

The Effects of Exercise on People with Parkinson's Disease—Review

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Abstract

Quality of life encompasses physical, psychological and social aspects of health. Apart from motor symptoms (physical aspects), Parkinson's disease (PD) is also closely related with various non-motor symptoms (psychological and social aspects) that can undermine quality of life greatly, even in early stages of the disease. Most research studies in this field focus on analysis of motor symptoms in PD sufferers. Although benefits of physical activity for the psychosocial quality of life are well-known, they have been mostly neglected in case of the people suffering from PD. Numerous studies clearly show that training programs can ameliorate the quality of life as far as non-motor functions in PD sufferers are concerned. The only psychological aspects of the disease related to the effects of exercise that have been researched so far are depression and cognitive functions. Depression is the most common denominator of poor quality of life, while dementia often accompanies the Parkinson's disease. Studies have shown positive effects of exercise on the social life of those suffering from the disease, especially in case of group exercise. Studying psychological and social aspects of such chronic conditions as PD is of utmost importance for monitoring the patient's adjustment to the disease, functioning with it, as well as the overall well-being and satisfaction with life. Thus far, the results have been pointing towards improvement of the quality of life. Exercise is a readily available method of treatment in case of PD, especially if applied in the early stages of the disease. In addition to reviewing the existing studies on the relation between exercise and quality of life of the patients, this paper will also focus on the way the psychological and social aspects of PD are influenced by exercise.

Keywords

Parkinson's Disease, Exercise, Non-Motor Symptoms, Quality of Life

1. Introduction

Parkinson's disease (PD) is a progressive illness of the central nervous system

which is characterized by movement and motor activity disorder, accompanied also by psychological and social disturbances [1]. Movement disorders are caused by decreased secretion of dopamine in the brain area that controls voluntary movement. There are two chemical substances (neurotransmitters) in the brain—dopamine and acetylcholine in a functional balance, transmitting messages between nerve cells and muscles. These messages allow us to perform a wide range of movements. In case of low dopamine levels, the messages sent by the brain that tell the body when and how to move are delivered more slowly, which makes the sufferers unable to begin or control movement in the usual manner. The exact causes of the dopamine deficiency are still unknown. There are several factors that may influence it, including genetic predisposition, environmental factors and viruses.

Parkinson's disease progresses slowly and years may go by before the first symptoms start disrupting a person's daily life. Being a non-terminal illness, it still allows many people to live long and productive lives. What causes the disease is still unknown. Medication helps ease the symptoms but the disease itself is incurable. Parkinson's disease affects both men and women. Between 3 to 5 percent of people are diagnosed with PD before the age of 40, whereas the incidence increases with age [2].

Motor symptoms of Parkinson's disease include rigidity, tremor, slowness of movement and postural instability (trouble with balance and walking). These disturbances lead to deteriorating functional status which affects the sufferer's ability to walk, stand up, roll over in bed or put the shoes on [3]. Limitations in normal functioning and performing daily activities often lead to poorer quality of life and loss of independence.

Non-motor symptoms of PD are important factors of the quality of life and impact its physical, psychological and social aspects. The most common non-motor symptoms that disrupt the patient's daily life include depression, anxiety, cognitive disorders, sleep disorders, fatigue and aches [4] [5].

The progression of the disease leads to more serious physical implications such as loss of muscle mass and physical shape, which in turn causes mental, social and economic repercussions for the patient. According to some authors [6] [7], non-motor symptoms are the primary cause of worsened quality of life, more so than motor symptoms. The psychosocial aspects of living with PD are considered to have a more substantial impact on the quality of life than the physical aspects. The progression of the disease often leads to various limitations of the social, work-related, functional and psychological status. All aspects of the patient's life need to be addressed, with an assessment of the physical, psychological and social functioning.

Over the course of the last several years, assessment of the quality of life has gained greater significance due to the fact that chronic diseases with their physical and psychosocial repercussions often have a negative impact on the patient's quality of life. Research in this field is of great importance, having in mind the increasing incidence of chronic non-communicable diseases [8].

Apart from presenting an overview of research studies on the relationship between exercise and quality of life of PD sufferers, this paper focuses also on the effects of exercise on the psychological and social aspects of the quality of life of those suffering from PD.

2. Quality of Life

Academic literature in this area often associates the concept of quality of life with the notion of health. For instance, the World Health Organization defines health as a “state of complete physical, mental and social well-being and not merely the absence of disease and infirmity” [9]. The definition implies that health should be regarded in a much broader sense than merely an absence of disease, whereas the quality of life relates to one’s perception of all aspects of life. This concept encompasses physical, psychological and social aspects of health, while each of the aspects consists of various segments.

The physical aspect of quality of life is associated with functional status and the stage of disease. A four-year research study conducted by Karlsen *et al.* emphasized the stage of disease as the most prominent factor contributing to reduced quality of life [10]. Walking abnormality and postural instability also contribute to deterioration of the patient’s quality of life.

Deteriorating psychological aspect of quality of life and high-functioning depression are usually caused by worsening of motor function, advanced stages of disease and higher prevalence of falls. At the same time, depression is strongly related with the patient’s ability to perceive the problem, which may result in a pessimistic view of the future [11]. The overall mental state and memory of the patients also play a key role in deteriorating quality of life [12].

As far as the social aspect is concerned, isolation has the most detrimental effect on quality of life and usually leads to troubled communication. The patients view the loss of social contacts and troubled family relationships as perhaps the most negative consequences of the disease [13].

The quality of life concept allows for a new approach to PD sufferers. The disease itself causes deterioration of physical and mental state as well as social functioning, which can result in worsened quality of life and shortened life span. The multidimensional approach implies an assessment of quality of life by taking into account all aspects of life [8]. The patient is the only reliable source for this assessment, which means that quality of life is regarded as a subjective category that depends primarily on the patient’s subjective perception of the current state. Instead of evaluating only the physical aspects of the condition, the patient needs to be treated as a whole person [14]. Studying quality of life of those suffering from PD is of utmost importance because it enables monitoring of the functioning with the disease, adjusting to the disease and current state, while it also provides an insight into the overall well-being and life satisfaction [15]. In case of a chronic condition, the state of the patient changes constantly depending on the stage of disease. As a result, the patient’s perception of quality of life may be influenced by improvement or deterioration over time.

The quality of life with PD is measured with four different instruments. The commonly used instruments include:

- 1) PDQ-39 (Parkinson's Disease Questionnaire-39)—Encompassing physical, mental and social aspects of life.
- 2) PDQL (Parkinson's Disease Quality of Life)—Inadequate for assessing self-care, sleep, cognition and close relationships [16].
- 3) SCOPA-PS (Parkinson's disease-psychosocial questionnaire)—Neglects physical and mental aspects of life.
- 4) BDI (Beck Depression Inventory)—An instrument for early detection and diagnosis of depression.

Academic literature agrees on the negative effects of Parkinson's disease on quality of life. The factors of reduced quality of life include: bradykinesia, tremor, resting tremor, postural instability, difficulties with walking, aches, fatigue, depression, cognitive difficulties, sleep disorder, social limitations and economic factors. Muslimović *et al.* emphasizes limited mobility and postural instability as those factors that lead to loss of personal independence, thus having a particularly negative effect on the patients [17]. A variety of motor and non-motor symptoms related with the disease can result in a limited ability of patients to carry out everyday tasks and lead normal lives [18]. Numerous factors related with this disease have been identified. In that regard, continuous physical, psychological and social assessments are requisite.

The effects of physical activity on the psychosocial quality of life in general are well-known but the effects on people suffering from PD are still not given due attention.

3. Parkinson's Disease, Exercise and Quality of Life

There are several treatment models for Parkinson's disease: pharmacological, surgical, educational and physical. While most of the treatments focus exclusively on the pharmacological and surgical approach in order to improve motor functions, quality of life can also be affected by non-motor functions which can be treated with educational means as well as physical exercise [19]. Numerous studies have shown that regular exercise decreases the risk of PD. Thacker, Chen and Patel have come to a conclusion that the risk of developing the disease reduces with regular exercise for people between the age of 30 and 40 that practice it longer than four years [20]. Moreover, the results of the meta-analysis conducted by Xu *et al.* show that reduced risk of developing PD is in correlation with physical activity [21].

People suffering from PD are eager to participate in group exercise, especially if the exercise programs are designed specifically for them [22]. Programs usually include stretching, strengthening, aerobic activities and balancing exercises. There are many useful programs for building stamina, improving balance and mobility [23] [24]. Some of them are based on traditional training concepts but applied in an alternative way. These include Nordic walking, tango (dance), tai chi, qi gong and boxing, all of which have been proven to improve balance, mo-

bility, walking, as well as psychological and social aspects of life.

Most of the studies that have dealt with patients with PD who were involved in exercise programs have shown improvement in mobility, range of movement, strength and relaxation. The results have shown positive effects of physical exercise on quality of life as well as certain daily activities such as standing up from a chair, rolling over in bed or laying down and getting up from bed [25]. Additionally, Kuroda *et al.* claims that exercise prevents physical deterioration that occurs due to the lack of activity [26]. As a result, the overall quality of life improves together with improved walking ability. Exercise also contributes to improving self-efficacy, higher self-esteem, muscle growth, better memory and accelerated movement. Goodwin *et al.* draw a conclusion from numerous studies on this matter that exercise is generally helpful in improving physical function and quality of life but the actual content of the training program (dosage and exercises) needs to be defined [27].

While most research studies point out positive effects of exercise on quality of life of people suffering from PD, some fail to acknowledge them. This inconsistency could be partly explained by the application of different training programs in the research studies [28]. In essence, different training programs produce different effects. Eight weeks of PoleStriding training program increases functional independence and quality of life notably [29], while a 36-hour aerobic and strengthening program can improve quality of life significantly [30]. However, Burini *et al.* failed to establish any positive effects of aerobic or Qi gong training on the patients' quality of life [31]. According to Keus *et al.*, physical therapy combined with pharmacological treatments improves quality of life, whereas the physical therapy itself is not likely to have a significant impact on the disease [32]. What it can do is to improve daily functioning by educating and training the patient. All of the aforementioned studies acknowledge that developing a training concept which optimizes positive effects of exercise on Parkinson's disease rehabilitation proves to be a challenging task.

Unlike motor dysfunctions, non-motor symptoms are often underestimated by clinical practice and neglected by medical profession [33]. It is important to understand that exercise cannot eliminate the symptoms or slow down the progression of disease, but it will improve the patient's physical and mental state which is essential when it comes to high quality of life.

4. The Effects of Exercise on Psychological Aspects of the Quality of Life of PD Sufferers

People suffering from PD are expected to adjust to the disease, while the process of adjustment may take different forms. The process could be accompanied by various psychological reactions such as depression, anxiety, apathy, panic, anger or rage. Psychological disturbances often have serious repercussions on PD sufferers. Depression is common and represents one of the most significant factors when it comes to quality of life [34], with clinical symptoms occurring in 40% - 50% of patients. Apathy manifests as reduced ability of speech, motor activity

and emotion. The prevalence of apathy in PD varies between 17 and 70% [35]. Although it is usually accompanied by cognitive dysfunction and depression, apathy may occur without dementia and depression in some patients. Anxiety in PD manifests as general anxiety, panic attacks and social phobia, often occurring together with depression. Cognitive dysfunction is usually associated with this disease. As for dementia, it affects up to 80% of patients in later stages of the disease.

Consequences of the psychological impact of Parkinson's disease include low self-confidence, mental disorders, drug abuse, suicidal tendencies, as well as inability to control the disease and its effects on physical, social and professional functions [36].

So far, only depression and cognitive functions have been studied when in relation with effects of exercise on the psychological aspects of PD.

4.1. Depression

It is a well-known fact that depression directly affects quality of life as well as psycho-social functioning of people suffering from PD. Depression is the most common determinant of reduced quality of life [37]. It has a substantial impact on quality of life of both the patients and their families. Menza, Dobkin and Marin point to the fact that depression is actually more harmful to the patient than the motor dysfunction. Symptoms of depression, aches, psychiatric disturbances, sleepiness during the day and motor symptoms affect the psychosocial quality of life and daily activities [38]. The research study conducted by Margis *et al.* confirms negative effects of depression on quality of life of PD sufferers and concludes that mobility is strongly related with the symptoms of depression [39]. This conclusion is in accordance with a Brazilian study which claims that depression is the most important determinant of quality of life [40].

The process of alleviating depression with exercise is still not fully understood. According to one theory, exercise induces an increase in endorphin release which results in strengthened immune system and improved pain perception, and an increased secretion of the neurotransmitter norepinephrine that is directly involved in improving mood. Lee N., Lee D. and Song point out that exercise can alleviate depression through beneficial effects of virtual dance [41]. The virtual dance program uses repetitive melodies as well as simple rhythms and moves. This type of exercise is amusing, simple and highly attractive to PD patients. Patients with chronic diseases who practice yoga show signs of alleviated depression, anxiety, fatigue and aches [42]. Patients who engage in physical activity take longer to get tired and are less affected by depression and apathy. Substantial improvement in depressive symptoms has been noticed in case of a group of patients that started with exercise earlier than another group [43]. The importance of this discovery lies in the fact that mood can often have a more decisive impact on quality of life with PD than the physical disorder itself.

Depression needs special attention in these cases. It is related with a more rapid deterioration in motor function, cognitive and self-care ability, which in

turn affects the overall quality of life [44]. Numerous research studies emphasize depression and anxiety as key non-motor symptoms responsible for reduced quality of life.

4.2. Cognition

Cognitive disorders are increasingly recognized as characteristic to Parkinson's disease in most of the cases. They occur even in the early stages with detrimental effects on the daily life, often related with functional disorders accompanied by executive dysfunction (planning, concept formation, solving problems), attention and memory disorder or visuospatial dysfunction [45]. Executive function indications, particularly working memory, are among the risk factors for dementia in patients with PD [46].

Multiple studies address the effects of exercise on cognitive functions in patients suffering from this disease [47] [48] [49]. There is a strong connection between physical performance and non-motor symptoms which are often the main source of stress. According to Larson *et al.*, exercising three or more times a week can improve cognitive functions and postpone dementia in people with neurodegenerative diseases [50]. The results show that different types of exercise have the potential to enhance cognitive functions and motor control in the mild and moderate stages of disease. By learning and practicing new motions and skills, patients with PD are believed to become more cognitively engaged, which may serve as a potential explanation of the changes in executive functions.

The relation between the frequency of exercise and improved cognitive functions can be explained by neurophysiological adaptation, strengthening of the psychological ability of self-regulation, or both. According to a theory recently presented by Audiffren and Andre, the „self-control strength model“ explains the positive effects of frequent exercising on executive functions through strengthening of the self-control capacity [51]. In that regard, not only does the exercise provide physiological stimulation that brings changes in cardiovascular and muscular system, but it also provides psychological stimulation which is necessary for improving executive function and strengthening self-control. Combined strength training and aerobic exercise is more beneficial to executive function than the aerobic exercises alone [52]. Also, another study [53] points out that 43 % of participants in a high frequency training program, including aerobic, strength and flexibility exercises, have shown more beneficial effects on executive functioning in comparison with low frequency training. The study also showed beneficial effects of exercise on the participants' working memory. Although exercise is considered to be an important instrument in delaying disease progression, the optimal frequency of exercise has yet to be defined.

Dementia is also commonly diagnosed when it comes to this particular population. Cognitive disorders tend to deteriorate motor symptoms. In fact, the presence of cognitive damage or dementia is related with the loss of independence, reduced quality of life and shortened working life. According to available data, exercise may have positive effects on the risk of falling and dementia

among the people suffering from PD [54] [55].

5. The Effects of Exercise on the Social Aspects of Quality of Life with PD

Little is known about managing social life as far as the patients with PD are concerned. There is still much to learn about the consequences of their inability to express emotions and the way it affects their social relationships and health in general. The social aspect of life proves to be highly important for people living with chronic diseases [56]. It encompasses social support, participation in social life and interaction with other people such as family members, friends, neighbors, etc.

Social support includes various forms of assistance available from other people. In other words, social support is a sense of belonging, emotional support, leading, assisting and providing a spiritual perspective in times of stress and life crisis [57]. According to Kljajić, social support as one of the social aspects is “a set of beneficial effects an individual might expect from interaction with close people, which helps that individual cope with stress and life crisis” [58].

The effects on the social aspect of life also include disturbances in informal and intimate relationships with other people, reduced social participation, avoidance of social interaction and stigmatization. Personal satisfaction coming from indulging in daily habits is another important aspect. Satisfaction with social participation is closely tied to personal goals and priorities, and does not necessarily depend on the stage of disease.

Difficulties in communication that aggravate relationships with close people represent a serious challenge to PD sufferers. The issues stated in the aforementioned PDQ-39 questionnaire related with communication—“difficulties with speech”, “inability to engage in proper conversation with other people” and “the feeling of being ignored by others” are common in most cases. This suggests that patients with PD find unhindered communication essential in maintaining relationships with family and relatives. They also regard acceptance by other people very important since it provides them with a feeling of belonging and security [59] [60]. As it turns out once again, the social aspect affects the overall quality of life of people suffering from Parkinson’s disease.

The results of these research studies point out positive effects of exercise on social functioning of the patients. In the PDQL questionnaire, social functioning includes abilities to perform activities like hobbies, leisure activities, transport and going on vacation. These activities are all related with motor abilities. The improvement can be explained by the fact that exercise enhances motor functions which in turn improves social functioning of the patients. Block *et al.* comes to the conclusion that exercise intended to improve self-efficacy leads to positive change in people with neuromuscular impairment [61]. Moreover, participation in exercise programs builds physical fitness which has a positive effect on self-confidence [62].

Social support is important in encouraging patients to engage in exercise, while the belief that physical activity helps slow down the progression of PD is actually the decisive factor. It is believed that exercise helps alleviate symptoms of the disease, thus having a positive influence on the patients' physical and mental health [63]. According to studies dealing with physical activity and PD, dance therapy can also be helpful since it encourages social interaction and psychosocial support, while demanding dynamic balance practice and adjusting to environment. One of the studies [64] had 75 patients divided in different groups: Tango, Waltz/Foxtrot, Tai Chi or the control group (did not participate in classes). Each program required social interaction with other participants in the context of a physical activity intended to improve mobility and balance. Quality of life in terms of mobility and social support of the participants in these dance groups improved substantially.

Group exercise is very likely to improve quality of life and encourage socialization. Satisfaction from doing exercise as well as socialization are recognized as key components of a successful program. The patients who participated in group exercise reported better quality of life than the patients doing exercise alone at their homes. Supervised group exercise has been proven more efficacious in improving daily activities, motor functions, mental, emotional and overall health condition compared to supervised individual exercise that takes place at the patient's home [65].

Most studies on daily life of these individuals are focused on their physical symptoms and deal with such treatments as exercise, taking medication or modifying activities in order to save energy and prevent falls. However, some of the studies in this area have focused primarily on social disturbances that accompany this disease. Social engagement and social support positively influence health and well-being of the patients. Studies typically do not examine the dynamics and management of social life. They do however show that people suffering from PD tend to become increasingly lonely, emotionally vulnerable and socially isolated as the disease progresses. People who live alone have decreased emotional well-being when compared to those who live with someone. Winter *et al.* claims that patients who do not live in a community tend to have worse quality of life than those who do [66]. Since the patients find relationships with close people extremely important, an adequate social support is essential for maintaining the well-being. Higher levels of depression, anxiety and stress are inextricably associated with poor social support [67].

6. Conclusions

The goal of research studies dealing with quality of life with PD is to examine certain health components, rather than to provide a global assessment. Quality of life encompasses physical, psychological and social aspects of health. The presence of any sort of physical disorder in an individual might seriously affect his or her psychophysical and social integrity. Studying quality of life in chronic diseases such as PD is of great importance as it allows us to monitor adjustment

to the disease, functioning with the disease, as well as the overall well-being and satisfaction with life.

Valid information concerning quality of life can be provided only by the patient, while the doctors are able to give an overall assessment of disease severity or the extent of deterioration. People have different expectations from the course of the disease and those expectations might change over time. Everything is subject to change, which is the very essence of the dynamic model of life quality. A continuous monitoring of the quality of life with PD is necessary.

As it is the case with most studies, those related with exercise in patients with PD are primarily focused on motor symptoms and usually neglect potential beneficial effects of exercise on non-motor symptoms. Exercise is an easily accessible treatment especially if applied in early stages of the disease development. Future studies should examine non-motor symptoms and the effects exercise has on them. The studies focused on potential benefits of exercise for patients with PD can contribute to reaching the goal of a simultaneous treatment of motor and non-motor symptoms, thus positively influencing the quality of life of people suffering from this disease.

Currently available results provide an important evidence of beneficial effects of exercise on quality of life. Negative developments can be identified, corrected or prevented. Besides that, group exercise programs are inexpensive, simple and efficacious, resulting in improved perception of quality of life, as well as lower social and health care costs. Since this disease is still incurable, it is highly important to establish the most effective way to improve psychological and social aspects of life in order to manage non-motor symptoms, thus enabling patients with PD to live relatively normal lives.

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