Adapted Physical Activity Can Increase Life Appreciation in Patients with Parkinson's Disease

Title: Adapted physical activity can increase life appreciation in patients with Parkinson's Disease

Abstract

Objectives: This study aimed to measure the effect of a treatment of adapted physical activity (APA) on motor symptoms and on positive psychological resources in a group of patients with PD.

Methods: 37 patients with PD (M_{age}= 71.5; 70.3% male) completed measures of disability level, motor performance, distress, well-being and quality of life before and after participating to a program of APA (duration: 7 months). Analysis of variance - repeated measures was performed to evaluate the effect of APA on disability, distress and well-being.

Results: After intervention, patients reported significant improvements in their motor autonomy, disability level, psychological distress and in life appreciation.

Discussion: A brief physical activity program was beneficial not only on patients' motor functioning, but also on their mental health, by reducing distress and promoting ife appreciation.

Keywords: Parkinson; Physical activity; Disability; Life appreciation; Well-being

Introduction

Parkinson's disease (PD) causes a progressive decline of functional autonomy. It is characterized by physical symptoms such as resting tremor, muscle rigidity, bradykinesia and balance disorders and by mental symptoms such as depression, apathy, somatic stress and anxiety. The complexity of this disorder may progressively impair patients' quality of life (Anzaldi & Shifren, 2019; Frazier, 2002; Sabari et al., 2015).

Even though PD is a progressive disease, medical guidelines recommend treatments aimed at reducing the motor side effects associated with PD's medical treatment, together with programs aimed at maintaining/re-activating the patient's physical and mental autonomy.

Recommended strategies consist in guided physical activity and physical rehabilitation (Sabari et al., 2015). These treatments benefit cardiorespiratory and musculoskeletal functions, metabolism, posture, body structure and also mental health (Sabari et al., 2015; Inoue et al., 2019; Ylitalo et al., 2019). Adapted physical activity - APA was applied for patients with PD and it was found to yield positive effects in terms of motor and physical functioning (e.g., motor symptoms) (Abrantes et al., 2012; Canning et al., 2012; Cugusi et al., 2014; Morris et al., 2009; Protas et al., 2005). Additionally, APA program was found to improve patient's life quality by providing benefits for self-efficacy, autonomy and social support (Inoue et al., 2019; Kosma et al., 2007).

The positive psychological effects of APA can be related to individuals' engagement in meaningful and challenging activities that may trigger a state of enjoyment and pleasure (Delle Fave et al., 2011; Hefferon & Ollis, 2006; Inoue et al., 2019). Furthermore, practicing physical activity is useful to prevent states of depression, stress and anxiety and it can be considered a key ingredient for promoting individual's well-being (Boen et al., 2019; Diener et al., 2017; Huffman et al., 2022; Netz et al., 2005). This approach is in line with the recent studies on neurodegenerative disorders, that broadened their focus by including also the positive aspects of life that may favour patients' coping with the illness, their resilience and well-being (Anzaldi & Shifren, 2019; Cesetti et al., 2017; Dural et al., 2003; Frazier, 2002; Vescovelli et al., 2019a, 2019b, 2020; Zhang and Chen, 2019).

Among different models of well-being, the one postulated by Ryff (1989, 2014) underlines the strong connections between psychological well-being (PWB) and physical well-being. PWB may have a buffering effect for stress and may influence the onset and progression of chronic illnesses (Huppert, 2009; Ryff, 1989, 2014). Ryff's model of PWB encompasses 6 dimensions (e.g., self-acceptance, positive relations with

others, autonomy, environmental mastery, purpose in life, and personal growth), which were found to have various patterns of correlations with different physical biomarkers (Ryff, 2014; Ryff et al., 2004).

The protective effect of physical activity and sports on well-being emerged also for older individuals (Bae et al., 2017; Boen et al., 2019; Diener et al., 2017; Huffman et al., 1995; Netz et al., 12005; Rector et al., 2019). Netz et al. (2005) found that aerobic and moderate intensity activities were significantly related to psychological well-being. At the same time, greater well-being may help sustain physical activity in the long term (Rector et al., 2019).

Physical activity may be linked to PWB in various ways. For instance, patient's awareness of his/her own physical condition may promote self-acceptance; the physical benefits of exertion may foster autonomy; an improvement in psychomotor skills and a direct familiarity with the environment may favour environmental mastery. Finally, group activities, social comparison and the opportunity to share personal experience with other group members may encourage positive relations with others and social well-being, leading participants to achieve a sense of personal growth and purpose in life out of the rehabilitation program (Boen et al., 2019; Claesson et al., 2018; Ghorbani et al., 2014; Kang & Ellis-Hill, 2015; Smith & Bryant, 2016; Zhang & Chen, 2021).

While some patients could perceive the chronic illness as traumatic other patients may experience it as a process of growth and may re-discover new sources of meaning and well-being (Vescovelli et al., 2018, 2019a, 2020). This psychological process had been labelled as post-traumatic growth (Tedeschi & Calhoun, 1996). Psychological well-being and post-traumatic growth, in turn, may favour patients' psychological adaptation to the illness and protect their physical and mental health (Vescovelli et al., 2018, 2019a, 2020).

Studies focused on the experience of positive psychological resources within a medical illness found a specific type of illness-related growth, conceptualised as "new awareness of the body" (Ghielen et al., 2017; Hefferon et al., 2009; Hefferon, 2012; Vescovelli et al., 2020). Originally, Tedeschi and Calhoun (1996) did not conceptualize this path of growth in their model of post-traumatic growth (PTG). Specifically, it consists in a new manner of connecting with the body, which leads to a greater awareness of the physical and the mental self and to a more positive illness adaptation. The embodied perception of PTG may be indicative of a peculiar dimension of this construct, conceived as "Corporeal PTG" (Hefferon, 2012). Individuals with cancer, cardiovascular diseases, HIV and other chronic medical conditions influencing body functioning reported to experience this corporeal PTG (Kampman et al., 2015; Barskova

& Oesterreich, 2009). Unfortunately, the PTG inventory developed by Tedeschi and Calhoun (1996) did not assess corporeal PTG and no other psychometric tools have been created up to date.

While some studies focused on psychological and post-traumatic growth in PD, only little research explored the benefits of physical activity programs in terms of promoting well-being and post-traumatic growth. With a qualitative methodology, Sheehy (2014) documented that PD patients were able to perceive benefits by participating to a group physical activity program, such as improvements in psychological symptoms through the use of better self-regulation strategies, and improvements in well-being. Patients reported that they were able to appreciate the use of humour and to help others, rather than focusing on their negative illness complaints.

To the best of our knowledge, none of existing studies on well-being and personal growth in chronic illnesses have explored these dimensions in a sample of patients with PD undergoing a physical rehabilitation program (APA). Given the protective role of well-being on the progression of chronic diseases as PD, this study aimed at evaluating the effects of APA in patients with PD, by analyzing neurodegenerative condition, physical/motor functioning, psychological distress, well-being and personal growth. Based on previous findings with other groups of PD patients, it was hypothesized that this specific APA program would have yielded beneficial effects in terms of reduction of disability and of psychological distress and improvement in well-being dimensions.

Methods

Participants

This study is part of a larger Phd project concerning the evaluation of well-being and psychological distress in patients with Parkinson's disease and their caregivers. For the purpose of the present investigation we included 37 consecutive patients with PD. They were recruited in a physical rehabilitation center located in Northern Italy. The inclusion criteria established by preliminary physician screenings were the following: diagnosis for PD (established by previous neurological exams based on specific clinical criteria and neurological tests); Hoehn and Yahr scale < 4 (Hoehn and Yahr, 1967); Mini Mental State Examination (MMSE) (Folstein et al., 1975) > 24; absence of a psychiatric illness or cognitive impairment. Patients participated to a 7-month adapted physical activity (APA) program in accordance with the regional directives of the healthcare system, consisting of exercises specifically tailored for PD patients.

The APA program started in September 2020 and finished in April 2021 and consisted of two 1-hour weekly sessions delivered by an expert in physical activity trained in physical exercises for PD. The program has never stopped but was interrupted only during Christmas holiday for 3 weeks, in compliance with the anti-covid regulations. During that period patients were recommended to continue the physical exercise at home guided by a manual delivered to them before the Christmas break. The physical exercises that were taught are displayed in BOX 1.

Only participants who voluntarily accepted to take part in the research study and provided their written consent were included in the research. All patients provided their informed consent and at the end of the program there were no drop-outs. These patients were involved only in this physical treatment (they did not take part to any other type of rehabilitation intervention). The Ethical Committee of the rehabilitation center approved the study protocol.

Measures

All patients underwent an extensive medical and psychological evaluation (BOX 2) before the beginning of the physical activity program (September 2020) and after its ends (April 2021).

Neurodegenerative condition

A physician (D.S.) evaluated patients' neurodegenerative condition with the following tools:

The *Unified Parkinson's Disease Rating Scale* (UPDRS) (Martinez-Martin et al., 1994) is one of the most used clinical interviews for measuring common symptoms of PD including psychological distress and the degree of motor disability. UPDRS is composed of four sections: evaluation of mental activity, behaviour and mood; self-evaluation of activities of daily living; evaluation of motor function; evaluation of therapy complications. The clinician administers semi-structured questions and rates patients' answers using a likert scale from 0 = normal functioning to 4 = severe impairment. For example, for evaluating cognitive impairment, a suggested question could be "Over the past week have you had problems remembering things, following conversations, paying attention, thinking clearly, or finding your way around the house or in town?".

The *Hoehn and Yahr Scale* has been used for the staging of the functional disability associated with Parkinson's disease. It helps in describing the progression of the disease through various stages, thus allowing us to measure the severity of each condition. The scale was originally published in 1967 in the

journal Neurology by Melvin Yahr and Margaret Hoehn. That version included stages 1 (symptoms on one side only, unilateral) to 5 needing a wheelchair or bedridden unless assisted. Since then, stage 0 has been added (no signs diseases) and stages 1.5 and 2.5 have been proposed and are widely used.

The *Mini-Mental State Examination* (MMSE) (Folstein et al., 1975) measures the severity and the progression of cognitive changes and impairment over time.

The *Parkinson's Disease Questionnaire 39 item* (PDQ39) (Jenkinson et al., 1997) is a patient-reported clinical trial endpoint, which estimates the state of health and the quality of life of patients with PD. With 39-item it aims to analyse the following conditions: mobility (10 items), activities of daily living (6 items), emotional well-being (6 items), stigma (4 items), social support (3 items), cognitions (4 items), communications (3 items), and bodily discomfort (3 items). Patients may answer this questionnaire by choosing an answer on a Likert-type scale ranging from 0 (never) to 4 (always). They have to rate how often in the last month they have experienced specific difficulties for having Parkinson's disease. Examples of items are "Had difficulty doing the leisure activities which you would like to do?" or "Had difficulty dressing yourself? The scores of the eight sub-scales could be summarized in a single total score Scale scores can range between 0 and 100 (100 = maximum level of problems). In the present study, Cronbach's alpha (α) for the PDQ39 total scale was 0.908. Cronbach's alpha for the PDQ39 subscales was as follows: α = 0.880 for mobility, α = 0.847 for activities of daily living, α = 0.855 for emotions, α = 0.713 for stigma, α = 0.596 for social support, α = 0.651 for cognition, α = 0.676 for communications, α = 0.557 for bodily discomfort.

Physical / Motor functioning

An expert in physical activity (D.M.) administered the following tests:

The *Six Minute Walking Test* (6MWT) (Balke, 1963) is a test that measures the patient's ability to walk as fast as possible for 6 minutes (taking breaks if needed). It provides information about the normal physical abilities and its potential functional limitations. After each minute, the instructor measured the patient's pulse rate, oxygen haemoglobin saturation and the meters walked. Dyspnoea was also measured before the conclusion of the test. For the purpose of this study, only the meters walked were considered.

The *Short Physical Performance Battery* (SPPB) (Guralnik et al., 1994) is an objective assessment tool that combines the results of the gait speed, chair stand and balance tests. The battery is composed of three sections. The first section consists in evaluating the motor balance of patients and is subdivided into three

different sections (1) the maintenance of balance in upright stand for a duration of 10 seconds; (2) the maintenance of balance in semi-tandem stand — by placing the hallux of one foot near the heel bone of the other — for a duration of 10 seconds; (3) the maintenance of balance in tandem stand—by placing the hallux of one foot behind the heel bone of the other—for a duration of 10 seconds. In this first macro-section a score between 0 and 4 may be assigned. The second section consists in evaluating patients' walking ability over a 4 linear meter surface on the basis of the performance time. In this section a score between 0 (unable to perform the test) and 4 (able to perform the test in less than 4.8 seconds) may be assigned. The third section consists in evaluating patients' ability to stand up and sit down from a chair for 5 times in a row. In this section, a score between 0 (unable to perform the test) and 4 (able to perform the test in less than 11.2 seconds) may be assigned.

Psychological distress

A clinical psychologist (F.V.) administered the following psychometric tests:

The *Psychosocial Index (PSI)* (Sonino & Fava, 1998; Piolanti et al., 2016) is a screening tool divided into two different sections: a self-rating test and an observer-rating test. The scale of self-rating includes 55 items, of which 38 items (item 1-20; 37-54) were selected from Kellner's Screening List for Psychosocial Problems (SLP). The first observed rated part of the questionnaire (12 items) was administered to collect *sociodemographic* and *clinical data* including information concerning medical and psychiatric history, the patient's family, employment and habits (such as alcohol or drug use). Then, patients answered to the self-report part of the questionnaire including 4 sections: stress, psychological distress, well-being, abnormal illness behaviour, quality of life. The section on stress (17 items with yes/no answers) is an integration of both perceived and objective stress, life events and chronic stress. The total score ranges from 0 to 17. The *Well-being* section (6 items with yes/no answers) covers different areas of well-being, such as positive relations with others, environmental mastery and autonomy, with a score ranging from 0 to 6. The *Psychological distress* section (15 items) consists of a checklist of symptoms addressing sleep disturbances, somatization, anxiety, depression and irritability. The total score may range from 0 to 45. Questions 37-40 refer to sleep disturbances (range 0-12) and may also be scored separately from the other questions. The section on *Abnormal illness behavior* (3 items) guides the clinician in the assessment of hypochondriacal beliefs and bodily preoccupations. The total score may range from 0 to 9. Finally the last item is a question for measuring *Quality of life* and its score may range from 0 to 4. Cronbach's alpha for the PSI total score in the present study is reported in BOX 3.

The *Symptom Questionnaire* (SQ) (Kellner, 1987) is a 92-item self-rating questionnaire composed of 92 dichotomous questions ("Yes" / "No"). It contains 4 scales of distress (anxiety, depression, somatic symptoms, hostility-irritability) and 4 scales of well-being (relaxation, happiness, physical well-being and friendliness). Each scale of stress varies within a range of 0-17 scores, whereas each scale of well-being varies within a range of 0-6 scores. Cronbach's alpha indicators in SQ total scales are reported in BOX 3.

Psychological well-being and personal growth

The *Psychological Well-Being Scales* (PWBS) (Ryff, 1989) is a 42-item self-rating scale. It is composed of six sub-scales in accordance with the six factors of positive functioning, namely autonomy, environmental mastery, personal growth, purpose in life, positive relations with others and self-acceptance. Patients answer the survey using a Likert-type scale ranging from 1 (strongly disagree) to 6 (strongly agree). The negative answers have to be recoded and summarized in the final score. In the present study the same items of the well-being section of the PSI were excluded in order to avoid redundancy (see previous section). Examples of items are: "In general, I feel I am in charge of the situation in which I live"; "I think it is important to have new experiences that challenge how you think about yourself and the world". Cronbach's alpha values for the PWBS values are reported in BOX 3,

The *Post-traumatic Growth Inventory* (PTGI) (Tedeschi & Calhoun, 1996) is a 21-item scale assessing the positive changes reported by individuals who have experienced a traumatic event. Patients are requested to provide an answer referring to their PD diagnosis on a Likert-type scale ranging from 0 (I did not experience this as a result of my crisis) to 5 (I experienced this change to a very great degree as a result of my crisis.). Patients are requested to answer to item as follows: "I have a greater appreciation for the value of my own life", "I have a greater sense of closeness with others". The questionnaire provides a final score and five sub-scales scores of the following sections: relating to others (7 items), new possibilities (5 items), personal strength (4 items), spiritual change (2 items), and appreciation of life (3 items). The total score may range from 0 to 105. In the present study, Cronbach's alpha for the PTGI total score is reported in BOX 3.

The *Life Satisfaction* (LS) (International Wellbeing Group, 2013) scale is a 1-item rating scale to estimate patients' life satisfaction by asking "How satisfied are you with your life as a whole?". Answer may range from 1 (completely dissatisfied) to 10 (completely satisfied).

Statistical analyses

Socio-demographic characteristics of the sample were analysed with descriptive statistics.

Bivariate correlations among neurodegenerative condition measures, physical/motor functioning measures, psychological distress measures and well-being measures before and after the physical activity program were calculated using Pearson's *r* coefficients (small = 0.1; medium = 0.3; large = 0.5) (Cohen, 1988). Since these are descriptive data, only correlations for the total scale scores are provided.

Pre-post differences in neurodegenerative condition (UPDRS, PDQ39), physical/motor functioning and psychological distress measures PSI, SQ) and well-being measures (PWBS, PTGI and LS) of the sample were analysed with Anova Repeated Measures. Effect sizes were calculated using Cohen's *d* (small = 0.2; medium = 0.5; large = 0.8). In order to provide a complete overview of the APA's effect, differences in all subscales of the questionnaires were analysed and reported. The software used for our statistical analyses was SPSS Statistics (25.0 version).

Results

Socio-demographic characteristics of the sample are reported in Table 1.

Correlations between variables are reported in Table 2 and Table 3. The most robust correlations were among indicators of physical/motor functioning and scores at UPDRS and PDQ39. Measures of psychological distress and psychological well-being were inversely correlated, but not significantly correlated to indicators of motor functioning, also after the APA program.

After APA, significant improvements were reported in UPDRS total score ($F_{1,36}$ = 15.040, p = 0.001), and PDQ39 total score ($F_{1,36}$ = 35.445, p < 0.001) (Table 4). PDQ39 resulted to be improved particularly in the sub-scales of mobility ($F_{1,36}$ = 13.069, p = 0.001), activities of daily living ($F_{1,36}$ = 22.262, p < 0.001), emotional well-being ($F_{1,36}$ = 7.765, p = 0.008), stigma ($F_{1,36}$ = 5.797, p = 0.021), cognitions ($F_{1,36}$ = 10.593, p = 0.002), and bodily discomfort ($F_{1,36}$ = 22.396, p < 0.001).

Concerning physical/motor functioning (Table 4), a significant improvement both in meters walked ($F_{1,36}$ = 14.532, p = 0.001) and in the physical test's final score ($F_{1,36}$ = 5.484, p = 0.025) emerged after APA.

Concerning the psychological distress dimensions, after APA patients reported significant improvements in PSI total score ($F_{1,36}$ = 14.331, p = 0.001), SQ total scale of anxiety ($F_{1,36}$ = 11.731, p = 0.002), somatic symptoms ($F_{1,36}$ = 13.385, p = 0.001), hostility-irritability ($F_{1,36}$ = 3.938, p = 0.055) (Table 4), documenting a beneficial effect of APA on patients' psychological distress.

Concerning pre-post differences on well-being dimensions (Table 5), a significant improvement in PTG sub-scale of appreciation of life ($F_{1,36}$ = 7.901, p = 0.008) was observed with the largest effect size among all variables included. PWBS and LS final scores were improved, but they did not reach statistical significance.

Discussion

The main purpose of this research was to examine the role of APA in improving physical and psychological health in individuals with PD. Our findings documented the beneficial effects of APA in regard to mobility, activities of daily life, bodily discomfort, and motor function. These results confirmed previous literature on the important role of APA in Parkinson's disease (Abbruzzese et al., 2016). Abbruzzese and his research team (2016) observed that physical rehabilitation should be considered as a key-factor of the medical treatment (medicines / surgery) for PD patients.

Concerning psychological distress, our results are in line with previous findings showing significant reduction in emotional distress, anxiety, somatic symptoms, and hostility-irritability following the physical activity program. The positive impact of the physical activity program on patient's mental symptoms appears to be in line with recent research studies and reviews (Abbruzzese et al., 2016; Boen et al., 2019; Cusso et al., 2016; Inoue et al., 2019; Wu et al., 2017).

The APA intervention had also a beneficial effect on some dimensions of well-being, particularly the life appreciation subscale of the PTG inventory, which showed the most robust change after APA, according to its effect size value. Life appreciation represents a core dimension of existential well-being and psychological growth. This result fits with the model of "corporeal growth" as conceptualized by Hefferon et al. (2012). A previous investigation documented that PD patients with high levels of psychological well-being reported also changes in the perception of their body functioning and more awareness of their bodies following the onset of their illness (Vescovelli et al., 2020). After improving their motor abilities through the APA program, our PD patients reported an increased appreciation of life. It is possible that they may have increased their body awareness and body functioning through the APA and, as a result, they also developed a better appreciation of their present life conditions. Alternatively, it is possible that the improvements in life appreciation might be due to the important role of social support, since APA was delivered in a group setting. This setting may favour a process of social support and social comparison among patients with PD (Boen et al., 2019; Claesson et al., 2018; Ghorbani et al., 2014; Kang & Ellis-Hill,

2015; Smith & Bryant, 2016; Zhang & Chen, 2021). These social benefits might result in a better appreciation of life as well. In fact, during the post assessment, patients referred that they found the group format very supportive and that the struggle of engaging in exercises helped them appreciate what they were still able to do. Since to date no standardized measures have been developed for evaluating the dimension of "corporeal growth", future studies are recommended for filling this gap of research (Vescovelli et al., 2020).

On the other hand, other dimensions of well-being, such as life satisfaction or other subscales of PTG and of PWB did not show significant differences from pre to post intervention. A possible explanation for these null results may be related to the small sample size, which limited the statistical power. Alternatively, it is possible that the APA program did not affect the cognitive dimensions of well-being, such as satisfaction with life or PWB subscales. In fact, the former has been defined as a global cognitive judgement of satisfaction with one's life (International Wellbeing Group, 2013), while the six dimension model of psychological well-being was found to be strongly associated with the level of education, with the cognitive skills and with the characteristics of the participants (Blasco-Belled & Alsinet, 2022). Thus, the suitability of these measures for detecting improvements in well-being following APA programs needs to be tested by future studies with larger samples.

This study is limited by the small, self-selected sample size, the absence of a control group, and the use of self-reports for assessing psychological distress and well-being. However, the findings documented that the physical activity program (APA) not only helped patients to improve their motor abilities, but it also helped patients to reduce their psychological symptoms and to increase their well-being.

The results of this study call for the necessity of enlarging the standard evaluation of patients with Parkinson's disease by including the assessment of well-being and other dimensions of positive functioning. The combined assessment of well-being and distress, through appropriate and sensitive quantitative measures, according to the clinimetric approach (Carrozzino et al., 2020) may help clinicians to better capture profiles of patients' problems and resources and to tailor treatments to their specific needs (Anzaldi & Shifren, 2019; Cesetti et al., 2017; Vescovelli et al., 2018, 2019a, 2019b, 2020).

APA program appeared to be particularly beneficial for our sample of patients in terms of physical functioning, psychological distress and life appreciation. However, APA's implementation may be difficult and it is not always included in the national health systems of countries. Future studies should better test the beneficial effects of APA interventions for PD patients by using control groups or by comparing APA

with other types of physical treatments.

A promising approach may be represented by the development of new digital technologies, such as virtual reality (VR) in order to deliver the APA treatment (Alves et al., 2015; De Melo et al., 2018; Thangavelu et al., 2020; Van der Kolk et al., 2019). Future studies should test if such VR approach might have similar positive results as traditional APA. In fact VR and computerized therapies may overcame barriers that patient with physical disabilities may encounter within traditional intervention and may be delivered directly at home. During the recent Covid-19 pandemic waves across countries, the possibility of maintaining rehabilitative programs for patients with chronic conditions as PD may be crucial, although the beneficial effects of the group setting might be lost. At the same time, it would be useful to support APA with a specific psychological program aimed to promote emotional well-being and life satisfaction in patients with vulnerable psychological profiles (Thangavelu et al., 2020; Zhang & Chen, 2021). Well-established psychological treatments (e.g., cognitive behavioural therapy, Thangavelu et al., 2020) or other mind-body techniques such as "Mindfulness" resulted to be well accepted by PD patients (Fitzpatrick et al., 2010) and to be effective in improving their cognitive and emotional functions (Advocat et al., 2016; Cash et al., 2016; Dissanayaka et al., 2016). These psychological programs may support and motivate PD patients to engage in specific rehabilitation program, which could further ameliorate their physical and mental conditions. The findings of this preliminary study, in fact, suggested that a simple rehabilitation program improved life appreciation and well-being of PD patients. Future studies with larger samples are needed to confirm and replicate these promising findings.

Clinical Implications

- Significant improvements in distress, cognition, mobility, activities of daily life, bodily discomfort, motor function and life appreciation emerged after an adapted physical activity program.
- A combined assessment of motor functioning and distress with the measurement of well-being may help clinicians to better capture profiles of patients' problems and resources to tailor treatments according to their specific needs.
- A brief physical activity program was beneficial not only on patients' motor functioning, but also on their mental health, by reducing distress and promoting well-being.

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Table 1 *Socio-demographic and clinical characteristics of patients with PD (N=37)*

	M / N	SD (%)
Age	71.5 (age range 52-84 yrs)	7.1
Years of education	11.6	4.4
Years since diagnosis	5.4	3.9
Gender		
Male	26	70.3%
Female	11	29.7%
Marital Status		
Not Married	6	16.2%
Married	31	83.8%
Children		
Yes	35	94.6%
No	2	5.4%
MMSE	28.8 (score range 24-30)	1.3

Notes. PD=Parkinson's Disease; MMSE=Mini Mental State Examination.

Table 2 *Correlations in patients with PD before APA*

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Covariable												
1. SPPB	-											
2. 6MWT	.748**	-										
3. UPDRS	-.628**	-.399*	-									
4. PSI total	-.107	-.145	.234	-								
5. PDQ39 total	-.280	-.302	.385*	.831**	-							
6. PWBS total	.233	.165	-.205	-.396*	-.375*	-						
7. SQ anxiety	-.211	-.071	.293	.643**	.641**	-.608**	-					
8. SQ depression	-.321	-.207	.397*	.531**	.535**	-.753**	.734**	-				
9. SQ somatization	-.195	-.210	.274	.699**	.594**	-.244	.652**	.507**	-			
10. SQ hostility-irritability	-.088	-.005	.325	.627**	.609**	-.336*	.678**	.583**	.525**	-		
11. LS Life satisfaction	.174	.104	-.191	-.318	-.347*	.472**	-.358*	-.244	-.217	-.154	-	
12. PTGI total	-.167	-.226	-.074	.066	.104	.275	-.048	-.212	.115	-.012	-.041	-

Notes. SPPB=Short Physical Performance Battery; 6MWT=Six minute Walking Test; UPDRS=Unified Parkinson's Disease Rating Scale; PSI=Psychosocial Index; PDQ39=Parkinson's Disease Questionnaire; PWBS=Psychological Well-being Scales; SQ= Symptom Questionnaire; LS=Life Satisfaction; PTGI=Post Traumatic Growth Inventory. *$p < 0.05$. **$p < 0.01$

Table 3 *Correlations in patients with PD after APA*

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Covariable												
1. SPPB	-											
2. 6MWT	.657**	-										
3. UPDRS	-.205	-.190	-									
4. PSI total	.259	-.258	.267	-								
5. PDQ39 total	-.052	-.291	.552**	.577**	-							
6. PWBS total	.064	.217	-.186	-.413*	-.462**	-						
7. SQ anxiety	.184	-.026	.529**	.708**	.742**	-.506**	-					
8. SQ depression	.160	-.006	.410*	.605**	.618**	-.739**	.854**	-				
9. SQ somatization	-.100	-.298	.272	.515**	.373*	-.121	.528**	.402*	-			
10. SQ host,-irritability	.120	-.025	.408*	.538**	.670**	-.366*	.729**	.669**	.264	-		
11. LS	.025	.188	-.157	-.356*	-.489**	.500**	-.493**	-.478**	-.276	-.328	-	
12. PTGI total	-.137	-.167	.006	-.155	.092	.319	-.086	-.290	-.041	-.022	.097	-

Notes. SPPB=Short Physical Performance Battery; 6MWT=Six minute Walking Test; UPDRS=Unified Parkinson's Disease Rating Scale; PSI=Psychosocial Index; PDQ39=Parkinson's Disease Questionnaire; PWBS=Psychological Well-being Scale; SQ= Symptom Questionnaire; LS=Life Satisfaction; PTGI=Post Traumatic Growth Inventory. *$p < 0.05$. **$p < 0.01$

Table 4 *Differences in patients with PD (N=37) between T1 (before APA) and T2 (after APA) in PSI, SQ, UPDRS, PDQ39, 6MWT, SPPB*

	T1		T2			
	M	SD	M	SD	F	Cohen's *d*
PSI						
Distress	10.59	5.29	7.35	6.31	13.036**	0.56
AIB	0.67	1.00	0.62	0.86	0.075	0.05
Stress	1.54	1.52	1.40	1.26	0.417	0.10
Well-being	7.03	1.14	7.24	1.74	0.722	0.14
Quality of life	2.49	0.77	2.65	0.79	0.225	0.20
PSI total	12.81	6.00	9.38	6.89	14.331**	0.53
SQ						
Anxiety	6.25	4.78	4.42	4.67	11.731**	0.39
Depression	6.11	4.21	5.78	4.45	0.496	0.08
Somatization	11.05	4.55	8.94	4.56	13.385**	0.46
Hostility-irritability	4.14	3.93	3.33	4.40	3.938*	0.19
UPDRS						
Non motor problems	14.53	6.63	12.22	5.91	6.846*	0.37
Motor problems daily life	13.03	7.30	10.25	6.3	11.065**	0.41
Motor exam	22.69	14.94	15.44	10.86	11.286**	0.55
Motor complications	1.28	2.63	0.69	1.73	2.190	0.26
UPDRS total	51.53	25.08	38.31	17.57	15.040**	0.61
PDQ39						
Mobility	40.59	24.47	28.73	20.67	13.069**	0.52
Daily activity	36.81	23.43	22.38	22.94	22.262**	0.62
Emotional Well-being	28.81	21.86	20.40	21.64	7.765**	0.39
Stigma	20.24	20.38	12.08	13.00	5.797*	0.48
Social support	13.05	21.86	9.86	19.70	1.068	0.15
Cognitions	35.54	23.37	25.76	18.03	10.593**	0.47
Communications	21.62	23.08	18.03	20.84	1.653	0.16
Bodily discomfort	42.59	28.07	24.08	21.71	22.396**	0.74
PDQ39 Total	238.70	106.90	160.89	84.84	35.445**	0.81
6MWT	384.2	110.0	415.7	102.4	14.532**	0.30
SPPB	9.3	2.5	10.1	2.6	5.484*	0.29

Notes. PSI=Psychosocial Index; AIB=Abnormal Illness Behavior; SQ=Symptom Questionnaire; UPDRS=Unified Parkinson Disease Rating Scale; PDQ39= Parkinson's Disease Questionnaire; SPPB=Short Physical Performance Battery; 6MWT=Six minute Walking Test *$p \leq 0.05$. **$p \leq 0.01$

Table 5 *Differences in patients with PD (N=37) between T1 (before APA) and T2 (after APA) in PWBS, LS, PTG*

	T1		T2			
	M	SD	M	SD	F	Cohen's *d*
PWBS						
Autonomy	31.89	5.36	33.13	5.28	2.327	0.23
Environmental mastery	30.94	5.88	31.78	6.51	1.276	0.13
Personal growth	30.67	6.79	30.62	5.58	0.005	0.01
Positive relationships	33.05	6.08	33.59	5.23	0.568	0.09
Purpose of life	28.11	5.28	27.94	5.83	0.024	0.03
Self-acceptance	30.86	6.54	31.29	6.38	0.276	0.07
PWBS total	185.54	27.09	188.38	25.01	0.947	0.11
LS	7.14	1.60	7.57	1.42	0.122	0.28
PTGI						
Relationships	20.46	7.94	21.29	8.46	0.454	0.10
New possibilities	11.51	7.51	12.40	6.40	0.760	0.13
Personal forces	9.86	5.51	10.84	4.84	1.931	0.19
Spirituality	4.27	3.61	4.51	3.16	0.267	0.07
Life appreciation	7.59	4.58	8.89	4.21	7.901**	0.29
PTGI total	53.70	26.33	57.94	23.84	1.714	0.17

Notes. PWBS=Psychological Well-Being Scales; LS=Life Satisfaction; PTGI=Posttraumatic Growth Inventory. **p≤0.05. **p≤0.01*

BOX 1

Exercises included in the protocol of Adapted Physical Activity

1. Mobilization for neck and back pain
2. Mobilization for posture
3. Exercises of stretching
4. Exercises for manual dexterity
5. Exercises for coordination, resistance and breathing
6. Exercises for flexibility
7. Exercises facial gymnastics and gesture
8. Mobilization for the ankle
9. Exercise for balance and equilibrium
10. Relaxation
11. Aerobic exercises

BOX 2 Description of questionnaires

Questionnaire	Abbreviation	Minimum value	Maximum value
Hoeh and Yahr	n/a	0 (absence of disability)	5 (most severe level of disability)
Mini Mental State Examination	MMSE	0 (most severe level of deterioration)	30 (absence of deterioration)
Unified Parkinson's Disease Rating Scale	UPDRS	0 (absence of signs and symptoms)	199 (most severe level of disability)
Parkinson's Disease Questionnaire 39	PDQ39	0 (absence of disability)	100 (most severe level of problems)
Six Minute Walking Test	6MWT	N/A	N/A
Short Physical Performance Battery	SPPB	0 (impaired lower extremity function)	12 (better lower extremity function)
Psychosocial Index	PSI	0 (lowest level of distress)	48 (higher level of distress)
Symptom Questionnaire Anxiety Scale	SQ	0 (lowest level of anxiety)	23 (all of the symptoms are present)
Symptom Questionnaire Depression Scale	SQ	0 (lowest level of depression)	23 (all of the symptoms are present)
Symptom Questionnaire Somatization Scale	SQ	0 (lowest level of somatization)	23 (all of the symptoms are present)
Symptom Questionnaire Hostility-Irritability Scale	SQ	0 (lowest level of hostility-irritability)	23 (all of the symptoms are present)
Parkinson's Disease Questionnaire 39	PDQ39	0 (absence of problems)	100 (maximum level of problems)

Psychological Well-being Scale	PWBS	0 (lowest level of well-being)	252 (higher level of well-being)
Post-Traumatic Growth Inventory	PTGI	0 (lowest level of change)	105 (highest level of change)
Life Satisfaction	LS	0 (lowest level of life satisfaction)	10 (highest level of life satisfaction)

BOX 3 Cronbach's Alpha indicators in the questionnaires at T1 (before APA) and T2 (after APA)

Questionnaire	Pre-test	Post-test
PDQ39 total scale	0.913	0.913
PSI total score	0.729	0.775
SQ anxiety	0.658	0.650
SQ depression	0.549	0.555
SQ somatic symptoms	0.709	0.725

SQ anger-hostility	0.773	0.726
PWBS total scale	0.726	0.699
PTGI total scale	0.956	0.939

Notes. PDQ39 = Parkinson's Disease Questionnaire; PSI=Psychosocial Index; AIB=Abnormal Illness Behavior; SQ=Symptom Questionnaire; PWBS=Psychological Well-Being Scales; PTGI=Posttraumatic Growth Inventory.