Literature Review

https://doi.org/10.1590/2317-6431-2023-2874en

Audiology Communication Research
ISSN 2317-6431

Swallowing and cognition in Parkinson's disease: an integrative review

Deglutição e cognição na doença de Parkinson: revisão integrativa

Jullyane Florencio Pachêco da Silva[1], *Adriana de Oliveira Camargo Gomes*[2], *Tatiany Cintia da Silva Brito*[3], *Jamilly Henrique Costa da Silva*[4], *Paula Rejane Beserra Diniz*[1]

ABSTRACT

Purpose: to understand the relationship between swallowing and cognition in individuals with Parkinson's disease. **Research strategy:** this integrative review was based on the research question, "What is the relationship between swallowing and cognition in Parkinson's disease?". It used the following health descriptors: Parkinson's disease, Cognition, Cognitive Dysfunction, Mastication, Swallowing, and Swallowing Disorders, to search the LILACS, MEDLINE/PubMed, SciELO, Web of Science, EMBASE, and Scopus databases. **Selection criteria:** the selection was based on independent reading by peers, including publications available in full text in Portuguese, English, or Spanish, with no restriction on the year. The review excluded studies that described cognitive and oral impairment associated with other parkinsonian syndromes or different neurodegenerative diseases. **Results:** altogether, 1701 studies were found, of which 306 duplicates were excluded. Based on abstract reading and the selection criteria, 24 studies were selected to be read in full text, and 14 of them were included in this review. Association was observed between cognitive decline and the oral phase of swallowing. **Conclusion:** the findings suggest that cognition can influence swallowing performance, with cognitive decline associated with dysphagia and sialorrhea. This relationship proved to be more evident in the oral phase of swallowing, but still controversial in the pharyngeal phase.

Keywords: Parkinson disease; Cognition; Cognitive dysfunction; Deglutition; Deglutition disorders

RESUMO

Objetivo: compreender a relação entre a deglutição e a cognição nos indivíduos com a doença de Parkinson. **Estratégia de pesquisa:** revisão integrativa guiada pela pergunta condutora: "*Qual a relação entre a deglutição e cognição na doença de Parkinson?*". Foram utilizados os seguintes descritores em saúde: Doença de Parkinson, Cognição, Disfunção Cognitiva, Mastigação, Deglutição e Transtornos de Deglutição. As bases de dados pesquisadas foram LILACS, MEDLINE/PubMed, SciELO, Web of Science, Embase *e* Scopus. **Critérios de seleção:** a seleção se deu de forma independente, por meio da leitura por pares, sendo inclusas publicações disponibilizadas na íntegra em português, inglês ou espanhol, sem restrição de ano. Estudos que descreviam o comprometimento cognitivo e oral associado a outras síndromes parkinsonianas ou diferentes doenças neurodegenerativas foram excluídos. **Resultados:** dos 1701 estudos, foram excluídos 306 duplicados. A partir da leitura dos resumos, aplicando-se os critérios de seleção, foram selecionados 24 estudos para leitura na íntegra, dos quais, 14 foram incluídos nesta revisão. Observou-se associação entre o declínio cognitivo e a fase oral da deglutição. **Conclusão:** os achados sugerem que a cognição pode influenciar o desempenho da deglutição, estando o declínio cognitivo associado à disfagia e à sialorreia. Essa relação se mostrou mais evidente na fase oral da deglutição, mas ainda controversa na fase faríngea.

Palavras-chave: Doença de Parkinson; Cognição; Disfunção cognitiva; Deglutição; Transtornos de deglutição

Study carried out at Universidade Federal de Pernambuco – UFPE – Recife (PE), Brasil.
[1]Programa de Pós-graduação em Neuropsiquiatria e Ciências do Comportamento (Doutorado), Universidade Federal de Pernambuco – UFPE – Recife (PE), Brasil.
[2]Departamento de Fonoaudiologia, Universidade Federal de Pernambuco – UFPE – Recife (PE), Brasil.
[3]Graduação em Medicina, Universidade de Pernambuco – UPE – Recife (PE), Brasil.
[4]Programa de Pós-graduação em Fonoaudiologia Neurofuncional (Especialização), Faculdade Integrada da Amazônia – Finama – Belém (PA), Brasil.
Conflict of interests: No.
Authors' contribution: JFPS was for study design, collecting, analyzing and interpreting data and writing the article; AOCG was responsible for analysis, interpretation of data and writing of the article; TCSB was responsible for collecting, analyzing and interpreting data and writing the article; JHCS was responsible for data collection, analysis and interpretation; PRBD was responsible for analysis, interpretation of data and review of the article.
Funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brazil (CAPES). Financing Code 001; Pró-Reitoria de Pós-Graduação (PROPG) - Universidade Federal de Pernambuco – UFPE.
Corresponding author: Jullyane Florencio Pachêco da Silva. E-mail: jullyanepacheco@gmail.com
Received: November 06, 2023; **Accepted:** May 09, 2024

INTRODUCTION

Parkinson's disease (PD) is a chronic, degenerative, progressive disease resulting from a complex interaction between environmental, genetic, and aging factors[1]. It affects more than 1% of the population over 65 years old and its prevalence is expected to double by 2030. It generally appears between 50 and 80 years of age, peaking in the seventh decade of life, being more prevalent in men[2,3].

It is characterized by the presence of α-synuclein protein aggregates and neuronal loss in the substantia nigra, causing striatal dopaminergic deficiency[3]. These neural changes can lead to the motor symptoms that define PD (resting tremor, muscle stiffness, bradykinesia, and postural instability) and non-motor symptoms such as swallowing changes and cognitive impairment[2,4-6].

More than 90% of PD patients present with non-motor symptoms in the course of the disease, as extra-nigral areas degenerate before the loss of nigral neurons[7]. These are the symptoms that often motivate people to seek health services, as they directly impact the quality of life, overload caregivers, and increase the costs of healthcare[3,8].

Bradykinesia, tremors, and muscle stiffness can affect orofacial and cervical muscles, impacting oral functions, including mastication and swallowing[2,9]. These dysfunctions can be reported in the early stages of the disease and intensify in later ones, causing discomfort and considerably affecting the quality of life. PD patients may have difficulties swallowing food and medications[10] and manage saliva.

Furthermore, aspiration pneumonia – a complication resulting from changes in swallowing function – has an incidence rate four times higher in PD patients than in the same-age general population and is one of the main causes of death, as reported by studies with long-term follow-up[11]. Consequently, the increasingly larger older population and the growing incidence of PD may intensify orofacial disorders and disabilities, turning them into a major social problem[9].

Cognitive impairment, in turn, can be up to six times more common in PD patients than in a similar-age healthy population. It is usually slow and insidious, impairing executive and visuospatial skills, possibly accompanied by changes in memory, attention, and language, and increasing the risk of early progression to dementia[3,12].

Changes in cognition in PD patients are predictors of changes in speech[13] and may be linked to oropharyngeal dysphagia[14]. Therefore, there is a hypothesis that changes in cognition may be associated with swallowing difficulties in PD patients. However, the pathophysiology underlying swallowing difficulties and their relationship with cognition in PD is complex and still poorly understood.

As the diagnosis of PD is mainly clinical and its treatment is symptomatic[3,12], the multiprofessional team must understand the relationships between dysfunctions throughout the disease. This will support interdisciplinary treatment plans more targeted to such needs to positively impact these individuals' quality of life.

OBJECTIVE

This study aimed to verify the available scientific evidence on the possible relationship between swallowing and cognition in PD patients.

RESEARCH STRATEGY

This is an integrative review of the literature[15], based on the research question, "What is the relationship between swallowing and cognition in PD?", which was created with the following strategy: Population (P) – PD patients; study variable (V) – impaired cognition and swallowing; outcomes (O) – the relationship between changes in cognition and swallowing.

Articles were searched with keywords indexed in the Health Sciences Descriptors/Medical Subject Headings (DeCS/MeSH) and free terms associated with the Boolean operators AND and OR: "Parkinson Disease" OR "Parkinson's Disease" AND "Cognition" OR "Cognitive Dysfunction" AND "Mastication" OR "Chewing" OR "Deglutition" OR "Swallowing" OR "Deglutition Disorders" OR "Dysphagia" (Chart 1).

The search was conducted in April and May 2023 and updated in March 2024 in the following databases: Latin American and Caribbean Health Sciences Literature (LILACS), International Literature on the Health Sciences (MEDLINE/PubMed), Scientific Electronic Library Online (SciELO), Web of Science, EMBASE, and Scopus.

SELECTION CRITERIA

The eligibility criteria were established as follows: articles that described swallowing in PD and cognitive skills, with no restriction on the year, available in full text in Portuguese, English, or Spanish. The review excluded studies that reported associations with other parkinsonian syndromes or neurodegenerative diseases, that reported only anatomopathological descriptions of the impairment, as well as editorial studies, literature reviews, and animal experiments.

The articles were evaluated and selected based on their title, abstract, and full-text reading to extract data. Two reviewers systematically and independently reviewed all studies, recording any deviations from the established criteria. Discrepancies between reviewers were resolved by consulting a third reviewer.

Data analysis

The following data were extracted: authors, year of publication, study type, general characteristics of the sample, tests used, main swallowing and cognition findings, and the relationship between them. These data were descriptively compiled in a previously prepared Excel table to help identify and reformulate topic categorizations.

Levels of evidence were analyzed based on the hierarchy pyramid of medical evidence[16] from the perspective of systematic review and meta-analysis. The pyramid was reconfigured according to the types of studies and their applicability. Randomized case-control studies are at the top of the model, followed by

Chart 1. Strategy for article search in each database

LILACS*	((parkinson disease) OR (parkinson's disease)) AND ((cognition) OR (cognitive dysfunction)) AND ((mastication) OR (chewing) OR (deglutition) OR (swallowing) OR (deglutition disorders) OR (dysphagia)) AND (db:("LILACS"))
MEDLINE/PubMed	(("Parkinson Disease"[Mesh] OR "Parkinson's Disease"[tw]) AND ("Cognition"[Mesh] OR "Cognitive Dysfunction"[Mesh]) AND ("Mastication"[Mesh] OR "Chewing"[tw] OR "Deglutition"[Mesh] OR "Swallowing"[tw] OR "Deglutition Disorders"[Mesh] OR "Dysphagia"[tw]))
Embase	('parkinson disease'/exp OR 'parkinson disease') AND ('cognition'/exp OR 'cognitive defect'/exp OR 'cognitive dysfunction' OR 'cognition') AND ('mastication'/exp OR 'chewing' OR 'swallowing'/exp OR 'deglutition' OR 'dysphagia'/exp OR 'deglutition disorders') AND [embase]/lim
Web of Science	((ALL=(("Parkinson Disease" OR "Parkinson's Disease"))) AND ALL=(("Cognition" OR "Cognitive Dysfunction"))) AND ALL=(("Mastication" OR "Chewing" OR "Deglutition" OR "Swallowing" OR "Deglutition Disorders" OR "Dysphagia"))
SciELO*	((parkinson disease)) AND ((cognition) OR (cognitive dysfunction)) AND ((mastication) OR (chewing) OR (deglutition) OR (swallowing) OR (deglutition disorders) OR (dysphagia))
Scopus	(TITLE-ABS-KEY ('parkinson AND disease') AND TITLE-ABS-KEY ('cognition' OR 'cognitive AND defect' OR 'cognitive AND dysfunction') AND TITLE-ABS-KEY ('mastication' OR 'chewing' OR 'swallowing' OR 'deglutition' OR 'dysphagia' OR 'deglutition AND disorders'))

*Using descriptors in Portuguese, English and Spanish

Subtitle: LILACS = Latin American and Caribbean Health Sciences Literature; MEDLINE/PubMed = International literature on health sciences; SciELO = Scientific Electronic Library Online

Source: Developed by the authors (2024)

cohort studies, case-control studies, and case series studies or database reviews.

RESULTS

The search initially found 1,587 articles, increasing to 1,701 when the search was updated. Of these 1,687 were excluded based on factors such as duplications, study types, title and abstract reading, and when necessary, full-text reading (Figure 1). Thus, 14 articles were included in this study.

All articles are in the level of evidence 4[16] for being non-experimental observational studies; three of them are case series studies. Six of them were published in Europe, five in Asia, two in North America, and one in Latin America. The oldest article included in this review was published in 2009, and the most recent one, in 2022.

The population's mean age in the selected articles (Chart 2) was between 59 and 75 years, and most of them were males. All articles used the Hoehn and Yahr Scale (H&Y) to analyze the progression and stage of PD, with patients concentrated in H&Y stages 1 and 2 and its subdivisions. However, there were some exceptions, such as the study whose participants were mostly in stage 3[26], and the one whose dysphagic patients were mostly in H&Y stages 3 to 5[29].

One[21] of the 14 studies did not describe the cognitive assessment instrument it used. Most[17,18,20,22-26,28-30] of the 13 studies that reported it used the Montreal Cognitive Assessment (MoCA) and/or Mini-Mental State Examination (MMSE), either alone[18,23,24,26,28-30] or in combination[17,20,22,25] with other types of cognitive tests.

Half[17,20-22,24,27,29] of the 14 articles included in this study assessed swallowing by videofluoroscopy or videoendoscopy. The other seven[18,19,23,25,26,28,30] used a wide range of dysphagia assessment resources, such as the categories of the Unified Parkinson's Disease Rating Scale (UPDRS)[25,28] and electromyography of suprahyoid muscles[19].

The studies that subdivided the PD group according to the presence or absence of dysphagia[22,23,25,28,29] found that the disease lasted longer in those who had swallowing difficulties. Nevertheless, in only two of them[22,23] was this difference greater than one year.

Three articles[20-22] demonstrated a significant association between cognitive impairment and performance in the oral phase of swallowing. However, these authors diverged on the involvement of the pharyngeal phase. One of the studies detected a slight association between the beginning of the pharyngeal phase and the score on the cognitive test used[20]. In the same sense, another article used the term "oropharyngeal" swallowing to encompass both oral and pharyngeal impairment in dual-task swallowing activities – i.e., when swallowing was performed simultaneously with other cognitive activities[21]. However, the other group of authors[22] did not find a significant relationship between cognitive test scores and the pharyngeal phase of swallowing.

All studies that analyzed swallowing with dual tasks[17,19,21,27] demonstrated that the greater cognitive demand to do the tasks influenced swallowing performance. This influence was found to occur in premature bolus escape, in pharyngeal residues[21], and in swallowing safety[27], all of them impaired by the need for greater cognitive flexibility and attention. It was also found that patients with lower cognitive test scores also had a greater variation of swallowing in both single and dual tasks[17].

There were also agreements and divergences between studies that addressed the involvement of salivation with cognition and/or swallowing[18,24,26,30]. The three agreeing articles[18,26,30] pointed out an association between cognitive deficits and sialorrhea. This occurred both in the prevalence of sialorrhea in groups with simultaneous PD and impaired cognition[30] and in performing a distracting task, which resulted in intense sialorrhea and fewer swallows[26]. Furthermore, cognition was negatively correlated with sialorrhea and was considered one of the important factors causing salivation[18].

On the other hand, the authors of another study concluded that, although sialorrhea and dysphagia are common in PD patients, sialorrhea is not a predictor of critical dysphagia. They suggest that the underlying cause of salivation is in the voluntary oral phase, which is negatively influenced by cognitive deficits[24].

During follow-up over the years, swallowing difficulties were verified in all PD stages[28]. Moreover, the worst cognitive test scores at the beginning of follow-up were correlated with worsening dysphagia[29]. However, it was pointed out that the early presence of dysphagia did not increase the risk of cognitive decline over the years[25].

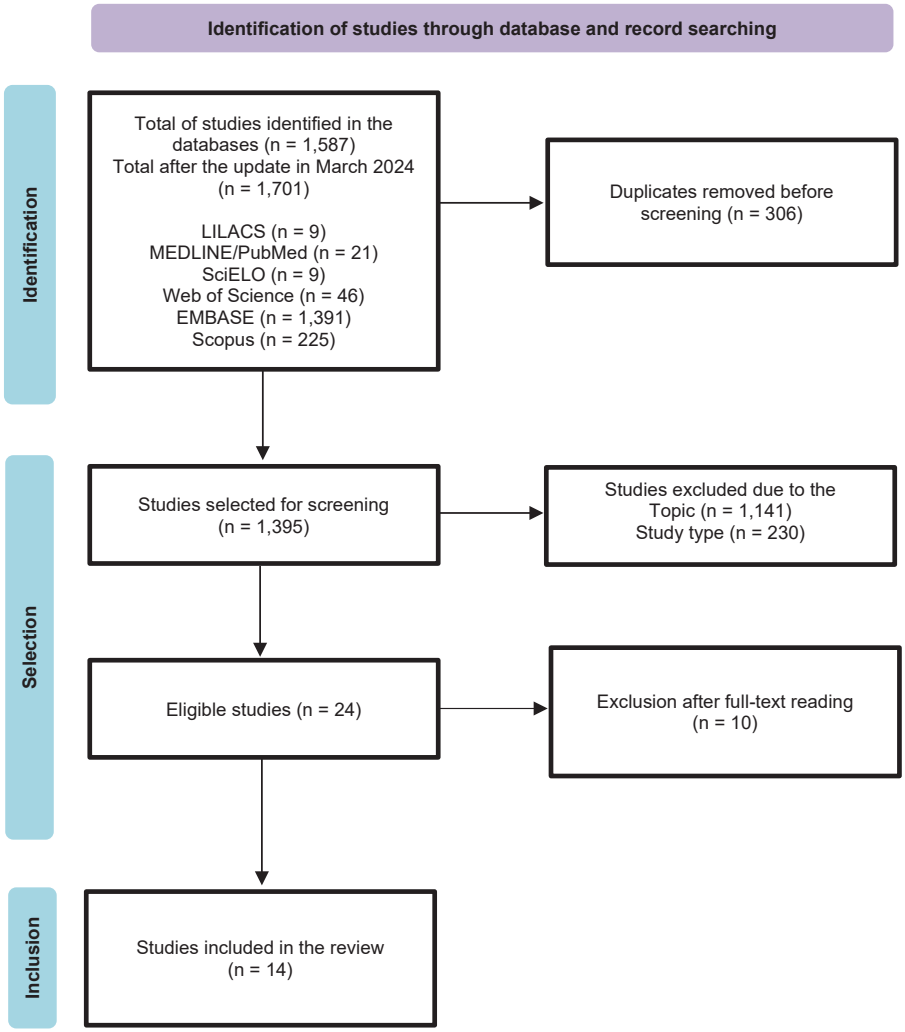

Figure 1. Flowchart of the selection of articles for the review
Source: Developed by the authors (2024)

Chart 2. General characteristics of the sample, findings on swallowing and cognition, and their correlation

AUTHOR(S)	GENERAL CHARACTERISTICS OF THE SAMPLE	FINDINGS ON SWALLOWING	FINDINGS ON COGNITION	CORRELATION
Ardenghi et al.[17]	n = 38: 19 PD patients – mean age of 61.5±7.1 years, matched with 19 HC - 60.8±8.7 years. 68.4% males. Mean of 8 years of education in the PD group and 10 years in the HC group. 12 of the PD patients were classified in H&Y stage 2; six in stage 3; and one in stage 4.	The PD patients' median score with a 3-ml volume was 2 for a single swallow and 4 for a dual task. Median scores were significantly lower among HC individuals. The same variation was with 5-ml volume, with a median score in the PD group of 2 for a single swallow and 4 for the dual task. The median score for the HC group was 0 for a single swallow and 1 for a dual task.	PD group: Score in MoCA 22.6±6.1 and MMSE 24.6±4.9. HC group: Score in MoCA 21.8±4.5 and MMSE 26.7±2.6.	There was greater variability in the BRACS score results in the PD group when compared with the HC group, with a significant difference only for the 3 ml volume. There was a significant inverse association between MoCA results and change in the BRACS scale between dual-task and single-task only in the PD group. Patients with lower MoCA scores had greater swallowing variation in the dual task.

Subtitle: BRACS = Boston Residue and Clearance Scale; CDR = Clinical Dementia Rating; COGNISTAT = (The Northern California Neurobehavioral Group, Inc., 1995); HC = healthy controls; PD = Parkinson's disease; DRS-II = cognitive functioning screening test for PD patients; H&Y = Hoehn & Yahr scale; KWST = Kubota Water Swallowing Test; MMSE = Mini-Mental State Examination; MoCA = Montreal Cognitive Assessment; PAS = Rosenbek Penetration-Aspiration Scale; SAI = Short-Latency Afferent Inhibition; SDQ-C = Swallowing Disturbance Questionnaire; SVLT = Seoul Verbal Learning Test; RT = reaction time; VDS = Videofluoroscopic Dysphagia Scale; UPDRS = Unified Parkinson's Disease Rating Scale; Stroop = Stroop Color-Word Test; SCOPA-AUT = Scale for Outcomes in Parkinson's disease – Autonomic
Source: Developed by the authors (2024)

Chart 2. Continued...

AUTHOR(S)	GENERAL CHARACTERISTICS OF THE SAMPLE	FINDINGS ON SWALLOWING	FINDINGS ON COGNITION	CORRELATION
Bakhtiyari et al.[18]	n = 85, mostly males (80%). Mean age of 59.40±4.79 and disease duration of 5.81±3.68 years. A mean H&Y scale score of 2.35±0.86. Most of the sample had a bachelor's degree (56.5%)	50.6% of the patients had dysphagia. The prevalence of sialorrhea was 70.6%.	MMSE: 23.89±4.81	It was concluded that the cause of salivation in PD results from a combination of factors, including dysphagia and cognitive impairment.
Brodsky et al.[19]	n = 10 (7 men and 3 women, all with PD). Mean age of 61.8±10.1 years. H&Y scale score ranged from 1.5 to 3.0. None of them complained of swallowing difficulties.	At baseline, the mean time of the anticipatory phase of swallowing was 2.572 ms±703 ms; the mean time of the oropharyngeal phase of swallowing was 2.790 ms ±1.449 ms. In the dual task, the participants' mean duration of the anticipatory phase was 2.597 ms ±770 ms and that of the oropharyngeal phase was 2.395 ms ±1.381ms.	COGNISTAT results were within normal limits for all participants. At baseline, the mean RT on target trials was 921 ms ± 426 ms. In the dual task, the mean RT for targets presented in the anticipatory phase of swallowing was 1,364 ms ±820 ms and in the oropharyngeal phase was 1,580 ms ±1,434 ms.	There was a significant increase in RT (443 ms) in the dual task during the anticipatory phase of swallowing compared to baseline. This means that the motor demands of swallowing were great enough to require additional cognitive support to achieve it competently during this phase. This data indicates that the introduction of an additional task can affect swallowing.
Kim et al.[20]	n = 56 with PD. Most of the sample were females (55.4%), with a mean age of 63.02±8.20; years of education of 10.98±4.01 and time of the disease 4.53±4.05. On the H&Y scale, 19 patients were in stage 1, 19 in stage 2, 13 in stage 2.5, and five in stage 3.	The overall oral phase mean was 2.22±1.82 and that of oral residue was 1.21±0.66; the general pharyngeal phase with 5.44±3.03 and pharyngeal residue 1.61±0.98.	MMSE: 27.48±2.60; CDR: 0.69±1.26.	There were significant negative associations between components of the oral phase of swallowing and frontal/executive function (identified with Stroop) and learning/ memory (identified with late and recognition SVLT). The pharyngeal phase onset was slightly associated with the MMSE score.
Labeit et al.[21]	n = 30 with PD. Most of the sample were females (77%), with a mean age of 65.90 ± 9.32, and a time of the disease 7.77 ± 4.75 years. The mean H&Y stage was 2.62±0.81.	Mild dysphagia was found in 53% of patients, with pharyngeal residues or premature bolus escape. Dysphagia with penetration or aspiration of one consistency was found in 7%. None of the patients had aspiration or penetration of more than one consistency. There was no significant influence of bolus consistency on aspiration/penetration and total score, but, for premature bolus escape, semisolid and liquid consistencies were higher. The opposite occurred in the pharyngeal residue, which was greater in solid consistency.	7% of PD patients had mild cognitive disability.	Swallowing scores were significantly worse in both cognitive and motor dual tasks. This was observed for premature bolus escape and pharyngeal residue, but not for penetration/ aspiration. Oropharyngeal swallowing was impaired due to the dual cognitive and motor task.

Subtitle: BRACS = Boston Residue and Clearance Scale; CDR = Clinical Dementia Rating; COGNISTAT = (The Northern California Neurobehavioral Group, Inc., 1995); HC = healthy controls; PD = Parkinson's disease; DRS-II = cognitive functioning screening test for PD patients; H&Y = Hoehn & Yahr scale; KWST = Kubota Water Swallowing Test; MMSE = Mini-Mental State Examination; MoCA = Montreal Cognitive Assessment; PAS = Rosenbek Penetration-Aspiration Scale; SAI = Short-Latency Afferent Inhibition; SDQ-C = Swallowing Disturbance Questionnaire; SVLT = Seoul Verbal Learning Test; RT = reaction time; VDS = Videofluoroscopic Dysphagia Scale; UPDRS = Unified Parkinson's Disease Rating Scale; Stroop = Stroop Color-Word Test; SCOPA-AUT = Scale for Outcomes in Parkinson's disease – Autonomic
Source: Developed by the authors (2024)

Chart 2. Continued...

AUTHOR(S)	GENERAL CHARACTERISTICS OF THE SAMPLE	FINDINGS ON SWALLOWING	FINDINGS ON COGNITION	CORRELATION
Lee et al.[22]	n = 29 with PD: 12 dysphagic patients and 17 without dysphagia. There was an equal number of men and women with dysphagia (6 and 6), but women predominated in the non-dysphagia group. The mean age in the dysphagia group was 73.33 ± 6.48 years, and in the non-dysphagia group, 71.06 ± 6.98 years. The mean time of the disease in the dysphagia group was 17.92 ± 9.16 months, and in the non-dysphagia group, 11.94 ± 4.98 months. The mean H&Y stage was 1.92±0.56 in the dysphagia group and 1.50±0.47 in the non-dysphagia group.	In the oral phase, chewing scores, premature loss of food bolus, apraxia, oral transit time, and general oral phase were higher in the PD with dysphagia group. In the pharyngeal phase, a higher score in pharyngeal swallowing triggering was observed in the PD group with dysphagia. In total, the VDS score was also higher in the PD with dysphagia group.	MMSE of PD with dysphagia: 25.25 ± 1.60; MMSE of PD without dysphagia: 26.82 ± 1.55. MMSE less than 24 was an exclusion criterion due to cognitive decline. SAI PD with dysphagia: 74.35 ± 15.09; SAI PD without dysphagia: 49.36 ± 8.34.	The MMSE and SAI values were significantly correlated with problems in the oral phase, but not in the pharyngeal phase. It is concluded that cholinergic and cognitive changes may contribute to dysphagia in early PD and can be used as markers to identify early dysphagia in this group. The SAI value can be used as a predictor of the risk of dysphagia and to detect subclinical dysphagia.
Miller et al.[23]	n = 137, all with PD; 106 drank 150 ml, and 31 drank less than that. The median age in the group that drank 150 ml was 73 years, H&Y was 2, and the disease duration was 5 years. In the group that drank less, the median age was 74 years, the H&Y was 3, and the disease duration was 8 years.	23% were unable to complete the 150 ml, ingesting an average of 68 ml. The volume ingested and swallowing time correlated with swallowing speed in those who consumed 150 ml. Of the 122 who answered whether they had difficulty swallowing drinks or food, 45 said yes. Of these 45, 12 were unable to complete the 150 ml intake. 14 of those who said they did not have swallowing problems were also unable to complete it.	MMSE of those who completed the 150 ml: 27. MMSE of those who did not complete it: 25.	Among those who did not complete the 150 ml, there was slower swallowing, worse H&Y scores, and a longer illness duration. Swallowing speed was correlated with MMSE, UPDRS part II, and H&Y. The stage of the disease was not a strong indicator in swallowing difficulties.
Nienstedt et al.[24]	n = 151: 119 PD patients and 32 HC. Most were males in both groups. The mean age in the PD group was 68.9 ± 10.1 years and in HC 68.1 ± 10.7 years. The mean education time in the PD group was 12.23 ±5.01 years and in HC, 12.75 ±4.62 years. The mean time of the disease was 9.7 ± 7.1 years, and there was greater prevalence on the H&Y scale of scores 2 (49%), 3 (27%), and 4 (17%).	50% of patients had sialorrhea, whereas only 9% of controls were affected by it. 24% of PD patients had severe dysphagia with critical aspiration, whereas none of the 32 controls had severe dysphagia. The salivation rate was higher in older patients, with a longer time of the disease, and, consequently, more cognitive deficits. 74% of PD patients did not have abnormal pharyngeal secretion control.	MoCA: mean in PD group 21.9 ± 4.8, mean in HC group 25.3 ± 3.0. About 85 (71%) patients were categorized with cognitive deficits in the PD group and 17 (53%) in the HC group.	Salivation and dysphagia are frequent but weakly related in PD patients. Sialorrhea cannot be considered a clinically useful early symptom of critical dysphagia. The pharyngeal reflex function is not the determining factor for salivation. However, salivation appears to be mainly related to swallowing dysfunction in the voluntary oral phase, which is negatively influenced by cognitive deficits. Those with cognitive impairment had more salivation.

Subtitle: BRACS = Boston Residue and Clearance Scale; CDR = Clinical Dementia Rating; COGNISTAT = (The Northern California Neurobehavioral Group, Inc., 1995); HC = healthy controls; PD = Parkinson's disease; DRS-II = cognitive functioning screening test for PD patients; H&Y = Hoehn & Yahr scale; KWST = Kubota Water Swallowing Test; MMSE = Mini-Mental State Examination; MoCA = Montreal Cognitive Assessment; PAS = Rosenbek Penetration-Aspiration Scale; SAI = Short-Latency Afferent Inhibition; SDQ-C = Swallowing Disturbance Questionnaire; SVLT = Seoul Verbal Learning Test; RT = reaction time; VDS = Videofluoroscopic Dysphagia Scale; UPDRS = Unified Parkinson's Disease Rating Scale; Stroop = Stroop Color-Word Test; SCOPA-AUT = Scale for Outcomes in Parkinson's disease – Autonomic
Source: Developed by the authors (2024)

Chart 2. Continued...

AUTHOR(S)	GENERAL CHARACTERISTICS OF THE SAMPLE	FINDINGS ON SWALLOWING	FINDINGS ON COGNITION	CORRELATION
Polychronis et al.[25]	n=398 patients with PD, 49 dysphagic and 349 non-dysphagic. Both groups had mostly males. The average duration of the disease was 6.96±6.21 months in the group with dysphagia and 6.41±6.42 months in the group without. Regarding the H&Y scale, the average in the dysphagia group was 1.59±0.49 and in those without dysphagia, it was 1.56±0.5.	SCOPA-AUT mean 14.94 (±7.28) in PD with dysphagia and 8.84 (±5.71) in PD without dysphagia. MDS-UPDRS part II mean 9.14 (±4.98) in PD with dysphagia and 4.9 (±3.67) in PD without dysphagia. Dysphagia was present in 12.3% of study patients.	MoCA in PD with dysphagia: 27.43 (±1.82); MoCA in PD without dysphagia: 27.08 (±2.38). 307 of the 398 patients with PD were cognitively normal.	No changes in cognitive functions were found between PD patients with and without dysphagia. Furthermore, the presence of dysphagia at the beginning of the study did not increase the chances of experiencing cognitive decline over time.
Reynolds et al.[26]	n=18 with PD. The majority were male. The median age was 75 years. The median duration of the disease, in years, was 5. Regarding the H&Y scale, 5 (27.8%) patients were in stage 2; 11 (61.1%) in stage 3; two (11.1%) in stage 4.	Median swallowing frequency at rest: 2.4 (1.33–4.23). Median frequency of swallowing with distraction: 1.1 (0.50–1.53)	MoCA: The median of 27.8 participants fell below the cutoff for normal cognition.	MoCA values were not significantly correlated with changes in swallowing frequency. The cognitive distractor task had a significant effect on the frequency of sialorrhea and swallowing, resulting in more sialorrhea and fewer swallows.
Troche et al.[27]	n=20, all with PD, 4 women, and 16 men. The average age of women was 75 years, while that of men was 70.5 years. The average length of illness was 6.85 years, and the average length of education was 16.85 years. As for the H&Y scale, 13 patients were in stage 2; 2 at stage 2.5; 5 in stage 3.	All had oropharyngeal dysphagia. SBP values did not differ significantly between the single-task and dual-task moments. Swallowing safety worsened for 8 patients when in the dual task, 5 did not change and 7 improved swallowing safety in the dual task. There was a decrease in all swallowing times (oral, pharyngeal, and total transit) in the dual task.	DRS-II in PD without change: 138.60 (4.56) DRS-II in PD that worsened swallowing safety: 139.88 (2.11). DRS-II in PD that improved swallowing safety: 137.33(4.412).	Swallowing safety was significantly related to baseline cognitive flexibility and attention scores.
Walker et al.[28]	n=75, all with PD, 24 with dysphagia, and 51 without dysphagia. Most were men. In the group of those with dysphagia, the mean age was 72.942 years, the duration of the disease was 5.783 years, and the H&Y scale was 2.719. In the group without dysphagia, the mean age was 76.014 years, the duration of the disease was 4.453 years, and the H&Y scale was 2.463.	The prevalence of self-reported dysphagia was 32%. 22.7% reported difficulties in ingesting food, 13.3% with liquids, 14.7% with tablets, and 13.3% reported coughing after eating or drinking. In UPDRS 7, no patient used a nasogastric tube, 2 consumed only soft foods, 7 had occasional choking and 11 rarely choked.	Mean MMSE of PDs with dysphagia: 24.52 (4.776); mean MMSE of PDs without dysphagia: 26.04 (5.127). 9 who had cognitive impairment needed help from family members to answer the questions.	A positive correlation was found between UPDRS question 7 and MMSE results. The impact of swallowing problems was correlated to several areas of the patients' lives, including cognitive function, quality of life, anxiety, depression, and general UPDRS. It was concluded that swallowing problems were experienced by people at all stages of PD and that, among other things, the greatest swallowing difficulties are associated with cognition.

Subtitle: BRACS = Boston Residue and Clearance Scale; CDR = Clinical Dementia Rating; COGNISTAT = (The Northern California Neurobehavioral Group, Inc., 1995); HC = healthy controls; PD = Parkinson's disease; DRS-II = cognitive functioning screening test for PD patients; H&Y = Hoehn & Yahr scale; KWST = Kubota Water Swallowing Test; MMSE = Mini-Mental State Examination; MoCA = Montreal Cognitive Assessment; PAS = Rosenbek Penetration-Aspiration Scale; SAI = Short-Latency Afferent Inhibition; SDQ-C = Swallowing Disturbance Questionnaire; SVLT = Seoul Verbal Learning Test; RT = reaction time; VDS = Videofluoroscopic Dysphagia Scale; UPDRS = Unified Parkinson's Disease Rating Scale; Stroop = Stroop Color-Word Test; SCOPA-AUT = Scale for Outcomes in Parkinson's disease – Autonomic
Source: Developed by the authors (2024)

Chart 2. Continued...

AUTHOR(S)	GENERAL CHARACTERISTICS OF THE SAMPLE	FINDINGS ON SWALLOWING	FINDINGS ON COGNITION	CORRELATION
Wang et al.[29]	n=48, all with PD, separated into groups according to the presence or absence of dysphagia, before and after 6 years. Group of those without dysphagia before: majority male, the mean age of 61.34±8.19 years, disease duration of 5.13±5.03 years, and H&Y stage 1-2.5. Group of those with dysphagia before: majority male, the mean age of 62.38±9.36 years, disease duration of 5.49±4.32 years, and H&Y stage 1-2.5. Non-dysphagic group after: majority female, the mean age of 65.79±8.65 years, disease duration of 9.50±4.93 years, and H&Y stage 1-2.5. Dysphagic group after: majority male, the mean age of 69.47±7.71 years, disease duration of 11.32±4.02 years, and H&Y stage 3-5.	Swallowing worsened over the years, with the percentage increasing from 27.08% to 39.58%. BP scores were significantly worse "after" than "before". The pharyngeal residue score was also significantly higher after 6 years. After 6 years, the KWST and SDQ-C were significantly different between those with and without dysphagia. Half of the patients who had silent aspiration had normal SDQ-C. No patient received formal swallowing therapy during the 6 years.	MMSE before: non-dysphagic 27.09±2.06 and dysphagic 28.31±1.25; MMSE after: non-dysphagic 27.10±2.77 and dysphagic 24.53±4.72.	Dysphagia tended to be more severe in men, with significant increases in SDQ-C and KWST when compared to the female group. Lower MMSE scores in the "before" were significantly correlated with worsening dysphagia over time. Males and cognitive impairment may predict the worsening of dysphagia.
Zhang et al.[30]	n=568, 454 with PD, and 114 HC. Analyses were performed using PD patients. The majority were male (57.3%) and had cognitive dysfunction (58.1%). The mean age of all PD patients was 61.54 ± 10.98 years; of those with cognitive dysfunction it was 62.80 ± 10.41 years; of those without cognitive dysfunction, it was 59.78 ± 11.52 years. The mean disease duration of all PD patients was 4.76 ± 4.18 years – 5.03 ± 4.35 years in the group with cognitive dysfunction, and 4.39 ± 3.90 years in the group without cognitive dysfunction. The average H&Y score of the general PD group was 2.35 ± 0.74, with a mean of 2.49 ± 0.77 in the group with cognitive impairment and 2.16 ± 0.64 in the group without. cognitive dysfunction.	Dysphagia in the entire group with PD corresponds to 160 (35.2%). The prevalence of non-motor symptoms such as sialorrhea was 92 (21.5%) in the entire group with PD, while that of "swallowing difficulties" was 71 (16.6%) in the entire group with PD.	264 PD patients had cognitive problems. Mean MoCA of all with PD: 23.69 ± 4.55; MoCA of those with PD and cognitive impairment: 20.77 ± 3.72; MoCA of those with PD, without cognitive impairment: 27.75 ± 1.40. When compared to HC, those with PD had significantly lower cognitive performance.	No significant difference was observed in dysphagia between patients with (38.6%) and without (30.5%) cognitive problems, but there were differences in those in the H&Y stage. Thus, swallowing problems increased with the H&Y stage. The PD group with cognitive problems had a higher prevalence of sialorrhea (25.1%) and "swallowing difficulties" (21.5%).

Subtitle: BRACS = Boston Residue and Clearance Scale; CDR = Clinical Dementia Rating; COGNISTAT = (The Northern California Neurobehavioral Group, Inc., 1995); HC = healthy controls; PD = Parkinson's disease; DRS-II = cognitive functioning screening test for PD patients; H&Y = Hoehn & Yahr scale; KWST = Kubota Water Swallowing Test; MMSE = Mini-Mental State Examination; MoCA = Montreal Cognitive Assessment; PAS = Rosenbek Penetration-Aspiration Scale; SAI = Short-Latency Afferent Inhibition; SDQ-C = Swallowing Disturbance Questionnaire; SVLT = Seoul Verbal Learning Test; RT = reaction time; VDS = Videofluoroscopic Dysphagia Scale; UPDRS = Unified Parkinson's Disease Rating Scale; Stroop = Stroop Color-Word Test; SCOPA-AUT = Scale for Outcomes in Parkinson's disease – Autonomic
Source: Developed by the authors (2024)

DISCUSSION

This review found that most of the population in the articles comprised older males, which is consistent with what the literature highlights. This review found that most of the population in the articles comprised older males, which is consistent with what the literature highlights[2,3,31,32]. As the incidence of PD usually increases with age[33], poor swallowing performance may also be related to physiological and anatomical changes typical of the aging process[34].

Such physiological/anatomical changes may include limited cortical plasticity, decreased perception of smell and taste, dental changes, sarcopenia, hyposalivation, reduced elasticity of the laryngeal ligaments, decreased oropharyngolaryngeal sensitivity, and skeletal changes in the vertebral column[34]. Age and disease duration are also risk factors for severe cognitive changes, such as dementia[35].

Moreover, the selected articles mostly included the initial levels of the disease in their research. Considering that signs of dysphagia may be present early in individuals with PD[36], it is necessary to assess swallowing and study all stages of the disease[23]. The findings of dysphagic individuals with an average H&Y stage between 1.59 and 2.7 are in line with other studies[36-38].

Most articles and various authors[4,39-41] in this review assessed cognition with global cognitive tests, such as MoCA and MMSE. Few studies combined MoCA and/or MMSE with other more specific tests – such as those that assess cognitive domains separately. This finding agrees with what is recommended by the International Parkinson and Movement Disorder Society (MDS).

The MDS states that cognitive impairment should be investigated with a battery of tests. It must include an exam that assesses the global cognition status and at least another one for each specific cognitive domain – which can be increased to more than one when analyzing the severity of cognitive decline[42-44]. It also recommends using both MMSE and the Mattis Dementia Rating Scale (MDRS) as global assessment tests – the latter being the most comprehensive[42,44].

It is believed that most articles in this review chose MoCA and/or MMSE because they are widely used, easily accessible, and applicable in clinical settings[2,39,44,45]. Despite MDS indication, more recent studies have already indicated MoCA as better than MMSE for discriminating levels of cognitive decline in PD patients. Moreover, it is considered the most widely validated screening scale in populations with PD[2].

Instrumental tests (e.g., videoendoscopy and videofluoroscopy) stood out among those used to assess swallowing, as observed in other studies[11,40]. Both tests are gold standards for assessing swallowing[40,46], but the comparison between the two diagnostic methods shows that one of the main advantages of videoendoscopy is that it does use ionizing radiation, making it possible to repeat the exam if necessary[46,47]. In addition, it is considered a more accessible and easy-to-perform exam that allows an adequate anatomical and functional assessment of the pharyngeal phase of swallowing[47].

The advantages of videofluoroscopy include visualization of the food bolus during all phases of swallowing, including the esophageal one, and the possibility of visually verifying the effectiveness of a given swallowing maneuver for that patient. It is also sensitive to oropharyngeal dysphagia and useful for identifying tracheal aspiration[48].

Furthermore, this study found that PD lasted longer in the group with swallowing problems. However the difference in disease duration between dysphagic and non-dysphagic individuals was not very extensive. Moreover, the PD stage in which swallowing is affected is variable[17,36], and the study sample was relatively small. Hence, the conclusions regarding the influence of disease duration in this group are limited.

The present review found an association between cognitive decline and the oral phase of swallowing. The disagreement, however, resided in the involvement or not of complications in the pharyngeal phase. It is understood that subjects must perceive the sensory characteristics of the food in the oral phase for their muscles to adjust appropriately and form the bolus. Of the three phases, this is the conscious one, as the main muscles involved — oral, perioral, and tongue regions — are subject to voluntary control[49] and can be influenced by cognition.

The pharyngeal phase, in turn, comprises the contraction of the pharyngeal muscles and begins when the tongue ejects the bolus, which then arrives on the posterior pharyngeal wall. This stage, therefore, involves the conduction of the oropharyngeal content to the esophagus and is considered involuntary, as it is under autonomic control, conducted by the swallowing center in the brainstem[49].

Hence, it can be assumed that the oral phase of swallowing is more easily affected in PD patients with cognitive impairment, as it depends on the integrity of executive functions. According to this hypothesis, dysfunction in the first stage would be related not only to motor disability but also to difficulties in understanding, evaluating, synthesizing, and integrating the somatosensory, memory, and learning information necessary to carry out this stage[50].

Furthermore, problems generated in the oral phase considerably contribute to dysfunctions in the pharyngeal phase. The literature demonstrates that when the organization, control, and ejection of the bolus are impaired in the first stage, the dynamics of the following phase are also negatively affected[50]. Therefore, the hypothesis is that, as the oral phase influences the pharyngeal phase and is dependent on cognition, cognitive impairment could also contribute to dysfunctions in these two stages.

A study points out that cognitive impairment may be linked to oropharyngeal dysphagia in PD, exacerbating it in more advanced stages of the disease[14]. Accordingly, neuroimaging examinations showed hypometabolism not only in the supplementary motor area but also in the anterior cingulate cortex, an area that among other things involves this population's cognitive function[51].

Previous studies have found a relationship between salivation and dementia in PD. It has been pointed out that the more severe the cognitive impairment, the greater the severity and frequency of sialorrhea[52]. This occurs due to difficulties in swallowing during the oral phase, rather than excessive saliva production[52,53].

Although an article in this review found that sialorrhea is not a predictor of critical dysphagia, this finding disagrees with other studies[54,55] that concluded that sialorrhea can be even considered an indicator of subclinical dysphagia[55]. It is believed that standardized methods to evaluate both swallowing and salivation can further mitigate these controversies.

Considering the level of evidence of the studies included in this review, one limitation is the impossibility of inferring that cognitive impairment causes dysphagia. Nonetheless, it helped understand the possible relationships between swallowing and cognition and may contribute to the development of personalized treatments to positively impact the individual's quality of life.

It is recommended that future studies aiming to associate cognition with swallowing performance consider which items of the cognitive tests are affected. Thus, they can analyze which cognitive domains exert greater or lesser influence on swallowing function.

CONCLUSION

It is suggested that cognition may influence swallowing performance, given that most studies in this review associated cognitive decline with dysphagia and sialorrhea. This relationship was more evident in the oral phase of swallowing and controversial in the pharyngeal phase.

ACKNOWLEDGMENTS

To the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES). To the post-graduate dean's office (PROPG) at the Universidade Federal de Pernambuco – UFPE.

REFERENCES

1. Tansey MG, Wallings RL, Houser MC, Herrick MK, Keating CE, Joers V. Inflammation and immune dysfunction in Parkinson disease. Nat Rev Immunol. 2022;22(11):657-73. http://doi.org/10.1038/s41577-022-00684-6. PMid:35246670.
2. Cabreira V, Massano J. Doença de Parkinson: revisão clínica e atualização. Acta Med Port. 2019;32(10):661-70. http://doi.org/10.20344/amp.11978. PMid:31625879.
3. Aarsland D, Batzu L, Halliday GM, Geurtsen GJ, Ballard C, Chaudhuri KR, et al. Parkinson disease-associated cognitive impairment. Nat Rev Dis Primers. 2021;7(47):1-21.
4. Baptista R, Alvarez AM, Nunes SFL, Valcarenghi RV, Barbosa SFF. Idosos com doença de Parkinson: perfil e condições de saúde. Enfermagem em Foco. 2019;10(5):99-102.
5. Armstrong MJ, Okun MS. Diagnosis and treatment of Parkinson disease. JAMA. 2020;323(6):548-60. http://doi.org/10.1001/jama.2019.22360. PMid:32044947.
6. Fernandes HCO, Scarpat LT, Carvalho MM, Oliveira ND, Salim RNH, Souza RR, et al. Depressão entre idosos portadores de doença de Parkinson: opinião dos membros da Associação Capixaba de Parkinson. Rev APS. 2019;22(3):554-73.
7. Souza RA, Vieira IVT, Silva JP. Biomarcadores clínicos de sintomas não motores na doença de Parkinson. Ver Neurociênc. 2021;29(1):1-14. http://doi.org/10.34024/rnc.2021.v29.11788.
8. Galeoto G, Berardi A, Colalelli F, Pelosin E, Mezzarobba S, Avanzino L, et al. Correlation between quality of life and severity of Parkinson's disease by assessing an optimal cut-off point on the Parkinson's Disease Questionnaire (PDQ-39) as related to the Hoehn & Yahr (H&Y) scale. Clin Ther. 2022;173(3):243-8. PMid:35612339.
9. Baram S, Karlsborg M, Bakke M. Improvement of oral function and hygiene in Parkinson's disease: a randomised controlled clinical trial. J Oral Rehabil. 2020;47(3):370-6. http://doi.org/10.1111/joor.12924. PMid:31837276.
10. Lee HJ. Literature review on variables for objectively assessing masticatory ability of patients with Parkinson's disease. J Speech Lang Hear Disord. 2020;29(3):37-44. http://doi.org/10.15724/jslhd.2020.29.3.037.
11. Gould FDH, Gross A, German RZ, Richardson JR. Evidence of oropharyngeal dysfunction in feeding in the rat rotenone model of Parkinson's disease. Parkinsons Dis. 2018;2018:6537072. http://doi.org/10.1155/2018/6537072. PMid:29713446.
12. Balestrino R, Schapira AHV. Parkinson Disease. Eur J Neurol. 2020;27(1):27-42. http://doi.org/10.1111/ene.14108. PMid:31631455.
13. Polychronis S, Niccolini F, Pagano G, Yousaf T, Politis M. Speech difficulties in early de novo patients with Parkinson's disease. Parkinsonism Relat Disord. 2019;64:256-61. http://doi.org/10.1016/j.parkreldis.2019.04.026. PMid:31078401.
14. Tjaden K. Speech and swallowing in Parkinson's disease. Top Geriatr Rehabil. 2008;24(2):115-26. http://doi.org/10.1097/01.TGR.0000318899.87690.44. PMid:19946386.
15. Dantas HLL, Costa CRB, Costa LMC, Lúcio IML, Comassetto I. Como elaborar uma revisão integrativa: sistematização do método científico. Rev Cient Enferm. 2021;12(37):334-45. http://doi.org/10.24276/rrecien2022.12.37.334-345.
16. Murad MH, Asi N, Alsawas M, Alahdab F. New evidence pyramid. Evid Based Med. 2016;21(4):125-7. http://doi.org/10.1136/ebmed-2016-110401. PMid:27339128.
17. Ardenghi LG, Signorini AV, Maahs GS, Selaimen F, Deutsch KM, Dornelles S, et al. Deglutition impairment during dual task in Parkinson disease is associated with cognitive status. Int Arch Otorhinolaryngol. 2021;25(1):e41-7. http://doi.org/10.1055/s-0039-3402440. PMid:33542750.
18. Bakhtiyari J, Mehri A, Maroufizadeh S, Amanian H. Drooling in Parkinson's disease: a multifactorial symptom. Arch Neurosci. 2020;7(2):1-5. http://doi.org/10.5812/ans.99300.
19. Brodsky MB, Abbott KV, McNeil MR, Palmer CV, Grayhack JP, Martin-Harris B. Effects of divided attention on swallowing in persons with idiopathic Parkinson's disease. Dysphagia. 2012;27(3):390-400. http://doi.org/10.1007/s00455-011-9381-x. PMid:22197910.
20. Kim JS, Youn J, Suh MK, Kim TE, Chin J, Park S, et al. Cognitive and motor aspects of Parkinson's disease associated with dysphagia. Can J Neurol Sci. 2015;42(6):395-400. http://doi.org/10.1017/cjn.2015.304. PMid:26551089.
21. Labeit B, Claus I, Muhle P, Regner L, Suntrup-Krueger S, Dziewas R, et al. Effect of cognitive and motor dual-task on oropharyngeal swallowing in Parkinson's disease. Eur J Neurol. 2021;28(3):754-62. http://doi.org/10.1111/ene.14603. PMid:33084118.
22. Lee KD, Koo JH, Song SH, Jo KD, Lee MK, Jang W. Central cholinergic dysfunction could be associated with oropharyngeal dysphagia in early Parkinson's disease. J Neural Transm. 2015;122(11):1553-61. http://doi.org/10.1007/s00702-015-1427-z. PMid:26199040.
23. Miller N, Allcock L, Hildreth AJ, Jones D, Noble E, Burn DJ. Swallowing problems in Parkinson disease: frequency and clinical correlates. J Neurol Neurosurg Psychiatry. 2009;80(9):1047-9. http://doi.org/10.1136/jnnp.2008.157701. PMid:19028764.

24. Nienstedt JC, Buhmann C, Bihler M, Niessen A, Plaetke R, Gerloff C, et al. Drooling is no early sign of dysphagia in Parkinson′s disease. Neurogastroenterol Motil. 2018;30(4):e13259. http://doi.org/10.1111/nmo.13259. PMid:29178420.

25. Polychronis S, Dervenoulas G, Yousaf T, Niccolini F, Pagano G, Politis M. Dysphagia is associated with presynaptic dopaminergic dysfunction and greater nonmotor symptom burden in early drug-naïve Parkinson's patients. PLoS One. 2019;14(7):e0214352. http://doi.org/10.1371/journal.pone.0214352. PMid:31344030.

26. Reynolds H, Miller N, Walker R. Drooling in Parkinson's disease: evidence of a role for divided attention. Dysphagia. 2018;33(6):809-17. http://doi.org/10.1007/s00455-018-9906-7. PMid:29785679.

27. Troche MS, Okun MS, Rosenbek JC, Altmann LJ, Sapienza CM. Attentional resource allocation and swallowing safety in Parkinson's disease: a dual task study. Parkinsonism Relat Disord. 2014;20(4):439-43. http://doi.org/10.1016/j.parkreldis.2013.12.011. PMid:24444532.

28. Walker RW, Dunn JR, Gray WK. Self-reported dysphagia and its correlates within a prevalent population of people with Parkinson's disease. Dysphagia. 2011;26(1):92-6. http://doi.org/10.1007/s00455-010-9317-x. PMid:21127909.

29. Wang P, Wang B, Chen X, Xiong B, Xie FY, Wu S, et al. Six-year follow-up of dysphagia in patients with Parkinson's disease. Dysphagia. 2022;37(5):1271-8. http://doi.org/10.1007/s00455-021-10387-0. PMid:34826007.

30. Zhang SS, Ou RW, Chen XP, Yang J, Zhao B, Yuan XQ, et al. Correlative factors of cognitive dysfunction in PD patients: a cross-sectional study from Southwest China. Neurol Res. 2016;38(5):434-40. http://doi.org/10.1080/01616412.2016.1139320. PMid:27092858.

31. Massimo C, Biagio R, Giovanni C, Massimo C, Pasquale S, Andrea G, et al. Orofacial functions and chewing efficiency in elderly patients with Parkinson's disease rehabilitated with removable prostheses. Open Dent J. 2020;14(1):13-8. http://doi.org/10.2174/1874210602014010013.

32. Conceição RNS, Pereira ABCNG. Análise epidemiológica das internações hospitalares de pacientes com doença de Parkinson nos últimos 5 anos nas regiões brasileiras. Rev Saúde. 2022;13(1):61-6.

33. Hirsch L, Jette N, Frolkis A, Steeves T, Pringsheim T. The incidence of Parkinson's disease: a systematic review and meta-analysis. Neuroepidemiology. 2016;46(4):292-300. http://doi.org/10.1159/000445751. PMid:27105081.

34. Muhle P, Suntrup-Krueger S, Wirth R, Warnecke T, Dziewas R. Physiologische veränderungen, schluckstörungen, diagnostik und therapie. Z Gerontol Geriatr. 2019;52:279-89. http://doi.org/10.1007/s00391-019-01540-4. PMid:30968223.

35. Cereda E, Cilia R, Klersy C, Siri C, Pozzi B, Reali E, et al. Dementia in Parkinson's disease: is male gender a risk factor? Parkinsonism Relat Disord. 2016;26:67-72. http://doi.org/10.1016/j.parkreldis.2016.02.024. PMid:26952697.

36. Broadfoot CK, Abur D, Hoffmeister JD, Stepp CE, Ciucci MR. Research-based updates in swallowing and communication dysfunction in Parkinson disease implications for evaluation and management. Perspect ASHA Spec Interest Groups. 2019;4(5):825-41. http://doi.org/10.1044/2019_PERS-SIG3-2019-0001. PMid:32104723.

37. Potulska A, Friedman A, Królicki L, Spychala A. Swallowing disorders in Parkinson's disease. Parkinsonism Relat Disord. 2003;9(6):349-53. http://doi.org/10.1016/S1353-8020(03)00045-2. PMid:12853234.

38. Mamolar Andrés S, Santamarina Rabanal ML, Granda Membiela CM, Fernández Gutiérrez MJ, Sirgo Rodríguez P, Álvarez Marcos C. Trastornos de la deglución en la enfermedad de Parkinson. Acta Otorrinolaringol Esp. 2017;68(1):15-22. http://doi.org/10.1016/j.otorri.2016.02.001. PMid:27269197.

39. Costa EM. Caracterização do risco de disfagia em paciente com doença de Parkinson [Trabalho de conclusão de curso]. São Paulo: Departamento de Fonoaudiologia, Universidade Federal de São Paulo; 2021.

40. Freitas SEO, Santos HKMS, Nunes LMS, Belo LR, Coriolano MGWS. A disfagia grave é comum na Doença de Parkinson e ocorre mesmo nos estágios iniciais: um estudo prospectivo de Coorte. Distúrb Comun. 2018;30(3):620-2.

41. Zimmermann TS, Trindade GS, Silva MAOM, Brandão BC, Lourenção LG. Análise videofluoroscópica da deglutição de indivíduos com a Doença de Parkinson. Enfermagem Brasil. 2017;16(3):164-9. http://doi.org/10.33233/eb.v16i3.1150.

42. Rocha NP, Carreira EX, Prado ACA, Tavares F, Tavares M, Cardoso F, et al. Cognitive evaluation in Parkinson's disease: applying the Movement Disorder Society recommendations in a population with a low level of formal education. Arq Neuropsiquiatr. 2023;81(2):119-27. http://doi.org/10.1055/s-0042-1759761. PMid:36948198.

43. Litvan I, Goldman JG, Tröster AI, Schmand BA, Weintraub D, Petersen RC, et al. Diagnostic criteria for mild cognitive impairment in Parkinson's disease: Movement Disorder Society Task Force guidelines. Mov Disord. 2012;27(3):349-56. http://doi.org/10.1002/mds.24893. PMid:22275317.

44. Dubois B, Burn D, Goetz C, Aarsland D, Brown RG, Broe GA, et al. Diagnostic procedures for Parkinson's Disease Dementia: recommendations from the Movement Disorder Society Task Force. Mov Disord. 2007;22(16):2314-24. http://doi.org/10.1002/mds.21844. PMid:18098298.

45. Dalrymple-Alford JC, MacAskill MR, Nakas CT, Livingston L, Graham C, Crucian GP, et al. The MoCA: well-suited screen for cognitive impairment in Parkinson disease. Neurology. 2010;75(19):1717-25. http://doi.org/10.1212/WNL.0b013e3181fc29c9. PMid:21060094.

46. Labeit B, Berkovich E, Claus I, Roderigo M, Schwake A, Izgelov D, et al. Dysphagia for medication in Parkinson's disease. NPJ Parkinsons Dis. 2022;8(1):156. http://doi.org/10.1038/s41531-022-00421-9. PMid:36371409.

47. Castro E, Fonseca L, Matos JP, Bernardo T, Silva AP. Videoendoscopia da deglutição: protocolo de avaliação. Ver Port Otorrinolaringol Cir Cérvico-fac. 2012;50(3):197-204.

48. Anéas GCG, Dantas RO. A videofluoroscopia da deglutição na investigação da disfagia oral e faringeana. GE Port J Gastroenterol. 2014;21(1):21-5.

49. Costa MMB. Neural control of swallowing. Arq Gastroenterol. 2018;55(55, Suppl 1):61. PMid:30156597.

50. Yamada EK, Siqueira KO, Xerez D, Koch HA, Costa MMB. A influência das fases oral e faríngea na dinâmica da deglutição. Arq Gastroenterol. 2004;41(1):18-23. http://doi.org/10.1590/S0004-28032004000100004. PMid:15499419.

51. Fasano A, Visanji NP, Liu LWC, Lang AE, Pfeiffer RF. Gastrointestinal dysfunction in Parkinson's disease. Lancet Neurol. 2015;14(6):625-39. http://doi.org/10.1016/S1474-4422(15)00007-1. PMid:25987282.

52. Rana AQ, Khondker S, Kabir A, Owalia A, Khondker S, Emre M. Impact of cognitive dysfunction on drooling in Parkinson's disease. Eur Neurol. 2013;70(1-2):42-5. http://doi.org/10.1159/000348571. PMid:23711510.

53. Chou KL, Evatt M, Hinson V, Kompoliti K. Sialorrhea in Parkinson's disease: a review. Mov Disord. 2007;22(16):2306-13. http://doi.org/10.1002/mds.21646. PMid:17659637.

54. Ou R, Guo X, Wei Q, Cao B, Yang J, Song W, et al. Prevalence and clinical correlates of drooling in Parkinson disease: a study on 518 Chinese patients. Parkinsonism Relat Disord. 2015;21(3):211. http://doi.org/10.1016/j.parkreldis.2014.12.004. PMid:25537930.

55. Nicaretta DH, Rosso AL, Mattos JP, Maliska C, Costa MMB. Dysphagia and sialorrhea: the relationship to Parkinson's disease. Arq Gastroenterol. 2013;50(1):42-9. http://doi.org/10.1590/S0004-28032013000100009. PMid:23657306.