







# Self-perceived oral health, toothbrushing frequency and quality of life of patients undergoing cancer treatment: a cross-sectional study

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**Objective:** The objective of this study was to evaluate the association of both exposures self-perceived oral health and daily brushing frequency and the outcome quality of life of cancer patients. **Methods:** This is a descriptive-analytical cross-sectional study, carried out with 399 cancer patients treated by an institution in Minas Gerais, Brazil. Tooth brushing frequency and self-perceived oral health were obtained through interviews and quality of life through the EORTC QLQ-C30 instrument. Statistical analysis consisted of descriptive and bivariate analyses followed by the use of multiple linear generalized models. **Results:** Most participants reported self-perception of good oral health (89.2%), being that 55.6% brush their teeth three or more times daily. Better quality of life was observed in the social capacity and diarrhea subscales, whereas worse quality of life was recorded in the insomnia and emotional capacity subscales. Self-perceived poor oral health was associated with worse quality of life scores in two symptoms [fatigue ( $p = 0.007$ ) and pain ( $p = 0.024$ )] and the following subscales: functional capacity ( $p = 0.006$ ), emotional capacity ( $p = 0.013$ ), cognitive capacity ( $p = 0.008$ ), and social capacity ( $p = 0.022$ ), independently of socioeconomic and health conditions. Tooth brushing frequency was not associated with any subscale. **Conclusion:** Self-perception of poor oral health was associated with a worse quality of life, however, the frequency of toothbrushing did not affect the quality of life of cancer patients.

**Keywords:** Quality of life. Oral health. Toothbrushing. Self concept. Medical oncology.

## Introduction

In Brazil, around 680,000 new cases of cancer were registered in the 2017-2019<sup>1</sup> biennium, being the second leading cause of death, after cardiovascular diseases<sup>2</sup>. However, in recent years, advances in oncology have led to a reduction in the lethality of various types of cancer, and the number of survivors has tripled<sup>3</sup>. Cancer has changed from a terminal illness to a chronic disease, in which the patient undergoes prolonged treatment that can last for years<sup>4</sup>. This increase in life expectancy resulted in the recognition of the importance of quality of life since these patients need not only a quantitative extension in their lifetime but also the maintenance of good living conditions<sup>5</sup>. Thus, in recent decades, quality of life has been increasingly viewed as essential for cancer patients<sup>6</sup>, being one of the factors that influence disease survival<sup>7</sup>.

Oral health conditions directly influence general health by determining chewing capacity and food options, and consequently nutrient intake<sup>8</sup>. Moreover, conditions such as periodontitis are characterized by chronic inflammation that causes immunological alterations<sup>9</sup>, and numerous studies have shown that the chronic presence of inflammatory cells and inflammatory mediators is a carcinogenic factor<sup>10</sup>. Indeed, an estimate indicates that at least 20% of all cancer cases in the world are initiated by chronic or persistent inflammation<sup>11</sup>. Oral health is also related to cancer treatment since both chemotherapy and radiotherapy can lead to adverse effects in the oral cavity, which include mucositis, changes in taste, hyposalivation and xerostomia, radiation caries, trismus, and osteoradionecrosis<sup>12</sup>. Oral health, as a pivotal component of physical and mental well-being, reflects psychological, social, and physiological conditions that are fundamental for quality of life<sup>13</sup>. The oral cavity composes quality of life at a basic biological level, through chewing and swallowing, and at a social and psychological level, through self-expression, communication, facial aesthetics, and self-esteem<sup>14</sup>. The experience of oral pain, untreated dental caries, and tooth loss are associated with quality of life<sup>15</sup>.

Despite this interrelationship between oral, general health, cancer, and quality of life, studies that investigate the association between oral health conditions and the quality of life of cancer patients are still scarce. Even more when considering the use of specific quality of life instruments addressed to the population in cancer treatment. Considering that the literature reports that good oral health conditions are related to better quality of life, it is plausible to assume that measures capable of reflecting oral health, such as self-perceived oral health and toothbrushing frequency, also affect quality of life<sup>16</sup>. Thus, this study aimed to assess the relationship between the exposures to self-perceived oral health and toothbrushing frequency and the outcome quality of life of patients undergoing cancer treatment in a Brazilian hospital, using the Quality of Life Questionnaire Core 30 (EORTC QLQ-C30) – a specific quality of life instrument addressed to the population in cancer treatment.

## Materials and Methods

This research was conducted by the STROBE declaration (<https://www.strobe-statement.org/>). The present study received approval from the institutional review board

of *Universidade Federal de ocult* (certificate number: *ocult*). Participation in the study was voluntary through a signed statement of informed consent.

## Population and study design

This is an observational, cross-sectional, and analytical study, performed with patients undergoing cancer treatment who attend an institution that provides support for these individuals in the south of Minas Gerais, Brazil. The inclusion criteria were: having a confirmed diagnosis of cancer, ongoing cancer treatment, not having communication difficulties that prevent the interview and intraoral clinical examination, and being 18 years old or older.

To calculate the minimum sample size, a population mean expressed for the sum of decayed, missing, and filled teeth (DMFT) for the adult population was used as a reference<sup>17</sup>. Therefore, the equation proposed by Silva<sup>18</sup> for infinite populations was considered:

$$n = \frac{Z^2 \times S^2 \times deff/TNR}{(\bar{X} \times \epsilon)^2},$$

where  $n$  refers to the final sample size;  $Z$  to the limit value of the rejection area considering a certain level of significance - in this study, the value 1.96 was used, corresponding to 95% confidence;  $S^2$  to the variance of the sample mean, that is, the square of the standard deviation of the variable;  $deff$  to the design effect factor = 3; TNR to the non-response rate = estimated percentage of loss of sample elements, the value 20% was used in this work;  $\bar{X}$  to the mean of the variable; and  $\epsilon$  represents an acceptable margin of error. The reference used was the DMFT index for the population of adults living in cities in the interior of the Southeast: mean (16.64) and standard deviation (8.04)<sup>17</sup>. A 95% confidence level was set, with a 10% error. To correct the sample size, the  $deff$  resource (design effect factor) was applied. The sample obtained was non-probabilistic, with the minimum sample size estimated at 309 subjects.

The intraoral clinical examination to identify the number of teeth was performed by two examiners, and the subjects participating in the training and calibration phase did not participate in the following stages of the study. The examination was carried out according to the guidelines of the World Health Organization using the DMFT index (decayed, missing, and filled teeth), by examiners previously trained and calibrated. The inter-examiner Kappa coefficient was 0.89, expressing good inter-exam agreement. Before the data collection procedures, a pilot study was conducted with 10 cancer patients to test the proposed methods. The results of the pilot study revealed no need to alter the methods. The participants in this phase were not included in the main study. Despite the number of teeth included in this study as a covariate, its obtaining took place using clinical assessment to meet the criteria of other studies to be developed with the same population with different objectives<sup>19</sup>.

For the collection of sociodemographic data, health-related habits, general health conditions, self-report of oral health conditions, and toothbrushing frequency, it was con-

sidered criteria, categorization, and variables described according to the theoretical reference of that subject<sup>1</sup>.

After applying the questionnaire, to assess the quality of life, the instrument EORTC QLQ-C30, developed by the European Organization for Research and Treatment of Cancer (EORTC)<sup>20</sup>, was used.

### Variables under study

The outcome evaluated was quality of life. For this purpose, data collected through the EORTC QLQ-C30 instrument were used, which is a structured specific questionnaire to analyze the quality of life of cancer patients. The instrument is reliable and validated for measuring the quality of life in different cultural contexts<sup>20</sup>, regardless of the patient's educational level<sup>21</sup>. In this study, the version translated and validated for Brazilian Portuguese was considered<sup>21</sup>. According to the instrument's scoring manual<sup>20</sup>, the questionnaire consists of 30 items, divided into two domains: the functional and global health status scale, and the symptoms and financial difficulties scale. The functional scale consists of questions with answers presented on a Likert scale ranging from 1 to 4, which assess physical, emotional, role, cognitive, and social functions. The global health scale is composed of two questions on a Likert scale ranging from 1 to 7. Posteriorly, the value obtained for each of these subscales is transformed into a score ranging from 0 to 100, where the higher the value, the better the patient's condition. The scale of symptoms and financial difficulties is composed of questions, with answers on a Likert scale ranging from 1 to 4. The questions evaluate the occurrence of nausea and vomiting, diarrhea, constipation, fatigue, pain, dyspnea, insomnia, anorexia, and financial difficulties related to cancer treatment. The values obtained in each of these nine subscales are transformed into a score from 0 to 100, in which the higher the value, the worse the patient's condition. Finally, the instrument results in 15 scores, one for each subscale<sup>20,21</sup>.

The independent variables of interest in this study were the daily toothbrushing frequency, categorized as 0 to 2 times daily and 3 or more times daily, and self-perceived oral health, categorized as good (for those who classified their oral health as excellent, good, or fair) or poor (or those who classified their oral health as poor or very poor). Covariates included the following sociodemographic conditions: age, gender, and education, which was classified as less than eight years of study or more than eight years of study; health habits (smoking, in which tobacco consumption in any frequency and quantity was considered); general health (multimorbidity, characterized as the coexistence of two or more self-reported chronic conditions<sup>22</sup>; cancer site {classified as head/neck or other}; and oral health (number of teeth, categorized as edentulous, 0 to 9 teeth, 10 to 19 teeth and 20 or more teeth). All variables were collected through a questionnaire, except for the number of teeth, which was collected in an intraoral clinical examination.

### Statistical analysis

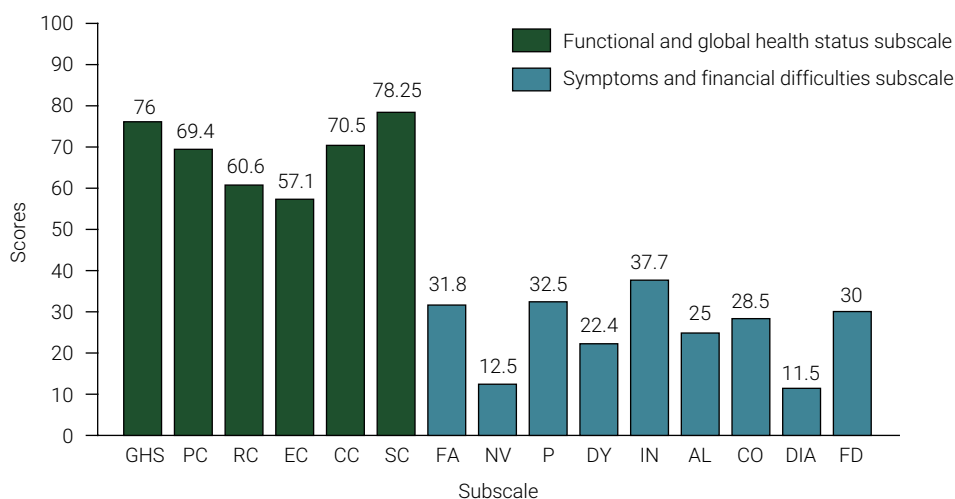
Statistical analysis was carried out using the Stata 14.0 program (Stata Corp LLP, College Station, TX). For all procedures, the significance level of 5% ( $p < 0.05$ ), bilateral,

was adopted. In the descriptive analysis, the age and dimensions of the EORTC QLQ-C30 were treated as continuous variables, expressed as means and standard deviations. Categorical variables were expressed as relative frequencies. Bivariate analysis was performed by comparing the means of the 15 subscales of the EORTC QLQ-C30 with the frequency of daily toothbrushing and self-perceived oral health. The Wilcoxon-Mann-Whitney test was applied considering the non-normal distribution of data. To verify whether the associations found in the bivariate analysis would remain significant even after adjustment for potential confounders, generalized multiple linear models were used. As adjustment variables, conditions known to be important according to the literature were used<sup>17</sup>.

## Results

The main characteristics observed in the sample were the predominance of females (232 – 58.2%), with up to 8 years of education (306 – 76.9%), and a mean age of 58.8 years. The majority reported not using tobacco (334 – 83.7%) and having one or no comorbidity (313 – 78.5%). Regarding the cancer site, few patients had head/neck lesions (28 – 7.1%). Concerning oral health conditions, there was a predominance of self-perception of good oral health (356 - 89.2%), and most participants reported brushing their teeth three or more times daily (222 -55.6%). Regarding the number of teeth, 36.1% (144 individuals) were edentulous; 13.5% had 1-9 teeth; 12.8% had 10-19 teeth; and 37.6% (150 individuals) had 20 or more teeth.

Figure A illustrates the mean scores obtained for each subscale of the quality of life measurement instrument. Scores indicating better quality of life were observed in the social capacity and diarrhea subscales. Scores indicating worse quality of life were recorded on the emotional capacity and insomnia scales.



GHS = Global health status; PC = Physical capacity; RC = Role capacity; EC = Emotional capacity; CC = cognitive capacity; SC = social capacity; FA = fatigue; NV= Nausea and Vomiting; P = pain; DY = Dyspnea; IN = Insomnia; AL = Appetite loss; CO = Constipation; DIA = Diarrhea; FD = Financial difficulties. N = 399 for all subscales. In the role and global health subscales, high scores indicate better quality of life, in the symptoms and financial difficulties subscales high scores indicate poorer quality of life.

**Figure A.** Quality of life scores measured using the EORTC QLQ-C30

In the bivariate analysis of self-perceived poor oral health, this variable was associated with worse quality of life scores on the global health status, role capacity, emotional capacity, cognitive capacity, social capacity, fatigue, pain, dyspnea, and diarrhea subscales (Table 1). The results obtained through the multiple models demonstrated that, except for the global health status subscale, the associations between self-perceived poor oral health and worse quality of life scores remained even after adjusting the data for sociodemographic and health conditions (Table 2).

**Table 1.** Bivariate analysis between self-perceived oral health and quality of life among patients undergoing cancer treatment at an institution in the southern region of Minas Gerais. 2020

		EORTC QLQ C30 Mean Score ± Standard deviation		
		Self-perceived OH		
		Good	Poor	p
Functional and global health status subscale	GHS	77.0±1.1	68.2±3.7	<b>0.0100</b>
	PC	70.2±1.3	62.6±2.9	0.0600
	RC	72.4±1.8	56.6±6.4	<b>0.0100</b>
	EC	59.0±1.8	42.0±5.1	<b>0.0030</b>
	CC	72.1±1.6	56.6±5.5	<b>0.0040</b>
	SC	79.7±1.5	66.2±4.8	<b>0.0030</b>
Symptoms and financial difficulties subscale	FA	29.8±1.6	48.3±5.0	<b>&lt;0.0010</b>
	NV	11.9±1.1	17.0±4.0	0.1100
	P	30.4±1.8	49.6±5.7	<b>0.0010</b>
	DY	19.5±1.7	46.5±6.8	<b>&lt;0.0010</b>
	IN	36.2±2.2	49.6±7.0	0.0800
	AL	23.6±1.9	36.4±6.6	0.0700
	CO	27.9±2.1	34.1±6.9	0.5100
	DIA	9.9±1.3	24.8±6.0	<b>0.0060</b>
	FD	29.3±2.0	36.4±6.3	0.2700

GHS = Global health status; PC = Physical capacity; RC = Role capacity; EC = Emotional capacity; CC = cognitive capacity; SC = social capacity; FA = fatigue; NV= Nausea and Vomiting; P = pain; DY = Dyspnea; IN = Insomnia; AL = Appetite loss; CO = Constipation; DIA = Diarrhea; FD = Financial difficulties. N = 399 for all subscales. In the role and global health subscales, high scores indicate better quality of life, in the symptoms and financial difficulties subscales high scores indicate poorer quality of life.

**Table 2.** Adjusted analysis of the association between self-perceived oral health and quality of life among patients undergoing cancer treatment at an institution in the southern region of Minas Gerais. 2020

		Coefficient	SE	z	p
Functional and global health status subscale	GHS	0.0012	0.0006	1.72	0.0850
	RC	0.0032	0.0015	2.17	<b>0.0061</b>
	EC	0.0056	0.0023	2.49	<b>0.0130</b>
	CC	0.0033	0.0012	2.64	<b>0.0080</b>
	SC	0.0021	0.0009	2.29	<b>0.0220</b>
Symptoms subscale	FA	0.0098	0.0036	2.68	<b>0.0070</b>
	P	0.0091	0.0040	2.25	<b>0.0240</b>

GHS = Global health status; RC = Role capacity; EC = Emotional capacity; CC = cognitive capacity; SC = social capacity; FA = fatigue; P = pain. N = 399 for all subscales. \* Model adjusted for age. sex. education. smoking. multimorbidity. and number of teeth.

Regarding tooth brushing analyses, bivariate models revealed that the habit of brushing teeth three times or more daily was associated with worse scores on the subscales of emotional capacity, cognitive capacity, social capacity, pain, and insomnia (Table 3). In turn, the multivariate analysis showed that, after adjusting the data for sociodemographic and health factors, the associations observed in the bivariate analysis were not maintained (Table 4).

**Table 3.** Bivariate analysis between daily brushing frequency and quality of life among patients undergoing cancer treatment at an institution in the southern region of Minas Gerais, 2020

		EORTC QLQ C30 Mean Score ± Standard deviation		
		Brushing frequency		
		0-2 times daily	3 or +	p
Functional and global health status subscale	GHS	77.6±1.4	74.8±1.6	0.4900
	PC	69.4±1.9	69.3±1.6	0.7100
	RC	73.3±2.7	68.5±2.3	0.0700
	EC	61.3±2.4	53.9±2.3	<b>0.0300</b>
	CC	75.1±2.2	66.8±2.1	<b>0.0040</b>
	SC	80.8±2.2	76.2±2.0	<b>0.0300</b>
Symptoms and financial difficulties subscale	FA	30.2±2.2	33.1±2.1	0.4100
	NV	12.5±1.8	12.4±1.3	0.2900
	P	26.5±2.4	37.2±2.4	<b>0.0030</b>
	DY	24.8±2.8	20.6±2.3	0.2000
	IN	30.8±3.0	43.1±2.9	<b>0.0050</b>
	AL	24.3±2.7	25.5±2.5	0.5800
	CO	25.1±2.8	31.2±2.8	0.2500
	DIA	12.0±2.1	11.1±1.8	0.9400
FD	28.8±2.9	31.1±2.6	0.5300	

GHS = Global health status; PC = Physical capacity; RC = Role capacity; EC = Emotional capacity; CC = cognitive capacity; SC = social capacity; FA = fatigue; NV= Nausea and Vomiting; P = pain; DY = Dyspnea; IN = Insomnia; AL = Appetite loss; CO = Constipation; DIA = Diarrhea; FD = Financial difficulties. N = 399 for all subscales. In the role and global health subscales, high scores indicate better quality of life, in the symptoms and financial difficulties subscales high scores indicate poorer quality of life.

**Table 4.** Adjusted analysis of the association between brushing frequency and quality of life among patients undergoing cancer treatment at an institution in the southern region of Minas Gerais, 2020

		Coefficient	SE	z	p
Functional subscale	EC	0.0005	0.0012	0.46	0.6460
	CC	0.0006	0.0006	0.87	0.3840
	SC	0.0002	0.0005	0.47	0.6400
Symptoms subscale	P	0.0077	0.0039	1.96	0.0500
	IN	0.0067	0.0036	1.83	0.0680

EC = Emotional capacity; CC = cognitive capacity; SC = social capacity; P = pain; IN = Insomnia. N = 399 for all subscales. \* Model adjusted for age, sex, education, smoking, multimorbidity, and number of teeth.

## Discussion

This was one of the first studies to assess the relationship between oral health conditions and quality of life using a specific instrument addressed to the population in cancer treatment in an upper-middle-income country. The results show that better quality of life was recorded in the social capacity and diarrhea subscales while worse quality of life scores were observed in the insomnia and emotional capacity subscales. Most participants reported self-perception of good oral health and just over half of the participants brushed their teeth three or more times daily. Self-perceived poor oral health was associated with worse quality of life outcomes in the functional, emotional, cognitive, and social capacity, in addition to fatigue and pain symptoms subscales. Toothbrushing frequency was not associated with any subscale of the EORTC QLQ-C30 instrument, independently of socioeconomic and health conditions.

In this study, worse quality of life scores were found in almost all EORTC QLQ-C30 subscales in comparison to data available in the reference values manual<sup>23</sup>. Of the 15 subscales, only three had better scores than the reference ones: global health status, functional capacity, and fatigue. The greatest difference was observed in the financial difficulties subscale, in which the result was almost twice as bad as the reference. Previous studies from different countries reported similar findings, with scores on the financial difficulties subscale worse than those indicated in the manual<sup>16,24-26</sup>, thereby suggesting that most cancer patients have a significant role of financial difficulties in their quality of life. Regarding the pain subscale, in this research, a worse score than that pointed out in the instrument's reference manual was observed. This result is expressive since other authors reported better scores in comparison to the values of the manual<sup>17,24-26</sup>. Considering the nausea and vomiting, and appetite loss subscales, the results revealed worse scores than those indicated in the reference manual. Other Brazilian studies have obtained similar findings<sup>25,26</sup>. Notwithstanding that, research carried out with Asian populations revealed better scores than those of the reference manual, in both subscales<sup>16,24</sup>, thus indicating a possible sociocultural influence. In general, except for the pain subscale, the observed scores corroborate findings in other Brazilian studies that used the same instrument to measure the quality of life of cancer patients<sup>25,26</sup>.

In this study, 89.2% of the sample classified their oral health as good, and only 10.8% as poor. Importantly, it should be emphasized that self-perception of oral health may not be consistent with clinical oral conditions, since self-perception is influenced by several factors, such as the cultural context<sup>27</sup>. The naturalization of tooth loss and oral problems over the years, the lack of knowledge about oral diseases, especially those that do not cause pain and/or aesthetic problems, and the little importance given to oral health are factors that can explain this discrepancy between self-perception and clinical conditions<sup>28</sup>. It is important to highlight that, in this study, more than a third of participants are edentulous, and only over a third have 20 or more teeth in their mouth. Few studies that investigated the self-assessment of oral health in cancer patients are available in the literature. Amaral et al.<sup>29</sup> evaluated the self-perceived oral health of patients undergoing radiotherapy treatment in the head and neck region and observed that, before treat-

ment, 24% of the patients had poor self-perceived oral health. During treatment, 40% classified their oral health as poor, and after treatment, only 16% had this perception. According to the authors, the impairment observed in self-perceived oral health during treatment may be related to adverse effects of radiotherapy in the oral cavity.

When assessing their own health, each individual considers physical, emotional, and cognitive aspects, therefore using notions that permeate the perception of quality of life, so that people who perceive themselves as healthy also tend to positively evaluate their quality of life<sup>29</sup>. In this sense, it is expected that self-perception of health reflects to some degree the quality of life. The findings of this study showed that self-perceived poor oral health was associated with lower quality of life scores in the functional capacity, emotional capacity, cognitive capacity, social capacity, fatigue, and pain subscales. Although no other research was found in the literature that evaluated the association between self-perceived oral health and quality of life among cancer patients, this result is consistent with a previous investigation by Yekaninejad et al.<sup>30</sup>, who evaluated the association between self-perceived health and oral health-related quality of life of patients undergoing cancer treatment. The authors pointed out that self-perception of good oral health was associated with better oral health-related quality of life (OHRQoL) results. The findings obtained in this research also corroborate the conclusions of prior studies that evaluated the relationship between self-perceived oral health and health-related quality of life in other populations, including the adult population in general<sup>31</sup>.

The bivariate analysis of this study demonstrated that brushing teeth three or more times daily was associated with worse scores on the subscales of emotional capacity, cognitive capacity, social capacity, pain, and insomnia. Nevertheless, these associations were not maintained after the adjusted analysis. This result differs from that observed by Yan et al.<sup>16</sup>, who used the EORTC QLQ-C30 to assess the quality of life of Chinese cancer patients and reported that brushing teeth twice a day was related to better scores on the subscales of physical capacity, cognitive capacity, social capacity, nausea and vomiting, and financial difficulties. This divergence may be explained due to the difference in methodology since the classification of toothbrushing frequency used was different, as well as the sample size, which in the case of the Chinese study included more than 9,000 people.

Toothbrushing is considered a fundamental self-care behavior for the maintenance of oral health, and toothbrushing frequency is one of the determining factors in the development of oral diseases, such as periodontitis and dental caries<sup>32</sup>. In fact, various factors interfere with the formation and maintenance of good oral hygiene habits. In general, the habit of brushing teeth requires the same determination for self-care as other health habits, for example, making healthy food choices and being physically active, with optimism and satisfaction with one's own life being essential elements for the development and maintenance of good health habits<sup>33</sup>. It is important to highlight the role of socioeconomic conditions, such as education, on quality of life. Educational level is the major factor in adhering to proper hygiene habits<sup>34</sup>. The findings obtained in this study showed that most of

the sample had 8 years of schooling or less and 56% of the sample declared to brush their teeth three or more times daily. These results are consistent with other Brazilian studies conducted with populations with similar educational levels<sup>34</sup>. However, toothbrushing frequency data collected through a questionnaire should be interpreted with caution, since social convention can influence the response of participants, who tend to overestimate the frequency with which they brush their teeth<sup>33</sup>.

This work has limitations and strengths that must be discussed. As far as we know, this is the first Brazilian study that aimed to assess the association between self-perceived oral health and quality of life among cancer patients. Among the strengths, it is noteworthy that the location of the study receives patients from an oncology center that is a reference in two health micro-regions of the southern macro-region of Minas Gerais, therefore a representative sample of a population of about 400 thousand inhabitants was used. It is important to declare that cancer treatment in Brazil is predominantly carried out by the public health system, being referenced regionally, according to the level of complexity. This hospital institution is the only reference in oncological treatment for a region in the interior of the Southeast of the country made up of 24 municipalities, whose sociodemographic and health characteristics are similar to those of the Brazilian population as referred to in the last national oral health survey conducted in the country<sup>17</sup>.

Regarding the limitations of this study, we can cite the cross-sectional design, which does not allow us to clarify whether and how changes in quality of life and oral health conditions occur during treatment. In this sense, future longitudinal studies can confirm whether the results obtained in this work remain over time, and also what the behavior of the quality of life throughout the different stages of cancer treatment. Furthermore, clinical measures of oral health should be used in the evaluation of the studied association. Another limitation involves the self-assessment of oral health. Although the assessment of tooth brushing occurred using self-report, studies in the area legitimize this type of approach. This is because objective assessment of toothbrushing in observational epidemiological studies becomes unfeasible. However, the literature highlights the use and parameters for this measure applied by self-report<sup>16,33</sup>. Finally, future studies should investigate the role of the cancer site in the assessment of the association between oral health conditions and quality of life in this population.

In conclusion, this study indicated an association between self-perceived poor oral health is associated with worse quality of life outcomes in the functional, emotional, cognitive, and social capacity, in addition to fatigue and pain symptoms subscales among cancer patients. However, a relationship between toothbrushing frequency and quality of life was not confirmed. Considering the multiplicity of factors capable of affecting the quality of life, further in-depth studies are needed to explore the role of oral health on the quality of life of cancer patients, considering the approach of specific instruments developed for that population.

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## Data availability

Datasets related to this article will be available upon request to the corresponding author.

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The authors declare having no funding in study.

## Conflicts of interests

The authors declare having no conflicts of interest.

## Authors' contributions

**Sheila Souza Parreiras** participated in the collection/interpretation of the data, critically revised and interpretation of the data and wrote the manuscript.

**Mariane Carolina Faria Barbosa:** participated in the collection/interpretation of the data and critically revised the manuscript.

**Bárbara Maria de Souza Moreira Machado:** participated in the collection/interpretation of the data and critically revised the manuscript.

**Leandro Araújo Fernandes:** to the conception and design of the study and critically revised the manuscript.

**Eduardo José Pereira Oliveira** participated in the interpretation of the data, contributed to the design of the study, performed the statistical analysis, and critically revised the manuscript.

**Daniela Coêlho de Lima:** contributed to the conception and design of the study and critically revised the manuscript.

All authors revised and approved the final version of the manuscript.

## Ethics approval statement

The present study received approval from the institutional review board of Universidade Federal de Alfenas (certificate number: 54701116.0.0000.5142). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

## Consent to participate and consent for publication

Participation in the study, as well as the publication of research data in scientific articles, was voluntary and authorized by participants who signed the consent form.

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## References

1. Brazilian Ministry of Health. National Cancer Institute. [Cancer Statistics]. Brasília; 2020 [cited 2022 feb 12]. Available from: <http://www.inca.gov.br/numeros-de-cancer>. Portuguese.
2. Brazilian Ministry of Health Brazil. [Mortality Information System]. Brasília; 2017. [cited 2019 Oct 20]. Available from: <https://svs.aids.gov.br/daent/centrais-de-conteudos/dados-abertos/sim>. Portuguese.
3. Lichtenberg FR. Has medical innovation reduced cancer mortality?, CESifo Economic Studies. 2014;60(1):135-77. doi: 10.1093/cesifo/ift014.
4. Chang HM, Okwuosa TM, Scarabelli T, Moudgil R, Yeh ETH. Cardiovascular complications of cancer therapy: best practices in diagnosis, prevention, and management: part 2. *J Am Coll Cardiol*. 2017 Nov;70(20):2552-65. doi: 10.1016/j.jacc.2017.09.1095.
5. Karimi M, Brazier J. Health, health-related quality of life, and quality of life: what is the difference? *Pharmacoeconomics*. 2016 Jul;34(7):645-9. doi: 10.1007/s40273-016-0389-9.
6. Bottomley A. The cancer patient and quality of life. *Oncologist*. 2002;7(2):120-5. doi: 10.1634/theoncologist.7-2-120.
7. Oskam IM, Verdonck-de-Leeuw IM, Aaronson NK, Kuik DJ, de Bree R, Doornaert P, et al. Quality of life as predictor of survival: a prospective study on patients treated with combined surgery and radiotherapy for advanced oral and oropharyngeal cancer. *Radiother Oncol*. 2010 Nov;97(2):258-62. doi: 10.1016/j.radonc.2010.02.005.
8. Natapov L, Kushnir D, Goldsmith R, Dichtiar R, Zusman SP. Dental status, visits, and functional ability and dietary intake of elderly in Israel. *Isr J Health Policy Res*. 2018 Dec;7(1):58. doi: 10.1186/s13584-018-0252-x.
9. Sedghi LM, Bacino M, Kapila YL. Periodontal disease: the good, the bad, and the unknown. *Front Cell Infect Microbiol*. 2021 Dec;11:766944. doi: 10.3389/fcimb.2021.766944.
10. Teodoric, J. Inflammation and cancer. In: Bast Jr RC, Groce CM, Hait WN, Hong WK, Kufe DW, Piccart-Gebhart M, et al. *Holland-Frei Cancer Medicine*. 9<sup>th</sup> ed. New Jersey: John Wiley and Sons; 2017. p.333-40.
11. Wang K, Karin M. Tumor-elicited inflammation and colorectal cancer. *Adv Cancer Res*. 2015;128:173-96. doi: 10.1016/bs.acr.2015.04.014.
12. Buglione M, Cavagnini R, Di Rosario F, Sottocornola L, Maddalo M, Vassalli L, et al. Oral toxicity management in head and neck cancer patients treated with chemotherapy and radiation: Dental pathologies and osteoradionecrosis (Part 1) literature review and consensus statement. *Crit Rev Oncol Hematol*. 2016 Jan;97:131-42. doi: 10.1016/j.critrevonc.2015.08.010. Epub 2015 Aug 12.
13. Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG, Weyant RJ. A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. *Am J Orthod Dentofacial Orthop*. 2017 Feb;151(2):229-231. doi: 10.1016/j.ajodo.2016.11.010.
14. Gift HC, Redford M. Oral health and the quality of life. *Clin Geriatr Med*. 1992 Aug;8(3):673-83.
15. Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, et al. Oral diseases: a global public health challenge. *Lancet*. 2019 Jul;394(10194):249-60. doi: 10.1016/S0140-6736(19)31146-8. Erratum in: *Lancet*. 2019 Sep 21;394(10203):1010. doi: 10.1016/S0140-6736(19)32079-3.
16. Yan R, Chen X, Gong X, Wang J, Yu J. The association of tooth loss, toothbrushing, and quality of life among cancer survivors. *Cancer Med*. 2018 Dec;7(12):6374-84. doi: 10.1002/cam4.1835.

17. Brazilian Ministry of Health. [National Oral Health Survey – SB Brazil 2010. Main Results]. Brasília; 2012 [cited 2022 feb 14]. Available from: [https://bvsmms.saude.gov.br/bvs/publicacoes/pesquisa\\_nacional\\_saude\\_bucal.pdf](https://bvsmms.saude.gov.br/bvs/publicacoes/pesquisa_nacional_saude_bucal.pdf). Portuguese.
18. Silva NN. [Probability sampling: an introductory course]. São Paulo: EDUSP; 1998. Portuguese.
19. Carvalho AA, Costa ABMV, Aragão GC, Silva ACC, Lima DC, Oliveira EJP. [Use of dental services by patients in oncological treatment]. *Rev Odontol UNESP*. 2022;51:e20220029. Portuguese. doi: 10.1590/1807-2577.02922.
20. Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, et al. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst*. 1993 Mar;85(5):365-76. doi: 10.1093/jnci/85.5.365.
21. Paiva CE, Carneseca EC, Barroso EM, de Camargos MG, Alfano AC, Rugno FC, et al. Further evaluation of the EORTC QLQ-C30 psychometric properties in a large Brazilian cancer patient cohort as a function of their educational status. *Support Care Cancer*. 2014 Aug;22(8):2151-60. doi: 10.1007/s00520-014-2206-3.
22. World Health Organization. Multimorbidity: technical series on safer primary care. Geneva: WHO; 2016. [cited 2019 sep 20] Available from: <https://apps.who.int/iris/bitstream/handle/10665/252275/9789241511650-eng.pdf?sequence=1>.
23. Scott NW, Fayers P, Aaronson NK, Bottomley A, Graeff A, Groenvold M, Sprangers MAG. EORTC QLQ-C30 reference values. 2008 [cited 2020 nov 10]. Available from: [https://www.eortc.org/app/uploads/sites/2/2018/02/reference\\_values\\_manual2008.pdf](https://www.eortc.org/app/uploads/sites/2/2018/02/reference_values_manual2008.pdf).
24. Hagiwara Y, Shirowa T, Taira N, Kawahara T, Konomura K, Noto S, et al. Mapping EORTC QLQ-C30 and FACT-G onto EQ-5D-5L index for patients with cancer. *Health Qual Life Outcomes*. 2020 Nov;18(1):354. doi: 10.1186/s12955-020-01611-w.
25. Salvetti MDG, Machado CSP, Donato SCT, Silva AMD. [Prevalence of symptoms and quality of life of cancer patients]. *Rev Bras Enferm*. 2020;73(2): e20180287. Portuguese. doi: 10.1590/0034-7167-2018-0287.
26. Morais VM, Araújo Júnior IB. [Influence of quality of life in the therapeutic of patients with malignant neoplasms]. *Rev Cienc Saude Nova Esper*. 2017;15(1):100-10. Portuguese.
27. Guevara-Canales JO, Morales-Vadillo R, Sacsquispe-Contreras SJ, Alberca-Ramos DE, Morgenstern-Orezzoli H, Cava-Vergíu CE. Association between self-perceived oral health and clinical indicators. *Oral Health Prev Dent*. 2018;16(1):33-41. doi: 10.3290/j.ohpd.a39685.
28. Ribeiro AE, Santos GS, Baldani MH. [Edentulism, need for dentures, and self-perception of oral health among institutionalized older people]. *Saude Debate*. 2023;47(137):222-41. Portuguese. doi: 10.1590/0103-1104202313716.
29. Amaral CC, Souza JDMD, Castilhos ED, Bighetti TI. [Self-perception of oral health and necessity of odontologic action on irradiated patients]. *Rev Bras Oncol Clin*. 2012;8(28):60-6.
30. Yekaninejad MS, Pakpour AH, Tadakamadla J, Kumar S, Mosavi SH, Fridlund B, et al. Oral-health-related quality of life in patients with cancer: cultural adaptation and the psychometric testing of the Persian version of EORTC QLQ-OH17. *Support Care Cancer*. 2015 May;23(5):1215-24. doi: 10.1007/s00520-014-2468-9. Epub 2014 Oct 15.
31. Appukuttan DP, Tadepalli A, Victor DJ, Dharuman S. Oral health related quality of life among tamil speaking adults attending a dental institution in Chennai, Southern India. *J Clin Diagn Res*. 2016 Oct;10(10):ZC114-20. doi: 10.7860/JCDR/2016/20099.8693.
32. Poklepovic Pericic T, Worthington HV, Johnson TM, Sambunjak D, Imai P, Clarkson JE, et al. WITHDRAWN: Interdental brushing for the prevention and control of periodontal diseases and dental caries in adults. *Cochrane Database Syst Rev*. 2019 Apr 24;4(4):CD009857. doi: 10.1002/14651858.CD009857.pub3.

33. Scabar LF, Amaral RC, Narvai PC, Frazão P. [Validity of an indirect assessment instrument on the frequency of brushing with toothpaste]. *Rev Bras Odontol* 2016;73(1):39-46. Portuguese. doi: 10.18363/rbo.v73n1.p.39.
34. Perazzo PAT, Moura C, Cavalcante FT, Cavalcante FT. [Lack of functional dentition and associated factors in adults in Northeast Brazil]. *Res Soc Dev* 2020;9(7): e59973752. Portuguese. doi: 10.33448/rsd-v9i7.3752.