DOI: 10.1590/1413-81232018243.10122017

Prevalence of chewing difficulty among adults and associated factors

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Abstract *The aim of this study was to estimate the prevalence of chewing difficulty and associated factors in adults aged 20 to 59 years in Patos, in the State of Paraiba in the Northeast Region of Brazil. A cross-sectional study was conducted with a random sample of 532 participants. The outcome chewing impairment was assessed using the question "How often do you have difficulty eating due to problems with your teeth or dentures?". Crude and adjusted prevalence ratios were estimated using Poisson regression. The prevalence of chewing difficulty was 30.5%. An association remained between the following variables and chewing difficulty in the final multivariate models: age group, schooling, being a smoker/non-smoker, length of time since last visit to the dentist, severe tooth loss, absence of functional dentitions, dental prosthesis use, need for a dental prosthesis, oral pain, and signs and symptoms of TMJ dysfunction. The magnitude of the associations between the variables and chewing difficulty, notably tooth loss and the need for a dental prosthesis, emphasize the importance of subjective indicators for assessing the oral health status of adults and shows that chewing difficulty is associated with a range of multi-dimensional factors.*
Key words *Adult, Chewing, Oral health, Oral health surveys*

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Introduction

Chewing isone of the most important functions of the stomatognathic system. It is related to nutritional aspects, craniofacial growth and development at a younger age, development of the orofacial musculature and temporomandibular joints, and occlusal stability[1-3].Chewing abilitycan therefore be influenced bytemporomandibular joint dysfunction, pain, orofacial myofunctional disorders, occlusal anomalies, tooth loss, the use of poorly fitting dental prostheses, the presence of caries, and periodontal disease[1-4].

Chewing difficulty is an important indicator of oral dysfunction[5]. A study conducted in Florida showed that 16% of adults reported being dissatisfied with their chewing ability, which was associated with normative conditions, such as dental caries, sore gums, periodontal disease, missing teeth, tooth mobility, abscesses, and self-reported conditions, including oral pain, and perceptions of oral health and the need for dental treatment[5].

In Brazil, the most recent national epidemiological survey, conducted in 2010, showed that the prevalence of chewing difficulty among adults was around 31%[6]. Other national population studies addressing chewing as a component of oral health[7,8] reported an association between dissatisfaction with chewing ability and a deterioration in oral health and quality of life[8].

Chewing ability may be assessed normatively, by health professionals, or subjectively, by the individual; however, the literature shows divergence in results obtained using these assessment methods[4,8,9]. In this respect, single-item oral health self-report instruments have been shown to be of vital importance for population surveys and their use is suggested to enable long-term systematic assessment through the health surveillance system[9].

The aim of the present study was to estimate the prevalence of chewing difficulty and analyze associated factors among adult patients in public primary healthcare centers in Patos in the State of Paraíba, Brazil.

Material and Methods

A cross-sectional study was undertaken between May and August 2016 in Family Health Centers (UBSF, acronym in Portuguese) in the urban area of Patos, a municipality with a population of approximately 107,000 people[10] located in the Northeast Region of Brazil.

Sample size was calculated using a 95% confidence interval, 5% sampling error, and prevalence of the outcome of 31%[6]. Twenty percent was added to compensate for eventual losses or refusals and a further 15% to control for confounding, resulting in a minimum sample size of523 individuals.

Data was collected in 32 UBSFs distributed throughout the north, south, east, and west regions of the municipality. Patients present in the waiting room were invited to participate in the study regardless of the type of treatment they were receiving. Interviews and physical examinations of the study participants were conducted in rooms available in the UBSFs with natural light. The following inclusion criteria were used: participants should be aged between 20 and 59 years and have signed an informed consent form. Individuals who were unable to answer the interview questions due to physical or mental impairment were excluded from the study.

Prior to data collection, the examiners were calibrated in relation to the normative conditions tooth loss and the use of and need for a dental prosthesis. The level of intra and inter-examiner agreement was measured to test study reproducibility. The percentage of intra and inter-examiner agreement was 90% (CI95%: 89.2-92.0) and 92% (CI95%: 90.4-93.7), respectively, for the use of and need for a dental prosthesis, and 100% for tooth loss. The percentage of intra-examiner agreement for the abovementioned normative conditions during data collection was over 94%.

Chewing difficulty (the dependent variable) was assessed according to the respondent's answer to the following question: *How often do you have difficulty eating due to problems with your teeth or dentures?*[11]. The response options were: never, rarely, sometimes, often, and always. Chewing difficulty was dichotomized as follows: yes (sometimes/often/always) and no (never/rarely).

The independent variables were: sex(female/male); age group in years(20-34/35-44/45-49); color (white/nonwhite); schooling in completed years of study (0/1-4/5-8/10-11/≥ 12); economic status (class A-B/C/D-E), based on the Economic Classification Criteria Brazil (CCEB, acronym in Portuguese)[12]; type of dental service used for the last dental consultation(public/private); length of time since the last dental consultation in years (< 1/1-2/3ormore); reason for the last dental consultation (prevention/pain/treatment); access to oral health information (yes/no); smoker (no/ex-smoker/smoker); daily frequency of

tooth brushing (once or twice/three or more); and use of dental floss (yes/no). The following aspects were assessed in the clinical examination: severe tooth loss[13], defined as fewer than nine natural teeth present (yes/no);the absence of functional dentitions[13], defined as having fewer than 21 functional natural teeth(yes/no);dental prosthesis use(yes/no); and the need for a prosthesis (yes/no). Auto-reported variables were: dental pain (yes/no); need for dental treatment (yes/no); and temporomandibular joint (TMJ) dysfunction using Fonseca's Anamnestic Index[14] (without dysfunction/mild/moderate/severe). The independent variables were arranged in four levels of hierarchy according to a conceptual hierarchical framework proposed by Victora et al.[15].

Quality control was conducted by carrying out reduced telephone interviewsof approximately 12% of the sample (n = 62). The Kappa statistic was calculated, ranging between 0.7 and 0.9 for dental prosthesis use.

Bivariate analysis was conducted using Pearson's chi-squared test to determine the association between the outcome and other independent variables, adopting a significance level of 5% ($p < 0.05$) and95% confidence interval (CI95%). Poisson regression with robust error variance was then performed to estimate crude and adjusted prevalence ratios and their respective CI95% and p-values (using the Wald test of heterogeneity and linear trend estimation)[16]. For the multivariate analysis an hierarchical model of determination was used to adjust the variables to the same levels and higher levels. The most distal variables were as follows: Level 1 (sociodemographic variables) - sex, age group, color, schooling, and economic status; Level 2(use of services, access to health information, and general and oral health habits), intermediate -type of service and length of time since last dental consultation; Level 3 (normative oral health conditions),intermediate -severe tooth loss, absence of functional dentitions, and dental prosthesis use; and Level 4 (subjective aspects of oral health), proximal -dental pain, need for treatment, and TMJ dysfunction. The variables that obtained $p < 0.20$in each level of hierarchy in the crude analysis were tested in multiple models and, following the same criteria, maintained in the adjusted analysis to control for confounding variables in the subsequent levels. The multidimensional model proposed by Gift et al.[20] and adapted by Martins et al.[8] was adopted for the analysis of factors associated with chewing difficulty.

Statistical analysis was performed using the software programs Statistical Package for Social Sciences (SPSS for Windows version 18.0, SPSS Inc., Chicago, USA) and Stata/SE 12.1 (StataCorp, College, Texas, USA).

This study was approved by the Ethics Committee of the Alcides Carneiro Hospital of the Federal University of Campina Grande and is registered in the National System of Information on Ethics in Research Involving Human Beings.

Results

Over half of the sample (n = 532), which had a follow-up rate of 91.7%, were women (52.6%). Average age was 36.7 years (Standard deviation – SD = 11.9) and 70% of the sample self-declared themselves brown, black, yellow, or indigenous. Approximately 40% of the sample had up to eight years of study and 53.1% belonged to economic class C, as shown in Table 1.

In relation to use of health services, 59.5% of the interviewees used the public service for their last dental consultation, 64,3% had had a consultation in the last year, and 63.1% had received oral health information in their last consultation. The results show that 77% of the respondents reported brushing their teeth three or more times a day, 53.6% did not use dental floss, and25% were smokers/ex-smokers, as shown in Table 1.

Table 2 shows that 8.7% of respondents had severe tooth loss and 23.9% had absence of functional dentitions, while 23.9% used some type of dental prosthesis and 32.4% needed a prosthesis. The results also show that 23.3% of the sample had suffered oral pain in the last six months and that the large majority needed dental treatment (69.2%), while over half of the respondents showed signs of TMJ dysfunction.

Prevalence of the outcome variable chewing difficulty was 30.5%.The results of the bivariate analysis showed that the following individuals were more likely to have chewing difficulty: those in the age groups34to44 years and 45 to 59 years; those with less than four years of schooling; those belonging to the economic classes C, D or E; those who used the public service for their last dental consultation; those who had last visited the dentist over a year ago; those who visited the dentist due to pain or to receive some kind of treatment; those who did not receive oral health information; smokers/ex-smokers; those who brushed their teeth between once and twice a day; and those who did not use dental floss (Table 1).

Table 2 shows that the prevalence of chewing difficulty was three times greater in individu-

Table 1. Description of the sample and distribution of prevalence of chewing difficulty based on sociodemographic characteristics, use of dental services, behavioral aspects, and general and oral health habits. Patos, State of Paraiba, 2016.

Variables	Sample	Chewing difficulty	CI95%	P-value*
	n (%)	Yes n (%)		
Total	532 (100.0)	162 (30.5)	26.5 – 34.3	
Sex				0.237
Female	280 (52.6)	79 (48.7)	41.0 – 56.4	
Male	252 (47.4)	83 (51.3)	43.5 – 58.9	
Age group				< 0.001
20-34 years	252 (47.3)	47 (29.0)	22.0 – 36.0	
35-44 years	119 (22.3)	37 (22.8)	16.3 – 29.3	
45-59 years	161 (30.4)	78 (48.2)	40.4 – 55.8	
Color				0.379
White	160 (30.0)	53 (32.7)	25.4 – 39.9	
Nonwhite	372 (70.0)	109 (67.3)	60.0 – 74.5	
Schooling				< 0.001
≥ 12 years	84 (15.7)	12 (7.4)	3.3 – 11.4	
10-11 years	237 (44.5)	58 (35.8)	28.4 – 43.1	
5-8 years	103 (19.3)	35 (21.6)	15.2 – 27.9	
1-4 years	72 (13.5)	34 (21.0)	14.7 – 27.2	
No schooling	36 (7.0)	23 (14.2)	8.8 – 19.5	
CCEB				0.014
A-B	94 (17.6)	18 (11.1)	6.2 – 15.9	
C	283 (53.1)	87 (53.7)	46.0 – 61.3	
D-E	155 (29.3)	57 (35.2)	27.8 – 42.5	
Type of service				0.071
Private	214 (40.6)	56 (34.8)	27.2 – 41.8	
Public	313 (59.4)	105 (65.2)	57.4 – 72.1	
Time since last dental consultation				< 0.001
< 1 year	339 (64.3)	84 (52.2)	44.7 – 60.1	
1-2 years	115 (21.8)	35 (21.7)	15.2 – 27.9	
3 or more years	73 (13.9)	42 (26.1)	19.1 – 32.6	
Access to information				0.021
Yes	333 (63.1)	90 (55.9)	47.9 – 63.1	
No	194 (36.9)	71 (44.1)	36.1 – 51.4	
Smoker				< 0.001
No	397 (74.6)	101 (62.3)	54.8 – 69.8	
Ex-Smoker	90 (16.9)	38 (23.5)	16.9 – 29.9	
Smoker	45 (8.5)	23 (14.2)	10.9 – 22.4	
Daily frequency of toothbrushing				< 0.001
Three or more	410 (77.0)	105 (64.8)	57.4 – 72.1	
Once or twice	122 (23.0)	57 (35.2)	27.8 – 42.5	
Use of Dental floss				< 0.001
Yes	247 (46.4)	54 (33.3)	26.0 – 40.5	
No	285 (53.6)	108 (66.7)	59.4 – 73.9	

***Pearson's chi-squared test ($p < 0.05$).**

als with severe tooth loss, absence of functional dentitions, and in those who needed a dental prosthesis in comparison with those who did not have these problems.

Table 3 shows the results of the hierarchical models of determination. An association between chewing difficulty and the following variables remained after adjustment: being aged be-

Table 2. Description of the sample and distribution of prevalence of chewing difficulty based normative and subjective oral health characteristics. Patos, State of Paraiba, 2016.

Variable	Sample	Chewing difficulty	CI95%	P-value*
		Yes		
	n (%)	n (%)		
Total	532 (100.0)	162 (30.5)	26.5 – 34.3	
Severe tooth loss				< 0.001
No	486 (91.3)	122 (75.3)	68.7 – 81.9	
Yes	46 (8.7)	40 (24.7)	18.0 – 31.3	
Absence of functional dentitions				< 0.001
No	405 (76.1)	80 (49.3)	41.6 – 57.0	
Yes	127 (23.9)	82 (50.7)	42.9 – 58.3	
Prosthesis use				< 0.001
No	405 (76.1)	103 (63.5)	56.1 – 70.9	
Yes	127 (23.9)	59 (36.5)	29.1 – 43.8	
Need for prosthesis				< 0.001
No	360 (67.6)	64 (39.5)	31.9 – 47.0	
Yes	172 (32.4)	98 (60.5)	52.9 – 68.0	
Dental pain				0.012
No	408 (76.6)	113 (69.7)	62.6 – 76.8	
Yes	124 (23.3)	49 (30.3)	23.1 – 37.3	
Need for treatment				0.105
No	164 (30.8)	42 (25.9)	19.1 – 32.6	
Yes	368 (69.2)	120 (74.1)	67.3 – 80.8	
TMJ dysfunction				< 0.001
No dysfunction	254 (47.7)	75 (46.2)	38.6 – 53.9	
Mild	217 (40.7)	55 (33.9)	26.6 – 41.2	
Moderate	49 (9.2)	24 (14.8)	9.3 – 20.2	
Severe	12 (2.4)	8 (5.1)	1.6 – 8.2	

*Pearson's chi-squared test ($p < 0.05$).

tween 45 and 59 years; having less than 11 years of schooling; over three years since the last dental consultation; being a smoker/ex-smoker; severe tooth loss; absence of functional dentitions; use of a dental prosthesis; need for a dental prosthesis; presence of dental pain; and showing signs of moderate to severe TMJ dysfunction.

Discussion

Approximately one-third of the sample reported chewing difficulty due to problems with their teeth or dentures, thus showing dissatisfaction with their ability to chew. This rate is similar to those reported by Hsu et al.[19] and Figueiredo et al.[9], slightly lower than that found by Braga et al.[19], and slightly higher than that observed by Peek et al.[20]. These findings are worrying because chewing difficulty or dissatisfaction can lead to dietary restrictions and have a negative impact on quality of life[11,21].

Prevalence of chewing difficulty was similar between men and women, showing that there was no association between gender and the outcome, as found by other studies[5,22]. However, a study conducted in Florida[20] with adults aged 45 years or older showed that the prevalence of chewing difficulty among women was double that of men, corroborating the findings of Braga et al.[19]. The fact that women are generally more concerned with the appearance and health of their teeth and mouth[22] than men and that tooth loss is greater among women in Brazil[23] may explain these findings.

Individuals in the older age group were more likely to have chewing difficulty, corroborating the findings of other studies[9,19,21], which show that the likelihood of impairment of the natural dentition with a direct effect on chewing difficulty and healthy food intake increases with age[11,21,24].

Multivariate analysis showed that there was an association between having less than11 years of schooling and chewing difficulty and that the

Table 3. Crude and adjusted analysis of factors associated with chewing difficulty based on the levels of the hierarchical model. Patos, State of Paraiba, 2016.

Variable	Crude Analysis		Adjusted Analysis	
	PR (CI95%)	P-value	PR (CI95%)	P-value*
Age group[1]		< 0,001		< 0,01
20-34 years	1.0		1.0	
35-44 years	1.67 (1.15-2.42)		1.20 (0.87-1.19)	
45-59 years	2.60 (1.92-3.52)		1.76 (1.15-2.65)	
Schooling[1]		< 0.001		0.011
≥ 12 years	1.0		1.0	
10-11 years	1.71 (0.97-3.03)		1.72 (1.02-2.91)	
5-8 years	2.38 (1.32-4.29)		2.07 (1.20-3.57)	
1-4 years	3.31 (1.85-5.89)		1.91 (1.10-3.34)	
No schooling	4.47 (2.51-7.98)		2.10 (1.19-3.72)	
CCEB[1]		0.014		0.457
A-B	1.0		1.0	
C	1.61 (1.02-2.52)		0.90 (0.67-1.56)	
D-E	1.92 (1.21-3.05)		1.34 (0.89-2.01)	
Type of service[2]		0.071		0.345
Particular	1.00		1.00	
Public	1.28 (0.97-1.69)		0.99 (0.86-1.34)	
Time since last dental consultation[2]		< 0.001		0.002
< 1 year	1.00		1.0	
1-2 years	1.23 (0.88-1.71)		1.09 (0.79-1.49)	
3 or more years	2.32 (1.77-3.04)		1.60 (1.22-2.10)	
Accessto information[2]		0.021		0.246
No	1.00		1.0	
Yes	1.35 (1.05-1.75)		1.21 (0.76-1.34)	
Smoker[2]		< 0.001		0.023
No	1.00		1.00	
Ex-Smoker	2.01 (1.44-2.35)		1.67 (1.19-1.89)	
Smoker	1.66 (1.24-2.23)		1.12 (1.08-1.76)	
Daily frequency of toothbrushing[2]		< 0.001		0.070
Three or more	1.00		1.00	
Once or twice	1.82 (1.42-2.35)		1.26 (0.98-1.16)	
Use of Dental floss[2]		< 0.001		0.122
Yes	1.00		1.00	
No	1.73 (1.31-2.29)		1.22 (0.95-1.58)	
Severe tooth loss[3]		< 0.001		< 0.001
No	1.00		1.00	
Yes	3.46 (2.86-4.19)		1.74 (1.33-2.28)	
Absence of functional dentitions[3]		< 0.001		< 0.001
No	1.00		1.00	
Yes	3.27 (2.58-4.13)		2.57 (1.97-3.35)	
Prosthesis use[3]		< 0.001		0.027
No	1.00		1.00	
Yes	1.83 (1.42-2.35)		1.19 (1.01-1.98)	
Need for prosthesis[3]		< 0.001		< 0.001
No	1.00		1.00	
Yes	3.20 (2.48-4.15)		2.47 (1.87-3.27)	
Dental pain[4]		0.002		0.004
No	1.00		1.00	
Yes	1.43 (1.09-1.87)		1.18 (1.01-1.41)	

it continues

Table 3. Crude and adjusted analysis of factors associated with chewing difficulty based on the levels of the hierarchical model. Patos, State of Paraiba, 2016.

Variable	Crude Analysis		Adjusted Analysis	
	PR (CI95%)	P-value	PR (CI95%)	P-value*
Need for treatment[4]		0.105		0.344
No	1.00		1.00	
Yes	1.27 (0.94-1.72)		1.02 (0.79-1.34)	
TMJ dysfunction [4]		< 0.001		0.001
No dysfunction	1.00		1.00	
Mild	0.86 (0.64-1.16)		0.91 (0.70-1.19)	
Moderate	1.66 (1.18-2.34)		1.50 (1.09-2.06)	
Severe	2.26 (1.45-3.52)		2.13 (1.26-3.62)	

PR = Prevalence Ratio; CI95% = 95% Confidence Interval; *P-value = Wald test of heterogeneity/linear trend estimation; 1Model 1: variables form the first level adjusted between themselves; 2Model 2: variables from the second level adjusted between themselves and for the variables from the previous level; 3Model 3: variables from the third level adjusted for the previous levels; 4Model 4: variables from the fourth level adjusted between themselves and for the previous levels. Variable inclusion/maintenance criterion ($p < 0.20$).

strength of association increased as schooling decreased. Other studies have shown[5,9,19,22] that the lower the level of education, the higher the dissatisfaction with chewing ability and that low levels of schooling and income have a negative impact on oral health. In this respect, level of income is associated with level of education, which in turn is associated with overall health, lifestyle, and access to health services and healthcare information[25].

No association was found between the type of service used by the respondents and chewing difficulty. However, prevalence of chewing difficulty was 60% higher in individuals who had not been to the dentist for at least three years in comparison to those who had visited the dentist in the last six months. In this respect, the regular use of dental services can minimize dental problems by catching them in the early stages, thus avoiding negative future impacts on chewing ability[5,19,25,26].

Lack of oral health information was associated with chewing difficulty only in the bivariate analysis, losing strength of association in the multivariate analysis. However, studies[19,26,27] show a number of short comings in relation to educational actions, notably in public primary healthcare services. In this respect, the provision of information on oral health problems and common risk factors for other chronic diseases is important for maintaining and improving oral and overall health.

The bivariate analysis showed that being a smoker/ex-smoker, brushing teeth once or twice a day, and not using dental floss regularly were risk behaviors for chewing difficulty. However, only being a smoker/ex-smoker remained in the final model. These findings show the importance of maintaining a constant flow of information on oral and general disease prevention to avoid future problems such as tooth loss.

A strong association was found between tooth loss, classified in the present study as severe tooth loss and absence of functional dentitions, and chewing difficulty, corroborating the findings of other studies[9,19]. Furthermore, the association between dental prosthesis use and the need for a prosthesis, variables related to tooth loss, and chewing difficulty was maintained in the final model. Although the restoration of chewing function via prosthetic rehabilitation may be assessed positively by individuals[28], the findings of the present study show that the prevalence of chewing difficulty among dental prosthesis users was three times greater in comparison to those who did not use a prosthesis. However, factors such as time of prosthesis use and prosthesis type and quality would need to be taken into account in order to provide a more accurate analysis.

A strong association was found between pain and signs of moderate to severe TMJ dysfunction and chewing difficulty. In this respect, the presence of pain during chewing affects specific food intake patterns and has important functional consequences for the muscles of the TMJ[29].

Study limitations include sample selection, which was restricted to primary healthcare centers, thus resulting in potential selection bias, and the reliance on self-reporting of the outcome, given that subclinical events can often be underestimated. Furthermore, cross-sectional study designs are susceptible to reverse causality bias and unable to demonstrate the temporal

relationships between the outcome and its predictors.

Conclusion

The findings of the present study show that chewing difficulty is associated with a range of multi-dimensional factors. The hierarchical analysis demonstrated the relationship between the distal and proximal variables and the outcome of interest. In this respect, the following variables maintained a strong association with chewing difficulty after adjusting using Poisson regression: age group, schooling, length of time since last dental consultation, being a smoker/ex-smoker, severe tooth loss, absence of functional dentitions, dental prosthesis use, need for a dental prosthesis, oral pain, and signs and symptoms of TMJ dysfunction.

Collaborations

FT Cavalcante, C Moura and PAT Perazzo, participated in study conception and planning, the introduction, data interpretation, discussion, and the critical review of content. FT Cavalcante and MT Cavalcante, participated in the critical review of content and final approval of the version to be published.

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Article submitted 21/09/2016
Approved 05/06/2017
Final version submitted 07/06/2017