UNIVERSIDADE ESTADUAL DE CAMPINAS
FACULDADE DE ODONTOLOGIA DE PIRACICABA

MARIANA DOS SANTOS FERNANDES LOPES

RELAÇÕES DAS FUNÇÕES OROFACIAIS COM A COGNIÇÃO, MEDIDAS ANTROPOMÉTRICAS E A POLIFARMÁCIA NO IDOSO

RELATIONSHIPS OF OROFACIAL FUNCTIONS WITH A COGNITION, ANTHROPOMETRIC MEASURES AND A POLYPHARMACY IN THE ELDERLY

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Tese apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual de Campinas como parte dos requisitos exigidos para a obtenção do título de Doutora em Biologia Buco-Dental, na área de Anatomia.

Thesis presented to the Piracicaba Dental School of the University of Campinas in partial fulfillment of the requirements for the degree of Doctor in Oral Biology, in Anatomy area.

Orientadora: Profa. Dra. Maria Beatriz Duarte Gavião

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RESUMO

A expectativa de vida da população aumentou, assim como o interesse no estudo dos agravos à saúde. O objetivo desta pesquisa, de caráter descritivo-observacional, foi avaliar se com o envelhecimento as alterações na função mastigatória estaria relacionada com a sensibilidade orofacial, cognição e medidas antropométricas, além de verificar se a polifarmácia influencia o fluxo salivar e os sintomas de disfagia, xerostomia e paladar. A amostra foi composta de 204 idosos (81 homens – 123 mulheres) referenciados ao Centro de Saúde Escola da Faculdade de Medicina da Fundação ABC (Unidade Básica de Saúde "Capuava"). A pesquisa foi apresentada em dois capítulos. No primeiro, intitulado "Relationship between masticatory function, oral health, nutritional and cognitive status in the elderly" as variáveis analisadas foram: perfil sócio-econômico, índice de massa corporal (IMC), circunferência de braço e perna, performance mastigatória e comportamento mastigatório (QAQM), força de mordida, sensibilidade oral (QST e DDP) e cognição. Foi realizada análise de agrupamento (*cluster*) que apontou a presença de dois perfis, um com 180 pacientes que corresponderam aos com pior quadro e um segundo, com 24, que foram àqueles com melhores parâmetros. Para análise do efeito da mastigação na cognição e no IMC foram ajustados modelos de regressão linear múltipla. Para a cognição, as mulheres apresentaram esse escore menor e a idade demonstrou efeito negativo. A escolaridade e o QST superior apresentaram efeito positivo e as demais variáveis não demonstraram significância. Para o IMC, observou-se efeitos significativos somente para idade, QAQM Frutas e CPOD, de maneira que o IMC tendeu a diminuir com o aumento dessas variáveis. Assim, pode-se observar a relação da saúde bucal para a manutenção de bons parâmetros de saúde geral, uma vez que houve relação da diminuição do IMC com o aumento do CPOD, bem como a observação de melhores parâmetros mastigatórios e antropométricos em um grupo menor. No segundo capítulo, "An overview of the relationship between polypharmacy, xerostomia, dysphagia, and taste in the elderly", foram avaliados os efeitos da polifarmácia no fluxo salivar, gustação, sintomas de disfagia (EAT-10) e xerostomia. Foram utilizados os testes Qui-quadrado, Mann-Whitney, Correlação de Spearman, Two-way ANOVA e ANCOVA e regressão de Poisson. A análise de variância não demonstrou efeito significativo da polifarmácia, do sexo e da interação entre os dois. A análise da

covariância demonstrou efeito significativo do sexo para a taxa de fluxo salivar e paladar, em que os homens apresentaram maior fluxo e menores pontuações para o sabor. A polifarmácia mostrou significância na disfagia e xerostomia, com maiores queixas entre idosos classificados com polifarmácia. Não houve significância entre sexo e polifarmácia. A mesma abordagem foi aplicada ao efeito de drogas xerogênicas e sexo em cada variável clínica, usando ANCOVA e controlando para a idade e nenhum efeito foi encontrado. Concluiu-se que a polifarmácia está associada à xerostomia e disfagia nos idosos, principalmente nas mulheres e a utilização de medicamentos xerogênicos não demonstrou significância estatística; as mulheres apresentaram paladar mais acurado, apesar de possuírem menor fluxo quando comparadas aos homens.

Palavras-Chave: Mastigação, Idoso, Xerostomia, Transtornos de Deglutição, Polimedicação.

ABSTRACT

The life expectancy of the population increased, as did the interest in the study of health problems. The objective of this descriptive-observational study was to evaluate whether aging with changes in masticatory function would be related to orofacial sensitivity, cognition and anthropometric measurements, as well as to verify if polypharmacy influences salivary flow and symptoms of dysphagia, xerostomia and taste. The sample consisted of 204 elderly people (81 men - 123 women) referred to the School Health Center of the Faculty of Medicine of the ABC Foundation (Basic Health Unit "Capuava"). The research was presented in two chapters. The first one, entitled "Relationship between masticatory function, oral health, nutritional and cognitive status in the elderly" The variables analyzed were: socioeconomic profile, body mass index (BMI), arm and leg circumference, masticatory performance and masticatory behavior (QMFQ), bite force, oral sensitivity (QST and TPD) and cognition. A cluster analysis was performed, which showed the presence of two profiles, one with 180 patients that corresponded to the worst and one with 24, which were those with the best parameters. For the analysis of the chewing effect on cognition and BMI, multiple linear regression models were fitted. For cognition, women had this lower score and age showed a negative effect. Schooling and upper QST presented a positive effect and the other variables did not show any significance. For BMI, significant effects were observed only for age, QMFQ Fruits and DMFT, so that BMI tended to decrease with the increase of these variables. Thus, it is possible to observe the importance of preserving oral health for the maintenance of good general health parameters, since there was a relation between the decrease in BMI and the increase in DMFT, as well as the observation of better masticatory and anthropometric parameters in one minor group. In the second chapter, "An overview of the relationship between polypharmacy, xerostomia, dysphagia, and taste in the elderly", salivary flow, taste, symptoms of dysphagia (EAT-10) and xerostomia were evaluated. The Chi-square, Mann-Whitney, Spearman Correlation, Two-way ANOVA and ANCOVA and Poisson regression tests were used to evaluate the effects of polypharmacy on the salivary flow, EAT-10, xerostomia and taste. Analysis of variance showed no significant effect of polypharmacy, gender and interaction between the two. The analysis of covariance

showed a significant effect of sex on salivary flow rate and taste, in which men presented higher flow and lower scores for flavor. Polypharmacy showed significance in dysphagia and xerostomia, with greater complaints among elderly individuals classified with polypharmacy. There was no significance difference between sex and polypharmacy. The same approach was applied to the effect of xerogenic drugs and sex in each clinical variable, using ANCOVA and controlling for age and no effect was found. It was concluded that polypharmacy is associated with xerostomia and dysphagia in the elderly, especially in women, and the use of xerogenic drugs was not significant. Moreover, women presented more accurate palate, despite having a lower flow when compared to men.

Key words: Mastication, Elderly, Xerostomia, Deglutition Disorders, Polypharmacy.

SUMÁRIO

1 INTRODUÇÃO

Com os avanços tecnológicos, principalmente na área médica e com as melhorias em saneamento básico, a população está vivendo mais e envelhecendo com possibilidade de melhor qualidade de vida. A Organização Mundial da Saúde caracteriza como idosos, em países em desenvolvimento, pessoas acima de 60 anos e considera importante a elaboração de políticas públicas que visem a projeção deste grupo, pois acreditam que “em todos os países, medidas para ajudar os idosos a permanecer saudáveis e ativos são uma necessidade, não um luxo” (WHO, 2002).

Para o Brasil, mesmo sendo considerado um país relativamente jovem, os dados do IBGE apontam que entre 2012 e 2016 a população idosa cresceu 16%, chegando a 29,6 milhões de pessoas (IBGE, 2017). Hoje nos deparamos com idosos mais ativos e saudáveis que há 20 anos atrás, porém deve-se lembrar que tal grupo é mais susceptível a problemas crônicos de saúde e podem apresentar múltiplas doenças. Sendo assim, a busca por melhores atendimentos em saúde faz-se necessário e isso só é possível quando há o entendimento das alterações funcionais inerentes aos idosos.

Neste contexto, a saúde oral exerce papel relevante na integralidade da saúde geral. Mesmo sendo clichê, a afirmativa “A saúde começa pela boca” não nega a respectiva relevância. A digestão se inicia na cavidade bucal pelo processo da mastigação, que consiste na degradação do alimento em partículas menores e juntamente com a saliva participam da formação do bolo alimentar, de modo a propiciar a deglutição confortável e saudável. A manutenção da saúde oral, para o desenvolvimento de uma boa qualidade de vida é indispensável. A preservação das estruturas dentárias e periodontais são essenciais para a execução das funções de forma adequada (Gil-Montoya et al., 2015; Coco et al., 2018; Morita et al., 2018); infelizmente tal informação não é bem difundida à população e a perda dentária ainda considerada um fator de normalidade. A desinformação e falta de políticas que incentivem a prevenção em saúde bucal na população de um modo geral é o reflexo disso e a prevenção possibilitaria a população preservar seus dentes para uma idade mais avançada.

As diversas alterações fisiológicas devem ser apreciadas com rigor, além de serem exploradas também suas possíveis relações. Sabe-se que ocorre um declínio

das funções no idoso e que tais funções (como por exemplo mastigação, deglutição e paladar) são complementares umas às outras e são dependentes da secreção salivar. Também se conhece que pode haver interferências medicamentosas no fluxo salivar e paladar. Tais interações podem acometer a nutrição do idoso e com isso gerar déficits nutricionais e como consequência, déficits cognitivos. Assim este trabalho aborda separadamente a importância de diferentes condições.

Padrões mastigatórios e cognição

A mastigação é um processo dinâmico e complexo que possui inúmeras variáveis, dentre elas: a força de mordida aplicada sobre os alimentos; a quantidade de dentes envolvidos nesse processo e a característica da oclusão dos indivíduos; fluxo salivar favorável para auxiliar na formação do bolo alimentar; e a tonicidade muscular de todo o sistema orofacial. A literatura sugere que o número de dentes presentes na boca e a integridade da dentição, seja natural ou protética, relacionam-se com a performance e a força mastigatória (Okada et al., 2010; Kimura et al., 2013; Morita et al., 2018).

O número de ciclos mastigatórios, a performance mastigatória e a força máxima de mordida (Douma et al., 2016; Kim et al., 2017; Morita et al., 2018) são métodos objetivos de avaliação dos padrões mastigatórios. Também é possível avaliar de maneira subjetiva o comportamento da mastigação por meio de questionários (Park; Hong, 2015; Hilassaca-Mamami et al., 2016). A auto-percepção da capacidade mastigatória foi relacionada com a capacidade funcional, ou seja, idosos mais independentes possuem melhor percepção da mastigação propriamente dita (Moriya et al., 2012; Cusson et al., 2015). Tais métodos de avaliação possuem importância e a associação de ambos apontam para a real condição do indivíduo. Este pode possuir boa função muscular e boa performance mastigatória, embora acredite que não realize a mastigação adequadamente devido à falta de dentes, próteses mal adaptadas ou até mesmo o medo de danificar reabilitações protéticas, além do desenvolvimento de hábitos como beber enquanto se alimenta ou ter que cortar os alimentos em pedaços menores. Nos idosos observam-se alterações como a diminuição da habilidade motora, perda de dentes, diminuição da força muscular, redução da percepção gustativa e secreção de enzimas digestivas (Ikebe et al., 2006; Moryia et al., 2011, Sulmont-Rossé et al., 2015).

Estudos experimentais mostraram que a perda dentária pode ser um fator de risco para o desenvolvimento de demências senis e que a deficiência mastigatória parece estar relacionada com o declínio cognitivo (Scherder et al., 2008; Almeida et al., 2012; Kimura et al., 2013; Teixeira et al., 2014; Fukushima-Nakayama et al, 2017). Yamamoto et al. (2012) relataram, em um estudo de coorte, como principais fatores de risco para o aparecimento de demência a presença de poucos dentes sem reabilitação protética, a ausência de consultas regulares ao dentista, a má mastigação e a existência de hábitos inadequados em relação à saúde bucal. Por isso, deve-se entender os fatores bucais associados à demência e assim prevenir os possíveis danos que podem ser gerados. Cabe ressaltar que a saúde bucal é muito importante para o bem estar geral.

Avaliação das medidas antropométricas – estado nutricional

A antropometria é uma das ferramentas utilizadas para avaliação da composição das medidas corporais e é essencial para a avaliação do estado nutricional. A utilização do índice de massa corporal está intimamente relacionada com a avaliação do estado nutricional de idosos. Sua utilização apresenta dificuldades em função do decréscimo de estatura, acúmulo de gordura e diminuição da quantidade de água decorrentes do aumento da idade, porém a aplicabilidade clínica possui vantagens por ser uma medida de fácil realização, com baixo custo e minimamente invasiva (WHO, 1995). A OMS recomenda que valores abaixo de 18,5 kg/m^2 definem baixo peso, entre 25 e 30 kg/m^2 presença de sobrepeso e acima de 30 kg/m^2 caracterizam obesidade (WHO, 1995). A circunferência de braço e perna também são bons marcadores de perda de peso e de massa muscular, respectivamente, que podem indicar desnutrição (Tsai, Chang, 2011; Tsai, Chang, 2017). Os três parâmetros antropométricos são bons previsores do risco de mortalidade em idosos e são facilmente mensuráveis (Tsai, Chang, 2011).

A literatura apontou que idosos com baixo índice de massa corporal mostraram performance mastigatória deficiente (Ikebe et al., 2006), mas em contrapartida existe a possibilidade do comprometimento da função mastigatória acarretar um déficit nutricional favorecendo à obesidade, pois os idosos acabam dando preferência a alimentos com consistência mais amolecida, mais gordurosos e por vezes menos nutritivos, devido à dificuldade na ingestão de alimentos mais

consistentes, ricos em fibras (Daly et al. 2003; Moriya et al., 2011; Singh et al. 2015; Nascimento et al., 2016; Kikui et al. 2017).

Saliva e polifarmácia

A saliva é uma substância aquosa e hipotônica que tem como funções a proteção da cavidade oral, participação da formação do bolo alimentar de forma coesa para uma boa deglutição, inibição de desmineralização dentária, além de apresentar propriedades imunológicas (Miranda-Rius et al., 2015; Turner, 2016).

A secreção salivar é estimulada pelo paladar, mastigação, pensamento e pelo olfato. O fluxo não estimulado pode variar de 0,3 a 0,5 mL/min e o estimulado pode variar de 1 a 2 mL/min (Miranda-Rius et al., 2015; Turner, 2016). Quando ocorre uma alteração nesse processo, os efeitos podem afetar drasticamente a qualidade de vida dos pacientes. As alterações comumente relatadas nos idosos são a xerostomia e a hipossalivação. A hipossalivação é a diminuição do fluxo salivar, ou seja, é um achado objetivo. Já a xerostomia é um achado subjetivo, já que se refere à sensação de boca seca (Thomson, 2015; Turner, 2016). Por isso, para o diagnóstico de xerostomia o paciente deve ser questionado sobre os sintomas de xerostomia, enquanto que para a hipossalivação é necessária a medição do fluxo salivar; valores abaixo de 0,1 mL/min já caracterizam a doença (Miranda-Rius et al., 2015; Thomson, 2015; Turner, 2016).

Dentre os fatores de risco para a boca seca, o uso de medicamentos está inserido. Os idosos utilizam mais medicamentos que qualquer outro grupo etário, devido ao maior risco de apresentarem doenças crônicas. Além disso, os que vivem em instituições de longa permanência acabam tomando mais medicações do que os que vivem em suas próprias residências (Thomson, 2015).

A polifarmácia é definida como a utilização de cinco ou mais medicamentos (Jyrkka et al., 2011; Golchin et al., 2015; Masnoon et al., 2017). Ela se relaciona com o aumento da incidência de efeitos adversos, que incluem a hipossalivação, que pode induzir alterações no paladar. A hipossalivação pode alterar a recepção, a transdução, a propagação ou a percepção dos sabores (Golchin et al., 2015). Mais importante que a quantidade de medicamentos é a qualidade, ou seja, há medicamentos que interferem diretamente no fluxo salivar e esse entendimento ainda é pouco explorado na literatura devido à dificuldade de padronização dos estudos na mensuração do fluxo e as possíveis interações medicamentosas (Villa et

al, 2016). Tan et al. (2018) constataram que a utilização de medicamentos foi associada ao risco de xerostomia e hipossalivação, sendo que os medicamentos com maiores riscos são os utilizados para incontinência urinária, seguido dos antidepressivos. Além disso, há tendência inerente à sensação de boca seca relacionada aos medicamentos.

Sintomas de Disfagia

A formação de um bolo alimentar coeso permite deglutição confortável e saudável. A deglutição também sofre alterações com o envelhecimento, uma vez que a motilidade muscular diminui com o aumento da idade. Essas interferências normalmente ocorrem de forma gradual (Namasivayan, Steele, 2015). Porém, a associação desse quadro com outras morbidades podem inserir esses indivíduos em um grupo de risco para disfagia e desnutrição. A disfagia é caracterizada pela dificuldade na condução do alimento da boca ao estômago, comandadas pelo mecanismo neuromotor. É uma condição clínica que exige a abordagem de uma equipe multidisciplinar para diagnóstico e tratamento visando a melhora efetiva do paciente. Assim, o quadro de disfagia está diretamente relacionado ao quadro nutricional do paciente, à função mastigatória, à xerostomia e à polifarmácia. A interação dessas morbidades pode caracterizar o conceito de síndrome geriátrica para disfunções orais e maxilofaciais, que é desencadeada devido ao quadro de fragilidade do idoso (Nam et al., 2017). Isso gera um ciclo vicioso e deve ser melhor estudado, pois o paciente acaba por vezes perdendo o apetite e selecionando alimentos mais pastosos ou líquidos que facilitem a deglutição, o que gera perda de peso, de massa muscular, de qualidade nutricional e de mastigação (Pedresen et al, 2002; Namasivayan, Steele, 2015;).

Avaliação sensorial

O sistema sensorial é composto por receptores sensoriais, que são as estruturas responsáveis pela percepção de estímulos provenientes do ambiente e do interior do corpo, sendo ele o responsável por transformar os estímulos em impulsos nervosos, que determinam as diferentes reações do organismo. Os mecanorreceptores são estruturas responsáveis por discriminar estímulos mecânicos, como a pressão e o tato. Segundo Siqueira (2011), a densidade de receptores em cada região do corpo determina a quantidade de detalhes, ou seja,

quanto maior, como no caso das mãos e da boca, maior será a definição. Identificar um estímulo depende da percepção e do julgamento do indivíduo de ter realmente percebido este estímulo. Dentre as modalidades de percepção, a sensibilidade somestésica inclui a percepção mecânica (tato, textura, pressão), dolorosa e térmica. A percepção mecânica está relacionada às fibras mais grossas, principalmente do tipo Aβ, e a percepção térmica e dolorosa relacionadas às fibras mais finas (tipo Aδ e tipo C) (Siqueira, 2011). Nos idosos a literatura sugeriu que existe relação entre o aumento da idade e a dificuldade da discriminação tátil, mas que não é explicada pelas alterações nas propriedades mecânicas da pele, mas por alterações no sistema nervoso que, consequentemente, afetam a velocidade e qualidade do processamento da informação (Heft e Robinson, 2010; Wang et al., 2017).

Outro fator relacionado com a qualidade de vida nos idosos é a percepção do paladar, que está relacionada com a quantidade e qualidade do fluxo salivar. A gustação permite que os indivíduos selecionem alimentos de acordo com seus desejos e necessidades metabólicas. O paladar é percebido pela presença de botões gustativos presentes nas papilas linguais. Com o avanço da idade, ocorre aumento significativo no limiar de detecção dos sabores (Methven et al., 2012; Silva et al., 2014; Sulmont-Rossé et al., 2015) prejudicando a detecção e a identificação do sabor (Kennedy et al., 2010) e podendo ocasionar perda de apetite. Além disso, com o maior número de doenças crônicas, o idoso se vê na necessidade de fazer uso de diversos medicamentos. Estes podem interferir na salivação e no paladar propriamente dito, já que existem evidências que alguns fármacos podem ser secretados na saliva por difusão, podendo interferir nos botões gustativos (Nam et al., 2017).

Considerando os fatores anteriormente expostos, este trabalho tem como objetivo avaliar possíveis alterações observadas nos sintomas orais da síndrome geriátrica. Especificamente, neste trabalho, pretende-se avaliar:

a) A relação dos padrões mastigatórios e sensoriais com o escore cognitivo e as medidas antropométricas;

b) A relação da polifarmácia com o fluxo salivar, xerostomia, disfagia e paladar.

2 ARTIGOS

2.1 ARTIGO: RELATIONSHIP BETWEEN MASTIGATORY FUNCTION, ORAL HEALTH, NUTRITIONAL AND COGNITIVE STATUS IN THE ELDERLY

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Abstract

The preservation of general well-being, especially in the elderly, is a factor of great importance. The literature indicates that chewing is also related to the general health of the individual, nutritional aspects and also cognitive. The objective of this study was to evaluate whether aspects of masticatory function (performance masticatory, bite force, chewing quality, oral health) and sensorial sensitivity (QST) were related to cognitive and nutritional aspects in 204 elderly patients attending a Basic Health Unit mean age = 69 years ± 6.5, 123 women). The sample profile was described by cluster analysis (hierarchical cluster) and "t" test, considering the variables under study. Also, multiple linear regression models were adjusted to estimate the cognition score and body mass index (BMI). The cluster analysis identified two very distinct groups: a group of 180 elderly patients with poorer masticatory and oral health quality and a second group with 24 elderly individuals who presented better performance and masticatory quality, higher bite force and lower DMFT index ($p < 0.01$), although with greater circumference of arm and leg and greater percentage of overweight and obesity (74.5% x 87.5%). The cognition score was dependent on gender (male), age and sensorial sensitivity (QST), while BMI was dependent on age, chewing quality and DMFT index. In the sample, two very distinct elderly profiles were identified, showing a relationship between masticatory function, oral health and nutrition. However, cognitive aspects were not related to chewing.

Key words: Mastication, Nutritional Status, Cognition, Health Services for Aged

INTRODUCTION

The number of elderly people in the world has increased and, with this, the interest and the search for means that bring improvements in the quality of life and the welfare of this part of the population grows. Aging makes people less active, thereby decreasing the performance of daily activities, facilitating the development of chronic diseases, and accompanied by psychological changes such as stress and depression (Douma et al., 2016).

The masticatory function is extremely important for the maintenance of the general health and quality of life of the people. It is responsible for breaking food into smaller particles and along with saliva play an important role in the formation of food bolus for swallowing to occur comfortably. In the elderly, such a function can suffer damages due to the oral health condition that undergoes modifications, the amount of teeth present in the mouth, the occlusal function and the quality of the rehabilitation with prostheses directly influence a good mastication (Okada et al., 2010; Morita et al., 2018). Those conditions can be associated with nutritional deficits, since the impaired oral conditions can influence choice and consumption of foods with a softer consistency and easier-to-chew, which usually are less dense in essential nutrients (Cusson et al., 2015). Moreover, the food chosen can be fat contributing for overweight and/or obesity (Moriya et al., 2011; Kikiu et al., 2007; Singh et al., 2005; Daly et al., 2003).

Another issue pointed out in the literature is the possible relationship between tooth loss and poorer masticatory performance with the cognitive ability of the elderly, which may also occur in a cycle where the difficulty of chewing generates a deficit in the consumption of some nutrients necessary for body metabolism; this fact could trigger impairment in cognitive ability (Tada, Miura, 2017). Some studies take into account tooth loss (Coco et al., 2008; Ishimya et al., 2018) and the performance of mastication (Park et al. 2015; Douma et al., 2016, Kim et al., 2017) and the two parameters evaluated together complement each other.

The possible relationship between tooth loss and poorer masticatory performance with the cognitive ability of the elderly has been studied. The respective relationship may occur in a cycle where the difficulty on chewing generates a deficit in the consumption of some nutrients necessary for body metabolism; this fact could

trigger impairment in cognitive ability (Coco et al., 2008; Park et al. 2015; Douma et al., 2016; Kim et al., 2017;Tada, Miura, 2017; Ishimya et al., 2018).

The sensory system also decreases its functioning with age, that is, the detection thresholds for the stimuli increase, and some deficits are perceived more easily, such as in the evaluation of vision and hearing, and others, such as thermal and tactile, not so much (Heft, Hobinson 2010; Wang et al., 2017). Changes in the peripheral sensibility of the elderly have been studied but not related to the loss of cognitive ability.

Thus, the objective of the study was to perform an exploratory analysis of the data through cluster analysis to identify patterns related to nutrition and to evaluate possible effects of masticatory and sensory patterns on cognition and anthropometric measurements of the elderly.

METHODS

The research was approved by the Research Ethics Committee of the Federal University of São Paulo (protocol number 1.575.842) and the Informed Consent was obtained from all participants after have received detailed written and oral information about procedures and possible discomforts or risks.

This study is characterized as a descriptive cross-sectional with a quantitative and qualitative approach. The sample consisted of 204 participants, 81 males and 123 females, aged over 60 years old that characterizes the elderly population (WHO, 2015). They were selected in a healthy care center (Unidade Básica de Saúde, Santo André, SP, Brazil) referenced to the ABC Medical School (FMABC, Santo André, SP, Brazil). The sample size was defined based on a previous study (Scherder et al., 2008), which evaluated the correlation between bite force and cognitive ability assessed by the Mini Mental State Exam (MMSE) in the elderly. Taking into account a correlation coefficient equal to 0.20, test power of 80% and alpha level of 0.05, a minimum of 200 elderly would be required to compose the sample.

As an inclusion criterion, the participants should demonstrate autonomy to attend routine medical appointments. Exclusion criteria were as follows: individuals living in long-term care facilities, Alzheimer's disease, Parkinson's disease, alcoholics

and smokers, so as not to directly compromise the evaluation results (Scherder et al., 2008).

The socioeconomic level was determined according to the Brazilian Economic Classification Criteria (ABEP, 2012), showing that the participants belonged to Class C, with scores ranging from 14 to 22 points. This instrument evaluates the purchasing power, quantifying the ownership of household goods and services. For schooling, the following levels were considered: illiteracy, incomplete / complete primary education, incomplete / complete secondary education and incomplete / complete higher education.

Dental Clinical Examination

The dental clinical examination was performed applying the decay-missing-filled index teeth (DMFT), which counts the number of decayed, missing and restored teeth and quantifies the oral health status (WHO, 1997). A single examiner performed the exam in a clear room in the healthy care center, using dental mirror number 5 following the biosafety standards. It was the method of choice because it was validated and easily applied. When the need for dental treatment was observed, the participant was duly informed and referred to treatment in the public or private clinic.

Moreover, the use of oral prosthesis was verified and categorized in “Do not wear”, “Fixed partial prosthesis”, “Partial removable prosthesis (in one arch)”; “Partial removable prosthesis (in two arches)”; “Double total prosthesis”.

Anthropometric variables - BMI, arm and leg measurements

The anthropometric evaluation involved measurements of weight, height and arm/leg circumferences using an anthropometric scale, stadiometer and specific tape. For the measurement of the arm circumference, the mean distance between the acromion and olecranon points was used as reference; for the leg, the largest calf circumference was taken into account. Subsequently, body mass index (BMI = Kg / m^2) was calculated. According to the WHO (1995) individuals are classified on following weight status categories: Underweight or thinness (Below 18.5); Normal or Healthy Weight (18.5 – 24.9); Overweight (25.0 – 29.9); Obesity (30.0 and above).

The references mean values of the arm are 24 (Garcia, Romani, Lira, 2007) already for the leg are considered values of 34 cm for men and 33 for women (Pagotto et al., 2018).

Assessment of cognitive status

The elderly were evaluated for cognitive ability using the Mini-Mental State Examination (MMSE), which is a practical and useful scale for examination of cognitive impairments and risk for dementia. It was developed and checked for validity and reliability in 1975 (Folstein, Folstein, and McHugh, 1975). After that, the MMSE has been extensively used in both clinical practice and research, for example, the studies of Kimura et al, 2013; Scherder et al., 2008, but its purpose has been not to provide a diagnosis for any particular nosological entity (Tombaugh and Mcltyre, 1992). In the present study, the validated version for Portuguese language was applied (Bertollucci et al., 1994). This test consists of 11 questions grouped into seven categories, each one designed to evaluate specific cognitive "function": orientation for time (5 points) and for location (5 points), register of 3 words, immediate memory (3 points), attention and calculation (5 points), recall of 3 words (3 points), language (8 points), and visual constructive capacity (1 point). The MMSE score can range from 0 (zero) to 30 points. The cutoff point used is 19 for individuals with no schooling and 23 for those with some degree of schooling. The MMSE takes only 5-10 minutes to administer.

Objective assessment of mastication

Masticatory performance and maximum bite force were the variables chosen to assess objectively the masticatory function. The masticatory performance was verified by the colorimetric method, using a color-changeable chewing gum (Masticatory Performance Evaluating Gum Xylitol, Lotte, Tokyo, Japan) accordingly Pedroni- Pereira et al. (2016). Briefly, the participants chewed it for one minute with or without oral prosthesis, as habitual. This chewing gum contains xylitol, citric acid and red, yellow and blue dyes that are mixed during the masticatory movements change the color from yellowish-green to red, because the yellow and blue dyes seep into saliva, and the red dye appears because of elution of the citric acid. A chronometer controlled the time. After that, the chewed gum was extracted, flattened

to a thickness of 1.5 mm in polyethylene films by compression between two glass plates (Hama et al., 2014) for color measurement using a visual color scale (Annex 2), with scores ranging from 1 to 10. High values mean better masticatory performance.

The bite force was measured using a digital gnatodynamometer (model DDK, Kratos Equipamentos Ind. Ltda., Cotia-SP, Brazil). The device has a fork force with12 mm high, 15 mm depth and 15 mm width, providing unilateral measurement of the force generated by each pair of teeth. The participants remained sat in a comfortable chair with the head in a relaxed position, the arms extended along the body and the hands extended on the legs. Each one was informed to bite the fork with maximum force at the molar height in both sides. This procedure was performed twice, on the left and right sides, with a one-minute pause between the records; the average value of the measurements was taken into account (Castelo et al., 2010, Rosar et al., 2016). If the volunteer used total or partial removable prostheses, the measurements were performed with the patient using them and in the absence of antagonistic teeth, the test was not performed due to impossibility of measurement.

Subjective assessment of mastication – Quality of Masticatory Function Chewing Questionnaire (QMFQ)

The mastication was also evaluated subjectively by means of the Quality of Masticatory Function Questionnaire (full version), which consists of 29 questions distributed in five domains: "Food-Mastication", "Habits", "Meat", "Fruits" and "Vegetables" that relate to the frequency and difficulty of chewing foods of different types of consistency in the two weeks prior to the evaluation of the subject. It is a self-applied instrument where each item presents five possible answers (5-Likert scale), according to the content of the question, whether about the intensity of the difficulty ("Food-Mastication" domain) or frequency of consumption of a given food (other domains). It explores subjective aspects of satisfaction with masticatory function, as well as habits and behaviors, such as drinking liquids during meals, removing the dental prosthesis to feed, feeling the need to cut into small pieces or kneading foods that are more consistent. The domains "Meat", "Fruits" and "Vegetables" still have an alternative to be indicated (not applicable - N/A), if the subject does not have the habit of eating these foods. Higher scores indicates poor

quality of masticatory function (Muller et al., 2008; Hilasaca-Mamani et al., 2015, 2016).

Sensory assessment

To evaluate the orofacial sensitivity, the Quantitative Sensitive Test (QST) and and Two-Point Discrimination (TPD) were applied.

The QST analyzes the perception in response to external stimulus of controlled quantity. Consists of seven tests measuring 13 parameters, which be grouped in thermal detection thresholds, mechanical detection thresholds for touch and pain (Rolke et al., 2006). In this study, Von Frey filaments were used (Aesthesio® Kit Precision Tactile Sensory Evaluation, LCC, USA), which consisted of nylon monofilaments of approximate length and different thicknesses. The filaments provide controlled force gradients to the skin mechanoreceptors to detect from light touch to deep pressure. The force applied by the monofilament can vary from 0.008g/mm^2 to 300mg/mm^2. It was performed with the subject seated and blindfolded in a quiet environment so that he/she could concentrate for execution in the red area of upper lip (anterior superior alveolar nerve) and chin skin (mentonian nerve). The filaments were compressed at a 90° angle against the skin until it bent, and thus held for 1.5 seconds, starting with the less-gauge filament (0.008 g/mm^2) and sequentially applying increasingly calibrious filaments until the participant has reported verbally to feel a light touch as instructed at the beginning test. This was considered as a positive (+) stimulus. After this positive report, the order was inverted for the next filament, but with a lower value until the participant no longer feel the application of the stimulus. This was considered as a negative stimulus (-). This measurement was performed for 5 positive and 5 negative stimuli and the geometric mean of these repetitions was calculated (Rolke et al., 2006; Svensson et al., 2011; Oono et al., 2013).

The two-point discrimination test (TPD) is considered a valid measure of functional sensitivity (Won et al., 2017). Usually, the test is performed with a rigid instrument of tips arranged in pairs at different distances. In this study, the two-point discriminator was used (Touch-Test TM, model NC12776, North Coast Medical, Inc., Ireland) with distances from 1 to 25mm. The instrument was positioned perpendicularly in the region of the upper lip (anterior superior alveolar nerve) and lower lip (mental nerve), being considered the dominant side of the patient. Participants were questioned whether one or two tips touched the assessed region,

with distances of 1 to 8 being tested three times each, in random order. As a response, the lowest perceived distance between the two points was considered, and should present at least two correct answers among the three attempts. The use of the discriminator does not cause pain or discomfort.

Statistics

The statistical analysis was performed using the software RStudio version 3.5, adopting the significance level of 5%.

Initially, a descriptive analysis of the sample by sex was performed for the variables: age, arm circumference, calf circumference, BMI, schooling, total score of the MMSE, masticatory performance, right bite force (BFR) and left bite force (BFL) mastication quality distributes by domains and total score of QMFQ questionnaire, DMFT, QST and TPD. For that, summary measures (mean and standard deviation) for the quantitative variables and frequency for the qualitative variables (Bussab, Morettin, 2013) were used.

In order to study the participants profiles, a cluster analysis was performed, which aims to organize a set of cases into homogeneous groups, in such way that the individuals belonging to a group are as similar to each other and different from the rest (Johnson and Wichern, 2007). Age, arm circumference, leg circumference, BMI, total MMSE, masticatory performance, BFR, BFL, QMFQ domains, DMFT, QST and TPD were included into the cluster (Johnson, Wichern, 2007). The hierarchical method was used, considering as a measure the Euclidean distance and the complete connection method (more distant neighbor). The final number of the clusters was based in the interpretability and reliability of the cluster solution. Afterwards, the dendrogram graph was built, showing the groups formed by means of connected lines according to the levels of similarity that grouped the variables.

It was also obtained the silhouette graph that measures the structural quality of the formed clusters. The silhouette width is defined as the mean silhouette among all the objects in the data set and assumes values in the range -1 and 1, and how closer to 1 the better is the internal homogeneity.

Student's t-test was used to compare the variables between the groups obtained. For the variables with significant differences, the standard scores (z-scores) were obtained. The standard score represents the number of standard deviations that separates a variable from the mean. The respective values of each

group were distributed in a line graph to easily visualize the difference between the groups.

Finally, for the analysis of the effect of variables on cognitive scores and BMI, two multiple linear regression models were adjusted adopting backward-forward stepwise elimination. The stepwise procedure was employed to choose the model with the highest adjusted R^2 and the variance inflation factor (VIF) at or near 1.0 (Goldberg and Cho, 2004). The total score of MMSE was the dependent variable in the first model and the explicative variables were sex, age, schooling, masticatory performance, mean values of bite force, total score of QAQM, DMFT, QST and TDP. In the second model, the BMI was the dependent variable and the explicative ones were age, schooling, masticatory performance, right and left bite force, domains of QAQM, and DMFT. The significance level was considered as alpha equal to 0.05.

RESULTS

The descriptive analysis with mean and standard deviation, median and percentiles for quantitative variables and frequency data for qualitative variables are described in Table 1. For the educational variable, the categories referring to elementary school, the second grade (complete and incomplete) and higher (complete and incomplete) were grouped. All analyzes were done according to sex.

Table 1: Descriptive analysis of the variables according to sex

	Male (n=81)	Female (n=123)
Age		
Mean (SD)	70.2 (7.2)	68.3 (5.9)
60-69 [n(%)]	84 (41.2)	44 (21.6)
70-75 [n (%)]	25 (12.3)	21 (10.3)
>75 [n (%)]	14 (6.9)	16 (7.8)
Schooling [n(%)]		
Illiteracy	2%	7%
Primary Education	56%	59%
Secondary Education	30%	22%
Higher Education	12%	12%
Anthropometric measurements		
Arm Circunference (cm) [Mean (SD)]	28.5 (3.7)	29.0 (3.9)
Leg Circunference (cm) [Mean (SD)]	35.1 (4.7)	29.0 (3.9)
BMI [Mean (SD)]	27.3 (4.3)	27.7 (4.9)
Mini-Mental [Mean (SD)]	27.1 (2.6)	25.9 (2.9)
DMFT [Mean (SD)]	23.1 (5.1)	24.0 (3.8)
BF rigth side (N) [Mean (SD)]	164.5(128.2)	116.8 (96.7)
BF left side (N) [Mean (SD)]	174.9 (145.2)	119.3 (107.3)
Performance [Median (25% - 75%)]	5 (3-6)	5 (4-5)
QMFQ [Median 25%-75%)]	22 (11-31)	26 (14-41.5)
QST upper [Mean (SD)]	0.03 (0.12)	0.01 (0.00)
QST lower [Mean (SD)]	0.01 (0.02)	0.01 (0.00)
TPD upper [Mean (SD)]	6.38 (1.72)	6.32 (1.72)
TPD lower [Mean (SD)]	6.11 (2.02)	6.54 (1.81)

BMI, body mass index; DMFT: decayed, missing and filled teeth; BF: Maximum bite force; QMFQ: Quality of masticatory function questionnaire; QST: Quantitative Sensitive testing; TPD: two point discriminator.

Table 2 describes the anthropometric indices of volunteers according to their body patterns.

Table 2: Description of anthropometric variables

	BMI Mean (SD)	Arm Circunference Mean (SD)	Leg Circunference Mean (SD)
Underweight	16.5 (1.5)	22.7 (4.9)	24.4 (5.1)
Normal	22.7 (1.6)	25.5 (2.4)	31.4 (4.1)
Overweight/obsesity	29.1 (3.7)	29.8 (3.3)	35.5 (3.9)

BMI, body mass index.

According to the cluster analysis, two groups were obtained, one with 180 participants and the other with 24 participants. The dendrogram (Figure 1) shows the respective distribution.

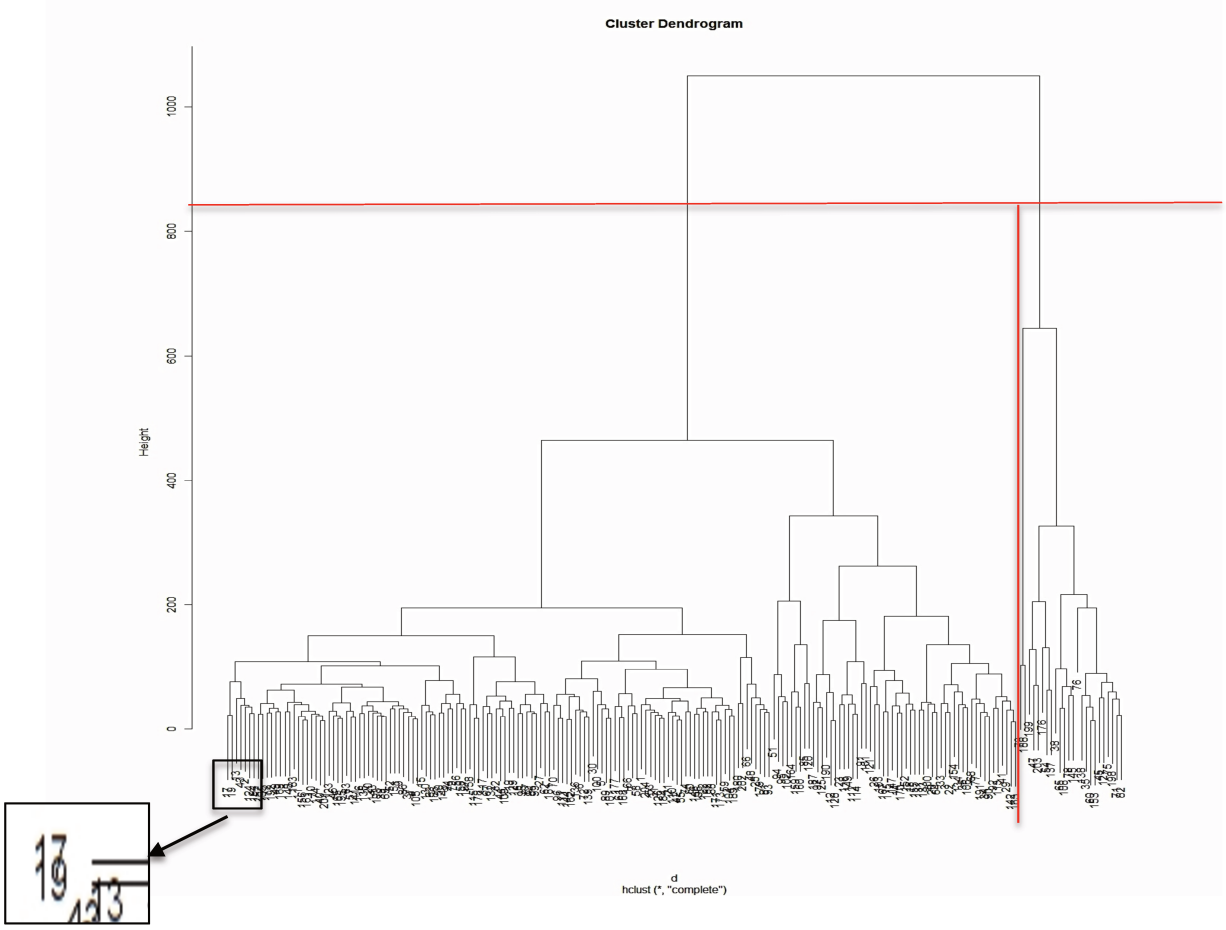

Figure 1: Dendrogram obtained by cluster- hierarchical method indicating the two groups formed. The enlarged box shows the position of the participants into the groups. The numbers mean the participant code.

The structural quality of the groups formed can be seen in the silhouette graph (Figure 2). For Group 1, the coefficient was 0.78, showing strong similarity between the components. In Group 2, the coefficient of 0.67 denoted reasonable similarity and the presence of outliers. The mean coefficient was 0.77.

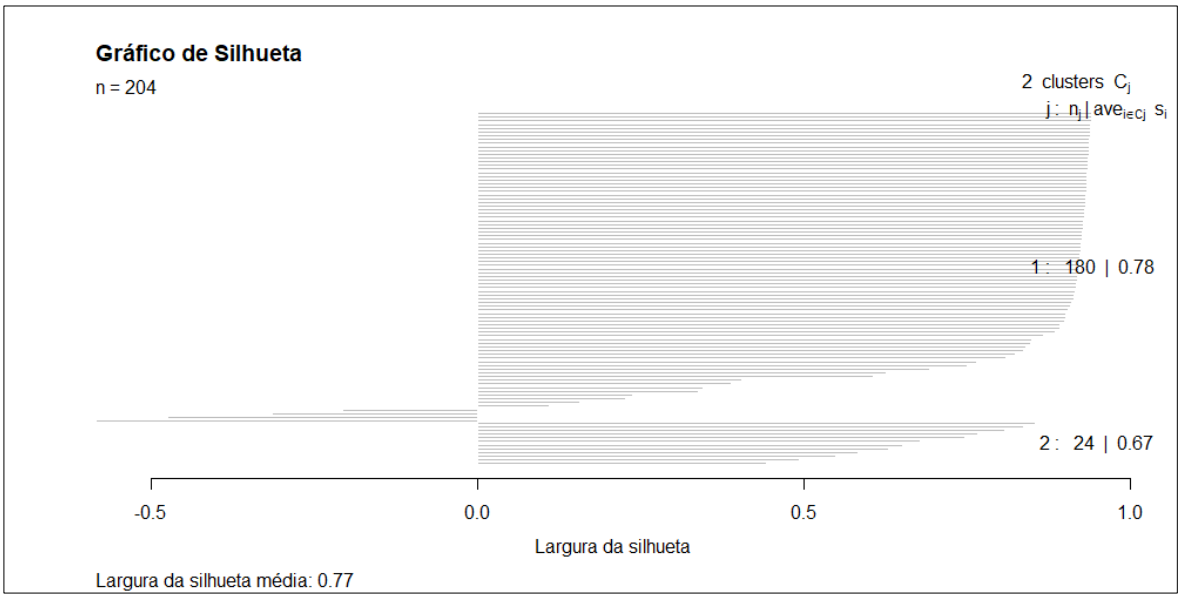

Figure 2: Silhouette graph used to evaluate the internal validity of the generated clusters. The mean silhouette coefficient was 0.77, being equal to 0.78 for group 1 and 0.67 for group 2

Table 3 shows the comparative data between the two groups formed by cluster analysis. Participants with higher values for bite force, masticatory performance, MMSE scores, and arm/leg circumferences formed the Group 2. It is also the group with the highest percentage of overweight/obesity individuals, 88%, while the correspondent value in Group 1 was 75%. In addition, Group 2 presented lower DMFT.

Group 1 presented higher QMFQ total and domain scores, except for vegetables and habits (Table 2), meaning greater perceived difficulty on mastication in those domains. Group 1 presented also worse values for the objective aspects of mastication and higher DMFT than Group 2. For the other variables, age, BMI, TPD and QST, no difference was observed between groups.

Table 3. Description of the groups obtained by cluster analysis regarding age, anthropometric values, cognitive scores, objective and subjective values of mastication

Variables	Group 1 (n=180) Mean (SD)	Group 2 (n=24) Mean (SD)	*P*-value*
Age	69.2 (6.4)	67.5 (7.1)	0.26
Anthropometric measurements			
Arm circumference (cm)	28.6 (3.7)	30.5 (3.7)	0.02
Leg circumference (cm)	34.1 (4.5)	36.7 (5.1)	0.02
BMI	27.3 (4.6)	29.1 (4.9)	0.11
MMST	26.2 (2.8)	27.7 (2.1)	<0.01
DMFT	24.2 (4.0)	19.8 (5.3)	<0.01
BFR (N)	104.8 (70.3)	365.4 (99.7)	<0.01
BFL (N)	106.4 (74.0)	401.0 (130.7)	<0.01
Masticatory Performance	4.5 (1.6)	6.1 (1.8)	<0.01
QMFQ			
Food/Mastication	7.3 (7.7)	1.9 (3.4)	<0.01
Meats	5.2 (5.0)	3.2 (3.9)	0.03
Fruits	8.6 (5.7)	4.8 (5.5)	0.01
Vegetables	6.0 (3.7)	4.9 (3.7)	0.23
Habits	5.3 (5.2)	3.7 (3.3)	0.05
QMFQ total	29.4 (20.5)	16.2 (12.8)	<0.01
QST (Upper)	0.01 (0.08)	0.01 (0.01)	0.52
QST (Lower)	0.01 (0.01)	0.01 (0.00)	0.21
TPD (Upper)	6.35 (1.78)	6.30 (1.22)	0.88
TPD (Lower)	6.37 (1.98)	6.39 (1.20)	0.93

BMI, body mass index; DMFT: decayed, missing and filled teeth; BF: Maximum bite force; QMFQ: Quality of masticatory function questionnaire; QST: Quantitative Sensitive testing; TPD: two point discriminator.

*Student *t* test

Figure 3 shows the graph with the z-scores for the variables that presented significant difference between the two groups.

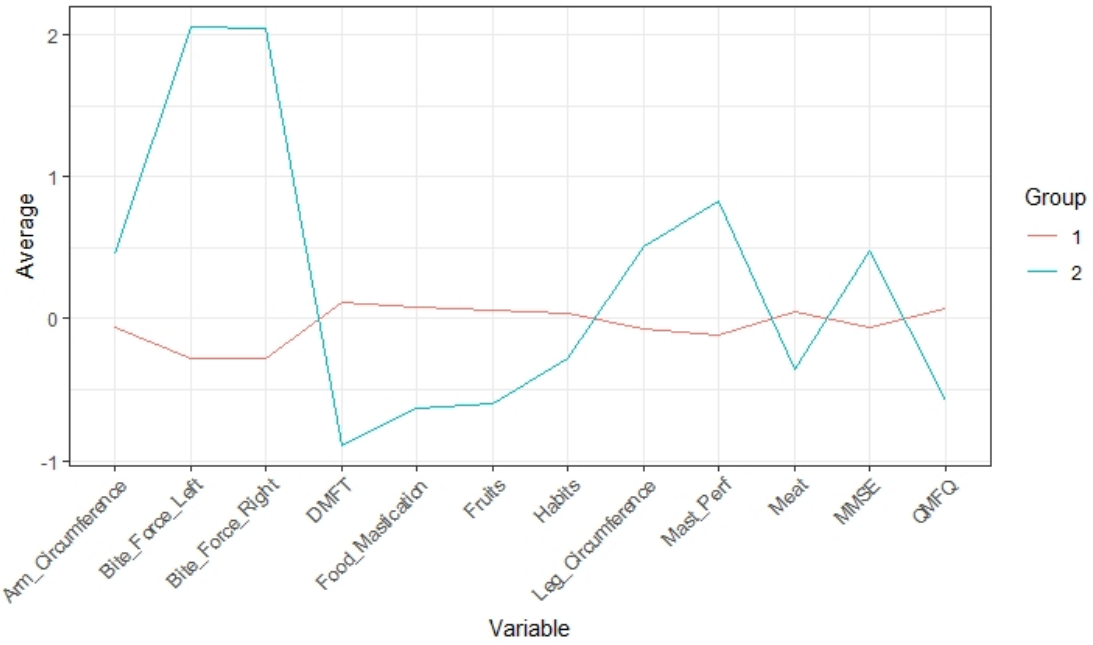

Figure 3: Mean Z-scores per group for significant variables in t-test.

Tables 4 and 5 describe the groups according to the BMI, indicating the prevalence of overweight and the distribution of the use and types of prosthesis within each group. The use of oral prosthesis and rehabilitation with fixed prosthesis in Group 2 prevailed.

Table 4. Description of clusters according to BMI

BMI (%)	Group 1 (n = 180)	Group 2 (n = 24)
Underweight	6 (3.3%)	-
Normal	40 (22.2%)	3 (12.5%)
Overweight/obesity	134 (74.5%)	21 (87.5%)

Table 5. Descriptions of clusters according to use and type of oral prosthesis

	Group 1 (n = 180)	Group 2 (n = 24)
Do not wear	18.4%	70.83%
Fixed partial prosthesis	7.78%	20.83%
Partial removable prosthesis (in one arch)	30.5%	8.34%
Partial removable prosthesis (in two arches)	21.1%	-
Double total prosthesis	22.22%	-

The first regression model, which was adjusted for schooling, identified that MMSE scores were dependent of gender, age and QST, that is, the female sex and age showed a negative relation with MMSE scores, while the QST showed a positive relation (Table 6). The model explains 34% of the variability of the cognitive scores and presented adequate adjusted parameters.

Table 6. Adjustment of the final model for cognition (confidence intervals with 95% confidence)

Coefficients	Estimation	Standard error	Lower Limit	Upper Limit	*P*-value
Intercept	21.85	0.80	20.28	23.41	< 0.01
Sex (Female)	-0.96	0.34	-1.63	-0.29	< 0.01
Age	-0.06	0.03	-0.11	-0.01	0.02
QST upper	5.33	2.27	0.88	9.78	0.02
Primary education	4.68	0.77	3.16	6.20	< 0.01
Secondary education	5.76	0.82	4.15	7.37	< 0.01
Higher education	6.85	0.88	5.12	8.57	< 0.01

R^2= 33,5%; VIF=1,5

QST: Quantitative Sensitive test

The results of the second regression model showed that BMI was dependent on the age, the scores of domain Fruits in QMFQ and the oral health condition, that is, the BMI showed a negative relation with age, with the difficulty perceived in chewing fruit and with the DMFT index. The model explains 17% of BMI variability and presented adequate adjusted parameters.

Table 7. Adjustment of the final model for BMI (confidence intervals with 95% confidence).

Coefficients	Estimation	Standard error	Lower Limit	Upper Limit	*P*-value
Intercept	34.17	2.04	30.16	38.17	< 0.01
Age	-0.18	0.05	-0.28	-0.07	< 0.01
QMFQ Fruits	-0.14	0.06	-0.25	-0.02	0.02
DMFT	-0.22	0.09	-0.39	-0.05	0.01

R^2= 17%%; VIF=1,2

QMFQ: Quality of Masticatory Function Questionnaire

DMFT: decayed, missing and filled teeth

DISCUSSION

Since elderly population has been increasing and changes in oral, systemic and cognitive functions can be occur, the present study focused on some variables involved in those functions. In this context, mastication, oral conditions, nutritional and cognitive status, and sensory perception were evaluated to verify their possible interrelationship in a group of elderly people. The participants were considered active elderly because they presented autonomy to frequent health center care as routine or when necessary, without a caregiver.

Brazil is a developing country that has passed in the last 5 years due to a period of economic crisis that affected the whole population. Thus, we are faced with a public that, even after having retired, still had an active work routine for the maintenance of the family's quality of life, and these facts are important for

understanding our results. Since older people are more debilitated and which are sometimes hospitalized in long-term homes, have completely different habits of life, where eating habits are controlled and patients are more susceptible to depression (Gil Montoya et al., 2015).

The most participants presented primary or second educational level and few were illiterates, inferring that the tasks could be performed properly. Moreover, 12% of the sample presented higher education, contributing also for reliable answers and procedures. The respective education level is in line with mean values of the MMSE, which are greater than 25, reflecting a normal cognitive status (Scherder et al., 2008). Accordingly to Bertolucci et al. (1994), the most important factor in MMSE performance is the education level. This finding is supported by the first model of the regression analysis, in which an increase in MMSE scores has been observed as the level of education increases.

Regarding anthropometric characteristics, a high mean BMI was found, characterizing 76% of the total sample as overweight/obesity, proportion higher than what has been observed in the Brazilian population of 53% (Vigitel, 2017). On the other hand, arm and leg circumferences were above the cut-off values, meaning lack of malnutrition and adequate muscle mass, respectively. These findings can be attributed to sample age, once more than 62% were from 60 to 70 years old and the level of physical and mental decline can be not well established, but the occurrence of changes in body composition can have increased fat mass and reduced fat-free mass (St-Onge and Gallagher, 2010). In the early stages of aging, weight gain occurs with a significant increase in body fat (Gallagher et al., 2000), but after 65 years it is possible to observe a significant weight loss accordingly with the population studied (Chumlea et al., 2002; Wang et al., 2000). Consequently, careful nutritional assessment and nutritional education are necessary in the elderly, for diagnosis and establishment of treatment strategies (Amarya et al., 2015).

Considering the sample size and the inter-individual variability of the variables, a cluster analysis was applied to identify groups of participants sharing similar characteristics. The profiles showed the formation of two clusters. The smaller cluster (Group 2) was composed of 11.76% participants, who demonstrated better chewing patterns (right and left bite force, masticatory performance, QAQM except domain vegetables), lower DMFT index and higher values for arm and leg circumference.

The participants of this group could be considered as “best chewers”, comparing to other group (Group 1) despite the different number of participants in each one. In this way, the participants in Group 1 were considered “worse chewers” presenting a higher score for QAQM, indicating a poor self-assessment of the mastication. Moreover, the lower DMFT index presented by Group 2 can infer that the total number and conditions of teeth present in the mouth could affect directly the choice of foods and their quality, improving the self-perception of mastication (Daly et al., 2003, Okada et al., 2010). Regarding the use of prostheses, in group 2, 70.83% of the participants did not use prostheses and 20.83% had fixed prostheses, showing the relevance of the preservation of natural teeth or with few prosthetic rehabilitations, since the use of removable prostheses may restrict the mandibular movement, decreasing masticatory performance (Morita et. al., 2018). Unexpectedly, the two cluster were composed of similar amount of participants characterized as overweight/obesity, thus indicating the needs to apply strategies focusing ageing and health (WHO, 2018).

An interesting fact observed in cluster analysis was the presence of participants with a better cognitive pattern in Group 2. In addition, the regression analysis showed that cognitive function was related to age and sex, that is, increasing age, a decrease in the mini mental score is expected; on comparing sexes, it is expected decrease of the mean score of the women in relation to men. Moreover, cognitive scores was dependent also of the level of education, as commented above. According to the literature, cognition is positively related to the factors: being a man, younger, with complete higher education, engaging in support for friends and family, and performing unpaid work (Li et al., 2015). Therefore, the results of the present study corroborate the literature related to the possible influence of sex, age, and schooling in the cognitive function. Therefore, to promote preventive interventions becomes necessary, but the strategies must be different for men and women. Women should be encouraged to keep up-to-date with studies and engaging in family support and work outside the home, as these factors have proven to be the most important (Li et al., 2015).

Regarding cognitive function and sensory patterns no difference between groups was obtained, but a relationship was observed between MMSE scores and QST. The upper lip threshold was higher when compared to the chin region (Heft and

Robinson 2010), and this fact may justify the relationship of QST of the upper lip with cognition. Moreover, it must be considered that the responses to the test depend also on the state of attention and can generates biases (Heft and Robinson, 2010). Peripheral neural degeneration, changes in sensory thresholds, abnormalities in central processing, or other factors have been related to ageing (Silva et al., 2014; Heft and Robinson, 2010). The use of QST in the orofacial region (Pigg et al., 2010, Costa et al., 2019), as well as the TPD (Won et al., 2017) has been evidenced, showing an increase in the perception threshold of somatosensory stimuli with increased aged (Heft and Robinson, 2010; Wang et al., 2017). Despite no difference between groups in TPD and no relationship on MMSE scores were found, it must taken into account that the use of the two-point discriminator has been used to discriminate the sensitivity of the mechanoreceptors and complement the QST evaluation. The lip region has a greater spatial acuity and its sensory pathways are specialized in the processing of tactile information, so small changes in this region can cause notable sensory damages (Won et al., 2017) and deserve clinical attention to identify possible changes due to age.

It is currently questioned whether masticatory function is related to cognitive function in the elderly. One of the hypotheses is based on impairment of mastication, which can induce the development of inadequate eating habits and the option for foods with soft consistency, compromising the intake of nutrients and, consequently, affecting the neurological system (Tada, Miura 2017). Moreover, depression, cognitive loss, good habits, such as exercise and health care were important predictors of masticatory performance (Park, Hong 2015). Scherder et al. (2008) evaluated the relationship between masticatory performance composed of mandibular excursions and bite force and the episodic memory domain and verified a significant within a group of older persons with full dentures. In the present study, no relationship between masticatory parameters and cognition was observed, agreeing with Scherder et al. (2008) in relation to MMSE scores, but differing from others (Park, Hong 2015; Tada, Miura 2017), probably due to the characteristics of the sample, such as age, schooling, oral conditions, and living at home. In addition, the different methodologies for masticatory performance evaluation could be influenced the results. Nevertheless, the real influence of the mastication on the cognitive

aspect is complex and should still be better studied (Fukushima-Nakayama et al., 2017).

It was observed that BMI was dependent on age, QMFQ Fruits domain and DMFT index, that is, decreases with ageing, with difficulty to eat fruits and with poor oral conditions, corroborating previous studies (Okada et al., 2010; Amarya et al., 2015; Singh et al, 2016). Over the years, the elderly people tend to lose more teeth due to the cumulative effect of oral diseases, such as the presence of periodontitis and development of caries, adapting the diet to their oral condition (Singh et al., 2016). Less-fibrous foods with a softer consistency, containing lower and greasier nutritional values, are normally preferred (Singh et al, 2016; Okada et al., 2010). Therefore, elderly with a high DMFT index, especially missing teeth, may assume inadequate nutritional status. For Song et al. (2017) elderly people who have worse oral conditions chew more slowly and asymmetrically and thus lose weight (Song et al., 2017). Nonetheless, longitudinal studies to test the causal relationship of tooth loss and body patterns are necessary (Nascimento et al., 2016), considering the cross-sectional characteristics of the cited studies. These data are extremely important for oral health programs related to prevention and maintenance of good oral health, as well as for oral rehabilitation if necessary. The respective importance is based in previous studies, which observed that elderly people with a full complement of natural teeth have a higher level of global cognitive functioning and level of education than those with full dentures (Haugejorden et al., 2003; Avlund et al., 2004; Scherder et al., 2008).

The understanding of oral function changes in the elderly is an important point for nutritional guidance and may lead to the establishment of programs aimed at the well-being of the elderly population. It is important to emphasize the importance of science in directing public agencies the merit of prevention.

CONCLUSIONS

In view of the presented results, it can be concluded that:

With the clustering analysis it was possible to verify the existence of two profiles of patients in the sample. A first group, composed of large number of participants, presenting lower values of bite force, masticatory performance, cognitive

scores and arm and leg measurements, and higher values in the domains and total of QMFQ, that is, individuals with worse conditions. The second group corresponded to those with higher values of bite force, masticatory performance, cognitive scores, arm and leg measurements and better quality in the QMFQ domains (except vegetables, in which no difference was identified between the groups). Such statements may support the nutritional counseling of the elderly.

There was no association of masticatory and sensory patterns in cognitive scores, but they were related to gender, age and schooling level. Moreover, the nutritional pattern was negatively related to age, DMFT and QAQM fruits. These data point to the importance of preserving oral health for the establishment of a good quality of life.

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2.2 ARTIGO: AN OVERVIEW OF THE RELATIONSHIP BETWEEN POLYPHARMACY, XEROSTOMIA, DYSPHAGIA, AND TASTE IN THE ELDERLY

Fernandes MS, Gavião MBD, Castelo PM

ABSTRACT

Geriatric oral/maxillofacial dysfunctions are part of the concept of geriatric syndrome and occur and/or are aggravated by polypharmacy. The purpose of this study was to perform a comprehensive evaluation of the relationship between polypharmacy and xerostomia, hyposalivation, symptoms of dysphagia and taste. A convenience sample of 204 individuals, aged over 60 years was included (mean 69 years), from who the following information were gathered: sociodemographic and medical aspects, specific therapies and profile of medication use, dryness of the mouth (Xerostomia Inventory XI), dysphagia complaints (Eating Assessment Tool/EAT-10), salivary flow (stimulated and unstimulated) and gustatory sensitivity. Data was analyzed using Chi-square and Mann-Whitney test, Spearman correlation test, Two-way ANOVA and ANCOVA and Poisson regression. Polypharmacy was found at a frequency of 18% of the sample and was related with xerostomia and dysphagia symptoms, but not with salivary flow ($p<0.05$). Dry mouth complaint was found in almost 50% of the sample, being associated with female sex, unstimulated salivary flow and the total number of medications in use ($p<0.05$), but not specifically with the number of xerogenic drugs; each extra medication taken increased 1.04 times the score of xerostomia. Considering the proposed EAT-10 cut-off, 12% of the sample presented higher risk of having dysphagia, being correlated with xerostomia and the number of medications in use; and angiotensin converting enzyme inhibitors users (n=36) showed more complaints of dysphagia ($p=0.038$). The frequency of taste dysfunction was low (less than 10%) and not associated with polypharmacy or xerogenic medications. As side effects of drugs and oral/maxillofacial dysfunctions may alter dietary choices and, ultimately, their nutritional aspects, clinicians need to pay attention and optimize chronic medication in the elderly.

Key-words: Xerostomia, Hyposalivation, Polypharmacy, Deglutition Disorders, Taste, Health services for the Aged,

INTRODUCTION

In Brazil, even being a relatively young country, official data show that between 2012 and 2016 the elderly population grew about 16%, reaching 29.6 million people (IBGE, 2018). However, aging puts the individuals at a higher risk of multimorbidity and the availability of diverse over-the-counter drugs, especially those considered inappropriate for the elderly, puts them at a risk of polypharmacy (Mortazavi et al., 2016).

There are several definitions for polypharmacy, but the most common is the numerical definition of five or more different drugs daily (Masnoon et al., 2017); its knowledge and understanding is important because of it can lead to harmful side effects. Common oral and maxillofacial dysfunctions associated with aging are salivary gland hypofunction, burning mouth symptoms, taste disorders, swallowing disorders (dysphagia), and oral oromandibular dyskinesia and dystonia; collectively, they are known as geriatric oral and maxillofacial dysfunctions, which are part of the concept of geriatric syndrome (Inouye et al., 2007; Nam et al., 2018) and occur and/or are aggravated by multimorbidity and polypharmacy (Nam et al., 2018).

Saliva is a hypotonic aqueous substance whose function is to protect the oral cavity; it participates in the food bolus formation, inhibits dental demineralization, and presents immunological properties (Miranda-Rius, et al. 2015; Turner, 2016). Salivary secretion is stimulated by taste, chewing, thinking and by smell and an unstimulated flow may range from 0.3 to 0.5 ml/min while the stimulated flow may range from 1 to 2 ml/min (Miranda-Rius et al., 2015; Turner, 2016). Quantitative and qualitative changes in salivary secretion can drastically affect the quality of life of the individuals and one of the most commonly reported complaints in the elderly is dry mouth, which has two aspects: xerostomia (subjective) and hyposalivation (objective) (Thomson, 2015; Turner, 2016). According to previous studies, values below 0.1 ml/min for unstimulated flow and values below 0.7 ml/min for stimulated flow characterize low salivary flow (Miranda-Rius et al., 2015; Villa et al., 2016).

Hyposalivation induced by xerogenic drugs may change the reception, transduction, propagation or perception of flavors (Jyrkka et al., 2011; Golchin et al., 2015; Gil-Montoya et al., 2016), while diuretic use may have an effect on taste qualities (Ossebaard et al., 1996). Some drugs may interfere directly and decisively

in salivary flow (e.g. anticholinergics), whereas other may have variable effect, which are still little explored in the literature due to the difficulty of standardizing the measurement of salivary flow and the possible drug interactions (Villa et al., 2016). According to Tan et al. (2018), among the drugs with the greatest effects on salivary secretion, are those used for the treatment of urinary incontinence followed by antidepressants, which notably present important anticholinergic effects.

Dysphagia is most common among the elderly population because aging process can negatively affect the oral, pharyngeal, and esophageal phases of the swallowing process, becoming worse in the presence of hyposalivation (Logrippo et al., 2017). In addition, polypharmacy in older people makes them vulnerable to the potentially harmful effects of drugs on the swallowing function (Miarons et al., 2016) and ageing-associated physiological changes that can alter the pharmacokinetics and pharmacodynamics may play an important role. Thus, as dysphagia negatively affects patient medication use, this is a major concern in old age.

The hypothesis of the present study is that xerostomia, taste and dysphagia complaints may be dependent on specific therapies which should be investigated by a comprehensive overview of the side effects related to drugs use. The literature lacks information on the relationship between polypharmacy and important oral and maxillofacial dysfunctions associated with aging. Thus, the purpose of the study was to evaluate the relation between polypharmacy and xerostomia and/or hyposalivation, symptoms of dysphagia and taste.

METHODS

Study design and sample

This is a cross-sectional study, approved by the Research Ethics Committee of the Federal University of São Paulo (protocol number 1.575.842).

A convenience sample was selected in a healthy care center, partner of the ABC Medical School (FMABC, Santo André, Brazil), being 81 men and 123 women (total of 204 individuals), aged over 60 years that characterizes the elderly population (WHO, 2015).

Each participant received detailed information about procedures and possible

discomforts or risks of the research. The Free and Informed Consent Form was delivered and signed for participation. After anamnesis, the oral health examination was performed and if there was a need for dental treatment, the participant was informed and referred to the public or private network. All participants received instructions for biofilm control and assisted tooth brushing.

Clinical evaluation

The family's socioeconomic status was evaluated using the Brazil's Economic Classification Criteria (ABEP, 2012). This instrument evaluates the purchasing power of urban families, quantifying the ownership of household goods and services (e.g. maid, TV, refrigerator and others) and aggregating points of each item present in the subject's house, ranging from 0 to 46 points.

Information about medical and dental history, the presence of chronic diseases, the use of specific therapies and the profile of medication use (name, classification, time of use and frequency) were also gathered. Polypharmacy was considered in cases of simultaneous and long-term use of 5 or more drugs (Jyrkka et al., 2011; Gil-Montoya et al., 2016).

The anthropometric evaluation involved measures of weight, height, arm and leg circumferences, using an anthropometric scale, stadiometer and specific tape, and the body mass index estimation (BMI=Kg/m^2).

Dry mouth complaints were evaluated using the Xerostomia Inventory XI, which was translated and validated for Brazilian Portuguese previously and evaluates the subjective degree of dryness of the mouth (Mata et al., 2012). The answer options are: Never (1 point), Almost never (2 points), Occasionally (3 points), With relative frequency (4 points) and Frequently (5 points). The total score was calculated by the sum of all points, ranging from 11 to 55 points. High scores mean high degree of xerostomia.

Symptoms of dysphagia were assessed by means of a subjective evaluation using the Portuguese version of the Eating Assessment Tool-10 (EAT-10) (Gonçalves et al., 2013). This scale was developed with information gathered from 482 patients, being a robust self-perception instrument for identification of the risk of dysphagia. It is composed of 10 selected items and easy to apply (Belafsky et al., 2008); the higher the score, the higher the self-perception of symptoms of dysphagia: weight loss and pain related to swallowing problems, need to swallow liquids during

the meal, swallowing difficulties, loss of pleasure to eat, among others. The proposed cut-off for the scale was 3, in which a score of EAT-10≥3 indicates a higher risk of dysphagia (Belafsky et al., 2008; Gonçalves et al., 2013).

Classification of drugs according to their xerogenical potential

Medications may act on the central nervous system and/or at the neuroglandular junction, which explains the gland dysfunction; the secretory cells are supplied with muscarinic M_1 and M_3 receptors (fluid secretion), α_1 and β_1 adrenergic (protein and fluid secretion), and certain peptidergic receptors that are involved in saliva secretion (Wolff et al., 2017). The drugs contained in the medications were classified according to xerogenic potential, considering the main mechanisms of regulation of salivary production (Tiisanoja et al, 2018). Thus, the drugs were classified as potentially xerogenic, potentially antixerogenic, variable interference or non-interfering.

Xerogenic drugs included those with known parasympatolytic or sympathomimetic activity, since blocking parasympathetic actions or sympathetic stimulation may reduce the flow or fluidity of saliva. Thus, this group includes anticholinergics (antimuscarinics and other groups with predictable antimuscarinic activity, such as antihistamines, antidepressants, antipsychotics, opioids and levodopa), adrenergics and thyroid hormones (which have secondary adrenergic activity). Antixerogenics include drugs that have direct or indirect sialagogue activity because they cause parasympathetic activation or sympatholytic activity. Accordingly, this group includes antiadrenergic and cholinergic drugs. Drugs classified as variable interference include pharmacological groups that are cited in the literature as xerogenic or antixerogenic, but this relationship seems not directly related to the mechanisms of regulation of salivary flow. This group includes antihypertensives (except antiadrenergic), ACE inhibitors, diuretics, sedatives, antidiabetics, NSAIDs, corticosteroids and antiulcerogenics (Balakumar et al., 2015). Finally, drugs that did not present a citation of interference in the mechanisms of saliva production or did not seem to be related to these mechanisms were classified as non-interfering.

Furthermore, the side effects related to prescription drugs use were reviewed to classify them according to the possible relation to dysphagia symptoms (other than

hypo/hypersalivation), such as cough, asthenia, fatigue, tiredness, and muscle relaxant activity (Schwemmle et al., 2015; Miarons et al., 2016).

Measurement of salivary flow

For salivary flow assessment, samples of unstimulated and stimulated mixed saliva were collected in the morning, in this sequence, with the participant fasted for at least 2 h after the last meal and 1 h after oral hygiene. The unstimulated mixed saliva was collected by the "spitting" method, with subjects comfortably seated, and after a few minutes of relaxation, having their mouths rinsed with distilled water. The participant remained with the head slightly tilted forward, without swallowing, allowing the saliva accumulated in the floor of the mouth to drip on a pre-weighed tube coupled to a funnel (Freitas et al., 2017) for 5 minutes. The flow was calculated according to the collection time in mL/min. The stimulated mixed saliva was collected by chewing on 0.3 g of Parafilm® for 5 min. During both collections, the participant was free to expel the saliva to the tube anytime.

Gustatory sensitivity

The evaluation of gustatory sensitivity was performed using the *three-drop-method*, as previously described (Mueller et al., 2003). The method consists of four liquid solutions in different concentrations related to primary flavors: salty (NaCl 0.25, 0.1, 0.04, 0.016 g/mL); sweet (sucrose 0.4, 0.2, 0.1, 0.05 g/mL); acid (citric acid 0.075, 0.041, 0.0225, 0.0125 g/mL); bitter (quinine hydrochloride 0.0015, 0.0006, 0.0002, 0.0001 g/mL). The solutions were given with a dropper (three drops) on the back of the tongue, being one drop of the tastant and two drops of distilled water. The order of presentation of the tastants was chosen for each individual, having four different random possibilities in an increasing order of concentrations: then, the participant chose one of the four options: sweet, salty, bitter or acid (sour), with no time limit for the response. Between each test the subjects were instructed to rinse the mouth with water to avoid residual taste that could interfere in taste perception. For each test correctly identified, the volunteer received 1 point, and zero for the incorrect answers, either because he could not identify the flavor or because he confused it with another flavor, did not score points.

Statistics

Data was statistically analyzed by using SPSS 24.0 (IBM Corp., NY, USA), considering an alpha level of 5% by one of the authors (PMC). The exploratory analysis consisted of means, standard deviation, medians, quartiles and percentages. Differences in the frequency (categorical data) and medians (continuous data) between groups were compared using Chi-square test and Mann-Whitney test, respectively.

A general linear model – a Two-way analysis of variance (Two-way ANOVA) - was used to test the effect of polypharmacy and sex (as categorical independent variables) on the demographic and physical variables under study.

The effect of xerogenic drugs and sex (as categorical independent variables) on EAT-10 and xerostomia scores, salivary flow rate and gustatory sensitivity was evaluated using Analysis of covariance (Two-way ANCOVA), controlling for “age”. The assumption of linearity between each dependent variable and the covariate “age” was tested previously by observing the scatterplots generated.

The correlation between the clinical variables was evaluated using the Spearman correlation test and examining a bubble graph. Finally, the estimation of xerostomia scores (as the dependent variable) was obtained using a Poisson regression: age, sex, gustatory sensitivity, salivary flow rate, total number of medications in use and the number of xerogenic drugs were considered as potential independent variables; adjustment of the final model was based on deviance, Pearson’s chi-square and Omnibus test.

RESULTS

The description of the sample according to sociodemographic and physical characteristics are shown in Table 1. Polypharmacy was found in a frequency of 17.7% of the sample.

According to the Two-way ANOVA, no significant effects of polypharmacy, sex and the interaction between these factors were observed on sociodemographic and physical characteristics ($p>0.05$).

Table 2 shows the total frequency of medication use according to xerogenic effects, with the highest percentage classified as variable interference while the antixerogenic ones showed a lower frequency.

Table 1. Demographic and physical characteristics of the sample according to sex and number of medications in use: a Two-way analysis of variance

	n	Age (months)	Sex	Schooling (>8 years)	ABEP score	BMI (Kg/m2)	Arm circumference (cm)	Leg circumference (cm)
		Mean (SD)	F/M	%	Median (25-75%)	Mean (SD)	Mean (SD)	Mean (SD)
Females	123	68.3 (5.9)	-	50.4	19 (15-24)	27.7 (4.9)	28.9 (3.9)	34.0 (4.5)
Males	81	70.2 (7.2)	-	54.3	21 (18.5-25)	27.3 (4.3)	28.5 (3.7)	35.1 (4.7)
Polypharmacy (≥5 medications)	36	70.6 (7.3)	26/10	33.3	18 (14-22)	28.8 (5.1)	29.7 (4.1)	34.5 (4.1)
Non polypharmacy (<5 medications)	168	68.7 (6.3)	97/71	56.5	20 (16-25)	27.3 (4.5)	28.6 (3.7)	34.4 (4.7)
Total	204	69.0 (6.5)	123/81	52.5	20 (16-24.75)	27.5 (0.3)	28.8 (0.3)	34.4 (0.3)
Two-way ANOVA (*polypharmacy*sex*) model p-value		-	-	0.246	0.135	0.378	0.483	0.279

ABEP, Criterion of Brazilian Economic Classification; BMI, body mass index.

Table 2. Frequency of medication in use according to xerogenic effects

Side effect	Specific effects	Medication in use	Number of individuals	%
Xerostomia	Xerogenic drugs	Anticholinergics Antidepressants Antipsychotics Opioids Levodopa Adrenergics Thyroid hormones	48/204	23.5
	Antixerogenic drugs	Antiadrenergics Cholinergics	31/204	15.2
	Variable interference	Antidiabetics Diuretics Antihypertensive ACE inhibitors Anti-inflammatory Corticosteroid Sedatives	151/204	73.5
	No evidence of interference	Vitamins Other	95/204	46.6

The clinical characteristics of the sample according to sex and presence of polypharmacy are shown in Table 3. Dry mouth complaint (an answer “yes” in the 4th question of the xerostomia inventory XI) was reported by 49% of the subjects from sample; on the other hand, and in accordance to the cut-offs reported in the literature, only 6.9% presented hyposalivation considering the unstimulated saliva flow and 46.1% presented hyposalivation considering the stimulated one.

According to the results of Two-way ANCOVA and considering polypharmacy and sex as factors (controlling for age), significant effect of sex was found for US flow rate and gustatory sensitivity, in which males showed higher salivary flow rate and lower taste scores.

Considering the EAT-10 cut-off of 3 points, 24 subjects (12% of the sample) presented higher risk of having dysphagia. Polypharmacy showed a significant effect on EAT-10 and xerostomia scores, with higher scores and complaints about swallowing problems and dry mouth among the elderly who were classified as

polypharmacy. No significant *polypharmacy*sex* interaction was found, meaning that the effects of these variables are independent (Figure 1).

The same approach was applied to the effect of xerogenic drugs and sex on each clinical variable (xerostomia, EAT-10, saliva flow and gustatory sensitivity), using Two-way ANCOVA and controlling for age; no significant effect was found for any clinical variable.

Table 3. Clinical characteristics of the sample according to sex and polypharmacy: a Two-way ANCOVA

	n	Total number of medications	EAT-10	Xerostomia inventory XI	US flow (mL/min)	SS flow (mL/min)	Taste total score
		Median (25-75%)	Median (25-75%)	Median (25-75%)	Mean (SD)	Mean (SD)	Median (25-75%)
Females	123	3 (2-4)	0 (0-1)	19 (15-24)	0.33 (0.02)	0.80 (0.04)	16 (15-17)
Males	81	2 (1-4)	0 (0-0)	18 (15-21)	0.42 (0.27)	0.97 (0.06)	15 (13-16.5)
Polypharmacy (≥ 5 medications)	36	6 (5-6.75)	0 (0-3.75)	20.5 (15-29.75)	0.30 (0.04)	0.83 (0.09)	15 (14-17)
Non polypharmacy (< 5 medications)	168	2 (1-3)	0 (0-0)	18 (14.25-23)	0.38 (0.02)	0.87 (0.04)	16 (14-17)
Two-way ANCOVA†							
model p-value		-	**0.005**	**0.041**	**0.039**	0.059	**0.005**
sex effect p-value		-	0.806	0.394	**0.025**	0.079	**0.001**
polypharmacy effect p-value		-	**0.001**	**0.041**	0.287	0.854	0.537
Xerogenic drugs users‡	48	4 (2-5)	0 (0-1.75)	20 (15.25-25)	0.309 (0.16)	0.801 (0.46)	16 (15-16.75)
Xerogenic drugs non-users	156	2 (1-3)	0 (0-0)	17 (15-23)	0.383 (0.27)	0.883 (0.52)	16 (14-17)
Total sample	204	2 (1-4)	0 (0-1)	18 (15-23.75)	0.36 (0.02)	0.86 (0.04)	16 (14-17)

EAT, Eating Assessment Tool-10; US, unstimulated saliva; SS, stimulated saliva.
† Polypharmacy*sex, controlled for age
‡ Xerogenic drugs: anticholinergic, adrenergic or thyroid drugs.

Figure 1 shows the polypharmacy effect on EAT-10 scores using the Two-way ANCOVA analysis, controlling for age.

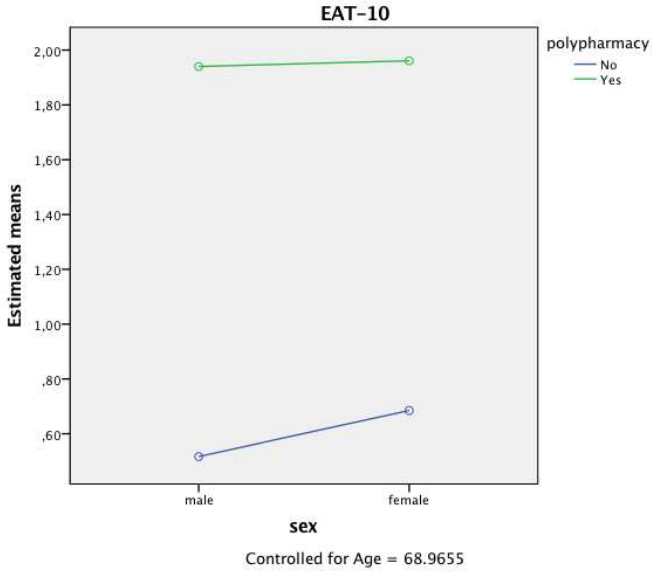

Figure 1. Effect of polypharmacy and sex on dysphagia symptoms (EAT-10 scores): a Two-way ANCOVA analysis (Sex effect: F=0.06, p=0.806, power=0.057; Polypharmacy effect: F=12.406, p=0.001, power=0.939; Age effect: F=0.104, p=0.748, power=0.062; polypharmacy*sex interaction: F=0.037, p=0.847, power=0.054).

The correlation coefficients found between the clinical characteristics of the sample are shown in a bubble graph (Figure 2). Significant correlations were found between the number of medications and age (rho=0.15; p=0.032), EAT-10 score (rho=0.30; p<0.001) and xerostomia scores (rho=0.20; p=0.004). In addition, EAT-10 score correlated positively with xerostomia (rho=0.26; p<0.001).

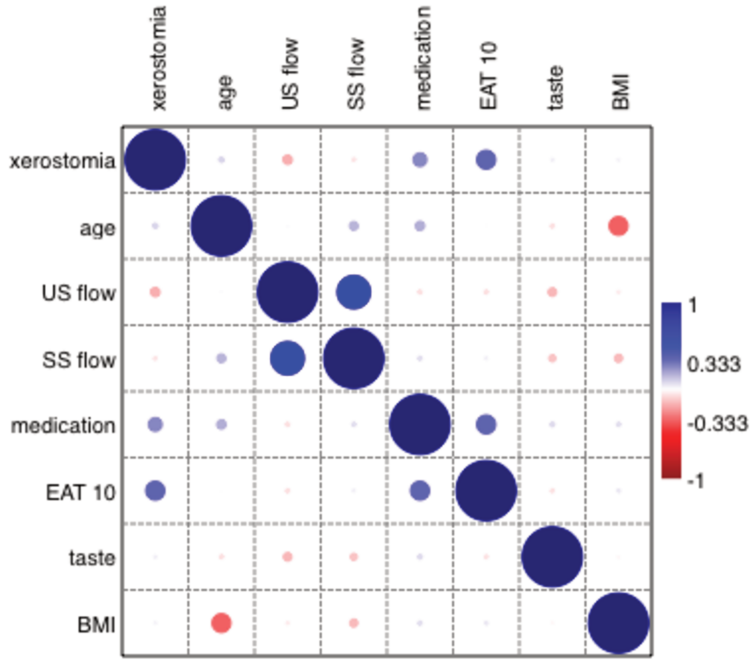

Figure 2. Bubble graph showing the correlations between the clinical characteristics of the sample: Xerostomia Inventory XI score, age, unstimulated (US) salivary flow, stimulated salivary (SS) flow, number of medications taken, Eating Assessment Tool-10 (EAT-10), taste sensitivity and body mass index (BMI). Positive correlations as shown in blue color, while negative correlations are shown in red.

Thus, taking xerogenic drugs had no significant effect on dysphagia complaints as polypharmacy did, and when exploring which medication had an impact on swallowing problems, it was observed that angiotensin converting enzyme (ACE) inhibitors users (n=36) scored higher on EAT-10 (ACE inhibitors users EAT-10 mean score = 1.7 x non-users = 0.7; Mann Whitney test, p-value = 0.038).

Table 4 shows the Poisson regression model used to estimate the scores obtained in the Xerostomia Inventory. Xerostomia scores variation was dependent on sex, unstimulated saliva flow and total number of medications in use, meaning that male sex and higher unstimulated saliva flow were related to lower scores on xerostomia inventory; in addition, xerostomia score was 1.04 times greater for each extra medication taken.

Table 4. Final model obtained by Poisson regression for estimation of xerostomia score (Xerostomia Inventory XI)

Independent variable	B	Exp (B)	CI (95%) Exp (B)	Wald Chi-square	p-value
Intercept	2.991	19.897	18.473 – 21.431	6229.030	**<0.001**
Sex: male	-0.067	0.935	0.876 – 0.998	4.127	**0.042**
Sex: female	0	1	.	.	.
US flow	-0.039	0.962	0.937 – 0.988	8.392	**0.004**
Total number of medications	0.037	1.038	1.023 – 1.053	21.831	**<0.001**

Omnibus test: Chi-square=45.579; DF=3; p<0.001
US, unstimulated saliva.

The percentages of second higher concentration correctly identified were greater than 90% for all tastants (sweet, sour, bitter and salty). The percentages were also tested between elderly classified as polypharmacy and between diuretic users and non-users. The frequency of correct answers in polypharmacy subjects did not differ from those non-polypharmacy, neither between subjects who were and were not taking diuretic drugs (Chi-square; p>0.05).

	Range	25% total sample	Median total sample	75% total sample	Correct (%) total sample	Correct (%) polypharmacy	Correct (%) diuretic users
n		**203**	**203**	**203**	**203**	**36**	**39**
Sweet 1	-	-	-	-	98.5	100.0	100.0
Sweet 2	-	-	-	-	98.0	100.0	97.4
Sweet 3	-	-	-	-	87.7	86.1	82.1
Sweet 4	-	-	-	-	49.3	50.0	41.0
Sweet total	0-4	3	3	4	-	-	-
Salty 1	-	-	-	-	93.6	100.0	94.9
Salty 2	-	-	-	-	91.1	91.7	89.7
Salty 3	-	-	-	-	84.7	88.9	87.2
Salty 4	-	-	-	-	66.0	66.7	69.2
Salty total	0-4	3	4	4	-	-	-
Sour 1	-	-	-	-	98.0	97.2	97.4
Sour 2	-	-	-	-	96.1	94.4	94.9
Sour 3	-	-	-	-	89.2	86.1	82.1
Sour 4	-	-	-	-	73.4	72.2	74.4
Sour total	0-4	3	4	3	-	-	
Bitter 1	-	-	-	-	97.5	97.2	94.9
Bitter 2	-	-	-	-	96.1	91.7	94.9
Bitter 3	-	-	-	-	79.8	77.8	76.9
Bitter 4	-	-	-	-	50.3	38.9	48.7
Bitter total	0-4	3	3	4	-	-	-

1 – highest concentration; 4 – lowest concentration

DISCUSSION

Polypharmacy was found at a frequency of 18% of the sample, a lower frequency than the range of 20-52% reported in previous studies (Jyrkka et al., 2011; Golchin et al., 2015), being related with xerostomia and dysphagia symptoms, and not with salivary flow and taste dysfunction. In addition, dry mouth complaints were associated with female sex, unstimulated salivary flow and the total number of medications in use, but not specifically with the number of xerogenic drugs. As the understanding of the pathogenesis of oral dysfunctions is complex because of the difficulty to discriminate between the specific effects of medications and the underlying diseases, the goal of this study was to perform a comprehensive overview of the relationship between the most common oral/maxilofacial dysfunctions and polypharmacy.

Xerostomia, hyposalivation and polypharmacy

It is estimated that xerostomia is present in approximately 20% of the population (Hopcraft and Tan, 2010; Miranda-Rius et al., 2015), ranging from 12% to 39% (Thomson, 2015) and being higher among the elderly and polypharmacy individuals; in addition, women seem to be more susceptible than men (Hopcraft and Tan 2010; Johanson et al., 2013; Miranda-Rius et al., 2015). In the present study, dry mouth complaints were observed in 49% of the sample, but considering unstimulated and stimulated salivary flow, signs of hyposalivation were observed in 7% and 46% of the sample, respectively. These findings corroborate the study of van der Putten et al. (2011) which observed a prevalence of xerostomia of 52%, without sex differences; the unstimulated and stimulated salivary flow, were observed in 24% and 60% of the sample, respectively; both studies also found lower salivary secretion rates in women, and possibly this is why women were more likely to show a greater number of xerostomia complaints in the regression analysis.

The present findings also observed that xerostomia is correlated to the unstimulated salivary flow, but not to with the stimulated one. There are two possible explanations: estimation of hyposalivation in the elderly may have a wider range, varying from 5% to 47%, being a challenge due to the different methods of collection, definitions (Thomson, 2005), and the inherent difficulties and limitations from each method (Thomson, 2015). In addition, since the stimulated saliva secretion has an

inherent greater flow, the perception of dry mouth tends to be diminished. Anyway, previous findings strongly suggest that xerostomia and hyposalivation are not necessarily concurrent (Osterberg et al., 1984; Thomson et al., 1999) and, in fact, a relatively small proportion of dry mouth sufferers have both conditions. Accordingly, it is prudent to measure both salivary flow and xerostomia whenever possible.

The elderly population commonly uses more medications and tends to be more vulnerable to the adverse effects that they can provide (Jyrkka et al., 2011). Physiologically, activation of the parasympathetic nervous system induces increased production of more fluid and electrolyte-rich saliva; on the other hand, the activation of the sympathetic nervous system induces the production of a less fluid (more viscous), protein-rich saliva. The literature reports that the main drugs that may lead to xerostomia are the anticholinergics, antidepressants, antihypertensives, antihistamines and sedatives (Villa et al., 2016), possibly because these types of drugs present antimuscarinic properties. Several studies (Miranda-Rius et al., 2015; Villa et al., 2016; Tan et al., 2018) have attempted to quantify the xerogenic potential of drugs and their influence on salivary glands, but those studies have not found conclusive evidence. When considering one class of drugs, an in-deep approach is necessary because each drug may have different types of mechanisms of action involved. In the present study, we considered as anticholinergic xerogenic drugs, the antihistamines, antidepressants, antipsychotics, opioids and levodopa, adrenergic drugs and thyroid hormone, besides the parasympathetic drugs; antihypertensives (excluding the antiadrenergics), antidiabetics and diuretics were excluded, since the mechanisms involved in this possible effect are poorly understood (Hopcraft and Tan, 2010; Balakumar et al., 2015; Djukic et al., 2015) and although they were already cited in the literature as xerogenic (Villa et al., 2015).

The hypothesis for the xerogenic effects of antihypertensives may be related to their hypotensive effect. When an antihypertensive agent causes hypotension, the sympathetic nervous system is activated, leading to the release of noradrenaline and adrenaline, known as xerogenic agents (Balakumar et al., 2015). The same mechanism may be attributed to the antidiabetics: when they cause hypoglycemia, a strong adrenergic response is triggered to increase glycemia through the stimulation of hepatic glycogenolysis. In addition, antihypertensives and diuretics may affect the hydroelectrolyte balance which may also be involved in the regulation of saliva

production. It is important to stress that many antihypertensives in current use (such ACE inhibitors) do not cause frequent hypotension episodes, since they control the production of mediators involved in increasing the of blood pressure (Israili and Hall, 1995). Similarly, antidiabetics such metformin (the most frequently taken in the sample) are currently considered antihyperglycemic rather than hypoglycemic agents, and thus their influence on salivary flow should be minimal. On the other hand, sulphonylureas (also frequently reported in the sample) are more frequently related to hypoglycemic episodes (Bodmer et al., 2008; van Dalem et al., 2016).

It is known that thyroid hormones indirectly increase the sympathetic activation, and therefore, they may be considered as indirect-acting adrenergics, such as increased heart rate and blood pressure observed in cases of hyperthyroidism. Considering that adrenergic agents can interfere in the saliva production, it can be expected a potential xerogenic effect from the use of levothyroxine, a synthetic thyroid hormone (Fuchs and Wannmacher, 2017).

In this study, no difference was observed in salivary flow or xerostomia considering the use of xerogenic drugs; however, dry mouth complaints were associated with the total number of medications in use, and the xerostomia score increased 1.038 times for each medication added. Curiously, this was not specifically related with the number of xerogenic drugs. The literature also supports the hypothesis that xerostomia is proportional to the number of drugs taken (Johanson et al., 2009; Saleh et al., 2011; Thomson, 2015), but the mechanism related to this phenomenon is still not well understood. A possible explanation would be the drug-drug interactions that may be involved (Hopcraft and Tan, 2010; Johanson et al., 2013), but the understanding of adverse drug events and interactions in people taking large numbers of drugs is limited (Guthrie et al., 2015). Studies reported that a specific drug taken alone may not have xerogenic effect, but when combined with other drugs, this combination may increase the perception of xerostomia (Hopcraft and Tan, 2010; Djukic et al., 2015). For example, drugs classified as variable interference in this work included pharmacological groups that are cited in the literature as xerogenic or even antixerogenic. Although this relationship does not seem directly related to the mechanisms of regulation of salivary flow (Balakumar et al., 2015), they may exacerbate the perception of dry mouth when combined with other drugs.

Symptoms of dysphagia, xerostomia and polypharmacy

Despite the presumed effects of some drugs on the swallowing function, the study of their impact has received little attention. People with hyposalivation and xerostomia have more difficulty speaking, chewing and swallowing, especially dry foods, and sometimes need to drink while they eat to facilitate swallowing (Thomson, 2015; Saintrain and Gonçalves, 2013). The present findings observed a positive correlation between the symptoms of xerostomia and dysphagia, corroborating with literature that demonstrates the direct influence of hyposalivation on the sensation of dry mouth and difficulty in swallowing (Saintrain and Gonçalves, 2013). Lee et al. (2016) observed the prevalence of xerostomia in 40% of their sample and observed that, of these, 75% showed difficulty in swallowing liquids. This fact is explained because food swallowing occurs when two thresholds are found, one being the food particle size threshold and the other the food bolus lubrication threshold obtained by the flow of saliva into the oral cavity (Pedersen et al., 2002).

In the study of Marquis et al. (2013), swallowing difficulties impaired extremely daily life in 12 % of the patients; they also observed that intentional non-adherence and altering the oral dose formulation were the most common harmful strategies used by patients to overcome their swallowing difficulties. According to the literature, patients using antipsychotics, antidepressants or drugs against dementia 9which present anticholinergic properties) were at a higher risk of having dysphagia; some case reports mentioned the adverse effects of antipsychotics, such as extrapyramidal symptoms and tardive dyskinesia, being a possible cause of swallowing problems (Sokoloff and Pavlakovic, 1997; Stewart, 2003; Dziewas et al., 2007; Miarons et al., 2016). In this study, this class of drugs was not explored because of the exclusion criteria.

The present findings also showed a relationship between symptoms of dysphagia and polypharmacy, but not a significant relationship to the use of xerogenic drugs; and when exploring which medication would have an impact on swallowing problems, ACE inhibitor users showed greater swallowing complaints, probably because cough is one of the most frequent side effects associated with ACE inhibitors (Mackay et al., 1999). It has been also suggested that some antidepressants with strong anticholinergic effect such as tricyclic antidepressants can produce xerostomia (Miarons et al., 2016), and benzodiazepines may affect the

swallowing function because of their depressant actions on the central nervous system; however, evidence is scarce and most of these results were observed in case studies (Korsten et al., 1991; Dantas and Souza, 1997; Crouse et al., 2018).

Taste, xerostomia and polypharmacy

Three functions were assigned to the sense of taste, namely a warning of danger, interpersonal communication and importance for eating and drinking (Stevenson, 2010). Therefore, it is important to understand the possible sensorial changes due to age and its interferences. Aging may be related to peripheral neural degeneration, changes in sensory thresholds, abnormalities in central processing, or other factors associated with age, such as the presence of chronic diseases like diabetes mellitus that may impact taste sensitivity (Silva et al., 2014; Heft and Robinson, 2010).

Considering similar concentrations of the tastants of the study of Boesveldt et al. (2011), the present findings did not observe great taste dysfunction as less than 10% of the sample showed severe gustatory dysfunction, comparing to the findings of that study, which observed severe gustatory dysfunction in 14.8% of a large sample of older adults. The lower frequency of taste dysfunction and the lower frequency of polypharmacy found in the studied sample are the probable reasons why no significant difference in gustatory sensitivity was observed in the elderly classified as polypharmacy or who were taking xerogenic drugs. Also, no significant correlation was found between taste sensitivity and xerostomia, and only a weak correlation was observed between taste and salivary flow rate, although previous studies suggest that saliva secretion play a key role for taste (Hummel et al., 2011). Corroborating previous findings, women showed a better taste perception when compared to men (Silva et al., 2014), although they presented, at the same time, lower unstimulated salivary flow. This finding may be explained by hormonal modulations or simply because of psychological aspects, since women are more likely to pay attention to details (Silva et al., 2014).

However, the literature suggests that many drugs may negatively influence patients' taste either through decreased function or perceptual distortions, although most of the mechanisms involved seems unclear (Hummel et al., 2011). Some types of diuretics could block the sodium channels in the taste cell, suggesting that it might

alter the taste of some salts (Doty et al., 2008), although in this study no significant gustatory changes were observed in diuretics users.

Innumerable changes, such as physiological, behavioral, physical and/or emotional, characterize ageing. The reduction in saliva secretion associated with the symptoms of xerostomia and dysphagia and the use of multiple medications are relevant and must be followed, since protective and adaptive functions evolved are related to the perception and acceptance of food, which may, in turn, have consequences to the elderly's nutritional status and their quality of life. As those adverse effects of drugs and oral/maxillofacial dysfunctions that characterizes the geriatric syndrome may alter dietary choices (Doty et al., 2008), clinicians need to regularly review and optimize chronic medication.

CONCLUSIONS

Polypharmacy was found at a frequency of 18% of the sample and was related with xerostomia, but not with salivary flow and taste dysfunction. In addition, dry mouth complaint was found in almost 50% of the sample, being associated with female sex, unstimulated salivary flow and the total number of medications in use, but not specifically with the number of xerogenic drugs.

Considering the proposed EAT-10 cut-off, 12% of the sample presented higher risk of having dysphagia, being correlated with xerostomia and the number of medications in use; moreover, angiotensin converting enzyme inhibitors users showed more complaints of dysphagia.

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3 DISCUSSÃO

Com base nos artigos apresentados, pode-se observar a importância do conhecimento das alterações fisiológicas decorrentes da idade e suas relações com a cognição, nutrição e a polifarmácia.

A proposta desse trabalho foi realizar uma análise exploratória dos dados, para verificação de problemas orofaciais relacionados com a idade, dentre eles se a perda dentária, perda sensitiva, diminuição dos padrões mastigatórios seriam fatores associados a cognição e ao padrão corporal, além da relação da polifarmácia, principalmente com a utilização de medicamentos xerogênicos, com fluxo salivar, sintomas de disfagia, xerostomia e paladar. A amostra desse estudo caracterizou uma população idosa com características de sobrepeso, índice CPOD alto, a maioria com nível de escolaridade até o ensino fundamental e média de idade 70 anos para os homens e 68 para as mulheres. Também observou-se presença de um pequeno grupo (cluster 2) denominado de “bons mastigadores” que apresentavam melhores padrões mastigatórios e com menor CPOD. Houve associação dos sintomas de disfagia e xerostomia, diferenças entre sexos relacionadas ao paladar e fluxo estimulado, e associação de hipossalivação e xerostomia apenas para a polifarmácia não relacionada com a utilização de medicamentos xerogênicos. Esses dados foram os mais relevantes nas análises desse estudo.

Segundo a OMS, o IMC tende a aumentar na meia idade e estabiliza por volta dos 50-60 anos nos homens e as mulheres tendem a atingir esse platô mais tarde, após os 70 anos, sendo que ambos tendem a diminuir por volta dos 70-75 anos de idade (WHO, 1995). Nesse estudo, 76,6% da amostra apresentaram índice de sobrepeso, corroborando com estudo de Oehschlaeger et al. (2015) que observou presença de sobrepeso e obesidade também na maioria da sua amostra, em 82,9%, sendo este estudo também realizado no Brasil. Sabe-se que o IMC elevado está associado ao risco de doenças crônicas e ao aumento de desgastes articulares que podem causar limitações funcionais no idoso (Tsai, Chang 2017), por isso a prática de atividades físicas é bem recomendada para os idosos (Oehschlaeger et al. 2015).

A avaliação dos padrões mastigatórios é extremamente importante para a nutrição e manutenção das funções musculares. Tais padrões não demonstraram diferenças entre homens e mulheres, e tal fato pode ser explicado. Os homens

apresentam força muscular maior e as mulheres podem compensar essa diferença com o aumento da velocidade do ciclo mastigatório devido à coordenação das funções motoras e sensoriais (Morita et al. 2018). Na verificação da influência dos padrões corporais com os padrões mastigatórios nosso estudo não apresentou diferença estatística, mas a literatura apontou que em idosos acima de 70 anos o desempenho mastigatório foi pior e estava associado à prevalência de síndrome metabólica, salientando a importância da manutenção e recuperação da mastigação (Kikui et a. 2017). Também observou-se associação negativa do IMC com a idade (a cada um ano de idade que aumenta, espera-se uma diminuição de 0,18 do IMC), com CPOD (o aumento de 1 ponto do CPOD, levou em média a diminuição de 0,22 no IMC) e com a avaliação subjetiva da mastigação no domínio frutas, onde a dificuldade de comer frutas, como maçã, demonstrou diminuição do IMC. A literatura aponta para o fato que a perda dentária dificulta o processo mastigatório e pode ser um fator de risco para o desenvolvimento de sobrepeso já que os alimentos ricos em fibras com maiores valores nutricionais acabam não sendo mais os de eleição (Song et al. 2017).

Com a análise de agrupamento dos dados, nota-se a importância da preservação de uma boa saúde oral, pois o grupo de bons mastigadores apresentaram melhores níveis em vários fatores. Para uma boa performance mastigatória o número de dentes presentes na boca, a condição de saúde dos mesmos, a qualidade da reabilitação são fatores extremamente relevantes (Kimura et al., 2013, Okada et al., 2010). Em relação ao uso de próteses, no grupo 2, 70,83% dos participantes não utilizavam próteses e 20,83% tinham próteses fixas, demonstrando a relevância da preservação dos dentes naturais ou com poucas reabilitações protéticas, pois o uso de próteses removíveis pode restringir a movimento mandibular, diminuindo o desempenho mastigatório (Morita et al., 2018).

Considerando fatores como perda cognitiva e comprometimento físico, a literatura apontou que tais fatores não são tão influentes na performance mastigatória (Okada et al. 2010) corroborando com nossos achados, embora a literatura também aponte que problemas na mastigação e alimentação parecem estar associados com a função cognitiva e demência (Cocco et al. 2018, Tada, Miura 2017). Segundo Okada et al. (2010) pessoas com quadro depressivo ou com comprometimento cognitivo não realizam o atendimento odontológico adequado, ou

a aceitação à prótese seja em menor escala devido ao próprio quadro físico que se encontram, onde tais fatores não são prioridade.

Outro dado que poderia estar associado ao quadro cognitivo, seria a avaliação sensorial, já que a realização dos testes sensoriais exige o máximo do estado de atenção do voluntário (Heft e Robinson et al, 2010). A detecção sensorial varia com a densidade de receptores em cada região, do aspecto emocional e ambiental e com a intensidade de estímulo (Siqueira, 2011). Além desses aspectos a sensibilidade somestésica diminui com a idade (Heft e Robinson, 2010; Siqueira 2011) e apresenta diferenças entre os sexos (Heft e Robinson, 2010; Siqueira, 2011; Costa et al., 2019). Os testes utilizados foram o QST e o de discriminação de dois pontos, que são testes com boa sensibilidade e especificidade (Svensson et al., 2011) para determinação de limiares táteis. Os resultados deste estudo não demonstraram significância da sensibilidade orofacial com os padrões mastigatórios e padrões corporais. Na regressão observou-se que o QST do lábio superior se associou positivamente com a cognição e tal observação pode estar associada à diferença de limiares existentes entre o lábio superior e inferior, pois os lábios superiores demonstram maior sensibilidade (Heft e Robinson, 2010).

Como relatado anteriormente, com a idade também aumenta o risco de desenvolvimento de doenças crônicas e tal fato vem acompanhado do uso de múltiplos medicamentos. Por possuírem efeitos colaterais associados, os medicamentos podem ter influência sobre o sistema nervoso autônomo. Quando bloqueiam o sistema parassimpático, influenciam na secreção salivar diminuindo o fluxo salivar. Já quando atuam sobre o sistema nervoso simpático, mudam a qualidade da saliva, produzindo uma saliva mais viscosa, que pode dar a sensação de boca seca, sintoma de xerostomia. Na literatura observa-se que os estudos apontam que a utilização de múltiplos medicamentos está associada à xerostomia (Miranda-Rius et al., 2015; Villa et al. 2016; Wolff et al., 2017), porém poucos associam a utilização de medicamentos xerogênicos e utilizam métodos de quantificação do fluxo salivar (Johanson et al., 2015).

A nossa hipótese foi a de que o uso de medicamentos potencialmente xerogênicos poderia estar associado aos sintomas de xerostomia e alteração no fluxo salivar, já que a literatura considera que algumas drogas, principalmente as anticolinérgicas e simpatomiméticas, teriam maior influência sobre o fluxo salivar, causando a hipossalivação (Thomson, 2015; Saleh et al., 2015; Tiisanoja et al.,

2018). Porém, não observamos tal correlação. Os achados do nosso estudo apontaram que a polifarmácia apresentou efeito sobre os sintomas de xerostomia e disfagia, mas não com o fluxo. O modelo preditivo obtido mostrou que o escore de xerostomia aumenta 1,038 vezes para cada medicação a mais utilizada e alguns estudos apontam para essa relação (Hopcraft, Tan, 2010; Johanson et al., 2015; Saleh et al., 2015). Uma possível explicação seria os diferentes efeitos dos medicamentos nas diferentes idades e as possíveis interações medicamentosas envolvidas (Hopcraft; Tan 2010; Johanson et al., 2015). Estudos relataram que um medicamento específico tomado isoladamente pode não demonstrar efeitos xerogênicos, mas quando associado a outros fármacos a combinação pode aumentar a prevalência de xerostomia (Hopcraft, Tan 2010; Djukic et al., 2015).

Outro ponto importante associado à saliva é a transdução química do paladar. Os idosos apresentam alterações no paladar que podem estar associadas com a degeneração neural periférica, anormalidades no processamento central, ou outros fatores associados com a idade como por exemplo a presença de doenças crônicas como diabetes mellitus (Heft, Robinson, 2010; Imoscopi et al, 2012; Silva et al., 2014), e essa perda pode ocasionar perda de apetite, e por consequência má-nutrição e perda de peso (Imoscopi et al., 2012; Doty et al., 2008). O presente estudo não apresentou diferença na sensibilidade gustativa em idosos com e sem polifarmácia, o que demonstra que os medicamentos tiveram pouca influência sobre o paladar. Imoscopi et al. (2012), apontaram que a prevalência de alterações no paladar, induzidas por medicamentos, é de apenas 21,7%, sendo uma prevalência baixa, e talvez por isso não observamos tais alterações. Porém, de acordo com Silva et al. (2014), constatou-se que as mulheres tinham melhor percepção do paladar quando comparadas com os homens apesar de terem apresentado, concomitantemente, menor fluxo salivar de repouso. Esse fato pode ser explicado por modulações hormonais ou simplesmente por aspectos psicológicos, pois as mulheres são mais atentas a detalhes (Silva et al, 2014).

O envelhecimento é caracterizado por inúmeras mudanças, sejam elas fisiológicas, comportamentais, físicas e/ou emocionais. A preservação da saúde bucal mantêm os padrões mastigatórios e isso garante melhor qualidade de vida e a diminuição da salivação, associada aos sintomas de xerostomia, disfagia e polifarmácia, é relevante clinicamente. Tais fatores devem ser acompanhados, já

que envolvem funções protetivas, adaptativas e são relacionadas com o estado nutricional do idoso.

4 CONCLUSÃO

Diante do exposto pode-se concluir que:

a) A polifarmácia pode ter relação com o aumento dos sintomas de disfagia e xerostomia, mas não afetou o fluxo salivar. Não observou-se associações dos fármacos potencialmente xerogênicos ao fluxo salivar, nem nos sintomas de xerostomia e disfagia. Além disso, os homens apresentaram pior percepção de paladar, porém com fluxo salivar mais alto, quando comparados com as mulheres.

b) Não houve associação dos padrões mastigatórios e sensitivos com a cognição. Entretanto, o estado bucal dos pacientes pareceu ter influência sobre o estado nutricional dos mesmos. Dois perfis de idosos bastante distintos foram identificados, mostrando uma relação entre função mastigatória, saúde bucal e nutrição.

Tais dados apontam a importância da preservação da saúde bucal para o estabelecimento de uma boa qualidade de vida.

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APÊNDICE 1

ANAMNESE, AVALIAÇÃO ANTROPOMÉTRICA E SOCIOECONÔMICA

ANAMNESE

Nome:_____idade:_____
Data de Nascimento:_____ Sexo:_____
Endereço:_____
Telefones:_____
Estado civil: _____

Histórico Médico

Possui alguma doença? ( )Sim ( ) Não
Se sim, quais?_____
Está em tratamento médico?_____
Faz uso de alguma medicação? ( )sim ( ) Não
Se sim, quais e quais as dosagens? _____
_____
Há quanto tempo você toma essas medicações? _____
Fuma? ( ) sim ( ) não Frequência:_____

AVALIAÇÃO ANTROPOMÉTRICA

Dados Atuais

Peso: _____
Altura: _____
Perímetro de braço: _____
Perímetro de perna: _____
IMC (kg/m^2) = _____

AVALIAÇÃO SÓCIO-ECONÔMICA
(ABEP, 2012)

Posse de itens

	Quantidade de Itens				
	0	1	2	3	4 ou +
Televisão em cores	0	1	2	3	4
Rádio	0	1	2	3	4
Banheiro	0	4	5	6	7
Automóvel	0	4	7	9	9
Empregada mensalista	0	3	4	4	4
Máquina de lavar	0	2	2	2	2
Videocassete e/ou DVD	0	2	2	2	2
Geladeira	0	4	4	4	4
Freezer (aparelho independente ou parte da geladeira duplex)	0	2	2	2	2

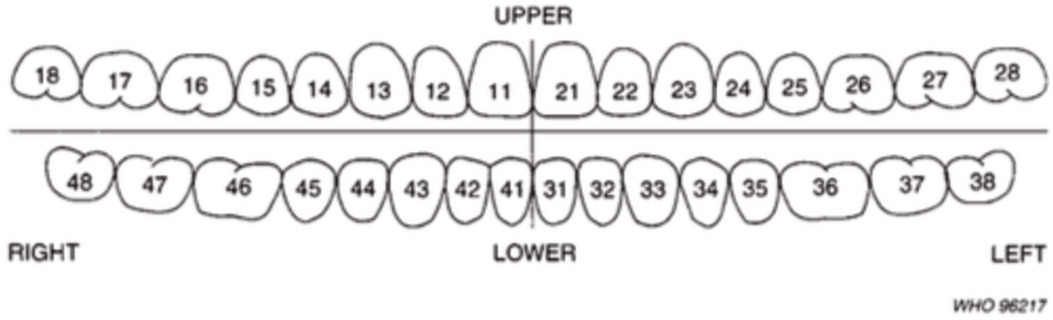
Grau de Instrução do chefe de família

Nomenclatura Antiga	Nomenclatura Atual	
Analfabeto/ Primário incompleto	Analfabeto/ Fundamental 1 Incompleto	0
Primário completo/ Ginasial incompleto	Fundamental 1 Completo / Fundamental 2 Incompleto	1
Ginasial completo/ Colegial incompleto	Fundamental 2 Completo/ Médio Incompleto	2
Colegial completo/ Superior incompleto	Médio Completo/ Superior Incompleto	4
Superior completo	Superior Completo	8

APÊNDICE 2

AVALIAÇÃO ODONTOLÓGICA

AVALIAÇÃO ODONTOLÓGICA



Exame dental – Descrição dente a dente

18_____
17_____
16_____
15_____
14_____
13_____
12_____
11_____
21_____
22_____
23_____
24_____
25_____
26_____
27_____
28_____
38_____
37_____
36_____
35_____
34_____
33_____
32_____
31_____
41_____
42_____
43_____
44_____
45_____
46_____
47_____
48_____

Número de dentes em contato: _____

Avaliação da Condição das próteses dentárias totais ou parciais removíveis

DEFEITOS NA PRÓTESE				
Tipo de defeito	Ausência (0)	Pequeno (1)	Grande (2)	Grave (3)
Ausência de dentes artificiais		( ) 1 a 2 dentes	( ) 3 ou mais dentes	( ) Total
Fratura de dentes artificiais		( ) 1 a 2 dentes	( ) 3 ou mais dentes	
Perda de área da base		( ) até 1 cm^2	( ) mais de 1 cm^2	
Fratura da prótese		( ) até 2 cm	( ) mais de 2 cm	
Subextensão da base		( ) selamento posterior		
		( ) tuberosidade		
		( ) papila retromolar		
Próteses imediatas			( ) sem a borda labial	( ) mais de um grande defeito
			( ) 2 pequenos defeitos	

MATERIAL DA PRÓTESE		
	SATISFASTÓRIO (0)	INSATISFATÓRIO (1)
Porosidade:		( ) mais de 1/3 da base da prótese
Reembasadores temporários:		( ) deficiente
Biofilme e/ou cáculo:		( ) biofilme ( ) cálculo

ESTABILIDADE		
	SATISFASTÓRIO (0)	INSATISFATÓRIO (2)
Deslocamento da linha média	( ) menos de 5mm	( ) mais de 5mm

RETENÇÃO		
	SATISFASTÓRIO (0)	INSATISFATÓRIO (3)
Abertura moderada da boca		( ) deslocamento da prótese

OCLUSÃO		
	SATISFASTÓRIO (0)	INSATISFATÓRIO (2)
Inserção de espátula metálica entre as superfícies oclusais	( ) 3 pontos de contatos em oclusão cêntrica	

CONDIÇÃO DOS TECIDOS MOLES			
	SATISFASTÓRIO (0)	INSATISFATÓRIO	
		(1)	(2)

Ulcerações relacionadas à prótese ( )	( ) ausentes	( ) 1 lesão	( ) mais de 1 lesão
Estomatite protética ( )	( ) ausentes	( ) 1 lesão	( ) mais de 1 lesão
Quelite angular		( ) 1 lesão	( ) mais de 1 lesão
Outras:		( ) 1 lesão	( ) mais de 1 lesão

Somatória da condição da prótese	**condição da prótese**	**Somatória**
	Satisfatória	0
	Insatisfatória	1-3
		4-7
		8-13

APÊNDICE 3 Avaliação do Estado Mental

AVALIAÇÃO DO ESTADO MENTAL (MINI MENTAL STATE EXAMINATION)

Paciente_____Idade_____

Entrevistador_____ Data ____ / ___ / ___

Agora vamos fazer algumas perguntas para saber como vai a sua memória. Sabemos que com o tempo, as pessoas vão tendo mais dificuldade para se lembrar das coisas. Não se preocupe com o resultado das perguntas.

ORIENTAÇÃO TEMPORAL

Dia da semana ( )Certo **( ) Errado**

Mês (**) Certo ( )**Errado

Data do mês ( )Certo ( ) Errado

Ano ( ) Certo ( ) Errado

Hora aproximada ( ) Certo ( ) Errado

Escore (Máximo cinco pontos): _____

(Para o dia do mês admite-se uma tolerância de um dia a mais ou a menos. Com relação às horas sem olhar para o relógio, admite-se uma tolerância de uma hora a mais ou a menos)

ORIENTAÇÃO ESPACIAL- Onde estamos

Local em que se encontra ( ) Certo ( ) Errado

Local específico ( ) Certo ( ) Errado

Bairro ou rua próxima ( ) Certo ( ) Errado

Cidade ( ) Certo ( ) Errado

Estado ( ) Certo ( ) Errado

Escore (Máximo cinco pontos): _____

REGISTRO- Repita as seguintes palavras

Vaso ( ) Certo ( ) Errado

Carro ( ) Certo ( ) Errado

Tijolo ( ) Certo ( ) Errado

(Caso o paciente repita as três palavras em qualquer ordem, computa-se três pontos. Cada palavra 1 ponto)

CÁLCULO E ATENÇÃO

100 – 7= _____ ( ) Certo ( ) Errado

93–7=_____ ( ) Certo ( ) Errado

86–7=_____ ( ) Certo ( ) Errado

79–7=_____ ( ) Certo ( ) Errado

72–7=_____ ( ) Certo ( ) Errado

Escore (máximo cinco pontos) _____

MEMÓRIA RECENTE: Quais foram as palavras que eu pedi que você repetisse há pouco?

1.Vaso ( ) CERTO ( ) ERRADO

2.Carro ( ) CERTO ( ) ERRADO

3.Tijolo ( ) CERTO ( ) ERRADO

Escore (máximo três pontos) _____

LINGUAGEM – Vou lhe mostrar dois objetos para que você me diga o nome deles

Relógio Certo **( )** Errado **( )**

Caneta Certo **( )** Errado **( )**

Escore (máximo dois pontos) _____

LINGUAGEM – Por favor, repita a seguinte frase:
"Nem aqui, nem ali, nem lá" Certo **( )** Errado **( )**

Escore (máximo um ponto) _____

COMANDO DE TRÊS ESTÁGIOS – Pegue este papel com a mão direita, dobre-o pela metade e coloque-o em cima da mesa.

Pegar o papel com a mão direita ( ) Certo ( ) Errado

Dobrar pela metade ( ) Certo ( ) Errado

Colocar sobre a mesa ( ) Certo ( ) Errado

Escore (máximo três pontos): _____

LEIA ESSA FRASE E FAÇA O QUE ELA PEDE

"FECHE OS OLHOS"

Escore (máximo um ponto) _____

POR FAVOR, ESCREVA OU DIGA UMA FRASE OU PENSAMENTO QUALQUER.

_____

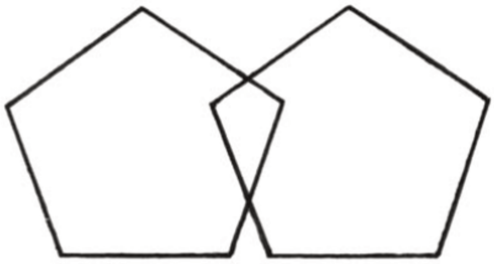
_____

_____

_____

Escore (máximo um ponto) _____

AGORA TENTE COPIAR ESSE DESENHO



Escore (máximo um ponto) _____

Escolaridade: Analfabeto**( )** Fundamental 1a**( )** 2a**( )** 3a**( )** 4**a( )** médio 5a**( ) 6**a**( ) 7**a**( )** 8**a( )** 2o Grau incompleto **( )** completo **( )** Superior incompleto **( )** completo **( )**

Escore total_____

APÊNDICE 4 Questionário de Avaliação da Qualidade de Mastigação (QAQM)

Questionário de Avaliação da Qualidade de Mastigação (QAQM)

Alimentação- Mastigação

	Extrema	Muita	Moderada	Pouca	Nenhuma dificuldade
1- Você tem dificuldade para mastigar carne de vaca cortada em pedaços pequeno? ( ) *Assinale se você não come carne.*	( )	( )	( )	( )	( )
2- Você tem dificuldade para mastigar frango cortado em pedaços pequenos? ( ) *Assinale se você não come frango.*	( )	( )	( )	( )	( )
3- Você tem dificuldade para mastigar carne moida? ( ) *Assinale se você não come carne moída.*	( )	( )	( )	( )	( )
4- Você tem dificuldade para morder legumes duros, crus, inteiros (exemplo: cenoura)?	( )	( )	( )	( )	( )
5- Você tem dificuldade para morder frutas duras, cruas, inteiras (exemplo: maçãs)?	( )	( )	( )	( )	( )
6- Você tem dificuldade para morder frutas duras, cruas, cortadas em quatro (exemplo: maçãs)?	( )	( )	( )	( )	( )
7- Você tem dificuldade para comer a casca de frutas duras, cruas ?	( )	( )	( )	( )	( )
8- Você tem dificuldade para mastigar pão com casca dura?	( )	( )	( )	( )	( )
9- Você tem dificuldade de mastigar nozes e grãos?	( )	( )	( )	( )	( )

Hábitos

Nas duas últimas semanas:

	Nunca	Raramente	Às vezes	Frequentemente	Sempre
10- Você retirou sua prótese para comer?	( )	( )	( )	( )	( )
11- Você teve que beber enquanto comia para engolir melhor?	( )	( )	( )	( )	( )
12- Você adicionou molho nos seus alimentos para engolir melhor?	( )	( )	( )	( )	( )
13- Você molhou os alimentos em líquidos para mastigar e engolir melhor?	( )	( )	( )	( )	( )
14- Sua escolha por comida foi limitada por causa da sua prótese?	( )	( )	( )	( )	( )
15- Você tem dificuldade para mastigar com sua prótese?	( )	( )	( )	( )	( )
16 – Em geral, os alimentos que você engole são bem mastigados?	( )	( )	( )	( )	( )

Carnes

Nas duas últimas semanas:

Nota: Se você não comeu carne, assinale a alternativa N/A (não aplicável).

	Nunca	Raramente	Às vezes	Frequentemente	Sempre	N/A
17- Foi necessário cortar a carne de vaca em pedaços pequenos?	( )	( )	( )	( )	( )	( )
18- Foi necessário desfiar a carne de vaca antes de comê-la?	( )	( )	( )	( )	( )	( )
19- Foi necessário cortar o frango em pedaços pequenos?	( )	( )	( )	( )	( )	( )
20- Foi necessário desfiar o frango antes de comê-lo?	( )	( )	( )	( )	( )	( )
21- Foi necessário cozinhar a carne até desmanchar antes de comê-la?	( )	( )	( )	( )	( )	( )

Frutas

Nas duas últimas semanas:

Nota: Se você não comeu essa fruta, assinale a alternativa N/A (não aplicável).

	Nunca	Raramente	Às vezes	Frequentemente	Sempre	N/A
22- Você mordeu maçãs cruas, inteiras?	( )	( )	( )	( )	( )	( )
23- Foi necessário descascar as maçãs antes de comê-las?	( )	( )	( )	( )	( )	( )
24- Foi necessário cortar as maçãs em quatro para mastigá-las?	( )	( )	( )	( )	( )	( )
25- Foi necessário cortar as maçãs em pedaços pequenos para mastigá-las?	( )	( )	( )	( )	( )	( )
26- Foi necessário amassar ou ralar as frutas duras cruas para comê-las?	( )	( )	( )	( )	( )	( )

Legumes

Nas duas últimas semanas:

Nota: Se você não comeu esse legume, assinale a alternativa N/A (não aplicável).

	Nunca	Raramente	Às vezes	Frequentemente	Sempre	N/A
27- Você mordeu cenouras cuas inteiras?	( )	( )	( )	( )	( )	( )
28- Foi necessário cortar as cenouras cruas em pedaços pequenos para mastigá-las?	( )	( )	( )	( )	( )	( )
29- Foi necessário fazer purê com os legumes duros para comê-los?	( )	( )	( )	( )	( )	( )

APÊNDICE 5 Questionários de Disfagia e Xerostomia

Questionário de Disfagia EAT (Eating Assessment Tool)

0= Não é problema 4= é um problema muito grande					
Meu problema para engolir me faz perder peso?	0	1	2	3	4
Meu problema para engolir não me deixa comer fora de casa?	0	1	2	3	4
Preciso fazer força para beber líquidos?	0	1	2	3	4
Preciso fazer força para engolir comida?	0	1	2	3	4
Preciso fazer força para engolir remédios?	0	1	2	3	4
Dói para engolir?	0	1	2	3	4
Meu problema para engolir me tira o prazer de comer?	0	1	2	3	4
Fico com comida presa/entalada na garganta?	0	1	2	3	4
Eu tusso quando como?	0	1	2	3	4
Engolir me deixa estressado.	0	1	2	3	4
	Total EAT:				

Questionário de Xerostomia (Mata et al, 2012)

1. Bebo um pouco de líquido para ajudar na deglutição dos alimentos
2. Sinto a boca seca durante as refeições
3. Levanto-me à noite para tomar líquidos
4. Sinto a boca seca
5. Tenho dificuldade em comer alimentos secos
6. Chupo balas ou guloseimas para aliviar a boca seca
7. Tenho dificuldades para deglutir certos alimentos
8. Sinto a pele da face seca
9. Sinto os olhos secos
10. Sinto os lábios secos
11. Sinto o interior do meu nariz seco

Tese **Anexo 1 - Verificação de Originalidade e Prevenção de Plágio**

ORIGINALITY REPORT

7%	5%	6%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Hilasaca-Mamani, Maribel, Taís de Souza Barbosa, Jocelyne Feine, Rívea Inês Ferreira, Rosana Cristina Boni, and Paula Midori Castelo. "Tradução e adaptação brasileira do Questionnaire D'Alimentation", Revista CEFAC, 2015. Publication	2%
2	repositorio.ufrn.br:8080 Internet Source	2%
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Kelly Guedes de Oliveira Scudine, Daniela Galvão de Almeida Prado, Débora Alves Nunes Leite Lima, and Paula Midori Castelo. "Chewing in adolescents with overweight and obesity: An exploratory study with behavioral approach", Appetite, 2016.

Publication

1%

Exclude quotes	Off	Exclude matches	< 1%
Exclude bibliography	On		

ANEXO 2

APROVAÇÃO COMITÊ DE ÉTICA EM PESQUISA

UNIVERSIDADE FEDERAL DE SÃO PAULO - HOSPITAL SÃO PAULO UNIFESP-HSP

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Avaliação da relação entre função mastigatória, estado nutricional e declínio cognitivo em idosos

Pesquisador: Paula Midori Castelo Ferrua

Área Temática:

Versão: 2

CAAE: 55362616.0.0000.5505

Instituição Proponente: UNIVERSIDADE FEDERAL DE SAO PAULO

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 1.575.842

Apresentação do Projeto:

Trata-se de respostas de pendencias apontadas no parecer inicial.

Número do Parecer: 1.550.223

DADOS DO PARECER

Projeto CEP/UNIFESP n:0525/2016

A população mundial está envelhecendo e nesse contexto torna-se importante o entendimento das alterações fisiológicas decorrentes da senilidade. Atualmente, há evidências que apontam interações da saúde bucal com a saúde geral e o conhecimento dessas é significativo para a melhora da qualidade de vida desses indivíduos. Com isso o objetivo dessa pesquisa é detectar possíveis alterações no funcionamento do sistema estomatognático, estabelecendo possíveis correlações com o estado nutricional e cognitivo do idoso para rastrear as deficiências do contexto clínico geriátrico na busca de melhorar a qualidade de vida do idoso. Essa pesquisa será de caráter observacional, onde serão avaliadas a performance mastigatória, o fluxo salivar, força de mordida, percepção gustativa, sensibilidade orofacial e habilidade cognitiva em 200 idosos (sendo 100 homens e 100

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mulheres) residentes no município de Santo André ?SP, referenciados ao Centro de Saúde Escola da Faculdade de Medicina da Fundação ABC (Unidade Básica de Saúde - Capuava). Com esses dados pode-se estabelecer relações entre as diferentes variáveis. Após 1 ano o mesmo grupo será reavaliado, na busca de estabelecer as possíveis alterações de forma longitudinal.

Objetivo da Pesquisa:

- Hipótese: A hipótese a ser testada é a de que com o envelhecimento a perda na função mastigatória está relacionada com a perda da sensibilidade orofacial e a perda cognitiva em idosos. -Objetivo Primário: o principal objetivo desse estudo é de estabelecer relações entre a função mastigatória, secreção salivar, sensibilidade orofacial e capacidade cognitiva em idosos.

Avaliação dos Riscos e Benefícios:

Conforme descrito no parecer inicial

Comentários e Considerações sobre a Pesquisa:

Trata-se de estudo sem obtenção de titulação acadêmica, vinculado ao Departamento de Ciências Biológicas, Campus Diadema. TIPO DE ESTUDO: Essa pesquisa será de caráter observacional, onde serão avaliadas a performance mastigatória, o fluxo salivar, força de mordida, percepção gustativa, sensibilidade orofacial e habilidade cognitiva de idosos . Com esses dados pode-se estabelecer relações entre as diferentes variáveis. Após 1 ano o
mesmo grupo será reavaliado, na busca de estabelecer as possíveis alterações de forma longitudinal.

Considerações sobre os Termos de apresentação obrigatória:

Trata-se de respostas de pendencias

Conclusões ou Pendências e Lista de Inadequações:

Pendencias apontadas no parecer inicial:

1-Em relação ao TCLE: a)- no parágrafo 7, a frase Os procedimentos a serem realizados não oferecem riscos, e, por isso, não há previsão de ressarcimento ou indenização por dano, não está adequada: não existe pesquisa sem riscos, por mínimo que sejam. Assim deve ser não usar a palavra "cópia" e sim, a palavra "via", já que o TCLE do participante não é uma cópia: é um documento original. Informar que o termo está sendo disponibilizado em 2 vias originais, uma para ficar com o participante e outra para ficar com o pesquisador.; c)- todas as folhas devem ser numeradas (ex: 1/4, 2/4, etc.) as quais deverão ser

rubricadas pelo pesquisador e pelo participante da pesquisa no momento da aplicação do TCLE. ; d)- retirar a palavra anexo do cabeçalho do documento. e)- informar que após 1 ano, todos os exames serão repetidos (se este for mesmo o caso, como foi informado no resumo do projeto) garantido o direito a tratamento gratuito na Instituição e o direito a indenização determinada por lei, no caso de ocorrer qualquer problema ou dano
pessoal.; b)- favor adequar o TCLE, no campo em que é informado que o participante receberá uma "cópia" do TCLE.

resposta: adequações no TCLE realizadas - pendencia atendida.

Considerações Finais a critério do CEP:

O CEP informa que a partir desta data de aprovação, é necessário o envio de relatórios parciais (anualmente), e o relatório final, quando do término do estudo.

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_672249.pdf	24/05/2016 16:51:17		Aceito
Outros	esclarecimentos_ao_parecer_consubstanciado.pdf	24/05/2016 16:49:16	Paula Midori Castelo Ferrua	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_corrigido.pdf	24/05/2016 16:46:54	Paula Midori Castelo Ferrua	Aceito
Folha de Rosto	folha_de_rosto.pdf	30/03/2016 20:10:00	Paula Midori Castelo Ferrua	Aceito
Projeto Detalhado / Brochura Investigador	projeto_de_pesquisa_idosos.pdf	11/03/2016 21:52:28	Paula Midori Castelo Ferrua	Aceito
Outros	Anexo7_QST_DDP.docx	11/03/2016 21:51:49	Paula Midori Castelo Ferrua	Aceito
Outros	Anexo6_QAQM.docx	11/03/2016 21:51:31	Paula Midori Castelo Ferrua	Aceito
Outros	Anexo5_MNA.docx	11/03/2016 21:51:17	Paula Midori Castelo Ferrua	Aceito
Outros	Anexo4_AVALIACAO_ODONTOLOGICA.docx	11/03/2016 21:51:04	Paula Midori Castelo Ferrua	Aceito
Outros	Anexo3_AVALIACAO_DO_ESTADO_MENTAL.docx	11/03/2016 21:50:50	Paula Midori Castelo Ferrua	Aceito
Outros	anexo2_ANAMNESE.docx	11/03/2016	Paula Midori	Aceito

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Continuação do Parecer: 1.575.842

Outros	anexo2_ANAMNESE.docx	21:49:00	Castelo Ferrua	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

SAO PAULO, 05 de Junho de 2016

Assinado por:
Miguel Roberto Jorge
(Coordenador)

Endereço: Rua Botucatu, 572 1º Andar Conj. 14
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ANEXO 3

ESCALA DE COR UTILIZADA PARA DETERMINAR A PERFORMANCE DA MASTIGAÇÃO

Oral Diseases

Home

Anexo 4 - Comprovante de submissão do artigo

Author

Review

Submission Confirmation

Print

Thank you for your submission

Submitted to
Oral Diseases

Manuscript ID
ODI-02-19-OM-6954

Title
An overview of the relationship between polypharmacy, xerostomia, dysphagia and taste in the elderly

Authors
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Castelo, Paula Midori
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Date Submitted
20-Feb-2019

Author Dashboard

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