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Ph.D. THESIS SUMMARY

Assessing the impact of therapeutic programs on people with Parkinson's disease during pandemic situations

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INTRODUCTION

The World Health Organization (WHO) estimates that by 2050, the global population of older people over sixty will increase to 2 billion, compared to 900 million in 2015, from 12% to 22%. The overall life expectancy for this category is constantly increasing and old age increases the risk of chronic diseases and health limitations, this leads to an increasing need for facilities in the health and social system (WHO, 2015, 48-50).

Based on recent surveys, the prevalence of neurological diseases in the elderly population is increasing. Among these neurological diseases is Parkinson's disease, which is based on the progressive degeneration of various areas of the brain that produce dopamine, mostly affecting people over the age of 60 (Slaughter, Slaughter, Nichols, Holmes, & Martens, 2001).

Physical therapy is increasingly recognized, as being important in the management of Parkinson's disease (Marck MA, 2013). In a review by Tomlinson and colleagues, 39 studies involving a total of 1827 participants with BP were examined to determine the effectiveness of physical therapy. Significant short-term benefits have been demonstrated for gait, endurance, balance, and overall motor function (Tomlinson C. P., 2013). Given the progressive nature of the disease, sustained exercise is considered essential for achieving optimal performance and maintaining the independence of daily activities (Nimwegen, et al., 2011).

Specialized studies have shown that exercise improves the quality of life of patients with Parkinson's disease, reducing motor disabilities. (Goodwin V., Richards, Taylor, Taylor, & Campbell, 2008), (Keus, et al., 2007). High-intensity exercise causes symptomatic improvement, and some authors believe that performing physical exercise may alter the course of the disease. (Petzinger G. M., et al., 2013)

This thesis aims to explore and analyze the effectiveness of physical therapy in the context of improving quality of life and reducing the risk of falls in Parkinson's patients. At the same time, the impact of the COVID-19 pandemic on these aspects is examined, through telephone monitoring, thus contributing to the development and optimization of therapeutic practices in this field.

The results obtained will contribute to the development and optimization of therapeutic practice in this field, having a significant impact on the quality of life of Parkinson's patients.

Research objectives

- Assessing the quality of life of people with Parkinson's disease using PDQ39 (Parkinson's Disease Questionnaire 39)
- Identify reasons that influence the involvement in physical and leisure activities of people with Parkinson's disease, using the PALMS questionnaire (Physical Activity and Leisure Motivation Scale)
- Conducting a comparative study to identify differences and similarities between elderly people without neurological pathologies and those with Parkinson's disease in terms of walking, fall risk, and foot typology, by using inertial sensors and baropodometry
- Implementation of LSVT Big Therapy in Cluj-Napoca
- Assess the long-term impact of the LSVT Big program on the daily autonomy of people with Parkinson's disease, by measuring independence in daily activities and functionality.
- Evaluation of study subjects on gait, fall risk, foot typology, and quality of life, using non-instrumented manual tests as well as instrumented ones such as inertial sensors and baropodometry
- Checking the degree of adherence of patients to the LSVT Big therapy program, by telephone monitoring during the pandemic
- Assessing the impact of COVID-19 on Parkinson's patients using Parkinson's Well-Being Map

PART I - LITERATURE REVIEW

Summary of Chapter 1. Parkinson's disease and the current state of knowledge

This chapter provides an overview of Parkinson's disease, including its epidemiology and prevalence, and the risk of falls associated with the disease. It also discusses the impact of disease on walking, balance, and quality of life, as well as the concept of neuroplasticity.

The symptoms of Parkinson's disease are different, but the most common are bradykinesia, rigidity, resting tremor, and postural instability are the distinguishing features of the disease and harm the quality of movement, gait performance, balance, and risk of falling (Duncan, et al., 2015) (Jankovic, 2008). In addition, non-motor characteristics such as cognitive decline, fatigue, apathy, and depression are common and affect patient functioning and quality of life (Rizos A, 2014).

In Romania, data from the Romanian Anti Parkinson’s Association reveal that over 72,000 Parkinson's patients are treated, but there are a much larger number of patients suffering from this condition, not yet being diagnosed. (http://www.asociatia-antiparkinson.ro/, 2020) (Rosca, Tudor, Cornea, & al., 2021)

According to the World Health Organization, falls are the second leading cause of accidental or unintentional injuries worldwide, after traffic accidents (WHO, 2007) Falls among the elderly population result in significant morbidity and occasional deaths, making it one of the major public health problems. (Cameron, et al., 2018). One in three adults aged 65 and over falls at least once a year, and for people over 80, the proportion rises to one in two elderly. (Gillespie, et al., 2012), (Stevens, Ryan, & Kresnow, 2007) As the world's population ages, the impact of falls on public health and costs to national health systems increase dramatically. (Hartholt, et al., 2012) (Salari, et al., 2023)

Exercise is a well-established means to reduce the risk of falls in older people by significantly improving balance, muscle strength, flexibility, and endurance. (Sherrington, et al., 2019) To maintain balance, the visual, vestibular, and somatosensory systems cooperate to create postural and kinetic reactions, but with age, these systems inevitably begin to decline so that the risk of falling is increasing. (Horak F. B., 2006) (Borel & Alescio-Lautier, 2014)

Studies have shown that exercise improves the quality of life of patients with Parkinson's disease, reducing motor disabilities. (Goodwin V. , Richards, Taylor, Taylor, & Campbell, 2008), (Keus, Bloem, Hendriks, Bredero-Cohen, & Munneke, 2007)

To improve brain plasticity and also the clinical picture of Parkinson's disease, it is necessary to take into account several key principles to provide patients with effective rehabilitation and exercise activities. (Sharp & Hewitt, 2014) The therapeutic proposal must be intense (maximizing synaptic plasticity), complex (major structural adaptation), rewarding (rewarding increases dopamine levels and promotes greater learning and relearning), and early (an early rehabilitation program could reduce the progression of disease processes). (Goodwin V. A., Richards, Taylor, Taylor, & Campbell, 2008)

Summary of Chapter 2. Intervention methods and tools in improving the quality of life of people with Parkinson's disease

Chapter 2 explores the methods and tools used to improve the quality of life of people with Parkinson's disease, with a focus on physical activity, physical therapy, specific recovery techniques, and precise assessment of motor parameters using inertial sensors.

Previous research has determined that practicing at least 90 minutes of moderate to vigorous physical activity per week can lead to a 14% reduction in the risk of all-cause mortality and increased life expectancy (Wen, et al., 2011) (Arem, et al., 2015). Previous research has determined that practicing at least 90 minutes of moderate to vigorous physical activity per week can lead to a 14% reduction in the risk of all-cause mortality and increased life expectancy (Li, et al., 2023). However, it has been found that, in general, people with Parkinson's disease do not meet recommendations in terms of physical activities and their duration. (Speelman, et al., 2011), (van Nimwegen, et al., 2011) (Timblin, Rahmani, Ryczek, Hill, & Jones, 2022)

People with Parkinson's disease who engage in organized, structured physical activity perceive functional mobility and self-efficacy as increased, and they are less depressed compared to those who do not exercise. (Ellis, et al., 2011).

Physical therapy plays a fundamental role in the rehabilitation of patients with Parkinson's disease focusing mainly on exercise, postural imbalances, and gait, with fall prevention, reduction of stiffness, and maintenance of functional capacities of subjects in ADLs (Deane, Jones, Playford, Ben-Shlomo, & Clarke, 2001); (Tomlinson, et al., 2014). Over the past decade, a considerable number of studies have highlighted how physical therapy brings long- and short-term benefits among patients with Parkinson's disease, with a focus on the effectiveness of strenuous exercise. (Okada, et al., 2021); (Ji, et al., 2022); (Tsukita, Sakamaki-Tsukita, & Takahashi, 2022).

Intensive rehabilitation programs and patient education regarding physical activity are key points that allow specialists to design therapeutic programs designed to make the patient understand that constant and sustained physical exercise over time has a neuroprotective action and could slow down the progression of the disease (Tsukita, Sakamaki-Tsukita, & Takahashi, 2022), (Ahlskog, 2011) (Frazzitta, et al., 2015).

Activities in daily life, also known as physical ADLs or basic ADLs, are the essential skills needed to cope with basic physical demands. These include personal care/hygiene, clothing, toileting, transfer/walking and eating, being functional skills learned early in life (Edemekong, Bomgaars, Sukumaran, & Schoo, 2022).

With aging, numerous changes occur in the body, including sensory, and proprioceptive changes, (Vaughan, Stanley, & Valdez, 2017), (Henry & Baudry, 2019), kinesthetic, vestibular, neural, cardiovascular, and cognitive, (Amarya, Singh, & Sabharwal, 2018), changes that can affect ADL performance, especially in people with BP given the progressive nature of the disease (Ribeiro & Oliveira, 2007), (Deal, Flood, Myers, Devine, & Gray, 2019).

The functional decline of Parkinson's disease (BP), characterized by decreased ability to perform everyday tasks, is often caused by typical motor dysfunction and can be exacerbated concomitantly by cognitive impairment, thus leading to an increase in dependence on caregivers (Stella, Banzato, Quagliato, Viana, & Christofoletti, 2008), occupational therapy being of major importance in this case.

Neuroscientists have long studied the use of rhythmic sensory stimulation to identify possible neural mechanisms in movement rehabilitation. There are different types of stimuli: auditory (metronome use, counting, snapping fingers, singing) (Ashoori, Eagleman, & Jankovic, 2015), visual (applying colored lines to the floor, going over an obstacle) (Bryant, Rintala, Lai, & Protas, 2010), tactile (tapping with the hand on the foot) (Klaver, et al., 2023) and cognitive (mental visualization of stride length) (Abraham, Duncan, & Earhart, 2021), use successfully in previous research.

Neurological disorders can interfere with the brain's ability to generate and maintain regular rhythmic patterns, leading to irregular and unstable movements (Nonnekes, et al., 2018), however, rhythmic sensory stimulation is effective in PD patients (Bella, et al., 2017), (Fox, Ebersbach, Ramig, & Sapir, 2012), having a positive impact on these gait disorders (Ghai, Ghai, Schmitz, & Effenberg, 2018). External sensory stimulation may be an effective strategy to improve motor skills, gait, and communication with Parkinson's patients (Nieuwboer, et al., 2007)

An example of instrumented versus non-instrumented assessment is given by the widespread use of the Timed Up and Go test, which evaluates balance, walking speed, functional mobility, and fall risk, proving to be valid and reliable both among the general population and in people with different disabilities. (Nicolini-Panisson & Donadio, 2013) (Ortega-Bastidas, Gómez, Aqueveque, Luarte-Martínez, & Cano-de-la-Cuerda, 2023). The TUG test involves several stages: getting up from the chair and sitting on the chair, walking straight for a distance of 3m, turning while walking, and initiating and stopping walking (Herman, Giladi, & Hausdorff, 2011), (Cedervall, et al., 2020). In the study (Galán-Mercant & Cuesta-Vargas, 2014), using inertial sensors in motion analysis based on the TUG test, precise data were obtained that could be used to quantify movement characteristics, such as step frequency, step asymmetry, acceleration of different body segments, trunk tilt. Thus, the use of devices with inertial sensors allowed researchers to analyze the kinematics of different subphases of TUG in a precise way, something that would not have been possible if a traditional assessment had been made. (Galán-Mercant & Cuesta-Vargas, 2014).

Summary of Chapter 3. The impact of the COVID-19 pandemic on the healthcare system and patients with Parkinson's disease

The COVID-19 pandemic has had a significant impact on health systems around the world and the lives of patients with various conditions, including those with Parkinson's disease (Fründt, et al., 2022) (Sabetkish & Rahmani, 2021) (Haileamlak, 2021). In Romania, this health crisis has highlighted pre-existing problems in the healthcare system and negatively affected access to care and treatment for patients with Parkinson's disease. (Rosca, Tudor, Cornea, & Simu, 2021)

Helmich and Bloem (2020) examine the impact of the COVID-19 pandemic on patients with Parkinson's disease (BP), highlighting both the consequences of isolation and emerging opportunities. The pandemic has decreased access to healthcare services, diminished social support, and increased anxiety and depression among PD patients. On the other hand, the authors identify emerging opportunities, such as increased use of telemedicine and digital health interventions, that have the potential to improve patient care in the future. (Helmich & Bloem, 2020)

Many researchers have stressed the importance of ensuring BP patients receive adequate care and support, even in times of crisis, to mitigate negative effects on their health and quality of life (Fabbri, et al., 2021), (Schirinzi, et al., 2020). Methods such as telemedicine and remote monitoring can play an important role in mitigating these negative effects, ensuring patients' continuity, appropriate care, and support. (Bhaskar, et al., 2020) (Hassan, et al., 2020)

PART II - PRELIMINARY RESEARCH

Summary of Chapter 4. Operational design of preliminary research

4.1. Purpose of preliminary research

For this preliminary research, we set out to assess the quality of life of people with Parkinson's disease and identify the reasons that lead them to perform different types of physical activity and leisure. The results will be used to implement a detailed intervention program looking at the long-term effectiveness of exercise in improving the quality of life of people with Parkinson's disease.

4.2. Objectives of Preliminary Research

- Assessing the quality of life of people with Parkinson's disease using PDQ39 (Parkinson's Disease Questionnaire 39).
- Identify the reasons that influence the involvement in physical and leisure activities of people with Parkinson's disease, by using the PALMS questionnaire (Physical Activity and Leisure Motivation Scale) according to gender, age categories, years from diagnosis, and stage of the disease.

4.3. Preliminary research hypotheses

- The quality of life of people with Parkinson's disease, assessed using the PDQ39 questionnaire, is influenced by gender, years after diagnosis, age, and stage of the disease.
- There are significant positive correlations between subdomains of the PDQ39 questionnaire and demographic variables age and years after diagnosis in people with Parkinson's disease.
- There are significant differences in the reasons that influence the involvement in physical and leisure activities of people with Parkinson's disease, depending on gender, age categories, years after diagnosis, and stage of the disease.

4.5. Methods of Preliminary Research

4.5.1. Bibliographic study method

We went through books, journals, and articles published in national and international databases such as PUBMED, EBSCOhost, WEB OF SCIENCE, SCOPUS, and Google Scholar, sources that gave us important information for our research.

4.5.2. Survey method – questionnaire type

The assessment of quality of life and motivation to perform physical activities and leisure time were assessed by administering two questionnaires:

- PDQ-39 (Parkinson's Disease Questionnaire-39)
- PALMS questionnaire

4.5.3. Statistical analysis

During the preliminary research, the obtained data were centralized in Microsoft Excel following their processing and interpretation through the IBM SPSS Statistics 23 (Statistical Package for Social Sciences) statistical program. Descriptive analyses allowed the calculation of statistical measures for the studied variables, including arithmetic mean, standard deviation, minimum and maximum value, and Cronbach Alpha test for analyzing the internal consistency of measurements. These statistics provided an overview of the distribution and characteristics of variables.

4.6. Organization of preliminary research

The preliminary research took place between December 2019 and January 2020 following a meeting organized by the Cluj-Napoca Trust Foundation at Marasti Cinema. The sample for the preliminary research included forty subjects diagnosed with Parkinson's disease, who chose to complete PDQ39 and PALMS questionnaires. The main goal of the preliminary research was to obtain a more comprehensive perspective on the quality of life of people with Parkinson's disease, which is why we did not establish inclusion and exclusion criteria, so those who showed interest in participating in the study were invited to complete the two questionnaires.

Summary of Chapter 5. Data presentation, analysis, and interpretation

In the preliminary research, the parameters of the subdomains of the two questionnaires applied PDQ39 and PALMS were evaluated, depending on the gender, age, number of years after diagnosis, and disease stage of the study participants. Also, the type of physical activity performed, and the number of hours dedicated to it were analyzed.

5.1. Description of study group demographic variables

The preliminary study involved 40 subjects with Parkinson's disease, predominantly female, consisting of 72% women and 28% men. In terms of background, 83% of respondents come from urban areas and 17% from rural areas. Patients included in the study ranged in age from 55 to 80 years, with an average of 66.48 ± 6.69 years. Looking at the age distribution by gender, no significant differences were identified ($p = .927$). The mean age of men included in the study was 66.64 years, with a standard deviation of 8.65, while the average age of women included in the study was 66.41 years, with a standard deviation of 5.96. Depending on the marital status of patients, the studied group consisted of 55% married persons; 30% widowed, 10% divorced, and 5% unmarried. Depending on the level of education, the studied group consists of 70% people with secondary education (high school or post-secondary); 12% with secondary education, and 18% with higher education. Analyzing the results of the study on the stage of H&Y disease, it is found that most people included in this survey experience stage III disease. 17.5% of participants are in stage II disease. A significant proportion, namely 48%, is in stage III of the disease. Interestingly, 35% of people surveyed do not know what stage their disease is in.

5.2. PDQ39 Quality of Life Questionnaire Results

5.2.1. PDQ 39 – Total Quality of Life Index

Scores on both the PDQ-39 and Total Quality of Life (PDSI) subdomains are encoded on a scale from 0 (perceived quality of life is perfect) to 100 (perceived quality of life is low). In the case of our group, the average value of the total PDQ-39 index was 38.51±19.81.

The most affected aspects of quality of life in our group were in descending order of the PDQ39 index: Physical discomfort with an average of 55.21±19.85, Mobility with an average of 45.00±27.10, Emotional Status 41.04±27.49 and ADLs with an average of 39.06±25.52. At the opposite end, the least affected subdomains are Social with an average of 27.92±24.93, Communication with an average of 30.00±24.45, Stigma with an average of 33.44±28.01 and Cognition 36.41±22.95.

5.2.2. Analysis of quality of life by gender, age, number of years since diagnosis and stage of disease

Although the analysis of quality of life by gender showed differences between averages for each category, including mobility, daily activities, emotional aspects, stigma, social impact, cognitive functions, communication, body discomfort, and total PDQ-39 score, statistically there were no significant differences between the two genders on any of the 8 subdomains of the questionnaire. Thus, men seem to have slightly higher scores on the emotional state (46.21±25.44 vs. 39.08±28.40) and mobility problems (48.18±26.10 vs. 43.79±27.81) while women seem to have higher scores on social impact (29.88±25.34 vs. 22.72±24.17)

Following the statistical analysis of PDQ39 quality of life according to the age group < 65 years and ≥ 65 years out of the 9 analyzed variables, significant differences could be observed only for the mobility subdomain. Thus, after performing the Independent t-test to compare the average scores of the <65 years group (M = 39.93, SD = 25.70) and the ≥65 years group (M = 54.86, SD = 26.10) according to PDQ39 subdomains, the test revealed a significant difference between the two groups only for the mobility variable (*p* = .036)

The independent t-test was performed with samples to identify the statistical significance of PDQ39 quality of life according to the number of years after diagnosis, so our group was divided into two subgroups, the group of those who are under 10 years after diagnosis and the group of those with over 10 years since diagnosis. Following statistical analysis from the 8 PDQ39 subdomains and the total PDQ39 SI score, significant differences were identified between the two groups for 4 of the variables: cognition *(p = .041), communication (p = .029), physical discomfort* (p = .012) and PDQ39 SI (*p = .032).*

The results showed significant differences between the averages of the two groups "Stage 2" and "Stage 3" respectively for the following dependent variables: "Mobility" (t(24) = -3.187, *p* = .004); "ADL" (t(24) = -2.503, *p* = .020); "Social" [t(24) = -2.113, *p* = .045]; "Cognition" [t(24) = -3.031, *p* = .006]; "Physical discomfort" (t(24) = -3.478, p = *.002) and "PDQ39 SI" (t(24) = -2.988,* p = .006). For the variables "Emotional", "Stigma" and "Communication", no statistically significant differences were observed between the two analyzed groups, with *p-value*> .05.

5.3. PALMS survey results

The highest average score was observed in the subdomain "Fitness" (M = 21.80, SD = 3,466), followed by "Mastery" (M = 21.08, SD = 3,206). On the other hand, the "Competition" subdomain recorded the lowest average score (M = 12.75, SD = 5,188)

5.3.1. Analysis of motivation by gender, age, number of years from diagnosis, and stage of the disease

The variables analyzed, such as mastery, physical conditions, interpersonal relationships, psychological state, physical appearance, social expectations, pleasure/enjoyment, and competition, showed p >.05 values, indicating that the gender of the subjects does not have a significant impact on these subdomains.

Significant differences were found for the competition subdomain between the "<65" group (M = 11.27, SD = 4.939) and the "≥65" group (M = 14.56, SD = 5.032), t(38) = -2.074, *p* = .045. The ≥65 group had significantly higher scores for the Competition compared to the <65 age group. For all other variables (Mastery, Physical Conditions, Interpersonal Relationships, Psychological State, Physical Appearance, Social Expectations, Pleasure/Enjoyment), there were no statistically significant differences between the two age groups (*p* >.05).

Summary of chapter 6. Conclusions of Preliminary Research

The preliminary research aimed to assess the quality of life of people with Parkinson's disease and identify the reasons that influence their choice of different types of leisure physical activities. By analyzing the results obtained, we were able to formulate several conclusions relevant to our study.

We were able to draw a profile of the patient with Parkinson's disease, so the study group included 40 people, mostly female (72%) and 28% male. The age is between 55 and 80 years, with an average of 66.48 ± 6.69 years. In terms of marital status, 55% are married, 30% widowed, 10% divorced and 5% unmarried. Regarding the stage of H&Y disease, 17.5% of participants are in stage II Parkinson's disease, while 48% are in stage III.

In terms of physical activity, most respondents (77.5%) either do not practice physical activities or dedicate a limited amount of time to them. Only a small fraction (17.5%) said they spend between 1 and 3 hours on exercises such as swimming, medical gymnastics, and sports games. In terms of walking, walking is the most practiced activity, being common to most respondents, with over 80% spending between 60 and 180 minutes/week. We can also conclude that the time spent by respondents in physical activities is made up of household chores and caring for children or grandchildren, with 52.5% of respondents spending between 1 and 3 hours per week on these activities and approx. 28% over 3 hours per week. This indicates that most participants regularly engage in physically demanding activities as a normal part of daily life. Although they can sometimes be neglected compared to more "traditional" activities, such as walking or cycling, these activities can make a significant contribution to a person's overall level of physical activity.

The group of investigated subjects experienced a series of difficulties in several aspects of quality of life, according to the average scores obtained based on the PDQ39 questionnaire, the most affected aspects of quality of life were identified as physical discomfort (M=55.21, SD=19.85), mobility (M=45.00, SD=27.10), emotional state (M=41.04, SD=27.49) and activities of daily life (ADL) (M=39.06, SD=25.52). The subdomains perceived as less affected were Social (M=27.92, SD=24.93), Communication (M=30.00, SD=24.45), and Stigma (M=33.44, SD=28.01).

Another factor that negatively affects the quality of life in Parkinson's disease is the duration of the disease. It is well known that as the disease progresses, there is generally a decrease in performance in motor and cognitive activities. People with a longer duration of illness show a significant deterioration in quality of life in these aspects compared to those with a shorter duration of illness. These findings may be important for understanding disease progression and its impact on quality of life as the years go by after diagnosis. The results can help develop appropriate intervention and support strategies for people with Parkinson's disease.

Also, following the analysis and interpretation of data regarding quality of life between the age group under 65 and 65 years and over, there is a significant difference in the mobility subfield. The average scores obtained for the mobility subdomain were significantly higher in the age group 65 years and older (M=54.86, SD=26.10) compared to the under-65 age group (M=39.93, SD=25.70), with a statistically significant difference (p=0.036).

These findings indicate that as PDQ39 SI scores increase, reflecting a deterioration in health, there is a pronounced negative impact on several areas of their lives. It suggests greater impairment of mobility, difficulty performing daily activities, decreased emotional well-being, increased perceived stigma, decreased social interaction, impaired cognitive functioning, communication difficulties, and increased physical discomfort are all strongly associated with an AND higher PDQ39 SCORE.

The application of the Motivation for Physical Activity and Leisure Scale (PALMS) allowed us to address and identify the reasons that lead our patients to engage in physical and leisure activities.

Based on the data obtained, we can see that the highest average scores are for motivations related to "Mastery" and "Physical Condition". This suggests that people with Parkinson's disease in this sample are motivated by personal growth, improvement, and physical well-being. These motivations align with the potential benefits of physical activity in managing Parkinson's symptoms and maintaining overall health.

Other motivations, such as "Interpersonal Relationships," "Psychological State," and "Pleasure/Joy," also have moderate average scores, indicating that respondents find value in social relationships, emotional well-being, and the joy that comes from engaging in physical activity.

Due to the small sample size of subjects in this study, conducting additional research and using a larger sample would be beneficial to have a comprehensive picture of the motivations underlying engaging in physical activity and leisure in this population.

In conclusion, assessing the quality of life of patients with Parkinson's disease through the PDQ39 questionnaire allowed us to understand the aspects perceived by patients as difficult in their lives. By using this tool, we were able to identify areas such as mobility, daily activities, emotional state, and physical discomfort that significantly affect the quality of life in Parkinson's disease. The relevance of quality-of-life assessment through PDQ39 is that it allows us to identify the specific needs of patients with Parkinson's disease and meet them with appropriate interventions. By understanding what is perceived as difficult, we can develop personalized management strategies that improve quality of life and bring significant benefits to these patients.

PART III PERSONAL CONTRIBUTIONS

Summary of Chapter 7. Operational design of the research

7.1. Research Purpose

This research aims to assess the impact and identify the long-term effects of an adapted and individualized intervention program for people with Parkinson's disease, with a focus on improving daily autonomy, reducing the risk of falls, and improving patients' quality of life. Through regular telephone monitoring, the study also aims to assess patients' adherence to the therapy program and identify any obstacles that could affect its success.

This study also aims to identify, through a comparative analysis, the differences and similarities between elderly people without neurological pathologies and those with neurological pathologies, especially Parkinson's disease, regarding walking, fall risk, and foot typology, using inertial sensors and baropodometry.

7.2. Objectives

- Identify differences and similarities between elderly people without neurological pathologies and those with Parkinson's disease in terms of walking, fall risk, and foot typology, by using inertial sensors and baropodometry in comparative analysis.
- Initial assessment of study subjects on gait, fall risk, foot typology, and quality of life.
- Implementation of LSVT Big therapy in Cluj-Napoca.
- Application of the recovery program "Puterea Sperantei.”
- Intermediate evaluation of subjects included in the study using non-instrumented manual tests.

- Checking the degree of adherence of patients to the LSVT Big therapy program, through telephone monitoring and identifying any obstacles or problems that may affect the adherence and success of the therapy.
- Assess the long-term impact of the LSVT Big program on the daily autonomy of people with Parkinson's disease, by measuring independence in daily activities and functionality.
- Assessing the impact of COVID-19 on Parkinson's disease patients using Parkinson's Well-Being Map
- Final evaluation of subjects included in the study using both non-instrumented and instrumented manual tests.

7.3. Hypotheses

- People with Parkinson's disease will show significant differences in gait and risk of falling compared to elderly people without neurological pathologies.
- People with Parkinson's disease who have flatfoot have a higher risk of falling compared to the elderly without neurological pathologies.
- LSVT Big therapy will significantly improve the functional mobility of patients with Parkinson's disease in the short and long term.
- The implementation and long-term monitoring of an adapted, individualized intervention program for people with Parkinson's disease will lead to increased autonomy in daily functional activities and, implicitly, to improved quality of life.
- Telephone monitoring among patients with Parkinson's disease during the pandemic will lead to a better quality of life, maintenance of daily activities for a longer period, increased daily functionality, and better mobility compared to patients who do not benefit from telephone monitoring.
- Regular telephone monitoring will encourage adherence to the therapy program and identify obstacles that may affect its success in patients with Parkinson's disease.

7.5. Subjects and place of actual research

The research itself took place between February 2020 and April 2021 and involved 3 studies.

Study 1: Comparative analysis between people with Parkinson's disease and elderly without neurological pathologies. Participants: Group B.P (Parkinson's disease): ten people and Group C.V (Elderly Control): ten people

Study 2: Evaluation of the effects of the LSVT Big program and the physical therapy program Puterea Sperantei among people with Parkinson's disease. Participants: LSVT Big Group: seven people and Puterea Sperantei Group: six people

Study 3: LSVT Big Group telephone monitoring over 12 months in the pandemic. Participants: LSVT Big Group: seven people

The first study in our research consisted of a comparative analysis between people with Parkinson's disease and the elderly without neurological pathologies. 15 people without neurological pathologies were evaluated within the day center for elderly people at Cluj-Napoca Foundation for Elderly Care. Thus, based on the inclusion and exclusion criteria, out of a total of 38 people initially evaluated (23 with Parkinson's disease and 15 elderly without neurological pathologies) the research itself involved four distinct groups of participants.

The comparative study consisted of analyzing two groups of 10 people each. The first group consisted of people diagnosed with Parkinson's disease (Group B.P) and the second group consisted of elderly people without neurological pathologies (Group C.V).

The experimental study, which included thirteen subjects diagnosed with Parkinson's disease, was divided into two groups: the LSVT $_{\text{Big group}}$ and the Power of Hope group. The first group included 7 subjects with B.P., 5 female subjects, and 2 male subjects, assigned to the LSVT Big program. The second group was composed of six subjects with B.P., 4 female subjects, and 2 male subjects, assigned to the Power of Hope program. The place of the intervention program is the physiotherapy room of St. Joseph Medical Center Cluj-Napoca, between February and March 2020.

The latest study of the research itself consisted of telephone monitoring of the LSVT Big group, once a month for 12 months based on the questionnaire - Parkinson's Well-Being Map™

7.7. Assessment methods

7.7.1. Assessment with motion sensors

To highlight the evolution of the subjects involved in the research itself, we used the following evaluation tools:

- BTS G Walk System: *Gait Analysis – 10 m Gait Test and Timed Up and Go (iTUG)*
- BTS P Walk System

7.7.2. Functional tests

The functional mobility assessment also included the non-instrumented tests "Timed Up and Go", and " 5 times Sit to Stand", tests that gave us insight into balance, gait, and fall risk among the two groups analyzed. The tests are easy to administer, accessible, and feasible in a clinical setting, where there is a need for periodic evaluation even when we do not have access to instrumented evaluation methods.

- "Timed Up and Go" test.
- "5 times Sit to Stand" Test
- Dynamometry
- Self-efficacy scale
- Parkinson's Well-Being Map™

7.8.1. LSVT BIG Therapy

Lee Silverman Voice Treatment (LSVT) BIG is a therapy used among people with Parkinson's disease focused on recalibrating the amplitude of movements and improving movements necessary for daily activities. This program was created after the Lee Silverman Voice Treatment LOUD intervention, which was developed to increase the volume and amplitude of speech in those with Parkinson's disease (LSVT Global, Inc., 2019)

It is a limited-duration, high-intensity rehabilitation program designed to be used by occupational therapists and physical therapists to target Parkinson's disease motor symptoms of bradykinesia and hypokinesia, in an outpatient setting, to improve motor function. (Janssens, Malfroid, Nyffeler, Bohlhalter, & Vanbellingen, 2014), (Farley, Fox, Ramig, & McFarland, 2008)

It focuses on intensive kinetotherapeutic exercises with an emphasis on amplitude, sensory calibration, and high effort (increased amplitude) (Smith, Jacobs, & Horak, 2014). It is believed that this will lead to normal and rhythmic movements, which will generalize untrained activities (Janssens, et al., 2014) (Ebersbach, et al., 2015).

Finally, the quantification component provides **for sixteen one-hour sessions four times a week for four weeks** to be delivered 1:1 by an LSVT BIG certified physiotherapist or occupational therapist, which ensures protocol standardization, increases patient feedback opportunities, and provides objective methods to document quality of life improvement (Bish - Ziegelhofer, 2014; Fini, 2011; LSVT Global,Inc., 2013).

LSVT BIG consists of seven standardized exercises, functional component tasks, AMPLE gait, and individualized hierarchical tasks. All exercises are focused on broad trunk movements and are classified as repetitive, sustained, or functional. In addition to sessions conducted at clinics, participants are encouraged to adhere to a twice-daily homework protocol that includes the same components as a session in the clinic, home records were handed out to patients at the beginning of the program to note at home the time and exercises performed.

(LSVT Global, Inc., 2016)

Summary of Chapter 8. Results of the research

8.1. Comparative group study Parkinson's disease vs. elderly without neurological pathologies

The comparative analysis included 20 participants, divided into two groups. The group of subjects with Parkinson's disease consisted of 10 people diagnosed with Parkinson's disease, while the elderly control group included 10 participants without neurological pathologies. Regarding the demographic and anthropometric characteristics of the subjects, we mention that the participants of the Parkinson's group include 7 female subjects and 3 male subjects, with an average age of 72.4 ±7.99 years, and the elderly group without neurological pathologies 8 female and 2 male, with an average age of 74.5 ± 5.02 years. Parkinson's group with an average weight of 79.4 ±23.09 kg and that of the elderly with an average weight of 74.10 ±13.12 kg.

8.1.1. Analysis G-Walk - Walk 10 m test.

Out of the 10 analyzed parameters, significant differences could be observed between the two groups for the following variables: left and right stride duration (p=.001, with strong effect size d = 1.82, respectively d = 1.83), left/right propulsion (p=.017/*p=.019*, with strong effect size *d* = 1.17/ *d* = 1.15), cadence (*p* = .002, Cohen d = *1.62) and speed (*p = .018, Cohen *d* = 1.16).

8.1.2. iTUG Test Analysis

Of the 17 variables extracted for the analysis (Table 30) we could observe statistically significant differences for only 4, namely: return of 1800 End Turning (p = .005, Cohen d = 1.41)*, time of getting up from the chair in standing STS* (p = .034, Cohen *d = 1.02),* anteroposterior acceleration during seating Stand to Sit AP acc (p=*.004*, Cohen *d=1.46)* and lateral acceleration Stand to sit lateral acc (*p=.048, Cohen d*=0.95).

8.1.3. Static and dynamic P Walk analysis among the two groups

In terms of weight load indices, the BP group averaged 54.13 (SD = 3.94) for the left side and 45.87 (SD = 3.94) for the right side. The CV group showed an average of 52.99 (SD = 2.86) for the left side and 47.01 (SD = 2.86) for the right side. In addition, dynamic curvature indices showed varying averages for the left side (BP: 18.20; SD = 7.90; CV: 21,44; SD = 6.51) and right (BP: 22.55; SD = 4.44; CV: 19,83; SD = 7.46). The surface measurements also showed variations, with the BP group having higher averages for both the left side (86.60 cm², SD = 20.05) and the right side (73.00 cm², SD = 14.05) compared to the CV group (left: 89.90 cm², SD). = 20,81; right: 78.80 cm², SD = 22.96). The time variable showed differences in walking time, with the BP group showing an average of 1138.00 ms (SD = 391.32) for the left side and 1147.00 ms (SD = 283.86) for the right side, while the CV group showed longer durations. (Left: 1311.00 ms, SD = 442.33; right: 1434.00 ms, SD = 688.67).

8.1.3.5. Static analysis of foot typology

Based on the three basic categories in terms of foot typology, in the group of elderly patients, only 15% have normal feet, while 85% present pes cavus. In the Parkinson's disease group, 25% of subjects have a normal foot, 5% have a flat foot, and 70% have pes cavus.

8.1.3.6. Dynamic analysis of foot typology

If in static analysis the percentage of subjects with normal feet was 15% for CV and 25% for BP, in dynamic analysis this percentage changed considerably, so for the CV group, it increased to 65%, and for the BP group, it increased to 60%. For the other categories, 5% of the CV group have flat feet and 30% pes cavus foot. For the BP group, 5% have flat feet, and 35% have pes cavus.

8.2. Study experiment programs interventions LSVT Big and The Puterea Sperantei

8.2.1. Results of the functional tests PRE and POST interventions

For the LSVT Big Group, we observed a significant decrease in TUG total time walking speed between PRE values (M = 12.02) and POST therapy ULVT Big (M = 10.61), W = 28.00, *p* = .016. There was also a significant decrease in the lifting speed from sitting to standing during the "Lifting from sitting to sitting of 5X" test between pre (M = 12.52) and POST exercise values (M = 11.10), W = 28.00, *p* = .016. In terms of self-efficacy, there was a significant increase between PRE values (M = 18.28) and POST therapy LSVT Big (M = 26.42), W = 0.00, *p* = .016.

For the Power of Hope Group, the results showed a significant decrease in walking speed of total TUG time between pre (M = 19.29) and POST exercise values (M = 16.96), W = 21.00, p = .031. There was also a significant decrease in the sit-to-stand lifting speed during the "Sitting to Standing 5X" test between PRE (M = 25.07) and POST exercise values (M = 19.73), W = 21.00, p = .031. In terms of self-efficacy, the test results showed a significant increase between PRE (M = 15.83) and POST exercise values (M = 21.66), W = 0.00, *p* = .036.

For the variable "Rising from sitting _de 5X _PRE" the independent T-test showed a significant difference between the "LSVT Big" and "Power of Hope" groups (t(11) = -2.215, *p* = .049, d = -1.232). The average "Rising from sitting _de 5X _PRE" score for the "LSVT Big" group (M = 12,520) was significantly lower than that for the "Power of Hope" group (M = 25,072). Regarding the "Rise from Sitting _de 5X" test POST interventions, the independent t-test showed a marginally significant difference between the "LSVT Big" and "Power of Hope" groups (t(11) = -2.186, *p* = .051, d = -1.216). The average "Rising from sitting _de 5X _POST" score for the "LSVT Big" group (M = 11.10) was significantly lower than that for the Power of Hope group (M = 19.73), which means an improvement in functional mobility and lower limb strength within both groups, the difference being greater for the LSVT Big group.

Comparing Self-efficacy_PRE between the LSVT Big group and the Power of Hope group, no significant differences were observed between them (U = 26.50, *p* = .468, r = 0.26). However, when analyzing Self-efficacy_POST data, a significant difference was identified between the two groups (U = 37.00, *p* = .026, r = 0.76). Thus, the results indicate a positive influence of LSVT Big therapy on self-efficacy in patients of the group, while therapy performed by the Power of Hope group did not show a significant difference in this aspect.

8.2.3. Presentation, analysis, and interpretation of functional test results obtained POST interventions LSVT Big/Puterea Sperantei and final of longitudinal study.

Significantly different results were maintained at the end of the 12-month study, with subjects in the LSVT Big group recording a significantly lower mean time (M=11.39, SD=1.31) compared to the meantime obtained by subjects in the P. Hope group (M=18.13, SD=6.60), (U=3.00, *p*=.008, r=-0.85).

For the variable "Rising from sitting _de 5X _FINAL" the Mann-Whitney U test showed a significant difference between the "LSVT Big" and "Power of Hope" groups (U = 2.00, *p* = .005, r = -0.90). The mean "Rising from sitting _de 5X _FINAL" score for the "LSVT Big" group (M = 11.57) was significantly lower than that for the Power of Hope group (M = 22.10), which means maintenance of functional mobility and lower limb strength within the LSVT Big group at the end of the study.

Results for the self-efficacy variable revealed significant differences between scores obtained by the LSVT Big and P. Hope groups. At the final assessment, participants in the LSVT Big group (M=23.21, SD=3.34) reported significantly higher self-efficacy scores compared to the P group. Hope (M=17.25, SD=2.96), U=38.00, *p*=.018, r=0.81.

Subjects in the LSVT Big group recorded an average time of 10.61 seconds (SD = 1.10) on the TUG POST-intervention test and an average time of 11.39 seconds (SD = 1.31) on the final assessment after 12 months. This change was statistically significant, (z = -2.36, p = .016, r = -1.00).

For "Getting up from sitting to stând_5X_POST," participants had an average score of 11.10 seconds (SD = 0.68) after the LSVT Big intervention and an average score of 11.57

seconds (SD = 0.74) at the end of the study after the 12 months of follow-up. The Wilcoxon assay showed an insignificant difference between post-intervention scores and final assessment ($z = -1.94$, $p = .063$, $r = -0.82$), suggesting maintenance of functional mobility and lower limb strength within the LSVT Big group at the end of the study.

Results for the self-efficacy variable revealed significant differences between post-intervention and end-of-study scores for the LSVT Big group. At the final assessment, participants in the LSVT Big group (M=23.21, SD=3.34) reported lower self-efficacy scores compared to scores reported after the LSVT Big intervention, Wilcoxon test results revealed a significant difference between the means of the two assessments, ($W = 21.00$, $z = 2.366$, $p = .022$, $r = 1.00$)

The subjects of the P. Sperantei group recorded an average time of 16.96 seconds (SD = 6.24) on the TUG POST-intervention test and an average time of 18.13 seconds (SD = 6.60) on the final assessment, after 12 months. This change was statistically significant, (W = 0.00.z = -2.20, $p = .031$, $r = -1.00$).

For "SIT TI STAND_5X_POST," participants had an average score of 19.73 seconds (SD = 10.49) after the intervention and an average score of 22.10 seconds (SD = 11.86) at the end of the study after the 12 months. The Wilcoxon test showed a significant difference between post-intervention scores and the final assessment, $W = 0.00$ $z = -2.20$, $p = .031$, $r = -1.00$.

Results for the self-efficacy variable revealed significant differences between post-intervention and end-of-study scores for the P. Sperantei group. At the final evaluation, participants in the P. Sperantei group (M=17.25, SD=2.96) reported lower self-efficacy scores compared to post-intervention scores, Wilcoxon test results revealed a significant difference between the means of the two assessments ($W=21.00$, $z=2.20$, $p=.036$, $r=1.00$)

8.2.4. Results of motion sensor assessments from experimental study

8.2.4.1 G-Walk iTUG evaluation results

The results showed a significant decrease in total iTUG time between the initial (MDN = 13.52, SD = 5.89) and final (MDN = 10.64, SD = 1.55), ($W = 26.00$, $p = .047$, $r = 0.85$). There was also a significant difference in the variable "ST_2_si_flexion peak" between the initial (MDN = 21.80, SD = 4.54) and final (MDN = 29.20, SD = 7.85) values, $W = 0.00$, $p = .016$, $r = -1.00$).

For the remaining variables, although with the decrease of the total iTUG time, the journey times divided by stages also decreased, such as getting up from the chair in standing "SI_2_ST" (MDN = 0.90, SD = 0.15) compared to the initial time (MDN = 1.10, SD = 2.44), forward "FWRD" (MDN = 2.40, SD = 0.81), compared to the initial time (MDN = 3.52, SD = 5.30); obstacle bypass time of 3 m "Mid_turn" (MDN = 2.30, SD = 1.01) and return time "Return_gait" (MDN = 2.13, SD = 0.85, compared to baseline time (MDN = 2.90, SD = 0.54) the Wilcoxon test showed no statistically significant differences between the two initial/final assessments, the p values being > .05.

The results of the nonparametric Wilcoxon statistical test indicated a significant difference between the total initial iTUG time traveled and the total iTUG time traveled at the end of the study W = 21.00, z = 2.20, *p* = .031. The Power of Hope subjects initially covered the 3 m TUG test in 27.03 seconds, with a standard deviation of 9.27 seconds. At the end of the study, the median iTUG Total decreased significantly to approximately 12.50 seconds, with a standard deviation of 4.11 seconds.

The Mann-Whitney U test showed significant differences for the total initial time of the iTUG test between subjects in the LSVT Big group (MDN = 13.52, SD = 5.90) and the Power of Hope group (MDN = 27.03, SD = 9.27), (U = 36.00, *p* = .035, r = 0.71); between vertical acceleration from standing to seated "ST_2_SI_vert_acc_I" of subjects from the LSVT Big group (MDN = 6.00, SD = 1.09) and the Power of Hope group (MDN = 3.10, SD = 0.82), (U = 2.00, *p* = .005, r = - 0.90).

At the final instrumented evaluation, both groups recorded a decrease in total iTUG travel time after 12 months: the LSVT Big group (MDN = 10.64, SD = 1.55) compared to baseline (MDN = 13.52, SD = 5.90), and the P. Sperantei group (MDN = 12.50, SD = 4.11) compared to the initial time obtained by (MDN = 27.03, SD = 9.27), but the Mann-Whitney U test did not register a significant difference between the two groups at the end of the study (U = 15.00, *p* = .445, r = -0.28).

Regarding the lifting time in standing orthostatism "SI_2_ST_F_(s)", the results of the Mann-Whitney U test showed a significant difference between the two groups at the end of the study, the LSVT Big group (MDN = 0.90, SD = 0.15), the P. Hope group (MDN = 1.49, SD = 0.90), (U = 0.50, *p* = .004, r = -0.97).

The Mann-Whitney U test also recorded a significant difference in return time "Return_gait_F" between subjects in the LSVT Big group (MDN = 2.13, SD = 0.85) and the Power of Hope group (MDN = 3.52, SD = 1.10), (U = 4.00, p = .018, r = -0.81)

8.2.4.2.G-Walk evaluation results – 10m walk

At the end of the study, the results of the Mann-Whitney U test showed no statistically significant differences between the LSVT Big Group and the Power of Hope Group in terms of gait parameters, although, for subjects of the LSVT Big group, there was a slight improvement in walking speed with a median of MDN = 1.03, SD = 0.19, compared to baseline values MDN = 0.85, SD = 0.23, as well as for "cadence" both subjects of the LSVT Big group (MDN = 111.73, SD = 14.13) and subjects of the P. Hope group (MDN = 106.21, SD = 17.62) obtained increased values compared to the initial ones.

8.3. Quality of Life PDQ 39

8.3.1. Analysis and interpretation of LSVT Big Group results (initial – final assessment)

The most affected aspects of quality of life in the LSVT BIG BP group at the initial assessment were in descending order of the PDQ39 index: physical discomfort with an average of 50.00±22.57 (18%), daily activity 41.07± 25.96 (15%), mobility with an average of 41.07±18.92 (15%) and cognitive 41.07±16.87 (15%)

For the "Mobility" subdomain, the paired t-test within the LSVT Big group showed a significant improvement after 12 months (M = 20.35, SD = 6.68) compared to baseline values (M = 41.07, SD = 18.92), (t(6) = 3.65, p = .011, d = 1.38).

The LSVT Big group's perception of daily activities "ADL" showed a significant improvement at the final assessment (M=26.78, SD=16.81) compared to baseline (M=41.07, SD=25.95), (t(6)=3.71, p=.010, d=1.40).

For the "Emotional" subdomain, the paired t-test showed no significant differences between the two moments, initial (M = 28.57, SD = 20.47) and final (M = 23.21, SD = 22.02), (t(6) = 1.65, p = . 150, d = 0.62) although the average patients' perception of the emotional state decreased slightly from baseline. The same can be said about the subdomains: "Communication" where the subjects of the LSVT Big group, initially obtained an average (M = 20.23, SD = 17.90) and final (M = 11.90, SD = 14.32), the paired t-test did not register a significant difference (t(6) = 1.62, p. = 156, d = 0.61) and the subdomain "Physical discomfort" where, the paired t-test did not identify a significant difference (t(6) = 2.29, *p* = .062, d = 0.86) although LSVT Big subjects' perception of physical discomfort decreased at the end time (M = 33.33, SD = 12.72) compared to baseline (M = 50.00, SD = 22.56).

At the end of the study, the mean score obtained by the subjects of the LSVT Big group for the total quality of life index "PDQ39SI" registered a significant decrease (t(6) = 3.80, p =

.009, d = 1.43), (M = 18.71, SD = 6.03) compared to the mean obtained initially (M = 34.45, SD = 15.46), suggesting a better quality of life of LSVT Big patients.

8.3.2. Analysis and interpretation of the results of Puterea Sperantei group (initial – final testing)

At the end of the study, for the P. Hope group, the paired t-test was applied to evaluate differences between initial and final assessments for PDQ39 quality of life subdomains. For the subdomain "Physical discomfort" a significant difference was observed between the two measurements, (t (5) = 3.50, p = .017, d = 1.43) This difference indicates a significant improvement in physical discomfort between baseline (M = 62.49, SD = 26.22) and final (M = 50.00, SD = 25.82). For the remaining subdomains, the paired t-test showed no statistically significant differences between the two initial and final times, the p-value being > .05

Also, the paired t-test results regarding the final PDQ39 index score did not indicate a significant difference for the P. Hope group (t(5) = 1.90, *p* = .115, d = 0.77), the final mean being low (M = 42.10, SD = 17.03) compared to the initial one (M = 50.87, SD = 25.53), which may suggest a slightly improved perception of quality of life for the P. Hope group.

8.3.3. Analysis and interpretation of comparative results between the two groups (initial – final testing)

Initial results from the independent t-test for the Mobility subdomain did not differ significantly between the two groups, although the mean was lower (41.07 ± 18.92) for the Big LSVT group compared to (60.83 ± 21.72) for the Power of Hope group, (t(11) = -1.75, p = .107, d = -0.97). At the end of the study, the independent t-test showed that there was a significant difference between the two groups (t(11) = -3.48, *p* = .005, d = -1.93).

For the "ADL" subdomain, initial results did not differ significantly between the Big LSVT group (M = 41.07, SD = 25.96) and the Power of Hope group (M = 50.00, SD = 30.16), (t(11) = -0.57, *p* = .577, d = -0.32). At the end of the study, the independent t-test showed significant improvement in the LSVT Big group (M=26.78, SD=16.81) compared to the P. Hope group (M=54.16, SD=19.18), (t(11) = - 2.75, p = .019, d = - 1.52).

The results of the independent T-test showed significant differences for both the initial and final "Emotional" subdomain between the two groups. Thus, the average values initially recorded by subjects from the LSVT Big group (M = 28.57, SD = 20.47) and the Power of Hope group (M = 64.58, SD = 19.32), (t(11) = - 3.24, *p* = .008, d = - 1.80). The final mean values were, for the LSVT Big group (M = 23.21, SD = 22.02) and the P. Hope group (M =

47.91, SD = 14.85), with a significant difference between the two groups at the end of the study (t(11) = - 2.32, p = .040, d = - 1.29).

The LSVT Big group showed a lower final average (11.90± 14.32) of the score obtained on the variable "Communication" compared to the Power of Hope group (34.72 ± 22.61), the results of the independent t-test were significantly different (t(11) = -2.21, p = .049, d = - 1.22) at the end of the study.

The results of the independent t-test regarding the final index score "PDQ39 SI" showed that the difference between the LSVT Big group (M = 18.71, SD = 6.03) and the P. Hope group (M = 42.11, SD = 17.03) was significant at the end of the study (t(11) = -3.41, p = .006, d = - 1.89)

8.4. LSVT Big Group Longitudinal Study

8.4.1. Phone monitoring results – „The Parkinson's Well-Being Map™"

In the follow-up study, we analyzed the dataset collected between May 2020 and April 2021, for the LSVT Big group, on scores for different symptoms within the 8 areas of the questionnaire.

The results indicate notable variations by month, with a higher initial average in "May 2020" (M = 2.13, SD = 0.92) and a downward trend until "August 2020" (M = 1.00, SD = 0.60). In "November 2020", an increase in the average scores was observed (M = 2.13, SD = 0.94) and by the end of the study, the average total scores gradually decreased.

Between May and June 2020, the difference in total average scores was significant (t(55) = 5,796, *p* <.001), suggestive of a significant change over time. Between July and August, the difference in average scores was significant (t(55) = 2.104, *p* = .040), indicating significant variation between these months. Between September and October, the difference in average scores was significant (t(55) = -4.960, *p* <.001), highlighting a significant difference between these months. Between November and December, the difference in average scores was significant (t(55) = 2.104, *p* = 0.040), indicating significant variation between these months. Between January and February, the difference in mean scores was not significant (t(55) = 0.434, *p* = .666), suggesting consistency between these months.

Between March and April, the difference in average scores was not significant (t(55) = -0.614, *p* = .542), indicating stability for these months.

Using the pair sample t-test, we analyzed differences between the initial month (May 2020) and final follow-up month (April 2021) scores concerning the Parkinson's Disease Symptom Score questionnaire „The Parkinson's Well-Being Map™".

The results indicate a statistically significant difference between these two months ($t(55) = 2.386$, $p = 0.020$). In May 2020, patients recorded an average score of 2,125 (SD = 0.916), while in April 2021, the average score was 1,821 (SD = 0.974).

Looking at the evolution of movement-related symptoms reported by patients in the Big LSVT group over the course of the study, we see a variation in the scores recorded. Thus, P.M. and P.Z patients often encountered "balance problems". Patients V.D. and T.L. had more often "pronounced tremor" and the other 3 patients reported difficulty leaving, slow movements, and morning stiffness upon waking.

Subsequently, between June and October 2020, the values reported by patients decreased, ranging from 2-1, signifying a frequency corresponding to the Likert scale 'sometimes' and 'occasionally' for symptoms perceived as more difficult to manage during this period. Subjects have variations in the evolution of reported scores. P.M. and V.D. subjects steadily reduced their scores, indicating continued improvement in motor symptoms. Other subjects, such as D.D., P.Z., and S.A., mostly maintain constant scores with slight fluctuations. A general tendency to improvement in motor symptoms is observed in the first months, followed by stabilization and slight fluctuations.

Subjects report quoted values - 3 - "often" in the moving domain in November, December, and January values that could have been correlated with a new increase in COVID-19 cases and the imposition of additional restrictions. Also, these fluctuations can be influenced by the specific conditions of the winter season, characterized by low temperatures.

The analysis suggests a varied evolution of motion domain scores. Most subjects show an initial improvement in motor symptoms followed by stabilization. However, there is variation between subjects, and some months have seen significant changes in scores, suggestive of specific influences or factors.

Summary of chapter 9. Conclusions

Following the analysis and interpretation of the data obtained during the actual research, we drew the following conclusions for the studies performed:

1. Following the comparative analysis between people with Parkinson's disease and those without neurological pathologies, we were able to identify those statistically different variables. Thus, the most significant differences were encountered for gait analysis where, out of 10 parameters analyzed, 6 were identified significant differences for left and right step duration, left/right propulsion, cadence, and walking speed, with strong effect sizes ($d \geq 1.15$).

2. For the iTUG analysis, out of the seventeen variables extracted for the comparative study, we could observe statistically significant differences for only 5 of them. Parkinson's group has a higher risk of falling compared to the CV group (*p* = .007, Cohen's d = 1.34). The return times of 1800 End Turning *(p = .005, Cohen d = 1.41), standing time STS (*p = *.034, Cohen d = 1.02), anteroposterior acceleration during seating Stand to Sit AP* acc (p=.004, Cohen d=1.46) and lateral Stand to Sit lateral acceleration acc (*p=.048, Cohen* d=0.95) being different significant for the two groups.

3. Regarding the static and dynamic analysis with the P-Walk system out of the 12 analyzed variables, we noticed that between the two groups there are no statistically significant differences for any of the analyzed variables, they are similar. This is also confirmed by the foot typology identified among the studied groups. Although some studies (Janchai S,2008; Bertani, M., 2017) state that with age, the plantar vault leaves, and elderly people presenting flat feet, our research subjects presented after static analysis foot pes cavus. In the elderly control group, only 15% have normal feet, while 85% have pes cavus. In the BP group, 25% of subjects have normal feet, 5% flat, while 70% have pes cavus.

4. If at static analysis the percentage of subjects presenting normal foot was 15% for the elderly group and 25% for the Parkinson's group, at the dynamic analysis this percentage changed considerably, so for the CV group, it increased to 65% and for the Parkinson's group it increased to 60%. For the other categories, 5% of the CV group has a flat foot and 30% pes cavus foot. For the Parkinson's group, 5% have flat feet and 35% pes cavus.

Verification of assumptions:

Conclusions 1 and 2 confirm the hypothesis that "*People with Parkinson's disease will show significant differences in gait and risk of falling compared to elderly people without neurological pathologies*." These findings provide clearer insight into the impact Parkinson's disease has on walking ability and fall risk among these patients.

Following conclusions 3 and 4, the hypothesis assumed that *"people with Parkinson's disease with flatfoot have a higher risk of falling compared to elderly people without neurological pathologies."* has been denied. Contrary to initial assumptions, our research showed that neither group showed flat feet. In contrast, we found a significant prevalence of pes cavus foot in both groups. Also, the fall risk assessment with the TUG test revealed that the Parkinson's group has a higher risk of falling compared to the CV group. This finding highlights the complexity of the relationship between foot features such as a modified plantar arch in the pes cavus foot and fall risk among people with Parkinson's disease. Although hypothesis 2 has not been confirmed by our data, these results provide new and important insight into the factors that may influence stability and fall risk in this population.

Following the analysis of the results obtained in the experimental study, having as subjects the LSVT Big intervention group and the group that participated in the Power of Hope intervention, we can conclude the influence of these interventions on functional mobility, fall risk, and self-efficacy in the context of the uninstrumented evaluations performed.

5. *For the LSVT Big group, a significant decrease in total TUG time (M = 10.61, p = .016) and sit-to-stand lift speed (M = 11.10, p = .016) was observed* after LSVT Big therapy. There was also a significant increase in the comprehension force for both hands, the grasp force for the right hand increased significantly (M = 20.57) POST therapy LSVT Big compared to the PRE intervention values (M = 17.21), W = 0.00, p = .022, as well as a significant increase in the prehension force score for the left hand between the values pre (M = 16.42) and post exercises (M = 19.14), W = 0.00, p = .034). These results suggest a significant improvement in motor skills, balance, and muscle strength following therapy.

6. For the Power of Hope group, the results also indicated a significant decrease in total TUG time (M = 16.96, p = .031) *and sitting speed of 5X (M = 19.73, p = .031)* after the intervention. In addition, a significant increase in grasp force was observed for the right hand (M = 14.00) post-intervention, compared to pre-intervention values (M = 12.00, *p* = .034). For left grasp force, no significant differences were observed between pre (M = 11.00) and POST exercise (M = 12.83), *p* = .098.

7. In terms of self-efficacy, both groups experienced significant increases in self-efficacy scores following their therapies. This may indicate an improvement in confidence in one's abilities to perform certain tasks and exercises related to mobility and strength.

The results suggest that LSVT Big therapy and the Power of Hope program had a significant positive impact on motor performance and self-efficacy, with subjects in the LSVT Big group seeing better improvements. These findings suggest that these therapies could be effective options in improving functional mobility, muscle strength, decreased risk of falls, and confidence in one's abilities.

8. When evaluating POST interventions, the LSVT Big group recorded a significantly lower time for total TUG travel time (M=10.61, SD=1.10) compared to the Power of Hope group (M=16.96, SD=6.24), (*p*=.008, r=-0.83). This significant TUG difference between the two groups was also maintained at the final 12-month evaluation, where the LSVT Big group achieved a significantly shorter time than the Power of Hope group (*p* = .008, r = -0.85). This suggests that LSVT Big therapy had a positive impact on functional mobility during both

assessment periods and this improvement was maintained over the long term.

9. At the final evaluation, the LSVT Big group scored a significantly lower average score on the "seated to sitting 5X" test compared to the Power of Hope group (p = .005, r = -0.90). This significant difference suggests that the LSVT Big group-maintained mobility and lower limb strength over the long term compared to the P. hope group.

10. The LSVT Big group, at the final evaluation, reported significantly higher self-efficacy scores compared to the Power of Hope group (p = .018, r = 0.81). This result indicates that LSVT Big therapy had a positive impact on the perception of self-efficacy and this improvement persisted over the long term.

The results and conclusions 5,6,7,8,9,10 for non-instrumented tests confirm the hypothesis that "*LSVT Big therapy will significantly improve functional mobility of patients with Parkinson's disease in the short and long term."* Thus, LSVT Big therapy can be considered an effective and sustainable intervention for improving the quality of life and functional mobility of patients with Parkinson's disease over an extended period.

11. At the instrumented G-Walk assessment, the LSVT Big group recorded a statistically significant decrease in total iTUG time (p = .047), between initial and final evaluation, after the 12-month telephone follow-up period. BIG LSVT therapy, along with long-term monitoring, can be an effective approach to improving functional mobility and lowering the risk of falls in Parkinson's patients, highlighting the importance of treatment personalization and continuous monitoring for optimal results.

12. Both groups of patients experienced a decrease in total iTUG test time at the final G-Walk instrumented assessment, but the difference between the two groups was not significant (p = .445). It is important to highlight that the Power of Hope group performed better on the final iTUG test compared to the initial iTUG assessment (p = .031) This finding caught our attention and we looked for the factors that led to this notable improvement among patients in this group, given that the P. Sperantei group did not benefit from telephone monitoring throughout the study. From discussions with patients whose results improved significantly during the year, also taking into account the pandemic context, we learned that favorable changes can be attributed to the adjustment of drug treatment. These adjustments were made due to worsening symptoms in the context of the pandemic.

13. Regarding standing lift time "SI_2_ST_F_(s)", the analysis performed revealed a significant difference between the two groups at the end of the study (p = .004) The LSVT Big group appears to perform better in terms of standing lift time compared to the Power of Hope group. Also, in terms of return time ("Return_gait_F"), there was a significant difference between

subjects in the LSVT Big group (*p* = .018) at the final assessment.

14. In the evaluation of G-Walk - Walk 10m, in the context of applying the ULVT Big therapeutic protocol, the statistical analysis revealed no significant differences between initial and final values in terms of walking parameters. However, there was a slight increase in mean stride length, walking speed, and cadence at the end of the study period compared to values recorded at the start of the study. These slight improvements, even if not statistically significant, might suggest that the LSVT Big program, along with monthly telephone monitoring, had a positive impact on the gait of participants in this group. For the P. Hope group, no significant improvements in gait parameters were identified between the initial and final study assessments. Also, the gait performance of participants in this group did not differ significantly from that of participants in the LSVT Big group in terms of G-walk gait analysis.

15. Quality of life improved at the end of the study within the LSVT Big group, for the total PDQ39 SI index (p = .009, d = 1.43), but also six of the eight subdomains of the PDQ39 questionnaire: subjects' perception of "Mobility" (p = .011, d = 1.38), and daily activities "ADL" showed a significant improvement at the final assessment compared to the initial one (p = .010, d = 1.40), regarding the "Emotional" subdomain, although the average patients' perception of emotional state decreased slightly during the study, no significant differences were identified between the two moments (p = . 150, d = 0.62). The subdomains "Communication" and "Physical discomfort" showed no significant differences at the final assessment compared to baseline (p > .05), "Stigma", (p = . 022, d = 1.15), "Social" (p = . 016, d = 1.26) and "Cognitive" (p = .035, d = 1.02) showed significant improvements at the end of the study.

16. For the group P. Sperantei, the perception of quality of life improved only for one subdomain of the eight, namely "Physical discomfort" (p = .017, d = 1.43), the decreases in the final averages for the other subdomains being insignificant, p > .05. As for the final PDQ39 index score, although the final average was lower (M = 42.10, SD = 17.03) compared to the initial one (M = 50.87, SD = 25.53), the decrease was insignificant (p = .115, d = 0.77).

17. At the initial assessment, no significant differences were observed between groups for subdomains such as 'Mobility', 'ADL' (Activities of Daily Life), 'Stigma', 'Communication', 'Social', 'Cognitive', and 'Physical Discomfort'. At the end of the study, the LSVT Big group showed significant improvements in multiple aspects of perceived quality of life, compared to the Power of Hope group, "mobility" (p = .005), "activities of daily life" (p = .019), "emotional" state *(p = .040) and "communication" (*p = .049). In addition, the total "PDQ39 SI" quality of

life score showed significant improvement in the LSVT Big group compared to the Power of Hope group (p = .006). The conclusion suggests that the LSVT Big group, which was monitored by telephone for 12 months after LSVT Big therapy, achieved significant improvements in various aspects of quality of life compared to the Power of Hope group, which did not receive the same monitoring.

Conclusions 11 to 17 confirm our hypothesis that " *Phone monitoring among patients with Parkinson's disease during the pandemic will lead to a better quality of life, maintenance of daily activities for a longer period, increased daily functionality, and better mobility compared to patients who do not benefit from telephone monitoring."*

Following the monitoring and self-reporting study on the symptom score in Parkinson's disease we can draw the following conclusions:

18. Within the 8 areas of the questionnaire applied, significant differences in total scores were identified between the various months assessed. These significant variations suggest that certain months show significant changes compared to others, reflecting changes or developments in perceptions and behaviors among the subjects surveyed. Thus, the detailed analysis of the results indicates that May and June 2020, July and August 2020, September and October 2020, as well as November – December 2020, show significant variations in average scores, while January and February 2021, as well as March-April 2021, demonstrate consistency or stability in average scores.

19. Significant differences in the scores of the Parkinson's Well-Being Map™ questionnaire between the initial month (May 2020) and the final month of monitoring (April 2021) support the hypothesis that telephone monitoring could positively influence the evolution of health status and patients' perception of their symptoms.

The findings confirm hypotheses about telephone monitoring among patients with Parkinson's disease during the pandemic, supported by the results of the study. The data collected and analyzed indicate that telephone monitoring brings significant benefits for patients with Parkinson's disease, contributing to an improvement in quality of life, maintenance of daily activities over an extended period, increased daily functionality, and better mobility, compared to patients who did not benefit from this type of monitoring.

The study identified significant variations in total questionnaire scores applied over different months, revealing significant changes in patients' perceptions and behaviors. This suggests that the telephone intervention had a positive impact on the evolution of health and their perceptions of symptoms.

The detailed analysis of the results also demonstrated that the LSVT Big group experienced significant improvements in multiple aspects of quality of life, functionality, and mobility compared to the Power of Hope group. This significant difference between groups supports our hypotheses about the benefits of telephone monitoring in the management of Parkinson's disease.

Overall, the conclusion solidifies the idea that regular telephone monitoring is an effective and promising approach to improving the quality of life and health of patients with Parkinson's disease in the context of the pandemic and other limiting situations. This approach not only encourages adherence to therapy but also identifies potential obstacles that have a significant impact on disease management.

Summary of chapter 10. Final considerations, limitations, and personal contributions to research

Study results suggest that intervention using LSVT Big therapy had a significant impact on participants' functional performance and self-efficacy levels compared to the Power of Hope group. In both the POST interventions assessment and the 12-month final evaluation, the LSVT Big group showed significant differences in total time traveled in the Timed Up and Go (TUG) test, with lower fall risk. The LSVT Big group also scored significantly lower on the "Getting up from sitting 5 times" test, indicating maintenance of functional mobility and lower limb strength at the end of the study. The results can serve as a basis for further research, such as expanding the sample of subjects.

A particularly interesting aspect of this research is that so far no studies have been conducted on the long-term effects of this intervention program. In particular, 12-month telephone monitoring in the context of the pandemic brings valuable insight into the sustainability and consistency of long-term benefits, providing important data on the adaptability of intervention under varied conditions and in the long term.

Overall, the research contributes to the development of therapeutic options for patients with Parkinson's disease and highlights the need for innovative approaches to medical recovery. However, to bring LSVT BIG therapy to the forefront of the rehabilitation of people with Parkinson's disease in Romania, would require a great paradigm shift in the general approach. It is necessary to move from a maintenance approach to a high-intensity, short-term approach with long-term effects, to improve the quality of life of people with Parkinson's disease.

The implementation of the LSVT Big intervention program in Parkinson's disease, in the context of Romania, by being a unique certified therapist in this therapy, represents a distinctive and significant contribution to the field of recovery at a national level. This initiative underlines the importance of transferring knowledge and innovative techniques from a global context to a local one, bringing significant benefits to Romanian patients diagnosed with Parkinson's disease. A first step would be to expand the sample of subjects to consolidate the results obtained. Future research could involve a larger number of participants, thus ensuring greater validity of the findings.

In the future, various ways of adapting and combining therapy could be studied to maximize benefits. Innovative technologies can also be integrated to effectively support and monitor patient progress.

Based on positive results, we can encourage the widespread implementation of this therapy in recovery centers in collaboration with certified specialists. This could extend the benefits of therapy to a greater number of patients.

Another important point is that the telephone monitoring was carried out in the context of the COVID-19 pandemic. This context could influence outcomes as patients may be exposed to stress, changes in their daily routines, and mobility restrictions as a result of the pandemic.

The therapy applied to patients in the selected group led to significant and positive improvements, thus highlighting its beneficial potential in treating Parkinson's disease. Despite the small sample size, the results objectively indicate that the therapeutic intervention had a favorable impact on the quality of life, functionality, and mobility of the patients involved in this research.

Finally, this research makes a significant contribution to understanding the impact of telephone monitoring in the management of patients with Parkinson's disease, especially in the context of a pandemic such as COVID-19. The results of the study support initial hypotheses about the benefits of telephone monitoring on patients' quality of life, functionality, and mobility.

In conclusion, the current study paves the way for future research to explore and further develop the potential of therapy for Parkinson's disease to improve the quality of life and health of affected patients.

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