

# Quality of life of people with Parkinson's disease after treatment with non-immersive virtual reality

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## ABSTRACT

**Objective:** To analyze the influence of treatment with non-immersive virtual reality games (VR) on the quality of life (QOL) of people with Parkinson's disease (PD). **Methods:** Uncontrolled clinical trial using 14 people with PD between stages I and IV of PD. Treatment with NIVR occurred for 6 months, 1 initial assessment and 2 quarterly re-evaluations. The instruments to measure the results were the Parkinson's Disease Questionnaire (PDQ-39) and a Self-Perception of Performance Questionnaire. The treatment protocol used was Kinect® for Xbox 360, and the following games: Kinect Adventures®, Your Shape: Fitness Evolved®, and Kinect Sports®. Statistical analysis of the PDQ-39 used the Wilcoxon test ( $p \leq 0.05$ ) while the Self-Perception of Performance Questionnaire was analyzed qualitatively for thematic content, identifying six categories. **Results:** There was a statistically significant difference after 3 months of treatment with the NIVR games in terms of mobility, emotional well-being, stigma, cognition, and total score of the PDQ-39. After 6 months of treatment the results were maintained, but no further gains. However, for a neurodegenerative disease this maintenance of gains is favorable for the functional prognosis of the patients. In the thematic categories, what stood out was an improvement of reports on mobility, activities of daily living, emotional well-being, stigma, and bodily discomfort. **Conclusion:** Treatment with NIVR benefits QOL of people with PD, especially including mobility, emotional well-being, stigma, and cognition.

**Keywords:** Parkinson Disease, Quality of Life, Occupational Therapy, Video Games, Rehabilitation

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## INTRODUCTION

Parkinson's Disease (PD) is the second leading neurodegenerative disease in the world, considered one of the leading causes of disability among the elderly.<sup>1,2</sup> Its primary clinical presentation is alterations in the motor system, which are manifested by tremor at rest, bradykinesia, muscle stiffness, and changes in postural reflexes.<sup>3,4,5</sup>

These characteristics are determinants for the losses in quality of life (QOL) of individuals with PD, remembering that QOL, for having a multidimensional concept, covers various personal aspects such as life expectancy, health perception, interests, physical, emotional, and socio-economic, among others.<sup>6</sup> From this perspective, maintaining the QOL is one of the main goals of treatment for people with chronic diseases.<sup>1,7</sup>

With the progression of PD, the effectiveness of drug treatment may diminish, which may cause fluctuations in motor performance and behavioral disorders. In this way, treatment with a multidisciplinary health team is indicated in order to promote functional capacity and quality of life.<sup>8,9</sup>

In this way, the technical and scientific competence of the occupational therapist is to analyze the activity, assessing the demands and bodily needs of the person with PD to perform activities, prescribing the ideal treatment method to facilitate the subject's occupational performance.<sup>10,11,12</sup>

Considering the performance combined with the improvement of the functional capacity of people with PD, it is necessary to search for therapeutic techniques that minimize the impact of the signs and symptoms of the disease in the occupational performance of the subject. To this end, virtual reality (VR) has emerged as a major ally in health issues, which can be exploited for this treatment, seeking greater independence and autonomy of individuals with PD.<sup>13,14</sup>

The games in non-immersive virtual reality (NIVR) that correspond to the type of interaction of the individual with the generated images for console video games, allow a more natural and safe interaction, because this technology allows the user to interact with a virtual scenario and make corrections during the execution of a task.<sup>15,16</sup> In view of the above, the NIVR games analyzed previously and prioritized in accordance with the motor capacities and limitations of this population, was the treatment method selected for treating the individuals with PD in this study.

## OBJECTIVE

To analyze the influence of treatment with non-immersive virtual reality (NIVR) on the quality of life (QOL) of people with Parkinson's disease (PD).

## METHODS

This is an experimental study, an uncontrolled clinical trial, developed in the Pro-Parkinson Program (an extension program of the *University Federal de Pernambuco/Hospital das Clínicas*, which promotes multidisciplinary care to patients with Parkinson's Disease at the HC/UFPE). The study was approved by the Human Research Ethics Committee at the Health Sciences Center, under the Certificate of Ethical Approval (CAAE) No. 0094.0.172.000-11. There were 14 people with PD who participated in this research and all participants signed the Informed Consent Form.

Participants were included according to the following criteria: male or female adults and elderly; no current rehabilitation treatment; clinical diagnosis of idiopathic PD attested by the Chief of Neurology (Pro-Parkinson: Neurology); satisfactory communicative and cognitive level (information obtained from medical records); normal or corrected visual acuity; no psychiatric abnormalities. The exclusion criteria were: any other neurological disease; non-treated systemic diseases; musculoskeletal dysfunctions.

As a result, we applied the Parkinson's Disease Questionnaire-39 (PDQ-39), which is highly reliable in relation to internal consistency and results of reproducibility.<sup>17,18</sup> THE PDQ-39 is composed of 39 items that assess 8 areas: Mobility, activities of daily living (ADL), emotional well-being, stigma, social support, cognition, communication, and bodily discomfort. The score ranges from 0 to 100, the closer to zero indicates a better patient perception of QOL and closer to 100 points a worse perception by the individual about their QOL.<sup>18,19</sup>

The treatment employed the equipment *Xbox 360*® from *Microsoft*, the *Kinect*® for the *Xbox 360*, and the games *Kinect Adventures*®, *Your Shape: Fitness Evolved*®, and *Kinect Sports*®. The selection of these technological resources gave the possibility of standardizing a therapy and the analysis of the activity performed before every game. It is noteworthy that in the first session there was some training directed to familiarize the individual with the technological resource.

In the science of Occupational Therapy a task and/or game is applied as a therapeutic resource and as a technique for analyzing activities that performs a thorough and detailed assessment of human action, which involves sensory-motor, perceptual-cognitive, and psychosocial components of the activity in question, thus determining the best task/game for the treatment.<sup>12,20</sup>

The treatment with NIVR games was held in individual sessions of 40 minutes, twice a week for 6 months with quarterly reassessment. After a period of 3 months, all 14 participants were re-assessed by the PDQ-39 and responded to a self-performance questionnaire, which included the data for qualitative analysis. This questionnaire included five questions: Can you do something now that you could not before? Do you think anything has changed in your PD symptoms? Has anything changed in your social activities? Has anything changed in your home activities? Is there anything you would like to improve?

During the more than three month period of treatment, which involved the same protocol (NIVR games, in individual sessions of 40 minutes, twice a week), only 9 of the 14 participants remained, four of them could not continue due to difficulties in urban transportation, and one needed to travel. After these last three months, which corresponded to the total period of 6 months of treatment, these remaining 9 subjects were reassessed with the PDQ-39 and the *Self-Perception of Performance Questionnaire*.

For the statistical analysis of the data obtained via the PDQ-39, the Wilcoxon test was applied for paired samples, using the software *Statistica*®, with significance of  $p \leq 0.05$ . The qualitative data, obtained by the *Self-Perception of Performance Questionnaire*, was applied to analyze the thematic content.<sup>21</sup> The six thematic categories resulting from the analysis that relate to the areas of the PDQ-39 were: *mobility, ADLs, emotional well-being, stigma, cognition, and body discomfort*. The categories were described by order of appearance.

## RESULTS

The main characteristics of the participants are presented on Table 1. Table 2 presents the scores and statistical analysis of the ratings obtained by the PDQ-39, which expressed the perception of the quality of life of patients with PD.

In the thematic category *mobility*, subjects reported feeling the body looser, easy to climb ladders, and more strength to go walking. After 6 months of treatment, some participants reported that their gains had reached a plateau, while others cited improvement in walking, as illustrated in the words of one participant: "(...) *the movements got better, it developed more coordination, balance*".

As for *ADLs*, what most of the people with PD said amounted to improvements in this area, according to what participants 1 and 5 said: "*I went back to eating crab meat with my wife; before, I couldn't make the fine movements*" and "*I decorated a large cake and it didn't even look like I had Parkinson's Disease.*" Of the people who participated in the treatment for 6 months, some said they had improved in the tasks of writing, dressing, bathroom, and food, and others reported maintaining their gains.

In the theme *emotional well-being* the participants expressed improvements in doing the tasks with more joy, calm, and willingness. Individuals with PD who stayed the course of 6 months of treatment perceived improvement in self-esteem and fewer episodes of crying and anxiety.

In *stigma*, the reports indicate that: "*Today I participate normally in everything/I don't even seem to have the disease/I understand my limits and the disease does not hamper me any more.*" After 6 months of treatment, some people with PD reported having improved their perception about the disease and its limitations.

Under *cognition*, after 3 months of treatment, one participant reported: "*I feel that my forgetfulness has improved, I used to be very forgetful, I feel better in that regard.*" In the category *bodily discomfort*, after 3 months of treatment, there have been reports about the perception of decreased tremors, stiffness, and pain, in addition to improvement in episodes of cramps. After 6 months of treatment, some participants said they had maintained their gains while others pointed to an improvement in fatigue and other symptoms.

Other reports do not directly related to the areas of the PDQ-39 that reinforce and enhance the use of the NIVR games were: "*It is good to make the movement without needing the object / without the effort of holding the actual object,*" "*it interferes in a good way because it challenges three things: your thoughts, your nerves, and the disease, in addition to being fun,*" and "*it is as if the windows of my brain had been opened.*"

**Table 1.** Characteristics of the participants

	N (♀)	Age	Schooling	Time with PD
3 months of treatment	14 (6)	64 (10)	15 (3)	6 (4)
6 months of treatment	9 (3)	64 (9)	15 (2)	7 (4)

N (♀): Total Number (Female Gender). Age in years. Schooling in years. PD diagnostic time (years) PD: Parkinson's Disease

**Table 2.** Means (standard deviation) obtained by ratings with the PDQ-39

	Initial Assessment	p	Re-evaluation 3 months	p	Re-evaluation 6 months
Mobility	43 (26)	0.016*	29 (20)	0.286	33 (22)
ADL	38 (27)	0.136	29 (22)	0.834	29 (20)
Emotional Well-being	37 (21)	0.015*	21 (19)	0.116	31 (32)
Stigma	29 (36)	0.018*	13 (28)	0.590	22 (30)
Social Support	6 (12)	0.855	5 (12)	-	6 (12)
Cognition	28 (22)	0.039*	16 (14)	0.675	16 (8)
Communication	14 (21)	0.612	11 (18)	1	12 (15)
Bodily Discomfort	34 (21)	0.534	31 (25)	0.499	27 (20)
Total	29 (16)	0.009*	19 (14)	0.594	22 (15)

ADL: Activities of Daily Living

## DISCUSSION

In all the domains, the means of the scores were lower than 50 points, which indicates homogeneity of the sample. The domain with greatest gains over the initial assessment was mobility, indicating that the largest loss in quality of life of people with PD is due to restrictions to walking and fear of falling.

The domain *mobility* only showed a statistically significant difference after 3 months of treatment, which indicates an intensification of gains in the first months of treatment. This finding confirms the applicability of these particular NIVR games for improved mobility, unlike other results.<sup>22</sup> However, it should be emphasized that the games and the use of technology applied in the study of Herz et al.<sup>22</sup> were different. Their gains were perceived by the subjects who reported feeling the body looser, easy to climb ladders, and having more strength to walk. After 6 months of treatment, some participants reported that the gain had reached a plateau and others cited improvement in walking, as illustrated in what one participant said: "(...) *the movements became better, it developed more coordination, balance*".

In *ADLs* there was no statistically significant difference, despite having fallen almost 10 points in the 3-month reevaluation. This reduction in the score may indicate a tendency for improvement, since the slowness in the implementation of the *ADLs*, including dressing and writing, are fairly common reported complaints by individuals with PD.<sup>23,24</sup>

In qualitative analysis, most of people scored improvements related to tasks of *ADL* both after 3 months and after 6 months of treatment.

In the domain *emotional well-being* there was a statistically significant difference after 3 months of treatment. This perception was also observed by participants who expressed to carry out the tasks with more joy, calm, and willingness, and noticed an improvement in self-esteem and decrease in episodes of crying and anxiety.

Seeing the statistically significant difference in the domains of *emotional well-being*, *stigma*, and *cognition*, it is suggested that the stimulation of body components had an impact on the gains. In this way, the treatment with NIVR games enabled the stimulation of various components, such as depth, sequencing, laterality, visual closure, and entertainment, among other things, in addition to the motor gains, which is characterized as multisensory stimulation,<sup>25</sup> that may have worked in the functional gains for these people after 3 months and in maintaining that status after 6 months of treatment.

Studies say that VR allows desired bodily movements, overcoming personal limitations to achieve a better performance in games and that this affects the motivation and well-being of the patients.<sup>14</sup> These aspects were identified in the present study, both in the statistical significance of the field *emotional well-being* and in the qualitative analysis, in which the participants claimed to have more desire to do things and more motivation.

In a study by Herz et al.<sup>22</sup> after therapy with NIVR games had a significant improvement in the areas of DLAs, *emotional well-being*, *Communication*, *bodily discomfort*, and in *total score*, which is similar to the number of fields with improved statistics in this study. Of these, only the *emotional well-being* and the *total score* were similar, suggesting that the emotional well-being and quality of life improve by treatment with NIVR games.

In *stigma*, after 3 months of treatment, there was a statistically significant difference and the reports corroborate this perception: *"Today I participate normally in everything/ it doesn't even seem like I have the disease/I understand my limits and the disease does not hamper me any more."* In spite of the score having increased after 6 months of treatment, some individuals reported having improved their perception about the disease and limitations

Statistically significant differences, after 3 months of treatment, were revealed by the report of the participant: *"I feel that my forgiveness has improved, I used to be very forgetful, I feel better in that regard."*

In the *bodily discomfort index*, there was a decrease in the score after 3 and 6 months of treatment, however this was not a statistically significant difference. After 3 months of treatment, persons with PD have reported perceiving a decrease in their tremors, stiffness and pain, in addition to improvement in episodes of cramps. After 6 months of treatment, some participants said they have maintained their gains while others scored an improvement in fatigue and a reduction of symptoms.

The other domains of the PDQ-39, not analyzed qualitatively by theme category, were: *Social support* and *communication*. Despite not being related to the domains of PDQ-39 some reports reinforce and enhance the use of the NIVR games as illustrated by some participants who said: *"It is good to make the movement without the need of the object/without the effort of holding the actual object/ it interferes in a good way, because it challenges three things: your thoughts, your nerves, and the disease, in addition to being fun"* and *"it is as if the windows of my brain had been opened."*

In the *total score*, the statistical significance stood out by matching the indicator for improvement in the quality of life of individuals with PD after 3 months of treatment with NIVR. In the study by Mirelman et al.<sup>26</sup> there

was also a statistically significant difference in the *total score* of the PDQ-39, which means that the quality of life of people with PD was also improved after training with VR. These findings reinforce the indication for treatment with VR for this population, regardless of the brand of equipment, since Mirelman et al.<sup>26</sup> and Herz et al.<sup>22</sup> used different equipment.

## CONCLUSION

The treatment with games in non-immersive virtual reality guided the clinical status of people with PD, selected and indicated by the technique of analyzing the activity, improves the quality of life of this population, especially in the aspects involving their mobility, emotional well-being, stigma, and cognition, after 3 months of treatment. After 6 months of treatment, their gains are maintained, which is favorable to the functional outcome of patients dealing with a neurodegenerative disease.

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