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Simple Behavioral Intervention May Increase Daily Physical Activity in Parkinson's Disease

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Abstract: Physical activity (PA) is a modifiable factor that may have an influence on the course of Parkinson's disease (PD). The aim of this study was to apply a simple behavioral intervention aimed at encouraging PD sufferers to increase their everyday physical activity and to assess which parameters of motor functions will be improved. The research covered 50 PD patients (28 men and 22 women) aged 40-81 years (65.38 ± 9.23), with duration of the disease 2-4 years, in stage 1-3 on the Hoehn and Yahr scale. The patients were randomly divided into two groups: the experimental group with behavioral therapy, and the control group without intervention. During 12 weeks the patients from the experimental group had five phone conversations. Each conversation lasted 15 minutes and was an interview about the subjects' physical activity in the last month. The results were assessed by the Timed Up and Go test (TUG), Unified Parkinson's Disease Rating Scale (UPDRS) – part III, FIR (Functional Index "Repty" – own modification of Functional Independence Measure (FIM)), Functional Ambulation Category (FAC) and International Physical Activity Questionnaire (IPAQ). The results showed that in the experimental group, spontaneous physical activity increased and the motor functions improved. Physical activity improvement depended on age, body mass index and gender.

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1. Introduction

Parkinson's disease (PD) is the second most common neurodegenerative disease. It affects more than 4.5% of people older than 80 years. The main symptoms of PD include bradykinesia, tremor, rigidity, and postural instability. Those axial symptoms cause difficulties with walking and keeping balance, and a growing risk of falls. Physical inactivity may occur before the onset of the disease and be one of the symptoms of PD.

The World Health Organization (WHO) has devoted in recent years more attention to the issue of impact of physical activity (PA) on human health. Experts have created an action plan for 2018-2030, which should lead to its improvement in people around the world (GAPPA − Global Action Plan on Physical Activity 2018-2030) [1]. The *British Journal of Sports Medicine* dedicated a special issue in which Bull et al. on behalf of WHO experts presented recommendations that all adults should be physically active for 150-300 minutes a week (at moderate intensity) or for 75-150 minutes, if the exercise is intense, or exercise with an equivalent combination of moderate aerobic exercise intensity and high intensity.

The guidelines recommend that all age groups undertake regular muscle strengthening exercises [2]. In addition, experts point out the need to limit time devoted to a sedentary lifestyle. As defined by Pate et al. [3], a sedentary way of life encompasses "activities characterized by an energy expenditure that remains notably close to the baseline resting level. This classification encompasses

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actions such as sleeping, sitting, reclining, engaging in screen-based entertainment, and includes endeavors that register an energy expenditure within the range of 1.0-1.5 metabolic equivalent units (METs), as operationalized. A sedentary lifestyle is not the same as not having it enough PA. Even if someone is physically active within the range recommended by the WHO, sitting for more than 7-10 hours per day is harmful to health [3].

It is well known that the PA of patients with PD is lower than in the general population; this has been confirmed in several scientific studies (van Nimwegen et al., 2011, Mantri 2018) [4,5]. Despite the introduction of novel methods of pharmacological therapy, deep brain stimulation (DBS) and focused high-intensity ultrasound for non-invasive thalamotomy and pallidotomy monitored by magnetic resonance imaging (MRgFUS)[6], it fails to control the progressive disability. In a recent publication, Omar Ahmad et al. [7] conducted a meta-analysis encompassing 25 eligible articles (with a combined participant count of 1505) centered on exercise interventions for Parkinson's disease. The investigations encompassed intervention durations spanning from four to 26 weeks. The collective findings revealed a favorable overarching impact of therapeutic exercise interventions on individuals with Parkinson's disease, as evidenced by a cumulative d-index of 0.155. Furthermore, the qualitative evaluation revealed a lack of discernible disparity between exercise forms categorized as aerobic and non-aerobic. Methods of comprehensive rehabilitation in PD have recently been enriched with music therapy, dance therapy, tai chi and qigong [8], but PA still plays an important role in the course of the disease. Improving PA delays the development of patients' physical disability and results in an increase in their quality of life (QoL). In 2017, Wu et al. [9] conducted a comprehensive systematic review that incorporated an assemblage of 11 studies, encompassing a participant cohort of 342 individuals, and encompassing the implementation of 17 distinct regimens of PA. Their findings demonstrated the efficacy of qigong in enhancing scores on the Unified Parkinson's Disease Rating Scale Part III (evaluating motor symptoms) and in mitigating the occurrence of diverse non-motor symptoms and depressive states. Moreover, they highlighted the potential of a balance-training regimen like tai chi to ameliorate postural stability and overall QoL. The researchers concluded that engagement in PA holds promise in retarding the degenerative progression of motor capabilities and depression, consequently enhancing the QoL for individuals afflicted with Parkinson's disease. Notably, among these activities, aerobic training emerged as particularly effective.

PA, exercise and fitness are terms sometimes treated as synonyms and treated interchangeably, but this is mistaken, because they describe different concepts. The WHO adopted the PA definition introduced by Caspersen et al. [10] in 1985, which delineates it as encompassing any bodily motion propelled by skeletal muscles resulting in energy expenditure. Researchers have differentiated exercise as a subcategory within this broader PA concept. Exercise is characterized by its deliberate, organized, and recurrent nature, pursued with the ultimate or intermediary intention of enhancing or sustaining physical fitness. This state of physical fitness embodies a spectrum of qualities interwoven with both health-related factors and proficiencies.

PA can be divided into: occupational, sports, conditioning, household and others. According to Strath et al. in a statement from the American Heart Association, the four PA dimensions include: 1) mode or type of activity, 2) frequency (daily, several times a week), 3) engagement time (e.g. 15, 30, 45, 60 or 90 minutes) and 4) intensity (low, moderate, significant) [11]. In the US Chief Surgeon's report, PA has been classified as moderate (walking, gymnastics, dancing, golf, bowling, horseback riding and gardening) and intensive (climbing, tennis, swimming, cycling, jogging, aerobics, handball, badminton and squash) [12].

Dontje et al. [13] analyzed accelerometer data from 467 patients diagnosed with PD who identified as mostly sedentary. Over 98% of their daily activities were sedentary to light. Notably, 82% were inactive (0 days/week of 30-min activity), and 17% were semi-active (1-4 days/week). Key determinants of reduced daily activity were older age, female gender, and lower physical capacity. A few authors (Cusso et al. and Cugusi et al.) have stated that PA may also improve motor and non-motor functions, as well as QoL in PD [14,15].

There are a number of ways to measure PA; they can be objective vs. subjective, or quantitative vs. qualitative. Subjective methods comprise questionnaires, diaries, etc., while objective methods

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include motion sensors, heart-rate monitors, etc. The International Physical Activity Questionnaire (IPAQ) stands as one of the premier global assessment tools. It emerged from the collaborative efforts of an International Consensus Group that convened in Geneva in 1998. The questionnaire underwent validation in 2003 across 12 nations [16]. Comprising five distinct sections encompassing 27 questions, the extended IPAQ delves into an individual's PA over the preceding 7 days. This tool quantifies PA in metabolic equivalent (MET-minutes/week) units across various life domains: occupational, travel-related, household, leisure, and sporting pursuits. It also captures the duration of sedentary behavior on both weekdays and weekends. The IPAQ facilitates the categorization of participants' PA into three tiers: low (below 600 MET-minutes/week), moderate (600-1500 or 600-3000 MET-minutes/week), and high (above 1500 or 3000 MET-minutes/week). Importantly, it gauges not only weekly energy expenditure but also domain-specific energy expenditure. This enables the isolation of energy consumption attributed to distinct activities such as walking, moderate, and vigorous exercises. The succinct IPAQ short version inquires about seven activities conducted within the past week [17].

The Physical Activity Scale for Individuals with Physical Disabilities (PASIPD) was formulated by Washburn et al. in 2002 [18]. This scale encompasses a total of 13 items, distributed among various domains: 6 pertain to leisure time activities, 6 are related to household tasks, and 1 involves occupational activities. The specific activities covered include: home repair, work and yard care, outdoor garden work, light housework, heavy housework, caring for another person, engagement in strenuous sport and recreation, exercises aimed at enhancing muscular strength, participation in light sport and recreation, involvement in moderate sport and recreation, walking and wheelchair propulsion outside the home (excluding exercise), and paid or volunteer work.

The WHO endorses the adoption of the Global Physical Activity Questionnaire (GPAQ), established by Bull et al. in 2009 [19]. This questionnaire encompasses a set of 19 inquiries strategically organized to encompass various behavioral domains of physical activity, specifically work-related, transportation-related, and discretionary activities, often referred to as leisure or recreational pursuits. In its entirety, the GPAQ yields data that demonstrates reproducibility and exhibits a moderate to strong positive correlation with the International Physical Activity Questionnaire (IPAQ). Within the British National Health Service (NHS) framework, there exists an obligation for general practitioners (GPs) to utilize a screening tool for evaluating adult physical activity levels during routine consultations. This tool, known as the General Practice Physical Activity Questionnaire (GPPAQ), furnishes a straightforward 4-level Physical Activity Index (PAI), categorizing individuals as Active, Moderately Active, Moderately Inactive, or Inactive [20].

According to Ainsworth et al. in 2015 [21], the objective of evaluating physical activity (PA) is to determine the occurrence, extent, intensity, and nature of behaviors conducted over a specific timeframe. The evaluation of PA encompasses self-report methods, involving the administration of questionnaires or the maintenance of detailed diaries and concise logs. Additionally, it encompasses direct measurement techniques employing motion sensors like accelerometers, pedometers, heart-rate monitors, and multi-sensor devices. The duration of PA assessment can vary, ranging from a few hours to an entire lifetime, contingent upon the chosen instruments. The selection of a PA assessment tool should encompass several considerations, including the literacy prerequisites of the tool, the intended purpose of the PA evaluation, the temporal scope being measured, the substantiating evidence of the assessment tool's validity for the target populations, and the applicability of the results across diverse demographic groups [21].

Skender et al. [22] conducted a systematic review encompassing 57 articles that included participants aged 18 years or older, with a minimum of 100 participants, focusing on the assessment of PA through accelerometry and questionnaires. The predominant wear time specified across most studies was seven days during waking hours, and the placement of devices predominantly involved affixing them to the hip via waist belts. The researchers' analysis led to the inference that, when considering self-reported PA, accelerometers demonstrated marginally greater consistency in results among male participants. Given the overall modest level of consistency, variations in the aspects captured by each method, and divergences in the dimensions under examination, the study recommended the concurrent utilization of both questionnaires and accelerometers for a more comprehensive depiction of PA patterns. Furthermore, Dowd et al. [23], through an analogous systematic review, recommended the integration of suitable objective measures tailored to specific behavioral domains of interest when evaluating PA in real-life settings, acknowledging the absence of a singular "perfect" tool for examining PA among adults.

2. Material and Methods

2.1. Subjects

The study group consisted of 50 non-demented PD patients aged 40-81 years (65.38 ± 9.23 years, 22 women, 28 men). The participants received care at the Neurology Clinic of the Silesian Medical University in Katowice (Poland) within an outpatient setting. Ethical approval for the study was obtained from the local Bioethics Committee, and all participants provided their informed consent. The diagnosis of PD adhered to the criteria outlined by the United Kingdom Parkinson's Disease Society Brain Bank (UKPDSBB) [24].

The inclusion criteria were: duration of the disease between 2 and 4 years, stage I-III on the H&Y scale, subjects able to walk independently: UPDRS questionnaire part III=0-42 points, FIR for walking=3 or 5 points, Functional Ambulating Category (FAC)=2-5 points, International Physical Activity Questionnaire IPAQ=0-21 points, unchanged pharmacological treatment – constant doses of drugs during the study. The Hoehn and Yahr (H&Y) scale consists of four stages of development of the disease [25]. The Unified Parkinson's Disease Rating Scale (UPDRS) was developed in 1987 as a rating tool used to gauge the severity and progression of PD. The UPDRS scale consists of six segments: 1) Mentation, Behavior, and Mood, 2) Activities of Daily Living – ADL, 3) Motor functions, 4) Complications of Therapy (in the past week), 5) Modified Hoehn and Yahr Scale, and 6) Schwab and England ADL scale [26]. Functional Index Repty was developed in 1997 as a motor modification of the Functional Independence Measure (FIM). FIR is the ADL scale which consists of 15 items; the scoring system is 1-3-5-7 points [27]. Functional Ambulating Categories (FAC) was developed by Holden et al. in 1986 and is a 6-point functional walking test that evaluates ambulation ability, determining how much human support the patient requires when walking [28]. Timed Up and Go test (TUG) was developed in 1991 by Podsiadlo and Richardson [29].

Patients were randomized to two groups: experimental (n=26) and control (n=24). Characteristics of the study groups are presented in Tables 1–3.

Table 1. Characteristics of the experimental group (n=26).

Variable M (SD)
Gender: Women/Men (n) 9/17
Age (years) 66.38 (8.44)
The duration of the disease (years) 6.96 (3.30)
Hoehn–Yahr scale (degrees) 2.25 (0.35)
Body Mass Index (BMI)(kg) 79.27 (13.82)

Table 2. Characteristics of the control group (n=24).

Variable M (SD)
Gender: Women/Men (n) 13/11
Age (years) 64.38 (10.19)
The duration of the disease (years) 7.58 (4.10)
Hoehn–Yahr scale (degrees) 2.21 (0.35)
Body Mass Index (BMI)(kg) 70.58 (10.96)

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Table 3. Distribution of features in groups: experimental (n=26) and control (n=24).

Feature		Experimental		Control		*p*
		n/mean (SD)	%/median (min-max)	n/mean (SD)	%/median (min-max)	
Gender	Women	9	35%	13	54%	0.791
	Men	17	65%	11	46%	
Age (years)		66 (9)	65.5 (50-80)	64 (11)	(40-81)	0.353
H&Y stage		2.25 (0.35)	2 (1.5-3)	2.21 (0.35)	2 (1.5-3)	0.003
Duration of disease (years)		6.96 (3.30)	7 (2-15)	7.58 (4.10)	7 (2-20)	0.041
BMI (kg/m²)		27.32 (2,74)	26.75 (21.88-32.19)	25.71 (3,16)	(18.67-30.10)	0.544

3. Results

The results are presented in Tables 4 and 5. In the experimental group the parameters of gait, ADL, motor functions (UPDRS part III) and PA (in IPAQ) after 12 weeks improved statistically significantly (Table 4). In the control group the parameters of gait, ADL, and PA (in IPAQ) improved statistically significantly, but motor functions as a whole (UPDRS part III) did not improve (Table 5). PA in the control group did not depend on the stage of PD, duration of disease, BMI, ability to walk, or mobility. The improvement of PA in the experimental group depended on gender (better in males), age (>66) and BMI (<26).

Table 4. Results of clinical tests in the experimental group (n=26).

Test	Experimental group day 1		Experimental group day 84		*P*
	mean (SD)	median (min-max)	mean (SD)	median (min-max)	
Gait in Functional Index Repty	4.4 (±0.91)	4.5 (3.0-5.0)	4.88 (±0.83)	5.0 (3.0-7.0)	0.018
Functional Ambulation Category	4.12 (±0.88)	4.0 (2.0-5.0)	4.52 (±0.71)	4.5 (3.0-5.0)	0.023
Timed Up and Go Test (sec.)	14.68 (±3.44)	14 (11-26)	12.08 (±2.86)	11 (10-19)	0.0002
UPDRS part III (motor examination)	11.28 (±6.83)	11 (2-25)	13.76 (±9.23)	12 (4-30)	0.045
Functional Index Repty total	96.6 (±7.42)	98 (75-105)	101.44 (±3.47)	102 (89-105)	0.00006
International Physical Activity Questionnaire	13.76 (±6.91)	14 (2-27)	17.36 (±4.47)	18 (4-26)	0.005

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Table 5. Results of clinical test in control group (n=24).

Test	Control group				*P*
	day 1		day 84		
	mean (SD)	median (min-max)	mean (SD)	median (min-max)	
Gait in Functional Index Repty	4.05 (±1.2)	4.0 (3.0-7.0)	5.19 (±0.87)	5.0 (3.0-7.0)	0.002
Functional Ambulation Category	4.19 (±0.87)	4.0 (3.0-5.0)	4.81 (±0.4)	5.0 (4.0-5.0)	0.007
Timed Up and Go Test (sec.)	14.52 (±4.35)	15 (10-26)	11.24 (±1.55)	11 (9-15)	0.0005
UPDRS part III (motor examination)	11.62 (±9.36)	10 (1-33)	11.95 (±9.52)	7 (2-30)	0.587
Functional Index Repty total	96.33 (±8.66)	97 (41-105)	101.48 (±3.31)	95 (77-105)	0.0008
International Physical Activity Questionnaire	14.76 (±4.16)	15 (6-23)	19 (±3.39)	19 (12-24)	0.0001

4. Discussion

PA is increasingly promoted as an adjunctive intervention for individuals dealing with PD. However, the specific advantages of PA for the diverse range of impairments prevalent among PD patients have not been distinctly delineated. The currently accumulated evidence suggests that PA holds potential as a significant non-pharmacological intervention in the context of PD. In 2018, Stuart et al. concluded that activities like walking and balance tasks during PA could prompt elevated cortical activity, particularly evident in older individuals and those with PD, in comparison to baseline conditions (sitting/standing) or control groups [30]. Furthermore, Monteiro-Junior et al. (2015) [31] underscored that exercise's favorable impact on PD could be attributed to a multitude of factors, including neurotrophic agents and notably, cerebral nerve growth factors, fostering neuroplasticity.

In 2020, Hidalgo-Agudo et al. [32] conducted a systematic review and meta-analysis focused on randomized controlled trials (RCTs) that investigated the efficacy of physical interventions in conjunction with conventional physical therapy for PD. A comprehensive total of 11 RCTs were encompassed in this review, with five contributing data to the subsequent meta-analysis. The ensuing statistical assessment showcased positive outcomes in the context of dance-based therapy, particularly concerning motor balance as evaluated through the TUG test and the Berg Balance Scale (BBS). Aquatic interventions exhibited favorable results in terms of enhancing balance confidence. The outcomes deduced from this comprehensive review accentuate the potential advantages of dance-based therapy in bolstering functional balance among individuals with PD, thus advocating for its inclusion in clinical practice. Nevertheless, it's important to recognize that numerous aspects necessitate further elucidation via subsequent research and the undertaking of high-quality studies in this domain [32].

In 2016, Lauze et al. [33] undertook the task of identifying the health parameters that stand most likely to ameliorate through PA interventions among patients grappling with PD. Collating insights from studies investigating PA interventions in PD patients, which offered statistical analyses of their outcomes, they systematically gathered data from 106 papers spanning the period from 1981 to 2015. The comprehensive review underscores that PA exhibits its most pronounced efficacy in enhancing physical capacities and functional capabilities, encompassing both physical and cognitive domains.

These improvements are particularly discernible in domains such as gait, mobility, posture, and balance. Remarkably positive effects of PA are observed on gait-related motor symptoms, gauged through the motor examination component of the Unified Parkinson's Disease Rating Scale (UPDRS Part III). Conversely, the potency of PA in addressing clinical symptoms of PD and psychosocial aspects of life appears comparatively constrained, with less than or around 50% of the outcomes reporting positive effects. However, it's noteworthy that the impact of PA on disease symptoms and psychosocial dimensions displays a moderate effect size and greater variability. This comprehensive analysis accentuates the exigency for further exploration into the effects of PA on cognitive functions, depression, and specific PD symptoms [33].

In 2020, Gorzkowska et al. [34] published the outcomes of their study, aimed at discerning potential factors that influence spontaneous PA among 134 PD patients. These patients had an average age of 65.2 ± 9.2 years and the stage in Hoehn-Yahr scale of ≤4. In the comprehensive explanatory model, a 13% of the variability in time spent engaged in sedentary activities was explicated, with significant predictors identified as secondary education and the results of the Unified Parkinson's Disease Rating Scale (UPDRS). Notably, patients with secondary and vocational education, those initiating treatment with dopamine antagonists, and those with milder Parkinson's symptoms (as reflected by UPDRS scores) exhibited less sedentary behavior. The authors concluded that the identification of determinants for spontaneous PA has the potential to unveil implications for influencing modifiable PA conditions and for devising appropriate strategies when addressing patients with unmodifiable PA-related factors [34].

Mantri et al. (2018) [5] conducted an investigation into self-reported PA scores and their correlations with clinical attributes among 383 individuals in the early stages of PD and 175 healthy counterparts. Notably, PA scores for PD participants were lower by 8% in comparison to the control group, and elevated scores were linked to younger age and male gender. Moreover, only 47% of PD subjects and 44% of controls adhered to the recommended activity levels for adults. The authors deduced that these findings underscore the imperative of advocating exercise even in the early phases of PD. In a study from 2013, Ellis et al. [35] ascertained that exercise could mitigate disability and enhance the QoL for individuals with PD. The contemporary perspective regards the maintenance of physical activity as a key determinant for sustaining or boosting cognitive functions, in addition to enhancing the performance of the frontal cortex in elderly individuals.

The investigation into the impact of PA on non-motor symptoms (NMS) in PD was undertaken by Cusso et al. [14]. Through a systematic review, the researchers identified 20 papers that fulfilled the inclusion criteria. The participant counts within these studies spanned from 18 to 191 individuals. Predominantly, the studies exhibited a higher proportion of male participants, with two maintaining equal gender ratios and three favoring female participants. The encompassed age range extended from 40 to 89 years. The majority of investigations carried out 2 to 4 sessions per week, with each session lasting between 20 to 90 minutes. The intervention duration displayed substantial variation, ranging from 4 weeks to 3 years, while the prevailing interval was 12 weeks.

The studies uniformly incorporated dynamic interventions, encompassing a spectrum of physical activities including aerobic training, treadmill exercises, walking, resistance training, balance training, Tai Chi, Qigong, and tailored regimens like physiotherapy, occupational therapy, physiotherapist-guided exercise, self-directed exercise, group exercise, active theater training, Argentine tango, exercise programs modified for PD initiation timing, Feldenkrais physical therapy program, Nordic Walking, customized fitness routines, gym-based exercise regimens, and the Ronnie Gardiner Rhythm and Music Method. However, comparing these diverse intervention methods proved challenging due to demographic heterogeneity and variations in methodologies. Despite this, it is apparent that physical activity can exert a favorable impact on the comprehensive burden of NMS, which encompasses aspects like depression, apathy, fatigue, daytime sleepiness, sleep patterns, and cognition. The authors underscored the necessity for further robust studies, adequately powered, to evaluate the therapeutic potential of physical activity for both motor and non-motor dimensions of PD. These investigations should be meticulously designed to appraise non-motor facets of the disease through instruments validated specifically for PD [14].

Cugusi et al. [15] aimed to ascertain the impact of an adapted physical activity (APA) program on a range of factors encompassing motor and non-motor symptoms, functional capabilities, and QoL in a cohort of nine consecutive PD patients (5 men, 4 women, aged 64.4 ± 6.8 years). Over a span of 9 weeks, the patients participated in a thrice-weekly APA regimen centered on exercises targeting balance, walking, strength, and functional tasks. Notable outcomes revealed a marked reduction in resting heart rate and a substantial increase in the distance walked. Concurrently, a discernible reduction in muscle strength was observed. Assessment through the BBS indicated a noteworthy enhancement in balance proficiency, and safety during mobility, as exemplified by the TUG test ($p < 0.005$). Ultimately, a considerable enhancement was observed in both motor and non-motor symptoms. The researchers concluded that a personalized exercise program tailored to PD patients can serve as a valuable adjunct to conventional therapy, fostering improvements in daily activities, motor and non-motor symptomatology, and ultimately contributing to an improved QoL of individuals with PD [15].

Our study was inspired by Dlugonski et al. who reported in 2012 that a behavioral intervention applied to 23 people with Multiple Sclerosis vs. 22 controls resulted in increased PA, which was maintained for at least three months of follow-up after the end of the intervention. Participants scheduled seven one-on-one 5-10 minutes video coaching sessions with a health behavior coach as part of the 12-week intervention; there were four in the first month, two in the second month, and one in the third month [36].

In our study the improvement of spontaneous PA was observed in both groups. This could be explained with such way: although subject from control group didn`t have any phone calls bud the expected for the control assessment which could motivate them and encourage them to be more active. We can see some limitations of this study: the application of pedometer would result in more objective evaluation of PA, and it would be rational make some follow-up, i.e. after 12 weeks. In their study, Frenne et al. (2020) [37] sought to address the query of whether the mere act of PA measurement can lead to an elevation in self-reported PA behavior within primary care settings. Through a systematic review and subsequent meta-analysis, the researchers determined that no substantial enhancements in objectively-measured PA were observed among control groups situated in primary care contexts. The findings underscore the need for further exploration into noteworthy escalations of PA levels within control groups, particularly among specific sub-groups of participants. This line of investigation could potentially wield implications for PA research and interventions targeting these specific populations.

5. Conclusions

The results obtained in this study indicate that a simple behavioral intervention may help increase spontaneous PA in Parkinson's disease. Behavioral intervention may also improve motor functions in Parkinson's disease. Improvement of PA depends on age, body mass index and gender.

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