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Original Article

Parkinson's disease and golf: The effects of golf on functional capacity, physical abilities, and quality of life

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Abstract
Introduction: Parkinson's disease (PD) is a progressive neurodegenerative disorder affecting dopaminergic neurons in the brain, leading to motor and non-motor symptoms that impair physical functions and quality of life (QoL). Traditional treatments, such as pharmacological management and physical therapy, often face challenges in effectiveness and patient adherence, highlighting the need for alternative therapies. Golf, known for its low to moderate intensity and broad appeal across age groups, combines physical exercise with social interaction, making it a promising candidate for therapeutic intervention. Golf involves essential activities such as walking, swinging, and maintaining balance, which are crucial for sustaining functional abilities in PD patients. Additionally, the cognitive challenges and outdoor settings associated with golf may enhance mental health and overall well-being. **Objective:** This study aimed to examine the effects of golf practice on the functional and physical capacities and QoL of individuals with Parkinson's disease. **Materials and Methods:** Twelve PD volunteers, 10 males and 2 females, aged 63.5 ± 8.82 years, participated in a 7-week golf practice program conducted twice a week for 90 min per session. The subjects were evaluated using the Hoehn & Yahr Scale (H&Y), Unified Parkinson's Disease Rating Scale (UPDRS), Parkinson's Disease Questionnaire (PDQ-39), and Senior Fitness Test (SFT). Data were analyzed using descriptive and inferential statistics, employing Student's t-test and repeated measures analysis of variance (ANOVA) with Bonferroni post hoc test. **Results:** Significant results were found in the SFT agility/dynamic balance ($F = 4.58$; $p = 0.01$) and PDQ-39 bodily discomfort ($F = 38.84$; $p = 0.00$). **Conclusions:** This study showed a positive impact of golf practice on agility, dynamic balance, and bodily discomfort, suggesting that golf can improve certain aspects of physical and functional capacity, as well as QoL, in individuals with Parkinson's disease.
Keywords: chronic disease, nervous system, physical fitness, exercise rehabilitation, health promotion

Introduction

Each year, over 25,000 people are newly diagnosed with Parkinson's disease (PD) (De Rijk et al., 1997). PD is the second most common neurodegenerative disease worldwide, after Alzheimer's. It is a chronic, progressive, and disabling condition that imposes emotional, economic, and social burdens on patients and caregivers (Balestrino & Schapira, 2020). In France, the number of PD cases doubled between 1990 and 2015. By 2030, it is estimated that approximately 260,000 people will be treated for this disease, with 1 in 20 individuals over the age of 45 being affected (Canonico et al., 2022).

The cause of PD is the progressive degeneration of dopaminergic neurons in the substantia nigra pars compacta, resulting in reduced striatal dopamine and the presence of Lewy bodies. The most common form, idiopathic PD, is characterized by cardinal symptoms such as rest tremor, asymmetry, and bradykinesia. A positive response to dopamine confirms the diagnosis in 99% of cases (Garcia-Agundez et al., 2019; Marsden, 1990)

A wide variety of physical therapy treatments are used for PD patients, and interest in the role of exercise in managing PD is growing among scientists worldwide. Traditional treatments, such as pharmacological management and physical therapy, often encounter challenges related to effectiveness and patient adherence, prompting the exploration of alternative therapies. Physical activity is one such treatment because it promotes important acute and chronic adaptations. Exercise can enhance neurobiological responses such as neurogenesis, angiogenesis, and synaptogenesis when practiced at moderate to vigorous intensity. These responses help maintain neuronal health and stimulate neural plasticity. These mechanisms collectively enhance functional and physical capacities, benefiting patients with improved postural balance and motor control.

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Behavioral improvements may also occur (Monteiro-Junior et al., 2015). This is why physical activity assessment is a key component of the American Academy of Neurology's quality guidelines for patients with PD (Mantri et al., 2018).

Golf is a sport enjoyed by over 60 million people worldwide. By the end of 2018, there were 38,864 golf courses in 209 of the world's 249 countries (The R&A, 2019). Golf is an excellent way to stay physically active and engage in a "lifetime" sport (Smith, 2016).

Golf is a social and physically enjoyable sport of low- to moderate intensity that all age groups can enjoy. One of its greatest advantages is that it is a leisure activity and a form of physical exercise. Its appeal across age groups, combined with physical exercise and social interaction, makes it an excellent option for therapeutic intervention. The sport involves essential activities such as walking, swinging, and maintaining balance, which are crucial for sustaining functional abilities in PD patients. Additionally, the cognitive challenges and outdoor settings associated with golf may enhance mental health and overall well-being. This can be particularly important for keeping individuals with chronic diseases such as PD engaged in regular exercise.

A six-week clinical study conducted in a community-based golf and exercise program for individuals with PD demonstrated that a curriculum comprising golf instruction and task-specific exercises significantly enhanced the quality of life (QoL) (assessed by PDQ-39) for seven out of eight participants (Cash et al., 2018). This finding is significant given the common challenges faced by people with PD in terms of overall or health-related QoL.

People with PD typically experience reduced QoL owing to the physical, functional, and psychological/cognitive symptoms associated with the disease. The close relationship between motor and cognitive functions significantly impacts QoL. Conversely, improving functional capacity through physical therapies has been shown to enhance overall QoL (Barbieri et al., 2012; Fayyaz et al., 2018).

A broad spectrum of motor and non-motor symptoms can influence the health-related QoL (HRQoL) in PD. A study investigating predictors of HRQoL in PD revealed that symptoms such as depression, anxiety, apathy, excessive daytime sleepiness, and impairments in activities of daily living (related to motor symptoms) were independently associated with a poorer HRQoL. These findings suggest that these factors are significant predictors in individuals with mild to moderate PD, highlighting the importance of identifying and prioritizing these symptoms for treatment, therapeutic development, and clinical outcomes (Kuhlman et al., 2019).

Individuals often experience declines in physical and functional capacities as PD progresses, which can decrease their QoL. Physical therapies can help slow down and alleviate these symptoms. However, golf offers more than just physical exercise; it is a multifaceted sport that promotes sociability, connects individuals with nature, and provides exposure to sunlight in a natural, green environment (known as 'Nature dose'). These aspects can positively impact individuals dealing with depression or other mood-related issues. They are compelling reasons for engaging in this sport, combining physical activity, social support, and a connection with nature.

Conventional treatments often encounter adherence challenges, underscoring the importance of exploring alternative therapies such as golf. Examining the potential benefits of golf as a therapeutic intervention can offer fresh perspectives and opportunities to enhance the QoL for individuals with PD. Therefore, the aimed of this study was to assess the impact of golf practice on the physical and functional capacities and the QoL of people living with PD.

Materials and Methods

Study Design

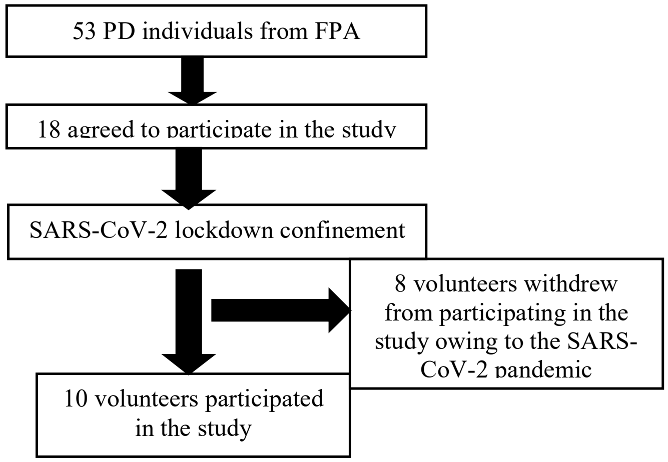
The study employed a quasi-experimental design, which aims to achieve a closer alignment with real-world environments while controlling for as many threats to internal validity as possible (Thomas et al., 2012).

Sample

A sample of 18 volunteers (4 females and 14 males) with PD was recruited from the France Parkinson Association (FPA) Ile de France zones 91 and 78 (Paris, France). The study included participants who met the following criteria: diagnosed with stages 1–3 of Parkinson's disease according to the Hoehn & Yahr scale (H&Y) (Hoehn & Yahr, 1967) and possessing a medical certificate allowing them to engage in golf. Exclusion criteria comprised uncontrolled chronic diseases, severe heart conditions, muscle or joint issues that unable the practice of physical activity, significant cognitive impairment, and inability to play golf.

The sample size was determined using G Power 3.1 software. Parameters included in the calculation were as follows: test family - F tests; statistical test - ANOVA: repeated measures, within factors; effect size = 0.5; $\alpha = 0.05$; power ($1 - \beta$ error probability) = 0.95; number of groups = 1; number of measurements = 3; and correlation coefficient among repeated measures = 0.5. According to G Power 3.1, a total of 12 individuals were required. Owing to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic, the French government enforced an eight-week lockdown, resulting in eight volunteers withdrawing from the study. Therefore, at the end of the sampling process, the study comprised a single group of 10 volunteers (2 females and 8 males) aged 45–73 years (mean age 63.5 ± 8.82) with PD duration ranging from 6 months to 14 years (mean duration 7.1 ± 4.3 years). Figure I show the details of volunteer recruitment.

Figure I: Flowchart of volunteer recruitment



Legend: PD (Parkinson's Disease); FPA (France Parkinson Association); SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2)

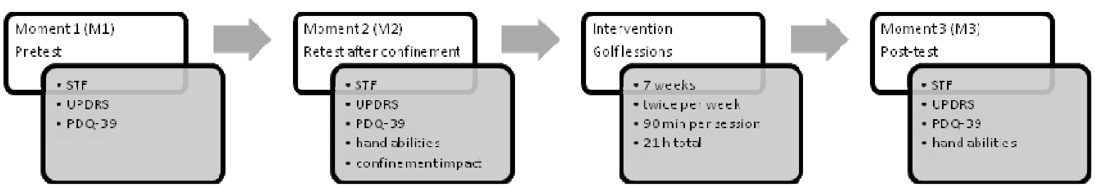
Research Ethics

The participants provided informed consent to participate in research involving human subjects, following the principles of the Declaration of Helsinki (World Medical Association, 2009). The experiment was submitted to the FPA department 91 in January 2020 and approved by POLETHIS (Council for Research Ethics and Scientific Integrity of Paris-Saclay University, France). Participants were informed about the experimental procedures and signed consent forms.

Procedure

The data were collected at UGolf Verrières le Buisson in Verrières-le-Buisson, France. The measurements were divided into three moments: (M1) pretest, (M2) retest following the eight-week lockdown period, and (M3) post-test after seven weeks of golf practice, as shown in Figure II.

Figure II: Study design



Legend: SFT (Senior Fitness Test); UPDRS (Unified Parkinson's Disease Rate Scale); PDQ-39 (Parkinson's Disease Questionnaire/39 questions)

Moment 1: Pretest (before the confinement)

All tests were administered by a physical education professional specializing in adapted physical activity, with each volunteer evaluated in a single 90-min session. Testing occurred over three days, with six volunteers assessed each day.

Before testing, volunteers signed an informed consent form. Functional and physical capacity were evaluated using the Senior Fitness Test (SFT) (Rikli & Jones, 1999). QoL was assessed subjectively using the Parkinson's Disease Questionnaire (PDQ-39) (Peto et al., 1995). Motor function was evaluated using the Unified Parkinson Disease Rating Scale (UPDRS) (Fahn, 1987).

Senior Fitness Test (SFT)

A battery of performance tests designed to assess key physical parameters associated with mobility in independent older adults aged 60–90+ (Rikli & Jones, 1999) is widely recognized. This battery comprises six exercises and is extensively used to evaluate functional mobility. It assesses physical abilities and provides an estimation of patients' functional independence (Cancela et al., 2012).

To assess functional capacity, the following tests from the SFT were utilized: **Strength** (chair stand and arm curl using 2 kg for females and 3 kg for males, performed for 30 s); **Flexibility** (chair seat and reach, and back scratch); **Balance** (an 8-foot up-and-go test where volunteers stand up from a chair, walk 2.5 m, turn around, return to the chair, and sit down as quickly as possible); **Endurance** (2-min step test involving lifting knees in place because the terrain for golf was not suitable for the 6-min walk test).

SFT test protocol was applied in the following order: (1) Chair stand (30-s), (2) Arm curl, (3) Chair seat and reach, (4) 8 feet up-and-go, (5) Back scratch, (6) 2-min step test.

Unified Parkinson Disease Rate Scale (UPDRS)

Originally developed in the 1980s, the UPDRS has since become the most extensively utilized clinical rating scale for PD (Postuma et al., 2015; Goetz et al., 2008).

Utilized to assess treatment benefits and in clinical trials, the UPDRS is a clinical rating scale widely used to evaluate new treatments for PD. It consists of four parts. Part I assesses behavioral issues such as cognitive decline, hallucinations, and depression. Part II evaluates patients' self-reported ability to perform daily activities such as dressing, walking, and eating. Part III focuses on motor disability assessment. Part III includes tremors, slowness (bradykinesia), stiffness (rigidity), and balance assessments. Part IV addresses treatment-related complications such as involuntary movements (dyskinesias), painful cramps (dystonia), and irregular responses to medication (motor fluctuations) (Movement Disorder Society, 2003). The UPDRS aims to offer a comprehensive, practical, and easily administered scale suitable for all patients, regardless of disease severity, medication regimen, or age (Goetz, 2010).

Parkinson Disease Questionnaire (PDQ – 39)

The PDQ-39 is a short 39-item health status questionnaire designed for use in PD. It consists of eight scales: Mobility (10 items), Activities of daily living (6 items), Emotional well-being (6 items), Stigma (4 items), Social support (3 items), Cognitive well-being (4 items), Communication (3 items), and Bodily discomfort (3 items). This disease-specific instrument has a maximum score of 100, indicating the worst possible health status (Peto et al., 1995).

All tests were overseen by the examiner, a specialist in adapted physical activity. Owing to the SARS-CoV-2 lockdown, all volunteers and the project coordinator were required to stay home, resulting in an 8-week postponement of the protocol's commencement.

Moment 2: Retest (after confinement)

During the eight weeks when volunteers remained at home, all tests had to be repeated. This allowed for an assessment of how the confinement affected the functional and physical capacities and the QoL of individuals with PD. The SFT, UPDRS, and PDQ-39 tests were performed under the same conditions as in moments 1 and 2, with additional new tests introduced for the re-evaluation:

Subjective questions on hand abilities (23 questions) were used to investigate potential differences before and after golf practice.

Subjective questions on the impact of confinement on the volunteers' HRQoL**:** (16 questions) related to their routines and their perception of the lockdown period on their HRQoL.

Golf Intervention

This project was entirely free for the participants and was performed at a compact 9-hole golf course (UGolf of Verrières le Buisson, France). The club loaned golf clubs and balls and provided practice balls for the driving range.

Golf lessons were performed by an experienced professional in golf and a physical education teacher specializing in special populations. PD patients participated in seven weeks of golf lessons twice a week, each lasting 90 min (totaling 21 h). Volunteers were divided into three groups: Monday and Wednesday afternoons (4 individuals), Tuesday and Thursday mornings (3 individuals), and Tuesday and Thursday afternoons (3 individuals). The collective nature of the lessons allowed participants to socialize with each other during the project, fostering a cheerful and relaxed atmosphere during the courses.

Each session began with a 10-min warm-up involving static and dynamic stretching exercises and joint mobility drills. The initial moment (the first six lessons) focused on learning golf techniques, conducted at the driving range (practice area for hitting balls), approach zone (for short shots), and putting green (for putting practice). Participants learned the swing (the movement used to hit balls), putting technique (to place the ball in the hole), and approach shots (small movements to place the ball near the flag and hole on the green).

The volunteers transitioned to playing on the golf course in the second moment. They played on the course for six consecutive lessons, followed by a swing lesson at the driving range to review and practice their technique. The 14^{th} and final lesson also took place on the golf course.

Moment 3: Post-test (after the seven weeks of golf practice)

The SFT, UPDRS, PDQ-39, and hand abilities were evaluated using the same protocols described earlier. The research coordinator organized a final lunch attended by most PD patients to commemorate the project's conclusion.

Data analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences software (SPSS 26.0, Chicago, USA). Sample size calculations were performed with GPower 3.1 (Frauz Faur Universität Kiel, Germany), using an effect size of 0.5, α of 0.05, and an estimated power of 0.95. The program initially estimated a sample size of 12 individuals; however, only 10 completed the golf program. Descriptive statistics were used to determine mean and standard deviation values. The Shapiro–Wilk (SW) and Levene's tests were used to assess normality and homoscedasticity, respectively. All variables examined exhibited normality and homoscedasticity, allowing for parametric analyses. Student's t-test was utilized to compare the two moments of subjective hand abilities questions (after confinement vs. after seven weeks of golf practice), and repeated measures analysis of variance (ANOVA) was applied with Bonferroni post hoc tests as needed. The level of significance was set at $p < 0.05$.

Results

The characteristics of the sample will be presented, along with the results pertaining to functional and physical capacities, QoL, subjective assessments of hand abilities, and the impact of confinement.

Table I: Descriptive analysis of the sample

	Age (years)	**Disease duration** (years)	**H&Y**	**TBM** (Kg)	**Stature** (m)	**BMI**
Mean	63.50	7.10		69.60	1.75	22.67
SD	8.82	4.36		13.46	0.08	3.08
Min. Value	45.00	0.5	1.00	42.00	1.56	17.26
Max. Value	73.00	14	3.00	83.00	1.86	23.99

Legend: SD (standard deviation); Min. (minimum); Max. (maximum); H&Y (Hoehn & Yahr scale); TBM (total body mass); BMI (body mass index)

The volunteers had a mean age of 63.5 years (±8.82) and a mean disease duration of 7.1 years (±4.36). Despite consisting of two women and eight men, the sample was considered homogeneous based on the SW and Levene's tests ($p > 0.05$). In terms of PD stages, according to the H&Y scale, patients ranged from mild to moderate (stages 1–3): 40% were in stage 1, 40% in stage 2, and 20% in stage 3. According to the World Health Organization (WHO) BMI classification, the sample's BMI indicated normal weight.

In terms of physical and functional capacities assessed by the SFT test, a significant difference ($p < 0.05$) was observed in one component: motor agility/dynamic balance ($F = 4.58$, $p = 0.01$). Table II presents the statistical results of the SFT across the three study moments.

Table II: Comparison of SFT moments

	M1 mean ± SD	**M2** mean ± SD	**M3** mean ± SD	**F (p value)**
Lower Body strength (rep)	12.40 ± 1.50	14.10 ± 2.84	12.85 ± 2.28	1.49 (0.24)
Upper Body Strength (rep)	17.95 ±3.94	19.30 ± 2.86	20.40 ± 4.28	1.07 (0.35)
Lower Body Flexibility (cm)	0.37 ±12.84	4.12 ±13.77	-.050 ±11.19	0.33 (0.72)
Motor Agility/Dynamic Balance (sec)	7.19 ± 1.56	7.26 ±1.47	5.68 ±0.75**	**4.58 (0.01)***
Upper Body Flexibility (cm)	9.90 ± 8.80	10.52 ± 8.45	7.90 ± 9.76	0.23 (0.79)
Alternative Aerobic Test (2-min step test (rep)	138.80 ± 51.10	140.00 ± 52.29	161.60 ± 43.06	0.68 (0.51)

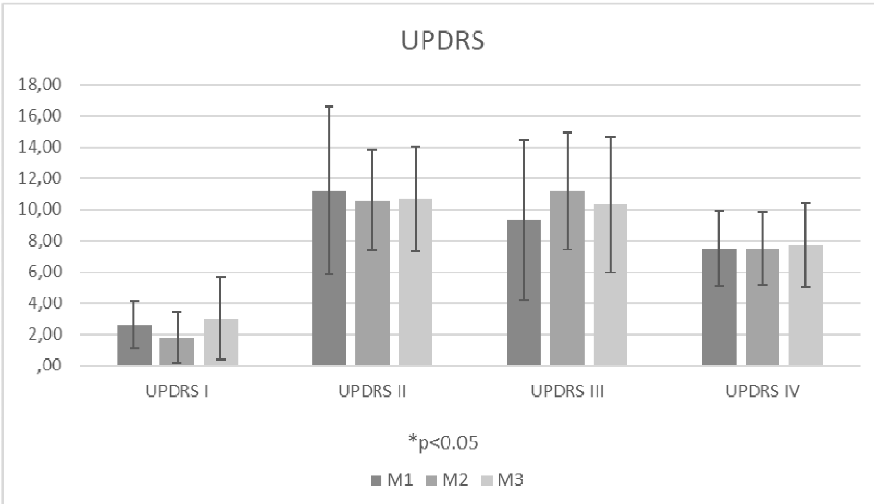
Legends: M1 (moment 1, before the confinement); M2 (moment 2, after the 8 weeks of confinement); M3 (moment 3, after the seven weeks of golf practice); SD (standard deviation); rep (repetitions); s (seconds); min (minutes). F = ANOVA one-way *significant difference ($p < 0.05$); ** Bonferroni post-hoc: significant difference between M3 and other moments (M1 vs. M3: $p = 0.049$; M2 vs. M3: $p = 0.037$).

A significant difference in the SFT component motor agility/dynamic balance was observed between M1 and M3 ($p = 0.04$) and M2 and M3 ($p = 0.03$).

Regarding the other variables evaluated by the SFT, no significant differences ($p < 0.05$) were found between the 3 moments: lower body strength ($F = 1.49$, $p = 0.24$); upper body strength ($F = 1.07$, $p = 0.35$); lower body flexibility ($F = 0.33$, $p = 0.72$); upper body flexibility ($F = 0.23$, $p = 0.79$); and alternative aerobic test ($F = 0.68$, $p = 0.51$).

In terms of the physical and functional capacities assessed by the UPDRS scale, there were no statistically significant differences ($p < 0.05$) among the three study moments: UPDRS I ($F = 0.951$, $p = 0.39$); UPDRS II ($F = 0.061$, $p = 0.94$); UPDRS III ($F = 0.460$, $p = 0.63$); and UPDRS IV ($F = 0.022$, $p = 0.97$). The results are presented in Figure III.

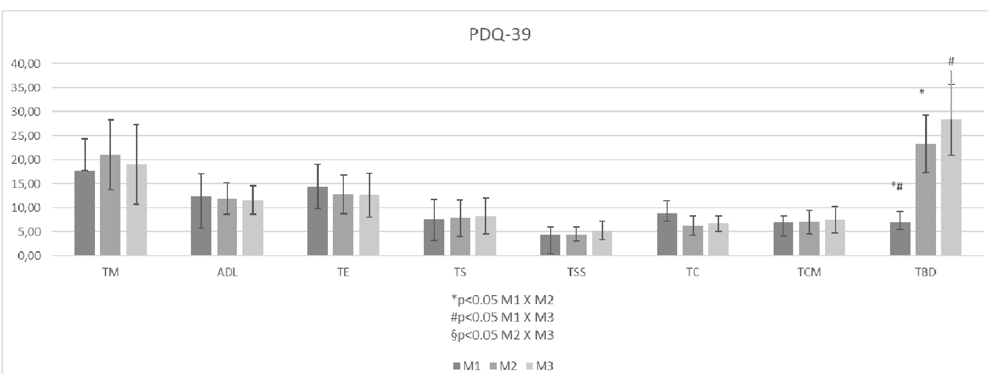
Figure III: UPDRS results



Legends: UPDRS I (behavioral and cognitive state); UPDRS II (activities of daily living); UPDRS III (motor examination); UPDRS IV (treatment complications)

The results of the PDQ-39 are presented in Figure IV. A significant difference was observed in the dimension of bodily discomfort ($F = 38.84$, $p = 0.00$) when comparing M1 vs. M2 ($p = 0.000$, $\Delta\% = 237.68$) and M1 vs. M3 ($p = 0.000$, $\Delta\% = 310.10$). No difference was found between M2 vs. M3 ($p = 0.178$, $\Delta\% = 21.46$). For the other dimensions of the PDQ-39, no significant differences ($p < 0.05$) were found: TM ($F = 0.501$, $p = 0.61$); ADL ($F = 0.117$, $p = 0.89$); TE ($F = 0.602$, $p = 0.55$); TS ($F = 0.088$, $p = 0.91$); TSS ($F = 0.591$, $p = 0.56$); TC ($F = 3.374$, $p = 0.049$); and TCM ($F = 0.195$, $p = 0.82$).

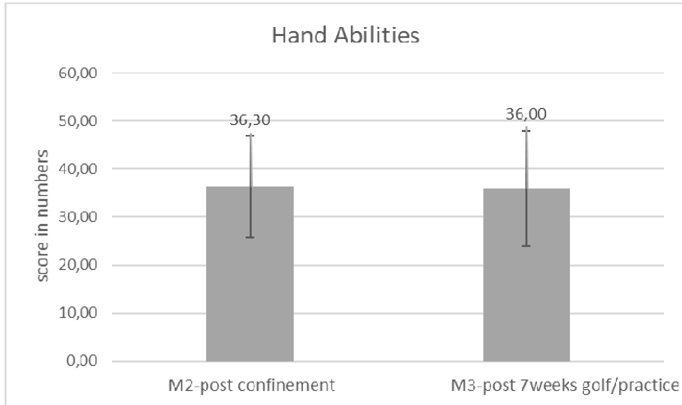
Figure IV**:** PDQ-39 results



Legend: PDQ-39 (Parkinson's Disease Questionnaire/39 questions); Total Mobility (TM); Activities of Daily Living (ADL); Total Emotional Well-Being (TE); Total Stigma (TS); Total Social Support (TSS); Total Cognition (TC); Total Communication (TCM); Total Bodily Discomfort (TBD).

The results regarding hand abilities and the impact of confinement on PD individuals participating in golf practice are presented in Figure V. No significant difference ($p < 0.05$) was found in the subjective perception of hand abilities between moment 2 (post-confinement) and moment 3 (after seven weeks of golf practice): ($T = 0.119$, $p = 0.90$).

Figure V: Subjective perception of hand abilities between M2 and M3



Legend: M2 (moment 2); M3 (moment 3)

The descriptive results of the HRQoL volunteers' subjective perceptions regarding the confinement impact are provided below. These questions were answered only in M2 of the study (post-confinement). The marital status of the sample consisted of 2 (20%) single individuals and 8 (80%) married individuals. Only one person spent the confinement period alone. Most of them (90%) missed their family or friends, but only one (10%) felt lonely. All of them (100%) went out for exercise, to visit the doctor, pharmacy, or supermarket; six (60%) had a home with a garden.

Regarding sleep quality, 3 (30%) reported poor sleep, while 7 (70%) reported sleeping for 5–7 h, and 3 (30%) reported sleeping for 8–10 h. Before the confinement, 2 (20%) spent more than 5 h per day seated, which increased to 3 (30%) during the confinement period.

All volunteers (100%) changed their exercise routines. Before the confinement period, 3 (30%) practiced physical activity 1–2 times a week, 4 (40%) exercised 3–4 times, and 3 (30%) exercised 5–7 times. During the confinement, 7 (70%) exercised 1–2 times a week, 2 (20%) exercised 3–4 times, and 1 (10%) exercised 5–7 times. Most of them, 7 (70%), exercised without supervision. The final question addressed their general subjective perception of the confinement regarding their HRQoL, revealing that 6 (60%) were neutral and 4 (40%) were negative.

Discussion

Regarding the results of this study, it is notable that despite the oldest volunteer being 73 years old, the sample cannot be classified as elderly according to the WHO (World Health Organization) definition, which classifies elderly individuals as 65 years or older. Although the sample meets the criteria for 'normal weight' according to the WHO BMI classification, attention should be given to the minimum BMI value of 17.26, which indicates underweight according to the WHO BMI classification. Energy expenditure in PD individuals may decrease owing to motor impairment, yet it can increase with the worsening of muscle rigidity (Kashihara, 2006). Despite an increased energy intake, PD patients often begin to lose weight several years before their disease is diagnosed (Chen et al., 2003).

Improving nutritional status can potentially enhance the QoL for individuals with advanced-stage PD. Weight loss warrants careful attention even in the early stages of the disease. Several factors contribute to disrupted energy intake and weight loss in PD, including dopa-induced dyskinesias, gastrointestinal absorption and motility issues, dysphagia, and depression-related anorexia (Kashihara, 2006).

In evaluating physical and functional capacities using the SFT, significant improvements were observed in PD individuals participating in golf practice, particularly in the agility/dynamic balance (ADB) component. These significant improvements were noted between M1 (before confinement) and M3 (after seven weeks of golf practice), as well as between M2 (after confinement) and M3. However, no significant difference was found between M1 and M2.

These results suggest that there was no significant change in the SFT ADB score among the volunteers after the eight-week lockdown period, but a significant increase was observed after the seven weeks of golf practice. Further studies are needed to explore this and other variables of the SFT in longer-duration golf practice programs.

Golfing is an activity that can improve both the physical and psychological aspects of balance control in older participants (Gao et al., 2011). In a three-year golf program, older golfers demonstrated improved static and dynamic balance control. These results likely stem from weight transfers during repeated golf swings, transitioning from a two-leg to a predominantly one-leg stance, and navigating uneven fairways (Tsang & Hui-Chan, 2010).

Good balance and precise posture control are essential to perform a golf swing effectively. A cross-sectional study comparing balance control and confidence between older golfers and non-golfing individuals demonstrated that golfers exhibit significantly better balance and higher balance confidence than controls (Gao et al., 2011).

Golfing has been shown to enhance balance control in older participants. Older golfers in a three-year golf program demonstrated improved static and dynamic balance. These results likely stem from weight shifts during repeated golf swings, transitioning from a two-leg to a predominantly one-leg stance, and navigating uneven fairways (Tsang & Hui-Chan, 2010).

A study examining the impact of a repetitive adapted golf program on functional fitness and balance in adults recovering from stroke found statistically significant increases in coordination, 'standing on one foot,' and strength among participants (Zoerink & Carter, 2015). Another study investigating the effects of an eight-week golf-specific exercise program on physical characteristics, swing mechanics, and golf performance concluded that such a program enhances strength, flexibility, and balance in golfers (LEPHART et al., 2007).

Although the other variables evaluated by the SFT did not show significant differences, it is conceivable that improvements in other SFT variables could potentially be observed with a longer study duration.

The other instrument used to assess physical and functional capacity related to QoL was the UPDRS scale. There are two versions of the UPDRS: the original UPDRS and a revised version developed to address identified issues while retaining the strengths of the original (Goetz et al., 2008). In this study, the original UPDRS was utilized. The UPDRS scale aims to provide a comprehensive, practical, and easy-to-administer tool that can be used across all patients regardless of age, severity of PD, or treatment regimen. It is a valuable instrument in clinical trials and assessing the efficacy of new treatments for PD. Widely recognized for its utility, the UPDRS scale remains the main choice for evaluating treatment-related benefits in PD (Goetz, 2010).

For the physical and functional capacities of PD individuals undergoing golf practice, as evaluated by the UPDRS scale, no statistically significant differences were observed among the three assessment points. It is important to note that the study duration was limited to 7 weeks; extending the study period may reveal significant differences.

One of the most commonly used questionnaires to assess the subjective QoL in PD is the PDQ-39. Regarding the QoL of PD individuals undergoing golf practice, as evaluated by the PDQ-39 questionnaire, a significant difference was found in the bodily discomfort (BD) variable.

The differences were observed between moments 1 (before the confinement) and 2 (after the confinement) and between moments 1 and 3 (after the seven weeks of golf practice). Upon analyzing these findings, it is evident that BD increased by 237.8% between M1 and M2, indicating a negative impact of confinement on this aspect of QoL. However, between M1 and M3, the increase in BD was 310%, suggesting that bodily discomfort did not significantly worsen after the seven weeks of golf practice. This is further supported by the non-significant difference ($\Delta\% = 21.46$) between M2 and M3. Therefore, it can be inferred that, despite PD being a progressive disease, golf practice may potentially slow down the progression of bodily discomfort in individuals with PD.

The results regarding the cognition aspects of the PDQ-39 indicated a modest but significant improvement ($p = 0.049$). This difference was observed between moments 1 (before the confinement) and 3 (after the seven weeks of golf practice). This finding suggests that if the volunteers had participated in the golf program for a longer duration, they might have continued to experience cognitive improvements. This hypothesis is supported by existing exercise studies in PD, which have demonstrated increased gray matter volume and cortical motor excitability, changes associated with behavioral improvements (Ellis & Rochester, 2018)

Results from a randomized controlled trial investigating the effects of golf training on cognition in older adults indicate that golf-based exercise interventions may enhance logical memory in this population (Shimada et al., 2018).

The sample for this study predominantly consisted of men (80%). Men appear to perceive their QoL less favorably based on the PDQ-39 questionnaire. A comparative study involving 40 individuals with PD aimed to assess QoL and explore potential correlations between disease severity and duration in men and women. According to the PDQ-39, men reported lower QoL and exhibited greater impairment in the dimensions of "activities of daily living" and "social support," according to the PDQ-39. In contrast, women demonstrated higher impairments in the dimensions of "emotions" and "bodily discomfort." Additionally, disease severity was associated with a lower perception of QoL, specifically related to the "activities of daily living" and "cognition" dimensions (Navarro-Peternella & Marcon, 2012).

Golf is a sport that heavily relies on and stresses the hands. During a golf game, the golfer's only point of contact with the club is through their hands. Individuals with PD often experience hand impairments such as rigidity (freezing), tremors (dyskinesia), or other symptoms such as pain or tingling. It can be argued that the hands perform some of the most critical kinematic functions of the body. They shape, mold, and grasp various objects with stability, strength, or delicate precision. The hands are pivotal in performing many daily activities (Holland, 2019).

About the results, no significant difference was found in the subjective perception of hand abilities among PD participants after seven weeks of golf practice compared to post-confinement. This suggests that, for the volunteers in this study, seven weeks of golf practice did not influence this variable. Future studies should investigate whether golf practice could impact the subjective perception of hand abilities in PD individuals, utilizing additional hand evaluations such as hand grip strength measured by a dynamometer.

Regarding the impact of confinement on HRQoL in people with PD, it is too early to determine whether COVID-19 will have long-term effects on patients with PD and other movement disorders. There is insufficient evidence to suggest that PD alone increases the risk of contracting COVID-19. However, the vulnerability of the elderly and the higher prevalence of PD in an aging population may increase the risks of COVID-19 infection among these individuals. Additionally, the pandemic-induced strain on hospitals compromises standard neurological care provision (Papa et al., 2020).

The results concerning the subjective perception of confinement's impact on HRQoL in PD patients who practiced golf showed that although 40% of the volunteers perceived it negatively, most (60%) perceived it neutrally. Notably, only one participant spent the confinement alone. Most were married, had homes with gardens, and all went out for exercise or other activities. These factors may have contributed to the volunteers' more favorable perception of this period.

Regarding sleep quality and sedentary lifestyle (hours seated per day), the results followed a similar pattern: only 30% of the volunteers reported poor sleep, and there was almost no change in the number of hours spent sitting each day.

A study evaluating neuropsychiatric symptoms and QoL in Spanish Alzheimer's disease patients after five weeks of COVID-19 lockdown confinement demonstrated a worsening of neuropsychiatric symptoms in patients with Alzheimer's disease and amnesic mild cognitive impairment, with agitation, apathy, and aberrant motor activity being the most affected symptoms. However, a decrease in QoL was not observed (Lara et al., 2020).

However, an analysis of their exercise routines reveals changes for all volunteers. Before the confinement period, 70% of the volunteers exercised three to seven times a week, while 30% exercised once or twice a week. During the confinement, these values were reversed: 70% exercised only once or twice a week, and 30% exercised three to seven times. Additionally, before confinement, all volunteers practiced exercises under the supervision of a physical activity professional. During confinement, 70% exercised without any supervision. This indicates that the confinement period had a negative impact on the volunteers' exercise routines.

A pilot study aimed at determining the relationship between physical activity and QoL during COVID-19 confinement concluded that there was a positive association between physical activity levels and perceived QoL during confinement (Slimani et al., 2020).

Although this study was performed over a short period, we observed a positive impact of golf practice on two variables: agility/dynamic balance (SFT) and bodily discomfort (PDQ-39). Therefore, we can conclude that golf practice can improve certain aspects of physical and functional capacity and QoL in individuals with PD.

Further studies are needed to investigate whether these variables continue to improve with a longer golf practice, whether extended golf practice could improve other SFT and PDQ-39 variables, and whether significant differences on the UPDRS scale could be identified. Additionally, other benefits of golf practice, such as its effects on executive functions, which is the most common cognitive impairment in PD patients, should also be explored. A seven-week study indicated that moderate physical activity could improve cognitive functions (Pompeu et al., 2012).

Conclusion

The findings suggest that golf practice positively impacts agility/dynamic balance and reduces bodily discomfort in individuals with PD. These improvements indicate that golf can be an effective alternative therapy for enhancing physical and functional capacities and QoL in PD patients.

For healthcare providers and rehabilitation centers, integrating golf as a therapeutic activity could offer a novel approach to managing PD, potentially improving patient outcomes and satisfaction. The social and cognitive aspects of golf also make it a valuable addition to traditional therapy regimens for mental health.

Future research should explore the long-term benefits of golf practice in PD patients, including its physical impact on cognitive functions.

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