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Descritores

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Dysarthria and Quality of Life in neurologically healthy elderly and patients with Parkinson's disease

Disartria e Qualidade de Vida em idosos neurologicamente sadios e pacientes com doença de Parkinson

ABSTRACT

Purpose: To compare the speech and voice of Parkinson's disease (PD) patients and neurologically healthy elderly adults (control group, CG), to find out whether these features are related to the disease or the normal aging process, and investigate the impact that dysarthria has on the Quality of Life (QoL) of these individuals. **Methods:** This is a cross-sectional study involving 25 individuals, 13 patients with PD and 12 CG. All the participants underwent vocal assessment, perceptual and acoustic analysis, based on "Dysarthria Assessment Protocol" and analysis of QoL using a questionnaire, "Living with Dysarthria". The data underwent statistical analysis to compare the groups in each parameter. **Results:** In the assessment of dysarthria, patients with PD showed differences in prosody parameter ($p=0.012$), at the habitual frequency for females ($p=0.025$) and males ($p=0.028$), and the extent of intensity ($p=0.039$) when compared to CG. In QoL questionnaire, it was observed that patients with PD showed more negative impact on the QoL compared to CG, as indicated by the total score ($p=0.005$) with various aspects influencing this result. **Conclusion:** The degree of modification of speech and voice of patients with PD resembles those seen in normal aging process, with the exception of prosody and the habitual frequency, which are related to the greatest negative impact on the QoL of patients with PD.

RESUMO

Objetivo: Comparar a fonoarticulação de um grupo com doença de Parkinson (DP) e um Grupo Controle (GC) de sujeitos neurologicamente sadios, a fim de descobrir se essas características são relacionadas à doença ou ao processo normal de envelhecimento, e investigar o impacto que a disartria acarreta à Qualidade de Vida (QV) desses sujeitos. **Método:** Trata-se de um estudo transversal com a participação de 25 sujeitos, sendo 13 pacientes com DP e 12 GC. Todos os participantes foram avaliados quanto à disartria, análise perceptivo-auditiva e acústica, com base no "Protocolo de Avaliação da Disartria", e à QV, utilizando-se o questionário "Vivendo com Disartria". Os dados foram comparados entre os grupos em cada parâmetro. **Resultados:** Na avaliação da disartria, o grupo com DP apresentou diferenças no parâmetro prosódia ($p=0,012$), na frequência habitual para os gêneros feminino ($p=0,025$) e masculino ($p=0,028$), e na média da extensão de intensidade ($p=0,039$), quando comparado ao GC. Em relação à QV, observou-se que a disartria apresenta um impacto mais negativo na QV dos pacientes com DP, quando comparados aos sujeitos do GC, conforme observado no escore total ($p=0,005$) e nos aspectos que influenciaram esse resultado. **Conclusões:** O grau de modificação da fonoarticulação dos pacientes com DP assemelha-se aos presentes no processo normal de envelhecimento, com exceção da prosódia e da frequência habitual, que estão relacionadas com o impacto mais negativo na QV dos sujeitos com DP.

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INTRODUCTION

The number of elderly people has been growing all over the world as a result of the increased life expectancy and the reduced mortality rate along with a drop in pregnancy rates, resulting, therefore, in a slower rhythm of population growth and an accelerated aging process⁽¹⁾. In Brazil, it is estimated that by 2020 the number of elderly will reach 32 million⁽²⁾.

The greatest challenge of this century will be to take care of this population, who represent, among many characteristics, elevated prevalence of chronic and incapacitating diseases⁽²⁾. Parkinson's disease (PD) is an example, for its incidence increases with age and affects 1–2% of the population over 65 years of age⁽³⁾.

The PD is a neurodegenerative chronic disease, characterized by the death of the dopaminergic neurons of the *substantia nigra* of the compact part of the midbrain. The dopaminergic neurons are responsible, among others, for the control of motor activities. The main clinical characteristics of the disease are tremors at rest, bradykinesia (slowness of movement), muscle rigidity (decrease in range movement), and alteration of posture maintenance reflexes, resulting in postural instability^(4,5).

Besides, it is estimated that 70–90% of the patients with PD have speech and voice alterations, called hypokinetic dysarthria. The most common symptoms of dysarthria found in PD are reduced vocal intensity, restricted modulation, monotone voice, changes of intonation, altered speed of speech, reduced frequency range, hoarse and breathy vocal quality, and articulatory imprecision^(6,7).

The PD is the second most common neurodegenerative disease among elderly, with its prevalence estimated to be 3.3% in Brazil. Considering that it is a disease that mainly affects elderly, it is necessary to have studies that identify and differentiate the PD characteristics from the normal aging process, once it is known that speech and voice alterations also occur during this process⁽⁸⁾. Moreover, the disability caused by the disease limits the patients' activities and their social participation, compromising their quality of life (QoL)⁽⁹⁾. The study of the impact such alterations bring upon the QoL of patients with PD is necessary due to the subjective consequences of living with a speech disease due to a progressive neurological condition⁽¹⁰⁾.

Therefore, this study aims to analyze and compare the voice and speech characteristics of PD patients with those of neurologically healthy individuals, in an attempt to differentiate the changes related to the disease from the ones related to the average aging process. Moreover, the impact dysarthria has on the QoL of these subjects was aimed to be investigated.

METHODS

This is a cross-sectional study, inserted in a broader study called "*Dysarthria e qualidade de vida nas doenças dos gânglios da base*," approved by the Research Ethics Committee of the Faculdade de Ciências Médicas of the Universidade Estadual de Campinas, endorsement no. 710/2011.

Selection of the subjects

The study consisted of 25 subjects, 13 patients in the PD group (PG) and 12 neurologically healthy individuals in the control group (CG). The patients involved were followed up by the Physical Activity Program for PD patients (PROPARKI), in the Posture and Locomotion Studies Laboratory (*Laboratório de Estudos da Postura e da Locomoção* – LEPLO), in the Physical Education Department — Bioscience Institute — in the Universidade Estadual Paulista (UNESP). The participants in the CG were selected according to the age range and schooling level similar to the ones in the PG.

The inclusion criteria were as follows: patients previously diagnosed with PD were classified in stages 1; 1.5; 2; 2.5 and 3 of the disease by the Hoehn and Yahr scale⁽¹¹⁾; they would be in the on-phase of the medication during evaluation.

The exclusion criteria were as follows: patients diagnosed in phases 4 and 5 of the disease⁽¹⁰⁾; submitted to surgical treatment; had been through or were under speech language treatment; and were with dementia or cognitive alteration conditions. For the CG, individuals with neurodegenerative diseases were not recruited.

All the participants in the research were volunteers in the participation and, after agreement, signed the informed consent.

Procedures

Data collection occurred in the Undergraduate course of the Bioscience Institute of UNESP in a room with low level of environmental noise.

The evaluation of dysarthria was performed according to the "Dysarthria Evaluation Report", adapting to the phonetic and linguistic characteristics of the Brazilian Portuguese, and formulated with the most altered components of the speech⁽¹²⁾. The data collected were recorded through audio and video, using an external sound board (by M-audio), microphone (SM-58), PRAAT (*Programa de Análise Acústica*) software, and Sony Cyber-shot camera of 7.2 megapixels.

The patients, during data collection, were sitting down, with the microphone placed approximately 15 cm from the mouth. Before carrying out each test, the patients were oriented on the correct way to conduct it.

According to the description of the protocol, the tests carried out by the participants were the filming of 1-minute breathing, to verify the respiratory cycles during this time; the emission of the number of words per exhalation, through the counting of numbers; the emission by vowels /a/ and /i/ and the consonants /s/ and /z/ in maximum phonation time (MPT); reproduction of phonemes, syllables, words, and affirmative, interrogative, and exclamatory phrases⁽¹²⁾. These tests were always performed with the previous explanation of the evaluator.

The speech samples of the subjects were evaluated through an auditory-perceptual and acoustic analysis of the voice. In the auditory-perceptual analysis, the parameters assessed were breathing, phonation, articulation, and prosody, through attentive hearing and observation by the evaluator. At the end of each

parameter, the evaluator gave scores from zero to six — zero, the absence of alteration and six, a severe alteration.

In the acoustic analysis, we collected the habitual frequency, habitual intensity, MPT, and sub-harmonic presence or absence, taken from the production of the sustained vowel /a/. In addition, we collected the frequency and intensity, and speech rate (syllables per second) of the phrase “*É proibido fumar aqui*” (“Smoking is prohibited here”). Both tasks are included in the “Dysarthria Evaluation Report”.

The acoustic measures were carried out by measuring the voice using the PRAAT software. The data used were selected from the most stable segments of the sustained vowel /a/ of the subjects, and the calculations were done manually, without the use of the software, to increase the reliability of data. Moreover, the acoustic measures of the extension of intensity in the phrase “*É proibido fumar aqui*” were analyzed in the vowels, for data standardization, considering that the vowel “u” after the fricative phoneme /f/ was excluded from the research, due to the interference of this phoneme. For the verification of the extension, we performed the calculation of the difference between higher and lower frequencies and intensities.

The auditory-perceptual and acoustic evaluations of the speech samples of the individuals in the research were analyzed randomly, and the analysis was carried out by two evaluators with experience with dysarthria, by consensus. This way, the evaluations of all the participants in the research were recorded on video, so that both evaluators could, together, observe the parameters that needed the image of the participant to be observed, such as cycles per minute, words per exhalation, resonance, and articulation. It is noteworthy that for the auditory-perceptual and acoustic analysis of the voice, the evaluators were blind, i.e., they did not make use of video-recorded images.

For the evaluation of the impact of dysarthria on the QoL of patients and elderly, the “Living with Dysarthria” (“*Vivendo com Disartria*”) questionnaire was used, developed by the Vardal Institute, translated into Brazilian Portuguese, and culturally adapted by Behlau and Padovani^(10,13). This instrument aims at evaluating the perception of difficulties in speech of individuals with dysarthria, i.e., the way subjects perceive themselves and their difficulties in speech^(10,13).

This questionnaire consists of ten sections, each containing five statements, to which the subjects must answer from one to six, the lowest number being “totally disagree” and the highest number being “fully agree”. For the analysis of this questionnaire, we calculated the median of the answers for the five statements in each section (1–10) and also the sum of the scores of all statements, totaling 50. The total score may reach minimum value of 50 and maximum of 300 points. Only in section 1, relevant to the speech and voice aspects (breathing, phonation, articulation, and prosody), the statements were analyzed individually, in addition to comparing the medians between groups.

Data analysis

The data obtained through the “Dysarthria Evaluation Report” and the questionnaire “Living with Dysarthria” were analyzed for comparing the PG and the CG.

For the statistical analysis, we used the Statistical Package for the Social Sciences software, version 13.0 for Windows, using the χ^2 test for the categorical variables and the Mann-Whitney test for numerical variables, assigning significance level of p -values < 0.05.

RESULTS

The clinical characteristics were similar between groups, which indicated that the groups were clinically compatible. Moreover, the group with PD presented, according to the Hoehn and Yahr scale⁽¹¹⁾, light to moderate stages of the disease, with two individuals in stage 1; five in stage 1.5; five in stage 2, and one in stage 2.5 (Table 1).

Table 1. Characterization of the sample according to age, gender, schooling, and time of disease in the group with Parkinson's disease and the control group

Variables	Groups	
	PG (n=13)	CG (n=12)
Age (years)		
Median	68	68
Minimum–maximum	40–76	40–77
Gender		
Female	7	7
Male	6	5
Schooling (years)		
Mean	8.9	7.4
Minimum–maximum	0–16	0–16
Time of disease (years)		
Mean	5.5	–
Minimum–maximum	2–12	–

Caption: PG = Parkinson's disease group; CG = Control group

In the evaluation of dysarthria (Table 2), it was observed that the PG showed significance difference in relation to the CG in the acoustic analysis for the habitual frequency among females ($p=0.025$) and males ($p=0.028$), in which both had higher frequency than in the CG. Moreover, the PG showed higher mean of intensity extension than the CG ($p=0.039$).

In the auditory-perceptual evaluation, only the prosody parameter showed significance difference in the comparison between the groups ($p=0.012$), demonstrating higher compromised in the patterns of emphasis, intonation, and speed of speech in the PG. The remaining parameters studied (respiration, phonation, resonance, and articulation) presented no statistical difference between the groups.

In the questionnaire “Living with Dysarthria” (Table 3), patients with PD had, in general, more negative impact on the QoL, when compared to the total score of the questionnaire ($p=0.005$). The patients had a worse subjective perception of the impact of speech and voice modifications when compared to the group of neurologically healthy individuals.

Among the most significant aspects, we highlight: the aspects related to speech, in which patients noticed speaking in a slower

Table 2. Comparison of the mean values and standard deviation of the auditory-perceptive and acoustic analysis and the percentage of the number of individuals with the presence of the subharmonic between the PG and CG

Analysis	PG	CG	p- value
	Mean±SD	Mean±SD	
Acoustic			
Habitual frequency – F (Hz)	212.7±34.3	179.2±34.7	0.025*
Habitual frequency – M (Hz)	168.2±33.2	128.2±21.4	0.028*
Habitual intensity (dB)	74.9±8.6	80.4±4.8	0.149
Frequency range (Hz)	109.5±33.1	130.0±49.7	0.480
Intensity range (dB)	8.6±3.9	5.7±4.3	0.039*
Rate of speech (sil/sec)	6.2±1.0	6.1±1.1	0.806
MPT (sec)	14.5±7.3	12.5±3.1	0.807
Subharmonic	61.5%**	41.6%**	0.320
Auditory-perceptual			
Breathing	1.8±1.2	1.1±1.0	0.621
Phonation	2.4±0.5	2.2±0.6	0.506
Resonance	0.6±1.1	0.08±0.2	0.287
Articulation	0.9±1.0	0.08±0.2	0.092
Prosody	1.4±1.0	0.1±0.3	0.012*
Dysarthria degree	7.0±3.3	3.6±1.4	0.327

*Significant p-value; **Percentage of individuals with sub-harmonic presence – Mann-Whitney and χ^2 test

Caption: PG = Parkinson's disease group; CG = control group; X = mean; SD = standard deviation; F = female; M = male; Hz = hertz; Db = decibel; sil/sec = syllables per second; MPT = maximum phonation time; sec = seconds

Table 3. Comparison of the medians of the sections, statements in theme 1 and total score of the questionnaire "Living with Dysarthria" in the Parkinson's and the Control Group

Sections of the questionnaire	PG	CG	p-value
1 - Communication related to speech	5	1	0.002*
A - I feel breathless when I speak	3	1	0.979
B - I get hoarse	4	1	0.123
C - My speech is slow	4	1	0.046*
D - My speech is dragged	5	1	0.002*
E - I have to repeat what I say because people don't understand me	5	1	0.002*
2 - Communication related to language and cognition	4	1	0.026*
3 - Communication related to tiredness	1	1	0.068
4 - Effects of the emotion	4	1	0.077
5 - Effects on different people	1	1	0.011*
6 - Effects on different situations	3	1	0.123
7 - My difficulties in communication affect my possibilities of...	1	1	0.068
8 - What do you believe contributes to the changes in your communication?	4	1	<0.0001*
9 - How is my communication altered?	3	1	0.046*
10 - How do you perceive the changes and the possibility of changing your way of speaking?	4	1	0.004*
Total score	148	87	0.005*

*Significant p-value – Mann-Whitney test.

and imprecise way, needing to repeat to be understood so that other people understand them; the aspects of language and cognition; the way how people see and communicate with the patients with PD; what patients believe contribute to their difficulties in speaking and how they think their speech is altered; and the perception and the possibilities of changes in the voice.

DISCUSSION

Most evaluation parameters for dysarthria revealed similar results between the studied groups. The main parameters differentiating the groups were the fundamental frequency and the prosody.

When identifying that most part of the studied parameters was similar between the groups of patients with PD and CG, the study indicates that such modifications may be more related to the average aging process of the speech and voice aspects (presbyphonia) rather than the dysarthria aspects themselves due to PD.

These results become relevant for considering that the speech and voice modifications may result from aging, especially in patients with PD in initial clinical stages of the disease (1–3) according to the Hoehn and Yahr scale⁽¹¹⁾.

However, this study showed that the fundamental frequency and the prosody are altered in the group of patients with PD. These two aspects may be considered as the main parameters of speech and voice differentiating groups, as well as the ones first to be affected by PD.

Studies correlating speech and voice of patients with PD with the stage of the Hoehn and Yahr scale⁽¹¹⁾ refer to different results, since the absence of significant results between patients in the initial and advanced stages to the studies relating deviations in the fundamental frequency of vowels, modifications in the speed of speech and in intensity⁽¹⁴⁾.

Thus, it is important to highlight that speech and voice alterations do not occur only due to PD. During the senile process, the laryngeal structures are also affected, i.e., anatomic and physiological alterations proper of aging will compromise the structure and function of the larynx and be related to voice alterations, called presbyphonia. Changes in voice quality are relatively common among elderly. Studies point out that approximately 29% of people aged over 66 years old report having different kinds of voice problems⁽¹⁴⁾.

Changes due to presbyphonia include alterations in the mucosa of the vocal fold, with reduced amounts of elastic fibers, resulting in less elasticity and diminished vibration wave in the vocal fold; calcification of the cartilage; muscle atrophy; reduced muscle control transmission, resulting in instability and voice tremor; voice fatigue; hoarseness; and reduced intensity⁽¹⁵⁻¹⁷⁾.

Modifications in the auditory-perceptual and acoustic analysis of speech and voice also occur in the process of aging, in which the decrease in the harmonics, alteration in the pneumophonoarticulatory coordination, reduction in MPT, and nasal resonance are observed^(15,16,18).

The alterations of the aging process justify the similarities between groups in the parameters of breathing, phonation, resonance

and articulation (auditory-perceptual analysis), habitual intensity, elocution rate, frequency range, MPT, and subharmonic presence.

However, studies carried out among elderly identify that the presbyphonic voice tends to result in modifications in the habitual frequency, in which men have more high-pitched voices and women the low-pitched ones⁽¹⁴⁾. In this study, the PG, both for females and males, presented higher habitual frequency when compared to the groups of neurologically healthy subjects.

The usual frequency considers the number of vibrations per second of the vocal folds in a given moment. It represents a direct relation with length, tension, rigidity, and mass of the vocal folds⁽¹⁹⁾.

The higher frequency is produced by the elongation of the vocal folds associated with a rapid vibration of the wave of the mucosa. Due to rigidity, one of the clinical aspects of PD, there may be a constant activation of the muscles of the vocal folds and, consequently, and elongation of the interarytenoid muscles, resulting in the emission of sound in a higher frequency⁽²⁰⁾.

Moreover, studies report that the elevation of the habitual frequency may be possible in patients with PD due to the “on” period of the medication derived from levodopa, which presents a discrete improvement in acoustic measures⁽¹⁹⁾.

In relation to the prosody, which consists of the rhythm and speed of speech, articulation, pauses in speech, and intensity variations⁽⁴⁾, patients with PD may have variable speed of speech, that being too fast in some moments of the emission, and occasionally alternating with slower ones⁽²⁰⁾. Alterations in the speed of speech associated with PD have been justified by the presence of abnormal patterns of muscle activity, reduced articulatory range of movement, deficient strength, and tremor of the orofacial structures^(20,21).

Moreover, other studies have justified the prosodic alterations not only due to muscle rigidity but also due to dysautonomia. Dopamine is important in the brain stem in autonomic regulation; considering this is the neurotransmitter affected in PD, the patients may present alterations both in central and peripheral pathways of the autonomic nervous system. In addition, studies report that the levodopa, usual medication of patients with PD, does not have relevant benefits in prosody^(22,23).

This way, the alterations in the habitual frequency and in prosody, found in the present study, were proved different between the group with PD and the group of neurologically healthy elderly, and such alterations may be the first findings of dysarthria in groups of patients with PD in the initial stages.

Thus, this study highlights the importance of the evaluation of these parameters in both groups, perhaps precociously aiding the differentiation of elderly and patients with PD.

When analyzing the prosody through the evaluation of the QoL related to the dysarthria, it was verified that the impressions related to the dysarthria suffered great impact, especially evidenced in section 1, statements “C” and “D,” with repercussion in the communication of the patients with PD and, consequently, the need for patients to repeat what they say to be understood (statement “1E”).

These findings show that, regardless of the fact that most parameters studies are similar between the groups, the parameters

changed (fundamental frequency and prosody) provide a negative impact on the QoL of these patients.

However, the fact that patients with PD suffer with the diagnosis of a chronic, neurodegenerative, incurable, and progressive disease is not ruled out, which may result in fear and despair, reflecting directly in the QoL of these subjects⁽⁹⁾. This may also cause some patients to face some typical aging signs as possible alterations caused by the progression of PD.

It is known that the QoL is multidimensional and involves several aspects, such as the degree of satisfactions in the family, love, social and environmental life, and having an unquestionable influence on the health of the individuals in the evaluation of their QoL⁽²⁴⁾. Specifically, when it comes to communication, not only the aspects of speech and voice are important, but also other aspects may be associated with the negative impact of the QoL on the communication of patients with PD.

The questions related to language and cognition also revealed negative impact on the QoL for the group with PD, as observed in section 2 of the instrument.

Patients with PD may have cognitive alterations already in the initial stages of the disease, even with light motor symptoms⁽²⁵⁾. Among the cognitive deficits most emphasized by the studies, there are alterations in memory, attention, executive functions, visuospatial capacity, language, and reduced abstractions capacity. Other studies highlight that the depression in PD is pointed out as one of the aspects which most cause impacts on cognition and has a great influence on the QoL of these patients⁽²⁶⁾.

During senescence, however, alterations in relation to language and cognition may also occurs, such as difficulties in organizing the thematic information of the narratives, alterations in the fast recovery of the lexicon in naming situations, difficulties in the access to the conceptual and perceptual information systems (linguistic and non-linguistic), and alterations in working memory, among many others⁽²⁷⁾.

Therefore, it is not possible to state, in this study, whether the alterations of language and cognition are due to PD or to the aging process, which is necessary for a more detailed investigation of the groups. However, it is evident that such aspects influence negatively on the QoL of patients with PD.

Moreover, other aspects are involved. With the progression of the disease, alterations in posture and gait contribute for the elevated risk of falls of these patients. This will lead patients into reducing their activity level and increasing the level of dependency on other people. From this moment, patients tend to isolate socially, due to their fear of leaving home, spending most of their time in the household environment and alone, resulting, thus, in the compromising of the social support, with their families and in the relationship with the society⁽⁹⁾, keeping them away, and causing different reaction in people.

Thus, the possible contributors for the changes in the QoL, focused on the communication of patients with PD, may be attributed to the social domain (such as problems in relationships and with the people in their social environment), difficulties in mobility and in daily life activities, the increased

risk of falls, emotional well-being, cognition and speech, and voice alterations⁽²⁴⁾.

As approached in the last two sections of the questionnaire of QoL, patients with PD are unsatisfied with the way and the quality of their communication, having the need of help from other people to maintain their communicative function. Moreover, they show little hope in relation to the improvement in communication, voice, and speech once that, from the moment they are diagnosed and know about their neurodegenerative and chronic disease, they get frustrated knowing that the medical treatment is just palliative and that there is no treatment available to interrupt the course of the disease and avoid it^(28,29).

This way, this study implies that the prosodic changes and of the habitual frequency in subjects with PD, together with physical and cognitive problems, the social isolation, and the perceptions of change and dissatisfaction with the communication, are determining factors for a negative view of the QoL.

Specifically in relation to the communication, the prosodic alterations and the habitual frequency are proved relevant, once that, even with the remaining parameters being similar between the groups (Parkinson and control), the PG had a more negative impact on the QoL focused on communication, i.e., the compromising of the prosody and the habitual frequency have an impact on the QoL of the subjects with PD.

Other significant data in voice evaluation were the intensity range, in which the PG had higher mean range. According to previous studies, such findings could be justified by the fact that the patients are conscious of their difficulties and, due to that, they perform more variations in the intensity to compensate the reduced vocal range⁽³⁰⁾.

From these results, the importance of speech therapy in the rehabilitation and in the QoL of patients with PD is emphasized. It is also important to emphasize the importance of therapeutic interdisciplinary planning with this population, once not only the aspects of speech and voice interfere on the QoL focused on communication.

This study provides important information on the differences between the speech and voice aspects of patients with PD and the average aging process and their impact on the QoL. However, new researches are necessary, considering that there is a need for the broadening of the studied sample and of longitudinal studies, once the PD is progressive.

CONCLUSION

The acoustic and auditory-perceptual analysis of individuals with PD showed similar parameters to the ones present in the average aging process. However, the prosody and the habitual frequency may be some of the first changes in dysarthria among patients with PD.

Besides, it is evident that issues of communication and speech have a negative effect on the QoL of the subjects with PD — prosody and habitual frequency being the most related ones, with other factors, such as language, cognition, and socialization problems.

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