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Original article

Dietary habits and neurological features of Parkinson's disease patients: Implications for practice

Michela Barichella^a, Emanuele Cereda^{b,*}, Erica Cassani^a, Giovanna Pinelli^a, Laura Iorio^a,
Valentina Ferri^a, Giulia Privitera^a, Marianna Pasqua^a, Angela Valentino^a,
Fatemeh Monajemi^a, Serena Caronni^a, Caterina Lignola^a, Chiara Pusani^a,
Carlotta Bolliri^a, Samanta A. Faierman^a, Alessandro Lubisco^c, Giuseppe Frazzitta^d,
Maria L. Petroni^e, Gianni Pezzoli^a

^a Parkinson Institute, ASST G.Pini-CTO, ex ICP, Milan, Italy^b Nutrition and Dietetics Service, Fondazione IRCCS Policlinico San Matteo, Pavia, Italy^c Department of Statistical Sciences "P. Fortunati", University of Bologna, Bologna, Italy^d Department of Parkinson Disease Rehabilitation, Moriggia-Pelascini Hospital, Gravedona ed Uniti, Fondazione Europea Ricerca Biomedica (FERB), "S.Isidoro" Hospital, Trescore Balneario, Italy^e Department of Functional Rehabilitation, "Sol et Salus" Hospital, Torre Pedrera, Rimini, Italy

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SUMMARY

Background & aims: Parkinson's disease (PD) patients can benefit considerably from appropriate nutritional care, particularly from diet. However, there is limited evidence on the eating habits of PD patients and their relationship with the features of the disease.

Methods: We conducted a large case–control study. Consecutive PD patients ($N = 600$) receiving systematic nutritional care and healthy controls ($N = 600$) matched (1:1) for age, gender, education, physical activity level and residence were studied using a 66-item food frequency questionnaire. The relationship between dietary habits and the following features of PD were investigated in patients: body weight, energy balance, constipation, and levodopa therapy (dose) and its related motor complications.

Results: PD patients had lower BMI and reported higher food intake than controls. BMI was found to be inversely associated with disease duration and severity, and levodopa-related motor complications, whereas energy intake was positively associated with these variables. An increase in protein intake by 10 g over physiological requirements (0.8 g/kg/day) corresponded to a mean increase in levodopa dose of 0.7 mg/kg/day. Constipation was also associated with higher levodopa requirements. Finally, protein intake and its distribution throughout the day influenced levodopa-related motor complications.

Conclusion: The management of protein intake and the treatment of constipation should be considered to be an integral part of the care of PD patients. Attention should always be focused on energy intake also. This would result in the maintenance of nutritional status, the optimization of levodopa-therapy and the minimization of its related motor complications.

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1. Introduction

Nutritional assessment and dietary therapy have an important role to play in the integrated management of PD [1]. First of all, calorie intake should be verified. Indeed, body weight changes have

been recorded throughout the course of the disease and are related to its duration. Weight loss can occur before the clinical diagnosis of the disease, before onset of symptoms [2]. Then, during the first years after onset of symptoms, body weight usually increases, probably on account of a reduction in motor function and/or the voracity that is sometimes induced by treatment with levodopa and dopamine agonists [1,3]. On the contrary, during the advanced stages of the disease, progressive body weight loss occurs, probably on account of the increase in energy expenditure produced mainly

* Corresponding author. Fondazione IRCCS Policlinico San Matteo, Viale Golgi 19, 27100 Pavia, Italy. Tel.: +39 0382 501615; fax: +39 0382 502801.

E-mail address: e.cereda@smatteo.pv.it (E. Cereda).

by muscle hypertonia and any dyskinesias [1,3–5]. In some patients calorie-rich food supplements may be required to counteract body weight loss, meeting calorie requirements [6]. An indirect demonstration that dyskinesias have an important role to play in energy consumption is the body weight gain that occurs in patients who undergo deep brain stimulation (DBS), which reduces motor fluctuations [7]. However, the specific mechanisms underlying changes in body weight after DBS have yet to be determined, as an association between weight gain and the reduction in motor symptoms has not always been reported [8,9] and the reduction in dyskinesias may be just one of the factors involved.

Regarding the intake of macronutrients, amino acids (especially the neutral ones) introduced with food compete with levodopa for intestinal absorption and transport through the blood–brain barrier, reducing its bioavailability [1,10,11]. To optimize the effect of levodopa, especially as the diseases progress and motor fluctuations appear, PD patients should be advised to follow a protein redistribution diet i.e. protein restriction at breakfast and at lunch followed by unrestricted protein consumption at dinner, which is to include a second main course with meat, poultry or fish [1,10–12]. The objective of this redistribution is to meet daily protein requirements, which should be 0.8–1.0 g/kg of body weight [10,13]. In some patients the consumption of special foods devoid of protein at lunch may be required to reduce the amount of protein introduced and competition with pharmacological therapy [4,14,15]. Regarding micronutrients, PD patients have been found to lack vitamin D (low concentrations in plasma). The deficiency of this vitamin appears to be greater in PD patients than in the healthy population [16].

Moreover, dietary therapy is a strategy designed to counteract non motor symptoms of nutritional interest [1]. About 60% of PD patients suffer from constipation, making a high fiber diet associated with correct hydration essential [1,17–19]. For all these reasons, the diet of PD patients should be monitored. Studies on the dietary habits of PD patients may provide data of considerable interest. To date such studies have been performed only on small samples of patients [20,21]. The objective of our work was to describe the dietary habits of a large sample of Italian PD patients in a case–control study, using a freeware investigational software and assessing the association with the neurological features of the patient. In particular, attention was focused on the following issues: body weight and energy balance throughout the course of the disease, constipation and the relationship among protein intake, levodopa therapy and its related motor complications.

2. Materials and methods

2.1. Study population (patients and controls)

We conducted a large, observational case–control study (January–September 2015). Dietary habits and lifestyle of patients suffering from idiopathic Parkinson's disease (PD) [22] and with normal cognitive functions (MMSE > 24 points) were the subject of this study. PD patients consecutively attending the out-patient clinic of the Parkinson Institute (ASST G. Pini-CTO, ex ICP, Milan, Italy) and coming from all Regions of Italy were considered eligible for inclusion. The Parkinson Institute is located in Lombardy, the most populated Region of Italy (total inhabitants: 10 003 419 – www.demo.istat.it [accessed 18th January 2016]). At this Institute nutritional care is provided routinely and all patients receive specific dietary advice for the management of any issue that may benefit from it. The anthropometric parameters and dietary habits of the patients were then compared with those of a control group matched (1:1) by gender, age (± 1 year), physical activity level (major intensity levels – please see below) and geographical area (province of residence). Controls had to be cognitively intact and

were selected among all the people in the electronic database of the “ON-GP” free online software, developed by the Grana Padano Observatory (OGP) [23,24]. Controls were selected among the spouses of the patients included or people accompanying them (community healthy controls) and patients attending the same hospital for other minor health reasons (hospital controls with minor neurologic, orthopedic, dermatologic or ophthalmologic disorders). Subjects and patients reporting the use of any type of dietary supplement and/or receiving artificial nutritional support were excluded. All the subjects recruited provided their informed consent to the study. The study was approved by the local Ethics Committee.

2.2. Assessments

On the same day, PD patients and controls underwent the following assessments:

1. *Anthropometry* – Anthropometric data were collected by well-trained dietitians in agreement with WHO indications [25]. Particularly, body weight and height were measured using the same portable calibrated flat scale provided with a telescopic vertical steel stadiometer (Wunder, Italy), while waist circumference was measured through plastic flexible tapes at the narrowest point between the lowest rib and the iliac crest.
2. *Dietary habits* – Dietary habits were investigated with a semi-quantitative 66-item Food Frequency Questionnaire (FFQ) [23,24], with the objective of assessing the frequency of consumption of the main food groups and drinks over the last 12 months. Trained dietitians completed the questionnaire by interviewing patients directly (with the aid of caregivers whenever necessary to avoid missing items). 24-hour dietary recall associated with the use of a food atlas was also considered for consistency of portion size and to confirm adherence to a protein redistribution diet (PRD). PRD was defined as protein restriction (no high-protein food sources) at breakfast and at lunch followed by unrestricted protein consumption at dinner (second main course with meat, poultry or fish) [10] for 5 days or more per week. The online “ON-GP” Software freeware was used for the assessment [23,24] and daily calorie, macronutrient, micronutrient and fluid intakes were calculated using the Italian Food Composition Tables [26]. In this way any excesses and/or deficiencies were highlighted. Based on the data processed, the software enabled us to print a report containing personalized advice to give the patient. This software is also able to collect the following information: gender; age; geographical area (residence), level of education and type of occupation; anthropometric data (body weight, height, BMI, and waist circumference); time dedicated to household chores, free time dedicated to sedentary hobbies and physical activity. Based on information related to hours of sleep, as well as to the duration and the types of occupation and recreational activities, which are linked to specific (tabulated) energy costs per minute [27], it was possible to calculate the total energy cost of each task. The sum of these energy costs and resting energy expenditure (REE) – according to the Harris–Benedict equations [28] – enabled the calculation of total daily energy expenditure (TDEE). The mean of seven days was considered in the analysis. Therefore, the physical activity level (PAL) was expressed as the ratio of TDEE and REE and was grouped into major intensity levels according to age and gender (Supplementary Table 1).
3. *Bowel habits* – Presence of constipation was diagnosed according to Rome-III criteria [29].
4. *PD features* – Furthermore, the following clinical information was collected for all PD patients: duration of disease, Unified

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