Impact of Smoking on Oral Health-related Quality of Life

Impacto do Tabagismo na Qualidade de Vida Relacionada à Saúde Bucal

Impacto del Tabaquismo en la Calidad de Vida Relacionada con la Salud Oral

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Abstract
The aim of this study was to assess smoking impact on oral health-related quality of life (OHRQoL). A cross-sectional study was carried out with smokers and non-smokers patients scheduled at a Faculty of Dentistry in Brazil. Sociodemographic data were collected and oral problems impact on quality of life were assessed through "Oral Health Impact Profile-14" (OHIP-14) questionnaire. The World Health Organization criteria were used to assess dental caries and periodontal disease. Data analysis was performed by descriptive and inferential statistics. Two hundred and seven individuals participated in the study, 112 non-smokers and 95 smokers. Most smokers were males (54.25%), the average smoking time was 24.74 ± 14.84 years and 54.72% of them reported smoking more than 11 cigarettes/day. Smokers scored higher values in OHIP-14 ($p = 0.026$) and in dimensions "functional limitation" ($p < 0.001$), "psychological discomfort" ($p = 0.024$) and "psychological disability" ($p = 0.047$). In addition, smokers had higher percentages of sextants with periodontal pockets ($p < 0.001$) and moderate to advanced attachment loss ($p = 0.029$). In short, smokers suffered a greater impact on OHRQoL, in addition to a worse periodontal condition compared to non-smokers.
Keywords: Tobacco use disorder; Quality of life; Oral health.

Resumo
O objetivo deste estudo foi avaliar o impacto do tabagismo na qualidade de vida relacionada à saúde bucal (QVRSB). Realizou-se um estudo transversal com pacientes tabagistas e não tabagistas atendidos numa Faculdade de Odontologia do Brasil. Dados sociodemográficos foram coletados e o impacto dos problemas bucais na qualidade de vida foi avaliado por meio do questionário "Oral Health Impact Profile-14" (OHIP-14). Os critérios da Organização

Mundial da Saúde foram utilizados para avaliação de cárie dentária e doença periodontal. A análise dos dados foi realizada por meio de estatística descritiva e inferencial. Duzentos e sete indivíduos participaram do estudo, sendo 112 não fumantes e 95 fumantes. A maioria dos fumantes foi do sexo masculino (54,25%), com tempo médio de fumo de 24,74 ± 14,84 anos, em que 54,72% relataram fumar mais de 11 cigarros/dia. Fumantes obtiveram maiores valores no OHIP-14 (p = 0,026) e nas dimensões "limitação funcional" (p < 0,001), "desconforto psicológico" (p = 0,024) e "incapacidade psicológica" (p = 0,047). Além disso, apresentaram maiores porcentagens de sextantes com bolsas periodontais (p < 0,001) e perda de inserção moderada e avançada (p = 0,029). Em suma, fumantes apresentaram maior impacto na QVRSB, além de pior condição periodontal quando comparados aos não fumantes.
Palavras-chave: Tabagismo; Qualidade de vida; Saúde bucal.

Resumen
El objetivo de este estudio fue evaluar el impacto del tabaquismo en la calidad de vida relacionada con la salud oral (CVRSO). Se realizó un estudio transversal con fumadores y no fumadores atendidos en una Facultad de Odontología de Brasil. Se recopilaron datos sociodemográficos y se evaluó el impacto de los problemas orales en la calidad de vida mediante el cuestionario "Oral Health Impact Profile-14" (OHIP-14). Se utilizaron los criterios de la Organización Mundial de la Salud para evaluar la caries dental y la enfermedad periodontal. El análisis de datos se realizó mediante estadística descriptiva e inferencial. Doscientos siete individuos participaron en el estudio, siendo 112 no fumadores y 95 fumadores. La mayoría de los fumadores eran del sexo masculino (54,25%), con un tiempo medio de tabaquismo de 24,74 ± 14,84 años, en los que el 54,72% refirió fumar más de 11 cigarrillos/día. Los fumadores presentaron valores más altos en el OHIP-14 (p = 0,026) y en las dimensiones "limitación funcional" (p < 0,001), "malestar psicológico" (p = 0,024) e "incapacidad psicológica" (p = 0,047). Además, tenían mayores porcentajes de sextantes con bolsas periodontales (p < 0,001) y pérdida de inserción moderada y avanzada (p = 0,029). En definitiva, los fumadores tenían un mayor impacto en la CVRSO, además de una peor condición periodontal en comparación con los no fumadores.
Palabras clave: Tabaquismo; Calidad de vida; Salud bucal.

1. Introduction

Smoking remains the global leader among the causes of preventable deaths; with estimates of 1 billion of deaths throughout the 21st century if effective control measures are not adopted (WHO., 2012). Besides, the smoking habit is considered a risk factor for the development of a series of chronic diseases, including several types of cancer, lung and cardiovascular diseases (Cardoso *et al*., 2021; WHO., 2004; 2011).

Tobacco is also associated with the occurrence of deleterious effects on oral health. Several previous studies demonstrate that smokers have a higher risk of tooth loss (Pereira *et al*., 2014; Dietrich *et al*., 2007), higher prevalence of periodontal diseases, dental caries and leukoplasia (Ahsan *et al*., 2020; Santos *et al*., 2022) as well as a higher risk of developing oral squamous cell carcinoma (Alves *et al*., 2017; Lopes *et al*., 2021). On the other hand, the literature is scarce on a possible impact of smoking on oral health-related quality of life (OHRQoL) (Bakri *et al*., 2018; Sagtani *et al*., 2020).

With the change from the medical paradigm to a broader one – social behavior – it became necessary to develop strategies to measure perceptions, feelings and behaviors focused on the individuals' subjective experiences. In this way, the quality of life emerged as an important health outcome to be assessed (Miotto *et al*., 2012).

OHRQoL is considered the self-perceived impact of oral conditions in the individuals' functional, social and psychological well-being, being determined by a variety of conditions that affect their perception, senses and behaviors in the exercise of the daily activity (Bakri *et al*., 2018; Alvarenga *et al*., 2011). More specifically, it is related to the ability to chew, speak clearly, have a socially acceptable smile, be comfortable and free from pain, have good breath and social performance; with the relative importance of these factors and their scope varies according to age, sex, and social norms (Sheiham & Spencer, 1997).

Since oral health is considered a crucial factor for the establishment of physical, mental, and social well-being, it is essential to understand if the use isof tobacco influences the OHRQoL, thus supporting the development of specific, individual and collective strategies that enable the achievement of better results for this health outcome. Therefore, the aim of this study was to assess the impact of smoking on OHRQoL.

2. Methodology

This was a cross-sectional, observational and analytical study carried out through personal interviews and intra-oral physical examination (Hochman *et al*., 2005).

The sample group consisted of adult individuals – over 18 years old –, smokers and non-smokers, of both genders, who required routine care at FO-UFF/ISNF. The group of smokers included those individuals who reported regular use of at least one smoked tobacco per day in the last three months. Users of complete or partial dentures in both dental arches and complete edentulous patients were excluded from the study. All participants received a copy from the Free and Informed Consent Term, and those who agreed to participate in the research were asked to sign the document.

The prevalence used for sample calculation was based on the study by Guerra *et al*. (2014), which found approximately 23% of impact, adding all dimensions of the questionnaire "Oral Health Impact Profile-14" (OHIP-14), in a sample of workers. To detect a clinically relevant difference, this study adopted a prevalence of 12 percentage points higher among smokers. The significance level adopted for the calculation was 0.05 and the power of the test was 0.80, which generated a sample of 224 participants.

Two examiners received theoretical-clinical training giving by a researcher with extensive experience in epidemiological surveys, responsible for the calibration process of the researchers who participated in the national epidemiological survey on oral health in Brazil. A pilot study was carried out prior to the beginning of data collection, with patients from FO-UFF/ISNF (n=15), to verify their understanding of the questions displayed in the forms that would be applied.

The sociodemographic variables evaluated were gender, age, education (years of study) and monthly income (values reported in BRL). Regarding general health, participants were asked about their previous diagnosis of heart and respiratory problems, diabetes, and systemic arterial hypertension (SAH). Participants were also asked about their oral hygiene habits, such as daily frequency of tooth brushing and dental floss use.

The measurement of the impact of oral problems on OHRQoL was performed by applying the validated Portuguese version of OHIP-14 questionnaire, consisting of 14 questions, in which were evaluated the individuals' self-perception concerning the impact of oral problems on their quality of life caused by dysfunctions, discomforts and disabilities generated by their oral conditions (Oliveira & Nadanovsky, 2005).

The oral clinical examination was performed in a clinical setting, on the dental chair, where patients' teeth and periodontal condition were evaluated using flat mirrors and periodontal probes recommended by the World Health Organization - WHO (model WHO-621). Following indexes were recorded: Decayed, Missing and Filled Teeth (DMFT – according to the criteria recommended by the WHO, 1997), Community Periodontal Index (CPI) and Periodontal Attachment Loss (PAL) (Ainamo *et al*., 1982).

A non-probabilistic procedure was adopted for sample selection, where patients were examined in order of arrival.

For the coding of the replies to the OHIP-14, a five-point Likert-type frequency scale was used, and the results were assessed in an additive way. Data regarding CPI and PAL were assessed by sextants and in a categorical manner; therefore, creating two categories for the CPI – absence of pocket and presence of pocket – and three categories for the PAL – mild, moderate and advanced. Regarding the CPI, sextants with clinical probing depth of 4 mm or more were classified as periodontal pockets, equivalent to codes 3 and 4 of the index. Regarding PAL, sextants with attachment loss less than 3 mm (equivalent to code 0 of the index) were classified as mild, while sextants with attachment loss from 4 to 5 mm (equivalent to code 1 of the index) were classified as moderate and those with attachment loss of 6 mm or more (equivalent to codes 2, 3 and 4 of the index) were classified as advanced.

The exploratory analysis was performed using descriptive statistical tests and frequencies. Softwares SigmaPlot 12.0®,
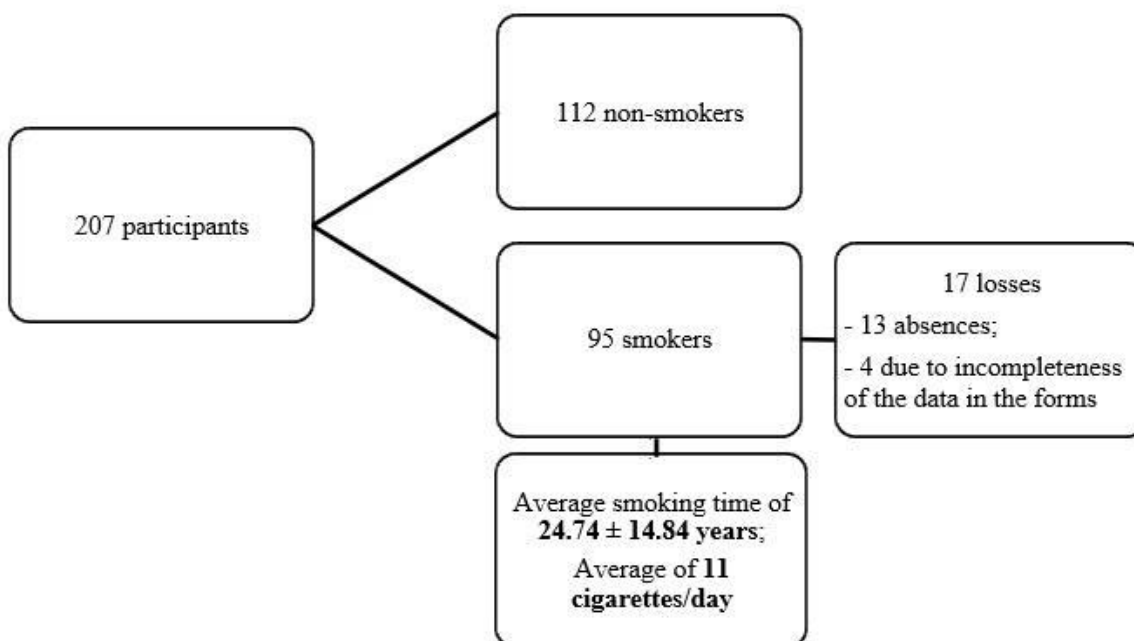
STATISTICA 10.0® and Jamovi 1.8.4® were used for the inferential analysis. Chi-squared test was applied to nominal qualitative variables while Mann-Whitney test was applied to quantitative variables, since these had non-parametric distribution after the Shapiro-Wilk normality test. Values of $p < 0.05$ were considered statistically significant.

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Research Ethics Committee of the Fluminense Federal University, Nova Friburgo Health Institute (FO-UFF/ISNF), Brazil, under the number: 3.712.636. All participants signed an informed consent form.

3. Results

In total, 207 individuals participated in the study, 112 non-smokers (54.1%) and 95 smokers (45.9%). The composition of the sample group, the time and the frequency of smoking are shown in Figure 1.

Figure 1 - Demonstrative flowchart of sample group composition.

Source: Authors.

Among smokers, most of the sample (54.25%) was composed of males ($p = 0.039$). In addition, smokers had a higher level of schooling when compared to non-smokers ($p = 0.039$); the average length of study was nine years for smokers and eight years for non-smokers. No statistically significant differences were found between the groups regarding age and income (Table 1).

Table 1 - Sociodemographic characteristics of the groups.

	Smokers (N = 95)	Non-smokers (N = 112)	p-value
Gender, %[a]*			0.039
Male	54.25	45.74	
Female	38.93	61.06	
Age, median[†]	47 (34-55)	50 (37.2-53)	0.053
Education, median[b]*	9 (7-13)	8 (5-12)	0.039
Income, median[#]	1000 (880-1.335)	954 (867.5-1412.5)	0.682

[*]$p < 0.05$, [a] Chi-squared test, [b]Mann-Whitney test [†]in years [#]in BRL. Source: authors.

It was identified a higher frequency of participants with respiratory problems in the group of smokers ($p = 0.009$). On the other hand, a higher prevalence of diabetics was verified among the non-smokers ($p = 0.043$). There were no significant statistical differences regarding the other conditions evaluated – heart problems and SAH – between the groups (Table 2).

Table 2 - Prevalence of comorbidities between groups.

	Smokers		Non-smokers		p-value
	n	(%)	n	(%)	
Heart problems	5	(5.26)	9	(8.03)	0.721
Respiratory problems[*]	24	(25.23)	11	(9.82)	0.009
Diabetes[*]	3	(3.15)	10	(8.92)	0.043
SAH	27	(28.42)	30	(26.78)	0.730

[*]$p < 0.05$; chi-squared test. Legend: SAH (Systemic Arterial Hypertension). Source: Authors.

Table 3 shows information regarding the impact on OHRQoL, assessed through the OHIP-14. In general, smokers had higher scores when compared to non-smokers in "total OHIP" ($p = 0.026$); in dimensions "functional limitation" ($p < 0.001$), "psychological discomfort" ($p = 0.024$), "psychological disability" ($p = 0.047$); and on issues related to "worsening food taste perception" ($p < 0.001$), "being self-conscious" ($p = 0.027$), "being embarrassed" ($p = 0.011$) and "being irritable with other people" ($p = 0.039$) because of the problems in the mouth.

Table 3 - Comparison between groups of OHIP-14 values by question, dimension and total score.

	Smokers Median (1º-3º quartiles)	Non-smokers Median (1º-3º quartiles)	p-value
OHIP-1 Have you had trouble pronouncing any words because of problems with your teeth, mouth or dentures?	0 (0-2)	0 (0-1.75)	0.278
OHIP-2 Have you felt that your sense of taste has worsened because of problems with your teeth, mouth or dentures?*	2 (0-4)	0 (0-2)	<0.001
Functional Limitation*	2 (0-4)	0 (0-3)	<0.001
OHIP-3 Have you had painful aching in your mouth?	2 (0-3)	2 (0-3)	0.810
OHIP-4 Have you found it uncomfortable to eat any foods because of problems with your teeth, mouth or dentures?	2 (0-4)	2 (0-4)	0.427
Physical Pain	4 (1-6)	4 (1-6)	0.576
OHIP-5 Have you been self-conscious because of your teeth, mouth or dentures?*	3 (0-4)	2 (0-4)	0.027
OHIP-6 Have you felt tense because of problems with your teeth, mouth or dentures?	2 (0-4)	2 (0-3)	0.111
Psychological Discomfort*	4 (2-8)	3.5 (0-6)	0.024
OHIP-7 Has your diet been unsatisfactory because of problems with your teeth, mouth or dentures?	0 (0-3)	0 (0-2)	0.280
OHIP-8 Have you had to interrupt meals because of problems with your teeth, mouth or dentures?	0 (0-1)	0 (0-1)	0.830
Physical Disability	1 (0-4)	0 (0-4)	0.367
OHIP-9 Have you found it difficult to relax because of problems with your teeth, mouth or dentures?	0 (0-2)	0 (0-2)	0.611
OHIP-10 Have you been a bit embarrassed because of problems with your teeth, mouth or dentures?*	3 (0-4)	2 (0-4)	0.011
Psychological Disability*	4 (1-6)	2 (0-4)	0.047
OHIP-11 Have you been a bit irritable with other people because of problems with your teeth, mouth or dentures?*	0 (0-2)	0 (0-0)	0.039
OHIP-12 Have you had difficulty doing your usual jobs because of problems with your teeth, mouth or dentures?	0 (0-0)	0 (0-0)	0.300
Social Disability	0 (0-3)	0 (0-2)	0.080
OHIP-13 Have you felt that life in general was less satisfying life because of problems with your teeth, mouth or dentures?	0 (0-4)	0 (0-2)	0.055
OHIP-14 Have you been totally unable to function due to problems with your teeth, mouth or dentures?	0 (0-0)	0 (0-0)	0.800
Handicap	0 (0-4)	0 (0-3)	0.129
OHIP Total*	17 (9-32)	13.5 (6-24)	0.026

*$p < 0.05$; Mann-Whitney test. Source: authors.

As per the oral condition, smokers had a higher percentage of sextants with periodontal pockets ($p < 0.001$) and moderate and advanced attachment loss ($p = 0.029$), which was evaluated by CPI and PAL indexes, respectively. On the other hand, no significant statistical differences were identified between the groups regarding DMFT and the number of missing dental elements (Table 4).

Table 4 - Comparison of CPI, PAL and DMFT and missing teeth values between groups.

	Smokers	Non-smokers	p-value
	n	n	
CPI, n (%)[a*]			<.001
Absence of pocket	284 (68.8%)	464 (82.3%)	
Presence of pocket	129 (31.2%)	100 (17.7%)	
PAL, n (%)[a*]			0.029
Mild	261 (63.3%)	393 (71.1%)	
Moderate	99 (24.0%)	98 (17.7%)	
Advanced	52 (12.6%)	62 (11.2%)	
DMFT Median (1°-3° quartiles)[b]	20 (11-24)	18 (13-22)	0.166
Missing teeth Median (1°-3° quartiles)[b]	7 (2-14)	5 (2-8)	0.098

[*]$p < 0.05$; chi-squared test [a]Sextants [b]Mann-Whitney test Legend: CPI (Community Periodontal Index), PAL (Periodontal Attachment Loss), DMFT (Decayed, Missing and Filled Teeth Index). Source: authors.

During the assessment of oral hygiene habits, 70.53% of non-smokers reported using dental floss daily, whereas only 52.63% ($p = 0.012$) of smokers reported to do the same. No differences were found between groups regarding the frequency of daily tooth brushing.

4. Discussion

This study identified that smokers suffered a greater impact on OHRQoL than non-smokers.

As for sociodemographic characteristics, a higher prevalence of males was identified among smokers, which is compatible with data historically published by the WHO (WHO, 2019). This research also identified that smokers have a slightly higher educational level (nine years) when compared to non-smokers (eight years), which contradicts some findings in the literature that indicate that smokers generally have a lower educational level (Bazotti *et al.*, 2016). A possible explanation for this fact was the probable occurrence of a random sample variation in the group of non-smokers, which may have influenced this result. On the other hand, when the average years of study is evaluated in isolation, our findings are in line with those of Vieira Rocha *et al.* (2019), for example, which identified an average schooling of 9.6 ± 6.1 years among smokers.

When analyzing data on general health status, a higher prevalence of respiratory problems was identified among smokers, which corroborates studies that reveals that smokers have a premature and faster decline in lung function, since the inhalation of tobacco smoke exposes the lung to numerous toxic substances and agents that reduce its antioxidant capacity that protects the cells (Nunes, 2006). Furthermore, smoking is associated with a 10-fold increased risk of death from chronic obstructive pulmonary disease (CDC, 2004). By contrast, when assessing the prevalence of diabetes between the groups, there was a lower percentage of diabetics in the group of smokers (3.15%) compared to non-smokers (8.92%). Especially in Brazil, smokers are part of a group that has less access to health services (male, low income and low schooling) (Bazotti *et al.*, 2016), generating a probable underdiagnosis of diabetes, which may have been reflected in this sample, once this data was collected through self-report.

Regarding the OHRQoL, it was identified a significantly greater impact among smokers when compared to non-smokers, represented by the total score of the OHIP-14. This finding is in line with those of Bakri *et al.* (2018) and Sagtani *et al.* (2020), who identified an association between smoking and a worse quality of life. Data demonstrated that smokers had worse scores in the "functional limitation" dimension, which comprises issues related to word pronunciation and sense of taste;

it was also detected a worse self-perception of taste, with a statistically significant difference, among smokers. This finding is corroborated by the study of Santos *et al.* (2014), which demonstrated that smokers have a lower capacity to recognize taste stimuli than non-smokers, because of changes in shape, number and vascularization of their taste buds, which influence both in detection and in gustatory perception.

However, greatest impacts detected on OHRQoL of smokers were related to issues and dimensions of psychological nature, represented by questions 5, 10 and 11 of the OHIP-14, which are related to "being self-conscious", "being embarrassed" and "being irritated with other people" because of oral problems, as well as higher values in the "psychological discomfort" and "psychological disability" dimensions. According to Slade (1997), the "psychological discomfort" dimension is related to the individual' problems with the perception of their personal image, represented in the instrument by questions about embarrassment and tension due to their oral condition. On the other hand, the dimension "psychological disability" refers to issues with deeper psychological impacts, which may affect the interaction with other individuals, such as the difficulty to relax and feeling ashamed because of dental problems, represented by questions 9 and 10 of OHIP-14.

In this regard, our findings lead us to think that smokers have a poor perception of their health and self-image. Alvarenga *et al.* (2011) states that the fact of feeling healthy or sick is a subjective matter, mediated by psychological, social and cultural factors, without any necessary relation to the individual's clinical situation. Another factor to be considered is the possible effect of the wide awareness campaigns and dissemination of the harmful consequences of the smoking habit over the last decades as one of the public policy actions to reduce tobacco use in several countries. Specifically in Brazil, through the National Tobacco Control Program (NTCP), it was adopted a strategy of wide dissemination of the harmful effects of tobacco use in various communication vehicles, such as newspapers, radio and TV, in addition to the mandatory inclusion of health warnings on the backs of cigarette packs associated with impacting images on the harm caused by smoking to health. Such factors possibly influenced this portion of the population to develop a worse self-perception of health, which may have even affected their perception of oral health. In addition, although not evaluated in this study, the literature demonstrates that part of the smoking population has psychiatric comorbidities, such as mood disorders, anxiety, depression, among others, since the psychoactive effect of tobacco affects the individual's neurocircuits (Santos *et al.*, 2019). Some studies state that the association between tobacco consumption and depression is well known and estimate that around 60% of smokers (male and female) have a history of clinical depression; and that this condition seems to be strongly associated with high levels of tobacco consumption (Nunes, 2006). Another important point is the relation between smoking and premature skin aging Suehara *et al.*, 2006), which may produce low self-esteem in the individual, especially when it occurs on the face and even more so when associated with a loss of dental aesthetics because of diverse dental problems caused by tobacco use (Pereira et al., 2014; Dietrich *et al.*, 2007; Ahsan *et al.*, 2020), mainly due to the fact that both facial esthetics and a healthy smile appearance are considered important aspects in social and cultural relations today.

Thus, these associations of smoking with mood disorders, anxiety, depression, premature skin aging, and worse dental esthetics may influence the development in the individuals of a negative perception of self-image and of their health condition.

Extensive literature demonstrates that smokers have worse oral health, represented by a greater number of periodontal problems, a greater number of missing dental elements, higher prevalence of oral cancer, among other diseases (Pereira et *al.*, 2014; Dietrich *et al.*, 2007; Ahsan *et al.*, 2020; Alves *et al.*, 2017; Lopes *et al.*, 2021; Santos *et al.*, 2022), which partially corroborates the findings of this study, since it identified, for example, a worse periodontal condition among smokers.

In general, smokers had higher percentages of sextants with periodontal pockets (31.2%), moderate attachment loss (24%) and advanced attachment loss (12.6%) when compared to non-smokers (17.7%, 17.7% and 11.2%, respectively). These findings may explain, in part, the worst scores of the group of smokers in the "functional limitation" dimension of OHIP-14, since individuals with many dental elements with advanced attachment loss and, consequently, cervical exposure and high

degree of mobility, may have difficulty eating and pronouncing certain words, because of the worsening of the masticatory function and the pain associated with dentinal hypersensitivity, for example. Moreover, on certain occasions, advanced periodontitis may cause considerable damage to dental esthetics, which may be related to the worst scores of smokers on psychological issues and dimensions of the OHIP-14, such as "have you been a bit embarrassed because of problems with your teeth, mouth and dentures" and "psychological discomfort".

Although no statistically significant results were found regarding the number of missing teeth and dental caries, it is noteworthy that high DMFT mean values were observed in both groups; it was slightly higher among smokers (20 among smokers and 18 among non-smokers). The fact that the study was carried out in a Faculty of Dentistry, which provides free of charge assistance to the local population, may have impacted this result, considering that the most of individuals who seek dental care in these places have a low socioeconomic status, which hinders access to health services and influences their health status.

This study may have some limitations because of its cross-sectional design. For example, it was not possible to produce considerations regarding the causality of the outcome evaluated. In addition, as the dependent variable (score of OHIP-14) had a non-parametric distribution, it was not possible to carry out a multiple linear regression analysis to assess the effect of the independent variables, such as smoking, diabetes, DMFT, CPI, PAL and missing teeth, in the studied outcome.

Importantly, this is the only study of which we have knowledge, developed so far, that assessed the impact of tobacco use on the OHRQoL of smokers through the participants' self-perception – with the OHIP-14 questionnaire – and the use of clinical indexes (CPI, PAL, DMFT and number of missing teeth). Another important fact is the large number of participants in this research providing robustness to our findings.

5. Conclusion

In general, this study demonstrated that smokers suffered a greater impact on OHRQoL and had a worse periodontal condition when compared to non-smokers. On the other hand, it showed that is essential to develop new studies, with different methodological designs, to understand how tobacco influences factors related to OHRQoL, thus supporting the development of individual and collective strategies, that may positively influence NTCP in Brazil.

In this sense, the development of prospective longitudinal studies will be able to show more clearly the causes associated with the impact on OHRQoL.

Acknowledgments

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