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Use of digital game therapy among elderly persons undergoing dialytic treatment: cognitive aspects and depressive symptoms

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Abstract

Objective: to evaluate the presence of depressive symptoms and cognitive disorders before and after an intervention program with a digital therapeutic game among elderly persons undergoing hemodialysis. *Method:* a quasi-experimental study was carried out with 26 elderly patients on hemodialysis. For the data collection, a questionnaire relating to sociodemographic and health conditions, the Geriatric Depression Scale - 15 items and Addenbrooke's Cognitive Examination Revised were used. The intervention with the digital therapeutic game was performed over 5 sessions. *Results:* of the participants, 80.8% were male, with a mean age of 66.7 (± 5.8) years. The mean pre-intervention depressive symptom score was 3.9 (± 3.0) while post-intervention it was 2.8 (± 2.9), representing a statistically significant difference ($p = 0.005$). Regarding cognitive function, there was no statistically significant difference before and after the intervention. There was a statistically significant difference in the mean of the depressive symptom scores, which were lower after the intervention. In addition, there was no statistically significant difference in the mean of the cognitive assessments. *Conclusion:* intervention studies with patients undergoing hemodialysis treatment are still scarce and this study describes the positive results of an intervention with a digital therapeutic game, demonstrating improvement in the depressive symptoms of the participants.

Keywords: Aged. Cognition. Depression. Renal Insufficiency Chronic. Technology.

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INTRODUCTION

Chronic kidney disease (CKD) is a major current public health problem. According to the dialysis census carried out by the Brazilian Society of Nephrology in July 2016, the total estimated number of dialysis patients was 122,825, among whom 92.0% were undergoing hemodialysis treatment[1]. Hemodialysis treatment causes disruption to lifestyle, requiring the individual to adapt to this new condition[2,3]. In particular, it results in a restricted daily life, causing limitations that affect the physical, social and psychological aspects of the patient's life [3].

The presence of depressive symptoms can have an impact on the quality of life of dialysis patients, as well as compromising adherence to treatment, affecting motivation and resulting in cognitive deficit[3-5]. Literature has described a relationship between depressive symptoms and cognitive impairment[6]. In individuals with kidney disease, the prevalence of depressive symptoms varies from 16.0% to 27.0%[5,7] while for cognitive disorders it ranges from 30.3% to 79.9%[8-10].

According to a study with 100 individuals undergoing hemodialysis treatment, there is an inversely proportional relationship between depressive symptoms and quality of life, reinforcing the negative relationship between the two[5]. Likewise, the impact of cognitive deficit on these individuals can be seen in a literature update, which highlights deficits in the domains of attention, cognitive flexibility and learning[10].

The evolution of society in the area of digital technologies has allowed the use of digital game therapy (DGT) as a new form of intervention in the area of health. This involves games that have a desired therapeutic effect on the patients who play them[11], combining entertainment with the aim of improving quality of life[12], based on medical requirements to comply with a therapeutic purpose[13]. A literature review with meta-analysis found that computerized interventions can provide benefits for cognition, depression, and anxiety in individuals with dementia[14].

A systematic review study identified successful results in cognitive training with digital devices, especially motivation and engagement, emphasizing the importance of the development of these resources in mobile devices for cognitive stimulation[15]. When analyzing the effects of therapeutic games on depressive symptoms, a literature review showed that most studies report promising results and that users are more receptive to adhering to new technologies as a form of treatment, but further testing is needed so that their effectiveness can be generalized[16].

Interventions with digital games as a complementary tool for rehabilitation have been a frequent focus of research [17]. In hospital settings, the use of digital games provides pleasure and alleviates distress, anxiety, sadness and isolation[18]. However, studies that prove the effectiveness of such games among the elderly are still incipient.

In this context, the use of new resources to improve the quality of life of the elderly in hemodialysis treatment is important. The present study therefore aimed to evaluate the presence of depressive symptoms and cognitive disorders before and after an intervention program with digital game therapy among elderly persons on hemodialysis.

METHOD

A quasi-experimental study was carried out in a Renal Replacement Therapy Unit in a city in the state of São Paulo, Brazil. The participants were selected for convenience, and therefore, all the individuals who met the following inclusion criteria were invited: age 60 or older, undergoing hemodialysis treatment, no serious impairment of language/comprehension or severe auditory or visual difficulties. The exclusion criterion was undergoing hemodialysis treatment in the morning due to the influence of sleep on cognition.

At the time of data collection, the service treated 59 elderly persons, 13 of whom were excluded because they underwent treatment in the morning. Of the remaining 46 elderly persons, 33 fulfilled the inclusion criteria of the study. All were evaluated, but only 26 completed the five intervention sessions, and were then reassessed.

Data collection was performed in two stages, before and after intervention. Sociodemographic data and clinical information were collected through a questionnaire containing information on: gender,

age, marital status, ethnicity/skin color, schooling, number of medications used, duration of treatment and subjective health assessment.

For the screening of depressive symptoms, the Geriatric Depression Scale - 15 items (GDS-15) was used. The score varies from 0 to 15 points, with 0 to 5 normal, 6 to 10 representing mild depressive symptoms and 11 to 15 representing severe depressive symptoms[19]. For cognitive evaluation, the Addenbrooke's Cognitive Examination Revised (ACE-R) was used, which includes the domains attention/orientation, memory, verbal fluency, language and visuospatial processing. The overall score ranges from 0 to 100 points[20].

These instruments were applied prior to the hemodialysis session, or, if not possible, within the first two hours after treatment. Due to the possibility that some of the participants might have visual problems and/or a low educational level, the instrument was applied through an individual interview between August and December 2016.

Intervention

The intervention used the therapeutic game entitled *Playing is good for you!*, developed by the Laboratory of Flexible and Sustainable Interaction of the Computer Department of the Universidade Federal de São Carlos in partnership with health professionals and patients of the Hospital Espírita de Marília, with the aim of aiding the treatment of depressive symptoms and cognitive stimulation[20,21].

The development of the game involved a multi-professional team comprising doctors, nurses, occupational therapists and hospital patients, as well as undergraduate and postgraduate professors and students from the Computer (CD), Nursing (ND) and Gerontology (GD) departments of the Universidade Federal de São Carlos (UFSCar)[21].

A theoretical framework based on participatory design and organizational semiotics was used in order to provide a representative scenario of therapeutic activity, in which the patient performs a set of interactive activities, defined to meet pre-determined therapeutic goals[13,20,21].

Playing is good for you! aims to aid in the treatment of depressive symptoms and cognitive stimulation. In order to achieve these therapeutic goals, the development of the game included analysis of studies that considered the end-user not only as a player, but also as a patient, using language designed to meet the precepts of game therapy[11,20,21], combining medical requirements with an attractive design which seeks to maintain engagement and enable greater utilization of this feature as therapy. Thus, the study of patients with depressive symptoms and health professionals from the Hospital Espírita de Marília contributed to the creation and improvement of the game, resulting in a scenario in which accomplishing tasks of daily living is related to the stimuli of a perception of well-being.

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Likewise, the introduction of cognitive stimuli sought to guide the player in a simple manner to activities that required attention, orientation, memory, executive function, visuospatial processing and perception._

The game was developed using the Godot Game Engine which enabled its application on the Microsoft Windows 7 platform. This game consists of five modules: 1) *Dressing Room,* which incorporates an activity to stimulate looking after one's personal appearance. Message: "Looking after yourself is good for you!"; 2) *Garden,* with offers an activity to stimulate care and appreciation. Message: "Taking care of something is good!"; 3) *Lake*, which provides an activity to stimulate leisure and entertainment. Message: "Having fun is good for you!"; 4) *Kitchen and Garage*, which includes an activity to stimulate learning. Message: "Learning something is good for you!", as shown in Figure 1.

Source: Laboratory of Flexible and Sustainable Interaction of the Computer Department of the Universidade Federal de São Carlos, 2015.

Figure 1. Screens from the game *Playing is good for you*!

The elderly person has to perform each of the tasks proposed in the modules, making their choices from the available items, with the level of difficulty predefined by the accompanying health professional. At the end of each of the modules, the player receives a cognitive stimulation activity related to the completed module.

Five individual sessions, with an average duration of one hour, were carried out during the first two hours of the hemodialysis session. The room was for collective use, but the participants did not interact with other people during the intervention.

The laptop containing the game on the Windows 7 platform was delivered to the elderly individuals who were accompanied by a researcher to help them with navigation during the game. The first session was aimed at familiarizing the elderly with the laptop, since most participants had never had contact with such a device. In the following sessions the elderly persons tried all the scenarios of the game, with freedom of choice of the order in which they would be played. They began by choosing the module for interaction, guiding the arrow with the mouse or touch pad from the text instructions for the execution of the task in question, and at the end of the task an incentivizing message appeared on the screen. Subsequently, the activity of cognitive stimulation began, and at the end a congratulatory message, or motivating message for a new attempt, was provided.

The study complied with the guidelines relating to ethics in research involving human beings, and all the participants signed a Free and Informed Consent Form before the interview. The research project was approved by the Ethics Research Committee of the Universidade Federal de São Carlos (approval nº. 1.394.924/2016).

The data were analyzed using the *Statistical Package for the Social Sciences* (SPSS para *Windows*) program, version 22.0. Calculations of descriptive data analysis were performed. To statistically evaluate the significance of the difference in the GDS-15 and ACE-R mean scores before and after the intervention, the paired Student's t-test was performed. The significance level adopted for the statistical tests was $p \leq 0.05$.

RESULTS

Of the 26 elderly people evaluated, the majority were male (80.8%), with a mean age of 66.7 (±5.8) years, with greater distribution among the 60-69

age group (69.2%) and white ethnicity/skin color (42.3%). There was a predominance of individuals who were married/lived with a partner (69.3%), the mean number of years of study was 5.92 (±4.2), and 42.6% had studied from 1 to 4 years (Table 1).

The mean duration of treatment was 51.9 (±79.8) months, and 34.6% were treated within 1 to 12 months. Regarding the subjective evaluation of health, 50.0% of the elderly persons judged their health to be fair (Table 1).

Table 1. Distribution of elderly patients on hemodialysis (N=26) according to sociodemographic and clinical characteristics. São Carlos, São Paulo, 2016.

Variable	n (%)
Gender	
Male	21 (80.8)
Female	5 (19.2)
Age group (years)	
60-69	18 (69.3)
70-79	8 (30.7)
Ethnicity/skin color	
White	11 (42.3)
Mixed race/brown	8 (30.8)
Black	7 (26.9)
Marital status	
Married / live with partner	18 (69.3)
Single Children	3 (11.5)
Divorced / separated	3 (11.5)
Widowed	2 (7.7)
Schooling (years)	
Illiterate	2 (7.7)
1-4	12 (46.2)
5-8	5 (19.2)
≥9	7 (26.9)
Number of medications	
1-3	3 (11.5)
4-6	16 (61.6)
7-9	7 (26.9)
Duration of hemodialysis (months)	
1-12	9 (34.6)
13-36	6 (23.1)
37-60	5 (19.2)
≥61	6 (23.1)
Subjective evaluation of health	
Very good	2 (7.7)
Good	11 (42.3)
Fair	13 (50.0)

With regard to the pre-intervention screening of depressive symptoms, 69.2% (n=18) had no depressive symptoms, 26.9% (n=7) mild depressive symptoms and 3.8% (n =1) severe depressive symptoms. In the post-intervention assessment, 80.8% (n=21) had no depressive symptoms, 14.4% (n=4) mild depressive symptoms and 3.8% (n=1) severe depressive symptoms.

Regarding cognitive evaluation, 42.3% (n=11) of the elderly with kidney disease exhibited cognitive disorders, considering the cut-off scores for schooling levels.

In the pre- and post-intervention comparison, it was observed that the mean GDS-15 score decreased after the intervention with digital game therapy, with a statistically significant difference between the two periods (p=0.005). There was no statistically significant difference in cognitive assessment, either by domain or total score, from the pre to the post-intervention assessment (Table 2).

Table 2. Comparison of GDS-15 and Addenbrooke's Cognitive Examination Revised (ACE-R) before and after intervention among the elderly on hemodialysis. São Carlos, São Paulo, 2016.

Variables	Pre-intervention Mean (±sd)	Post-intervention Mean (±sd)	*p*-value
GDS-15	3.9 (±3.0)	2.8 (±2.9)	**0.005**
Total ACE-R	63.3 (±15.0)	63.9 (±14.9)	0.521
Attention / orientation	14.0 (±2.7)	14.4 (±2.7)	0.290
Memory	15.0 (±4.6)	15.5 (±4.6)	0.536
Verbal fluency	5.5 (±3.0)	6.3 (±2.4)	0.055
Language	19.6 (±4.7)	19.4 (±4.1)	0.625
Visual spatial processing	9.0 (±3.4)	8.3 (±3.0)	0.099

Student paired t-test; sd=standard deviation; ACE-R= *Addenbrooke's Cognitive Examination Revised.*

DISCUSSION

The participants were mostly male, with a mean age of 66.7 (± 5.8) years, lived with a partner, had a low level of schooling, and had been in treatment for one to 12 months. In terms of the subjective evaluation of health, half of the participants considered their health to be fair. The data obtained in the present study corroborated data found in literature in relation to individuals with CKD[5,22,23].

With regard to screening for depressive symptoms, it was found that 30.7% of the elderly had mild or severe depressive symptoms. The mean GDS-15 post-intervention score was lower than the pre-intervention score, and the difference between the two was statistically significant. A survey with 140 elderly persons found that elderly persons who used digital games, even occasionally, had a better psychological performance than elderly people who did not, thus reflecting successful aging[12].

Advances in modern medicine have resulted in an increase in the survival rate of people with CKD, but the physical and mental suffering resulting from the symptoms of the disease and its treatment can lead to depressive symptoms in this population[7,24]. A study conducted with people undergoing hemodialysis showed an association between depressive symptoms and an increased risk of mortality [25]. The interactions between depression and CKD are complex, bidirectional and multifactorial, and interventions should be sought that provide improvements in the quality of life of these individuals[26].

Digital games have great potential as technological innovations in the quest to improve the quality of life of the elderly, providing fun and developing physical, social and emotional aspects and cognitive abilities. However, studies that approach this theme among the elderly population are still incipient, and there is a need for targeted research among this audience[27].

A study that evaluated cognitive tests indicates that depression contributes significantly to lower scores in the evaluation of cognitive performance[28]. The present study did not find a statistically significant difference between the preintervention and the postintervention period in the means of the cognitive domains and the total ACE-R score. This result contradicts findings in literature, which find that digital games can help elderly people towards cognitive improvement, strengthening their self-image through a process of constant challenges and discovery of their abilities[13,29].

A literature review discusses the possibility of a cognitive stimulation intervention during hemodialysis and emphasizes the importance of improvement in cognition for such individuals in terms of performing activities of daily living and decision making[30]. A review of literature on digital games for the elderly identified significant improvements in processing speed, sustained attention, alertness, visuospatial working memory, cognitive flexibility, immediate and delayed visual memory, and visual-motor-spatial coordination[29].

Intervention studies with patients undergoing hemodialysis treatment are still scarce and the present study provides positive results of an intervention with DGT, demonstrating improvement in the depressive symptoms of the participants. It is hoped that the present study will contribute to the planning of strategies for health promotion and disability prevention, associated with depressive symptoms, among both the elderly and nephrology teams. The continuation of this line of research may contribute to improving the quality of life of these individuals.

However, one limitation of this study was the short period for post-intervention cognitive reassessment, contradicting literature that describes an interval of at least six months, taking into account the effects of learning in the responses to the evaluation instrument.

CONCLUSION

The data of the present study indicate that the majority of the elderly in dialysis were men aged between 60 and 69 years, married, white and with from one to four years of schooling. They had been in treatment for between one and 12 months, used four to six medications per day and assessed their health as fair.

Playing is good for you! was found to be important in the improvement of depressive symptoms in elderly people undergoing hemodialysis, but did not achieve significant results in relation to cognitive performance. Studies that further investigate effects on cognition, with longer time periods, are required.

In view of these results, intervention with digital game therapy can be considered beneficial, offering elderly persons in hemodialysis treatment an innovative tool with increasing potential in the area of mental health. It is worth noting, however, that it is not possible to generalize the results due to the short reevaluation period. It is hoped that this study will contribute to the development of strategies that assist in the planning and implementation of interventions that maintain and care for health, increasing the quality of life of elderly persons in hemodialysis.

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