Hyperdopaminergic Manifestations in Parkinson's Disease: Correlation between Impulse Control Disorders and Levodopa-Induced Dyskinesia

Original Article

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ABSTRACT

Objective: To explore the relationship between levodopa-induced dyskinesia and impulse control disorders (ICDs) in Parkinson's disease (PD), exploring the hyperdopaminergic motor and non-motor state.

Methods: A cross-sectional study was conducted on 30 PD patients with dyskinesia. All Participants were assessed by motor and non-motor validated scales. These included the third part of the Unified Parkinson's Disease Rating Scale owned by the movement disorders society MDS-UPDRS III, The Unified Dyskinesia rating scale (UDysRS) , Non -Motor symptoms scale for Parkinson's disease (PD NMSS) in addition to dopamine dysregulation syndrome and impulse control disorders, cognition, depression and anxiety .

Results: The study group had a mean age of 58 ± 6.9 years, with 76.7% males. The mean disease duration was 8.8 ± 4 years. Impulse control disorders (ICDs) were observed in 60% of patients, with excessive medication intake being the most common. All patients had moderate to severe motor symptoms, while the majority exhibited severe to very severe non-motor manifestations. A weak non-significant correlation (r = 0.194, p = 0.304) was found between levodopa-induced dyskinesia assessed by UDysRS and Impulse control disorders assessed by the Questionnaire for impulsive compulsive disorders in Parkinson's disease (QUIP-RS), suggesting a possible association between both conditions.

Conclusion: While a non-significant positive correlation between dyskinesia and impulse control disorders was identified, further studies are needed to explore the complex interplay between hyperdopaminergic motor and non-motor symptoms in Parkinson's disease.

Key Words: Impulse control disorders, levodopa induced dyskinesia, levodopa equivalent dose, Non- Motor, Parkinson's.

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INTRODUCTION

Parkinson's disease is a long-term, progressive, and debilitating condition characterized by a combination of motor and non-motor symptoms[1]. Dopaminergic replacement therapy remains the cornerstone of Parkinson's disease (PD) treatment[2]. However, prolonged use of dopaminergic medications is frequently linked to the emergence of motoric and behavioral complications, primarily manifesting as mixed hyperkinetic movement disorders known as levodopa induced dyskinesia (LID) and impulse control and dopamine dysregulation syndrome[3].

Impulse control disorders (ICDs) are neuropsychiatric conditions marked by a persistent inability to resist urges or impulses that may be harmful to oneself or others. These disorders encompass behaviors such as pathological gambling, compulsive sexual activity, binge eating, compulsive shopping, and compulsive hobbyism. Additionally, punding a term describing repetitive, non-goal-oriented activities like sorting objects, excessive organizing, or dismantling items is often observed. Another related condition is dopamine dysregulation syndrome (DDS), characterized by the compulsive overuse of dopaminergic medications[4]. A focus on manifestations other than the traditional triad of idiopathic Parkinson's (PD) has grown in recent years. There is now ample evidence that cognition and emotion are also impaired, with psychiatric symptoms prevalent in more than 60% of PD patients[5].

Levodopa-induced dyskinesia and impulse control disorders are common and disabling complications of

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dopaminergic therapy in Parkinson's disease. They may coexist and are possibly related[6].

AIM OF THE STUDY

Aim of the study is to study the association between levodopa- induced dyskinesia and impulse control disorders in PD (correlation between motor and non-motor hyperdopaminergic state).

MATERIALS AND METHODS

This observational cross-sectional study was conducted over seven months on 30 Parkinson's disease patients consulting at the movement disorders clinic of Ain Shams University Hospitals. The Inclusion Criteria: Both males and females above 18 years age, Patients were selected according to the MDS 2015[7], disease duration more than 5 years, and on oral therapy of Levodopa and/or dopamine agonists and developed any kind of dyskinesia. Each participant signed a written consent form to be included in this study. Our Exclusion Criteria: Patients with atypical or secondary Parkinsonism diagnoses, any patients who were implanted with leads of Deep Brain Stimulation (DBS), Moreover any patient with ablative basal ganglia operations. We also excluded any patient who have any other neurological disorder or any premorbid psychiatric disorders (including significant depression and anxiety) or intellectual impairment.

All the participants underwent a history taking, neurological examination and MRI brain before being evaluated on the following scales:

- The Movement Disorder Society- Unified Parkinson's Disease Rating Scale (MDS-UPDRS) parts III and IV[8] Maximum score of part III is 132 (mild motor dysfunction less than or equal 32, moderate degree 33-58 and severe degree more than or equal 59).
- Hoehn and Yahr rating (H&Y)[9].
- Unified Dyskinesia Rating scale (UDysRS)[10]. It consists of 4 parts with total score of 104.
- Questionnaire for Impulsive Compulsive Disorders in Parkinson's Disease Rating Scale (QUIP-Rating Scale)[11]. The total score is 112 with the following cutoff values (pathological gambling ≥ 6, compulsive buying ≥8, hypersexuality ≥8, binge eating ≥ 7, hobbyism ≥7, punding ≥7, PD medication overuse ≥ 7, total ICD score ≥ 10).
- Non-Motor Symptoms Scale for Parkinson's Disease (NMSS)[12]. Its maximal score is 360 (mild degree 1-20, moderate 21- 40, severe 41-70 and very severe more than or equal 71).
- Montreal Cognitive Assessment Arabic version (Arabic MoCA)[13]. Its total score is 30 with cutoff point of less than or equal to 23.
- Beck depression inventory scale (BDI)[14]. The total score of BDI scale is 63 (normal 1-10, mild mood disturbance 11-16, borderline clinical depression 17-20, moderate depression 21-30, severe depression 31-40 and extreme depression for more than 40).
- Parkinson anxiety scale (PAS)[15]. Its total score is 48 with cutoff value of positive anxiety of more than or equal 14.

STATEMENTS AND DECLARATION

This manuscript was developed following the STROBE Statement Checklist[16]. The study complied with the ethical principles outlined in the Declaration of Helsinki, and all participants provided informed consent prior to enrollment. Confidentiality was upheld throughout the research, ensuring that all data were anonymized before analysis.

Data Processing and Statistical Analysis

The collected data underwent thorough examination, coding, and organization before being entered into a computerized system utilizing the Statistical Package for Social Sciences (SPSS) version 26. The presentation and subsequent analysis of the data were determined based on the nature of each variable.

Descriptive Statistics:

- For parametric numerical data, results were expressed as mean, standard deviation (± SD), and range.
- For non-parametric numerical data, results were presented as median and interquartile range (IQR).
- For categorical (non-numerical) data, frequency distributions and percentages were reported.

Analytical Statistics:

- **Correlation Analysis**

  * Pearson's correlation coefficient was used to assess the relationship between two continuous variables. The correlation strength and direction were represented by the coefficient (r):

    - 0 to 0.29 → Weak correlation.
    - 0.30 to 0.59 → Fair correlation.
    - 0.60 to 0.79 → Moderate correlation.
    - 0.80 to 0.99 → Very strong correlation.
    - 1 → Perfect correlation[17].

- **Comparative Tests:**

  * Student's t-test: Applied to determine whether there was a statistically significant difference between the means of two study groups.

  * Chi-square test: Used to assess associations between categorical variables.

  * Fisher's exact test: Employed when the expected count was less than 5 in more than 20% of the cells to ensure accurate analysis of qualitative variable relationships.

RESULTS

The study sample included 30 patients with Parkinson's disease 23 male and 7 females. The mean age of the study group is 58 ± 6.9 years, 23 of the study group are males (76.7%) and the mean Levodopa Equivalent Daily Dose (LEDD) is 848± 289. The mean duration of the disease in years in our group is 8.8 ±4 and the mean duration of levodopa is 8.2±3.5. The mean score of MDS-UPDRS Part III is 68.57 ±18.852 and of part IV is 10.27± 2.828. The mean score of PD NMSS is 74.30± 32.705, the mean score of MOCA-B is 24.33± 2.796 and mean score of PAS is 16.63 ±6.077. The mean score of UDysRS values is 32.17 ±17.040, the mean score of QUIP-RS results is 16.77±11.849 and the mean value of BDI results is 16.30 ± 8.272.

18 patients of the study group (60 %) are with impulse control disorders. Among the 18 patients diagnosed with impulse control disorders, the distribution of specific behaviors was as follows: one patient exhibited compulsive gambling, six patients experienced excessive sexual behavior, one patient engaged in compulsive shopping, eight patients displayed episodes of uncontrollable overeating, five patients showed signs of obsessive hobby engagement and repetitive non-goal-directed behaviors (punding), and nine patients demonstrated excessive use of Parkinson's disease medications. 20 of our patients in the study had anxiety while 10 did not have anxiety. According to BDI: Among our patients, eight exhibited no mood abnormalities, ten experienced mild emotional disturbances, three showed signs of borderline clinical depression, nine were diagnosed with moderate depressive symptoms, and two presented with severe depression. Concerning cognition: only 10 out of 30 patients had cognitive impairment. Regarding the motor impairment assessed by MDS-UPDRS part III: 10 of our patients were moderate degree while 20 were severe in degree. In terms of the non-motor manifestations assessed by PD NMSS: 5 were moderate in degree, 8 were severe and 17 were very severe.

Table 1: Association Between Levodopa-Induced Dyskinesia (UDysRS Total Score) and Impulse Control Disorders (QUIP-RS Total Score) in Parkinson's Disease.

		Total Score QUIP-RS
Unified Dyskinesia Rating Scale	Pearson Correlation	.194
	P value	.304

This table showed that there is a poor positive correlation (not significant) between total scores QUIP-RS and UDysRS.

Table 2: Comparison of Demographic, Clinical, and Neuropsychological Factors in Parkinson's Disease Patients With and Without Impulse Control Disorders.

	Positive QUIP-Rs	Negative QUIP-Rs	*P Value*
Mean age	61.00	58.48	0.72
Mean LEDD	875.00	847.41	0.92
Mean disease duration	7.00	8.90	0.65
Mean levodopa duration	7.00	8.31	0.72
Male	14	9	0.597
Female	4	3	
PAS Positive N (%)	13(72.2)	7(58.3)	0.46
Negative N (%)	5 (27.8)	5 (41.7)	
BDI Normal	3(16.7)	5(41.7)	0.14
Mild mood disturbance	6(33.3)	4(33.3)	
Borderline clinical depression	3(16.7)	0(0)	
Moderate depression	4(22.2)	5(25)	
Severe depression	2(11.1)	0(0)	
Negative MOCA-B	11(61.1)	9(75)	0.69
Positive MOCA-B	7(38.7)	3(25)	
MDS-UPDRS part 3 Moderate	6(33.3)	4(33.3)	1
MDS-UPDRS part 3 Severe	12(66.7)	8(66.7)	
Unified Dyskinesia Rating Scale Less than 30	9(50)	8(66.7)	0.36
Unified Dyskinesia Rating Scale Greater than or equal to 30	9(50)	4(33.3)	
PD NMSS Grades Moderate	2(11.1)	3 (25)	0.1
PD NMSS Grades Severe	3(16.7)	5 (41.7)	
PD NMSS Grades Very severe	13 (72.2)	4 (33.3)	

This table demonstrated that there is no significant statistical distinction between patients with positive and negative QUIP-RS scores, regarding the following: Age, Sex, LEDD, Disease duration in years, levodopa duration in years, regarding positive and negative PAS, BDI grades, in relation to MOCA -B scale grades, regarding grades of MDS-UPDRS part 3, regarding Unified Dyskinesia Rating Scales divided by the median, regarding grades of PD NMSS.

Table 3: A correlation study between impulse control disorders and (age, LEDD, disease duration in years, levodopa duration in years, MDS-UPDRS part 3, depression, anxiety, cognition and non motor manifestation).

		Age	LEDD	Disease duration	Levodopa duration	MDS-UPDRS part 3	PD NMSS	Anxiety scale (PAS)	Depression scale (BDI)	Cognition (MOCA- B)
Total score of QUIP-Rs	Pearson Correlation	-.072	.036	.048	.106	.005	.181	.084	.005	-.038
	P value	.707	.850	.800	.576	.978	.337	.661	.978	.841

This table illustrated that there was no significant correlation between QUIP-RS score, age, and MOCA-B scale scores, LEDD, disease duration, levodopa treatment duration, MDS-UPDRS Part III, as well as PD NMSS, PAS, and BDI scores.

Table 4: Comparison between severity of dyskinesia in patients with each of (sex, age, LEDD, Disease duration and levodopa duration) whereas 30 is the median of UDysRs scores.

	Unified Dyskinesia Rating Scale		*P value*
	Less than 30	Greater than or equal to 30	
Male sex	12	11	0.42
Female sex	5	2	
Mean age	57.59	59.85	.385
Mean LEDD	816.18	890.38	.497
Mean Disease duration	8.88	8.77	.942
Mean Levodopa Duration	8.06	8.54	.721

This table indicated that stratifying the Unified Dyskinesia Rating Scale (UDysRS) based on the median value did not reveal any statistically significant variations in relation to age, sex, levodopa-equivalent daily dose , disease duration, or duration of levodopa therapy.

Table 5: A correlation study Dyskinesia compared with (age, LEDD, disease duration in years, levodopa duration in years, severity of motor manifestations and cognition).

		Age	LEDD	Disease duration	Levodopa Duration	UPDRS part 3	MOCA- B
Unified Dyskinesia Rating Scale (UDysRs	Pearson Correlation(r)	0.294	0.461	0.304	0.387	0.375	-0.113
	P value	0.115	0.010	0.103	0.035	0.041	0.553

Table 5 highlighted a moderate positive correlation between the total Unified Dyskinesia Rating Scale (UDysRS) score and the following factors: disease duration, duration of levodopa therapy, levodopa-equivalent daily dose, and MDS-UPDRS Part III score. Additionally, a weak correlation was identified between the total UDysRS score and both age and MOCA-B total score.

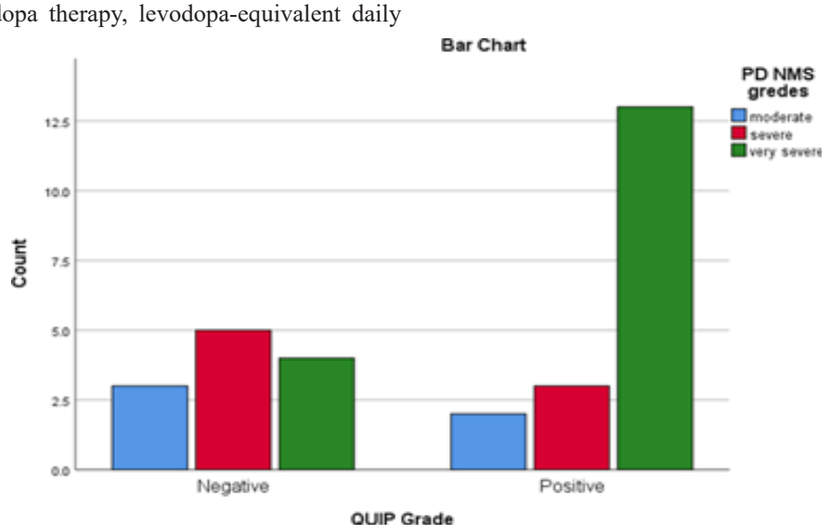

Fig. 1: Comparison between cases with positive and negative QUIP- Rs in relation to grades of PD NMSS.

DISCUSSION

Parkinson's disease is associated with both motor and non-motor complications, with levodopa-induced dyskinesia and impulse control disorders being among the most notable adverse effects of dopaminergic therapy (Carbone and Djamshidian, 2024)[18]. While both conditions are linked to prolonged dopamine replacement therapy, their relationship remains controversial, with conflicting findings across studies. The present study aimed to explore the potential correlation between LID and ICDs in PD patients.

Regarding the Correlation between the Unified Dyskinesia MDS Scale results and the results of the Impulse control disorder rating scale, our study revealed a poor positive correlation (insignificant) (*p value*=0.304). These results denoted that no significant correlation between dopaminergic therapy associates hyperkinetic movement disorders and the compulsive behavioral syndrome in PD. This conclusion is in line with Ricciardi and colleagues studies in 2020, 2023[19,20] who concluded that levodopa-induced dyskinesia and compulsive behavioral syndrome in Parkinson's disease are common but unrelated disorders in PD.

Ramirez Gomez and colleagues (2017)[21] did not found an association between LID and ICB . Whereas the ALTHEA study by Biundo and co-workers (2017)[6] confirms the correlation (*p-value* =0.004), this difference may be due to the smaller sample used in our study which is 30 cases which may limit discovery of small associations. ***Ramirez Gomez et al.*** (2017)[21] reported a higher prevalence of levodopa-related involuntary movements in individuals who did not exhibit compulsive behavioral syndromes. Additionally, Parkinson's disease patients without impulse control behaviors had a significantly longer disease duration compared to those with such behaviors. These findings align with the notion that these two conditions are not directly linked by a shared pathological mechanism; however, they may still present together due to overlapping risk factors, namely elevated levodopa-equivalent daily doses and prolonged disease duration[20].

The overall frequency of impulse control disorders in the ALTHEA study[6], which enrolled 251 patients with PD with various degrees of dyskinesias, was 55%, and the frequency of impulse control disorders was 40 % in Ricciardi and colleagues work[20] who enrolled 88 PD patients (29 females). While the frequency in our study (30 patients) was 60 %, given that both studies are using the same QUIP- Rs cutoff values.

Meanwhile Ricciardi and his team (2020)[19] who studied 55 PD patients, 25 of them had dyskinesias, found that there was no difference between the two groups with and without dyskinesias regarding the impulse control disorders assessed by the QUIP-Rs.

In addition to that, our study doesn't reveal any statistically meaningful difference when comparing positive and negative impulse control disorder cases using QUIP-Rs regarding mean age, sex, mean levodopa equivalent daily dose, mean disease duration, mean levodopa duration, Motor assessment score from the Movement Disorder Society Unified Parkinson's Disease Rating Scale part III score, depression by BDI, cognition by Arabic MOCA, anxiety by PAS, NMSS score results and Unified Dyskinesia Rating Scale (UDysRs) total score results. This is consistent with the results of ***Ricciardi et al.*** (2023)[20] who reported No noticeable variation in the proportion of males and females among PD patients with and without impulse control behaviors ICB. This is consistent with (***Wang et al.,*** 2016)[22] who reported no statistically significant difference between positive and negative impulse control disorders in Parkinson's patients regarding age, gender and disease duration but it revealed a significant difference relating to LEDD, noting that this study used the modified Chinese version of the Minnesota Impulsive Disorders Interview to assess impulse control disorders, not QUIP-Rs, and only 9 out of 217 PD patients were positive impulse control without any regard to whether they had dyskinesias or not.

Unlike The ALTHEA study by ***Biundo et al.*** (2017)[6] supports the associations regarding age, sex, depression by BDI and UDysRs total score results, while the ALTHEA study revealed no association with LEDD, mean disease duration, MDS-UPDRS part 3 score and cognition (MOCA). Cao and his coworkers in 2022[23] conducted a meta-analysis that demonstrated that there was a significant association when comparing positive impulse control disorders with non-impulse control disorders in PD, assessed by semi-structured interviews according to the clinical diagnostic criteria of ICBs, not QIP- Rs, against age, sex, disease duration and LEDD, depression (assessed by Hamilton Depression Rating Scale) and cognition assessed by Mini-Mental State Examination , however, it found an insignificant association with MDS-UPDRS part 3.

Regarding the association between impulse control disorder symptoms, as measured by the Questionnaire for Impulsive-Compulsive Disorders in Parkinson's Disease Rating Scale (QUIP-RS), and various clinical parameters, including patient age, total daily dopaminergic medication dosage (LEDD), length of disease progression, duration of levodopa therapy, motor function scores (MDS-UPDRS Part III), non-motor symptom severity (PD NMSS), and anxiety levels (PAS), depression (BDI) and cognition (Arabic MOCA), our study reported no significant correlation. This is corresponding to (***Paolini Paoletti et al.,*** 2019)[24] who denied any correlation between QUIP-RS and both disease duration and LEDD but there is no published literature about the other correlations up till now.

When comparing the Unified Dyskinesia Rating Scale results, divided into 2 groups (less than 30 (the median) & equal to or greater than 30) regarding sex, mean age, mean LEDD, mean disease duration and mean levodopa duration, there was no significant difference.

With respect to the relationship between Unified Dyskinesia Rating Scale (UDysRS) scores and various clinical parameters, including age, levodopa-equivalent daily dose (LEDD), duration of Parkinson's disease, length of levodopa therapy, motor impairment severity (MDS-UPDRS Part III), and cognitive function (MOCA scale), our study identified a moderate positive association with LEDD, disease duration, levodopa treatment duration, and MDS-UPDRS Part III scores, though it was an insignificant correlation with age and the MOCA scale. This is in agreement with ***Cubo et al.*** (2018)[25] who found that the total Unified Dyskinesia Rating Scale score showed no association with age but demonstrates a positive correlation with the duration of the disease (*p-value* <0.0001), this difference in the degree of correlation may be due to the large sample of the study in comparison to our study (2113 patients versus 30 patients of our study).

CONCLUSION

In conclusion, our findings suggest that LID and ICDs are common complications in PD patients receiving dopaminergic therapy; however, a definitive relationship has not yet been established. Further research with larger, more diverse populations and objective behavioral assessments is warranted to elucidate the distinct mechanisms underlying these disorders and to develop targeted therapeutic strategies.

Study Limitations:

One of the primary constraints of this research was the limited sample size, which restricts our ability to detect significant associations. Statistical analyses typically require a larger cohort to enhance the reliability of findings and ensure a more representative reflection of the broader population.

Another significant obstacle was the scarcity of reliable data of patients and lack of prior research studies on the topic in our country and even in the Arab world. In addition to that, self-reported data could contain some bias in the form of selective memory, exaggeration and cultural and religious value.

RECOMMENDATIONS

1. Future large-scale research is necessary to investigate clearly the correlation between the levodopa- induced dyskinesia and Compulsive behavioral disturbances in Parkinson's disease in our population.
2. More research to demonstrate accurately the pathogenesis of Compulsive behavioral disturbances in Parkinson's disease. and confirm the genetic polymorphism in its mechanism to predict the high-risk occurrence of impulse control disorders in PD.
3. Routine screening of Parkinson's disease patients using QUIP-Rs for early recognition and prompt intervention and hence Enhance well-being and daily functioning, and emotional well- being and decrease care burden.
4. Studies identifying management of impulse control disorders in PD by pharmacological and non-pharmacological treatment.
5. Additional studies are needed to identify and optimize the search for markers associated with impulse control disorders in PD, such as the recently suggested ICD risk score (ICD-RS).

DECLARATION

This Manuscript was written according to the STROBE Statement Checklist (14)(von Elm et al., 2008). And The study adhered to the Declaration of Helsinki, and informed consent was obtained from all participants before inclusion. Patient confidentiality was ensured throughout the research process, with data anonymized prior to analysis. This cross sectional study was approved by Faculty of Medicine Ain Shams University local Institutional Ethics Committee, IRB No; MS 439/2021

CONFLICT OF INTERESTS

There is no conflicts of interest.

AUTHORS' ROLE

A.M. put the main idea ,A.M and A.A collected the data , A.A was responsible for in data curation , A.M was responsible for the formal analysis , A.M, and A.G revised the methodology and A.M ,A.A and H.K wrote the main manuscript , A.G, and A.M revised the manuscript , S.E shared in editing in the manuscript.

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اضطرابات التحكم في الاندفاع وخلل الحركة الناجم عن الليفودوبا في مرض باركنسون، هل هناك علاقة؟

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المقدمة: التحقيق في العلاقة بين خلل الحركة الناتج عن الليفودوبا واضطرابات التحكم في الاندفاع في مرض باركنسون من خلال استكشاف الحالة الحركية وغير الحركية المرتبطة بفرط الدوبامين.

المنهجية: تم إجراء دراسة رصدية مقطعية على ٣٠ مريضًا بمرض باركنسون يعانون من خلل الحركة في عيادة اضطرابات الحركة بجامعة عين شمس. استوفى المشاركون معايير الجمعية الدولية لاضطرابات الحركة، وخضعوا لتقييمات حركية وغير حركية باستخدام مقاييس معتمدة. تضمنت هذه التقييمات الجزء الثالث من مقياس التصنيف الموحد لمرض باركنسون لمملوك للجمعية الدولية لاضطرابات الحركة، بالإضافة إلى الاستبيانات الموصى بها من الجمعية لخلل الحركة والأعراض غير الحركية. كما تم إجراء تقييم مفصل للأعراض غير الحركية باستخدام مقاييس لمتلازمة خلل تنظيم الدوبامين واضطرابات التحكم في الاندفاع، بالإضافة إلى تقييم الإدراك، والاكتئاب، والقلق .

النتائج: كان متوسط عمر المشاركين ٥٨±٦,٩ سنة، و بلغت نسبة الذكور ٧٦,٧ ٪. كان متوسط مدة المرض ٨,٨± ٤ سنوات، و متوسط جرعة الليفودوبااليومية المكافئة ٨٤٨±٢٨٩ ملغ. تم تشخيص اضطرابات التحكم في الاندفاع لدى ٦٠ ٪ من المرضى. بلغ متوسط الدرجة في الجزء الثالث من مقياس التصنيف الموحد لمرض باركنسون لمملوك للجمعية الدولية لاضطرابات الحركة ٦٨,٥٧. بينما كان متوسط الدرجة في مقياس الأعراض غير الحركية لمرض باركينسون ٧٤,٣٠، و متوسط الدرجة في مقياس مونتريال للادراك المعرفي ٢٤,٣٣. و كان متوسط الدرجات في المقاييس اللأخرى: ١٦,٦٣± ٦,٠٧

٣٢,١٧±١٧,٠٤, ١٦,٧٧±١١,٨, ١٦,٣±٢٧

مقياس القلق لمرض باركنسون، مقياس تصنيف خلل الحركة الموحّد، مقياس تصنيف اضطرابات الاندفاع والقهر في مرض باركنسون، ومقياس بيك للاكتئاب على التوالي. و أظهرت الدراسة أن هناك ارتباط بين خلل الحركة الناجم عن الليفودوبا واضطرابات التحكم في الاندفاع بمعامل ارتباط بيرسون يساوي ٠,١٩٤

و القيمة الاحتمالية تساوى٠,٣٠٤.

الاستنتاج: على الرغم من تحديد ارتباط ضعيف بين خلل الحركة واضطرابات التحكم في الاندفاع، هناك حاجة إلى مزيد من الدراسات لاستكشاف التفاعل المعقد بين الأعراض الحركية وغير الحركية المرتبطة بفرط الدوبامين لدى مرضى باركنسون.