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Improving the Quality of Life
in the Parkinson's Community

**Sleep in
Parkinson's Disease:
A comparison between
those with and without
Deep Brain Stimulation**

Spring 2014

INTRODUCTION

Sleep disorders are one of the most common and disturbing non-motor symptoms in Parkinson's disease (PD), affecting an estimated 60% to 98% in this population (Comella, 2003; Lees, et al, 1988; Tandberg, et al, 1998). Fragmented sleep, one of the most common night-time sleep complaints, is associated with parkinsonian symptoms, medication effects, psychiatric disorders, such as depression or anxiety, co-existing medical conditions, autonomic disturbances (e.g., frequent night-time urination), sleep apnea (shallow breathing or short or long pauses in breathing), rapid eye movement (REM) sleep behavior disorder (abnormal sleep involving vivid dreams along with physical acting out of dreams), restless leg syndrome, and periodic limb movements of sleep (Comella, 2003).

In PD, deep brain stimulation (DBS) is intended to treat motor symptoms of PD, but it may have a positive impact on non-motor symptoms, such as sleep disturbances. Among individuals who underwent DBS-STN, increased total sleep time is reported in several research studies (Arnulf et al., 2000; Cicolin et al., 2004; Deuschl et al., 2006; Hjort, Ostergaard Dupont, 2004; Kumar et al., 1998). For example, in one study, total sleep time increased by almost an hour when compared to total sleep time prior to DBS (7.7 hours at baseline versus 8.4 hours at 6 months; Deuschl et al., 2006). In addition to increase in total sleep time, other researchers found improvements in other aspects of sleep after DBS of the subthalamic nucleus (STN), including an increased duration of uninterrupted sleep (Cicolin et al., 2004), and decreased wakefulness after sleep onset. In another study, several participants attributed their improved sleep to improved night-time mobility (Kumar et al., 1998), whereas another study suggested that DBS reduced the motor disturbance at night and dystonia in the early morning (Arnulf et al., 2000; Kumar et al., 1998). Supporting the value of DBS on sleep, Volkman and associates (2009) reported on long term effects on quality of life (QOL) for patients who underwent DBS of either STN or GPi; six months after the procedure, QOL related to sleep and rest improved from baseline in both groups.

OBJECTIVE

1. To investigate the prevalence of sleep disturbance in a large sample of individuals with PD using the Parkinson's Disease Sleep Scale-2 (PDSS-2).
2. To investigate the similarities and differences of self-reported sleep disturbance in individuals who have PD **with DBS** and **without DBS**.

METHODS

There were 1,247 individuals who participated in this survey, including 353 participants with PD who underwent **DBS** and 894 individuals with PD **without DBS (Non-DBS group; see Table 1 for demographics)**. Of the DBS participants, 10 had stimulation in the thalamus, with the remainder having stimulation in the Subthalamic Nucleus (STN) and Globus Pallidus Interna (GPi). The data analyses did not include individuals who received thalamic stimulation. Participants who participated in previous surveys conducted by The Parkinson Alliance (PA) were invited to participate in this study, and additional participants were recruited through advertisements at PD support groups, announcements in medical clinics, The PA website, or the DBS-focused affiliate website to The PA (DBS4PD.org). For the **DBS group**, 86% of the surveys were completed independently, whereas 14% of participants required assistance. For the **Non-DBS group**, 84% of the surveys were completed independently, and 16% of participants required assistance. Participants represented 50 states, with California (18.8%), Florida (10.8%), Arizona (9.5%), New Jersey (9.2%), New York (8.6%), and Texas (7.5%) being the top 5 states that had the most participants. There were 12 international participants.

The Demographic Questionnaire and Questions Related to Sleep:

The demographic questionnaire included questions related to background information and to a broad range of variables related to sleep, including quality of sleep, sleep habits, treatments for sleep disturbances, emotional well-being, quality of life, and the perceived impact of DBS on sleep (if applicable).

Parkinson's Disease Sleep Scale-2 (PDSS-2; Trenkwalder, 2011):

The PDSS-2 consists of 15 questions about various sleep and night-time disturbances. It is a standardized measure that was designed to be rated by individuals with PD using one of five responses, from 0 (never) to 4 (very frequent). The PDSS-2 total score ranges from 0 (no disturbance) to 60 (maximum nocturnal disturbance). There are three subscales, each consisting of 5 questions; the subscale scores range from 0 (no disturbance) to 20 (maximum nocturnal disturbance) and include the following categories: (1) Motor Symptoms at Night; (2) PD Symptoms at Night; and (3) Disturbed Sleep (See Table 2). The differences between subscale

items classified as Motor Symptoms at Night and PD Symptoms at Night, as determined by the “instrument design,” can be seen in Table 2. Note, within this study, “Motor Symptoms” and “PD Symptoms at Night” will often be combined in their description and will be referred to as “symptoms related to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing.”

* Sample sizes noted in the sections below may vary somewhat within specific groups (e.g., younger, older, early, advanced, DBS, Non-DBS etc.), since some individuals may not have responded to a specific question.

Factors to consider when interpreting the results:

This study used a survey-based methodology. Some symptoms, such as depression and anxiety, and quality of life, were based off of one question, and thus interpretation of the findings related to these variables needs to keep this in mind. Generalizability of the results may be limited. Level of awareness of sleep disturbance may be reduced, which may impact one’s report of sleep disturbance. Furthermore, participants have different surgeons and neurologists, which may result in diverse outcomes and management of symptoms.

RESULTS

The summary of the demographic information for this study can be found in Table 1. The average age for the **DBS group** participants was 66 and 71 for the **Non-DBS group**. The average age of PD onset was 51 years for the **DBS group** and 64 years for the **Non-DBS group**. Gender (male greater than female), marital status (majority being married), race (majority being White/Caucasian), and education (majority having higher education) were equally represented between groups.

Table 1. Demographics and Clinical Features of the Sample

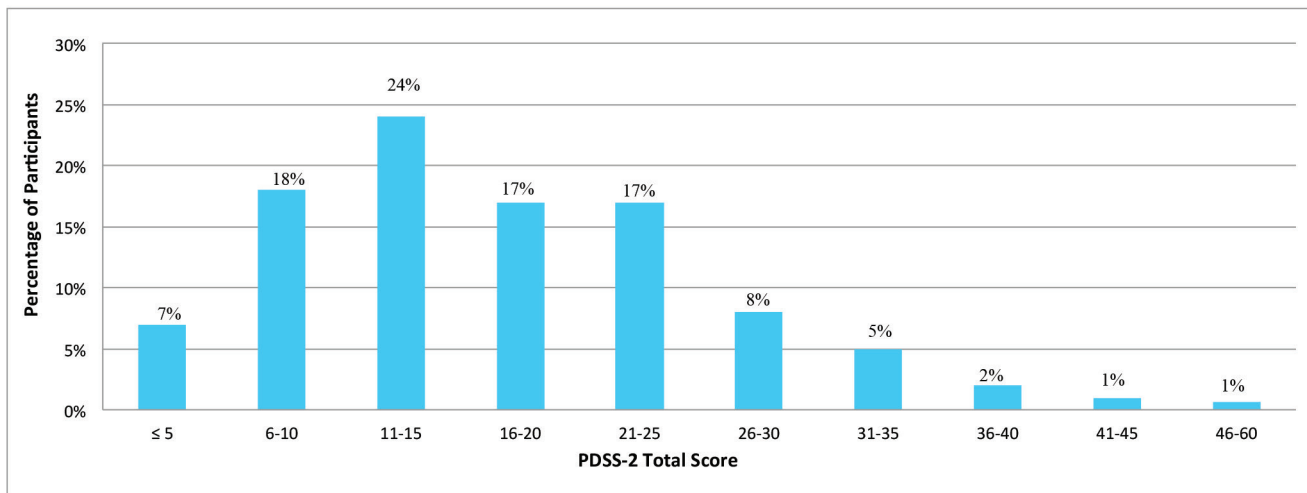
Variable	DBS (N=343)	Non-DBS (N=894)
Average Age in Years * (Range)	66 (41-86)	71 (38-101)
Duration of PD in Years * (Range)	15 (2-45)	7 (0-46)
Average Age of PD Onset * (Range)	51 (21-76)	64 (27-89)
Average Age at Time of DBS in Years (Range)	60 (33-85)	n/a
Average Duration since DBS in Years (Range)	5.2 (0-16)	n/a
Bilateral Stimulation	90%	n/a
Unilateral Stimulation	10%	n/a
Male	62%	58%
Female	38%	42%
Married	78%	77%
Living with Someone	89%	85%
Race		
White/Caucasian	95%	96%
Black/African American	1%	1%
Asian	1%	1%
Other	<1%	<1%
Hispanic	3%	2%
Native Hawaiian or Other Pacific Islander	0%	<1%
Education: ≤ High School	12%	13%
Some College	24%	23%
College	26%	27%
Graduate/Advanced Degree	39%	36%
Symptoms First Appeared – Right Side	46%	41%
Left Side	48%	42%
Not Sure	6%	17%

* Denotes significant differences between the groups n/a = not applicable

SLEEP IN PARKINSON'S DISEASE: WHOLE SAMPLE (DBS and Non-DBS participants)

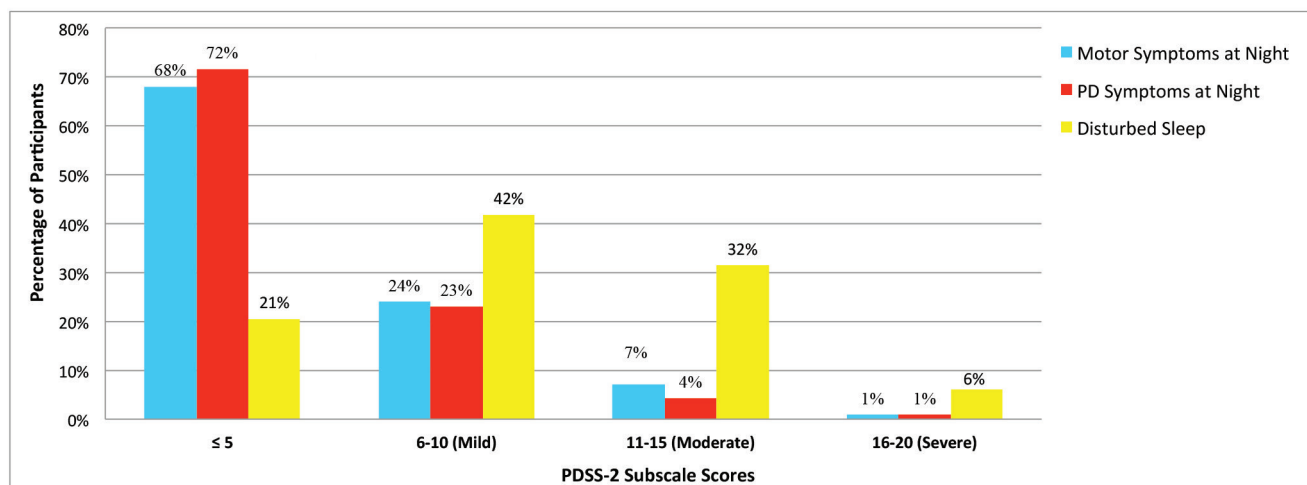
- For participants in this study, the average amount of hours slept without waking was 4.9 hours.
- The average cumulative hours slept in an evening was 6.9 hours.
- As shown in Figure 1, responses on the Parkinson's Disease Sleep Scale-2 (PDSS-2) indicate that approximately 93% of the participants endorsed at least some symptoms of sleep disturbance.
 - 48% of the participants experience minimal to mild night-time sleep disturbance.
 - 52% of the participants experience mild-to-moderate to severe night-time sleep disturbance.

Figure 1. Parkinson's Disease Sleep Scale-2: Total Score (N= 1,237 participants with PD)



- **Higher PDSS-2 scores indicate greater night-time sleep disturbance; Scores of ≤ 5 reflect minimal sleep disturbance; Scores of ≥ 6 reflect clinically significant sleep disturbance.**
- **The distribution of scores reflect mild to moderate sleep disturbance for most participants (Trenkwalder, 2011).**
- When looking at the PDSS-2 subscores (See Figure 2; see Table 2 for specific items endorsed by participants):
 - Among those reporting disturbed sleep, approximately 30% of the participants reported significant sleep disturbance due to symptoms related to Motor Symptoms at Night and PD Symptoms at Night (including sleep disturbance due to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing).
 - Approximately 80% of the participants reported significant night-time sleep disturbance due to general sleep difficulties (i.e., not sleeping well, difficulty falling and staying asleep, frequent night-time urination, and feeling tired and sleepy in the morning).

Figure 2. Parkinson's Disease Sleep Scale-2 (N= 1,237 participants with PD): Distribution of SubScores Per Level of Severity



- Higher scores indicate greater night-time sleep disturbance; Scores of ≤ 5 reflect minimal sleep disturbance; Scores of ≥ 6 reflect significant sleep disturbance.
- Within the group who does not have significant sleep disturbance (≤ 5), a higher percentage of participants reported greater motor and PD symptoms at night, whereas those with clinically significant sleep symptoms reported a higher relative rate of [general] disturbed sleep compared to complaints of motor or other PD-related symptoms.

Table 2. Percentage of Participants Reporting Sleep Disturbance on the PDSS-2 Individual Items

PDSS-2 Questions by Domain	Percentage of Participants Endorsing Sleep Disturbance				
	Never	Occasionally	Sometimes	Often	Very Often
<i>Motor Symptoms at Night</i>					
Did you have restlessness of legs or arms at nights causing disruption of sleep? (N=1219)	51%	22%	14%	8%	5%
Was your sleep disturbed due to an urge to move your legs and arms? (N=1214)	55%	22%	13%	7%	3%
Did you suffer from distressing dreams at night? (N=1218)	46%	30%	15%	6%	3%
Did you wake early in the morning with painful posturing of arms and legs? (N=1216)	54%	22%	12%	7%	5%
On waking, did you experience tremor? (N=1212)	59%	18%	11%	7%	5%
<i>PD Symptoms at Night</i>					
Did you suffer from distressing hallucinations at night? (N=1216)	78%	12%	6%	2%	2%
Did you feel uncomfortable at night because you were unable to turn around in bed or move due to immobility? (N=1220)	39%	21%	17%	11%	12%
Did you feel pain in your arms and legs, which woke you up while sleeping at night? (N=1218)	52%	24%	13%	7%	4%
Did you have muscle cramps in your arms or legs, which woke you up while sleeping at night? (N=1220)	49%	29%	14%	6%	3%
Did you wake up at night due to snoring or difficulties with breathing? (N=1222)	70%	19%	7%	3%	1%
<i>Disturbed Sleep</i>					
Overall, did you sleep well during last week? (N=1213)	6%	13%	28%	29%	24%
Did you have difficulty falling asleep each night? (N=1208)	38%	28%	19%	9%	6%
Did you have difficulty staying asleep? (N=1220)	18%	25%	22%	21%	14%
Did you get up at night to pass urine? (N=1217)	5%	12%	15%	29%	39%
Did you feel tired and sleepy after waking in the morning? (N=1221)	15%	32%	24%	19%	10%

Additional Sleep Information:

- 50% of the participants reported significant daytime sleepiness.
- The majority of the participants take naps, with the duration of naps being less than 60 minutes for 64% of the participants.

- 27% take naps once or twice per week.
- 31% take naps almost daily.
- 12% take a nap every day.
- 10% take at least two naps a day.
- 20% reported that they have been diagnosed with a sleep disorder.
- 14% reported having sleep apnea, and of these diagnosed with sleep apnea, 9% use a CPAP (continuous positive airway pressure) or BiPAP (bilevel positive airway pressure) machine.
- 35% of the participants reported using a medication for sleep, with the majority of those who take medication for sleep indicating that the medications were helpful.
- 48% of the participants are experiencing minimal to mild night-time sleep disturbance (PDSS-2 Total score ranging between 0 and 15).
- 52% of the participants are experiencing mild-to-moderate to severe night-time sleep disturbance (PDSS-2 Total score ranging between 16 and 60).
- Approximately 30% of the participants reported sleep disturbance due to symptoms related to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing (related to Motor Symptoms and PD Symptoms at Night; PDSS-2 Subdomain Score ranging between 6-20).
- Approximately 80% of the participants reported sleep disturbance due to not sleeping well, difficulty falling and staying asleep, frequent night-time urination, and feeling tired and sleepy in the morning; PDSS-2 Subdomain Score ranging between 6-20).

Emotional Disturbance and Quality of Life:

- Experiencing depressive symptoms were endorsed by 55% of participants in this study (Mild=41%; Moderate=11%; Severe=3%; Not at all=45%).
- Anxiety symptoms were prevalent for 59% of participants in this study (Mild=42%; Moderate=14%; Severe=3%; Not at all=41%).
- Depression and anxiety were significantly related to sleep disturbance.
- Quality of life (QOL) was generally reported “good” to “excellent” for 61% of the participants. 32% rated their QOL as “fair,” 6% rated their QOL as “poor,” and <1% rated their QOL as “the worst one can imagine.”
 - QOL was related to sleep disturbance.

SLEEP AS IT RELATES TO AGE AND DISEASE DURATION:

- Participants were divided into groups matched on disease duration and age.
 - Age: Age groups were divided into Younger PD group =50-69 years of age and Older PD group =70+ years.
 - Disease Duration: In previous research on PD, the average time from symptom onset to development of motor complications was 6 years (Politis, et al., 2010; Shrag & Quinn, 2000). Based on that research, the participants in this study were divided into the groups **Early Stage** versus **Advanced Stage PD**, <6 years and 6+ years, respectively, to define a valid partition between early and advanced disease states. To better understand the impact of disease duration on sleep, the Advanced Stage PD group was further divided into **Advanced Stage PD 6-10 years** and **Advanced Stage PD 11+ years**.
- **Early Stage PD (PD less than 6 years):**
 - **Younger** (50-69 years of age): N=182
 - **Older** (70+ years of age): N=254
- **Advanced Stage PD 6 to 10 years:**
 - **Younger Group:** N=119
 - **Older Group:** N=172
- **Advanced Stage PD 11+ years:**
 - **Younger Group:** N=188
 - **Older Group:** N=161

Early PD group: Younger and Older PD participants

Within the **Early Stage group**, there were **significant differences** between the **Younger** and **Older PD groups**:

- The **Younger group** reported **MORE** sleep disturbance due to symptoms related to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing (PDSS-2, Motor and PD Symptoms at Night) than the **Older Group**.
- The **Younger group** reported **MORE** sleep disturbance due to not sleeping well, difficulty falling and staying asleep, frequent night-time urination, and/or feeling tired and sleepy in the morning (PDSS-2, General Sleep Disturbance) than the **Older Group**.
- The **Younger group** reported **GREATER** overall night-time sleep disturbance than the **Older Group**.
- The **Younger group** reported **LESS** average hours of sleep per night (cumulative) than the **Older Group** (**Younger group** = 6.8 hours of sleep on average; **Older group** = 7.3 hours of sleep on average).
 - Thus, for individuals who have had PD for less than 6 years, the younger participants appear to experience greater night-time sleep disturbance than the older participants, suggesting possible nuances to the disease process as it relates to the age cohort during which symptoms of PD begin.

There were **no statistically significant differences** between the Younger and Older groups on the following variables: average hours of sleep without waking (**Younger group** = 4.7 hours of sleep without waking; **Older group** = 5.0 hours of sleep without waking), depression, anxiety, or quality of life.

Advanced Stage PD 6-10 years group: Younger and Older PD participants

Within the **Advanced Stage PD 6-10 years group**, there were **significant differences** between the **Younger** and **Older PD groups**:

- The **Younger group** reported **MORE** sleep disturbance due to pain or muscle cramps in arms and legs, difficulties moving in bed, distressing hallucinations, snoring, or difficulties with breathing (PDSS-2, PD Symptoms at Night) than the **Older Group**.
- The **Younger group** reported **LESS** average hours of sleep per night (cumulative) than the **Older Group** (**Younger group** = 6.6 hours of sleep on average; **Older group** = 7.0 hours of sleep on average).

There were **no statistically significant differences** between the Younger and Older groups on the following variables: general sleep disturbance, sleep disturbance due to PDSS-2 “motor symptoms” specifically related to restlessness in legs, the urge to move one’s legs or arms, distressing dreams, painful posturing in arms or legs in the morning, and/or experiencing tremor upon waking, average hours of sleep without waking (**Younger group** = 5.0 hours of sleep without waking; **Older group** = 4.6 hours of sleep without waking), depression, anxiety, or quality of life.

- Thus, for individuals who have had PD for 6-10 years, the younger participants appear to experience comparable sleep disturbance when compared to the older participants, with exception to greater amounts of sleep disturbance due to PD symptoms and somewhat less cumulative hours of sleep per night.

Advanced Stage PD 11+ years group: Younger versus Older PD participants

Within the **Advanced Stage PD 11+ years group**, there were **NO significant differences** between the **Younger** and **Older PD groups** on the variables assessed: sleep disturbance due to symptoms related to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing, general sleep disturbance, average hours of sleep without waking (**Younger group** = 4.9 hours of sleep without waking; **Older group** = 5.1 hours of sleep without waking), cumulative night-time sleep hours (**Younger group** = 6.6 hours of sleep on average; **Older group** = 6.9 hours of sleep on average), depression, anxiety, or quality of life.

Thus, disease duration is an important mediating variable for sleep disturbance when comparing the Younger and Older PD groups, such that the longer the duration one has PD, sleep disturbance occurs comparably for both Younger and Older individuals. Moreover, those who have been recently diagnosed with PD (PD <6 years) and are between the ages of 50 and 69 have greater vulnerability to experiencing night-time sleep disturbance when compared to those individuals with PD who are 70+ years of age. As the disease progresses, however, there does not appear to be a difference between younger and older individuals as it relates to night-time sleep disturbance.

SLEEP AND DBS AND NON-DBS SUBGROUPS (after controlling for age and disease duration):

- The **DBS Group** reported **LESS** sleep disturbance due to symptoms related to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing than **Non-DBS Group** on the PDSS-2.
- The **DBS Group** reported significantly **MORE** average hours of sleep without waking than **Non-DBS Group** (See Table 3)
- The average duration of [cumulative] sleep at night for the **DBS group** was more than **Non-DBS Group** (See Table 3), albeit not a statistically significant difference.

There were **no statistically significant differences** between the **DBS and Non-DBS groups** on the following variables: general disturbed sleep (not sleeping well, difficulty falling and staying asleep, frequent night-time urination, and feeling tired and sleepy in the morning), depression, anxiety, or quality of life.

Table 3. Average hours of Sleep for the DBS vs Non-DBS Groups

Duration of Sleep	Young, Advanced 6-10		Young, Advanced 11+		Older, Advanced 11+	
	DBS Group (N=27)	Non-DBS Group (N=92)	DBS Group (N=103)	Non-DBS Group (N=79)	DBS Group (N=230)	Non-DBS Group (N=187)
Average hours slept without waking	5.7	4.8	5.1	4.6	6.1	4.7
Average hours slept at night	6.8	6.5	6.8	6.3	7.1	6.8

Note: Differences were not examined between the **DBS** and **non-DBS** groups within the **Older Advanced 6-10 PD** group, because the sample size was too small for the **DBS group** (n = 8).

DBS SPECIFIC QUESTIONS:

To what extent has DBS helped improve your sleep?

- 71% of the participants indicated that sleep has improved following DBS.
 - 25% responded “extremely improved”
 - 27% responded “moderately improved”
 - 19% responded “mildly improved”
 - 27% responded sleep has not changed
 - 2% responded sleep “worsened”

To what extent has DBS improved your quality of life (QOL)?

- 97% of the participants indicated that DBS has improved quality of life.
 - 52% responded “extremely improved”
 - 33% responded “moderately improved”
 - 12% responded “mildly improved”
 - 1.5 % responded “no change”
 - 1.5 % responded QOL “worsened”

How satisfied are you with the effectiveness of DBS in general?

- 91% reported that they are satisfied with the effectiveness of DBS.
 - 45% responded “completely satisfied”
 - 46% responded “somewhat satisfied”
 - 1.8% responded “indifferent”
 - 53% responded “somewhat dissatisfied”
 - 1.8% responded “completely dissatisfied”

SUMMARY AND DISCUSSION

Sleep disorders are one of the most common and disturbing non-motor symptoms in Parkinson's disease (PD), and are highly prevalent. Although intended to treat motor symptoms of PD, Deep Brain Stimulation (DBS) has been found to have a positive impact on sleep disturbance for individuals with PD. This study had two objectives: 1. To investigate the prevalence of sleep disturbance in a large sample of individuals with PD using the Parkinson's Disease Sleep Scale-2 (PDSS-2), and 2. To investigate the similarities and differences of self-reported sleep disturbance in individuals who have PD **with DBS** and **without DBS**.

TAKE HOME POINTS FROM THIS SURVEY:

Objective 1: Prevalence of sleep disturbance in a large sample (1,247 individuals) and findings from the PDSS-2

- 93% of the participants endorsed at least some symptoms of sleep disturbance on the PDSS-2.
 - Of those reporting sleep disturbance, 52% were in the mild-to-moderate to severe range, while 48% of the participants are reporting minimal to mild levels of sleep disturbance (based on the PDSS-2 Total Scale Score).
 - When looking at the PDSS-2 subdomains, general sleep disturbance (not sleeping well, difficulty falling and staying asleep, frequent night-time urination, and feeling tired and sleepy in the morning) is more prevalent (approximately 80% of the participants) than sleep disturbance due to symptoms related to PD, physical discomfort, distressing dreams, hallucinations, and/or difficulties with snoring or breathing (approximately 30% of the participants).
- For participants in this study, the average amount of hours slept without waking at night was 4.9 hours.
- The average cumulative hours slept in an evening was 6.9 hours.
- 50% of the participants reported significant daytime sleepiness.
- 20% reported that they have been diagnosed with a sleep disorder.
 - Given the high report of sleep disturbance and the low report of a diagnosis of sleep disorder, it is plausible that sleep disorders are commonly underdiagnosed and that individuals with PD may need more education about their sleep symptoms and the possible explanations for them.
- 35% of the participants reported using a medication for sleep, with the majority of those who take medication for sleep indicating that the medications were helpful.
- Depression and anxiety were prevalent and were related to sleep disturbance.
- Sleep disturbance can adversely impact quality of life.

Sleep disturbance as it relates to age and disease duration:

- Those who have been recently diagnosed with PD (PD <6 years) and are between the ages of 50 and 69 have greater vulnerability to experiencing night-time sleep disturbance when compared to those individuals with PD who are 70+ years of age and have been diagnosed with PD for less than 6 years. In contrast, as the disease progresses to the advanced stages (i.e., 11+ years following PD diagnosis), there does not appear to be a difference between younger and older individuals as it relates to night-time sleep disturbance. There are a few explanations to consider:
 - It is possible that the disease processes earlier in the course of PD have different effects (or are experienced differently) based on the individual's age, but these effects are less evident as the disease progresses (i.e., when individuals are in the advanced stages of PD).
 - The possible effects of medications on sleep need to be considered, particularly the use of different types of medications and their dosages during various stages of the disease course (e.g., Early versus Advanced stages).
 - Psychosocial stressors/situational variables may be different for different cohorts (e.g., for the **Younger PD group**, possible work-related matters, younger families, etc. may create additional life demands or psychosocial stressors that adversely impact sleep).

Objective 2: Similarities and differences in sleep disturbances in individuals with PD with and without DBS

- DBS appears to have a favorable impact on sleep disturbance. When compared to the **Non-DBS group**, the **DBS group** reported less night-time sleep disturbance specifically related to motor symptoms and other PD symptoms (PDSS-2).

- The **DBS group** reported longer duration of consecutive hours of night-time sleep as compared to the **Non-DBS group**, which is consistent with other research (Cicolin et al., 2004).
- General sleep disturbance (not sleeping well, difficulty falling and staying asleep, having to go to the bathroom at night, and feeling tired and sleepy in the morning), however, was similar between the **DBS** and **Non-DBS groups**.

As it relates to DBS:

- 71% of the participants indicated that sleep improved following DBS.
- 97% of the participants indicated that DBS, in general, improved quality of life.
- 91% reported that they are satisfied with the effectiveness of DBS.

IMPLICATIONS AND RECOMMENDATIONS:

Sleep disturbance can occur in both younger and older individuals with PD and across the duration of the disease. There is an increased vulnerability to sleep disturbances as one gets older and as the disease progresses. A number of factors contribute to sleep disturbance in individuals with PD, including symptoms related to motor disturbance, pain, medications, depression, anxiety, frequent night-time urination, and sleep disorders such as sleep apnea, REM sleep behavior disorder (abnormal sleep involving vivid dreams and acting out of dreams), periodic limb movement disorder, and restless leg syndrome (Comella, 2003).

- When you have difficulties sleeping, consult with your movement disorder doctor. In some situations, an evaluation by a psychiatrist or sleep specialist is indicated.
 - A first step is to clarify the type of sleep disturbance (e.g., difficulty falling asleep (initial insomnia), maintaining sleep, or awakening too early, abnormal leg movements, apnea, or dreams/nightmares) and how the sleep disturbance is related to PD motor symptoms. For example, fragmented sleep is often related to recurrent PD motor symptoms, but other causes include medications, coexistent sleep apnea, and periodic leg movements. Clarifying the type of sleep disturbance and the multiple contributing causes, and education about the sleep disturbance may bring some comfort to the individuals with PD and family members.
 - Once the cause is identified, appropriate interventions can be initiated.
- There are numerous effective treatments for nocturnal sleep disturbances, including behavioral interventions, medications to facilitate sleep, and specialized sleep devices (i.e., CPAP or BiPAP machines for sleep apnea). In some instances, the most effective treatment is to remove or modify the patient’s medication that has negative effects on sleep, if appropriate.

Sleep hygiene and behavioral changes (modifying behavior to assist with improving sleep):

With regard to behavioral interventions, it often helps to think about the following question, “What are the variables over which I have control?” Thus, it is of great importance to put into practice good sleep hygiene techniques. For example:

- Have routine sleep habits.
 - Go to bed around the same time every night and get up around the same time every morning (to the extent the mind and body make that possible).
 - Establish a bedtime routine that involves relaxing within 30 minutes before going to bed.
 - Rest and naps during the day may be necessary or at the minimum help reduce sleepiness in the daytime. Shorter naps are preferred, and do not take naps in the late afternoon or evening.
 - Do not consume caffeinated products within 4 to 6 hours before going to bed.
 - Minimize significant consumption of liquid within 2 hours of going to bed.
 - Room temperature is best around 65 to 68 degrees Fahrenheit.
- Engage in daily exercise. If needed, consult with your doctor, or meet with an exercise specialist or specialist in physical medicine and rehabilitation who is knowledgeable about PD.
- Get adequate exposure to daylight.
- Scheduling an appointment with a psychologist to learn techniques to improve sleep may be helpful.
- If you are experiencing depression and/or anxiety, psychotherapeutic intervention provided by a mental health professional knowledgeable about PD is recommended, as reducing depression and anxiety may help improve sleep.

Points to consider regarding Medications:

- Medicines, if used to treat insomnia, should be selected thoughtfully and used in combination with good sleep practices. For some patients, changes in the PD regimen can improve motor function at night and thus reduce nighttime sleep disturbances. However, PD and other medications may also cause sleep disturbances in a number of ways. As mentioned previously, discuss with your doctor whether disturbed sleep is a potential side effect of prescribed medications.
- Only a few studies have investigated medication treatments for sleep disturbances in PD.
 - Medications that may help you fall asleep and stay asleep include:
 - Certain antidepressant medications, e.g., trazodone (Desyrel), mirtazapine (Remeron), nortriptyline (low dose; Pamelor); low dose Doxepine.
 - Among the non-benzodiazepine hypnotics, eszopiclone (Lunesta) may be helpful with maintaining sleep and can be better tolerated than other medications in that class, e.g., zolpidem (Ambien), ramelteon (Rozerem), zaleplon (Sonata), although some PD patients experience adverse side effects.
 - Medications that may help you fall asleep, but also cause problematic side effects such as over-sedation, confusion, or imbalance and falls include:
 - Benzodiazepines such as clonazepam (Klonopin), lorazepam (Ativan), and alprazolam (Xanax).
 - Antihistamines, such as diphenhydramine (Benadryl), which can also be components of over-the-counter sleep medications.
 - Medications that may interfere with sleep include:
 - Dopamine agonists and anticholinergic agents.

Disruption of sleep secondary to urinary frequency:

- Treatment of urinary frequency during the night depends on the cause of such symptoms. Consultation with one's physician is pivotal in determining the treatment approach. Accurate diagnosis of causes for frequent urination is very important so as to implement the best approach to treatment, including behavioral, pharmacological, or interventional. It is important for patients with PD to be aware that anticholinergic medications used to treat urinary frequency, e.g. tolterodine (Detrol) can have negative effects on memory functions or cause confusion.

Sleep Apnea:

- Sleep apnea is a sleep disorder characterized by shallow or infrequent breathing or pauses in breathing during sleep, where some pauses (or cessation of breathing) can last from seconds to several minutes. An individual with sleep apnea is rarely aware of having difficulty breathing, even upon awakening. Rather, sleep apnea is recognized as a problem by others witnessing the individual during episodes (excessive snoring, prolonged pauses in breathing) or is suspected because of its effects on the body (excessive fatigue, not feeling rested after awakening, etc.).
- Sleep apnea is common in PD and often not considered, is under-assessed and undertreated. A referral to a sleep specialist is necessary for evaluation and treatment if symptoms of sleep apnea are identified or a concern. A sleep specialist can help determine the appropriate treatment for sleep disturbance (e.g., whether or not a CPAP or BiPAP machine will be helpful, if one experiences sleep apnea).
- Notably, using a CPAP or BiPAP machine can also have a positive effect on thinking skills (e.g., attention and concentration) and an indirect and positive effect emotional well-being.

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REFERENCES

- Arnulf, I., Bejjani, B.P., Garma, L., Bonnet, A.M., Houeto, J.L., Damier, P., Derenne, J.P., Agid, Y. Improvement in sleep architecture in PD with subthalamic nucleus stimulation. *Neurology*, 2000; 55(11): 1732-4.
- Cicolin, A., Lopiano, L., Zibetti, M., Torre, E., Tavella, A., Guastamacchia, G., Terreni, A., Makrydakis, G., Fatori, E., Lanotte, M.M., Bergamasco, B., Mutani, R. Effects of deep brain stimulation of the subthalamic nucleus on sleep architecture in parkinsonian patients. *Sleep Med.*, 2004; 5(2): 207-10.
- Comella, C. Sleep disturbance in Parkinson's disease. *Current Neurology and Neurosciences Reports*, 2003; 3:173-180
- Deuschl, G., Schade-Brittinger, C., Krack, P., et al. A randomized trial of deep-brain stimulation for Parkinson's disease. *N Engl J Med.* 2006;355(9):896–908.
- Hjort, N., Ostergaard, K., Dupont, E. Improvement of sleep quality in patients with advanced Parkinson's disease treated with deep brain stimulation of the subthalamic nucleus. *Movement Disorders*, 2004; 19(2): 196-9.
- Kumar, R., Lozano, A., Kim, Y., Hutchison, W., Sime, E., Halket, E., Lang, A. Double-blind evaluation of the subthalamic nucleus deep brain stimulation in advanced Parkinson's disease. *Neurology*, 1998; 51(3): 850-5.
- Lees, A.J., Blackburn, N.A., Campbell, V.L. The nighttime problems of Parkinson's disease. *Clin Neuropharmacol.* 1988;11:512–519.
- Tandberg, E., Larsen, J.P., Karlsen, K. A community-based study of sleep disorders in patients with Parkinson's disease. *Movement Disorders.* 1998;13:895–899.
- Trenkwalder, C., Kohlen, R., Hogl, B., Metta, V., Sixel-Doring, F., Hulsmann, J., Frauscher, B., Martinez-Martin, P., Chaudhuri, K. R. Parkinson's Disease Sleep Scale – Validation of the Revised Version PDSS-2. *Movement Disorders.* 2011; 26(4): 644-652.
- Volkman, J., Albanese, A., Kulisevsky, J., Tornqvist, A.L., Houeto, J.L., et al. Long-term effects of pallidal or subthalamic deep brain stimulation on quality of life in Parkinson's disease. *Movement Disorders*, 2009; 24(8): 1154-61.