The Effect of Virtual Zen Garden on Quality of Life and Affect of Residents in Long-Term Care Home

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Abstract
Background: Increasing attention has been paid to the therapeutic effect of garden in long-term care home. However, problems on set up and reliability of implementation were still of concern in studies. Virtual Zen garden is an innovative intervention that transfers the beneficial effect of garden into long-term care home.
Objectives: To examine the effect of virtual Zen garden on quality of life and affect of long-term care home residents in Hong Kong.
Methods: A single blinded randomized controlled trial with repeated measure and convergent mixed methods design was adopted. Participants were randomly allocated to received virtual Zen garden intervention(IG) or activity control(CG). Each participant received bi-weekly session for 3 months. Quality of life and affect before(T0), after(T1) and 3-month post-intervention(T2) were measured. Semi-structured interview were conducted to explore the experience of participants in virtual Zen garden.
Results: Significant interaction effect in quality of life ($F = 17.806$, $p < 0.001$), depression ($F = 12.684$, $p < 0.001$), anxiety ($F = 15.909$, $p < 0.001$), pain ($F = 10.640$, $p < 0.001$) and neuropsychiatric symptoms ($F = 20.795$, $p < 0.001$). Significant differences in post hoc analysis were only found in IG instead of CG. The improvement in quality of life and affect in IG sustained for 3 months after intervention. Four themes were drawn from thematic analysis, including influence of virtual Zen garden on (1) physical health; (2) psychological health; (3) social relationship; and (4) environment.

Keywords: Quality of Life, Virtual Reality, Garden, Zen Garden, Long-Term Care

1. Introduction

Quality of life is a broad and complex concept influenced by physical, spiritual and social situations of individuals, personal, faith, as well as relationship with the environment (WHO, 1998). A variety of interventions have been developed to promote quality of life in long-term care home residents. One of these interventions is the use of garden (Chalfont, 2007; Tyson, 2002; Zeisel, 2007). Quantitative studies showed small yet consistent effect of outdoor garden as a multisensory environment on improving affect and wellbeing in older persons (Cox et al., 2004; Detweiler et al., 2008; Hernandez, 2007). Given that there is a limitation of space, recent studies have begun to put emphasis on the use of virtual reality to evoke some of the beneficial effects of garden in a more feasible way (Kim, 2017; Liszio, 2018).

Virtual reality resembles real-life situations in which users can have close-to-reality experiences (Baus & Bouchard, 2014). As a mean to improve accessibility of older persons to nature, past studies have shown that virtual nature is beneficial to reduce stress, heart rate and blood pressure while it can increase restoration, vitality and positive affect (Mattila et al., 2020; Yu, 2018). These effects often attribute to two influential theories, namely the attention restoration theory and stress recovery theory (Brown et al., 2013; Gladwell et al., 2012). The attention restoration theory proposed that voluntary attention depletes in urban environments and cognitively demanding tasks, and restores in natural environment (Kaplan, 1995). The stress recovery theory claims that natural environments influence affective states and hence facilitate recovering from stressors (Ulrich et al., 1991). However, virtual reality experience and its therapeutic effect are affected by the design of content being represented which might lead to unwanted effects such as motion sickness and boredom (Moyle et al., 2018; Reese et al., 2022). Therefore, careful consideration on the type and design of virtual garden is needed to optimize its effectiveness.

Zen garden from Asian culture is specifically developed to calm one's mind by viewing miniaturized scenery (Goto et al., 2014). The word 'Zen' signifies its use in meditation. For example, the world-famous Zen garden is composed with only fifteen small stones on white sand and it is used by practitioners of meditation in Ryoan-ji Temple (Goto et al., 2018). Previous studies have shown that viewing Zen garden improves quality of life of older persons (Goto et al., 2013; Goto et al., 2018). Unlike other gardens that facilitate physical interaction with the elements of nature, Zen garden requires no direct physical contact with, or movement of person within the garden (Gonzalez & Kirkevold, 2014). It is a pictorial representation of nature to be viewed from certain specific viewing points. Viewers being still in the process puts Zen garden to advantage of minimizing unwanted effect of motion sickness when being virtually represented. Therefore, Zen garden can be readily transformed to a virtual intervention with desirable effect on quality of life.

The design of Zen garden emphasizes on the principles of naturalness, simplicity, and austerity. The sparse and seemingly random composition of rocks and empty rectangle of raked gravel form a beloved landscape. A good design of Zen garden is based on two aspects (Gyoba et al., 1985). One is the spatial structure that refers to the perceptual attributes of stimuli. While the rocks have irregular and asymmetrical shapes, natural patterns formed by them are often self-similar and contribute to implicit regularity of Zen garden. Another aspect of good design is the integrated impression that refers to the synthesized evaluations mad by viewers (Gyoba et al., 1985). The rocks abstractly represent natural elements such as islands in ocean, mountain top above the clouds or strokes of the Chinese character meaning 'heart' or 'mind'(Gyoba et al., 1985). A well-designed Zen garden induces a sense of harmony and

imagination during the inexhaustible process of engagement. These distinctive features should be incorporated when developing virtual Zen garden.

Virtual Zen garden is a virtual representation of Zen garden that has potential to improve quality of life of residents in long-term care home. A feasibility study has shown that residents in long-term care were satisfied with virtual Zen garden and its positive benefit on affect and social relationship (Yuen & Kwok, 2024). Compared with another study on virtual vegetable garden in Taiwan which evoked positive emotions by stimuli related to participants' experience of garden in the past, effect of virtual Zen garden was less dependent on viewers' characteristics (Hsieh et al., 2022). This suggests latent factors contributing to consistent effect of virtual Zen garden on residents with various background in long-term care home. While virtual garden yielded a range of effect, studies on its effect on quality of life is limited (Hsieh et al., 2022; Reese et al., 2022). The present study aimed to examine the extent of effect of virtual Zen garden on quality of life and to explore the process and experience of residents in virtual Zen garden in long-term care home.

2. Methods

2.1 Participants and Procedure

A single blinded randomized controlled trial with repeated measure and convergent mixed methods design was adopted. Inclusion criteria were age 65 or above, length of residence of more than 3 months and informed consent obtained. The exclusion criteria included blindness, severe hearing impairment that could not be resolved by hearing aid, recent change in psychoactive medication and medical emergency. The research was approved by the Survey and Behavioural Research Ethics Committee of the Chinese University of Hong Kong. Informed consent was obtained from residents without dementia and guardian of residents with dementia before data collection started.

One hundred and seventy participants were recruited from local two long-term care homes. There were 10 residents (5.9%) excluded due to meeting the exclusion criteria or refusal reasons, including 3 residents hospitalized, 4 residents' guardians not reachable, and 3 residents' guardians declined to participate. A total of 160 residents completed baseline measurement and were randomized into intervention group (n = 80) or control group (n = 80). The structure and format of two groups were designed to parallel each other in terms of their duration (i.e., 1 hour per session) and frequency of sessions (i.e., 2 times per week), number of facilitator and group size. Quantitative measurements were conducted by trained assessors blinded to group allocation in periods of preintervention (T0), post-intervention (T1) and post 3-months follow up (T2). For semi-structure interview, trained interviewers were independent from facilitation of intervention period and quantitative measurements of the trial.

2.2 Measures

2.2.1 QUALIDEM-C

The QUALIDEM-C will be used to measure the primary outcome as quality of life of participants. It is a 37-item proxy-rating questionnaire which has been found applicable to all stages of dementia based on observations of participants in the past 7 days (Arons et al., 2018), with Cronbach's alpha of 0.895 in our validation study. It consists of 37 items categorized into care relationship, positive affect, negative affect, restless tense behavior,

positive self-image, social relations, social isolation, feeling at home, and having something to do. Each item was rated on a 4-point scale ranging from never (0), rarely (1), sometimes (2) to frequently (3). Higher scores indicate higher level of quality of life.

2.2.2 Rating Anxiety in Dementia Scale

The Rating anxiety in dementia scale was used to rate the level of anxiety of participants based on observation of the past 14 days, with Cronbach's alpha of 0.83 (Creighton et al., 2019). It includes 18 items being scored on a 4-point scale and 2 items not included in scoring, marked as present or absence with described observation. Higher scores indicate higher level of anxiety.

2.2.3 Cornell Scale for Depression in Dementia

The Cornell scale for depression in dementia was used to rate the level of depression of participants based on observation in the past 7 days (Kørner et al., 2006). It includes 19 items being scored on a 3-point scale. Higher scores indicate higher level of depression.

2.2.4 Chinese Neuropsychiatric Inventory, Nursing Home Version

The Chinese Neuropsychiatric Inventory, Nursing Home version, was used to evaluate the neuropsychiatric symptoms of participants. The Cronbach's alpha was 0.84 (Leung et al., 2001). Higher scores indicate higher frequency and severity of neuropsychiatric symptoms.

2.2.5 Abbey Pain Scale

The Abbey pain scale was used to rate the level of pain of participants based on observation before and after each session (Lovell et al., 2015; Ludvigsson et al., 2020). It includes 6 items being scored on a 4-point scale. Higher scores indicate higher level of pain.

2.3 Data Analysis

Analysis were performed by SPSS. A 2-tailed P value $P < 0.05$ was considered statistically significant. The baseline demographic and clinical characteristics and outcome variables of continuous data among IG and CG were verified for normality. For between group comparison of continuous variables, independent t-test was used. For within group comparison of continuous variables, paired t-test was used. For categorical variables, Chi-squared test was used. Intention-to-treat analysis was used for the analysis. Missing value were not imputed to avoid possible bias. Two-way repeated measures multivariate analysis of variance with post-hoc analysis was used to evaluate significant main and interaction effects of group allocation and time of measurements.

3. Results

Significant interaction effect in quality of life ($F = 17.806$, $p < 0.001$), depression ($F = 12.684$, $p < 0.001$), anxiety ($F = 15.909$, $p < 0.001$), pain ($F = 10.640$, $p < 0.001$) and neuropsychiatric symptoms ($F = 20.795$, $p < 0.001$). Significant differences in post hoc analysis were only found in IG instead of CG. The improvement in quality of life and affect in IG sustained for 3 months after intervention. Four themes were drawn from thematic analysis, including influence of virtual Zen garden on (1) physical health; (2) psychological health; (3) social relationship; and (4) environment.

4. Discussion

The present study examined the effect of virtual Zen garden on improving quality of life and affect. The results showed that virtual Zen garden, when compared with the activity control, significantly improve quality of life, depression, anxiety, pain, neuropsychiatric symptoms and staff distress. Besides, the effect of virtual Zen garden sustained for 3 months after intervention. The current findings support that virtual Zen garden is effective in improving quality of life and affect in long-term care home residents. Despite the encouraging findings of virtual Zen garden for improving quality of life and affect in long-term care home residents, the results of this study can only be generalized to long-term care home populations. Further studies with recruitment of community and residential populations are needed to improve the generalizability of the study.

5. Conclusion

Virtual Zen garden demonstrated positive beneficial effect on quality of life in physical, psychological, social and environmental perspectives. The findings were encouraging for introduction of virtual Zen garden, as an innovative intervention, into long-term care home. This offers a possible mean of easy and reliable delivery of garden intervention in long-term care home. Besides, the type and design of virtual garden should be considered to deliver promising therapeutic effect.

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Note

1. Virtual Zen garden indicates the potential of virtual nature intervention to improve quality of life in older persons.
2. Virtual Zen garden is a feasible option of intervention to improve older persons' quality of life in limitation of space.
3. Type and design of garden should be considered to deliver promising effect of intervention.

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