

Combat PD – Innovative delivery of a home-based gamified therapeutic exercise programme for Parkinson’s disease. A usability study of a technology-assisted health care approach

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Background

- Parkinson’s disease (PD) is the second-most common neurodegenerative disease in Singapore. The cardinal symptoms include bradykinesia, rigidity, impaired postural reflexes and resting tremors.
- Aerobic Exercise Training (AET) has shown to have neuroprotective effects on PD and improvements in cognitive skills, executive function and memory.
- Despite the strong evidence supporting the benefits of physical activity, there is low compliance for home exercise programmes as current home exercise programmes often do not meet the needs of early-stage PwP.
- The locally-designed novel exergaming mobile application (“*Combat PD*”) can potentially meet the above service gaps by delivering gamified aerobic exercises sessions specifically for people with early PD. Additionally, current local PD management involves largely clinic-based physical management without incorporating gamifications.

Aims

1. To investigate whether *Combat PD* is effective in increasing the heart rate (HR) of People with PD (PwP) to therapeutic levels.
2. To investigate the perceptions of patients towards the use of *Combat PD* and other exergames available in the market as part of their rehabilitation programme.

Methods

Study Design – Mixed method, Cross Sectional Pilot Study

Sampling: Convenience sampling

DSRB Ref: 2019/ 00209 dtd 29 April 2020

- Session 1**
 - Participants played each exergame for 10 minutes: (1) *Shape Up* (Xbox Kinect), (2) *Arms* (Nintendo Switch) and (3) *Combat PD*
 - Focus group was conducted to assess the usability of *Combat PD* and 2 other commercial games.
- Session 2**
 - Participants played *Combat PD* for 30 minutes
 - Participants’ HR was monitored throughout 30-minute session.
 - Survey to better understand the perception of PwP towards exergames based on *Combat PD*.

Participants

Inclusion Criteria

- Diagnosis of idiopathic PD by a neurologist for ≥ 2 years
- Early-stage disease (Hoehn and Yahr Stage I to II)
- Stable dopaminergic medication for at least 4 weeks prior to study

Exclusion Criteria

- Atypical PD
- Pregnant women, cognitive impairment or depression, high cardiovascular risk, poorly controlled hypertension/diabetes mellitus, BMI > 30, unstable cardiac disease, and any medical orthopaedic psychiatric/visual impairment affecting participants ability to participate.
- Gait and balance impairments
- Photosensitivity
- Severe tremors/incoordination

Main Outcomes

Focus group discussion data & survey to evaluate usability

HR changes pre and post gaming

HR and HR duration in targeted HR zone based on HR Reserve (HRR) method

Borg’s Scale (Rate of Perceived Exertion [RPE], 0- 10)

Analysis

Transcripts of focus group were coded & analysed using thematic analysis

Wilcoxon signed rank test

Descriptive statistics

Descriptive statistics

Analysis

- Heart rate changes (pre and post games) was analysed using the Wilcoxon signed-rank test
- Transcripts of patients’ perceptions towards *Combat PD* and other exergames were coded and analysed using a thematic approach by 2 study team members

Results

8 participants, 7 males and 1 female, mean age (SD) = 62.8 (7.4), median Hoehn & Yahr Stage=2, Mean number of years since diagnosis (SD) = 3.13 (1.1) completed both sessions.

Theme 1 Perceived motivators

Participants overall had a positive experience and can envision themselves incorporating exergaming into their physical activity routine

Theme 2 Perceived enjoyment from the games

Participants shared the possibility of building a community through the *Combat PD* and the positive feelings when playing the game

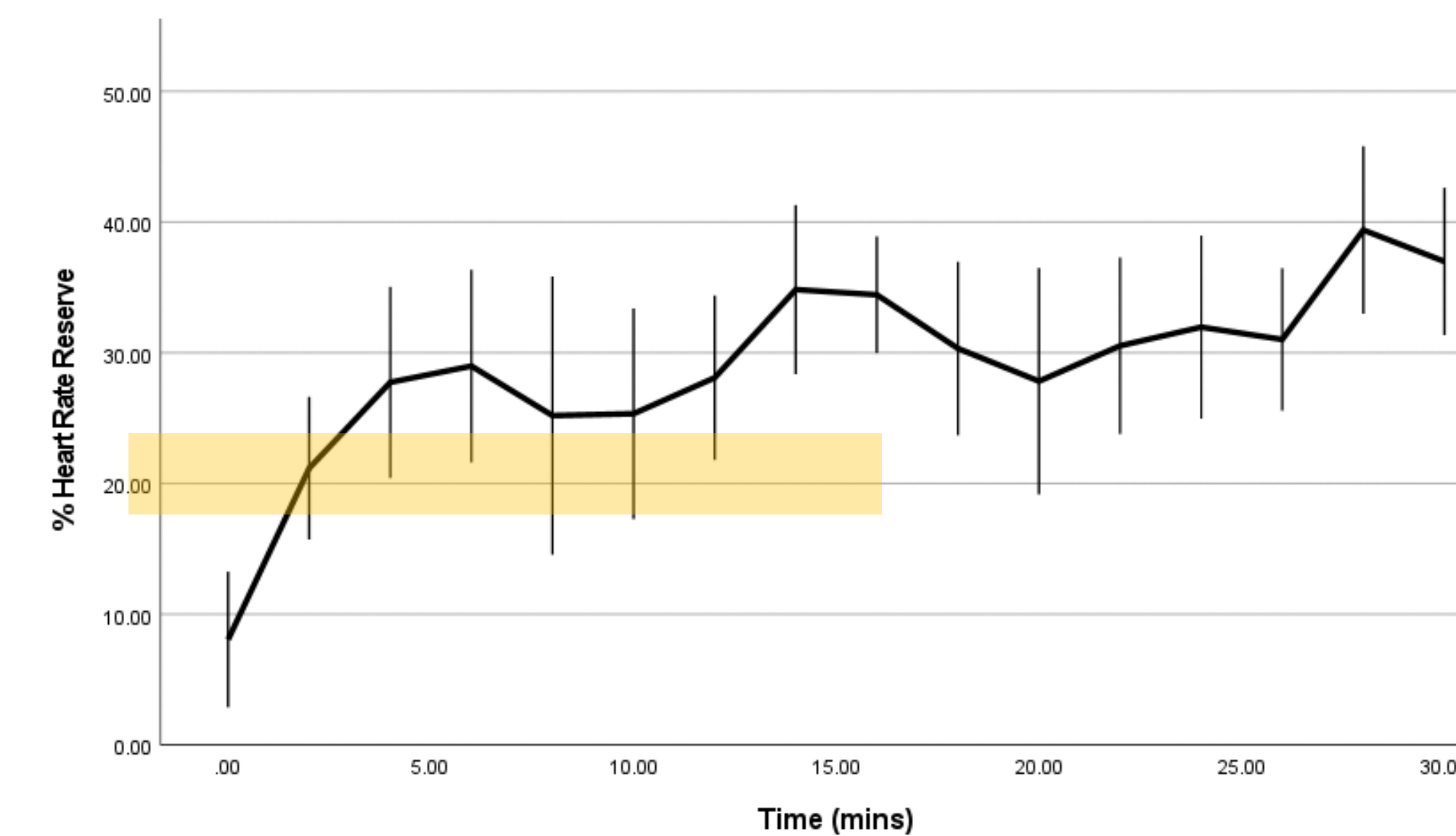
Theme 3 Perceived physical benefits

Majority of patients agreed that *Combat PD* was sufficiently difficult and introduced a new way of exercising which was different from their usual regime

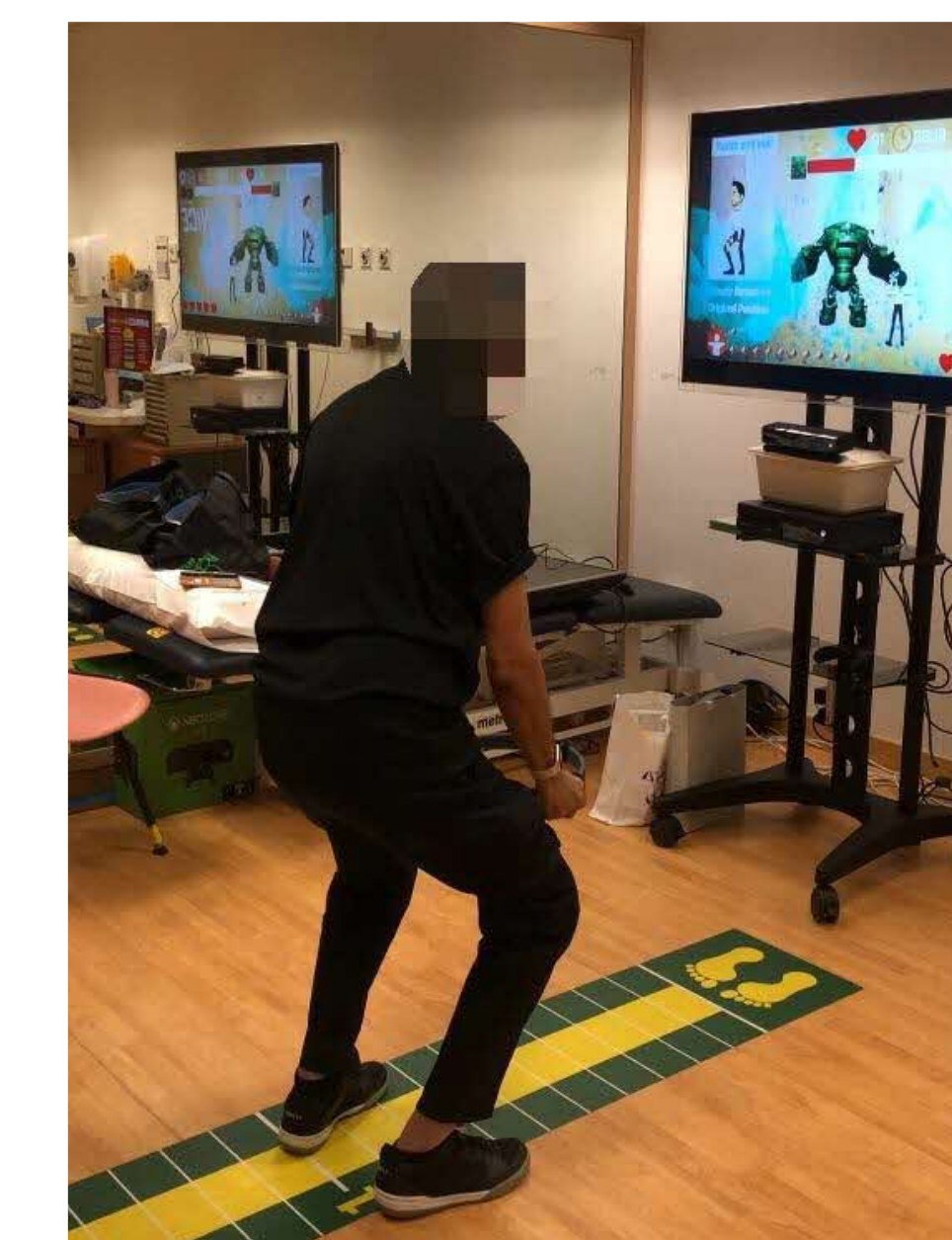
Theme 4 Potential barriers of home based exergaming

Most participants shared that they might grow bored of the game after multiple sessions and that self discipline was still a difficult hurdle to overcome

All 8 participants completed session 2 without adverse events. The mean baseline HR was 80 (9.4) bpm, mean HR during session was 103(6.1) bpm, mean Max HR was 118(7.5) bpm and mean RPE 5.5 (2.2). Wilcoxon Signed Rank test showed a significant increase in heart rate from baseline to post-session, Z= -2.52 , P=0.012. Figure 1 shows the % Heart Rate Reserve that all participants were exercising at every 2 minutes.



Mean heart rate reserve response of all participants (expressed as a percent of Heart Rate Reserve) to a 30min *Combat PD* session. All values are expressed as mean (SD). Target Heart Rate = [(max HR – resting HR) × Training %] + resting HR



Discussion

This pilot study provides valuable first insights into cardiovascular response during exergaming and patients response to exergaming as an exercise program for early-stage PD. Although there is great potential for *Combat PD* to be used in PD rehabilitation, further testings must be done to assess its clinical efficacy and safety as a home-based programme.

A qualitative study exploring the feasibility of exergames among people with Parkinson's disease

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Objectives

- 1) To compare the usability of a newly developed exergame application (*Combat PD*) designed for people with early stage of Parkinson's disease (PD) to existing commercial games
- 2) To investigate the experiences after testing with focus on further improving the acceptability and feasibility of adopting *Combat PD* as a rehabilitation tool for people with early-stage PD

Background

- PD is the second-most common neurodegenerative disease in Singapore
- Regular exercises has found to have positive impact on PD symptoms and could potentially delay disability onset
- Compliance to a long-term exercise program remains challenging
- Current home exercise programs often do not meet the needs of people with early-stage PD
- Exergaming, which refers to as exercising with gamified components could potentially improve motivation and adherence

Methods

Study Design: Qualitative descriptive with semi-structured interview and a survey

Sampling: Convenience sampling
DSRB Ref: 2019/ 00209

Session 1

- Participants played each exergame for 10 minutes (1) *Shape Up* (Xbox Kinect), (2) *Arms* (Nintendo Switch) and (3) *Combat PD*
- Focus group was conducted to assess the usability of *Combat PD* and 2 other commercial games.

Session 2

- Participants played *Combat PD* for 30 minutes
- Participants' heart rate was monitored throughout a 30-minute session.
- *Combat PD* evaluation survey to better understand the perception of towards exergames based on *Combat PD*

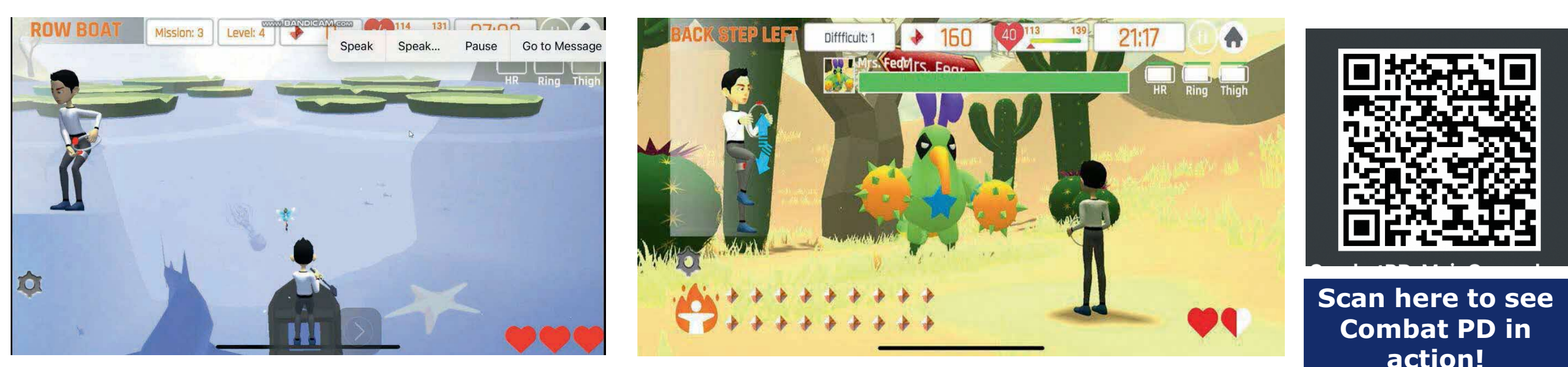


Fig 1a & b. Screenshot of *Combat PD* gameplay

Participants

Inclusion Criteria

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- Photosensitivity
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Reference

Barry G, Galna B, Rochester L. The role of exergaming in Parkinson's disease rehabilitation: a systematic review of evidence. *J Neuroeng Rehabil.* 2014 Mar 7;11:33.

Acknowledgement

We would like to thank Taggle Pte. Ltd. for prototype development, Ng Teng Fong Healthcare Innovation Programme and Academic clinical Programme for funding this project.

Results

10 participants (8 males, mean age (SD) = 62.8 (7.4)) with early PD (Hoehn & Yahr Stage 2) and mean 3.13 (SD1.1) years since diagnosis completed the sessions without any adverse events.

Two main themes emerged from the interview data:

Theme 1: Perceived benefits through engagement and usability

Participants overall had a positive experience and can envision themselves incorporating exergaming into their physical activity routine. Participants experienced fulfilment by achieving game goals and were motivated to exercise during the gaming session. Participants perceived benefits for the use of exergame as a rehabilitation tool.

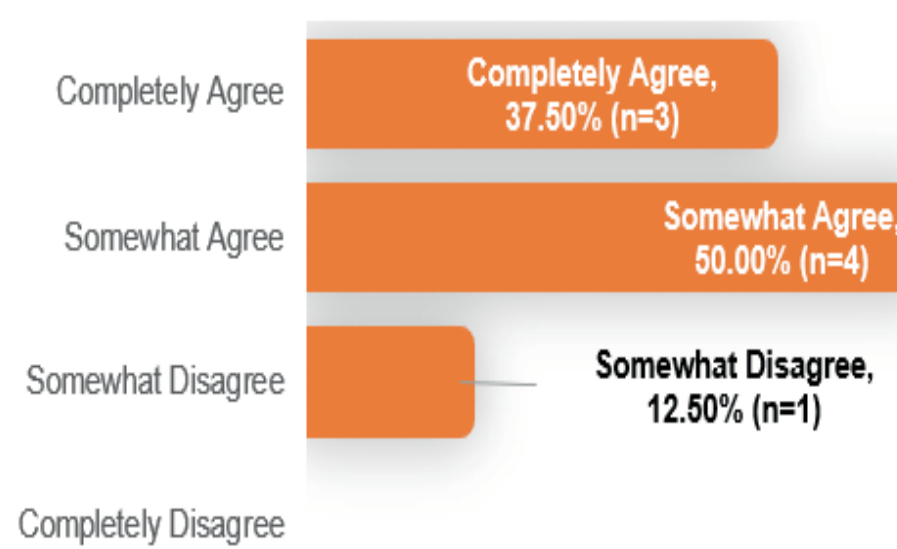
"Certain times I'm so focused on the game so I'm distracted and forget that I'm exercising" [PD-05]

"...Everyone (can) come together (to) play game, can have thousands of people. should do this kind and promote to public ..." [PD-09]

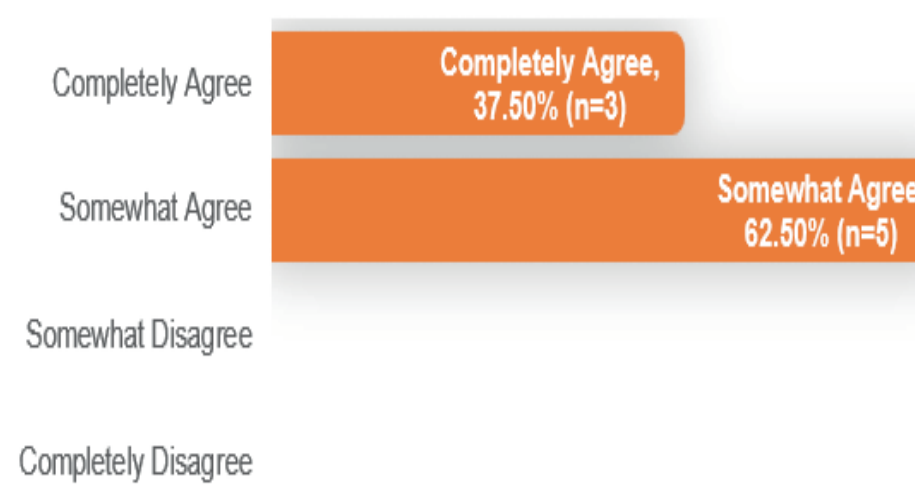
"...It's effective. It's really a workout especially the thighs. Fun way of exercise" [PD-04]

"...I think for me, I will like this at home because I can stretch my muscles" [PD-03]

I enjoyed Combat PD



The difficulty level of Combat PD was appropriate for me.



Theme 2: Implementing exergame in rehabilitation

Potential enablers identified include feasibility of exercising at their own home and own pace, user friendliness of the technology, adaptability to individual's ability to ensure effectiveness and safety, and remote monitoring by health professional.

"Once you do it often, you're repeating it again. After a time, you feel a bit slack. You want something new, need change. Need updates if not lose interest. Need to update, after 3 months update so it keeps me going..." [PD-03]

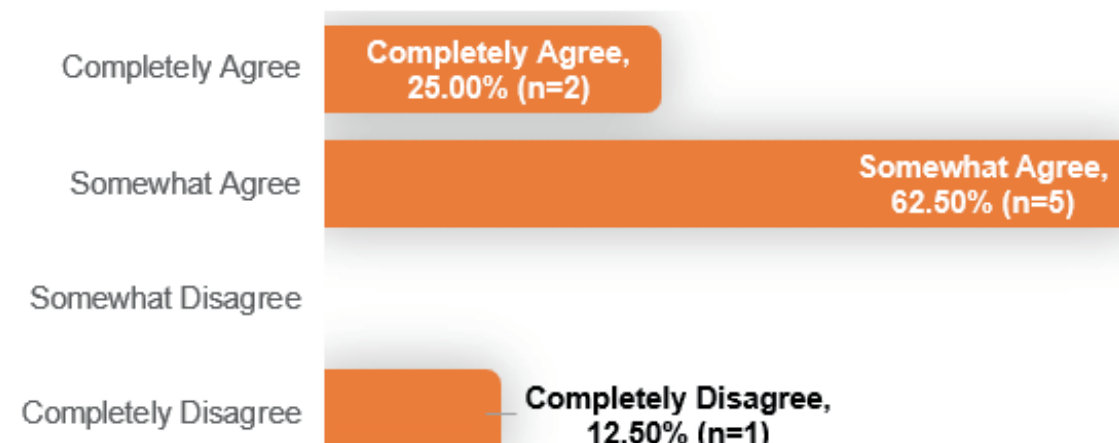
"... I don't need to be engaged but need guidance, motivation, and self-discipline." [PD-01]

"...if exergame is targeted and engaging, still would appreciate physiotherapist input to give feedback regarding accuracy of movement ..." [PD-06]

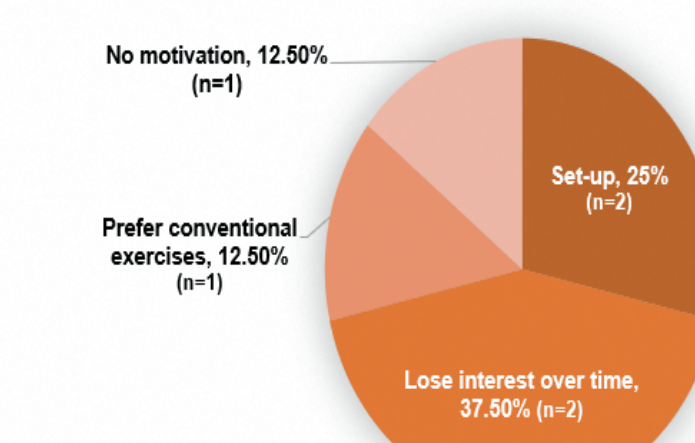
"... important to get reassurance from online..." [PD-04]

"The intensity was appropriate because the swimming takes a lot of squatting and its exerting my strength.... some of the movements like squatting and moving my shoulders. I don't do that because I do more walking, slow jogging and stretching." [PD-06]

I can foresee myself playing exergames regularly



Barriers to continued regular usage of Combat PD



Discussion

Our findings were in line with current literature that show the feasibility of exergaming for people with PD (Barry et al., 2014). The use of commercial games may also be too difficult and exergames may need to be customised specially to the rehabilitation needs and capabilities of people with PD. It is still unclear if *Combat PD* can continuously and consistently engage patients at their home. A clinical trial (NCT05737316) using *Combat PD* is currently underway to establish its adherence, safety and clinical effectiveness, particularly in the home, and if *Combat PD* can consistently and continuously engage patients after multiple sessions.

Conclusion

The findings from this qualitative study suggest that exergaming is acceptable and is perceived to be beneficial as a form of rehabilitation for people with PD. Usability, customization to individual rehabilitation needs and capabilities and remote monitoring are considered as important elements for optimal efficacy, adherence, and safety.