A closer look at Balance in Parkinson's disease for those with and without Deep Brain Stimulation: The patient's perspective

INTRODUCTION

Among the cardinal features of Parkinson Disease (PD), including bradykinesia, rigidity, resting tremor, abnormal postural reflexes and gait disturbance, gait and balance disturbances as well as falls are a leading cause of disability and dependence on others (Muslimovic et al., 2008). The inability to move around due to gait and balance problems is one of the most important causes of decreased quality of life, morbidity, and mortality in patients with PD (Forsaa, et al., 2008; Muslimovic et al., 2008; Pickering, et al., 2007; Rahman et al., 2008). It is known that falls represent a major threat to health status and independence, causing pain and cessation of physical activities, whether due to fear of falling, declining mobility, or balance. In fact, PD patients have 3 times the falls and 5 times the injuries when compared to age-matched individuals who do not have PD (Horak, 2005). Furthermore, there is some indication that Deep Brain Stimulation (DBS) of the subthalamic neucleus (STN) or globus pallidus interna (GPi) can improve gait and balance (e.g., such as speed of walking, as cited in Hausdorff, et al., 2009), while other studies have found that DBS of the STN made gait and balance worse, (e.g., as evidenced by the increased number of falls reported in those patients with DBS as compared to those with medication management only; Weaver et al, 2009).

In addition to motor dysfunction that impacts balance, one must consider some relevant non-motor symptoms. More specifically, it is important to consider the relationship between psychological factors and disturbances of balance. Some research has found that one's belief system (**balance confidence**, which is the amount of confidence individuals have in doing specific activities where balance may be challenged; emotional well-being, etc.) can impact balance. For example, Adkin and colleagues (2003) stated that the greater degree of fear of falling may be an independent risk factor for postural stability. Mak and Pang (2008) found that balance self-efficacy (a person's belief about his or her ability to maintain good balance) is indeed an important determinant of functional walking capability in patients with PD. They believe that improving balance confidence could be crucial in promoting better walking capability. Other research has found that depression is one of the variables that may impact balance disturbance (e.g., Gassmann & Rupprecht 2009; Gassmann, Rupprecht & Freiberger, 2009). Since depression is common in PD (e.g., with several studies identifying 20 to 40% of PD patients meeting criteria for depression; Allain et al., 2000; Cummings, 1992; Menza and Marsh, 2006), it is important to keep this variable in mind when conceptualizing balance confidence in the PD population.

Other non-motor symptoms to consider as it relates to balance disturbance is difficulty with cognition (thinking skills) and sleep disturbance. Some research has found that one's cognitive capability can impact balance (e.g., impaired cognition can adversely impact balance). Moreover, in the PD population, as the brain has more to process, gait speed is slowed down and gait rhythm is

disturbed, which can adversely impact balance. Hausdorff and colleagues (2005) indicated that routine walking relies upon higher levels of cognitive abilities called executive functioning (such as attention, planning, sequencing, organizing, initiating activity, solving problems, etc.). In fact, as these higher-order functions become dysfunctional, gait and balance disturbance and fall risk are likely to result. For example, Bernal and co-investigators (2005) found that as the demands on attention increase on PD patients, increased likelihood of gait disturbance ensues, which could in turn impact balance. Furthermore, sleep disturbance, which is another common non-motor symptom in PD (Menza and Marsh, 2006), has been found to adversely impact thinking skills as well (Meguro et al., 1990). Thus, whether depression and/or sleep disturbance adversely impacts cognitive functions directly or, at a minimum, influences one's balance confidence (as indicated above), it is understandable that symptoms of depression and sleep disturbance may indeed adversely impact balance indirectly.

OBJECTIVE

The goal of this project was to learn more about balance in people with Parkinson's disease (PWP) and specific variables that are related with balance confidence, such as depression, reported cognitive capability, and sleep. We also wanted to compare individuals with Parkinson's disease who have and have not undergone DBS-STN.

METHODS

The participants were recruited from a variety of sources. Some had participated in previous surveys conducted by The Parkinson Alliance; others responded to study announcements in medical clinics around the country, and still others found out about the study through their participation in local PD support groups, The Parkinson Alliance website (www.parkinsonalliance.org), or our affiliate website devoted to DBS (www.dbs-stn.org). Participants came from around the United States, Canada, India, and South Africa. The participants in this report included 130 individuals with PD who underwent DBS and 163 individuals with PD without DBS (non-DBS).

The participants in this study completed a demographics questionnaire, the Activities-Specific Balance Confidence Scale (ABC), and the Geriatric Depression Scale-Short Form (GDS-SF) each of which will be explained below.

The Demographic Questionnaire:

The demographic questionnaire included questions related to background information of the participants as well as questions related to one's opinion about their balance, amount of falls, and utilization as well as efficacy of assistive devices for balance/walking. Additional questions were asked regarding other difficulties that may be related to or affect one's balance such as amount of sleep, fatigue, cognitive functioning, and co-existing medical conditions.

Activities-Specific Balance Confidence Scale (ABC):

The Activities-Specific and Balance Confidence (ABC) Scale is a questionnaire developed to measure an aspect of the psychological impact of balance impairment and/or falls. The ABC was developed to include a wider variety of activities that makes it more sensitive to detecting loss of

confidence among lower and higher functioning individuals (McAuley et al., 1997; Powell & Myers, 1995). There are 16 ABC items that are rated on a 0 to 100% scale (i.e., 0% = no confidence to 100% = complete confidence in performing the specified activity) and are averaged to produce a total ABC score that ranges from 0 to 100. Total ABC scores are operationalized so that higher scores reflect higher balance confidence. Also, significantly lower ABC scores were associated with lower levels of mobility (Powell and Myers, 1995) and falls (Lajoie and Gallagher, 2004).

The Geriatric Depression Scale-Short Form (GDS-SF):

The GDS-SF is a subjective depression screening inventory that looks at 15 commonly endorsed symptoms related to depression. The test is typically used for older adults but has been shown to be efficacious in younger adults (Ferraro, 1996) as well as individuals with medical ailments (Cully, 2009) as the test minimizes physical symptoms of depression that are often seen in a medically-ill population without depression. The higher the score on this 15 item questionnaire, the more depressive symptoms a person is endorsing. This measure is often used to get a better understanding of symptoms of depression that may impact an individual's outlook on life.

RESULTS

The summary of the demographic information for this study can be found in Table 1. The average age of PD onset was 47 years for the **DBS group** and 62 years for the **Non-DBS group**. Male and female participants were equally represented for each group and most of the patients had some college education or higher. The **DBS group** was younger, had an earlier age of onset of PD, and had longer duration of PD than the **Non-DBS group**.

Table 1. Demographics and clinical features of the sample

Variable	**DBS** (n=130)	**Non-DBS** (n=162)
Mean Age in years*	62	70
Duration of PD in years *	15.4	8.0
Percent Male	59%	57%
Percent Female	41%	43%
Mean Age of PD onset (in years)*	47	62
Age at Time of DBS	57	n/a
Average Time since DBS-STN (in years)	4.6	n/a
DBS Target STN	92%	n/a
DBS Target GPi	5%	n/a
DBS Target Thalamus	3%	n/a
Percentage with Initial Bilateral Stimulation	87%	n/a

* Denotes significant differences between the groups

Age and Duration of PD within the two groups:

There was a significant difference in age as well as duration of PD between the two groups (**DBS**>**Non-DBS**; see Figures 1 and 2). The majority of **Non-DBS** participants were 70 years of age or older and their duration of PD has been shorter than the **DBS group**. The majority of the **DBS group** was in the 50-69 years of age cohort, and they have had PD for a longer period of time when compared to the **Non-DBS group**. For research purposes it is important to take age and duration of PD into consideration, which was done for all of the results reported below.

Figure 1. Age Categories for DBS and Non-DBS groups

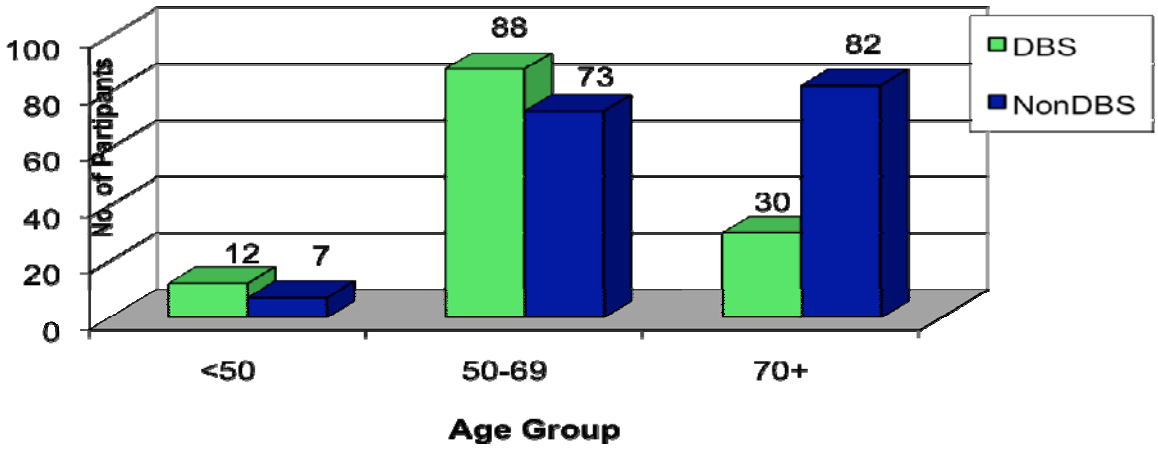
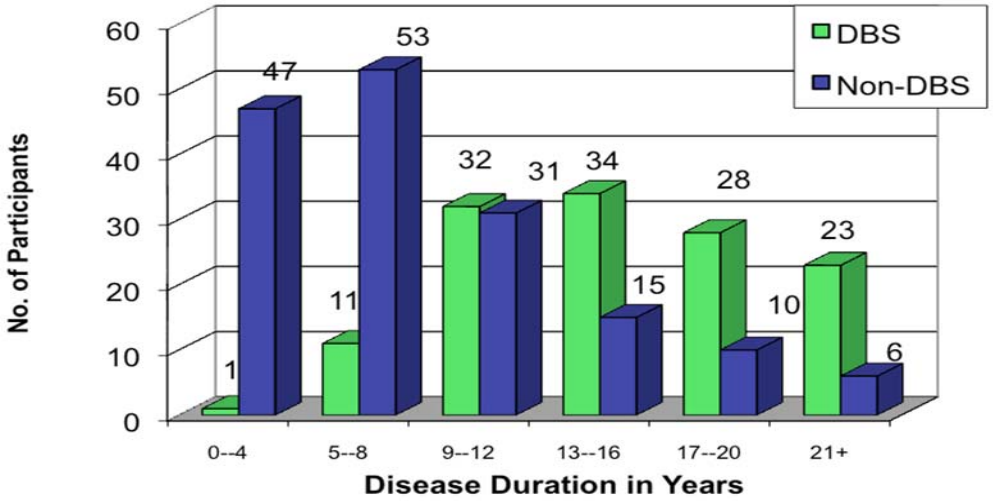


Figure 2. Disease Duration Categories (in Years) for DBS and Non-DBS groups



Demographic Questionnaire:

DBS Effect on Balance

The summary of individuals reporting improvement in balance-related activities is reported in Table 2. It is notable that the majority of individuals who underwent DBS reported improvement with balance, walking straight ahead, and ability to turn directions. Since there was a large range of ages represented in the DBS group, we also looked at differences between different age groups (<50, 50-69, and 70+).

As it relates specifically to balance:

- The younger group (<50) did not find DBS as helpful as the mid range group (50-69)
- There was no difference in age with regard to walking in a straight line.
- With turning or changing direction, the older group (70+) did not find DBS as beneficial as the mid range group (50-69).

Table 2. Demographic Questionnaire

Variable	**DBS** (n=125) Yes	No
Do you believe DBS has helped with your balance?	59%	41%
Do you believe that DBS has helped your walking in a straight ahead direction?	67%	33%
Do you believe that DBS has helped your ability to turn or change direction when you are walking?	62%	38%

Co-existing medical problems that can interfere with balance

It is important to consider other medical conditions that could impact balance when looking at this data. For example, Table 3 illustrates other medical problems that were reported to co-exist with PD participants in this study. Since the vast majority of the individuals in this study had co-existing medical conditions that could account for some of the difficulties in balance (87%), it was not statistically appropriate to compare those without additional medical conditions to those who have additional medical conditions that could interfere with balance. Although we did not analyze the significance of co-existing medical conditions on balance confidence for the two groups, the important point is that the vast majority of individuals with PD are contending with both PD and a co-existing medical condition that can impact balance and balance confidence. Moreover, it is likely very common for individuals with PD to also experience other medical problems that may interfere with balance, and this data likely expresses the voice of many individuals with similar difficulties.

Table 3. Percentage of participants reporting co-existing medical conditions

Medical Conditions Reported	DBS (n=96)	Non-DBS (n=133)
Musculoskeletal/Orthopedic Problems	46%	47%
Cardiovascular Problems	23%	38%
Stroke	2%	4%
Seizures	0%	3%
Neuropathy	25%	22%
Respiratory Problems	9%	8%
Metabolic Problems	4%	6%
Visual Disturbance	21%	27%
Sleep Apnea	13%	15%
Vertigo	14%	17%

Falls

The summary of frequency of falls is listed in Table 4. The **DBS group** reported falls in greater frequency than the **Non-DBS group**, when considering that only 12.5% of the **DBS group** reported having falls less than 1 time per year or not at all as compared to the 38.2% of the **Non-DBS group** who reported fall frequency in the same time period. In other words, 87.5 % of the **DBS group** reported having falls ranging between greater than 4 times per week to one time per year, while 61.8% of the **Non-DBS group** reported having falls in the same time frame.

Table 4. Reported falls

Variable	DBS (n=128)	Non-DBS (n=157)
How often do you experience a fall?		
Greater than 4x per week	7.8%	1.9%
2-4x per week	5.5%	6.4%
1x per week	7.0%	1.3%
2-3 x per month	14.8%	12.7%
1x per month	11.7%	10.2%
1x every few months	28.9%	15.3%
1x per year	11.7%	14.0%
Less than 1x per year or not at all	12.5%	38.2%**

** Significant difference between groups

Utilization of Assistive Devices

The summary of utilization of assistive devices is listed in Table 5. Approximately half of each group identified that they used assistive devices. There was no difference between the **DBS** and **Non-DBS** groups in using a cane, wheelchair, or scooter. Although, in those that endorsed using an electric scooter the **Non-DBS** aged 70+ group used the scooter with more frequency than the comparably aged **DBS group.**

The **DBS group** was more likely to use a walker when younger (<50 and 50-69) than the **Non-DBS group** of comparable ages. In regard to frequency of using a walker, the <50 aged **DBS group** was more likely to use a walker at least sometimes as compared to none of the **Non-DBS group.**

The majority of both groups found the assistive devices helpful. Other devices noted to assist with walking/standing/turning included walking sticks (trekking pole/walking staff), handrails, chair lifts, and a wheeled suitcase as a purse.

Table 5. Percentage of participants using the specific assistive devices

Variable	DBS (n=130)	Non-DBS (n=158)
Use of an Assistive Device	41%	46%
Cane	42%	33%
Walker *	40%	28%
Wheelchair	23%	22%
Electric Scooter	23%	15%
Person to help stand	34%	34%
Helpfulness of Devices		
Not helpful	8%	0%
A little bit helpful	14%	19%
Moderately helpful	21%	14%
Quite a bit helpful	26%	31%
Extremely helpful	31%	35%

*Significantly different at the .05 level

Sleep

The summary of average amounts of sleep for each group is listed in Table 6. There were no significant differences between the groups in average amount of hours slept per night without waking or total number of hours slept. When broken into the age groups, it was found that DBS group aged 70+ did have a higher average of hours slept without waking as compared to the Non-DBS group (5.8 vs. 4.9 hours). Both groups also reported feeling fatigued or tired throughout the day. There were no other age or duration differences within the groups.

Not surprisingly, sleep disturbance had a significant, but modest, relationship to one's balance confidence. In other words, the less sleep on average that individuals in this study get per night, the less balance confidence they had as well.

Table 6. Reported sleep related issues in the participants

Variable	DBS (n=127-129)	Non-DBS (n=155-157)
Avg. hours of sleep w/o waking per night	4.95	4.82
Avg. hours of sleep per night	7.13	6.98
Do you feel tired/fatigued during the day	81%	72%

Activities-Specific Balance Confidence Scale (ABC Scale):

As can be seen in Table 7, there was a statistically significant difference, but modest, between overall ratings of balance confidence between the **DBS** and **Non-DBS groups**, where the **Non-DBS group** reported greater levels of balance confidence in the scenarios presented within the ABC scale.

A list of all of the scenarios and the participants' confidence levels are also found in Table 7. For example, for the majority of the participants in both the **DBS** and **Non-DBS groups**, "Reaching at your eye level" was the scenario in which they have the highest degree of confidence. Moreover, 85% of the **DBS group** and 83% of the **Non-DBS group** indicated that they have a high degree of confidence performing this function, whereas 9% and 11% reported that they had an average rating of confidence for the **DBS** and **Non-DBS groups**, respectively. And, six percent of **both groups** reported that they have a low degree of confidence when reaching at their eye level.

As for the **DBS group**, the top three scenarios where the majority of the participants rated their confidence as the highest included (from higher levels of confidence to lower levels of confidence):

1. **Reaching at your eye level**
2. **Walking outside to a nearby car**
3. **Getting in/out of a car/transport**

Conversely, the three scenarios where the majority of participants rated their confidence as the lowest included (from lower to higher levels of confidence):

1. **Walking on slippery floors**
2. **Reaching while standing on a chair**
3. **Using an escalator without holding the railing**

As for the **Non-DBS group**, the top three scenarios where the majority of the participants rated their confidence as the highest included (from higher levels of confidence to lower levels of confidence):

1. **Reaching at your eye level**
2. **Walking around the house**
3. **Sweeping the floor**

Conversely, the three scenarios where the majority of participants rated their confidence as the lowest included (from lower to higher levels of confidence):

1. **Reaching while standing on a chair**
2. **Walking on slippery floors**
3. **Using an escalator without holding the railing**

On several of the individual items noted in Table 7 and Figure 3, there were statistically significant differences between the two groups. The **DBS group** reported less confidence than the **Non-DBS group** on the following items:

- **Walking around the house**
- **Picking up a slipper or something from the floor**
- **Reaching at your eye level**
- **Reaching while on your tiptoes**
- **Sweeping the floor**
- **Walking outside to a nearby car**
- **Getting in/out of a car/transport**
- **Walking across a parking lot**
- **Walking up and down a ramp**
- **Walking in a crowded mall**
- **Being bumped while walking in a crowd**

That being said, however, the patterns between the two groups are very similar (as can be seen in Figure 3), and overall, there does not appear to be a clinically meaningful difference between the two groups. In other words, balance confidence is actually similar between the two groups, and the findings do not reflect a need to approach treatment for one group any differently than the other group.

Table 7. Balance confidence ratings for specific situations in the ABC Scale

Variable	Level of Confidence	% of DBS (n=124-129)	% of Non-DBS (n=154-159)
Total Score*		**61%**	**69%**
Reaching at your eye level*	Low	6%	6%
	Average	9%	11%
	High	85%	83%
Walking outside to a nearby car*	Low	7%	12%
	Average	18%	14%
	High	75%	74%
Getting in/out of a car/transport*	Low	9%	10%
	Average	19%	16%
	High	72%	74%
Walking around the house*	Low	5%	8%
	Average	26%	10%
	High	69%	82%
Walking across a parking lot	Low	11%	11%
	Average	22%	13%
	High	67%	76%

Table 7. Balance confidence ratings for specific situations in the ABC Scale (continued)…

Variable	Level of Confidence	% of DBS (n=124-129)	% of Non-DBS (n=154-159)
Using an escalator while holding the railing	Low	10%	17%
	Average	25%	14%
	High	65%	69%
Sweeping the floor*	Low	16%	15%
	Average	19%	9%
	High	65%	76%
Picking up a slipper or something from the floor	Low	13%	13%
	Average	28%	17%
	High	59%	70%
Walking up and down a ramp*	Low	17%	15%
	Average	24%	16%
	High	59%	69%
Walking up and down stair	Low	14%	20%
	Average	32%	16%
	High	54%	64%
Reaching while on your tiptoes*	Low	24%	22%
	Average	31%	17%
	High	45%	61%
Walking in a crowded mall*	Low	27%	21%
	Average	33%	17%
	High	40%	62%
Being bumped while walking in a crowd*	Low	34%	27%
	Average	29%	18%
	High	37%	55%
Using an escalator without holding the railing	Low	38%	36%
	Average	27%	26%
	High	35%	38%
Reaching while standing on a chair	Low	46%	39%
	Average	28%	22%
	High	26%	39%

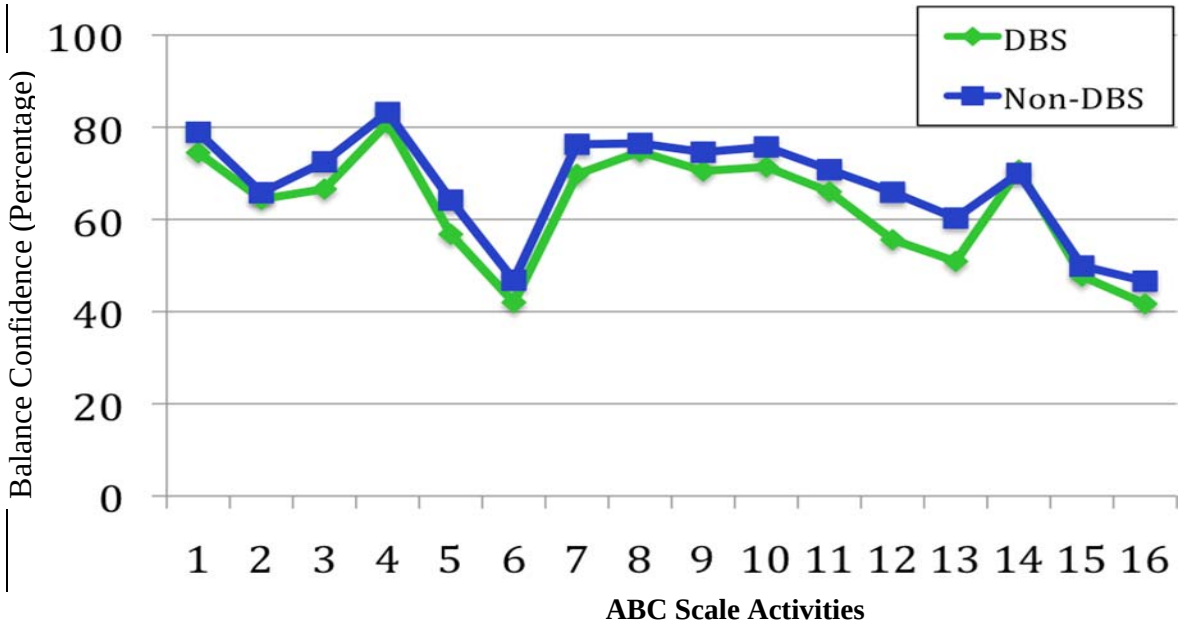
Table 7. Balance confidence ratings for specific situations in the ABC Scale (continued)…

Variable	Level of Confidence	% of DBS (n=124-129)	% of Non-DBS (n=154-159)
Walking on slippery floors	Low	48%	38%
	Average	27%	24%
	High	25%	38%

* Statistically significant difference between the two groups

Low = 0 to 33% of the participants fell in this range of level of confidence
Average = 34 to 66% of the participants fell in this range of level of confidence
High = 67 to 100% of the participants fell in this range of level of confidence

Figure 3. Reported balance confidence for each of the 16 activities composing the ABC scale for the DBS and the Non-DBS groups.



ABC Scale Activities: 1. Walking around the house. 2. Walking up and down stairs. 3. Picking up a slipper or something from the floor. 4. Reaching at your eye level. 5. Reaching while on your tiptoes. 6. Reaching while standing on a chair. 7. Sweeping the floor. 8. Walking outside to a nearby car. 9. Getting in/out of a car/transport. 10. Walking across a parking lot. 11. Walking up and down a ramp. 12. Walking in a crowded mall. 13. Being bumped while walking in a crowd. 14. Using an escalator while holding the railing. 15. Using an escalator without holding the railing. 16. Walking on slippery floors.

Geriatric Depression Scale-Short Form (GDS-SF)

The summary of the GDS-SF information for this study can be found in Table 8. The DBS group had a higher score than the Non-DBS group for the total score on the GDS-SF. It should be noted though that both group means were slightly below clinical cut off for significant depressive symptoms. The DBS group (44%) was more likely to endorse clinically significant symptoms of depression as compared to 29% of the Non-DBS group.

Table 8. Depression ratings using the GDS-SF

Variable	DBS (n=129)	Non-DBS (n=163)
GDS-SF Total Score*	5.3 (3.9)	4.3 (3.7)
% meeting clinical significance*	44%	29%

* Denotes significant differences between the groups

Depression and Cognition and their relationship with Balance Confidence:

As for depression and balance confidence, there was a significant relationship between them. Specifically, as one may expect, the greater the reported level of depression based on the scale used in this study, the less confidence a participant had with regard to balance. Conversely, the less depression the participants endorsed, the more confidence the participant appeared to have. In another analysis looking at variables that can impact balance confidence, depression was found to be a primary determinant for the level of balance confidence for both the **DBS group** and the **Non-DBS group**. Furthermore, it is worth noting that depression was significantly related to the cognitive functions addressed in this report. Moreover, the greater the reported level of depression, the greater the perceived difficulties with attention, focus, transitioning, planning, initiating, organizing, and problem solving.

Specific cognitive functions about which this survey inquired were also assessed to see if there were factors in determining balance confidence. For the **DBS group**, difficulties with focusing, transitioning, planning, organizing, multi-tasking, and problem solving (aspects of higher order thinking – executive control) were related to one's level of balance confidence. Moreover, when individuals endorsed experiencing difficulties with these functions, they reported less balance confidence. Out of these cognitive functions, perceived difficulties with attention and focus were found to be predominant factors in determining balance confidence.

For the **Non-DBS group**, however, there was no significant relationship between the perceived difficulties with thinking skills and their report of balance confidence. This is an interesting finding, with the implication that DBS may have a significant impact on one's perception of cognitive capabilities and consequently having an impact on balance confidence.

**It is important to note that the levels and types of medication that the participants in this study are taking were not investigated in this study. Thus, interpretation of our findings (e.g., as it relates to*

*depression, cognition, and balance within and between the **DBS** and **Non-DBS groups**) needs to be done so with this factor in mind.*

DISCUSSION

- The majority of individuals that underwent DBS believe that they have noticed improvement with balance, walking straight ahead, and ability to turn directions. When looking at specific age groups, however, (<50, 50-69, and 70+), DBS was reported to be the most helpful for the middle age group (ages 50 to 69).
- Even though the **DBS group** reported improvement with balance-related functions, the **DBS group** reported more falls than the **Non-DBS group** within a year's time period (refer to Table 4).
- It is important to note that the **DBS group** had a disease duration that was almost double that of the **Non-DBS group**. With that in mind, and knowing that balance and gait abnormalities are strongly related with progression of disease, it is important to note that the two groups were virtually indistinguishable in terms of balance and gait. Thus, DBS may indeed be having a positive effect.
- Approximately half of each group **(DBS** and **Non-DBS groups)** identified that they used assistive devices, and the majority of both groups found the devices helpful.
- There was a statistically significant difference, although modest, between balance confidence as it relates to the overall ratings and some individual activities between the **DBS** and **Non-DBS groups.** Specifically, the **Non-DBS group** reported greater levels of balance confidence in some of the scenarios presented within the ABC scale. In general, however, both groups had similar balance confidence ratings. Thus, it can be concluded that there is not a clinically meaningful difference between the two groups as it relates to balance confidence. In other words, balance confidence is actually similar between the two groups, and the findings do not reflect a need to approach treatment for one group any differently than the other group.
- Symptoms of depression were endorsed by a significant portion of the participants in both the **DBS** and **Non-DBS groups, which is generally consistent with previous research on this topic.**
- Balance confidence is clearly impacted by symptoms of depression for both the **DBS group** and **Non-DBS group.** Depression was found to be a determinant for the reported level of balance confidence. In other words, depression led to lower levels of balance confidence for both groups. Identifying the role of depression in the lives of individuals with PD has broad implications, both psychologically and physically. Thus, exploring the PD patient's worldview and identifying and treating symptoms of depression is important, as addressing the psychological well-being of this population can assist in improving mental health and likely physical functionality (e.g., through improving confidence when engaging in activities).
- Balance confidence is related to perceived cognitive capability in the **DBS group**, particularly as it relates to functions within the domain of executive control (e.g., focusing, transitioning, planning, organizing, multi-tasking, and problem solving). Difficulties with attention and focus, in particular, were determinants in the level of one's report of balance confidence. Thus, understanding the PD patient's cognitive capability and related perception of cognitive capability in the DBS population is critical for understanding reasons for a specific level of balance confidence. A greater understanding in this context could in turn

help with treatment intervention and possibly improve quality of life and possibly even general function.

- Sleep disturbance had a significant relationship to the participants' balance confidence. In other words, the less sleep on average that individuals in this study get per night, the less balance confidence they had as well. Sleep disturbance is very prevalent in PD (Menza and Marsh, 2006), and understanding the impact of sleep disturbance on balance problems is of importance.
- Although this study did not analyze the significance of co-existing medical conditions on balance confidence for the **DBS** and **Non-DBS groups**, the important point is that the vast majority of individuals with PD in both groups reported that they were contending with both PD and a co-existing medical condition that can impact balance and balance confidence. Further research regarding balance confidence as it relates to the co-existing conditions with PD is warranted.
- The levels and types of medication that the participants in this study are taking were not investigated in this study. Thus, interpretation of our findings (e.g., as it relates to depression, cognition, and balance within and between the **DBS** and **Non-DBS groups**) needs to be done so with this factor in mind.

ACKNOWLEDGEMENTS

As we complete our 9th DBS-STN patient survey, I want to express my gratitude to all those who participated in this study and to the many carers without whom our lives would not be as meaningful. I want to extend my appreciation to our consulting clinical neuropsychologist and lead researcher, Dr. Jeffrey Wertheimer, who assists in the development, oversight, and generation of our research reports. Dr. Wertheimer is a staff Neuropsychologist and Director of Research for Persona Neurobehavior Group, South Pasadena, CA. Thanks goes to Dr. Julie Smith, staff Neuropsychologist at the VA Illiana Health Care System, Danville, IL, who also assists with data analysis and generation of our reports. I want to extend a special thank you to Dr. Fay Horak and Dr. Michele Tagliati for their contributions to this research project. Dr. Horak is a Physical Therapist and Motor Control Neurophysiologist of the Oregon Health & Science University. Dr. Tagliati is an Associate Professor and Division Chief Movement Disorders at Mount Sinai Medical Center in New York, and he is the Scientific and Medical Director for The Parkinson Alliance. Additionally, I want to thank Valentina Trepatschko, the DBS Survey Coordinator for The Parkinson Alliance, for all of her diligence and assistance in data collection and data entry. Furthermore, I want to acknowledge the ongoing dedication and tenacity of Carol Walton, Chief Executive Officer for The Parkinson Alliance.

Margaret Tuchman
President
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References

1. Adkin, A., Frank, J., Jog, M. (2003). Fear of falling and postural control in Parkinson's disease. Movement Disorders. 18 (5), 496-502.

2. Allain, H., Schuck, S., Manduit, N. (2000) Depression in Parkinson's disease. British Medical Journal, 13; 320 (7245), 1287-1288.

3. Bernal, A., Arango, G., Grandados, A., & Fernandez, W. (2005). Gait assessment in parkinsonism, dementia, and normal aging. Poster presentation at the 9th International Congress of Parkinson's Disease & Movement Disorders, New Orleans.

4. Cully, J., Johnson, M., Moffett, M., Khan, M., Deswal, A. (2009). Depression and anxiety in ambulatory patients with heart failure. Psychosomatics. 50 (6), 592-8.

5. Cummings, J. (1992). Depression and Parkinson's disease: A review. American Journal of Psychiatry, 149, 443-54.

6. Ferraro, F., Chelminski, L. (1996). Preliminary normative data on the Geriatric Depression Scale-Short Form (GDS-SF) in a young adult sample. J Clin Psychol. 52 (4), 443-47.

7. Forsaa, E., Larsen, J., Wentzel-Larsen T., Herlofson K., Alves, G. (2008). Predictors and course of health-related quality of life in Parkinson's disease. Movement Disorders. 23 (10), 1420-27.

8. Gassmann, K., Rupprecht, R.; IZG Study Group. (2009). Dizziness in an older community dwelling population: a multifactorial syndrome. J. Nutr. Health Aging. 13 (3), 278-82.

9. Gassmann, K., Rupprecht, R., Freiberger, E.; IZG Study Group. (2009). Predictors for occasional and recurrent falls in community-dwelling older people. Z Gerontol Geriatr. 42(1): 3-10.

10. Hausdorff, J. (2009). Gait dynamics in Parkinson's disease: common and distinct behavior among stride length, gait variability, and fractal-like scaling. Chaos. 19 (2), 026113.

11. Hausdorff, J., Yogev, G., Springer, S., Simon, E., & Giladi (2005). Walking is more like catching than tapping: Gait in the elderly as a complex cognitive task. Poster presentation at the 9th International Congress of Parkinson's Disease & Movement Disorders, New Orleans.
12. Horak, F. (2005). Balance and Gait in Parkinson's Disease. Presentation at The 9th International Congress of Parkinson's Disease and Movement Disorders. New Orleans, March 2005.

13. Lajoie, Y., Gallagher, S. (2004). Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and the Activities-specific Balance Confidence (ABC) scale for comparing fallers and non-fallers. Arch Gerontol Geriatr. 38 (1), 11-26.

14. Mak, M., Pang, M. (2008). Balance self-efficacy determines walking capacity in people with Parkinson's disease. Movement Disorders. 23 (13), 1936-39.

15. McAuley, E., Mihalko, S., Rosengren, K. (1997). Self-efficacy and balance correlates of fear of falling in the elderly. Journal of Aging and Physical Activity, 5,329-340.

16. Meguro, K., Ueda, M., Yamaguchi, T., Sekita, Y., Yamazaki, H., Oikawa, Y., Kikuchi, Y., Matsuzawa, T. (1990). Disturbance in daily sleep/wake patterns in patients with cognitive impairment and decreased daily activity. J AM Geriatric Soc. 38 (11), 1176-82.

17. Menza, M. & Marsh, L. (2006). Psychiatric Issues in Parkinson's Disease: A Practical Guide. Taylor & Francis, United Kingdom.

18. Muslimovic, D., Post, B., Speelman, J., Schmand, B., De Haan, R. (2008). Determinants of disability and quality of life in mild to moderate Parkinson's disease. Neurology. 70 (23), 2241-7.

19. Pickering, R., Grimbergen, Y., Rigney, U., Ashburn, A., Mazibrada G., Wood B., Gray, P., Kerr, G., Bloem, B. (2007). A meta-analysis of six prospective studies of falling in Parkinson's disease. Movement Disorders. 22 (13), 1892-900.

20. Powell, L., Myers, A. (1995). The Activities-Specific Balance Confidence (ABC) Scale. Journal of Gerontology: Medical Sciences, 50A, M28-M34.

21. Rahman, S., Griffin, H., Quinn, N., Jahanshahi, M. (2008). Quality of life in Parkinson's disease: the relative importance of the symptoms. Movement Disorders. 23 (10), 1428-34.

22. Weaver, F., Follett, K., Stern, M., Hur, K., Harris, C., Marks, W. Jr, Rothlind, J., Sagher, O., Reda, D., Moy, C., Pahwa, R., Burchiel, K., Hogarth, P., Lai, E., Duda, J., Holloway, K., Samii, A., Horn, S., Bronstein, J., Stoner, G., Heemskerk, J., Huang, GD; CSP 468 Study Group. (2009). Bilateral deep brain stimulation vs best medical therapy for patients with advanced Parkinson disease: a randomized controlled trial. JAMA. 301(1), 63-73.