

## Research Article

# Tele Virtual Reality-based Peer Support Programme for Cancer Patients: A Preliminary Feasibility and Acceptability Study

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## Abstract

**Introduction:** Cancer patients often struggle with psychological distress, and their health-related quality of life (QOL) and life expectancy are limited. Peer support activities, wherein patients exchange information from their experiences, are reportedly useful. Exercise intervention also helps in improving psychological distress and, possibly, life expectancy. In this pilot study, we integrated these interventions and developed a group education programme using virtual reality (VR) technology and investigated its feasibility and acceptability. **Methods:** Five cancer patients (four females; 57.8±4.3 years) were instructed to participate in the VR cancer peer support programme at home for five weeks. They were required to almost daily perform 10-minute exercises and actively communicate with each other. We recorded and analysed the adherence to this programme and their opinions. If suitable, these were analysed using non-parametric tests. **Results:** All participants successfully completed the protocol. During the study period, the participants attended the VR cancer peer support for 24.4±10.0 days. The total exercise time was 458.8±210.7 minutes, and the facilitator significantly increased the time spent in one attendance ( $p=0.011$ ). The programme was assessed as useful for overcoming physical laziness and encouraging to adopt as an exercise habit after completion. **Discussion:** With a small number of participants, our VR programme was considered feasible to become an exercise habit. Hence, with more participants, it would improve psychological distress and exercise habits of cancer patients.

**Keywords:** Peer support, cancer survivorship, virtual reality, exercise, group education

## Introduction

The Recent advancements in the treatment of malignancy have steadily improved the overall survival rate. However, diagnosis and treatment have disrupted almost all aspects of a patient's life and is associated with psychosocial sequelae including depression, anxiety, and fear of recurrence [1,2]. Hence, peer support programmes (i.e. contemporaries with whom patients can share their common experience) is a treatment intervention that is widely offered by local communities. These mostly include psychosocial support to cancer patients and families, and the programmes contain psycho-education and counselling that target social support, explain how life events affect the influence social functioning,

and provide normalisation and validation to patients' experiences and reactions to cancer [3]. Fulfilling cancer patients' supportive care needs and providing support during psychological distress, interventions such as peer support programmes have demonstrated promising effects on psychological distress management, health-related quality of life (QOL), and health behaviours [4-6]. Furthermore, some studies demonstrated improved adherence and better survival among cancer patients due to peer support [7,8]. Apart from peer support programmes targeting psychosocial distress, exercise interventions for cancer patients could improve global health-related QOL, social functioning, and emotional

Well-being, possibly with greater expected length of survival [9-11]. there are several types of exercise interventions that target physical functioning (e.g. group or personal exercise, light-intensity body conditioning/stretching, and physical therapy by physiotherapists), with or without educational and psychosocial perspectives such as educational programmes on home-based exercise, progressive relaxation training, information and coping skill training, and psycho-educational support therapy [9]. Considering these, peer support programmes and exercise interventions could be provided for cancer patients at the same time.

Although the forms of providing support varies, they might have different effects on outcomes for cancer patients [4]. Since such varied forms are considered to be necessary as platforms for resolving several barriers that cancer patients face when receiving care, the considerable heterogeneity has been accepted and these forms have not been standardised. One of the major barriers is feeling embarrassed and stressed, especially in one-to-one and face-to-face forms of care. Another is difficulty in accessing the care during physical distancing and time constraints. Hence, providing care in online and group forms could be suitable for cancer patients. Moreover, patients generally prefer to mitigate the risk of their private information being exposed to other people. We created a novel peer support programme using

virtual reality (VR) technology for cancer patients (the VR cancer peer support programme) with the following criteria: (1) target psychosocial distress and exercise education; (2) online and group interventions; (3) assurance of anonymity to participants. This pilot study sought to demonstrate the feasibility and acceptability of our VR cancer peer support programme for the provision of treating psychosocial distress and educating cancer patients on exercise habits.

## Methods

### Participants

This Five patients [four females; age 57.8±4.3 mean ± standard deviation] with a history of cancer treatment participated in this feasibility and acceptability study (Table 1). All participants were outpatients in the Department of Pain and Palliative Medicine, at The University of Tokyo Hospital, with a complaint of either physical symptoms (chemotherapy-induced neuropathic pain and dysesthesia, postoperative lymphedema, aromatase inhibitor-induced arthralgia, and/or fatigue) or psychological distress. The local ethics committee of The University of Tokyo Hospital approved the trial protocol (2020029NI), and written informed consent was obtained from each patient before participating in the study. This study was registered in the University Medical Information Network (UMIN trial ID: UMIN000040930).

**Table 1.** Summary of subject characteristics

Subject	Gender	Age, (year)	Cancer history	Chief complaint(s) of cancer- and cancer treatment-related symptoms	Cancer treatment status (Disease free periods)	Other clinical conditions
1	Female	61	Breast	Muscle weakness of lower legs, CIPN, AI-induced arthralgia	Post treatment (more than 8 years)	None
2	Female	53	Uterus	Weakness, chronic abdominal pain	Post treatment (2 months)	Thoracic OPLL
3	Female	63	Uterus	Weakness, incontinence	Post treatment (more than 4 years)	None
4	Female	54	Breast	Lymphedema	Post treatment (more than 1 years)	None
5	Male	58	Gastric	Low back pain	Receiving chemotherapy	Lumbar adhesive arachnoiditis

Abbreviations: AI: aromatase inhibitor; CIPN: chemotherapy-induced peripheral neuropathy; OPLL: ossification of posterior longitudinal ligament.

### Content of VR cancer peer support programme

In our VR cancer peer support programme (Figure 1), the participant comfortably sat on a stool and wore the head-mounted display (Oculus Quest; Facebook Technologies, California, USA), which was equipped with acceleration sensors to monitor the eyesight field translocation based on the participant's head movements. Through the avatar, the participant watched their virtual hand movements. The participant grasped the hand tracking sensors using their hands, and the movements were tracked. An avatar was created as a proxy for the participant, and it entered into the virtual world as a three-dimensional computer graphic (3D-CG) image created by 3D-CG software (Unity2019, Unity Technologies, California, USA). Five kinds of virtual worlds (i.e. seashore, football stadium, sports gym, boxing ring, and the woods) were created, where the virtual exercise trainer appeared once every 20 minutes. The virtual trainer instructed and performed exercise simultaneously for about 10 minutes and then disappeared during the 10-minute interval. The five exercises in a sitting position (i.e. stretching, trunk muscle stabilisation exercise, boxercise, cardiopulmonary fitness, and

progressive relaxation training) were presented by the trainer and fixed for the respective virtual worlds. The world, presented to the participant, was randomly changed every day, and therefore, the participant could not arbitrarily select the virtual world and the content of exercise. The virtual world started from 7 AM to 11 PM every day, and during these hours, the participants were permitted to enter and exit the virtual world arbitrarily multiple times and spend time as desired. In the virtual world, multiple participants' avatars could enter, and they had visual contact with other avatars and could interact through verbal communication using the microphone and earphones equipped with the head-mounted display (Figure 1). The participants were required to enter the virtual world and perform the exercise at home for at least five days a week. The participants were informed that other avatars had received cancer treatments and were required to actively communicate and consult other avatars about their health. The study periods were set for 36 days, including the instruction session day. A healthcare-professional facilitator entered the virtual world for 30 to 60 minutes 11 times within the study period, and the participants were informed about the schedules beforehand.



**Figure 1.** Scenes from the virtual reality (VR) cancer peer support programme. (A) From a first-participant perspective, view of exercise performance on the virtual boxing ring. Participants follow the instructor (black arrow) to perform exercise with other participants' avatars (white arrows) in the virtual worlds as three-dimensional computer graphic (3D-CG) images. (B) Demonstration of the participants (upper and bottom) and a facilitator (middle) when participating in the VR programme (performing the boxercise). Participants of the VR programme wore the head-mounted display and grasped the hand tracking sensors. In the virtual worlds, participants have visual contact with other avatars and interact through verbal communication by using the microphone and earphones equipped with the head-mounted display. (C) Other scenes of the virtual worlds: woods (left) and seashore (right).

## Evaluation

Adherence to our VR cancer support programme was tracked using participant attendance, and verbal communications were recorded by our backyard engineers. Based on the records, attendance days and time spent per attendance during the study periods were extracted for each participant. Contexts of verbal communications were analysed in an unstructured manner. After the completion of the study periods, the participants were required to answer the semi-structured questionnaires about the preference of exercise contents, physical demand, communication with other avatars, and the virtual reality system and debrief the VR cancer peer support. The debrief was also analysed in an unstructured manner. Nonparametric tests (Mann-Whitney test and Kruskal-Wallis test) were applied if suitable.

## Results

All participants completed the protocol of our VR cancer peer support programme. During the 36-day study period, the participants attended the VR cancer peer support for  $24.4 \pm 10.0$  days (67.8±27.9% of the study days;  $4.9 \pm 2.0$  days per week). The days during study periods of the former, middle, and latter third parts were  $9.4 \pm 2.1$ ,  $7.6 \pm 4.3$ , and  $7.4 \pm 4.6$ , respectively (K-W test,  $p=0.67$ ). The attendance times during the periods were  $1.04 \pm 0.58$  times per day. Two of the five participants attended the VR cancer peer support programme more than once a day. The attendance times during the study periods of the former, middle, and latter third parts were  $15.2 \pm 7.2$ ,  $11.2 \pm 6.7$ , and  $10.0 \pm 8.5$ , respectively (K-W test,  $p=0.53$ ). The total of the average exercise time throughout the study period was  $458.8 \pm 210.7$  minutes, and the time spent per attendance in the programme was  $12.8 \pm 1.24$  minutes. An announcement informed the participants that presence of a facilitator in the programme did not affect their attendance (presence 76.0±30.5%, absence 64.6±28.7%; M-H test,  $p=0.53$ ), but the facilitator significantly extended the minutes spent per attendance of the participants (presence  $19.4 \pm 4.1$ , absence  $12.2 \pm 1.6$ ; M-H test,  $p=0.011$ ).

There were no adverse events, such as nausea, vomiting, and dizziness or performing exercise in pain, associated with the VR system, as reported by all the participants.

Post-termination questionnaires revealed that the participants generally preferred all contents of exercise and felt comfortable while performing them. They assessed that this VR programme helped them overcome their physical laziness and encouraged them to adopt them as exercise habits after the completion of this VR programme. Some participants desired tailor-made exercise contents corresponding to their respective physical conditions (e.g. lymphedema and chronic scar stiffness after cancer surgery) rather than the five contents. More realistic 3D-CG human-appearance and more

precise and improved visibility of the avatar movements were desired by most of the participants. Two of the five participants never met any other participants, including the facilitator, as they often did the VR programme at late hours. In the absence of the facilitator, the participants met others for 76 minutes in the 36-day study period. In the short meeting time, the participants kept their greetings brief and performed exercise without talking. On the other hand, in the presence of the facilitator, the participants interacted with each other. However, most interactions were directed to the facilitator, and were regarding counselling about their general health conditions and behaviours and prevention of cancer recurrence. More detailed background information about other participants' medical history were desired for online VR communication and peer support by most of the participants.

## Discussion

The results of this pilot study suggest that our VR cancer peer support programme is feasible and acceptable for cancer patients regarding safety and adherence. As a pilot study with limited sample size, these results should be interpreted with caution and cannot be generalizable to all cancer patients. With a small number of participants, our exercise content was accepted and people were encouraged to adopt exercise habits. However, peer support was insufficient in the present VR programme protocol. Due to arbitrary properties that deserve individual participants' convenience, often the participants did not meet each other. Consequently, interactive communication among the participants did not occur, and peer support was almost lacking without the facilitator. Considering these results, our VR cancer peer support would need more participants and more meeting opportunities to more frequently provide reciprocal peer supportive communications, with more assistance from facilitators.

Delivering high-quality care to all patients with cancer by healthcare professionals and patients present numerous challenges, including difficulties with care coordination and access. Such cancer care would ideally be a community-based service delivery intervention designed to promote access to timely diagnosis and treatment of cancer and other chronic diseases by eliminating barriers to the care [12]. However, along with physical distancing and time constraints, the recent pandemic due to COVID-19 has made it difficult to provide face-to-face care of patients in the community. Alternatively, 'online' (e.g. by telephone, internet talking, and social networking services) care has been provided. Evidence has demonstrated the intimate associations between psychosocial distress and its clinical routine assessments and cancer prognosis through the diagnostic, treatment, and post-treatment phases of cancer [13,14]. As evidence has demons-

-trated the intimate associations between exercise habits, muscle dysfunction, tolerability to cancer treatments, and cancer prognosis [9, 15], we developed and intended to convene the online virtual reality-based peer supportive group educational programme for psychosocial distress and exercise habits, where anonymities of personal information of participants are assured. Unlike peer support for psychosocial distress, exercise habits have not still had clear evidence [16]. In the present study, our 10-minute exercise content was accepted and considered feasible to be adopted as exercise habits. As middle to high- intensity exercise habits (i.e. 8000 daily steps) is associated with reduced cancer mortality [17], we should prepare more intense exercise contents and tailor-made exercise contents corresponding to participants' physical conditions. Although our VR cancer peer support would need some assignments for exercise content, with more participants, meeting opportunities, and more frequent peer supportive communications, our VR cancer peer support programme would improve psychological distress and exercise habits of cancer patients.

## Conclusion

With a small number of participants, our VR programme was considered feasible to become an exercise habit. With more participants, it would improve psychological distress and exercise habits of cancer patients.

## Abbreviations

3D-CG: Three-dimensional computer graphic; QOL: Quality of life; VR : Virtual reality.

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