VR and control arms.

	VR Arm			Control Arm			
Predictor	**VAS Pre-exposure Mean (SE)**	**VAS Mean (SE)**	**VAS Change (SE)**	**VAS Pre-exposure Mean (SE)**	**VAS Mean (SE)**	**VAS Change (SE)**	**Group Differential* VR vs Control, (95%CI)**
Overall							
Pre-during	54.97 (1.84)	43.10 (1.84)	**-11.87 (0.72)**	57.27 (1.89)	45.09 (1.89)	**-12.18 (0.79)**	0.31 (-1.79, 2.45)
Pre-post	54.97 (1.84)	44.55 (1.84)	**-10.42 (0.72)**	57.27 (1.89)	42.96 (1.89)	**-14.31 (0.79)**	3.89 (1.78, 6.21)
CL/WN							
Pre-during	45.87 (2.5)	33.50 (2.50)	**-12.37 (1.14)**	40.07 (2.53)	31.01 (2.53)	-9.07 (1.16)	-3.30 (-6.47, 0.05)
Pre-post	45.87 (2.5)	37.74 (2.50)	-8.12 (1.14)	40.07 (2.53)	33.58 (2.53)	-6.49 (1.16)	-1.63 (-4.94, 1.74)
VMW							
Pre-during	54.57 (2.19)	45.94 (2.19)	-8.64 (1.14)	56.23 (2.29)	45.24 (2.29)	**-10.99 (1.25)**	2.35 (-1.04, 5.51)
Pre-post	54.57 (2.19)	44.68 (2.19)	-9.89 (1.14)	56.23 (2.29)	41.00 (2.29)	**-15.23 (1.25)**	5.33 (1.80, 8.37)
OB							
Pre-during	55.35 (2.44)	40.80 (2.44)	**-14.55 (1.35)**	58.41 (2.60)	44.77 (2.61)	**-13.64 (1.51)**	-0.91 (-4.93, 3.12)
Pre-post	55.35 (2.44)	44.24 (2.44)	**-11.11 (1.35)**	58.41 (2.60)	43.35 (2.61)	**-15.06 (1.51)**	3.95 (-0.35, 7.50)
WF							
Pre-during	57.05 (2.23)	46.93 (2.23)	**-10.13 (1.33)**	58.70 (2.34)	49.89 (2.34)	-8.81 (1.42)	-1.32 (-4.60, 2.38)
Pre-post	57.05 (2.23)	46.00 (2.23)	**-11.05 (1.33)**	58.70 (2.34)	44.38 (2.34)	**-14.32 (1.43)**	3.27 (-0.34, 7.15)

Notes: a) Compares the change (pre-during or pre-post) in individual pain scores between the two groups, b) MCID = -10mm,
c) Scores adjusted for age, and duration, d) * Negative values indicate VR group performed better than control; positive values indicate control better.

5) In the weekly instruments only the SF-MPQ demonstrated a reduction trend, which was only clinically important in the control arm, and may not necessarily have been related to NPI use (Figure 2).

Conclusions

For chronic cancer pain:

- VR applications are capable of providing clinically important pain reduction as adjunctive NPIs.
- Cognitive applications were superior for VR pain reduction during-exposure, whilst meditative applications provided better immediate post-exposure pain relief.
- VR applications are not significantly superior to non-VR multimedia NPIs, and are significantly more costly.
- Their effectiveness is highly individualised but both VR and computer based interactive multimedia can provide effective pain reducing adjunctive NPIs for some people.

References: 1) Garrett B, Taverner T, McDade P: Virtual Reality as an Adjunct Home Therapy in Chronic Pain Management: An Exploratory Study. JMIR Med Inform 5:e11, 2017 . **2)** Garrett B.M., Taverner, T., Tao G., Cordingley E., Sun C. (2020) Patients Perceptions of Virtual Reality Therapy in the Management of Chronic Cancer Pain. Heliyon. 6(5) doi: https://doi.org/10.1016/j.heliyon.2020.e03916 3) Garrett B, Taverner T, Gromala D, Tao G, Cordingley E, Sun C: Virtual Reality Clinical Research : Promises and Challenges. JIMR Serious Games JMIR Serious Games; 6:e10839, 2018. 4) Fu H, Garrett B, Tao G, Cordingley E, Ofoghi Z, Taverner T, Sun C, Cheung T: Virtual Reality–Guided Meditation for Chronic Pain in Patients With Cancer: Exploratory Analysis of Electroencephalograph Activity. JMIR Biomed Eng 6:e26332, 2021

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