DBS4PD.org
an affiliate of The Parkinson Alliance
Improving the Quality of Life in the Parkinson's Community

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Nutrition in Parkinson's Disease:
A Closer Look from the Patient's Perspective

INTRODUCTION

Hippocrates once uttered, "Let food be thy medicine and medicine be thy food." Food is a fundamental physiological need, has a strong relationship with psychological well-being, and is at the center of many social interactions. These concepts are intricately interwoven, and the meaning of and value placed on food are as myriad as the food possibilities themselves. Further still, Parkinson's disease brings with it a complex array of variables that impacts diet and nutrition habits.

Nutrition and dietary factors have a bidirectional relationship with Parkinson's disease (PD). Some foods can impact the absorption of medications used to treat PD and the risk or progression of PD. Similarly, PD symptoms and medications can impact one's nutritional status. It is important to understand the contribution of nutrition in neuroprotection, neurodegeneration, and general well-being[1].

There is an increasing body of literature that suggests neuroprotective benefits of certain food groups in PD[1-3], including phytochemicals (biologically active chemical compounds found in plants), omega-3, soy, caffeine, and tea (see Figure 1).

- Phytochemicals found in fruits and vegetables possess antioxidant properties, and have been found to reduce the rate of PD progression or risk[4-6]. This is particularly important as research pertaining to brain structures involved in PD suggests metabolic failure in antioxidant processes that can lead to or exacerbate parkinsonian features[7].
- While there are no studies that address whether omega-3 polyunsaturated fatty acids (PUFAs) are neuroprotective for PD, studies have found that omega-3 supplements reduced depression in PD patients[8], reduced cell death in dopaminergic cells[9], and decreased levodopa-induced dyskinesias (involuntary muscle movements) in parkinsonian primates by up to 40%[9].
- Animal studies suggested promise of neuroprotective benefits of soybean as a protein for prevention of PD in post-menopausal women[10].
- Caffeine from both coffee and non-coffee sources (i.e., dark chocolate) has a reported inverse relationship with PD[12-14], and has been found to be neuroprotective against dopaminergic degeneration and toxicity in animals. Notably, estrogen can adversely limit the neuroprotective capabilities of caffeine, with greater improvement in male PD patients and post-menopausal women not on hormone replacement therapy compared to females[14-15]. High caffeine intake was found to have a relationship with a higher risk of PD among women using hormones[14].
- Several studies indicated that regular tea consumption is neuroprotective against PD[16-18]. One study associated delayed onset of PD motor symptoms with drinking more than three cups of tea daily[19]. Unfortunately, these studies did not distinguish between use of green versus black tea, though animal models have revealed neuroprotective impact of both types of tea for PD.
- Food can also increase risk and progression of PD. For example, there is a strong positive association observed for milk consumption (but not cheese or yogurt) and increased risk of PD[20-21].

Figure 1. Food groups that may elicit neuroprotection and neurodegeneration[1]

Role of nutrients in PD. Epidemiological and biochemical studies suggest that inclusion or exclusion of certain food groups may elicit neuroprotection or neurodegeneration. Foods are shown on a spectrum. Foods shown in the red promote neurodegeneration and foods in green promote neuroprotection. Foods shown in the middle (or yellow) part of the spectrum have conflicting results and need to be studied further to assess if they play a role in neurodegeneration or neuroprotection, as cited in Seidl, et al., 2014.

As much as good nutrition management may be helpful for individuals with PD, PD symptoms can be a significant barrier to good nutrition habits. Individuals with PD have been found to be at a higher risk of malnutrition than same-age cohorts and a quicker progression of age-related sarcopenia (i.e., loss of muscle mass, composition, and quality) due to unintentional weight loss and a sedentary lifestyle[22].

- Classic PD motor features (i.e., bradykinesia (slowness of movement), impairment of voluntary movement, rigidity (stiffness), and tremor) are associated with a higher risk of decreased nutritional intake and increased loss of weight and body mass[22].
- Other PD related motor symptoms can also impact weight loss, and limit independent engagement in activities of daily living (i.e., shopping, cooking, and feeding). Specifically, difficulty swallowing (e.g., coughing, choking, sensation of food feeling stuck), decreased hand-mouth coordination, difficulty with fine motor movements, difficulty chewing, muscular rigidity and increased involuntary movements such as dyskinesia and tremor can impact weight loss[23].
- Neuropsychiatric symptoms associated with PD, such as mood symptoms (e.g., depression, anxiety, apathy) and cognitive changes (e.g., concentration difficulties, dementia, and confusion) are found to be present at a higher rate in individuals with PD when compared to same age cohorts[22]. These neuropsychiatric symptoms are also associated with reduced food intake, weight loss, and malnutrition risk in individuals with PD[24], particularly depression, anhedonia (loss of interest in activities that bring one pleasure), and concentration difficulties[25].
- Other non-motor PD symptoms have also been associated with weight loss and malnutrition among individuals with PD, including changes in smell and taste, constipation, insufficient food digestion, premature feelings of being full, nausea, sweating, and excessive salivation[22,25].
- Side effects of medications and PD treatments can also impact nutritional status. Dopamine replacement therapy, such as levodopa, can have side effects of nausea, vomiting, a loss or lack of appetite for food, and weight loss[23, 26-27]. Certain foods may impact absorption of PD medications[28], such as a high protein meal may limit effective absorption of levodopa, or foods with high concentration of tyramine could increase blood pressure when used with MAO-B inhibitors (e.g., rasagiline or selegiline).

OBJECTIVE

Given the complexity of nutrition and its impact on PD symptoms and the impact that PD symptoms have on nutrition habits and management, the objective of this study was to obtain a more simplistic understanding about the patient's perspective about nutrition and their related experiences.

METHODS

- Participants were recruited from previous participants in surveys conducted by The Parkinson Alliance (PA), advertisements at PD support groups, announcements in medical clinics, The PA website, or a DBS-focused affiliate website to The PA (DBS4PD.org).
- There were 1,492 individuals who participated in this survey, including 402 participants with PD who underwent **DBS** and 1,090 individuals with PD without DBS (**Non-DBS group**; see Table 1 for demographics and clinical features).
- For the **DBS group** and **Non-DBS group,** approximately 86% of the surveys were completed independently, whereas, approximately 14% of participants required writing assistance.
- Participants represented 50 states, with California (14%), Arizona (11%), Texas (11%), Florida (10%), New York (8%), New Jersey (7%), Pennsylvania (5%), Colorado (4%), Virginia (3%), and Michigan (3%) being the top 10 states that had the most participants. Geographical distribution was comparable between groups.

Measures:

The Demographic Questionnaire and Questions Related to Nutrition:

Questions related to demographic information/individual characteristics and nutrition were included in this survey.

Comparisons based on age and disease duration groups:

- The results will be presented using the entire sample (N=1,492) and groups matched on age and disease duration.
  - Age: Age groups were divided into a **Younger PD group** (ages 50-69 years of age) and an **Older PD group** (ages 70+ years)
  - Disease Duration: In previous research pertaining to individuals with PD, the average time from symptom onset to development of motor complications was 6 years[29,30]. Previous research has divided groups into **Early Stage (<6 years)** and **Advanced Stage PD (6+ years)** to define a valid partition between early and advanced disease states. To better illustrate the impact of disease duration on nutrition-related variables in individuals with PD, the **Advanced Stage PD group** was further divided into **Early Advanced Stage PD (6-10 years)** and **Late Advanced Stage PD (11+ years)**.

Factors to consider when interpreting the results:

- This study used a survey-based methodology. Generalizability of the results may be limited (i.e., individuals with moderate to severe functional difficulty may be under represented in this study; demographic variables are skewed (i.e., education, race) and may limit generalizability of results). 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.

RESULTS

The summary of the demographic information for this study can be found in Table 1. The **Non-DBS group** was significantly older than the **DBS group (average 71 versus 67 years).** By contrast, the **DBS group** had a younger average age of PD diagnosis **(52 years)** than the **Non-DBS group (63 years)** and a longer duration of PD (see Table 1). Gender (male greater than female), marital status (majority being married), race (majority being White/Caucasian), and education (majority having higher education) were comparable between groups.

Table 1. Demographics and Clinical Features of the Sample

	DBS (n =402)	Non-DBS (n =1090)
Average Age in Years (range)*	67 (39-87)	71 (24-103)
Duration of PD in Years (range)*	15 (3-50)	7 (0-51)
Average Age of PD Diagnosis (range)*	52 (21-76)	63 (20-91)
Average Age at Time of DBS in Years (range)	61 (31-84)	n/a
Average Duration since DBS in Years (range)	5 (0-29)	n/a
Bilateral Stimulation	77%	n/a
Target: STN	48%	n/a
GPi	8%	n/a
Thalamus	3%	n/a
Not Sure	41%	n/a
Male	56%	53%
Female	44%	47%
Married	76%	77%
Lives Alone	14%	15%
Race		
Caucasian	92%	92%
Latino/Hispanic	4%	3%
African American	<1%	1%
Asian	1%	2%
American Indian	1%	1%
Other	<1%	<1%
Education		
<12 years	3%	4%
High School	9%	8%
Some College or Associate's Degree	24%	23%
College	27%	30%
Graduate/Advanced Degree	37%	35%

*Clinically significant difference between groups
n/a = not applicable

ATTITUDES ABOUT NUTRITION AND GENERAL HABITS (N=1,492):

- 93% of participants believe that diet/nutrition is important in managing symptoms of PD.
- 63% perceive themselves as eating a healthy diet most of the time, while 36% report eating a healthy about "half the time" and just under 11% report eating a healthy diet "seldom to sometimes" or "not at all."
- 40% reported that they are on a specific diet.
- 11% of the participants reported that a treatment provider has recommended a specific diet.
- Of those who were recommended to follow a specific diet (186 participants), the individuals who provided the recommendation included (from most frequent source to the least frequent source who discussed diet or nutrition):
  - Self-educated by resources such as magazines, books, internet (31%)
  - Family/Friend (19%)
  - A doctor (12%)
  - Nutritionist (9%)
  - Speech Therapist (4%)
- For those who are currently on a specific diet, the DURATION of being on the diet was reported to be:
  - Less than a month : 1 % of the participants
  - 1 to 3 months: 2 % of the participants
  - 4 to 6 months: 2 % of the participants
  - Greater than 6 months: 18 % of the participants
- When asked about types of diets that the participants follow (1,492 participants):
  - 32% of the participants eat meat, poultry with emphasis on whole grains, vegetables, fruits, unprocessed foods.
  - 5% eat a vegetarian diet with fish and dairy
  - <1 % eat a vegan diet, no animal products of any kind
  - <1% eat a paleolithic diet (i.e., meat, nuts and berries; low carbohydrate)
  - 11% reported "Other" diets
  - The remainder did not indicate that they engage in a specific "diet"
- More generally, 93% of the participants reported regularly eating meat, poultry, or fish:
  - 32% reported eating fish (i.e., salmon, jack mackerel, herring, tuna, or sardines) at least twice per week
  - 30% of the participants use fish oil capsules
- For those who follow a specific diet, many individuals reported perceived improvement in general health (N=439):
  - 47% reported noticing some improvement in their health
  - 29% reported feeling quite a bit of improvement in their health
  - 24% did not perceive any improvement in their health
- Improvement in PD symptoms that was perceived as influenced by diet/nutrition was reported (N=412):
  - 42% reported noticing some improvement with PD symptoms
  - 12% reported feeling quite a bit of improvement with PD symptoms
  - 46% did not perceive any improvement with symptoms of PD

- 7% of the participants in this survey are using an altered food consistency program to obtain their nutrients
- 3% of the participants are on a liquid diet
- 86% of participants have regular dental appointments to assist with good mouth hygiene

WEIGHT CHANGE:

- Within the last 2 years:
  - 239 participants reported gaining weight: Average weight GAIN = 19 pounds
  - 405 participants reported losing weight: Average weight LOSS = 20 pounds
- Within the last 6 months:
  - 207 participants reported gaining weight: Average weight GAIN = 14 pounds
  - 143participants reported losing weight: Average weight LOSS = 13 pounds

CHANGES IN THE QUANTITY OF FOOD REGULARLY EATEN (N=1,463):

- 16% reported that they have increased the amount of food they eat
- 34% reported that they decreased the amount of food they eat

VITAMINS:

- 80% of the participants take vitamins/use supplements. Table 2 provides a list of common supplements and the percentage of participants who use them.

Table 2. Common supplements and the percentage of participants who use them

Vitamin D	47%
Multivitamin	44%
Calcium	32%
Vitamin B	25%
Vitamin C	18%
Magnesium	18%
Coenzyme Q10	16%
Probiotics	14%
Melatonin	12%
Green Tea	10%
Vitamin E	10%
Coconut Oil	8%
Cinnamon	8%
Flaxseed	7%
Tumeric plus ground black pepper	6%
Zinc	5%
Ginger	5%
Alpha Lipoic Acid	3%
Acetyl-l-carinitine	3%
Vitamin K	2%
Other Supplements	84%

NUTRITION MANAGEMENT AND ACTIVITIES OF DAILY LIVING (ADLS):

- For the purpose of this study, activities of daily living (ADLs) involved in eating and nutrition management include feeding one's self, preparing meals/cooking, shopping for groceries, managing medication, and maintaining self-care.
  - The majority of the particpants were "independent" or requiring "minimal assistance" with ADLs involving eating and nutrition management.
  - The ADLs involving the need for the greatest level of assistance for the participants in this study included shopping and cooking (see Figure 2).
- Table 2 illustrates the level of independence/level of assistance needed across age and disease duration. The majority of participants are independent with eating and nutrition management, with exception to the **Older, Late Advanced PD group** where the majority of whom appear to require increased levels of assistance.
- Also seen in Table 2 is a cumulative score for ADLs related to eating and nutrition management across disease duration and age cohorts.
  - Although the level of difficulty in completing the respective activities of daily living ranges from "independent" to "unable to perform," the average scores reflect generally minimal assistance is needed with eating habits for the majority of participants in this study.
  - As duration of PD and age increase, increased assistance with the respective activities of daily living is apparent.

Figure 2. Activities of Daily Living involving eating and nutrition management (N=1,492)

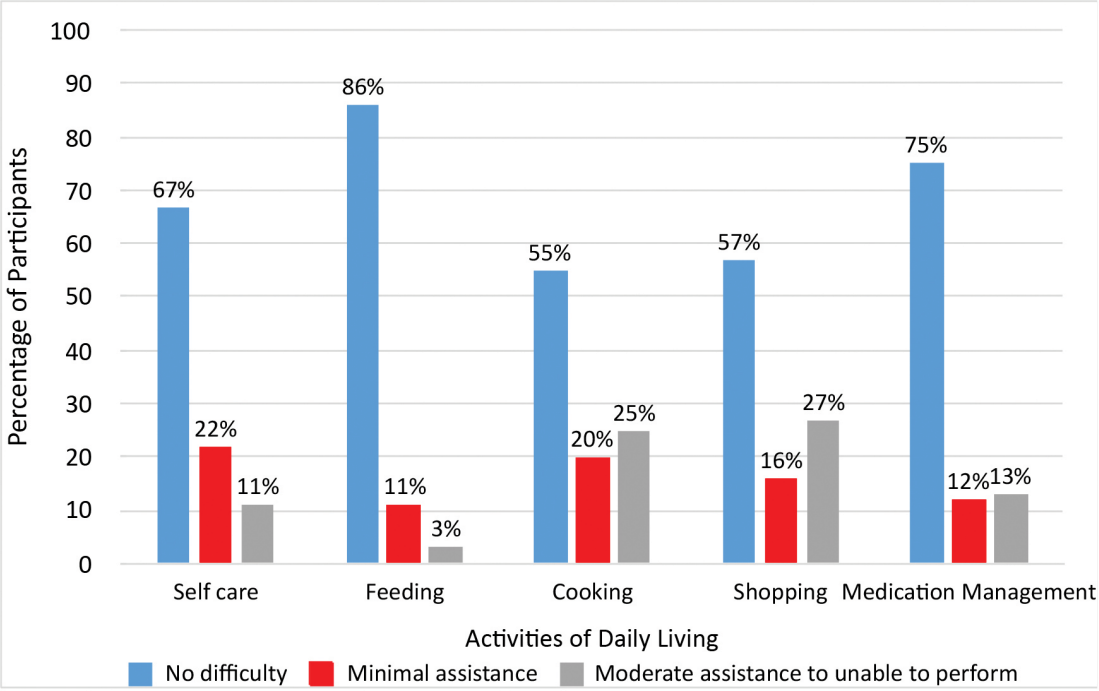

Table 2: Assistance with nutrition management/ADLs related to eating and nutrition

	Early PD Group		Advanced PD Group			
	(< 6 years duration)		6-10 years duration		11+ years duration	
Life Satisfaction	**Younger (50-69 years) (n =243)**	**Older (70+ years) (n =235)**	**Younger (50-69 years) (n =164)**	**Older (70+ years) (n = 225)**	**Younger (50-69 years) (n =228)**	**Older (70+ years) (n =234)**
Participants completely independent with nutrition management	86%	75%	74%	60%	60%	38%
Average Ratings for level of assistance needed for Activities of Daily Living (ADLs) related to eating/nutrition management *,**	6.24 (Range) (5-19)	7.03 (Range) (5-22)	6.98 (Range) (5-20)	8.40 (Range) (5-21)	8.27 (Range) (5-20)	10.63 (Range) (5-24)

*Possible range of scores is 5 (complete independence) and 25 (unable to perform).
** Higher scores reflects greater assistance needed.

NON-MOTOR SYMPTOMS AND BEHAVIORS RELATED TO NUTRITION (see Tables 3 and 4)

- Non-motor symptoms were highly prevalent for **Younger and Older Groups** and **Early Advanced** and **Late Advanced Stage Groups**.
- Changes in smell and taste are highly prevalent and occur early in the disease course, and appeared to become more prevalent in both **Older** and **Advanced Stage PD** cohorts.
- Diminished appetite was reported by approximately half of the participants across cohorts.
- Swallowing difficulties are influenced by reduced muscle control and leads to coughing, choking, sensation of food feeling stuck, and a wet vocal quality (i.e., gurgly sound) after eating or drinking. Swallowing difficulties were reported by most participants and were reported in greater prevalence with increased age and disease duration.
- Difficulty chewing was less prevalent than swallowy difficulty, but chewing difficulty became more prevalent with increased age and disease duration.
- Gastrointestinal issues (i.e., constipation, incomplete bowel movement, flatulence, heart burn), dry mouth, depression, anxiety, stress, and fear of choking were the most commonly endorsed.
    - The following symptoms demonstrated increased prevalence with increased age and disease duration: fear of choking, dry mouth, tooth decay/tooth loss, constipation, and incomplete bowl movement.
- The **Younger PD group** as compared to the **Older PD group** across disease duration cohorts had greater levels of obsessions/compulsions (i.e., within the moderate to extreme range).
- Increased difficulties using utensils was apparent with increased age and disease duration.
- Physical activity diminished with increased age and disease duration.
- The majority of individuals eat a main meal of the day within a 30 minute period. As age and disease duration increase, individuals to engage in a longer duration of a meal, but typically not exceeding 45 minutes. Notably, the increased duration to complete a meal may be attributed to cultural factors (i.e., in the context of generational priorities) in addition to the possible impact of PD symptoms on the experience of eating.

Table 3: Symptoms and activities related to nutrition across age and disease duration cohorts

	Early PD Group (< 6 years duration)		Advanced PD Group 6-10 years duration		Advanced PD Group 11+ years duration	
Symptoms that can impact nutrition	Younger (50-69) (n =248)	Older (70+) (n =243)	Younger (50-69) (n =171)	Older (70+) (n = 237)	Younger (50-69) (n =238)	Older (70+) (n =245)
To what extent have you experienced DIMINISHED APPETITE?						
Not at all	53%	59%	54%	57%	54%	56%
A little bit	36%	23%	27%	28%	31%	28%
Moderately	8%	12%	13%	9%	10%	12%
Quite a bit/Extremely	3%	6%	6%	6%	5%	4%
To what extent do you have problems SWALLOWING OR CHOKING on food or liquids?						
Not at all	53%	49%	45%	49%	25%	31%
A little bit	36%	36%	40%	38%	49%	45%
Moderately	8%	9%	11%	8%	21%	11%
Quite a bit/Extremely	3%	5%	4%	5%	5%	13%
To what extent do you have DIFFICULTY CHEWING?						
Not at all	79%	77%	72%	71%	61%	55%
A little bit	17%	16%	22%	23%	28%	28%
Moderately	4%	7%	5%	5%	8%	11%
Quite a bit/Extremely	<1%	2%	1%	1%	4%	5%
To what extent have you experienced loss of SMELL?						
Not at all	26%	28%	20%	20%	21%	19%
A little bit	15%	17%	21%	13%	16%	19%
Moderately	16%	14%	14%	19%	13%	15%
Quite a bit/Extremely	44%	41%	45%	48%	49%	48%
To what extent have you experienced loss of TASTE?						
Not at all	45%	44%	33%	30%	37%	34%
A little bit	27%	27%	35%	36%	32%	27%
Moderately	17%	16%	21%	17%	20%	26%
Quite a bit/Extremely	4%	13%	11%	17%	11%	13%
To what extent do you have difficulty using UTENSILS?						
Not at all	46%	50%	42%	36%	33%	31%
A little bit	35%	32%	37%	43%	41%	38%
Moderately	14%	11%	17%	13%	20%	20%
Quite a bit/Extremely	<1%	7%	4%	8%	6%	11%

To what extent do you have OBSESSIONS and/or COMPULSIONS related to Eating?						
Not at all	48%	60%	43%	59%	44%	56%
A little bit	29%	28%	32%	25%	35%	28%
Moderately	14%	9%	15%	11%	14%	10%
Quite a bit/Extremely	9%	3%	10%	5%	7%	6%
To what extent have you decreased your PHYSICAL ACTIVITY?						
Not at all	55%	53%	42%	41%	37%	31%
A little bit	21%	21%	28%	23%	29%	26%
Moderately	14%	14%	16%	19%	18%	28%
Quite a bit/Extremely	10%	12%	14%	17%	16%	13%
On average, how long does it take you to finish one main meal?						
Less than 30 min.	82%	69%	74%	67%	67%	57%
30 to 44 minutes	13%	27%	24%	31%	26%	37%
45 to 60 minutes	4%	4%	2%	3%	5%	5%
Longer than 60 min.	<1%	<1%	0%	0%	<1%	1%

Table 4: Non-motor symptoms of PD that may directly and indirectly relate to nutrition: Across age and disease duration cohorts

	Early PD Group		Advanced PD Group			
	(< 6 years duration)		6-10 years duration		11+ years duration	
Symptoms experienced by Individuals with PD	Younger (50-69) (n = 249)	Older (70+) (n =248)	Younger (50-69) (n =171)	Older (70+) (n = 241)	Younger (50-69) (n =237)	Older (70+) (n =247)
Fear of Choking	19%	16%	28%	20%	27%	28%
Dry mouth	50%	52%	58%	58%	62%	63%
Tooth decay/Tooth loss	11%	8%	15%	15%	21%	24%
Nausea	12%	9%	14%	8%	10%	5%
Abdominal bloating after meals	17%	13%	25%	16%	21%	17%
Abdominal cramping	7%	4%	12%	5%	10%	9%
Feeling full soon after starting to eat	13%	16%	17%	13%	21%	17%
Heartburn	25%	25%	26%	22%	29%	26%
Frequent Flatulence	31%	38%	34%	35%	32%	36%
Constipation	50%	54%	60%	56%	57%	64%

Incomplete bowel movement	23%	21%	33%	26%	34%	34%
Diarrhea	7%	4%	9%	6%	7%	10%
Moderate to severe depression	23%	22%	26%	16%	31%	28%
Moderate to severe anxiety	31%	25%	32%	25%	35%	33%
Moderate to severe stress	41%	30%	43%	30%	43%	38%

- 32% of the participants reported having been diagnosed with depression in their past.
- 24% of the participants reported having been diagnosed with anxiety in their past

DBS VERSUS NON-DBS PARTICIPANTS:

- Generally, after taking into account age and disease duration, the **DBS group** did not differ in nutritional habits and experiences (in the main), with exception of a higher incidence of choking experience and difficulties chewing when compared to the **Non-DBS group**, which is consistent with other research[31,32].

QUALITY OF LIFE:

- Although some decrement in quality of life may occur with increased age and disease duration, quality of life was rated as good to excellent for the majority of participants across age and disease duration cohorts (see Table 5).

Table 5: Quality of Life: Across Age and Disease Duration Cohorts

	Early PD Group		Advanced PD Group			
	(< 6 years duration)		6-10 years duration		11+ years duration	
Life Satisfaction	**Younger (50-69 years) (n =247)**	**Older (70+ years) (n =240)**	**Younger (50-69 years) (n =169)**	**Older (70+ years) (n = 237)**	**Younger (50-69 years) (n =237)**	**Older (70+ years) (n =245)**
Excellent	26%	22%	18%	14%	14%	18%
Good	50%	55%	50%	56%	52%	47%
Fair	20%	21%	26%	25%	30%	28%
Poor	4%	<1%	6%	4%	4%	7%
Worst Imaginable	<1%	0%	0%	<1%	<1%	<1%

SUMMARY AND DISCUSSION

Nutrition and dietary factors have a bidirectional relationship with Parkinson's disease (PD). Nutrition can impact metabolism of medications used to treat PD and the risk or progression of PD. Similarly, PD symptoms or medications can impact one's nutrition and dietary habits.

TAKE HOME POINTS, IMPLICATIONS, AND RECOMMENDATIONS:

- Conceptualizing nutrition and dietary habits in the context of the complexity of managing PD symptoms and the many variables that are related to general well-being is illustrated in this study.
- Although the vast majority (93%) believe that diet/nutrition is important in managing symptoms of PD, almost half of the participants perceive themselves as not eating healthily the majority of the time, only 40% follow a specific diet, and very few have been educated about or have been recommended to follow a specific diet.
    - For those who are conscientious about nutrition, most individuals are self-educated (i.e., reading information on-line, in magazines and books, etc.).
    - Education about nutrition in PD is limited and difficult to access, and the educational process for individuals with PD is understudied.
- Non-motor symptoms (i.e., constipation, changes in smell and taste, depression, etc.) are highly prevalent. Consistent with other comments by other researchers, non-motor symptoms at early stages (and even late stages) of PD may affect dietary choices and therefore adversly impact nutritional status observed in PD[1].
- Swallowing difficulties are influenced by reduced muscle control and leads to coughing, choking, sensation of food feeling stuck, and a wet vocal quality (i.e., gurgly sound) after eating or drinking. Swallowing difficulties were reported by most participants and were reported in greater prevalence with increased age and disease duration. Notably, swallowing difficulties may be unknown to some patients due to reduced sensation in the throat (i.e., silent aspiration) and may be under reported.
- As age and disease duration increase, non-motor symptoms and motor symptoms may be barriers to optimal nutrition management, and increased assistance from others may become necessary.
    - The results of this study reinforce the need for a holistic and interdisciplinary approach to addressing the needs of individuals with PD.
        - Evaluations conducted by an interdisciplinary treatment team over time is indicated, which is consistent with the recommendations by the American Academy of Neurology (annual assessments of motor and non-motor symptoms)[32].
        - Seek education and guidance from your Movement Disorder Neurologist pertaining to symptoms of PD and medication effects that relate to or impact nutrition and dietary habits.
        - It is recommended that individuals with PD meet with a Nutrition Specialist or Registered Dietician familiar with PD.
        - Given the high prevalence of swallowing difficulties, intermittent assessment and treatment (as indicated) provided by a Speech Language Pathologist who specializes in swallowing is prudent.
        - An Occupational Therapist may be of assistance in addressing barriers to eating and maintaining nutritional habits. For example, they may help improve function with use of specialized, adaptive eating utensils.

        - Psychological factors, such depression, anxiety, and apathy, can adversely impact good nutrition habits and general well-being. Working with a psychologist/neuropsychologist may be helpful.
        - Meeting with an Exercise Specialist (i.e., physical trainer familiar with PD) or Physical Therapist to discuss appropriate exercise and its impact on nutrition hygiene may also be helpful.

- Research has led to general recommendations for individuals with PD. Moreover, there is preliminary evidence that indicates that some nutrients may increase an individual's risk for PD, while other nutrients may be neuroprotective (reference Figure 1).
    - Maintaining a healthy weight by eating prudently is important.
    - Maintaining a well-balanced diet rich in a variety of foods, including numerous servings of vegetables, fruits (especially those containing nicotine such as tomatoes, potatoes, eggplant, peppers, cauliflower), and moderate amounts of omega-3 fatty acids, tea, and caffeine may be neuroprotective and may provide other health benefits[1].
- Other general guidelines for diet for individuals with PD include[28]:
  * It is important to speak to a registered dietitian regarding food and nutrition and its impact on symptoms of PD and medications.

Medications and Supplements and PD

- Taking medication 30 minutes before a meal or 60 minutes after a meal allows for Levodopa to reach the small intestine and absorb faster. However, a carbohydrate snack (crackers, toast, oatmeal) may be necessary to prevent nausea. Talk to your doctor about recommendations pertaining to the optimal timing of eating and use of medication.
- Dopamine agonists (such as pramipexole and ropinirole) do not require any dietetic adjustment.
- Those who take MAO-B-inhibitors (rasagiline or selegiline) should eat with moderation, but not eliminate foods that contain high concentrations of tyramine (i.e., cured meats; aged cheeses; fermented cabbage, soybean products). MAO-B inhibitors increase tyramine, and the combination could elevate blood pressure.
- Iron supplements can also decrease absorption of Levodopa so they should be separated from medications by at least two hours.

Dietary Changes and Easing PD Symptoms

- Constipation is common in PD. Increased fluid and fiber consumption can help maintain regularity.
- Warm liquids (i.e., in the morning) can stimulate bowel movements.
- Dietary sources of fiber consist of fruits (with the peel), vegetables, legumes, whole grain breads, and cereals. Most of these foods are high in antioxidants as well.
- Low blood pressure is a symptom of PD, and a side effect of some medications.
    - Raising fluid and salt intake will boost blood pressure, but speak with your physician about your diet, particularly if you have heart or kidney problems.

- Although caffeine among other hot liquids can be good for you, such beverages can lead to dehydration and affect blood pressure. Eating frequent, small meals, can also smooth blood pressure fluctuations.
- The spice turmeric may help address painful muscle cramping, especially at night and as medications wear off. Drinking tonic water, which contains quinine, may also help address painful muscle cramping.
- It is recommended to speak to a registered dietitian for help with meal choices and supplements.

Protein and PD

- People with PD tend to need somewhat more protein than other individuals. It is common for individuals with PD to feel more "on time" when they skip protein. When not eating enough protein, however, they may experience a state of protein-calorie malnutrition.
- Eating a large amount of protein in the evening can block evening levodopa absorption (particularly true if one has gastroparesis (a condition in which the stomach cannot empty food properly) or small bowel bacterial overgrowth, both of which are fairly common due to PD's effect on the autonomic nervous system).
- For those individuals with diabetes, which is not uncommon, or COPD, overreliance on carbohydrates all day long worsens blood glucose control, and those with COPD, respiration can be affected.
- Increased "off time" may be due to slowed stomach emptying, preventing subsequent medications from clearing the stomach and entering the small intestine. Meeting with a registered dietitian may help identify meal choices that clear the stomach more quickly. Increased "off time" can also be due to prolonged constipation. Alleviating constipation can help facilitate medications effects.

Aspiration Precaution and Prevention

- Increase attention to coughing and choking sensations and wet vocal quality (gurgly sound).
- Sit in an upright position without turning one's head when eating food or drinking fluids.
- Avoid talking and other distractions when actively eating.
- Chewing effectively, managing the pace of eating and taking small bites and small sips.
- Modify what you are eating: Avoid specific foods or beverages that increase risk for choking.
- Attending to when there is a need to clear one's throat and/or repeat swallowing.
- Keep the person sitting upright for 30 to 45 minutes after eating.
- Maintain good oral hygiene and engage in regular follow-ups with a dentist.

- Note: as Seidl and colleagues point out, in spite of promising effectiveness of good nutritional management on well-being for individuals with PD, there is a lack of definitive evidence-based answers addressing many questions pertaining to nutrition and well-being related to PD[1]. Well-designed studies are needed to increase our understanding about and intervention related to nutrition.

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