

# Nutritional assessment and the use of levodopa with protein meals among patients with Parkinson's disease in the city of Macaé, Rio de Janeiro, Brazil

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## Abstract

Parkinson's disease (PD) is characterized by a reduction in dopamine in the central nervous system. It has a gradual progression, and is mainly known for causing tremors and difficulty in performing movements. Studies have shown that there is a significant change in the nutritional status of patients with PD. The main medication used in the treatment of patients is levodopa, and its use, without respecting the minimum intervals of 30 minutes before or one hour after meals, may diminish the pharmacological effect of the drug because of drug-nutrient interactions. The present study aimed to identify PD patients at nutritional and protein consumption risk associated with the use of levodopa in the city of Macaé. A cross-sectional quantitative and descriptive study was performed. The instruments used were the Mini Nutritional Assessment (MNA) and an estimated 3-day dietary record. The analysis was descriptive. To form the sample population a survey was performed of patients diagnosed with PD in two Department of Health programs and from the Parkinson's Association of Macaé. A total of 40 individuals were evaluated, of whom 57.5% were male. Of these, 62.5% presented a risk of malnutrition or MNA defined malnutrition, with nutritional deficit. The protein intake of the study population was 1.4 g/kg/day. The highest protein intake was during the day, including the meals between breakfast and the afternoon snack. A total of 74.7% of total protein was consumed by the population during this period. Overall, 75.0% of the elderly persons consumed their medications containing levodopa simultaneously with meals or did not follow the interval recommended by ANVISA. The study found that the total daily intake of most individuals was hyper-proteic, with proteic content being poorly distributed among meals throughout the day, and that they did not follow the recommended levodopa interval.

**Key words:** Parkinson Disease; High-Protein Meal; Drug-Nutrient Interactions; Malnutrition; Levodopa.

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## INTRODUCTION

The incidence of Parkinson's disease (PD), as well as other non-communicable diseases and conditions, has been increasing as a result of population aging.<sup>1</sup> It is the second most common neurodegenerative disease in the elderly, with an estimated prevalence of 3.3% in Brazil.<sup>2</sup>

There are 17.4 cases per 100,000 people per year, while among people aged between 50 and 59 there are 93.1 cases per 100,000 people per year. There is also a 1.5% risk of developing the disease for people aged between 70 and 79. The average age of when the disease starts is 60 and the average duration of the disease, from diagnosis to death, is 15 years, with a mortality rate of 2 to 1. Among western populations, there is a higher incidence in people over 70 years of age.<sup>3</sup>

The main causes suspected for the development of the disease in early stages of life are stress, infections, malnutrition and exposure to pesticides and chemical products. With respect to the appearance of the disease in later stages of life, the main factors include aging and arteriosclerosis.<sup>4</sup>

PD is characterized by the reduction of the neurotransmitter dopamine in the central nervous system (CNS). It is a disease of slow progression, characterized by four basic components: bradykinesia, resting tremor, rigidity and postural instability arising from the impairment of the nigrostriatal pathway.<sup>5,6</sup>

Treatment of PD seeks to increase dopamine levels and relieve the symptoms, and L-Dopa (levodopa) is currently the most widely used drug. Levodopa is converted into dopamine by the Aromatic L-amino acid decarboxylase enzyme.<sup>7</sup>

Among the alterations caused by PD, weight loss is common. The loss of appetite is associated with frequent depression and sensory disorders of

varying intensity. This weight loss is continuous and can begin before the diagnosis of disease. The cause may also originate from motor difficulties and increased energy expenditure due to tremors, resulting in a state of malnutrition in these patients.<sup>8</sup>

It is widely recognized that nutritional assessment should be incorporated into the treatment of patients with PD, as the provision of a nutritionally adequate diet can contribute to the improvement of symptoms and ensure better quality of life for these individuals.<sup>4,8</sup>

Concomitant use of drugs and foods can interfere with the pharmacokinetics and pharmacodynamics of medication, as well as affecting the digestion, absorption and utilization of nutrients. In this condition, medication may not have the necessary effect and food does not exert its expected nutritional function. Amino acids and levodopa compete for the same active transport mechanism in the gastrointestinal tract and the blood-brain barrier. High-protein meals associated with ingestion of the drug favor the interaction between the amino acids and levodopa, however, the principles of nutritional therapy of PD patients seek to reduce this interaction.<sup>9</sup>

The ideal approach is to maintain a balance of the amount of protein in meals throughout the day, without excessively high protein content meals, even if the total daily intake of protein is high. Priority should be given to protein intake in the evening, when there is less medication ingestion, as this will reduce drug-nutrient interactions, in addition to avoiding the ingestion of levodopa close to meals, respecting the 30 minutes before or one hour after interval.<sup>8,9</sup>

The present study aimed to identify patients with Parkinson's disease facing nutritional and protein consumption risk associated with the use of levodopa in the city of Macaé, Rio de Janeiro.

## METHOD

A cross-sectional, quantitative and descriptive study was carried out. The research was conducted with humans and was approved by the Research Ethics Committee (CEP) of the Estácio de Sá University of Rio de Janeiro (UNESA), CAAE: 24290313.9.0000.5284.

Although there is no statistical data on the prevalence of PD in the city of Macaé, RJ, there are health centers in the city that treat a significant number of the PD patients in the region, whose conditions have been established through medical diagnosis described in patient records.

To compose the sample group, a survey was carried out of the number of patients diagnosed with PD from two programs run by the State Health Department: the Programa de Assistência Integral à Saúde do Idoso (PAISI) (Integral Elderly Health Care Assistance Program) and the Programa de Atendimento Domiciliar Terapêutico (PADT) (Home Care Therapy Program) as well as all members of the Macaé Parkinson's Association suffering from the disease.

PAISI, which is a specialized treatment unit for the elderly in Macaé, RJ, has about 40 patients diagnosed with PD out of a total of 3,312 patients registered in the program, therefore representing 1.2% of all patients treated at this clinic.

The Home Care Therapy Program, PADT, in Macaé has 21 patients diagnosed with PD out of a total of 319 patients treated in the program, therefore representing 6.6% of patients registered.

The Macaé Parkinson's Association has seven members suffering from the disease who are not registered in either of these two programs. The remaining members with PD are registered with PAISI or PADT, and are therefore already accounted for within the number of patients of these units.

This data is an estimate, due to the fact that there are no municipal statistics related to the prevalence of PD. Based on this data, there are a total of approximately 61 Parkinson's patients in the two health units (PAISI and PADT) and seven members with PD from the Parkinson's Association. Even so, these numbers do not represent the entire population of Macaé, RJ diagnosed with PD. Furthermore, while the total number of patients found was 68, it was not feasible to perform the research on all of them, due to their being hospitalized (three), difficulty of access to the homes of the patients (six), non-existent phone numbers registered in the medical records (sixteen) and their moving to another city (three).

Therefore, the sample group was composed of 40 patients with PD, from both genders, of ages varying between 60 and 93, resident in the city of Macaé, RJ. The collection of data was carried out in the period between January and April 2014.

As inclusion criteria, patients were selected who used medication comprising levodopa and who were able to verbally answer the questions asked by the researcher and make notes necessary for the research or patients whose caregiver or guardian could carry out such actions.

Patients were interviewed for the implementation of the Mini Nutritional Assessment (MNA), an internationally validated instrument that is a simple and quick method of nutritional assessment of the elderly. It is composed of anthropometric measurements, such as weight, height and weight loss; a general assessment, with six questions related to lifestyle, medications used and mobility; a dietary questionnaire with eight questions related to the number of meals, food and liquid intake and autonomy associated with diet; and a subjective assessment, based on self-perception of health and nutrition.<sup>10</sup>

The questions contained in the MNA were directed to the patient and if they could not respond, due to a degree of dementia that is common among PD patients, the caregiver then became responsible for providing the answers.

The questions were asked in a very calm and careful manner in order for the patient and/or caregiver to understand, and when necessary, the questions were repeated with explanations of what was being asked, so that the responses obtained were as reliable as possible.

In order to fill out the MNA, the necessary measurements were taken such as weight, height, arm circumference (AC) and calf circumference (CC) and a calculation of the body mass index (BMI) was carried out. The researcher responsible for the assessment received prior training in order to perform anthropometric measurements.

Waist circumference (WC) was also measured as it is the best indicator of visceral fat mass which is strongly related to cardiovascular diseases, which currently affect much of the elderly population and which can also lead to the emergence of other diseases such as mellitus diabetes and high blood pressure, further aggravating the condition of Parkinson's patients.<sup>11</sup> The measurement of the WC was performed using a non-extendable tape measure that circles the individual horizontally around the waistline or lesser curvature located between the chest and the hip. The reading was taken at the time of normal exhalation.<sup>11</sup>

The weight of patients who could walk was measured using a Filizola brand mechanical platform scale with a capacity of 150Kg. The weight was measured with the subject in the center of the base of the scale, in an orthostatic position without shoes and with heavier clothes and objects removed. For these patients, their

height was measured in centimeters using a vertical anthropometer for adults.<sup>11</sup>

For bedridden patients and those with significant column curvature, the standard of measurements was adopted in which the weight of the patients was estimated indirectly by means of the Chumlea et al formula for current estimated weight.<sup>12</sup> This formula is recommended for older people who are unable to walk. The height of these patients was estimated by means of knee height (KH) in centimeters, using the Chumlea et al equation.<sup>13</sup>, in which the age of the patient is also a relevant variable. To obtain the KH, the individual had to be sitting with the left leg bent so as to form a 90° angle with the knee.<sup>11</sup>

To measure the skinfold subscapularis (SS), the researcher palpated the scapula to the location of the lower angle, emphasizing the fold diagonally.<sup>11</sup>

In order to obtain the AC, the arm was bent towards the chest, forming an angle of 90°. The midpoint between the acromion and the olecranon was marked. The individual extended the arm in a relaxed state alongside the body, with the palm of the hand turned towards the thigh. The measuring tape was wrapped around the arm at the point marked and was adjusted appropriately.<sup>11</sup>

To obtain the CC, the individual was required to sit (with the legs dangling without touching the ground). The measuring tape was positioned horizontally, at the point of the widest diameter of the calf. A cutoff point  $\geq 31$ cm was established, with values below this indicating loss of muscle mass and consequently nutritional risk.<sup>11</sup>

Due to the close correlation between morbidity and mortality, the ease of obtaining data and its importance in nutrition surveillance systems, BMI can be a good indicator of the nutritional

state of the elderly, provided specific cutoff points according to age are used, especially if associated with anthropometric measurements that express the composition and distribution of body fat, such as WC measurement.<sup>14</sup> For the classification of the BMI, the cutoff point for the elderly according to Lipschitz,<sup>15</sup> was used, considering a suitable BMI of  $>22$  or  $<27$  Kg/m<sup>2</sup>.

Patients underwent assessment of food intake by means of estimated dietary records; this method consists of daily annotation of all that is prospectively ingested. The annotations were registered on three non-consecutive days, one of which was a weekend day. The annotation forms were given to the caregiver who was responsible for registering the data, due to the difficulty in writing that some patients with PD present arising from the development of micrographia (a symptom of the disease). As a result, the fact that the responsibility of annotation lay with the caregivers was standardized across the group.

Three sheets of dietary intake records were provided with an organized table and legible, visible handwriting, with enough space for annotations. All food and drink consumed on the day were registered including the time they were consumed and the portion size of each food and drink.

The researcher gave verbal guidance on the registration of the data and was available to clarify any doubts. The explanation was given in a calm and careful manner so that the caregiver had full understanding of how to carry out annotations correctly.

In addition to the estimated dietary intake record sheets, a guidance sheet on how to carry out the recording of data was provided and contained tips and examples. The tips were highlighted and the guidance sheet was stapled to the three record sheets.

The records remained with the patient until the deadline defined for delivery, by hand, to the researcher who was available to review what was written in the annotations together with the individual responsible. If there were any errors or lack of data, the recording process was reapplied.

All medications taken containing levodopa, and the times they were taken, were noted on a separate sheet. This information was acquired by the researcher by means of direct questions to the patient and/or caregiver and confirmed against medical prescriptions provided at the time the information was recorded.

As a reference for intervals, the present study utilized the medication instruction leaflet, in accordance with Resolution – RDC n°47/2009,<sup>16</sup> which indicates the administration of levodopa + benserazide at a minimum interval of at least 30 minutes before or one hour after meals, regardless if the meals are high-protein.

In order to analyze the average energetic and protein intake of patients per meal and per day, the nutrition software DietWin, version plus was used. Analysis was performed of protein intake per meal per day and an average was calculated. Dietary Reference Intakes (*DRI*s) were used as a reference for protein intake. Microsoft Excel, Professional Plus 2010 version, was used for calculating the averages and standard deviation.

## RESULTS

A total of 40 patients were included in the study, of these, 57.5% were male. The age of the men varied between 60 and 93 and that of the women between 60 and 87. The nutritional profile of the population studied is shown in Table 1.

**Table 1.** Nutritional profile of patients with Parkinson's disease. Macaé, RJ, 2014.

Variables	Man (n=23)	Woman (n=17)	Total (N=40)
Age*	77.0 ( $\pm$ 8.4)	76.7 ( $\pm$ 8.4)	77.0 ( $\pm$ 8.4)
Weight (Kg)*	57.7 ( $\pm$ 19.7)	51.5 ( $\pm$ 16.6)	50.8 ( $\pm$ 19.9)
Height (m)*	1.5 ( $\pm$ 0.1)	1.4 ( $\pm$ 0.9)	1.5 ( $\pm$ 0.1)
BMI (Kg/m <sup>2</sup> )			
Low	6 (26.1%)	9 (52.9%)	15 (37.5%)
Adequate	10 (43.5%)	5 (29.4%)	15 (37.5%)
Above	7 (30.4%)	3 (17.7%)	10 (25.0%)
Waist Circumference			
Normal	11 (47.8%)	9 (52.9%)	20 (50.0%)
Increased	8 (34.8%)	3 (17.7%)	11 (27.5%)
Very increased	4 (17.4%)	5 (29.4%)	9 (22.5%)
Nutritional status			
Malnutrition	4 (17.4%)	5 (29.4%)	9 (22.5%)
Risk of malnutrition	7 (30.4%)	9 (52.9%)	16 (40.0%)
Without risk of malnutrition	12 (52.2%)	3 (17.7%)	15 (37.5%)

\*Average and standard deviation.

Regarding the classification of nutritional status according to MNA, 62.5% presented risk of malnutrition or malnutrition, characterizing nutritional deficit. Weight loss was observed in 52.5% of patients in the last three months according to MNA, while the majority (57.1%) reported a loss of weight of between 1 and 3 Kg.

In relation to WC, 50.0% of the individuals of both genders presented an increased or greatly increased WC.

It was found that of the elderly individuals assessed, 37.5% presented low weight, 37.5% an adequate BMI and 25% were overweight.

Regarding dietary assessment, the average intake of energy and protein calculated using the estimated dietary records shown in Table 2.

An average consumption of 27.8 Kcal/kg of body weight per day was observed. Of the assessed individuals, 100.0% had three or more meals a day, according to the MNA.

**Table 2.** Mean energy and protein intake calculated using the estimated 3-day dietary record. Macaé, RJ, 2014.

	Men (n=23)	Women (n=17)	Total (N=40)
Total Energy (kcal/day)*	1464.8 ( $\pm$ 293.3)	1342.0 ( $\pm$ 277.5)	1412.6 ( $\pm$ 289.7)
Total Protein/day (g)*	67.8 ( $\pm$ 17.1)	59.4 ( $\pm$ 17.3)	64.2 ( $\pm$ 17.5)
Total Protein/day(%)*	18.5 ( $\pm$ 2.8)	17.9 ( $\pm$ 3.0)	18.3 ( $\pm$ 2.9)
Protein g/Kg/day*	1.4 ( $\pm$ 0.6)	1.6 ( $\pm$ 0.6)	1.4 ( $\pm$ 0.6)

\*Mean and standard deviation.

Table 3 shows the average protein intake in grams (g) per meal. The highest intake was during the day period, which is considered the meals consumed between breakfast and the afternoon snack. The consumption of protein of the population in this period was 74.7% of total protein, in that the consumption of men was 72.2% and women 77.7%.

According to the relevant section of the MNA, all patients took more than three medications a day and all used medication containing levodopa, which

was either levodopa and benserazide (prolopa) or levodopa and carbidopa.

With respect to proteins and medication ingested throughout the day, table 4 shows the analysis of compliance with the recommended interval between the ingestion of food and the intake of levodopa. It was observed that 75.0% took their medications composed of levodopa simultaneously with meals or by not following the recommended interval of at least 30 minutes before or one hour after meals.

**Table 3.** Intake of proteins in grams (g) per meal. Macaé, RJ, 2014.

	Men (n=23)	Women (n=17)	Total (N=40)
Breakfast*	19.0 ( $\pm$ 16.9)	17.2 ( $\pm$ 16.7)	18.2 ( $\pm$ 16.6)
Morning snack*	3.8 ( $\pm$ 3.9)	2.4 ( $\pm$ 3.4)	3.3 ( $\pm$ 3.7)
Lunch*	22.8 ( $\pm$ 7.0)	20.5 ( $\pm$ 7.2)	21.8 ( $\pm$ 7.1)
Afternoon snack*	11.8 ( $\pm$ 6.4)	9.8 ( $\pm$ 4.8)	10.9 ( $\pm$ 5.7)
Dinner*	16.2 ( $\pm$ 9.6)	10.2 ( $\pm$ 7.2)	13.6 ( $\pm$ 9.0)
Supper*	5.9 ( $\pm$ 4.2)	4.1 ( $\pm$ 2.8)	4.7 ( $\pm$ 3.7)

\*Mean and standard deviation.

**Table 4.** Analysis of compliance with the recommended interval between food intake and ingestion of levodopa. Macaé, RJ, 2014.

	Men (n=23)	Women (n=17)	Total (N=40)
Compliance with the recommended interval	6 (26.1%)	4 (23.5%)	10 (25.0%)
Non-compliance with the recommended interval	17 (73.9%)	13 (76.5%)	30 (75.0%)

## DISCUSSION

In the study of Dias et al.,<sup>17</sup> of the nine elderly patients with PD evaluated, 22.2% were underweight, 22.2% had adequate BMI and 55.6% were overweight. Similar results are found in the present study, in that the percentage of inadequate BMI due to low weight and the percentage of adequate BMI are the same.

It was observed that 62.5% of the study population presented malnutrition or risk of malnutrition, according to the MNA, characterizing most of the elderly persons as having a nutrition deficit, although 62.5% of the individuals were also classified with an ideal or high BMI. Therefore, BMI should not be used alone, since it measures only the total body mass, and does not consider the division of lean body mass and fat body mass. The MNA, however, identified a greater number of individuals with nutritional impairment, demonstrating that in this case it is a more reliable instrument for early identification of compromised nutritional status. It is therefore clear that it is necessary to use other evaluation methods in addition to BMI, such as the MNA, which analyze the nutritional status of the individual more thoroughly, considering a range of factors.

Similar to the results shown in the present study, Fracasso et al.<sup>9</sup> encountered an occurrence of 53.0% of elderly people with Parkinson's with a risk of malnutrition according to the MNA. Malnutrition is a disorder that affects much of the elderly population in general, and is also prevalent in patients with PD due to the progression of the disease being accompanied by severe weight

loss, which can be caused by several factors such as the difficulty to chew due to less flexibility in the mandibular muscles, increased energy expenditure due to tremors and lack of appetite, among others.<sup>18-21</sup>

Weight loss was present in most elderly PD patients (52.5%), the majority of whom lost between 1 and 3kg. According to the study by Abbott et al.,<sup>22</sup> weight loss was recorded in 52.0% of PD patients, which, although considered moderate in the case of the majority of individuals, exceeded 28 kilos in 22.0% of patients. In a study by Beyer et al.,<sup>23</sup> the average weight loss of PD patients was 7.2 kg compared with a gain of 2.1 kg in a controlled group. This demonstrated that weight loss was experienced by the majority of the population studied. This weight loss can contribute to the development of malnutrition, in addition to further weakening the individual and, in turn enhancing the rigidity of the muscle tissue caused by the disease.<sup>24-26</sup>

However, according to Nirenberg & Waters,<sup>27</sup> weight gain may also sometimes occur as a result of the lack of control of compulsive eating. In the present study, 25.0% of the population had an above adequate BMI, although this index should not be used alone as a parameter, as in the elderly there is a greater increase in adipose tissue followed by a greater reduction in muscle tissue. Therefore, a high BMI in the elderly population is predictive of excess body fat and does not exclude the individual from possible risk of malnutrition, in that it represents sarcopenic obesity, characterized by increased fat mass associated with loss of lean body mass, functional capacity and reduction of strength.



Of the elderly individuals studied, 50.0% had an increased WC, that is, the presence of excess abdominal fat, resulting in cardiometabolic risk, which impairs nutritional status. Considering that the majority of elderly individuals presented an inadequate nutritional status, it is important to assess other risk factors that may aggravate the situation of the patient, thus corroborating the use of various nutritional assessment methods in clinical practice.

The study by Turcato et al.<sup>28</sup> verified that the measurement of WC and abdominal girth were the anthropometric indicators of fat mass distribution that most accurately related the risk of cardiovascular diseases in elderly people, regardless of their BMI.

In the study by Scherer et al.,<sup>29</sup> a greatly increased risk of developing cardiovascular disease was more prevalent among men (98.5%) than among women (92.5%), which did not occur in the present study, in that increased risk was much more common among women (29.4%) than in men (17.4%). In contrast, most men presented cardiovascular risk (52.2%) compared to 47.1% of women.

WC has been used to identify visceral adiposity (providing information on fat reserves) and risk of cardiovascular disease and metabolic disorders.<sup>18</sup> Abdominal circumference can be considered independently, and is more reliable than BMI at predicting the metabolic and cardiovascular complications associated with obesity.<sup>28</sup>

The average caloric intake of patients in the present study was 1412.6 kcal per day, in that an average of 27.8Kcal/kg of body weight per day was registered, showing that the elderly individuals ingested a normocaloric diet (25 to 30Kcal/kg). In the study by Sharma & Turton,<sup>30</sup> the average caloric intake of patients with PD was 1662.5 Kcal a day, which was assessed by dietary records of three consecutive days. An average of 21Kcal/kg of body weight per day was registered, showing that the assessed individuals consumed a reduced calorie diet. In the study by Pare et al.,<sup>31</sup> the individuals presented an average intake of 2163 Kcal, with an average of 39 Kcal/Kg body weight per day,

characterizing a high calorie diet intake. The prescription of a norm-, hypo- or hyper-calorie diet for patients with PD will depend on their nutritional status. Regardless of the total energy value of the diet, the most important aspect is the quantitative balance of macronutrients in a manner that ensures that protein in particular is well distributed.

The average consumption of protein by the population with Parkinson's disease studied by Dias et al.<sup>17</sup> was 1.13g/Kg of body weight per day. In the study by Marczevska et al.,<sup>32</sup> the protein intake of patients with PD was 1.2g/kg/day, representing more than 50.0% of the daily recommendation for such patients (0.8g/Kg/day). In the study by Morais et al.,<sup>8</sup> the average intake was 1.0 g/Kg/day. The protein intake of the present study population was 1.4 g/kg/day, which is characterized as a high protein diet, and is not just greater than the daily protein recommendation for Parkinson's patients, but greater than the intake observed in other studies.

Considering the average intake of 64.2g of protein per day, this represents a value of 18.3% of protein intake in relation to the total sum of energy (1412.6Kcal). In the study by Marczevska et al.<sup>32</sup> a consumption of 14.2% of protein in relation to the total sum of energy (2360Kcal) was observed. According to the 2008/2009 Household Budget Survey (HBS),<sup>33</sup> elderly men consumed 16.9% of protein in relation to total calories consumed (1774Kcal). In general, all values are within the protein recommendation for the elderly ranging from 10 to 35% of total energy (DRI/IOM/2005).<sup>20,34</sup>

The highest protein intake was in the day period, with 74.7% of the total protein intake between breakfast and the afternoon snack. In the study by Fracasso et al.,<sup>9</sup> higher protein intake during the day was also observed, with consumption between breakfast and the afternoon snack representing 70.4% of the total daily protein intake. In the study by Pare et al.,<sup>31</sup> it was observed that, by prioritizing the majority of protein content in the diet at night, there is a reduction of the motor fluctuations that may be caused by the interaction of the protein with

levodopa. Ideally protein intake should be higher at night than during the day. In the present study, the protein was concentrated in the daytime meals, therefore resulting in inadequate distribution of the protein throughout the day.

Levodopa is absorbed mainly in the small intestine, by a saturable system of transport, allowing it to be shared with amino acids in the transport at the blood-brain barrier. This creates a strong interaction between medication and nutrients resulting in impairment of the motor fluctuations of the patient.<sup>7,35-38</sup> Of the studied population, 75.0% ingested their levodopa based medication at the same time as their meals, not following the recommended interval.

Contin & Martinelli<sup>7</sup> suggest that an interval of at least 30 minutes before meals is observed, which confirms the instructions in the guidebook for health professionals in accordance with Resolution – RDC n<sup>o</sup>47/2009.<sup>16</sup>

Fracasso et al.<sup>9</sup> reported that in relation to the time medication was taken, approximately half of the sample population (47.1%) consumed their medications with meals or in a shorter time interval than recommended.

Literature is divergent about what truly favors the interaction between levodopa and amino acids, with some studies suggesting it is the intake of a high protein diet and others finding that it is simply the presence of protein. There are still no studies that prove that a diet with low protein content provides effective benefits to these patients. More research is necessary to further investigate the process of interaction between levodopa and amino acids, to assess more thoroughly how protein intake can interfere in the bioavailability of this drug. The protein anabolism is already highly compromised by the presence of sarcopenia, characterized by a loss of muscle tissue that is physiological during aging, coupled with muscular atrophy, which these

patients present due to muscle stiffness caused by the disease, while some patients also present malnutrition or even pressure ulcers. Therefore, a normo-proteic diet does not meet the suggested intake of (0.8g/kg) in patients with PD in these situations. Proteins play an important role in healing, allowing revascularization, fibroblast proliferation, collagen synthesis and the formation of lymphocytes. Malnourished patients with pressure ulcers who received normo- to hyper-protein diets improved their level of healing.<sup>34</sup>

It is important to emphasize the lack of studies that address the issue of interaction between levodopa and protein in the diet and also the nutritional status of patients with PD. This study aims to change this scenario by encouraging more research and studies focusing on PD and diet in order to provide a better quality of life for these patients.

## CONCLUSION

The present study verified that the majority of elderly patients presented nutritional risk. Most had a high protein daily intake, with protein content unevenly distributed in meals throughout the day. The issue does not revolve around whether the diet consists of normal or high levels of protein, but how patients balance the amount of protein in their meals, whether they prioritize the consumption of protein at night, and if they comply with the recommended meal times and times for the intake of levodopa based medication. However, high protein diets can be applied, providing that the patient distributes the quantity of protein uniformly and does not concentrate intake in a single meal, in addition to complying with the recommended intervals. The guidance of the physician and nutritionist is fundamental in relation to the appropriate times for meals and intake of medication.

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