



GLOBAL JOURNAL OF MEDICAL RESEARCH: J
DENTISTRY & OTOLARYNGOLOGY
Volume 24 Issue 1 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

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GJMR-J Classification: NLMC Code: QZ 241-260



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Oral Complications in Cancer Patients: The Role of Chemotherapy and Radiotherapy

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Results: The most common treatment was the combination of chemotherapy and radiotherapy (36.34%), while radiotherapy alone was the least common (13.78%). Among the oral changes after cancer treatment, the most prevalent were xerostomia (60.15%) and dietary changes (57.64%). Chemotherapy was associated with taste changes (OR: 2.44; 95% CI: 1.22-4.90). Chemotherapy and radiotherapy together were associated with greater odds of taste changes (OR: 3.86; 95% CI: 1.92-7.75) and mucositis (OR: 2.51; 95% CI: 1.06-5.94).

Conclusions: Patients undergoing chemotherapy alone or in combination with radiotherapy treatments were more prone to oral complications. This underscores the significance of dental care in promoting the well-being and quality of life for these patients.

Keywords: chemotherapy, radiotherapy, oncology hospital services, oral health, questionnaires and surveys.

I. INTRODUCTION

Dental care is pivotal to the health of cancer patients. Both the disease itself and the therapeutic approaches used for treatment can give rise to oral complications¹.

Considered the second leading cause of death in the world, cancer poses significant public health challenges due to its multifaceted nature and its epidemiological, social, and economic impacts. GLOBOCAN's 2020 estimates showed approximately 19 million new cancer cases worldwide, resulting in around 10 million deaths. In such a scenario, malignant tumors of the lung, breast, prostate, skin, and oral cavity, as well as hematological and lymphatic tumors, were identified as the most prevalent cancer types². In the Brazilian context, cancer is also considered an important public health problem. During the 2020-2022 triennium, an estimated 625,000 new cancer cases were expected annually^{3,4}.

Surgery, radiotherapy, chemotherapy, bone marrow transplantation, and targeted molecular therapy are commonly used, either in isolation or in combination, to treat cancer⁵. Advances in cancer treatments have contributed positively to the increase in survival and quality of life of these patients. Although there is no consensus on the best therapeutic approach for the treatment of cancer, it is notable that around 70% of patients undergo chemotherapy as their primary treatment⁶. However, chemotherapy's broad-spectrum toxicity affects not only neoplastic cells, but also healthy tissues, leading to oral complications and exacerbating pre-existing complications⁷. Furthermore, radiotherapy, is have reaching a utilization rate of 52% in the external irradiation modality, contributing to an increase in the patient's survival rate⁸.

Therefore, the clinical manifestations of cancer and the effects of oncological therapies on the patient's oral health warrant attention. In addition to oral and dental complications that include mucositis, infections, pain, salivary gland dysfunction, taste changes, dysphagia, trismus, and necrosis of soft and hard tissues^{9,10,11}, patients can experience pronounced speech and swallowing impairments, aesthetic changes, sensory deficits, and chronic pain¹². Such issues can substantially affect patient quality of life and

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survival. It is estimated that approximately 40% of patients who receive radiotherapy and chemotherapy develop oral complications resulting from direct or indirect stomatotoxicity⁶. Even though radiotherapy, especially for head and neck cancers, which is a primary cause of oral complications, surgical procedures and chemotherapy can also induce or exacerbate dental and periodontal issues¹³.

Considering the toxicities arising from cancer therapeutic approaches for the soft and hard tissues of the oral region, oncological treatment may even be halted, resulting in harmful events, such as increased morbidity and decreased survival¹⁴. In this context, dental assessments, and adequate management of cancer patients throughout the treatment phases of the disease are crucial for a holistic and multidisciplinary approach to patient care^{15,16,17} to eliminate or reduce the risk of such complications. Therefore, attention and knowledge regarding the prevention, diagnosis, and management of oral complications from oncological therapies are essential so that all health professionals, including dentists, can contribute to mitigating the impact of these complications on the patient's life^{18,19} and, thereby, enhancing their quality of life, reducing adverse effects and local complications of oncological treatment, and promoting more prolonged survival.

Given these considerations and the complications the cancer itself and the for treatment can give rise to oral health, the aim of this study was to assess the association between oncological treatment types and the onset of oral complications in patients treated in a High Complexity Oncology Care Unit (HCOCU) in southern of the Minas Gerais state, Brazil.

II. MATERIAL AND METHODS

a) Ethical considerations

This study was submitted for evaluation by the Human Research Ethics Committee of the Federal University of Alfenas (UNIFAL-MG), being approved under opinion no. 2,487,546. Voluntary participation was consented to by signing the Informed Consent Form (ICF). The procedures used in this study adhere to the tenets of the Declaration of Helsinki and the Resolution 466, December 2012, of the Brazilian National Health Council, respecting the principles of the beneficence, non-maleficence, autonomy, confidentiality and justice.

b) Study design, setting, and participants

A cross-sectional study was conducted on a sample of patients assisted by the *Associação dos Voluntários Vida Viva de Alfenas*. The approached patients received treatment at the HCOCU of *Santa Casa de Caridade Nossa Senhora do Perpétuo Socorro* in Alfenas, MG, Brazil. This oncology center offers public treatments including chemotherapy, immunotherapy, hormone therapy, radiotherapy, and surgery, serving regions in southern Minas Gerais, Brazil. This region

covers 24 municipalities, being the reference for cancer treatment for a population of 437,005 inhabitants²⁰. The *Casa do Café* of the *Associação dos Voluntários Vida Viva* was selected for this study because is the reference for the oncological patients attended in the southern region of Minas Gerais.

The minimum sample size was determined using the average DMFT (decayed, missing, and filled teeth) for the adult and elderly population²¹. This index is widely used as to produce a snapshot of the oral health conditions of the population as to parameterize sample size once caries and tooth loss are conditions with high dissemination and well described in many populations.²¹ To this end, the equation proposed by Silva²² was used:

$$n = \frac{Z^2 \cdot S^2 \cdot \text{deff} / \text{TNR}}{(\bar{X} \cdot \varepsilon)^2}$$

where n refers to the final sample size; Z to the limit value of the rejection area, considering a certain level of significance (1.96 corresponding to 95% confidence); S^2 to the DMFT²¹ variance; deff (design effect – design effect) = 3; TNR at non-response rate = estimated percentage of loss of sample elements - 20%; $\bar{X}$: average DMFT²¹; ε represents acceptable margin of error – 10%. The reference were the DMFT indexes for the population of adults living in cities in the countryside of Southeastern Brazil: mean (16.64) and standard deviation (8.04), obtained from the last national oral health survey – SB Brasil 2010²¹. A confidence level of 95% was established. This led to an estimated sample size of 309 subjects. The sampling process was random, being interviewed those who agreed to participate in the study were listed until the minimum sample size was reached, covering 399 cancer patients attending the *Casa do Café* of the *Associação dos Voluntários Vida Viva de Alfenas*. The inclusion criteria were: accepting participation in the study and expressing consent in the Informed Consent Form; attending the study's location - *Casa do Café* of the *Associação dos Voluntários Vida Viva de Alfenas*; undergoing treatment at the Oncological Center of the *Casa de Caridade Nossa Senhora do Perpétuo Socorro* during the period the study, between 2017 and 2019; being over 18 years old; having any cancer (not specific) or are being monitored after treatment for a neoplasm; and being able to communicate with the researcher.

c) Variables

Outcomes were self-reported oral complications, including xerostomia, halitosis, taste changes, dietary changes, trismus, mucositis, and presence of infection/inflammation.

The primary exposure was the type of oncological treatment adopted, classified as chemotherapy; radiotherapy; chemotherapy and

radiotherapy; and others (surgical and/or drug treatment).

Covariates included socioeconomic factors health habits, general health, and oral health conditions. Socioeconomic factors included age; gender; education level (≤ 8 years of study/ > 8 years of study). Health habits included current smoking and current drinking. General health conditions included multimorbidity (0-1 conditions/ ≥ 2 conditions); polypharmacy (< 4 medications/ ≥ 4 medications); tumor location (other sites/head and neck); time of treatment (≤ 1 year/ > 1 year); previous cancer (yes/no). Oral health conditions included number of teeth (0 to 9 teeth; 10 to 19 teeth; 20 or more teeth); prosthesis use; dental caries; gum bleeding; periodontal pockets; self-assessment of poor/very poor oral health (yes/no); oral health guidance received during oncology treatment (yes/no).

The blocks "socioeconomic factors", "general health", "health habits", "oral changes" and the variables "self-assessment of poor oral health" and "oral health guidance" from the "oral health" block were collected exclusively through interviews and recorded in a questionnaire. The other variables in this block were assessed through intraoral physical examination. This examination was carried out under natural light, using a mouth mirror, gauze, and a ballpoint-type periodontal probe, following the criteria recommended by the World Health Organization (WHO)^{23,24} by two duly trained examiners (B.M.S.M.M., and M.C.F.B.), and calibrated in a previous pilot study conducted with 20 patients at the same institution as the main study. Pilot study participants were not included in the main study. The inter-examiner agreement coefficient (Kappa) was 0.89, expressing good agreement^{23,24}.

d) Data analysis

The descriptive analysis was carried out with estimates of measures of central tendency and its dispersion (for age) as well as absolute and relative frequencies, according to the type of oncological treatment. Associations between treatment types and other variables were determined using the chi-square test with Rao-Scott correction (Table 1).

For significant oral changes predicted by oncological treatment type ($p < 0.05$) in Table 1, both crude and adjusted analyses were carried out using Logistic Regression models. Results were expressed using odds ratios (OR) and their respective 95% confidence intervals for detailing the risk of each of the oral changes, according to the oncological treatment type (chemotherapy; radiotherapy; chemotherapy and radiotherapy; others). The reference category was the "others" group. To define the variables listed as adjustment measures for the association between the oncological treatment type and oral changes, crude analyses of the association between the independent variables and the outcomes (oral changes) were

conducted, and those independent variables whose association showed $p < 0.05$ in the crude analysis were inserted as adjustment measures (Table 2). It is important to highlight that only relevant conditions were considered in this study, according to the literature.

The results were generated using the Stata 14.0 program (Stata Corp LLP, College Station, TX). For all procedures, a significance threshold of 5% ($p < 0.05$) was adopted.

III. RESULTS

399 of the 1200 patients undergoing cancer treatment in the HCOCU in Alfenas, MG, Brazil between 2017 and 2019 were interviewed, exceeding the minimum required sample of 309 participants. In this way, it is possible to state that the sample was statistically representative of the study population. Table 1 describes the socioeconomic factors, health habits, general health, and oral health conditions, and oral changes following cancer treatment for the study participants. The average age of those interviewed at *Casa do Café* was 58.8 (± 13.8) years. The sample included a majority of women (58.15%), people with low education levels (76.88% studied up to primary school), and low income (63.91% receive less than one monthly minimum wage). Health habits revealed 16.29% smokers and 13.03% reported regular alcohol consumption. The general health status of a quarter of patients undergoing cancer treatment is also affected by a set of other diseases (21.55% have two or more chronic conditions alongside cancer), with 22.50% of this population on at least four medications daily in the last three months. Head and neck tumors constituted 8.54% of cases, and most participants have been undergoing treatment for more than a year (61.79%).

Regarding oral health conditions, around half of the participants (49.62%) had severe tooth loss (between zero and nine remaining teeth), and 59.90% used prostheses. About one third of participants (31.83%) had active caries and the most prevalent periodontal condition was gingival bleeding with 84.71%. only 10.78% of the respondents rated their oral health as poor or very poor and only 13.03% received guidance about their oral health during cancer treatment. Regarding the oncological treatment type, the combination of chemotherapy and radiotherapy was most common (36.34%). Among the oral changes after cancer treatment, the most prevalent were xerostomia (60.15%) and dietary changes (57.64%). Oncological treatment types were associated with the occurrence of taste changes ($p < 0.001$), dietary changes ($p = 0.001$), and the occurrence of mucositis ($p = 0.002$). Patients who underwent chemotherapy or chemotherapy associated with radiotherapy had more oral changes (taste changes, dietary changes, and mucositis).

Table 1: Characterization of the sample of cancer patients, according to the type of treatment received. Alfenas, MG, 2019.
(continues)

	Total		Type of cancer treatment				p-value
	n	%	Others	Chemo	Radio	Chemo/Radio	
			%	%	%	%	
Total	399	100	17.29	32.58	13.78	36.34	
Socioeconomic conditions							
Sex							
Man	167	41.85	18.56	36.53	16.77	28.14	0.032
Woman	232	58.15	16.38	29.74	11.64	42.24	
Education level							
≤8 years of study	306	76.88	18.63	31.37	15.03	34.97	0.194
>8 years of study	92	23.12	11.96	36.96	9.78	41.30	
Income							
≤1 minimum wage	193	63.91	15.54	29.53	14.51	40.41	0.316
>1 minimum wage	109	36.09	14.68	39.45	10.09	35.78	
Health habits							
Current Smoking							
No	334	83.71	17.07	32.04	14.07	36.83	0.918
Yes	65	16.29	18.46	35.38	12.31	33.85	
Current alcohol							
No	347	86.97	17.58	32.85	13.54	36.02	0.946
Yes	52	13.03	15.38	30.77	15.38	38.46	
General Health							
Multimorbidity							
0-1 conditions	313	78.45	14.70	34.19	14.38	36.74	0.065
≥2 conditions	86	21.55	26.74	26.74	11.63	34.88	
Polipharmacy							
<4 medications	279	77.50	16.49	32.26	13.26	37.99	0.264
≥4 medications	81	22.50	23.46	34.57	14.81	27.16	
Tumor location							
Others sites	364	91.46	16.71	34.25	13.70	35.34	0.157
Head/neck	34	8.54	21.21	15.15	15.15	48.48	
Time in treatment							
≤1 year	149	38.21	22.82	40.27	11.41	25.50	<0.001
>1 year	241	61.79	13.28	27.80	14.94	43.98	
Previous câncer							
No	313	78.45	18.21	31.31	13.42	37.06	0.620
Yes	86	21.55	13.95	37.21	15.12	33.72	
Oral Health							
Number of teeth							
0 - 9 teeth	198	49.62	17.17	31.31	17.17	34.34	0.136
10 a-19 teeth	51	12.78	25.49	29.41	15.69	29.41	
20 or more teeth	150	37.59	14.67	35.33	8.67	41.33	
Use of prosthesis							
No	160	40.10	14.37	35.00	10.00	40.63	0.116
Yes	239	59.90	19.25	30.96	16.32	33.47	
Dental Caries							
No	272	68.19	17.28	33.46	13.60	35.66	0.954
Yes	127	31.83	17.32	30.71	14.17	37.80	
Gum bleeding							
No	338	84.71	17.46	32.54	14.79	35.21	0.485
Yes	61	15.29	16.39	32.79	8.20	42.62	
Periodontal pocket							
No	330	82.71	17.58	30.61	13.94	37.88	0.302
Yes	69	17.29	15.94	42.03	13.04	28.99	
Poor oral health							
No	356	89.22	16.57	32.02	14.04	37.36	0.491
Yes	43	10.78	23.26	37.21	11.63	27.91	



Table 1: Characterization of the sample of cancer patients, according to the type of treatment received. Alfenas, MG, 2019.

	Total		Types of cancer treatment				p-value
	n	%	Others	Chemo	Radio	Chemo/Radio	
			%	%	%	%	
Orientation in Oral Health							
No	347	86.97	18.73	32.85	14.99	33.43	0.007
Yes	52	13.03	7.69	30.77	5.77	55.77	
Oral changes							
Xerostomia							
No	159	39.85	18.87	29.56	14.47	37.11	0.741
Yes	240	60.15	16.25	34.58	13.33	35.83	
Halitosis							
No	291	72.93	17.87	34.02	15.12	32.99	0.133
Yes	108	27.07	15.74	28.70	10.19	45.37	
Change in taste							
No	208	52.13	23.56	32.69	15.38	28.37	<0.001
Yes	191	47.87	10.47	32.46	12.04	45.03	
Dietary changes							
No	169	42.36	23.08	24.85	18.34	33.73	0.001
Yes	230	57.64	13.04	38.26	10.43	38.26	
Lockjaw							
No	332	83.21	17.47	33.43	13.55	35.54	0.826
Yes	67	16.79	16.42	28.36	14.93	40.30	
Mucositis							
No	262	65.83	20.23	32.06	16.79	30.92	0.002
Yes	136	34.17	11.76	33.82	8.09	46.32	
Inflammation/infection							
No	300	75.19	18.33	30.67	15.67	35.33	0.135
Yes	99	24.81	14.14	38.38	8.08	39.39	

Table 2 displays the crude and adjusted Logistic Regression models for oral changes and oncological treatment types. Radiotherapy alone didn't show any associations, whereas chemotherapy was associated to an increased likelihood of taste changes (OR: 2.44; 95% CI: 1.22-4.90). Chemotherapy and

radiotherapy together were associated with more odds of taste changes (OR: 3.86; 95% CI: 1.92-7.75) and mucositis (OR: 2.51; 95% CI: 1.06-5.94), independently of socioeconomic factors, health habits, general health, and oral health conditions.

Table 2: Crude and adjusted analyzes of the associations between type of cancer treatment and oral changes among cancer patients. Alfenas, MG, 2019.

	Chemotherapy		Radiotherapy		Chemo/Radio	
	OR (CI95%)	p	OR (CI95%)	p	OR (CI95%)	p
Change in taste						
An. Crude	2,23 (1,20-4,17)	0,012	1,76 (0,83- 3,71)	0,137	3,57 (1,93-6,62)	<0,001
An. Adjusted ¹	2,44 (1,22-4,90)	0,011	2,07 (0,91-4,73)	0,084	3,86 (1,92-7,75)	<0,001
Dietary changes						
An. Crude	2,72 (1,49-4,97)	0,001	1,01 (0,49-2,06)	0,986	2,01 (1,12-3,60)	0,019
An. Adjusted ²	2,08 (0,90-4,78)	0,084	0,71 (0,25-2,00)	0,515	2,18 (0,95-5,00)	0,066
MUCOSITIS						
An. Crude	1,81 (0,93-3,53)	0,079	0,83 (0,35-1,97)	0,669	2,58 (0,17-0,53)	<0,001
An. Adjusted ³	1,96 (0,80-4,81)	0,140	0,74 (0,23-2,38)	0,614	2,51 (1,06-5,94)	0,036

OR: odds ratio; CI95%: 95% confidence interval.

¹Model adjusted for: age, sex, polypharmacy, tumor site, number of teeth, use of prosthesis, self-assessment of oral health, oral health guidance received in Oncology;

²Model adjusted for: age, education, income, alcohol, polypharmacy, tumor location, treatment time, scholarship, oral health self-assessment, oral health guidance received in Oncology;

³Model adjusted for: age, sex, education, income, alcohol, tumor location, number of teeth, oral health guidance received in Oncology.

IV. DISCUSSION

This study contributes to understanding the association between different cancer treatment types and oral complications. Their findings indicate that the most prevalent oral changes after cancer treatment are xerostomia and dietary changes. Furthermore, chemotherapy is associated with more odds of taste changes, whereas the combination of chemotherapy and radiotherapy is associated with taste changes and mucositis. These findings can contribute to a better approaching of the cancer patients as oncological scenario as in oral health management.

Among the oral complications after cancer treatment, the study showed that xerostomia (60.15%) and dietary changes (57.64%) were the most prevalent. Such data aligns with existing literature on the topic. In previous studies, Floriano et al.²⁵ showed that xerostomia (71.9%), mucositis (67.7%), and candidiasis (32.3%) were the most common oral lesions after cancer treatment. Freire et al.²⁶ highlighted xerostomia (53.8%) as the most common oral manifestation, followed by purpura (15.4%), gingival bleeding (7.7%), periodontitis (7, 7%), thrombocytopenia (7.7%) and granulocytopenia (7.7%). Araújo et al.²⁷ identified in their study that xerostomia (21.0%) and mucositis (12.3%) were the most common manifestations during cancer treatment. However, the researchers observed that, in participants who had completed treatment between 2-5 years prior, the prevalence of xerostomia and mucositis was similar. In patients who had completed treatment more than five years earlier, only xerostomia was identified (8.8%), and no other oral manifestations which suggests that some oral manifestations of cancer treatment can attenuate along time. However, it must not be ignored the permanent oral problems resulted. Amaral et al.²⁸ also observed that the most identified oral complications were xerostomia (60.3%), mucositis (39.7%), and burning mouth syndrome (27.9%). Faza and Brun²⁹ observed that the most common complications were xerostomia, taste changes, and aphthous lesions. Considering xerostomia as the most prominent oral disorder, as in this study, Paiva and Biase³⁰ point out that it remains at a high incidence even after treatment has ended, as, in addition to the transitory decrease in saliva production, some therapeutic agents are capable of causing irreversible damage to glandular acini leading to lasting severe salivary dysfunction. Floriano et al.²⁵ warn that such conditions may be due to the lack of dental treatment both before oncological therapy, as well as during and after treatment, highlighting the importance of dental treatment or follow-up. Thus, Araújo et al.²⁷ reinforce the participation of the dentist during and after antineoplastic treatment. For Faza and Brun²⁹, the role of dental professionals in the multidisciplinary cancer treatment team is evident, both in the initial phases during the course of therapy and

after the end of treatment, to guarantee a better quality of life. This is a special issue when considering that many of these oral complications can be prevented or even better managed in order to reduce losses in oral health, general health and quality of life of these patients.

This study showed that radiotherapy was not associated with any oral changes while chemotherapy resulted in greater odds of taste changes. However, chemotherapy and radiotherapy together were associated with greater odds of taste changes and mucositis. This result is consistent with the findings of Araújo et al.²⁷, who noted a greater occurrence of oral manifestations when the patient underwent chemotherapy associated with radiotherapy when compared to individuals who underwent only one of these therapies. It must be considered that chemotherapy is the most widely adopted treatment for cancer, and this may contribute to its association with oral complications^{28,29}. Despite radiotherapy not being directly associated with any of the oral changes observed in this study, the literature points out that radiotherapy causes disturbances in the integrity and function of the patient's oral cavity, leading to the development of oral complications. Gaetti-Jardim Júnior³¹, in a study carried out with patients undergoing head and neck radiotherapy, observed the presence of xerostomia, mucositis, and other side effects. Patients irradiated shortly after the start of radiotherapy develop severe mucositis, dermatitis, dysgeusia, xerostomia, and, to a lesser extent, candidiasis. After completion of radiotherapy, 68% of patients had grade III or IV mucositis. It was also found that the development of mucositis makes oral hygiene difficult, exacerbating inflammation in periodontal tissues. At the end of the study, the researchers concluded that the primary cause of radiotherapy abandonment as well as the severity of the sequelae depends on the oral conditions of the patients before starting treatment and the lack of dental treatment prior to oncological treatment. Braam et al.³² agree that radiotherapy, whether applied alone or in conjunction with chemotherapy or surgery, can induce significant immediate and long-term side effects to the oral cavity. These effects range from xerostomia and challenges with chewing and swallowing to impaired taste and a heightened risk of tooth decay or oral candidiasis. Based on this assumption, the researchers carried out a study to describe long-term changes in quality of life and its correlation with parotid salivary output in patients with head and neck cancer who underwent radiotherapy. Upon concluding their study, the researchers observed an improvement in the quality-of-life score related to xerostomia post-radiotherapy. In short, radiotherapy has been identified as a frequent cause of xerostomia, affecting 70% to 100% of patients treated with this therapeutic modality, worsening xerostomia and mucositis, as well as the occurrence of

radiation-induced cavities²⁹, causing devastating effects on the oral cavity. Such effects often complicate the continuation of radiotherapy procedures^{31,32,33,34}, as well as negatively influence the quality of life of cancer patients^{31,35,36,37,38}. Nonetheless, the magnitude of such complications depends on a series of factors related to the treatment, the tumor, and the patient³⁰. This may partially explain the lack of association between radiotherapy and oral changes in this study, especially given that only 13% of our sample was subjected exclusively to radiotherapy.

Chemotherapy frequently emerges as the primary treatment option, either as a standalone or in combination with radiotherapy and other treatments^{3,8}. The choice of treatment method depends on factors such as the nature, extent, and location of the tumor and the patient's health conditions. As therapies that can be performed alone or in combination with other modalities, as observed in this study, chemotherapy and radiotherapy can damage the patient's oral cavity during and after treatment. This accentuates the pivotal role of dental professionals in conducting pre-treatment evaluations and overseeing care throughout and after the cancer treatment. Therefore, it is expected that the combination of chemotherapy and radiotherapy can in fact amplify potential adverse outcomes, precipitating the onset of oral complications.

It should be noted that the present study has limitations, such as the cross-sectional design, which did not allow inference regarding the sequence of events investigated. Therefore, it was not possible to determine precisely which occurred first: the oncological treatment or the oral problems. However, it is useful to clinical purposes to identify and describe such correlations in order to prevent some of these oral manifestations as well as to provide a better management and treatment. Furthermore, oral changes were investigated based on the subjects' self-report, which conditioned the investigation on the patients' memory and perception of their own health. It should also be noted that despite the robustness of the study design and sample determination, patients who expressed interest participated in the study, and it was not possible to carry out a draw to choose potential participants. This constraint arose from the specific characteristics of the study site, as well as the health status and availability of the patients. However, strengths include collecting data from patients with tumors from different locations, representing a health region with more than 400,000 inhabitants. This is because the oncology center that served as the population base for carrying out the study is the only one to provide oncological treatment via public health system in the specified region. Additionally, it is important to mention that oncological treatment is predominantly performed in public health system in Brazil³. Moreover, the study employed an adequate

sample size, using instruments and techniques widely recognized internationally^{39,40} to evaluate the conditions investigated. Future studies should explore in greater depth the associations and non-associations observed here, particularly the lack of association between radiotherapy and oral complications based on clinical data as well as to investigate how these complications can impact daily lives of the patients by means tools assessing quality of life.

V. CONCLUSION

Antineoplastic treatment is recognized as being associated with oral manifestations. Patients undergoing chemotherapy or the combination of chemotherapy and radiotherapy are more susceptible to oral problems, such as mucositis, taste changes, and dietary changes. Cancer patients must be monitored before, during, and after antineoplastic therapy by a dentist, included in a multidisciplinary team, to offer a holistic approach to patient care and prevent and control the occurrence of such complications. Options of treatment with reduced negative impact on oral health and well-being of the patients should be encouraged towards the view of the continuity between oral and general health, and, thus, assist the effectiveness of treatment, as well as promoting good health, well-being, and quality of life for these patients.

Authors Contributions

B.M.S.M.M., P.C.M.X., and M.C.F.B. participated in data collection and e databank interpretation. B.M.S.M.M. drafted and critically revised the manuscript. L.A.F., E.J.P.O., and D.C.L participated in conception and study design. E.J.P.O. participated in databank construction and interpretation. All authors reviewed and approved the final version of the manuscript.

Conflicts of Interests/Competing Interests

The authors declare having no conflicts of interest.

Funding

This study was funded by Universidade Federal de Alfenas (UNIFAL - Federal University of Alfenas) and the following Brazilian fostering agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES - Coordination for the Advancement of Higher Education Personnel - COD 001).

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