

The relationship between feeding and depression, independence and mental health in elderly

Relação entre aspectos alimentares e depressão, independência e estado mental em idosos

Relación entre aspectos alimentarios y depresión, independencia y estado mental en ancianos

Verônica Fernandes Ramos¹, Anderson Francisco Silva²,
Letícia Correa Celeste³, Melissa Picinato-Pirola⁴

1.Fonoaudióloga, Mestre. Universidade de Brasília (UnB), Faculdade de Ceilândia, Departamento de Fonoaudiologia. Brasília-DF, Brasil. Orcid: <https://orcid.org/0000-0002-9183-5278>

2.Fonoaudiólogo. Universidade de Brasília (UnB), Faculdade de Ceilândia, Departamento de Fonoaudiologia. Brasília-DF, Brasil. Orcid: <https://orcid.org/0000-0002-3260-5069>

3.Fonoaudióloga, Doutora. Professora Adjunta do curso de Pós-Graduação em Ciências da Reabilitação, Universidade de Brasília (UnB). Brasília-DF, Brasil. Orcid: <https://orcid.org/0000-0002-2384-3989>

4.Fonoaudióloga, Doutora. Professora Adjunta do curso de Fonoaudiologia da Faculdade de Ceilândia, Universidade de Brasília (UnB). Departamento de Fonoaudiologia. Brasília-DF, Brasil. Orcid: <https://orcid.org/0000-0001-5045-931X>

Resumo

Objetivo. Verificar se os aspectos alimentares e as funções orofaciais são influenciados pelo risco para depressão, dependência para realizar atividades de vida diária e estado mental em idosos. **Método.** Trata-se de um estudo observacional, transversal e analítico. Participaram do estudo 30 idosos com média de idade de 67,13 anos. Foi aplicado um questionário quanto as dificuldades durante a alimentação e foi realizada avaliação das funções de mastigação e deglutição por meio da aplicação do instrumento padronizado Protocolo de Avaliação Miofuncional Orofacial com Escores para Idosos. O dispositivo *Biofeedback* Pró-Fono: Pressão de Lábios e de Língua foi utilizado para avaliação da força de pressão de lábios e ponta e dorso de língua. Foram aplicadas a Escala de Atividades Instrumentais de Vida Diária, Escala de Depressão Geriátrica e o Mine-Exame do Estado Mental. **Resultados.** Foi encontrada relação significativa entre o risco para depressão geriátrica e autopercepção de aumento de tempo para mastigar, de dificuldade para deglutir e de alteração de apetite; e entre Atividades Instrumentais de Vida Diária e autopercepção de alteração de apetite. Não foi encontrada relação entre a força de lábios e língua e as escalas aplicadas. **Conclusão.** Idosos com risco para depressão geriátrica apresentaram autopercepção de aumento de tempo mastigatório, dificuldade durante deglutição e alteração de apetite. O declínio cognitivo decorrente do envelhecimento saudável, o risco para depressão geriátrica e maior dependência para realizar atividades de vida diária não foram associados a redução do desempenho das funções de mastigação e deglutição e força de pressão de lábios e língua.

Unitermos. Envelhecimento; Mastigação; Deglutição; Sistema Estomatognático; Testes de Estado Mental e Demência

Abstract

Objective. To verify whether the eating difficulties and/ or force of pressure on the lips and tongue can be influenced by the risk of depression, dependence and mental health of the elderly. **Method.** This is an observational, cross-sectional and analytical study. Thirty elderly people took part in the study with average age of 67.13 years. A questionnaire was given to the participants to ascertain if they experienced any eating difficulties, and an evaluation of masticatory and deglutitory functions was carried out by utilizing the standardized instrument Orofacial Myofunctional Evaluation with a Scores for Elders Protocol. An evaluation of the pressure strength of the lips, tip and back of the tongue was also performed using the Pro-

Fono Biofeedback Lips and Tongue Pressure device and the Instrumental Activities Of Daily Living Scale, Geriatric Depression Scale and the Mini-Mental State Examination. **Results.** A significant association was found between the risk of geriatric depression and a self-perceived increase in masticatory time, difficulty during deglutition and changes in appetite and between Instrumental Activities of Daily Living and self-perceived changes in appetite. No association was found between the strength of the lips and tongue of the scales applied. **Conclusion.** Elderly who had risk of geriatric depression had a self-perceived increase in masticatory time, difficulty during deglutition and changes in appetite. The cognitive decline resulting from healthy aging, the risk of geriatric depression and a more dependence during daily living activities didn't have association with reduced performance masticatory and deglutitory functions and lip and tongue pressure strength.

Keywords. Aging; Mastication; Deglutition; Stomatognathic System; Mental Status and Dementia Tests

Resumen

Objetivo. Verificar si los aspectos dietéticos y las funciones orofaciales están influenciadas por el riesgo de depresión, dependencia para realizar actividades de la vida diaria y estado mental en ancianos. **Método.** Se trata de un estudio observacional, transversal y analítico. Participaron del estudio 30 ancianos con una media de edad de 67,13 años. Se aplicó un cuestionario sobre las dificultades durante la alimentación y se realizó una evaluación de las funciones de masticación y deglución mediante la aplicación del instrumento estandarizado Orofacial Myofuncional Assessment Protocol with Scores for the Elderly. Se utilizó el dispositivo Biofeedback Pro-Fono: Presión de Labios y Lengua para evaluar la fuerza de presión de los labios y punta y dorso de la lengua. Se aplicaron la Escala de Actividades Instrumentales de la Vida Diaria, la Escala de Depresión Geriátrica y el Mine-Examen del Estado Mental.

Resultados. Se encontró una relación significativa entre el riesgo de depresión geriátrica y la autopercepción de mayor tiempo para masticar, dificultad para tragar y cambio de apetito; y entre las Actividades Instrumentales de la Vida Diaria y la autopercepción del cambio de apetito. No se encontró relación entre la fuerza de labios y lengua y las escamas aplicadas.

Conclusión. Las personas mayores con riesgo de depresión geriátrica tenían una autopercepción de mayor tiempo de masticación, dificultad para tragar y cambios en el apetito. El deterioro cognitivo debido al envejecimiento saludable, el riesgo de depresión geriátrica y una mayor dependencia para realizar las actividades de la vida diaria no se asociaron con un rendimiento reducido de las funciones de masticación y deglución y la fuerza de presión de los labios y la lengua.

Palabras clave. Envejecimiento; Masticación; Deglución; Sistema Estomatognático; Pruebas de Estado Mental y Demencia

Research developed at Universidade de Brasília (UnB), Faculdade de Ceilândia, Departamento de Fonoaudiologia. Brasília-DF, Brazil.

Conflict of interest: no

Received in: 11/22/2022

Accept in: 02/15/2023

Corresponding address: Melissa Picinato-Pirola. Faculdade de Ceilândia. Campus Universitário - Centro Metropolitano, Ceilândia Sul. Brasília-DF, Brazil. CEP 72220-275. Phone: +55 61 3107-8440. E-mail: melissapicinato@unb.br

INTRODUCTION

Healthy cognitive ageing is characterized by an absence of diseases that may develop some form of cognitive impairment¹, however there may be a cognitive decline such as the lowering of fluid intelligence², in addition to changes

in the performance of stomatognathic functions, such as mastication³ and deglutition⁴. For healthy ageing it is important to consider a persons life style and their stimulation throughout life and what kind of activities they did to keep their cognition active and their receptiveness to new ideas and concepts⁵.

Changes in the performance of mastication and deglutition may occur due to missing teeth⁶, reduced mobility and reduced muscle strength of orofacial structures⁷. Because of this there may well be a preference for foods with a softer consistency⁸.

Cognitive decline, risk of depression and dependency to perform day to day activities are risk factors for developing difficulties during mastication and deglutition and due to the increased need for help to perform daily activities, oral health may be compromised which consequently can lead to tooth loss⁹.

Elderly people who are in good health but lack adequate oral hygiene, according to self-perception, tend to have dental absences, consequently leading to further tooth loss and difficulties in mastication, which in turn may lead to a higher risk of depression and a decrease in socialization¹⁰. Oral health programs directed towards the elderly population are very important especially in light of the impact on social skills and mental health¹¹. These programs are effective and it is important that there is clarification, motivation and self awareness of oral hygiene to be effective and become habitual¹².

Difficulties in eating are factors that may lead to the development of depression in the elderly, because changes in masticatory performance may interfere with socialization and can result in the need to make compensations and adaptations such as preferences for softer foods^{13,14}. It is important for the elderly to have regular family meal times and elderly people who have the opportunity to eat at least three meals a day with other family members are less susceptible to depression. This shows the importance of socializing at mealtimes which helps maintain a healthy mental condition¹⁵.

Elderly people who have cognitive decline tend to have lower tongue pressure strength and less motor ability of this structure, suggesting that the integrity of orofacial structures and stomatognathic functions are related to higher levels of mental status. This result was found in another study that verified the relationship between oral motor skills, tongue pressure, the masticatory function and the mental condition of healthy elderly people¹⁶.

As explained, the literature points to a relationship between the risk of geriatric depression, mental condition and reduced independence in performing day to day activities and the functions of mastication, deglutition and the associated difficulties of the elderly in performing these functions due to missing teeth caused by poor oral hygiene⁹. Currently there are no studies that demonstrate the association of these variables with the clinical assessment of masticatory and deglutitory functions, standardized by

protocols and with the self-perception of difficulties during eating. The objective of this study is to verify whether dietary aspects and orofacial functions are influenced by the risk of depression, and dependency to perform day to day activities and the mental condition of the elderly.

METHOD

Sample

To define the sample size, were used the GPower software and the independent Student t-test which. A pilot sample size of 50 (25 seniors and 25 young adults) was considered, using the obtained mean and standard deviation values. The significance level was 0.05 and power of the test were 80%. The sample size defined was 30 seniors and 30 young adults, according the test applied. To this study, was considered and analyzed the data only of the seniors.

Participants had to be over 60 years old as part of the inclusion criteria, regardless of tooth loss and or had to wear partial or complete dentures or have dental implants. People with motor disorders, intellectual difficulties, neurological changes, toothache or orofacial pain and who were undergoing surgical procedures or had suffered trauma to the head and neck were excluded from the study. The data was verified by observational evaluation and during anamnesis through reports by the participants. According to the inclusion and exclusion criteria mentioned above, 30 elderly people were selected to participate in the study, 15 women and 15 men, with a average age of 67.13 years.

This is an observational, cross-sectional, analytical study, approved by the Research Ethics Committee of the Faculty of Ceilandia (CEP/FCE), number 2.380.411, CAAE 74811317.5.0000.8093. All participants who agreed to participate in the study and who met the inclusion criteria signed a consent form.

Procedure

Data collection was carried out at the Human Communication and Orofacial Functions Laboratory of the Speech Therapy course at the Faculty of Ceilândia, University of Brasilia.

At first, an anamnesis was performed using a semi-structured questionnaire given out by the researchers. The participants were asked questions regarding difficulties eating and the participants had to rate their own masticatory function and self-perception of their degree of independence on a scale of 1 to 10 points, the higher the score the better the classification (Figure 1).

The following methods were used because they are standardized for the elderly:

- The Instrumental Activities of Daily Living Scale (IADL)¹⁷ was used to verify the degree of independence of the elderly, classified as totally dependent, severely dependent, moderately dependent, mildly dependent and independent, defined according to the sum of the scores corresponding to the responses of the participants.

- The Geriatric Depression Scale (GDS)¹⁸ is a screening test that is used to identify symptoms of depression in older adults. The scale is a 15-item, self-report instrument that uses a "Yes/No" format. The responses considered to be at risk of depression are known as "d" responses, and the greater the number of these responses, the greater the risk of depression.

Figure 1. Elderly person's questionnaire.

1.	Tooth Loss						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
2.	Do you wear dentures?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
3.	Food consistency preferences						
<input type="checkbox"/>	soft	<input type="checkbox"/>	creamy	<input type="checkbox"/>	liquid	<input type="checkbox"/>	no preferences
4.	Do you experience pain when chewing?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
5.	Do you have difficulties when chewing?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
6.	Does it currently take you longer to chew?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
7.	Do you have difficulties swallowing?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
8.	Do you become tired when eating?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
9.	Have you lost weight during the last 12 months?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
10.	Does it take you longer to eat at meal times?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
11.	Have you experienced any changes in appetite?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
12.	Have you experienced a change in your sensation of taste?						
<input type="checkbox"/>	yes	<input type="checkbox"/>	no				
13.	On a scale of 1-10 (1 being the minimum and 10 being the maximum. Active and independent), do you consider yourself to be a healthy person, typically active and independent?						
14.	On a scale of 1-10, how do you rate your chewing, the higher the score, the better your ability to chew?						

- The Mini-Mental State Examination (MMSE)¹⁹ is a 30-point questionnaire that is used to measure cognitive impairment, through tests of temporal and spatial orientation, immediate memory, attention and calculation, recall memory and language. The score is analyzed according to the education of the participant, the higher the score the better the mental state of the participant. Table 1 shows the reference values adopted for the analysis of the level of education and the expected result in the test.

Table 1. MMSE cut off score according to educational level.

Educational level / years of study	Cut off score
Illiterate	<20
1 to 4 years	<25
5 to 8 years	<26.5
9 to 11 years	<28
Greater than 11 years	<29

During the assessment participants remained seated in a chair with a backrest and with their feet flatly on the floor. They were filmed using an iPhone 7 with a 12 MP camera. The phone was mounted on a tripod and positioned in front of the participant at a distance of 1 meter. The height of the tripod was adjusted to focus on the participant's face, neck and shoulders.

To evaluate masticatory and deglutitory functions the Orofacial Myofunctional Evaluation with Scores for Elders

Protocol (OMES-ELDERS)²⁰ was used, with a maximum score of 18 points for mastication and 32 points for deglutition. Each participant was given a Maizena® biscuit (Marilan, Marília, São Paulo, Brazil) and asked to chew the biscuit as normal.

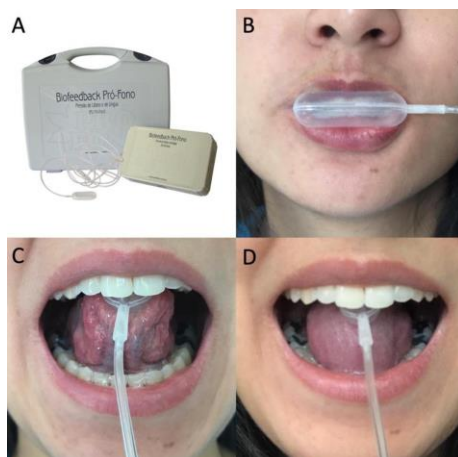
An analysis of 25% of the results obtained from the masticatory function evaluation was conducted by two trained researchers. Agreement between them was verified, in order to check the reliability of the clinical evaluation.

The Biofeedback Pro-Fono device: Lip and Tongue Pressure (PLL Pro-Fono) was used to check the force of pressure of the lip and the tip and back of the tongue. This equipment has an air bulb device, connected to a pressure sensor by means of a flexible plastic tube, and is used to measure the pressure force of the lips and tongue. This sensor converts the air changes that occur inside the bulb into pressure signals which can be measured in Kilo Pascal (kPa).

To measure force of pressure on the tip and back of the tongue, the bulb was positioned in the alveolar region and in the region at the back of the tongue respectively, then the tongue pressed against the hard palate. To check the pressure of the lips, the bulb was positioned between the lips and pressure was exerted against the bulb (Figure 2). For each evaluated structure, pressure was applied for three seconds, at three different moments, with an interval of 30 seconds between each one, timed by means of a digital timer²¹. Afterwards, a graph was generated showing the

pressure values of each area and the average of the values of the three measurements.

Figure 2. Evaluation of the force of pressure of the lips, tip and dorsum of the tongue. A: PLL Pró-Fono Device (Pró-Fono, 2016); B: Lip pressure; C: Tongue tip pressure; D: Back of tongue pressure.



Statistical Analysis

Descriptive statistical analysis was calculated for all variables and expressed as a percentage for categorical variables and as an mean, median and standard deviation for numeric variables.

To verify the association between the independent qualitative variables shown in Figure 1; the quantitative variables total masticatory score; total deglutitory score and the dependent variables IADL, risk for geriatric depression and mental state, Fisher's Exact Test were used for categorical variables and the Kruskal-Wallis Test for quantitative variables. A simple log-binomial regression model was used to relate the pressure force of the tip and

the back of the tongue and the lips with the IADL, GDS and MMSE scales.

The Kappa coefficient was used to verify the agreement of the analysis of 25% of the sample total, considering the evaluation of the masticatory function. Values between 0.81 and 1.00 were found, indicating an almost perfect concordance force.

The statistical analysis was carried out using SAS 9.2 software with a significance level of 5%.

RESULTS

According to the GDS and IADL scales, it can be seen that 83.3% of the elderly are not at risk of depression and the same percentage were considered as independent. According to the MMSE, an average of 24.43 points were found and the average number of educational years was 8.83 (high schooling), demonstrating that the participants studied were below the standardized values (Table 2).

A significant association was found between the risk of depression and the self-perception of increased masticatory time; self-perception of difficulty in deglutition; and self-perception of altered appetite. A significant association was also found between increased dependence in performing day to day activities and self-perceived changes in appetite (Table 3).

Table 4 represents the analysis of the association between the force of pressure of the lips and tongue and the IADL, GDS and MMSE scales.

Table 2. Descriptive analysis of the GDS, IADL, MMSE scales and education of the participants.

Scale	%
GDS	
No risk of depression (1-4 points)	83.3
Strong possibility of depression (5-9 points)	13.3
Real indication of depression (10 or more points)	3.3
IADL	
Independent (26-27 points)	83.3
Slight dependency (21-25 points)	13.3
MMSE	
M: 24.43	
MD: 25.00	
DP: 3.093	
Years of study	
M: 8.83	
MD: 11.00	
DP: 3.81	

IADL: Activities of daily living; GDS: Geriatric Depression Scale; DP: Standard Deviation; M: Mean; MD: Median; MMSE: Mini-Mental State Exam.

No significant association were found for any analysis performed, demonstrating that dependence, risk of depression and dementia are independent of the force of pressure of the tip and back of the tongue and lips.

DISCUSSION

The objective of this study was to verify by carrying out standardized tests if eating difficulties such as a reduction in masticatory and deglutitory performance or reduced force of pressure of the lips and tongue can be an influenced by the risk of depression, dependence and the mental state of the elderly. According to the analysis of the results obtained to realize the objective of the study, relevant data was found which is consistent with other studies on the subject and will be presented and analyzed below.

Table 3. Association between the IADL, GDS and MMSE scales and the questions in the questionnaire (Figure 1) and the masticatory and deglutition functions.

		IADL	GDS	MMSE
Food Consistency	Soft – 26.7% No Restrictions – 73.3%	0.31	0.49	0.65
Dental absences	Yes – 43.3% No – 56.7%	0.29	0.99	0.36
Dental prostheses	Yes – 86.7% No – 13.3%	0.12	0.54	0.17
Pain during mastication	Yes – 6.7% No – 93.3%	0.31	0.31	0.99
Difficulties during mastication	Yes – 20% No – 80%	0.99	0.99	0.99
Self-perception of an increase in masticatory time	Yes – 43.3% No – 56.7%	0.18	<0.01*	0.67
Do you have difficulties during deglutition?	Yes – 10% No – 90%	0.43	0.03*	0.50
Does eating make you feel tired?	Yes – 3.3% No – 96.7%	0.17	0.17	0.99
Did you loose any weight in the last 12 months?	Yes – 6.7% No – 93.3%	0.99	0.99	0.99
Do you take longer eating meals?	Yes – 20% No – 80%	0.13	0.13	0.30
Have you experienced any changes in your appetite?	Yes – 30% No – 70%	<0.01*	<0.01*	0.64
Have you experienced any changes in the sensation of taste?	Yes – 23.3% No – 76.7%	0.07	0.42	0.12
Self-perception of independence	M: 8.30 MD: 8.00 DP: 1.368	0.45	0.52	0.56
Self-perception of masticatory function	M: 7.13 MD: 7.50 DP: 1.795	0.48	0.43	0.20
Total masticatory score	M: 15.13 MD: 26.14 DP: 15.20	0.54	0.72	0.85
Total deglutitory score	M: 26.87 MD: 26.50 DP: 1.98	0.82	0.32	0.77

IADL: Activities of daily living; GDS: Geriatric Depression Scale; SD: Standard Deviation; M: Mean; MD: Median; MMSE: Mini-Mental State Exam. Test used for statistical analysis: Fisher's Exact Test for qualitative variables and the Kruskal Wallis Test for quantitative variables.

Table 4. Association between the force of pressure of the lips and tongue and the scales IADL, GDS e MMSE.

Variables	IADL			GDS			MMSE		
	Dependency/ Independence	SD	p	Risk/ No presence of risk	SD	p	Dementia/ no presence of dementia	SD	p
Pressure force at the tip of the tongue	18.06 31.70	12.57 19.61	0.17	33.07 28.70	24.35 18.47	0.62	30.63 24.62	20.42 13.21	0.52
Pressure force at the back of the tongue	35.91 36.57	18.00 21.66	0.95	41.76 35.40	21.31 20.98	0.53	35.52 40.22	19.80 26.20	0.67
Pressure force of the lips	26.22 25.70	13.51 15.78	0.95	21.34 26.71	7.88 16.27	0.50	23.74 33.65	14.52 16.47	0.18

IADL: Activities of daily living; GDS: Geriatric Depression Scale; SD: Standard Deviation; M: Mean; MD: Median; MMSE: Mini-Mental State Exam. Test used for statistical analysis: Simple log-binomial regression model.

The IADL test was carried out in order to verify the degree of independence of the participants studied and it was found that 13.3% of the elderly are mildly dependent and only 3.3% are moderately dependent. These findings agree with other study²², which found that an increase in age results in an increase in dependence for help in performing day to day activities. The most pronounced increase in dependency which is classified as moderate to severe, occurs from the age of 90. The average age of the participants in the study was 67.13, which accounts for only mild to moderate dependence, and a lower prevalence, in the participants studied, this study did not assess people older than the average participant age of the study.

According to the MMSE the values of the participants studied were below the standardized values. This low value can be explained as a result of normal healthy ageing. There will be a reduction in fluid intelligence, which is characterized

by the ability to solve new problems immediately² and also a reduction in working memory, leading to a decrease in the syntactic complexity of written production²³. On the other hand, other areas improved, such as the understanding of language, vocabulary and general knowledge on various topics, according to the life experience of the person².

According to the analysis of the association between eating difficulties and the IADL, GDS and MMSE scales, a significant association was found between risk of depression and self-perception of increased masticatory time and difficulty during deglutition. It was also found that 26.7% of the elderly had a preference for softer foods. This finding demonstrates that in view of these eating difficulties, the elderly may need to make adaptations, such as preferences for softer foods leading to a higher occurrence of depressive symptoms, corroborating the findings of other studies^{13,14}. Meal times should be pleasant and be an opportunity for socializing, external factors that imply constraints and changes in this process can lead to a reduction in the psychosocial well-being of the elderly¹⁵, justifying the association found in this study.

A significant association was also found between self-perceived loss of appetite and the risk for geriatric depression and reduced independence in performing day to day activities. This data corroborates existing studies because decreased appetite is frequent in people with depression²⁴ and a decline in independence in performing day to day activities is directly related to depressive

symptoms, demonstrating that mental health care can guarantee greater independence for the elderly²⁵.

With ageing performance in mastication³ and deglutition⁴ is reduced. This study supports the association between the aforementioned functions, the force of pressure at the tip and the back of the tongue and lips and the IADL, GDS and MMSE scales. No other significant association was found and in addition it was also found that 43.3% of the elderly have dental absences and that 86.7% wore dental prostheses. This data corroborates the findings of a study which was carried out in Japan²⁶, demonstrating that the cognitive decline resulting from healthy ageing alone does not account for a reduction in the masticatory³ and deglutitory performance⁴ and in the reduction of strength of lips and tongue²⁷, but external factors, such as tooth loss, the wearing of dentures⁶, poor oral hygiene¹⁰ and consequently a preference for food with a softer consistency^{8,13,28}.

Elderly people who have dental absences can benefit greatly from wearing a dental prostheses because they will have better dental occlusion and consequently the masticatory function will be improved^{3,26}. However, when comparing the elderly with natural dentition and those who have undergone some form of prosthetic rehabilitation, it was found that the second group had more problems, such as denture instability during mastication which consequently reduced the performance of this function²⁹. The findings of these studies reinforce the importance of prevention

programs, which must be based on the clarification and importance of oral health care on a regular basis, so that they may attain their proposed objectives¹².

Speech therapy aims to improve the performance of stomagnatic functions and strengthen orofacial structures⁸. Early intervention by the speech therapist with elderly people who suffer from eating difficulties can contribute to an improvement in quality of life and make eating a more pleasurable experience²⁸. One of the jobs of the speech therapist is the stimulation of the masticatory function, which is important to maintain cognition in the elderly, because during the process of food mastication there is greater blood oxygenation of the prefrontal cortex and the hippocampus, essential regions for learning and memory³⁰.

One of the limitations of the study was the heterogeneity of the elderly sample, due to the difficulty of finding a number of people with the same characteristics and that fitted within all the inclusion criteria and who accepted to participate in the research, making it impossible to divide into subgroups. However, the data was consistent with other studies. The association between cognitive decline and reduced chewing and swallowing performance could not be seen due to the average age of the elderly which was very close to 60. If a group of elderly people with a higher average age were considered, some significant association could have been found.

CONCLUSION

Elderly who had risk of geriatric depression had a self-perceived increase in masticatory time, difficulty during deglutition and changes in appetite. The cognitive decline resulting from healthy aging, the risk of geriatric depression and a more dependence during daily living activities didn't have association with reduced performance masticatory and deglutitory functions and lip and tongue pressure strength, suggesting influence by factors related to ageing.

REFERENCES

1. Li S-C, Schmiedek F, Huxhold O, Röcke C, Smith J, Lindenberger U. Working memory plasticity in old age: practice gain, transfer, and maintenance. *Psychol Aging* 2008;23:731. <https://doi.org/10.1037/a0014343>
2. Salthouse TA. When does age-related cognitive decline begin? *Neurobiol Aging* 2009;30:507-14. <https://doi.org/10.1016/j.neurobiolaging.2008.09.023>
3. Ramos VF, Silva AF, Picinato-Pirola M. Masticatory function in elderly compared to young adults. *CoDAS* 2022;34:e20200364. <https://doi.org/10.1590/2317-1782/20212020364>
4. Okamoto N, Morikawa M, Yanagi M, Amano N, Tomioka K, Hazaki K, *et al.* Association of tooth loss with development of swallowing problems in community-dwelling independent elderly population: the Fujiwara-kyo study. *J Gerontol A Biomed Sci Med Sci* 2015;70:1548-54. <https://doi.org/10.1093/gerona/glv116>
5. Shafto MA, Henson RN, Matthews FE, Taylor JR, Emery T, Erzinclioglu S, *et al.* Cognitive Diversity in a Healthy Aging Cohort: Cross-Domain Cognition in the Cam-CAN Project. *J Aging Health* 2020;32:1029-41. <https://doi.org/10.1177/0898264319878095>
6. Baumgarten A, Schmidt JG, Rech RS, Hilgert JB, Goulart BNG. Dental status, oral prosthesis and chewing ability in an adult and elderly population in southern Brazil. *Clin (Sao Paulo)* 2017;72:681-5. [http://doi.org/10.6061/clinics/2017\(11\)06](http://doi.org/10.6061/clinics/2017(11)06)
7. Rech RS, Baumgarten A, Colvara BC, Brochier CW, Goulart B, Hugo FN, *et al.* Association between oropharyngeal dysphagia, oral functionality, and oral sensorimotor alteration. *Oral Dis* 2018;24:664-72. <https://doi.org/10.1111/odi.12809>
8. Lima R, Amaral A, Aroucha E, Vasconcelos T, Silva H, Cunha D. Chew, deglutition and speech adaptations in aged people at a long

- permanence institution. Rev CEFAC 2009;11:405-22. <http://dx.doi.org/10.1590/S1516-18462009000700017>
9. Kimura Y, Wada T, Ishine M, Ishimoto Y, Kasahara Y, Konno A, *et al.* Food diversity is closely associated with activities of daily living, depression, and quality of life in community-dwelling elderly people: Letters to the editor. J Am Geriatr Soc 2009;57:922-4. <https://doi.org/10.1111/j.1532-5415.2009.02235.x>
10. Cho MJ, Kim EK. Subjective chewing ability and health-related quality of life among the elderly. Gerodontology 2019;36:99-106. <https://doi.org/10.1111/ger.12385>
11. Duque AD, Malheiros Z, Stewart B, Romanelli HJ. Strategies for the prevention of periodontal disease and its impact on general health in Latin America. Section III: Prevention. Braz Oral Res 2020;34(suppl 1):e025. <https://doi.org/10.1590/1807-3107bor-2020.vol34.0025>
12. Carvajal P. Periodontal disease as a Public Health problem: the challenge for Primary Health Care. Rev Clín Period Implantol Rehab Oral 2016;9:177-83. <https://doi.org/10.1016/j.piro.2016.07.001>
13. Yamamoto T, Aida J, Kondo K, Fuchida S, Tani Y, Saito M, *et al.* Oral Health and Incident Depressive Symptoms: JAGES Project Longitudinal Study in Older Japanese. J Am Geriatr Soc 2017;65:1079-84. <https://doi.org/10.1111/jgs.14777>
14. Wright FA, Law GG, Milledge KL, Chu SKY, Hsu B, Valdez E, *et al.* Chewing function, general health and the dentition of older Australian men: The Concord Health and Ageing in Men Project. Community Dentistr Oral Epidemiol 2019;47:134-41. <https://doi.org/10.1111/cdoe.12435>
15. Kang Y, Kang S, Kim KJ, Ko H, Shin J, Song Y-M. The Association between Family Mealtime and Depression in Elderly Koreans. Kor J Fam Med 2018;39:340. <https://doi.org/10.4082/kjfm.17.0060>
16. Kugimiya Y, Ueda T, Watanabe Y, Takano T, Edahiro A, Awata S, *et al.* Relationship between mild cognitive decline and oral motor functions in metropolitan community-dwelling older Japanese: The Takashimadaira study. Arch Gerontol Geriatr 2019;81:53-8. <https://doi.org/10.1016/j.archger.2018.11.008>
17. Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. Gerontologist 1969;9:179-86. <https://pubmed.ncbi.nlm.nih.gov/5349366/>
18. Paradela EMP, Lourenço RA, Veras RP. Validation of geriatric depression scale in a general outpatient clinic. Rev Saúde Públ 2005;39:918-23. <https://doi.org/10.1590/s0034-89102005000600008>
19. Brucki SM, Nitrini R, Caramelli P, Bertolucci PH, Okamoto IH. Suggestions for utilization of the mini-mental state examination in Brazil. Arq Neuropsiquiatr 2003;61:777-81. <http://dx.doi.org/10.1590/S0004-282X2003000500014>
20. Felício CMD, Lima MdRF, Medeiros APM, Ferreira JTL. Orofacial Myofunctional Evaluation Protocol for older people: validity, psychometric properties, and association with oral health and age.

- CoDAS 2017;29:e20170042. <http://doi.org/10.1590/2317-1782/20172017042>
21. Clark HM, Solomon NP. Age and sex differences in orofacial strength. *Dysphagia* 2012;27:2-9. <https://doi.org/10.1007/s00455-011-9328-2>
22. Zunzunegui MV, Nunez O, Durban M, de Yébenes M-JG, Otero Á. Decreasing prevalence of disability in activities of daily living, functional limitations and poor self-rated health: a 6-year follow-up study in Spain. *Aging Clin Exp Res* 2006;18:352-8. <https://doi.org/10.1007/BF03324830>
23. Kemper S, Marquis J, Thompson M. Longitudinal change in language production: effects of aging and dementia on grammatical complexity and propositional content. *Psychol Aging* 2001;16:600-14. <https://doi.org/10.1037/0882-7974.16.4.600>
24. Lee JS, Kritchevsky SB, Tylavsky F, Harris TB, Ayonayon HN, Newman AB. Factors associated with impaired appetite in well-functioning community-dwelling older adults. *J Nutr Elderly* 2007;26:27-43. https://doi.org/10.1300/J052v26n01_02
25. Kiyoshige E, Kabayama M, Gondo Y, Masui Y, Inagaki H, Ogawa M, *et al.* Age group differences in association between IADL decline and depressive symptoms in community-dwelling elderly. *BMC Geriatr* 2019;19:309. <https://doi.org/10.1186/s12877-019-1333-6>
26. Ikebe K, Matsuda K, Kagawa R, Enoki K, Yoshida M, Maeda Y, *et al.* Association of masticatory performance with age, gender, number of teeth, occlusal force and salivary flow in Japanese older adults: is ageing a risk factor for masticatory dysfunction? *Arch Oral Biol* 2011;56:991-6. <https://doi.org/10.1016/j.archoralbio.2011.03.019>
27. Park JS, You SJ, Kim JY, Yeo SG, Lee JH. Differences in orofacial muscle strength according to age and sex in East Asian healthy adults. *Am J Phys Med Rehabil* 2015;94:677-86. <https://doi.org/10.1097/PHM.0000000000000230>
28. Oliveira B, Delgado S, Brescovici S. Changes of mastication and swallowing in the process of feeding institutionalized elderly. *Rev Bras Geriatr Gerontol* 2014;17:575-87. <http://dx.doi.org/10.1590/1809-9823.2014.13065>
29. Ayres A, Teixeira A, Martins M, Gonçalves A, Olchik M. Analysis of the Stomatognathic System Functions in Aged Denture Wearers. *Rev Bras Ciênc Saúde* 2016;20:99-106. <https://pesquisa.bvsalud.org/portal/resource/pt/lil-789422>
30. Miyake S, Wada-Takahashi S, Honda H, Takahashi SS, Sasaguri K, Sato S, *et al.* Stress and chewing affect blood flow and oxygen levels in the rat brain. *Arch Oral Biol* 2012;57:1491-7. <https://doi.org/10.1016/j.archoralbio.2012.06.008>