Clinical and nutritional correlations in Parkinson's disease: Preliminary report

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Abstract

Background. Parkinson's disease (PD) is one of the most common neurodegenerative disorders. Malnutrition is an essential problem in the late stage of PD. Lowering of body mass is seen in 30% of patients, and malnutrition or the risk of malnutrition in 24% and 60%, respectively.

Objectives. The aim of the study was an analysis of the relationships between the parameters of the nutritional stage and the advancement of clinical symptoms in PD patients.

Material and methods. A total of 40 patients (18 men, 22 women) with PD were analyzed, mean age: 70.7 years. In all patients, structured anamnesis, Nutrition Risk Screening (NRS 2002), body mass index (BMI), morphology, and basic biochemical tests were conducted. Skin fold thickness was also measured. The results were referred to the score of different scales.

Results. The study showed a lot of correlations between the severity of PD, mostly motor symptoms in the Unified Parkinson's Disease Rating Scale (UPDRS), and parameters characterizing the patient's nutritional status. We revealed a correlation between malnutrition and PD duration, and L-DOPA frequency intake. The global score of parts I, II and III of UPDRS were correlated with the nutritional status. The results confirmed the existence of more severe smell change and taste impairment in the late stage of PD, with more pronounced malnutrition.

Conclusions. The duration of PD, motor and non-motor PD symptoms, and the frequency of L-DOPA intake closely correlate with the nutritional status. Understanding of the multifactorial interdependence might be useful in the estimation of the algorithm for monitoring the nutritional status of PD patients and taking early nutritional intervention.

Key words: malnutrition, Parkinson's disease, Nutrition Risk Screening, Unified Parkinson's Disease Rating Scale, skin fold thickness

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Introduction

Parkinson's disease (PD) has the 2nd highest incidence rate, after Alzheimer's disease, for neurodegenerative disorders in the population above 50 years of age. Parkinson's disease occurs in about 1% of the population above 65 years of age.¹ Malnutrition is an essential problem in the late stage of PD. Lowering of body mass is seen in 30% of patients, and malnutrition or the risk of malnutrition in 24% and 60%, respectively.¹ Malnutrition could be caused by lowering of food intake, motor dysfunctions, motor side effects of treatment (choreatic dyskinesia), dysphagia, or dysautonomia (gastroparesis, constipation).² Cognitive dysfunction, depression and/or a lack of family attention could exacerbate malnutrition in PD patients. Dietary protein manipulation, burning mouth syndrome, removable dentures in oral dyskinesia, and side effects of antiparkinsonian drugs (nausea, vomiting and xerostomia) could influence the nutritional status. Autonomic disturbance, e.g., dysfunction of the subthalamic region responsible for body mass control, is thought to be an important factor in the etiology of PD malnutrition. Other coexisting diseases must be considered in the analysis of malnutrition risk factors.^{2–5}

The aim of the study was the analysis of the relationships between the parameters of the nutritional status and the advancement of clinical symptoms in PD patients.

Material and methods

All patients gave informed written consent to participate in the study. The study was approved by the local Bioethics Committee at Wrocław Medical University (Poland).

Forty patients with a diagnosis of PD according to the Movement Disorder Society (MDS) clinical criteria from 2015 were analyzed.⁶ There were 18 men and 22 women in the study group, mean age: 70.7 years. Five patients were professionally active, 35 were retired and all of them lived in a city having above 650,000 inhabitants. All of them were analyzed in an outpatient clinic. All examinations were conducted by clinical nutrition specialists and blinded neurologists specializing in extrapyramidal disorders. In all patients, structured anamnesis was performed: age, sex, disease duration, PD pharmacological therapy, disturbances of smell, taste and gastrointestinal tract, other disorders and their treatment, and addiction to stimulants. The risk of malnutrition was established based on the Nutrition Risk Screening (NRS 2002) and body mass index (BMI).⁷ In NRS 2002, results ≥ 3 indicate the threat of malnutrition and the necessity for nutritional intervention. The thickness of 3 skin folds was measured: deltoid, abdominal, and subscapular. The neurological status was based on the Unified Parkinson's Disease Rating Scale (UPDRS, v. 1987; at the time of the study the new version, MDS-UPDRS, had not yet received official approval in Poland),⁸ Schwab and England Activities of Daily Living Scale (SEADLS),⁹ Hoehn-Yahr Standing Scale (H-YSS),¹⁰ and Beck Depression Scale (BDS).¹¹

Each of the points of UPDRS, the collective results of parts I, II and III of UPDRS, and the global result of UPDRS were compared with the parameters of the nutritional status. Blood samples with an estimation of morphology, urea, creatinine, electrolytes (sodium – Na, potassium – K, calcium – Ca), magnesium – Mg, and phosphorus – P), liver enzyme activity, as well as lipids, global protein and vitamin D levels were analyzed.

For pairs of parameters, we analyzed the correlation with an estimation of the Pearson's or Spearman's correlation coefficient. A p-value ≤ 0.05 was considered significant. We used the statistical software program EPIINFO 7.1.1.14 (CDC, Atlanta, USA).

Results

Nutrition Risk Screening 2002 correlations

In 10 (25%) PD patients, the result of NRS 2002 was ≥ 3 points. The results of NRS 2002 positively correlated with PD duration, while taste disturbances correlated negatively with BMI. A positive correlation was also seen between NRS 2002 result and the frequency of L-DOPA intake, while there was no such correlation between BMI and the frequency of L-DOPA intake (Tables 1, 2).

Table 1. Correlations between the nutritional parameters and the results of SEADLS and H-YSS

Parameter I	Parameter II	r	p-value
Abdominal fold*	SEADLS	0.43	0.017
Smell**	SEADLS	−0.34	0.0441
Abdominal fold**	H-YSS	−0.56	0.00122
Subscapular fold**	H-YSS	−0.40	0.0276
Frequency of L-DOPA intake*	NRS 2002	0.41	0.012

UPDRS – Unified Parkinson's Disease Rating Scale; H-YSS – Hoehn and Yahr Standing Scale; SEADLS – Schwab and England Activities of Daily Living Scale (Parkinson's Disease); NRS 2002 – Nutritional Risk Screening 2002;

* Pearson's correlation; ** Spearman's correlation.

Table 2. Correlations between the nutritional parameters and the global results of UPDRS, and with parts I, II and III separately

Parameter I	Parameter II	r	p-value
Abdominal fold*	part I score of UPDRS	−0.36	0.040
Smell**	part I score of UPDRS	0.34	0.0442
Abdominal fold*	part II score of UPDRS	−0.46	0.010
Subscapular fold*	part II score of UPDRS	−0.42	0.019
BMI*	part III score of UPDRS	−0.39	0.020
Abdominal fold*	part III score of UPDRS	−0.37	0.044
Subscapular fold*	part III score of UPDRS	−0.37	0.041
NRS 2002**	part III score of UPDRS	0.35	0.0336
Abdominal fold*	global score of UPDRS	−0.49	0.006
Subscapular fold*	global score of UPDRS	−0.41	0.022

NRS 2002 – Nutritional Risk Screening 2002; UPDRS – Unified Parkinson's Disease Rating Scale; BMI – body mass index; * Pearson's correlation;

** Spearman's correlation.

Correlations of other parameters of the nutritional stage

We revealed a negative correlation between the thickness of the subscapular fold and PD duration, and between the thickness of the abdominal and subscapular folds and the results of H-YSS. The SEADLS scores positively correlated only with the thickness of the abdominal fold (Tables 1, 2).

Smell and taste correlations

We found a positive tendency, though not statistically significant, between disturbances in smell and taste, and H-YSS results. A negative correlation was observed between disturbances in smell and SEADLS score (Tables 2, 3, Fig. 1).

Unified Parkinson's Disease Rating Scale and the nutritional status correlations

In our study, negative correlations were seen between the collective result of part I of UPDRS and the thickness of the abdominal fold, as well as the collective results of parts I and III of UPDRS and the thickness of the abdominal and subscapular folds. The collective result of part III of UPDRS, the global UPDRS score and BMI negatively correlated with the thickness of the abdominal and subscapular folds. Point 3 (describing depression) and 4 (describing motivation and initiative) of UPDRS negatively correlated with BMI, and the thickness of the abdominal and subscapular folds. Paradoxically, the results from BDS did not correlate with NRS 2002 score, BMI or the thickness of the skin folds. Point 3 positively correlated with part III of UPDRS and with NRS 2002 score. The following points negatively correlated with the thickness of the skin folds: 9 (cutting food, handling utensils) with the abdominal

fold, 14 (freezing when walking) with the abdominal and subscapular folds, 24 (bilateral hand movements) with the subscapular fold, and 29 (gait) and 30 (postural stability) with the abdominal fold. Positive correlations were noted for point 40 of UPDRS (anorexia, nausea, vomiting) and the thickness of the deltoid, abdominal and subscapular folds, and with BMI. We revealed positive correlations between NRS 2002 score and UPDRS points: 14 (freezing when walking), 28 (posture), 31 (body bradykinesia and hypokinesia), 32 (duration: in what proportion of the walking day are dyskinesias present?), and 33 (disability: how disabling are dyskinesias?).

Disturbances in smell positively correlated with points 9 (cutting food, handling utensils) and 20 (tremor at rest for the right upper limb), as well as the collective result of part I of UPDRS. Taste disturbances positively correlated with point 23 (finger taps for the right upper limb) of UPDRS. The level of vitamin D positively correlated with point 17 of UPDRS (sensory complaints related to parkinsonism). The correlations described above are shown in Tables 1–3.

Discussion

The study showed a lot of correlations between the severity of PD, mostly motor symptoms in UPDRS, and parameters characterizing the patient's nutritional status. In 25% of PD patients, we revealed the threat of malnutrition or undernutrition. Wang et al. presented similar results in PD patients in a Chinese population (22.9%) and Barichella et al. in an Italian patient group (20%).^{12,13} In the Chinese group, malnutrition was seen in 2% of PD patients. In previous studies, detailed correlations between consequent clinical symptoms in UPDRS and nutritional status parameters were not analyzed. The authors focused only on a comparison between the nutritional parameters and

Fig. 1. A negative correlation observed between disturbances in smell and Schwab and England Activities of Daily Living Scale (SEADLS)

Table 3. Correlations between the nutritional parameters and the results of the respective points of UPDRS

Parameter I	Parameter II	r	p-value
Point 3 of UPDRS (depression)*	BMI	−0.37	0.0288
Point 3 of UPDRS (depression)*	abdominal fold	−0.36	0.0495
Point 3 of UPDRS (depression)*	subscapular fold	−0.46	0.00844
Point 4 of UPDRS (motivation/initiative)*	BMI	−0.35	0.0413
Point 4 of UPDRS (motivation/initiative)*	abdominal fold	−0.49	0.00623
Point 9 of UPDRS (cutting food and handling utensils)*	abdominal fold	−0.37	0.0414
Point 9 of UPDRS (cutting food and handling utensils)*	smell	0.37	0.0266
Point 14 of UPDRS (freezing when walking)*	deltoid fold	−0.41	0.0237
Point 14 of UPDRS (freezing when walking)*	abdominal fold	−0.46	0.00978
Point 17 of UPDRS (sensory complaints related to parkinsonism)**	vitamin D	−0.35	0.0406
Point 20 of UPDRS LLR (tremor at rest)**	vitamin D	0.35	0.0449
point 21 of UPDRS LLL (action or postural tremor of hands)*	deltoid fold	−0.36	0.0467
Point 23 of UPDRS L (finger taps)*	abdominal fold	−0.51	0.00375
Point 23 of UPDRS L (finger taps)*	subscapular fold	−0.45	0.0116
Point 24 of UPDRS R (hand movements)*	subscapular fold	−0.50	0.00435
Point 24 of UPDRS L (hand movements)*	subscapular fold	−0.37	0.0400
Point 26 of UPDRS L (leg agility)*	BMI	−0.37	0.0310
Point 26 of UPDRS L (leg agility)*	abdominal fold	−0.48	0.00788
Point 29 of UPDRS (gait)*	abdominal fold	−0.38	0.0380
Point 30 of UPDRS (postural stability)*	abdominal fold	−0.41	0.0241
Point 40 of UPDRS (anorexia, nausea or vomiting)*	BMI	−0.50	0.00199
Point 40 of UPDRS (anorexia, nausea or vomiting)*	deltoid fold	−0.43	0.0159
Point 40 of UPDRS (anorexia, nausea or vomiting)*	abdominal fold	−0.54	0.00197
Point 40 of UPDRS (anorexia, nausea or vomiting)*	subscapular fold	−0.55	0.00145

UPDRS – Unified Parkinson's Disease Rating Scale; ULR – upper limb right; LLL – lower limb left; LLR – lower limb right; L – left; R – right; BMI – body mass index; * Spearman's correlation.

the global score of parts I, II or III of UPDRS. Only the BMI results or unintended weight loss were considered the basic criteria of the nutritional status. There was no analysis of the skin fold thickness. Body mass index seems to be a rather limited parameter, because it relates only to body

mass and not to the nutritional status, and it gives false results in some groups of patients (asthenic, very tall or very short), or in patients with posture changes resulting from the reductions in height.^{14,15} Such a situation can cause BMI augmentation. In our study, a negative correlation

was seen between BMI and part III of UPDRS. Sheard et al. compared the Subjective Global Assessment (SGA) with the global score of UPDRS and showed a positive correlation between these parameters.¹⁶ Fereshtehnejad et al. disputed these results, as they did not find any statistical differences in terms of malnutrition when comparing a large population of Iranian PD patients with healthy people.¹⁷ Barichella et al. analyzed the clinical stage of PD patients with malnutrition in each part of UPDRS.² They revealed lower body mass and BMI in the patient group. The authors did not correlate the results of the executive parts of UPDRS with the nutritional status.

The most important correlation was seen between the risk of malnutrition in NRS 2002 and the duration of PD. These results were compatible with the findings of Jaafar et al.¹⁸ Most of the previous studies indicated the loss of body mass with the rising severity of the disease.^{4,12,19}

Our very interesting observation was the influence of the frequency of L-DOPA intake on the nutritional status. We revealed a greater risk of malnutrition in patients who took L-DOPA more frequently. We did not find any correlation between L-DOPA intake frequency and BMI. Sheard et al. and Fereshtehnejad et al. also did not show any relationship between the L-DOPA global dose and the nutritional status.^{16,17} The dependence of the nutritional status and the risk of malnutrition in PD patients on the frequency of L-DOPA intake could be connected with the reduction of the amount of food intake, mainly proteinaceous. The reduction of food intake in order to improve L-DOPA absorption and high energy cost in the course of choreatic dyskinesia are important risk factors for malnutrition. Nausea, as a side effect of L-DOPA treatment, can also cause the reduction of food intake.

According to a theory presented by Braak et al., smell changes could be the 1st symptoms of PD.²⁰ In our patients, we revealed a negative correlation between these smell changes and SEADLS score. These results confirmed the existence of more severe smell changes in the late stage of PD, with more pronounced malnutrition. A positive correlation was seen between smell changes and the global score of part I of UPDRS, e.g., the intellectual status, mood and behavior. Taste impairment positively correlated with the results of NRS 2002. In the available literature, no one describes the influence of taste impairment on the risk of malnutrition.^{3,12,13,15,19}

The estimation of skin fold thickness is a very important parameter in the analysis of malnutrition. According to our findings using UPDRS and H-YSS, skin fold thickness depends on PD duration and the grade of progression. Abdominal fold thickness seems to be the best parameter, which correlates with all used scales. The problems of self-feeding and alternative limb movements, and the occurrence of freezing (points 14, 23, 24, and 26 of UPDRS) negatively influence skin fold thickness. Parkinson's disease patients fed by their caregivers had smaller skin folds than PD patients with preserved self-feeding ability.

We also revealed the negative influence of depression, as well as motivation and initiative disturbances (point 3 and 4 of UPDRS) on BMI and skin fold thickness. Our results are compatible with those presented in the study by Fereshtehnejad et al.²¹ Emotional disturbances influence the nutritional status, and the early recognition of these allows for preventative steps to be taken, as well as early treatment.

In the late stage of PD, the frequency of falls is greater. We observed a negative correlation between the thickness of the abdominal fold and postural stability. The enhancement of sensory complaints (point 17 of the UPDRS) and lowering of vitamin D level could be important factors for the risk of falling. The prevention of malnutrition with vitamin D supplementation could diminish the risk of falling and its complications, e.g., bone fractures.

Conclusions

The duration of PD, motor and non-motor PD symptoms, and the frequency L-DOPA intake closely correlate with the nutritional status. Understanding of the multifactorial interdependence might be useful in the estimation of an algorithm for monitoring the nutritional status of PD patients and early nutritional intervention.

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