Title: A cross-sectional feasibility study of nutrient intake patterns in people with Parkinson's compared to government nutrition guidelines.

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Abstract

Diet could have implications for disease progression and management in people with Parkinson's (PwP). However, the knowledge of diet intake patterns in PwP is limited.

Objectives

We set out to assess the feasibility of collecting diet data in PwP to determine food and nutrient intake, in order to compare to national nutrition guidelines and thus understand the habits in this population.

Methods

In this cross sectional feasibility study PwP were approached through local support groups through out the Thames Valley and were asked to complete a Food Frequency Questionnaire. Eligibility criteria included a self-reported neurologist confirmed diagnosis of Parkinson's. Completeness of questionnaires was reported and 80% was considered appropriate for each measure including demographic information.

Results

Response rate was 61% and missing data for the 121 returned questionnaires was 74%, however of the 90 used for analysis there was 100% completion of the questionnaires. Compared to the UK government guidelines, protein was significantly higher for both males and females and fluid intake lower for both genders ($p<0.001$). There were several other differences in nutrient intake compared to guidelines.

Conclusion

We observed high levels of engagement from PwP and found that assessing food and nutrient patterns in PwP was feasible. Importantly, the diet was generally healthy overall, yet there were specific nutrients that may affect medication metabolism in PwP which were found to be high. Therefore further research into this emerging and important area is warranted.

Keywords: Protein; diet; Parkinson's

Introduction

A healthy diet is known to benefit physical and cognitive functioning throughout the lifespan [1, 2], and to protect against a number of long term conditions and associated symptoms [3, 4]. However there is limited evidence of the role of diet in disease progression and symptom management in people with Parkinson's (PwP) [5, 6].

Whilst diet is known to impact on the effectiveness of drug metabolism [7], dietary patterns are not typically measured clinically in PwP and there is a need to consider diet in both disease progression and management. Although only a modest effect of diet on risk of Parkinsons's has been shown [8], the role of diet after diagnosis is more promising [9, 10]. Evidence so far has suggested a more healthy diet is associated with lower levels of disability and symptom severity in PwP, yet good quality comprehensive research is lacking and subsequently there are no specific nutritional guidelines for PwP [6, 11].

PwP have been found to consume less fluids than the control population, partially as a result of symptoms such as dysphagia [12]. High protein intake have also been noted in PwP and the higher the intake the larger the dose of levodopa required, with a correlation seen between higher protein intake and levodopa related motor complications [13]. A recent study looked into the effect of food groups on Parkinson's progression and found that 'healthy' food such as fresh vegetables, fresh fruit, nuts and seeds, non fried fish, olive oil, wine, coconut oil, fresh herbs, and spices were related to a reduced progression of disease, where as fruits and vegetables, diet and non diet soda, fried foods, beef, ice cream, yogurt, and cheese were associated with increased progression [14].

77 The aim of the present study is to determine the feasibility of collecting information about
78 food and nutrient intakes in PwP using a standardised comprehensive diet questionnaire, and
79 to highlight habits and potential areas of concern for PwP considering the disease and its
80 management.
81
82 **Methods**
83
84 This was a cross sectional pilot study designed to assess aspects of feasibility including the
85 efficiency of data collection methods through completion and return of questionnaires,
86 identification of missing data and recruitment rate. Participants were recruited throughout
87 Buckinghamshire and Oxfordshire either via the Parkinson's UK Research Network or
88 through Parkinson's UK support groups and questionnaires were administered in person and
89 were returned through mail. Potential participants were provided with information about the
90 study and if they agreed to take part, consent was implied through the completion and return
91 of anonymised questionnaires. Eligibility criteria included a self-reported neurologist
92 confirmed diagnosis of Parkinson's. Ethical approval for this study was granted by University
93 Ethics Committee (150895).
94
95 The EPIC-Norfolk Food Frequency Questionnaire [15] was used to measure habitual food
96 intake over the previous 12 months. It included questions about specific food items, such as
97 seasonal consumption of fruit and vegetables and habitual consumption of meat, fish, dairy
98 products, potatoes, breads, rice, fats and sugars. The FFQ was analysed using software from
99 the European Prospective Investigation into Cancer (EPIC-Norfolk) Cohort study; from
100 which the accuracy of the analysis was originally validated and therefore has not been

validated in those with Parkinson's. Demographic information was self reported and included weight, height, gender, and date of birth.

Dietary Reference Values (DRVs) are a series of estimates of the energy and nutritional requirements of different groups of healthy people and are based on the UK populations [16]. These were set by the Committee on Medical Aspects of Food and Nutrition Policy (COMA) in 1991. Therefore in the current study the nutrient intakes from the participants were compared with the optimal intake values based on the government guidelines.

Statistical analysis

A sample size of 82 PwP was calculated based on a population of 554 PwP throughout Oxfordshire (assuming 227 new diagnoses annually and 227 existing), a confidence interval of 10% and a confidence level of 95%. Demographic data was described using descriptive analysis and recruitment rate was determined. Completeness of questionnaires was reported and 80% was considered appropriate for each measure including demographic information [17].

Nutrient data was compared to the SACN guidelines to identify any obvious and major differences in nutrient intake in PwP compared to the UK population (± 1 SD). These nutrients were then further analysed. Therefore, the data were first descriptively analysed before performing further analysis.

Significance level was set at 5%. Multicollinearity was assessed and collinear variables were not included. Data were analysed using SPSS Statistics Version 23 (IBM SPSS Statistics for Windows, IBM Corp, Armonk, NY, USA). Independent two sided t tests for males and females were performed to compare mean values for each nutrient to the UK guideline recommendation for these nutrients.

Results

This was a cross-sectional feasibility study including 90 PwP (men 52; women 38) over 18 years of age (mean years 68 ± 9.64 SD, body mass index 25.02 ± 4.27 SD mg/k^2) recruited between 2016 to 2017. 200 questionnaires were administered randomly in the support group meetings and of those 121 returned (61%), 90 were used for analysis (45%). Missing data for the 121 returned questionnaires was 74%, however of the 90 used for analysis there was 100% completion of the questionnaires (fig 1).

[See appendix for: figure 1]

Comparison to UK nutrition guidelines

In the current study, the nutrient intake in PwP was compared to the SACN guidelines and table 1 represents nutrients that were significantly different from the UK guidelines. Protein intake was significantly higher compared to the UK guidelines and fluid intake lower in both genders ($p<0.001$). Also, other nutrients were shown to have significance compared to SACN guidelines, for example energy intake was lower for men ($p=0.002$), zinc was higher for females ($p<0.001$) and fibre and vitamin D were lower for both genders ($p<0.001$) yet iron, vitamin C, folate, phosphorus, B6, B12, calcium were higher for both genders ($p<0.001$).

[See appendix for: table 1]

Discussion

We assessed diet in a representative sample of PwP and notably observed that protein intake was twice that recommended by UK guidelines. Other interesting findings were lower fluid, fibre and vitamin D intake and more differences were found in men compared to SACN guidelines who generally had a poorer diet than women. Although research is limited, nutritional status may play a significant role in symptoms in PwP [17]. Our findings suggest that monitoring diet is feasible and well received and that the development of approaches to effectively support optimal and specific diets for PwP may be important for management of the disease and symptoms.

Although fluid consumption tended to be similar between the sub groups in this cohort of PwP, the intake of fluids was at the lower end of 'optimal' when compared to UK guidelines. In the current study intakes were around 800 ml whereas guidelines recommend a minimum of 1200 ml a day for health [18]. Men have been found to have fewer coping strategies when it comes to bladder management and may restrict fluid intake in order to manage urinary frequency, resulting in dehydration [19], however the reason for lower intakes in women is not known. Symptoms such as dysphagia may be responsible for the lower fluid intake in PwP as reported previously [12].

PwP in the current study were found to have double the required intake of protein which confirms findings from 2006, when a smaller study observed similar high intakes of protein [6]. Protein intake interrupts the efficiency of levodopa and therefore PwP are advised to reduce and redistribute their protein intakes. Therefore it may be detrimental for PwP to be consuming above the recommendations for this nutrient, especially if on disease modifying medication for their condition. However, when limiting protein intake, Virmani et al. [7]

found 60% of patients experienced weight loss and therefore this must be monitored closely for optimal effects especially considering the low energy intake particularly in men. This shows that dietary behaviour does not appear to have altered over time and the need for research of possible interventions to support optimal diet for symptom management in PwP.

The interaction between protein restriction for improving GABA and glutamate concentrations in the brain may show potential in neurodegenerative disorders including Parkinson's and therefore may be another incentive for reducing protein intake in those with the condition [20].

Interestingly, intake of vitamin B6 was greater in this sample of PwP compared to the UK recommendations. Low vitamin B6 intake has been shown to increase risk of developing Parkinson's may slow disease progression [21]. Vitamin B6 is an essential cofactor in the conversion of homocysteine to cysteine and alpha-ketobutyrate, and homocysteine is thought to be linked to neurological pathogenesis in Parkinson's. However the vitamin could interact with certain Parkinson's medications and therefore high levels may be harmful to some PwP.

Limitations

In order to provide more comprehensive results a larger sample size would be beneficial from other geographical locations and the collection of more demographic information and possible confounders (smoking, exercise habits etc) would have provided a stronger statistical analysis of the results. Data was self-reported, including diagnosis of PD (no clinical confirmation obtained). The sample may have been biased as those who attend support groups are more likely to be physically able and also to be retired.

The EPIC FFQ is a good indicator of nutritional intake as significant correlations have been found between nutrients derived from the FFQ in comparison to biological analysis markers [22]. Despite it being comprehensive and a detailed assessment of food intake over a year time span, it does have several limitations such as it may not include all foods consumed and/or all cooking methods. Also, intake is not necessarily an indicator of nutritional status due to factors such as bioavailability, nutrient absorption and combination of food consumed [23].

Conclusion

This study provides a current snapshot of comprehensive assessment of the food and nutrient patterns in PwP compared to nutritional guidelines. Research into the diet patterns in this group was shown to be feasible and well received. This study is the first to show that PwP generally have healthy diets compared to the UK guidelines, yet may be unhealthy on some critical dietary components for their condition. The development of clear specific dietary guidance and pathways for implementation may be required to maintain the health of PwP and to help them understand the importance of optimal dietary manipulation for their condition.

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Author contributions

All authors contributed to the writing, data analysis, project design and data collection.

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309 Figure 1.

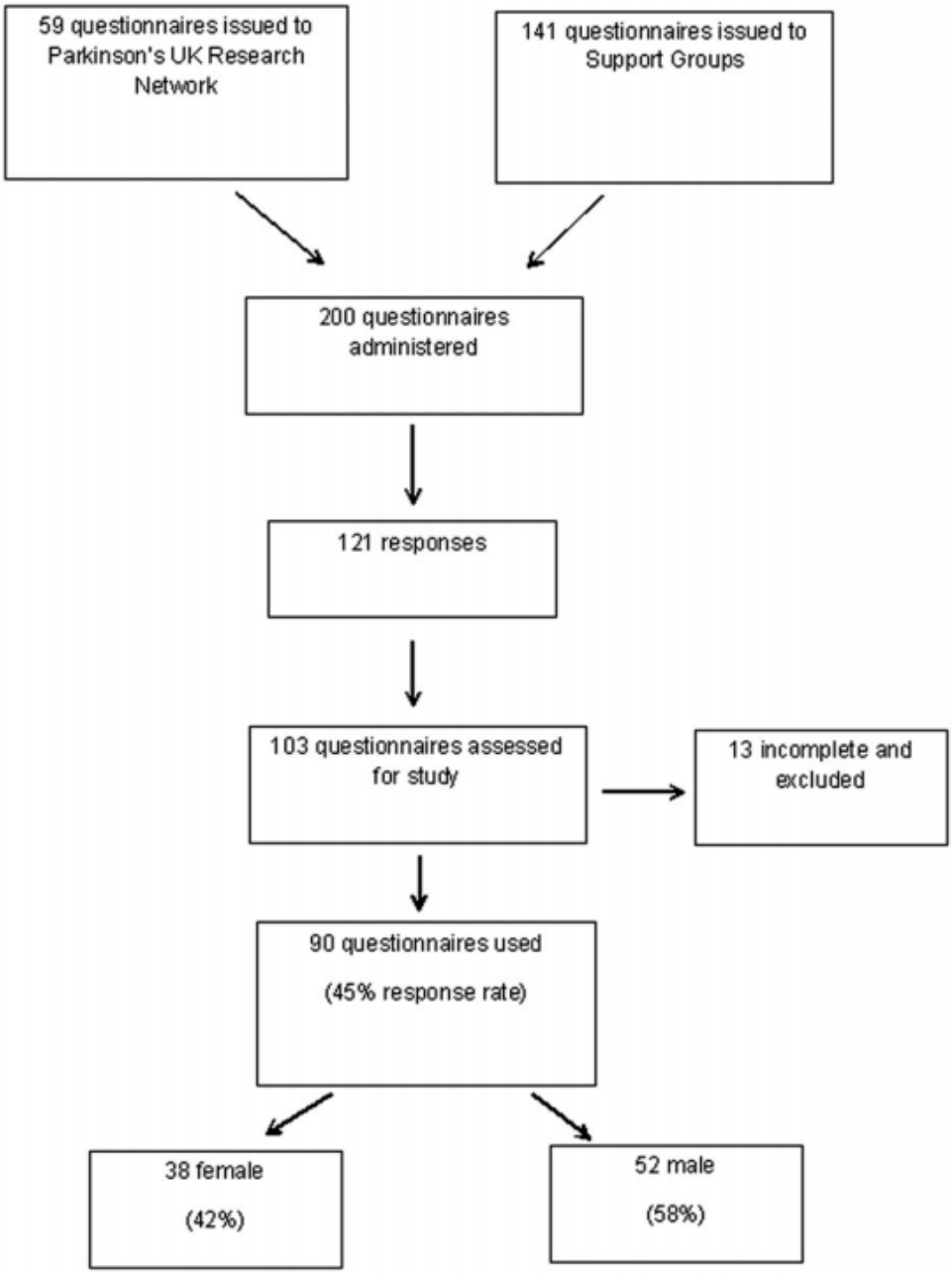

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Table 1. Nutrient/Food Intake in People With Parkinson's (PwP) Compared to UK Government Science Advisory Committee on Nutrition (SACN) Guidelines.

Nutrient	Energy (kcal)	Protein (g)	Fiber (g)	Iron (mg)	Zinc (mg)	Calcium (mg)	Vit C (mg)	Vit D (µg)	B6 (mg)	B12 (µg)	Phosphorus (mg)	Folate (µg)	Chloride (mg)	Non alcoholic beverages (g)	Alcohol (g)
PwP															
Female	1916	83	20	12	10	962	143	3	2	7	1453	327	4315	816	39
Male	2034	85	19	13	10	993	136	3	2	8	1504	327	4190	811	196
SACN															
Female	1912	46.5	30	8.7	7	700	40	10	1.2	1.5	550	200	2500	1200	–
Male	2342	53.5	30	8.7	9.5	700	40	10	1.4	1.5	550	200	2500	1200	–

Note. Intake in PwP refers to mean data from the 90 Food Frequency Questionnaires. Nutrients were chosen from 60 nutrients and were those above or below one standard deviation from the SACN recommendations. Whole food groups were also considered. Vit C: vitamin C; Vit D: vitamin D.