RESEARCH PAPER (ORIGINAL)

Clinical Predictors of Oral Health-Related Quality of Life in Older Adults with Diabetes

Preditores Clínicos da Qualidade de Vida Relacionada com a Saúde Oral em Idosos Diabéticos

Predictores Clínicos de la Calidad de Vida Relacionada con la Salud Bucal en los Mayores Diabéticos

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Abstract

Background: The assessment of Oral Health-Related Quality of Life (OHRQoL) is essential to planning oral health programs, but there is a lack of research on this issue with chronic patients.
Objectives: To assess clinical predictors of OHRQoL in older adults with diabetes.
Methodology: A cross-sectional study was carried out with 207 older adults with diabetes in Northeast Portugal. Clinical examination provided data on oral health parameters. OHRQoL was assessed based on the short version of the Oral Health Impact Profile (OHIP-14) and the score was dichotomised into OHIP-14 with and without impact. Logistic regression models provided adjusted odds-ratio (OR) and respective 95% confidence interval (95%CI) for the clinical predictors of OHRQoL.
Results: In this sample, 84.1% of older adults reported a negative impact on OHRQoL. According to the logistic regression analysis, the number of natural posterior teeth (OR=0.85; 95%CI:0.80-0.92) and a feeling of dry mouth (OR=3.30; 95%CI:1.08-10.10) are predictor variables of OHIP-14 with impact.
Conclusion: Our findings highlight the importance of preventing tooth loss to ensure OHRQoL in these older adults.

Keywords: Health; elderly; diabetes mellitus; quality of life

Resumo

Enquadramento: Avaliar a Qualidade de Vida Relacionada com a Saúde Oral (QVRSO) é crucial no planeamento de programas de saúde, mas é escassa a investigação nesta matéria em populações com patologia crónica.
Objetivos: Avaliar preditores clínicos da QVRSO de idosos diabéticos.
Metodologia: Estudo transversal em 207 idosos diabéticos no Nordeste de Portugal. Os parâmetros de saúde oral foram obtidos com exame clínico. As 14 questões do *Oral Health Impact Profile* (OHIP-14) forneceram um score de QVRSO que foi dicotomizado em OHIP-14 com e sem impacto negativo. Os modelos de regressão logística forneceram valores ajustados de odds-ratio (OR) e respetivo intervalo de confiança a 95% (IC95%) para preditores clínicos da QVRSO.
Resultados: Dos idosos, 84,1% reportaram impacto negativo na QVRSO. De acordo com a análise de regressão logística, o número de dentes naturais posteriores (OR=0,85;IC 95%:0,80-0,92) e a sensação de boca seca (OR=3,30;IC 95%:1,08-10,10) são variáveis preditoras de OHIP-14 com impacto.
Conclusão: Este estudo realça a importância de prevenir perda dentária para assegurar a QVRSO nestes idosos.

Palavras-chave: Saúde; idosos; diabetes mellitus; qualidade de vida

Resumen

Marco contextual: Evaluar la calidad de vida relacionada con la salud oral (QVRSO) es crucial en la planificación de los programas de salud. Sin embargo, hay poca investigación en esta materia en poblaciones con enfermedad crónica.
Objetivos: Evaluar predictores clínicos de la QVRSO en mayores diabéticos.
Metodología: Estudio transversal realizado en 207 mayores diabéticos residentes en el Nordeste de Portugal. Los parámetros de salud oral se obtuvieron mediante un examen clínico. Las 14 preguntas del *Oral Health Impact Profile* (OHIP-14) proporcionaron un resultado de QVRSO que se dividió en OHIP-14 con y sin impacto negativo. Mediante modelos de regresión logística se obtuvieron valores ajustados de odds-ratio, o razón de momios, (OR) y el respectivo intervalo de confianza al 95 % (IC95%) para los predictores clínicos de la QVRSO.
Resultados: De los mayores, el 84,1 % dio un impacto negativo en la QVRSO. De acuerdo con el análisis de regresión logística, el número de dientes naturales posteriores (OR=0,85; IC 95 %:0,80-0,92) y la sensación de boca seca (OR=3,30; IC 95 %:1,08-10,10) son variables predictoras de OHIP-14 con impacto.
Conclusión: Este estudio pone de manifiesto la importancia de prevenir la pérdida de dientes para asegurar la QVRSO en estos mayores.

Palabras clave: Salud; adultos mayores; diabetes mellitus; calidad de vida

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Introduction

In Europe, over the last three decades, the proportion of older people (individuals aged 65 years or over) has been steadily increasing and reached 15% in 2012 (World Health Organization Regional [WHO], 2012). This figure is expected to double over the next four decades (Petersen & Yamamoto, 2005). This increase in population ageing, which is a result of the substantial decline in mortality, has led to an increase in the prevalence of debilitating chronic diseases whose incidence increases with age (Prince et al., 2015). The increasing population ageing is a challenge for health policy-makers.

The effects of ageing and the consequences of chronic diseases, particularly type 2 diabetes, deteriorate oral health, compromising oral function and contributing to a decrease in the quality of life of the elderly population (Petersen & Yamamoto, 2005). Thus, elderly patients with chronic diseases are expected to have increased needs for oral health care and services which makes it essential to correctly assess the clinical parameters with harmful effects on the quality of life of this population.

The purpose of this study is to assess which clinical parameters of oral health have an impact on the oral health-related quality of life (OHRQoL) of older adults with diabetes living in a small municipality in Northeast Portugal.

Background

Global population ageing poses serious challenges to public health professionals who are responsible for planning healthcare services and allocating financial and human resources. Indeed, increased life expectancy is also associated with increased likelihood of developing chronic diseases, which are usually debilitating and contribute to physical disability and poor quality of life (Petersen & Yamamoto, 2005). Type 2 diabetes is one of the most prevalent of these chronic disorders and its incidence increases with age (Prince et al., 2015).

Ageing has negative repercussions on oral health which are explained by the cumulative effect of the exposure to risk factors throughout the life cycle, in particular the lack of access to oral health care and the lack of oral health habits. Tooth loss, periodontal disease, dental caries and xerostomia are the most common oral health problems in the elderly population (Corte-Real, Figueiral, & Campos, 2011; Petersen & Yamamoto, 2005).

There is a strong interrelationship between general health and oral health, given that the weakness of the former causes deterioration of the latter which, in turn, exacerbates the consequences of the chronic disease (Petersen & Yamamoto, 2005). This association is even more evident in people with diabetes. The state of chronic hyperglycemia that characterises diabetes causes deep changes in body metabolism and vascular failure. As a result, individuals with diabetes have a higher likelihood of developing periodontal disease, caries and xerostomia than individuals without diabetes (Huang, Chan, & Young, 2013; Negrato & Tarzia, 2010). In these circumstances, older adults with diabetes are a population group with high risk of oral health deterioration and, therefore, with greater oral health needs.

The level of oral health influences a wide range of activities inherent to the physiology of the stomatognathic system. Chewing, tasting and enjoying food, speech and, consequently, communication and socialisation, as well as self-image and self-esteem are aspects deeply influenced by the pathological conditions of the oral cavity. Therefore, the clinical conditions that indicate deterioration of oral health, namely dental caries, periodontal disease and tooth loss, have a negative impact on OHRQoL, as they restrict the functions of the stomatognathic system (Huang et al., 2013).

In the current context of public health, the promotion of a healthy ageing is valued through the implementation of strategies to meet the needs for dental treatment and provide mechanisms for oral rehabilitation in the elderly population. This is intended to alleviate the negative impact of oral pathology on the quality of life of the elderly (Petersen & Yamamoto, 2005). It is only possible to identify the real oral health needs of the population if the objective evaluation of clinical parameters is accompanied by subjective measures. The subjective evaluation allows assessing two aspects: how individuals perceive their oral health; and the level of interference of oral health in their well-being. Both forms of evaluation (subjective and objective) of the oral condition allow identifying the clinical parameters with greater impact on the well-being of the individual, optimising

the clinical decision case by case, allowing a better planning of preventive strategies, as well as an adaptation of oral health care to the real needs of users (Petersen & Yamamoto, 2005; Sanders, Slade, Lim, & Reisine, 2009; Slade, 1997; Ulinski et al., 2013). Over the last two decades, multidimensional instruments have been developed to measure the impact of the conditions of the oral cavity on OHRQoL (Slade, 1997). Of these instruments, the Oral Health Impact Profile (OHIP) is the one that gives greater emphasis to psychosocial impacts and has good psychometric properties to assess OHRQoL (Rodakowska, Mierzynska, Baginska, & Jamiolkowski, 2014). It is one of the most widely used instruments to assess OHRQoL, particularly in elderly populations (Dahl, Wang, Holst, & Ohrn, 2011; Duque-Duque et al., 2013; Kotzer, Lawrence, Clovis, & Matthews, 2012; Lahti, Suominen-Taipale, & Hausen, 2008; Pires, 2009; Rodakowska et al., 2014; Stenman, Ahlqwist, Bjorkelund, & Hakeberg, 2012; Ulinski et al., 2013). The validity, replicability and consistency of its original version with 49 items (OHIP-49) and of the simplified version with only 14 items (OHIP-14; Slade, 1997) were confirmed. The same happened with the simplified version translated into Portuguese to be used in the Brazilian population (Ulinski et al., 2013). In Portugal, the proportion of elderly people has increased from 9% in 1970 to around 20% in 2012, and Portugal is currently one of the oldest countries in the European region. In parallel, there was also an increase in the prevalence of diabetes in this population (WHO, 2012), with more evident consequences in more advanced ages (Prince et al., 2015).

Taking into account this scenario, a high prevalence of oral diseases is expected with a strong impact on the quality of life of the elderly population in Portugal. However, the research that explores the relationship between clinical oral health indicators and the quality of life of the elderly population in Portugal is scarce. Therefore, it is of extreme relevance to identify the clinical parameters that are predictors of negative impact on OHRQoL.

Research Question

The research question underlying this study was to determine the clinical parameters of oral health with an impact on the OHRQoL of older adults with diabetes.

This study aimed to (1) characterise the oral health conditions of these older adults through clinical examination, (2) characterise OHRQoL using the OHIP-14 so as to (3) identify which oral health conditions are associated with OHRQoL.

Methodology

Between March and July 2013, a cross-sectional study was conducted, taking as reference all individuals with diabetes aged 65 years or over, living in a village of the region of Trás-os-Montes (Northeast Portugal) and users of the healthcare centre of this village ($n=293$). Based on the record files of these users, there was direct contact at the residence in order to invite them to participate in the study. Of this population, 207 older adults with diabetes were considered, after 10 older adults being excluded for not being able to provide a coherent answer to the questions raised, 33 for not being present in their usual residence after two contacts during the study period and 43 for being toothless. All participants were explained the objectives of the study and signed the informed consent. The information was obtained through a face-to-face interview and clinical oral examination by a single researcher. During data collection and analysis, a protocol of procedures was followed in order to ensure anonymity and confidentiality.

For each older person, information from sociodemographic variables was obtained: age (dichotomised in 65-75 years and over 75 years); marital status (with or without a companion) and education (≤ 4 and > 4 years of schooling).

The clinical evaluation of the oral condition was performed according to the following pre-established observation protocol that was equally applied to all participants:

(1) Calculation of the total number of natural teeth in the oral cavity classified into two groups according to their position in the dental arcade - anterior and posterior -, considering 12 and 20 teeth as maximum values in each group, respectively; (2) Assessment of the rehabilitation of edentulous areas through dental prosthesis, enabling the classification of participants into four groups: without need for rehabilitation (full natural dentition), with totally rehabilitated edentulous areas, with partially rehabilitated edentulous areas, and with areas edentulous without

MARIA JOSÉ ALMENDRA RODRIGUES GOMES et al. *Revista de Enfermagem Referência*
Journal of Nursing Referência - IV - n.° 7 - 2015

83

any rehabilitation; (3) Calculation of the number of decayed teeth and number of teeth with periodontal pocket, according to the criteria proposed by the World Health Organization (WHO, 1997). Based on the values obtained, the percentages of decayed teeth and teeth with periodontal pocket in the total number of natural teeth in the oral cavity were calculated; (4) and the participants were questioned regarding the sensation of dry mouth reported with two answer options (yes or no).

The impact on OHRQoL was assessed using the OHIP-14 questionnaire, namely the version validated in Portuguese (Ulinski et al., 2013). As shown in Table 1, the 14 questions of this index refer to oral health problems experienced over the last 12 months. For each question relating to the impact on a particular life activity, there are five possible answers, according to a Likert-type scale in which 0 is *never experienced*, 1 is *hardly never experienced*, 2 is *occasionally experienced*, 3 is *fairly often experienced* to 4 is *very often experienced*. Scores 3 and 4 indicate that

there is a negative impact on OHRQoL. By summing the scores obtained in the 14 questions, a total score between 0 and 56 points is obtained; the higher the score, the greater the impact of oral health problems on quality of life (Ulinski et al., 2013). The questions are grouped into seven dimensions (two questions per dimension) that reflect the impact of oral condition on the following aspects: functional limitation; physical pain; psychological discomfort; physical disability; psychological disability; social disability; and handicap (Ulinski et al., 2013). Based on the answers to each question of the OHIP-14, a variable with two categories was created, according to the level of impact of oral health on OHRQoL. Thus, the categories *OHIP-14 with impact* and *OHIP-14 without impact* were established, in that answers with scores of 3 (*fairly often experienced*) or 4 (*very often experienced*) in at least one of the 14 items of the scale indicated the presence of impact (Duque-Duque et al., 2013; Kotzer et al., 2012; Stenman et al., 2012).

Table 1

Items of the OHIP-14 according to the dimensions (Ulinski et al., 2013)

Dimensions	Items reported during the past 12 months	Options *				
		0	1	2	3	4
Functional	Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?					
	Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?					
Physical pain	Have you had a painful aching in your mouth?					
	Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?					
Psychological Discomfort	Have you been self-conscious because of your teeth, mouth or dentures?					
	Have you felt tense because of problems with your teeth, mouth or dentures?					
Physical Disability	Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?					
	Have you had to interrupt meals because of problems with your teeth, mouth or dentures?					
Psychological Disability	Have you found it difficult to relax because of problems with your teeth, mouth or dentures?					
	Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?					
Social Disability	Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?					
	Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?					
Handicap	Have you felt that life in general was less satisfying because of problems with your teeth, mouth or dentures?					
	Have you been totally unable to function because of problems with your teeth, mouth or dentures?					

* 0 = never; 1 = hardly never; 2= occasionally; 3 = fairly often; 4= very often

The median, the Interquartile Range (IQR), the mean and the respective standard deviation were calculated for the total OHIP-14 and for each of the seven dimensions. The prevalence of negative impact on OHRQoL was also calculated for the total OHIP-14 and for each dimension as being the percentage of individuals with scores of 3 and/or 4 in at least one of the items of the OHIP-14.

Bivariate analysis was performed with the description of the independent variables in each one of the groups of the OHIP-14 dichotomous variable (OHIP-14 with impact and OHIP-14 without impact), comparing frequencies of distribution and median values between both groups of the dependent variable.

To assess which clinical and sociodemographic variables are predictors of the presence of impact, we developed logistic regression models. The selection of variables was based on the procedure of *forward deletion* in which, based on the model without independent variables, the variables that contribute significantly to the model were added. Odds Ratios (OR) with respective confidence interval at 95% (CI) were obtained to estimate the strength of association between independent variables and the dichotomised OHIP-14. The goodness-of-fit was assessed through the Hosmer-Lemeshow test.

The statistical analysis was performed using the *Statistical Package for the Social Sciences* (SPSS), IBM version 19.0. Statistically significant associations were inferred for a significance level of 0.05.

Results

Of the 207 diabetic older adults with natural teeth, 50.2% ($n=104$) were women, around two-thirds ($n=141$; 68.1%) were married or cohabiting and a large proportion of individuals ($n=188$; 90.8%) had up to 4 years of schooling.

The clinical evaluation indicated a low level of oral health. The mean number of natural teeth in the oral cavity was 15.3 (±10.12) and the median number was 7 (IQR: 2-12) for anterior teeth and 8 (IQR: 2-15) for posterior teeth. Functional dentition (number of natural teeth higher than 20) was observed in 39% ($n=80$) of the participants and full natural dentition was observed in only 12% ($n=25$). The median values for the percentages of decayed teeth and teeth with periodontal pocket were 27% (IQR: 4%-100%) and 45% (IQR: 10%-100%), respectively. The feeling of dry mouth was reported by 91% ($n=188$) of the elderly.

Table 2 shows, for the total score of the OHIP-14 and for each dimension, the median values and respective IQR, the mean values and respective standard deviations, as well as the percentage of individuals who reported negative impact on at least one of the items (answers coded with scores 3 and/or 4). The median for the total score of the OHIP-14 was 24 (IQR: 15-35), its mean score was 25.0 (±13.53) and 84.1% of the elderly reported negative impact on at least one of the items. The most scored dimensions (with more negative impact) were functional limitation, physical pain and physical disability.

Table 3 describes the sociodemographic characteristics and clinical indicators according to the two categories of the OHIP-14 (OHIP-14 without impact and OHIP-14 with impact), and statistically significant differences were found between both groups. With respect to sociodemographic variables, there is a higher percentage of women ($p=0.012$) and a smaller percentage of individuals with higher educational level ($p=0.009$) in the group of OHIP-14 with impact. In relation to clinical indicators, a higher percentage of individuals reporting dry mouth ($p=0.001$), the lowest median number of posterior teeth ($p<0.001$), and the highest median number for the percentage of decayed teeth ($p<0.001$) and for the percentage of teeth with periodontal pocket ($p<0.001$) were observed in the group of OHIP-14 with impact

Table 2

Medians, means and prevalence of impacts by dimension and total of OHIP-14

		Possible maximum value	Median and e [IIQ]	Mean ± standard deviation	% of impacts*
Total OHIP-14		56	24 [15 − 35]	25.0±13.53	84.1
Dimensions	Functional Limitation	8	4 [2 − 6]	4.3±2.29	65.7
	Physical pain	8	4 [3 − 6]	4.4±2.31	58.5
	Psychological discomfort	8	2 [0 − 5]	2.7±2.58	29.0
	Physical disability	8	4 [2 − 6]	4.0±2.43	56.0
	Psychological disability	8	2 [0 − 4]	2.3±2.15	33.8
	Social disability	8	3 [2 − 5]	3.4±2.27	43.5
	Handicap	8	4 [2 − 6]	3.9±2.45	39.1

* at least one item with an answer of "fairly often" or "very often"

Table 3

Sociodemographic and clinical characteristics according to the level of OHIP-14

	n (%) or median [IIQ]		p-value*
	OHIP- Without impact n=33	OHIP- With impact n=174	
Gender			
male	23 (69.7)	80 (46.0)	0.012
female	10 (30.3)	94 (54.0)	
Age (years)			
65 - 75	22 (66.7)	84 (48.3)	0.053
> 75	11 (33.3)	90 (51.7)	
Marital status			
Married/co-habiting	27 (81.8)	114 (65.5)	0.065
Single/widowed/divorced	6 (18.2)	60 (34.5)	
Level of education (years of schooling)			
=<4	26 (78.8)	162 (93.1)	0.009
>4	7 (21.2)	12 (6.9)	
Feeling of dry mouth			
yes	25 (75.8)	163 (93.7)	0.001
no	8 (24.2)	11 (6.3)	
Rehabilitation of edentulous areas			
Full natural dentition without need for rehabilitation	10 (30.3)	15 (8.6)	
Totally rehabilitated edentulous areas	2 (6.1)	16 (9.2)	0.005
Partially rehabilitated edentulous areas	2 (6.1)	22 (12.6)	
Edentulous areas without any rehabilitation	19 (57.6)	121 (69.5)	
Number of natural anterior teeth (maximum=12)	12 [6 - 12]	7 [2 − 12]	0.064
Number of natural posterior teeth (maximum=20)	15 [10 -19]	6 [2 − 12]	<0.001
Percentage of decayed teeth	3 [0 - 14]	36 [8 − 100]	<0.001
Percentage of teeth with periodontal pocket	7 [0 - 28]	55 [12 − 100]	<0.001

*chi-square test

Table 4 shows the results of the multivariate logistic regression analysis, after including the variables that contribute significantly to the model. According to the table, the number of natural posterior teeth (OR= 0.85; 95%CI: 0.80-0.92) and the feeling of dry mouth (OR= 3.30; 95%CI: 1.08-10.10) are predictor variables of OHIP-14 with impact. The p-value for the Hosmer-Lemeshow test was 0.420.

Table 4

Predictors of impacts on OHRQoL (OHIP-14 with impact vs. OHIP-14 without impact)

Predictor variables *	OR (95%CI)
Number of natural posterior teeth	0.85 (0.80 − 0.92)
Feeling of dry mouth (yes vs. no)	3.30 (1.08 − 10.10)

*p-value for the Hosmer -Lemeshow test: 0.420

Discussion

This study explored the potential influence of clinical indicators of oral health in the OHRQoL of older adults with diabetes living in a community in Northeast Portugal. In addition to a low level of oral health, there is a clear low level of OHRQoL in these elderly people. The main predictors of negative impacts on OHRQoL were the number of posterior teeth in the oral cavity and the feeling of dry mouth.

OHRQoL has been estimated based on the percentage of individuals who reported having *fairly often* and very *often* experienced interference or limitations in the activities related to the stomatognathic system, a percentage which is usually designated as prevalence of negative impacts on the OHRQoL of the population. The lower the level of OHRQoL, the higher will be the prevalence of negative impacts, indicating greater needs for oral treatment and rehabilitation in the population (Duque-Duque et al., 2013; Kotzer et al., 2012; Stenman et al., 2012). In this study, the prevalence of negative impact on OHRQoL is evident, given that 84% of the elderly reported negative impacts on at least one item of the OHIP-14. This percentage is higher than that observed in another study conducted in Portugal (Pires, 2009), in studies conducted in other European countries (Dahl et al., 2011; Duque-Duque et al., 2013; Lahti et al., 2008; Stenman et al., 2012) and in non-European countries, namely Canada (Kotzer et al., 2012; Locker, Matear, Stephens, Lawrence, & Payne, 2001), Australia (Sanders et al., 2009), the United States (Sanders et al., 2009) and Brazil (Ulinski et al., 2013).

The fact that we only considered older adults with diabetes in our study, excluding the healthy individuals of the population, could have inflated the prevalence of negative impact, since debilitating chronic diseases exacerbate the deterioration of oral health (Huang et al., 2013; Negrato & Tarzia, 2010; Petersen & Yamamoto, 2005). However,

when comparing with studies in which the sample included a large proportion of elderly people with chronic diseases (Locker et al., 2001), the prevalence of negative impacts found in our study is higher, indicating a low level of OHRQoL in this population.

Underlying the level of OHRQoL that emerges from our results is a scenario of precarious conditions of the clinically assessed oral cavity, which is evidenced by tooth loss. In fact, the mean number of natural teeth in these older adults is 15 (almost half of what would be the full natural dentition) and the percentage of individuals with functional dentition (number of natural teeth higher than 20) is only 40%. Although these values are similar to those observed by Pires, 2009, they are lower than those observed in other studies (Dahl et al., 2011; Locker et al., 2001; Rodakowska et al., 2014; Stenman et al., 2012).

One of the most used clinical parameters to assess the condition of the oral cavity is tooth loss which reflects not only the cumulative effect of a set of pathological situations, namely the progression of periodontal disease and dental caries, but also the limited access to dental treatment (Petersen & Yamamoto, 2005). The reduction of the mean number of natural teeth compromises functionally chewing and phonetics but also has direct consequences on the aesthetics by changing self-image and self-esteem. The aesthetic aspect is more dependent on anterior teeth and the lack of posterior teeth seriously compromises chewing, restricting the type of diet (Nassani et al., 2009). Thus, tooth loss will have different negative impacts on the OHRQoL of individuals depending on the importance assigned to aesthetics and chewing. However, it is known that the differences in the degree of valuation of each of these aspects are intrinsically linked to cultural aspects (Nassani et al., 2009).

According to previously published studies, the relationship between OHRQoL and the total number of natural teeth in the oral cavity is not always consistent. Some authors report a strong association

between these two variables, in such a way that the lower the number of natural teeth, the lower is the OHRQoL (Dahl et al., 2011; Lahti et al., 2008; Sanders et al., 2009; Stenman et al., 2012), while others show that this association is weak or inexistent (Locker et al., 2001; Rodakowska et al., 2014; Ulinski et al., 2013). We chose to assess the association between the number of natural teeth and OHRQoL, taking into account their position in the dental arcade. The level of OHRQoL increases if the number of posterior teeth also increases, but it does not change with the variation in the number of anterior teeth. It follows that our sample attaches more importance to aspects related to chewing, speech and palate than to aesthetics, which can be corroborated by the higher percentage of elderly people reporting negative impacts on the dimensions of functional limitation, physical pain and physical disability. In other studies, the dimensions related to psychological discomfort and psychological disability are the ones with the highest percentage of negative impact, although physical pain is also highly scored (Dahl et al., 2011; Duque-Duque et al., 2013; Locker et al., 2001; Ulinski et al., 2013). These aspects indicate differences in the valuation of the limitations and interference in the activities related to the stomatognathic system.

The precariousness of oral health observed in the participants of this study reflects not only the cumulative effect of oral pathology, but probably also the lack of dental treatment throughout the life cycle, as is the case in other populations (Kotzer et al., 2012; Rodakowska et al., 2014). Indeed, disparities in access to oral health care explain the precariousness of oral health at more advanced ages, evidenced by tooth loss (Petersen & Yamamoto, 2005). The Portuguese elderly population was marked by a history of poor access to oral health care and by the lack of specialised oral services in the interior rural areas. Geographical isolation and distance hamper the access to dental treatment during the life cycle, leaving indelible marks, as observed in the elderly participants of this study (Furtado & Pereira, 2010).

The proportion of elderly who reported a feeling of dry mouth is much higher than that observed in other studies (Locker et al., 2001; Stenman et al., 2012). This high proportion may be explained by the fact that all the elderly included in this sample have diabetes, which is a factor that increases the risk of xerostomia. However, according to the authors of these studies,

we found a strong correlation between the feeling of dry mouth and OHRQoL. This association is explained by the role played by saliva in the process of chewing, swallowing, tasting and speaking (Corte-Real et al., 2011), which are activities hampered when the salivary flow decreases.

A limitation of this study was the fact that it was conducted in a very restricted geographical area, in a very specific population of elderly individuals with diagnosis of diabetes mellitus. This aspect hinders the generalisation of our results to other populations of older people. However, the sampling methodology allowed a good characterisation of this population regarding both the main parameters clinically assessed and their association with OHRQoL.

The OHIP-14 questionnaire used in this study was validated for the Portuguese language to be used in the Brazilian population, but it has not yet been validated for the Portuguese population. There are some cultural differences between Brazil and Portugal that could be considered as a limitation to the use of this questionnaire in the Portuguese population. However, the Portuguese language does not substantially differ between both countries and there are ties of proximity between both cultures, by which this was not considered a limitation to using this version of the questionnaire in this study.

Conclusion

Important conclusions for public health may be drawn from the results found in this study. Tooth loss was one of the oral health indicators with the greatest impact on the life quality of these older adults with diabetes. We believe that it is important to invest in the access to and availability of services directed to prevention, early diagnosis and dental treatment to prevent tooth loss throughout the life cycle, thus investing in a greater OHRQoL.

It is also important to introduce oral health in the follow-up consultations of patients with diabetes for the prevention or early treatment of oral diseases, particularly periodontal disease, thus avoiding the extreme situation of tooth loss in this high-risk population. Hence the need emerges to define an interdisciplinary plan of action with the intervention of the health professionals who monitor the oral health status and understand the perception of the

population groups about oral health. This procedure will make it possible to adapt oral health care to the real needs of the population with positive effects in the OHRQoL throughout the life cycle of the individual.

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