

Evaluation of oral health-related quality of life in individuals with type 2 diabetes mellitus

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Aim: The aim of the present study was to evaluate the impact of oral problems on the quality of life of individuals with type 2 diabetes mellitus (DM2). **Methods:** A population-based, cross-sectional study was conducted with a random sample of 302 individuals with DM2 who answered the Oral Health Impact Profile 14 (OHIP-14) questionnaire as well as a questionnaire addressing socioeconomic and oral health characteristics. After filling out the questionnaires, the participants were submitted to a clinical dental examination Periodontal diseases, dental caries and edentulism. Data analysis involved descriptive statistics, bivariate analysis and logistic regression. **Results:** The prevalence of impact on oral health-related quality of life (OHRQoL) was 47%. In the multivariate analysis, the variables that remained significantly associated with a negative impact on quality of life were xerostomia (OR= 2.15; 95% CI: 1.07-4.30), denture need (OR= 3.71; 95% CI: 1.17-11.73) and periodontitis (OR= 5.02; 95% CI: 2.19-11.52). **Conclusion:** The prevalence rate of impact on OHRQoL was high in the sample studied. Xerostomia, denture need and periodontitis posed a risk of negative impact on the quality of life of individuals with DM2, independently of socioeconomic status.

Keywords: Oral health. Quality of life. Diabetes Mellitus.



Introduction

Type 2 diabetes mellitus (DM2) is a metabolic disorder characterized by high levels of glucose in the blood due to defects in the action and secretion of insulin¹. DM2 is the most common form of diabetes, accounting for 90 to 95% of all cases and generally occurs in obese adults over 40 years of age. However, there has been an increase in cases diagnosed in younger people due to the association between DM2 and obesity, the incidence of which is also high among younger people².

From the epidemiological standpoint, diabetes is considered a public health problem in both developed and developing countries². The number of individuals with diabetes was 171 million throughout the world in 2000 and is expected to reach 366 million by 2030³. In Brazil, the most recent study published on this issue reports approximately 10.3 million individuals with diabetes⁴.

DM2 is associated with systemic complications, such as microvascular diseases (retinopathy, nephropathy and neuropathy) as well as cerebrovascular and cardiovascular diseases⁵. DM2 accounts for 5.2% of deaths in Brazil and is an important risk factor for cardiovascular disease, which accounts for 31.3% of deaths in the country⁶.

Among the oral problems found in patients with DM2, high prevalence rates of periodontitis, dental caries, edentulism and xerostomia have been described^{5,7-11}. There are no characteristic phenotypic features that are unique to periodontitis in patients with diabetes mellitus. On this basis diabetes-associated periodontitis is not a distinct disease. Nevertheless, diabetes is an important modifying factor of periodontitis, and should be included in a clinical diagnosis of periodontitis as a descriptor. According to the new classification of periodontitis, the level of glyce-mic control in diabetes influences the grading of periodontitis¹². Studies reveal that individuals with DM2 are at greater risk for the development of periodontal disease due to the diminished defense mechanisms against the action of biofilm (bacterial plaque)^{9,11,13}. Although not pathognomonic of DM2, these oral problems are highly prevalent in this population and can exert a negative influence on quality of life due to the functional, psychological and social impacts^{8,14}.

The few studies that have evaluated the impact of oral problems on the quality of life of individuals with diabetes have methodological limitations, such as the absence of a population-based sample, the studies in the review vary in quality and have several common methodological limitations. These include: lack of reported response rates, varying questionnaires used to measure study outcomes; limited validated questionnaires and inadequate discussion of confounding factors that may have affected the findings (age, education, income level). Studies included were from both high and low income countries and therefore it is not known whether the different health care systems and cultural beliefs across these countries could have affected the knowledge, attitudes and practices of people with diabetes in relation to oral health care. Self-reported data from the studies also limit the generalization of the findings. The systematic review undertaken also has limitations. There is also the possibility of outcome reporting bias¹⁵. Thus, the aim of the present study was to investigate the impact of oral problems on the quality of life of individuals

with type 2 diabetes mellitus in a population-based study conducted in northeastern Brazil.

MATERIALS AND METHODS

Characterization of sample

A population-based sample was conducted involving a randomly selected sample by simple lottery of 302 male and female individuals with DM2 (mean age: 63.1 years) registered with primary care units of the Family Health Program in the municipality of Pombal, state of Paraíba, Brazil. The participants were selected from a total population of 778 individuals with DM2 according to data furnished by the municipal secretary of health. The municipality of Pombal is located in northeastern Brazil and has an estimated population of 32,766 inhabitants as well as a Human Development Index of 0.634¹⁶.

The sample size was calculated using a proportion estimate for a finite population and considering a 5% margin of error, 95% confidence interval and 50% prevalence rate of the oral problems investigated. The minimum sample was determined to be 258 individuals, to which 20% was added to compensate for possible dropouts. Thus, the sample was composed of 310 individuals.

Ethical aspects

This study received approval from the Human Research Ethics Committee of the *Universidade Federal de Pernambuco* (certificate number: 47981015.8.0000.5208) and was conducted in compliance with the precepts stipulated in Resolution nº 466 of December 12, 2012 of the Brazilian National Board of Health. All participants received clarifications regarding the objectives and procedures of the study and agreed to participate by signing a statement of informed consent.

Eligibility criteria

The inclusion criteria were registration with a primary care unit of the Family Health Program in the municipality of Pombal, diagnosis of DM2 at least one year earlier based on the criteria recommended by the Brazilian Society of Diabetes (fasting blood glucose ≥ 126 or glycated hemoglobin $> 6.5\%$),² age 18 years or older and signed statement of informed consent. The exclusion criteria were neuropsychomotor disorder, pregnancy and systemic complications of DM2 that could lead to an underestimation of the impact of oral problems on quality of life, such as amputations and blindness.

Training and calibration exercises

The training and calibration exercises were conducted by a researcher with ample experience in the use of the epidemiological indices employed in this study. The first step consisted of theoretical explanations of the indices and the data collection routine. In the practical phase, the experienced researcher and the examiner being trained performed clinical examinations of 30 patients using the indices employed in the study. The level of agreement between the examiner and experi-

enced researcher regarding the diagnoses was determined. The 30 patients were examined again after a seven-day interval for the determination of intra-examiner agreement. Cohen's Kappa statistic was used for this purpose, which furnished the following minimum coefficients for the variables collected: inter-examiner $K = 0.85$ and intra-examiner $K = 0.87^{17}$.

Pilot study

A pilot study was conducted with 30 individuals prior to the main study to test the methods as well as the use of the questionnaire and clinical charts. The sample in the pilot study was composed of individuals with DM2 from the same municipality. These individuals were not included in the main study.

Data collection

Non-clinical data

The participants answered a questionnaire administered in interview form addressing socioeconomic characteristics and aspects related to oral health, such as oral hygiene frequency and visits to a dentist.

The Brazilian version of the Oral Health Impact Profile 14 (OHIP-14) was used for the assessment of oral health-related quality of life (OHRQoL)¹⁸. This scale has 14 items distributed among seven domains (functional limitation, pain, psychological discomfort, physical disability, psychological disability, social disability and handicap). Each item has five response options on a rating scale: never = 0; rarely = 1; sometimes = 2; often = 3; and very often = 4. As recommended by the authors of the questionnaire, impact on OHRQoL was considered when at least one item was scored ≥ 2 (response options "sometimes", "often" and "very often") and the absence of impact was considered when all items were scored ≤ 1 (response options "never" and "rarely").

Clinical data

After filling out the questionnaires, the participants were submitted to a clinical dental examination by the dentist who had undergone the training and calibration exercises. The clinical examinations were conducted at the dental offices of the primary care units in the municipality of Pombal. The examiner used individual protective equipment (white coat, mask, gloves and protective eyewear). All instruments and materials used during the examination, such as a mouth mirror (PRISMA, São Paulo, SP, Brazil), University of North Carolina periodontal probe (PCPUNC 15® Hu-Friedy, Chicago, IL, USA), ball point probe (GOLGRAN, São Paulo, SP, Brazil) and dental gauze, were sterilized and packed into individual kits for each patient. After the examination, individuals with oral problems were sent for treatment. The conditions investigated during the examination were periodontitis, dental caries, xerostomia and edentulism.

For the analysis of periodontitis, all teeth were examined, except third molars and teeth indicated for extraction. Each tooth was probed at six sites (mesio-vestibular, mid-vestibular, disto-vestibular, disto-lingual, mid-lingual and mesio-lingual). Peri-

odontitis was diagnosed based on gingival recession, probing depth, clinical attachment loss, bleeding on probing and tooth mobility. Regarding Dental Mobility, the following classification was used: Grade 1 (mobility of the tooth crown 0.2 - 1.0mm horizontally); Grade 2 (mobility of the dental crown exceeding 1.0mm horizontally); and Grade 3 (mobility of the tooth crown in the vertical and horizontal directions)^{12,19,20}. The criteria established by the American Academy of Periodontology²¹ were used for the classification of severity based on the occurrence of at least one site with the following combinations of periodontal findings (Table 1).

Also using the criteria of the American Academy of Periodontology²¹, the extent of periodontitis was classified as localized ($\leq 30\%$ of teeth affected) or generalized ($> 30\%$ of teeth affected).

Dental caries was assessed using the Decayed, Missing and Filled Teeth (DMFT) index recommended by the World Health Organization²². Edentulism was classified based on the number of missing teeth (edentulous arch, short arch or complete arch) as well as the location of the missing teeth (anterior loss, posterior loss or anterior and posterior loss)²³. Denture need was evaluated using an adaptation of the criteria used in the 2010 Brazil Smiling program²⁴: absence of need (all teeth present, some missing teeth with dentures in adequate condition for use and complete edentulism with dentures in adequate condition for use) and presence of need (missing teeth with no dentures, complete edentulism with no dentures or dentures present but inadequate for use).

Xerostomia was evaluated based on the study conducted by Busato et al. (2012). The following question was posed: "Have you had a sensation of dry mouth every day for the last six months?" Xerostomia was considered present when the respondent answered "yes"²⁵.

Statistical analysis

Descriptive statistics were performed for the characterization of the sample with regard to socioeconomic, oral health and clinical data as well as the OHIP-14 items. In the bivariate analyses, the chi-square test and likelihood ratio test were used to determine associations between the independent variables and negative impact on quality of life ($p < 0.05$). Multivariate logistic regression analysis was then performed using the forward stepwise procedure, in which each variable with a p-value < 0.20 in bivariate analysis was incorporated into the model one by one. The data were entered an Excel spreadsheet and subsequently analyzed using the SPSS for Windows, version 20.0 (SPSS, Chicago, IL, USA).

Table 1. Classification of severity based on the occurrence of at least one site with the following combinations of periodontal findings

	MILD	MODERATE	SEVERE
Probing depth	> 3 and < 5 mm	≥ 5 and < 7 mm	≥ 7 mm
Bleeding on probing	Present	Present	Present
Clinical attachment loss	1-2 mm	3-4 mm	≥ 5 mm

RESULTS

Three hundred two individuals with DM2 participated in the present study, corresponding to 97.4% of the total number of individuals selected based on the sample calculation. The eight dropouts (2.6%) were individuals who declined to participate during the data collection. However, the final number of participants was higher than the minimum number determined during the calculation of the sample size.

The analysis of the distribution of the sample according to the socio-demographic data revealed that the female sex accounted for 71.2% of the sample. Mean age was 63.1 years and 58.9% of the participants were between 51 and 70 years of age. The majority was married (58.9%). Monthly household income ranged from R\$ 80 to R\$ 10.000 and 60.3% earned up to the Brazilian monthly minimum wage. A total of 77.8% of the participants had an incomplete primary school education, 50.3% reported being retired and 22.5% reported having paid employment. Moreover, 48.7% reported going to the dentist due to pain and 37.4% reported brushing their teeth three times a day.

With regard to the clinical diagnoses, 49.3% of the individuals examined had a short arch, 47.7% had an edentulous arch; 85.4% had anterior and posterior tooth loss and 72.2% had denture needs. The prevalence of xerostomia was 52.6% and 29.5% had at least one tooth with caries experience. Bleeding on probing occurred in 47.7% of the patients and periodontitis was diagnosed in 38.4%, among whom 49.1% had severe periodontitis, 25% had moderate periodontitis and 25.9% had mild periodontitis. With regard to extent, 68.1% of these individuals with had generalized periodontitis and 31.9% had localized periodontitis. Tooth mobility was diagnosed in 30.2% of the sample, 37.1% of whom had Grade 1, 31.4% had Grade 2 and 31.4% had Grade 3 (Table 2).

The prevalence of impact on OHRQoL in the sample was 47%. The OHIP-14 items with the greatest frequency of impact were Items 3 ("have you had painful aching in your mouth?") and 4 ("have you found it uncomfortable to eat any foods because of your teeth, mouth or dentures?"), with rates of 53% and 57.9%, respectively (Table 3). These items belong to the pain domain, which was the most prevalent (74.5%), followed by the physical disability (56.3%) and psychological discomfort (51.0%) domains (Table 4).

In the bivariate analysis, the independent variables significantly associated with the impact on OHRQoL were edentulism ($p < 0.001$), denture need ($p = 0.002$), bleeding on probing ($p = 0.007$), periodontitis ($p = 0.000$) and degree of mobility ($p = 0.017$) (Table 5). In the multivariate analysis, xerostomia (OR = 2.15; 95% CI: 1.07 to 4.30), denture need (OR = 3.71; 95% CI: 1.17 to 11.73) and periodontitis (OR = 5.02; 95% CI: 2.19 to 11.52) remained significantly associated with a negative impact on OHRQoL (Table 6).

In the analysis per OHIP-14 domain, xerostomia was significantly associated with all domains ($p < 0.05$), except physical disability ($p = 0.082$) and social disability ($p = 0.132$). Denture need was significantly associated with the pain, psychological discomfort and physical disability domains. Periodontitis was associated with all domains ($p < 0.05$) except social disability ($p = 0.062$).

Table 2. Distribution of the sample according to clinical diagnosis data

Variable	n	%
Edentulism		
Full arch	9	3,0
Short arch	149	49,3
Toothless arch	144	47,7
Location of dental loss		
Loss only anterior	1	0,3
Loss only posterior	34	11,3
Loss anterior and posterior	258	85,4
No Information (Full arch)	9	3,0
Denture Need		
No	84	27,8
Yes	218	72,2
Xerostomia		
No	143	47,4
Yes	159	52,6
Number of carious teeth (NC)		
NC=0	69	22,8
NC>0	89	29,5
No information (Toothless Arch)	144	47,7
Bleeding after Probing		
Absent	14	4,6
Present	144	47,7
No information (Toothless Arch)	144	47,7
Periodontitis		
Ausent	42	13,9
Present	116	38,4
No information (Toothless Arch)	144	47,7
Severity of Periodontitis		
Light	30	25,9
Moderate	29	25,0
Severe	57	49,1
Total	116	100,0
Periodontitis extension		
Localized	37	31,9
Generalized	79	68,1
Total	116	100,0
Dental mobility		
No	81	69,8
Continue		

Continuation		
Yes	35	30,2
Total	116	100,0
Grade of dental Mobility		
Grade 1	13	37,1
Grade 2	11	31,4
Grade 3	11	31,4
Total	35	100,0
Total	302	100,0

Table 3. Prevalence of impact of oral alterations on OHIP-14 quality of life among subjects with DM2

OHIP (Questions)	Without Impact (Never; Rarely)		With Impact (sometimes, Repeatedly, always)		Total	
	n	%	n	%	n	%
Q01 - Speech	240	79,5	62	20,5	302	100,0
Q02 - Palate	199	65,9	103	34,1	302	100,0
Q03 - Pain	142	47	160	53	302	100,0
Q04 - Chewing	127	42,1	175	57,9	302	100,0
Q05 - Worried	169	56	133	44	302	100,0
Q06 - Tense	216	71,5	86	28,5	302	100,0
Q07 - Alimentation	155	51,3	147	48,7	302	100,0
Q08 - Meal	172	56,9	130	43,1	302	100,0
Q09 - Relax	223	73,9	79	26,1	302	100,0
Q10 - Shame	194	64,2	108	35,8	302	100,0
Q11 - Irritation	251	83,1	51	16,9	302	100,0
Q12 - Daily activities	238	78,8	64	21,2	302	100,0
Q13 - Life	220	72,9	82	27,1	302	100,0
Q14 - Work	239	79,2	63	20,8	302	100,0

Table 4. Prevalence of impact of oral changes in quality of life per OHIP-14 domain among individuals with DM2

OHIP (Dimension)	Without Impact		With impact		Total	
	N	%	n	%	n	%
Functional Limitation	176	58,3	126	41,7	302	100,0
Pain	77	25,5	225	74,5	302	100,0
Psychological Discomfort	148	49,0	154	51,0	302	100,0
Physical Inability	132	43,7	170	56,3	302	100,0
Psychological Inability	162	53,6	140	46,4	302	100,0
Social Inability	209	69,2	93	30,8	302	100,0
Disability	190	62,9	112	37,1	302	100,0

Table 5. Impact on quality of life (QoL) according to the variables independentes

Variable	Impact QoL				Total		Valor p	OR (IC 95%)
	without Impact		with Impacto		n	%		
	n	%	N	%				
Sex	Male	44	27,5	43	30,3	87	28,8	0,594 ¹ 0,87 (0,53-1,44)
	Female	116	72,5	99	69,7	215	71,2	
	Total	160	100,0	142	100,0	302	100,0	
Age	Up to 50 years	21	13,1	23	16,2	44	14,6	0,133 ¹ - (--)
	From 51 to 70 years	89	55,6	89	62,7	178	58,9	
	Over to 70 years	50	31,3	30	21,1	80	26,5	
	Total	160	100,0	142	100,0	302	100,0	
Civil status	Single	18	11,3	15	10,6	33	10,9	0,479 ¹ - (--)
	Married	90	56,3	88	62,0	178	58,9	
	Divorced	7	4,4	9	6,3	16	5,3	
	Widower	45	28,1	30	21,1	75	24,8	
	Total	160	100,0	142	100,0	302	100,0	
Income	Up to R\$937,00	95	59,4	87	61,3	182	60,3	0,664 ² - (--)
	From R\$937,00 to R\$2811,00	56	35,0	51	35,9	107	35,4	
	from R\$2811,00 to R\$4685,00	6	3,8	3	2,1	9	3,0	
	Over R\$4685,00 to R\$ 14055,005	3	1,9	1	0,7	4	1,3	
	Total	160	100,0	142	100,0	302	100,0	
Scholarity	Up to Grade 1 incomplete	129	80,6	106	74,6	235	77,8	0,389 ¹ - (--)
	1st to 2nd grade	15	9,4	21	14,8	36	11,9	
	2nd grade until Unvers incomplete	12	7,5	9	6,3	21	7,0	
	Univ comp to Postgrad / Graduate	4	2,5	6	4,2	10	3,3	
	Total	160	100,0	142	100,0	302	100,0	
Work Activity	work	32	20,0	36	25,4	68	22,5	0,092 ¹ - (--)
	Housewife	38	23,8	44	31,0	82	27,2	
	Retired	90	56,3	62	43,7	152	50,3	
	Total	160	100,0	142	100,0	302	100,0	
Visit to the Dentist	Never	16	10,0	9	6,3	25	8,3	0,160 ¹ - (--)
	Because of the pain	75	46,9	72	50,7	147	48,7	
	Once a year	48	30,0	31	21,8	79	26,2	
	Twice a year	13	8,1	16	11,3	29	9,6	
	More than twice a year	8	5,0	14	9,9	22	7,3	
Total	160	100,0	142	100,0	302	100,0		

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Continuation

Brush the teeth	Less than once a day	5	3,1	5	3,5	10	3,3	0,949 ¹	-
	Once a day	23	14,4	22	15,5	45	14,9		
	Twice a day	57	35,6	52	36,6	109	36,1		
	Three times a day	63	39,4	50	35,2	113	37,4		
	More than three times a day	12	7,5	13	9,2	25	8,3		
	Total	160	100,0	142	100,0	302	100,0		
Edentulism	Full arch	9	5,6	-	-	9	3,0	<0,001 ²	-
	Short arch	67	41,9	82	57,7	149	49,3		
	Toothless Arch	84	52,5	60	42,3	144	47,7		
	Total	160	100,0	142	100,0	302	100,0		
Location of dental losses	Loss anterior	-	-	1	0,7	1	0,3	0,327 ²	-
	Loss posterior	20	13,2	14	9,9	34	11,6		
	Loss anterior e posterior	131	86,8	127	89,4	258	88,1		
	Total	151	100,0	142	100,0	293	100,0		
Denture need	No	57	35,6	27	19,0	84	27,8	0,002 ¹	2,36 (1,39-4)
	Yes	103	64,4	115	81,0	218	72,2		
	Total	160	100,0	142	100,0	302	100,0		
Xerostomia	No	84	52,5	59	41,5	143	47,4	0,074 ¹	1,55 (0,99-2,45)
	Yes	76	47,5	83	58,5	159	52,6		
	Total	160	100,0	142	100,0	302	100,0		
Number of carious teeth (NC)	NC=0	37	48,7	32	39,0	69	43,7	0,288 ¹	1,48 (0,79-2,79)
	NC>0	39	51,3	50	61,0	89	56,3		
	Total	76	100,0	82	100,0	158	100,0		
Bleeding after Probing	No	12	16,0	2	2,4	14	8,9	0,007 ³	7,62 (1,64-35,29)
	Yes	63	84,0	80	97,6	143	91,1		
	Total	75	100,0	82	100,0	157	100,0		
Periodontitis	No	32	42,1	10	12,2	42	26,6	0,000 ¹	5,24 (2,35-11,69)
	Yes	44	57,9	72	87,8	116	73,4		
	Total	76	100,0	82	100,0	158	100,0		
Severity Periodontitis	Light	13	29,5	17	23,6	30	25,9	0,194 ¹	-
	Moderate	14	31,8	15	20,8	29	25,0		
	Severe	17	38,6	40	55,6	57	49,1		
	Total	44	100,0	72	100,0	116	100,0		
Periodontitis extension	Localized	18	40,9	19	26,4	37	31,9	0,155 ¹	1,93 (0,87-4,29)
	Generalized	26	59,1	53	73,6	79	68,1		
	Total	44	100,0	72	100,0	116	100,0		
Dental Mobility	No	35	79,5	46	63,9	81	69,8	0,115 ¹	2,2 (0,92-5,28)
	Yes	9	20,5	26	36,1	35	30,2		
	Total	44	100,0	72	100,0	116	100,0		

Continue

Continuation								
Grade of Dental Mobility	Grade 1	5	55,6	8	30,8	13	37,1	0,017 ²
	Grade 2	4	44,4	7	26,9	11	31,4	-
	Grade 3	-	-	11	42,3	11	31,4	(--)
	Total	9	100,0	26	100,0	35	100,0	

1- Pearson's Chi-square test; 2 Likelihood ratio test; 3 Chi-square with continuity correction; R\$ Real.

Table 6. Multivariate analysis of the association between independent variables and impact on OHRQoL

Variable	Coef.	E.P.	χ^2	Valor p	OR ¹	IC 95%	
						Minimum	Maximum
Denture need	1,31	0,59	4,98	0,026	3,71	1,17	11,73
Xerostomia	0,76	0,35	4,63	0,031	2,15	1,07	4,30
Periodontitis	1,61	0,42	14,53	0,000	5,02	2,19	11,52
Constante	-2,70	0,70	14,72	0,000	0,07		
Hosmer-Lemeshow test	p-valor		Test Omnibus	p-valor		R ² of Nagelkerke	
2,91	0,573		27,912	0,000		0,216	

Legend: c2 - chi-square; 1-OR-odds ratio; CI - confidence interval; Coef- coefficient of the variable; E.P- standard error; R2 - coefficient of determination

DISCUSSION

Studies on OHRQoL are more complete than those restricted to measuring clinical data due to the ability to express the extent of the negative impact of oral problems on the lives of populations and therefore constitute an important collective health tool that can contribute to the planning of public health policies²⁶⁻²⁸. Studies have evaluated quality of life in patients with DM2, but few have investigated OHRQoL in this population²⁷⁻²⁹.

In the present study, oral problems exerted a negative impact on quality of life among nearly half of the population with DM2. A similar result is reported in a study conducted in the United States, in which the prevalence of impact on OHRQoL was 47.7%²⁸. Other studies, however, report lower prevalence rates ranging from 22.5 to 34.4%^{10,25,29}. Such divergences may be explained by cultural differences among the populations surveyed as well as differences in the methods employed in the studies. A strong point of the present investigation is the fact that it was the population-based study with a randomized, representative sample.

The OHIP-14 items related to pain were the most prevalent. The population studied reported greater impact on Items 3 ("have you had painful aching in your mouth?") and 4 ("have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?"), with rates of 53% and 57.9%, respectively. These findings are similar to those reported in studies conducted in Iran¹⁴, the United Kingdom³⁰ and Brazil³¹, suggesting that oral problems with the potential to cause physical pain and discomfort have the greatest negative impact on quality of life.

The socio-demographic data were not significantly associated with OHRQoL. This finding is in agreement with data described in a study conducted in Iran¹⁴, but is in disagreement with findings described in other studies^{8,26,32}. In the present investigation, the sample was quite homogeneous with regard to socio-demographic variables, especially sex, income and schooling, which may have influenced the results, as reported in study of Mohamed et al (2013)¹⁰, where educational level was originally measured as (0 = illiterate, 1 = literate, 2 = primary school, 3 = middle school, 4 = high school, 5 = college, 6 = post-graduation studies) and was recoded into illiterate = 1 (including the original category 0) and literate = 2 (including the categories 1–6). Employment status was measured as (0 = unemployed, 1 = student, 2 = housewife, 3 = retired, 4 = employed), then recoded into unemployed = 1 (including the original categories 0–3) and employed = 2 (including the original category 4).

The literature reports that individuals with inadequate oral hygiene habits and infrequent visits to a dentist have a greater chance of having an unfavorable oral health status, which can exert a negative impact on quality of life^{26,33}. Such findings suggest that the effects of self-care and dental treatment can improve OHRQoL. However, this association was not found in the present study, which may be explained by the profile of the sample. The fact that nearly half of the sample was composed of completely edentulous individuals may have led to an underestimation of the role of oral problems, such as dental caries and periodontal disease, which are dependent on the control of biofilm and are therefore related to hygiene habits.

There is a consensus in the literature regarding the role of dental caries as a factor associated with a negative impact on quality of life in different populations, including individuals with DM2^{14,34}. Caries is an oral problem that can cause pain and, in some situations, have a negative impact on esthetics, with functional, psychological and social repercussions³⁵. In the present study, however, no such association was found in the individuals with DM2. One should bear in mind that the sample was composed mainly of older adults and other oral problems, such as periodontal disease, are more prevalent than dental caries in this age group³⁵ and therefore have a greater impact on quality of life.

Xerostomia is of the most prevalent oral manifestations in diabetic patients and exerts a negative impact on quality of life due to the fact that it affects speaking, the use of dentures and food intake^{14,23,36,37}. This condition was highly prevalent in the present investigation, which is similar to data described in a study conducted in Sweden involving adults with DM2⁸. However, a difference observed between the two studies regarding the impact on quality of life. Unlike the study conducted in Sweden, xerostomia was associated with a negative impact on quality of life in nearly all the domains of the OHIP-14 in the present investigation. In a Brazilian study involving patients with type 1 diabetes mellitus, the authors also report the impact of xerostomia on quality of life, demonstrating the importance of the prevention and treatment of this condition for improving the quality of life of diabetic patients¹⁷. It should be pointed out that xerostomia is a condition that may or may not be associated with hyposalivation. The evaluation of xerostomia is limited to self-reported information and is considered to be an important aspect of OHRQoL in patients with DM2¹⁷. However, further studies

should be conducted involving the analysis of saliva flow to determine the impact of hyposalivation of OHRQoL in this population.

A strong association was found between periodontitis and the negative impact on quality of life, which is in agreement with data described in previous studies^{10,14,38}. The multivariate analysis revealed that individuals with DM2 and a diagnosis of periodontitis had a fivefold greater risk of a negative impact on quality of life. Moreover, all domains of the OHIP-14, except social disability, were significantly associated with periodontitis. These findings confirm the fact that periodontitis is the most important oral complication of diabetes due not only to its high prevalence, but also its impact on quality of life, underscoring the need for specific strategies aimed at minimizing the negative effects of periodontal disease on the quality of life of individuals with DM2.

In many cases, tooth loss is a consequence of periodontal disease. Edentulism has functional and esthetic repercussions that compromise quality of life⁸. Differently from the findings of previous studies^{8,10,39}, however, no significant association was found between edentulism and quality of life in the present investigation when considering either the number or location of missing teeth. The divergence in comparison to other studies may reflect differences in the meaning attributed to tooth loss in different social and cultural contexts. For some populations, tooth loss is understood as a natural circumstance of the ageing process⁴⁰, which may make this condition not have a negative impact on quality of life.

As reported in other studies^{41,42}, individuals with denture needs in the present investigation had a greater chance of experiencing a negative impact on quality of life. In the analysis per domain, denture need was associated with the domains related to pain, psychological discomfort and physical disability. The absence of the impact of tooth loss and the associations between denture need and the domains cited reveal that tooth loss is not important to the population studied provided that prosthetic rehabilitation is adequate. Moreover, this finding supports the inference that the experience of pain, stress and functional loss stemming from edentulism prevails over the impact on esthetics and its psychological and social repercussions.

The present study has limitations that should be addressed. The cross-sectional design places limits on causal inferences between the independent variables and the occurrence of impact on quality of life. Therefore, longitudinal studies should be performed to confirm the inferences revealed in the present investigation. Moreover, there is the possibility of memory bias with regard to questions related to the past. However, the present investigation was a population-based study randomized, and the results can be extrapolated to the population, making the findings useful for the definition of priorities that need to be considered in the planning of public health policies directed at the population with DM2. The predictive factors of a negative impact on OHRQoL differ among different populations and therefore the needs of each population should be analyzed in an individualized manner. Oral healthcare policies for individuals with type 2 diabetes mellitus should encompass specific strategies based on studies addressing OHRQoL.

In conclusion, for patients with this systemic condition, the present findings reveal that xerostomia, denture need and periodontitis constitute risks for the negative impact oral health-related quality of life, independently of socioeconomic status.

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