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Periodontal Disease Indices in Pre-treatment Patients with the Most Frequent Types of Cancer

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ABSTRACT

Aim: The purpose of the present retrospective study was to investigate the incidence of the most frequent types of cancer in patients referred to a private dental practice for periodontal treatment and to assess possible correlations between those and periodontal disease severity in the population sample examined.

Material and Methods: Data were collected from the health questionnaires and the dental and medical records of 550 individuals. Stepwise multiple linear regression analysis was carried out to assess correlations between the most frequent types of cancer as independent variables and periodontal indices: the number of remaining teeth, the relative frequency of periodontal pockets (PPD) of ≥ 5.0 and clinical attachment loss (CAL) of ≥ 6.0mm, as the dependent ones.

Results: The relative frequencies of remaining teeth were 20.5 and 21.1 for individuals who suffered from gastric and colorectal cancer, whereas the relative frequencies of PPD ≥ 5.0 mm were 5.6 mm and 5.8 mm for lung and gastric cancer patients, respectively. It was also found that the relative frequencies of CAL ≥ 6.00 mm were 6.6 mm and 6.0 mm for individuals who suffered from gastric and colorectal cancer, respectively. The number of remaining teeth was negatively and significantly correlated with the presence of lung (p=0.000) and gastric cancer (p=0.031), PPD was significantly correlated with the presence of the same cancer types, (p=0.007) and (p=0.007) respectively, and colorectal cancer (p=0.044), whereas CAL was significantly correlated with the same cancer types (p=0.003) and (p=0.015), respectively, and with the presence of colorectal cancer (p=0.036). After adjustment for age, gender and smoking, the mentioned correlations remained.

Conclusion: Significant correlations between lung, gastric and colorectal cancer and periodontal disease severity were found after using of the number of remaining teeth, PPD and CAL as clinical indices for periodontal disease severity.

KEYWORDS

Cancer; Health; Questionnaire; Periodontitis; Indices.

INTRODUCTION

Recent and previous researches have been published pointing towards a link between Periodontal Disease (PD) and various systemic diseases or disorders. Some of those have focused on a possible role for PD as a risk factor for systemic diseases including cardiovascular diseases (CVD), respiratory diseases, cerebral infarction, hypertension, respiratory allergies, diabetes mellitus (DM), rheumatoid arthritis, osteoporosis, endocrine disorders, adverse pregnancy out-comes and various types of cancer [1-6].

Other investigations have shown that PD patients are affected by one or more systemic diseases or disorders such as CVD, DM, renal diseases, respiratory diseases, allergy, endocrine disorders, blood vascular disorders and orthopedic diseases including arthritis and rheumatoid arthritis and others that affect a large amount of human organ systems [7-13].

The frequency of those systemic diseases and disorders among the PD patients have been recorded by previous and

recent researchers and varies between 30.5% [9] and 81.96% [8], whereas other investigators have recorded median rates as 47.3% [14], 49.4% [13], 52.5% [15], and 60% [7]. CVD and DM were the most prevalent among PD patients [9-11].

It has been proposed that some of those conditions may be bidirectional and that PD involves both a local and a systemic host inflammatory response [1-4, 16]. To be more specific the link between PD and DM is considered to be bidirectional: DM as a risk factor for PD and PD as a possible risk factor for DM [1,2,4,17-20].

Several possible hypotheses have been suggested to explain the association between PD occurrence and systemic diseases. However, the exact connection between PD and systemic diseases still remains complicated and unknown. Chronic PD represents the source of chronic inflammation that may be a significant contributing factor in the pathogenesis of other inflammatory based diseases, such as CVD. PD consists of progressive inflammation, leading to the destruction of the supporting tissue and alveolar bone loss and might increase the systemic bacterial load, inflammatory cytokines, endotoxins, bacterial antigens, that invoke an inflammatory response [21]. C-reactive protein (C-RP), an inflammation biomarker, has been found to be elevated in PD patients and the inflammatory response is involved in the pathogenesis of many chronic diseases such as CVD, type 2 DM, and rheumatoid arthritis. In addition, PD and some systemic diseases share common risk factors such as smoking, age, socio-economic status, genetic factors etc [13].

Cancer is the second leading cause of death globally, and is responsible for an estimated 9.6 million deaths in 2018, about 1 in 6 deaths, and causes the second highest number of deaths in Europe after CVD. Etiological and risk factors are environmental and genetics factors such as male gender, advanced age, cigarette smoking, cancer family history and genetic predisposition, previous diseases such as Chronic Obstructive Pulmonary Disease, infections with hepatitis B orC (HBV/HCV) and human papilloma virus (HPV), etc. Only a part of its incidence can be explained by the mentioned factors, whereas other possible etiological or risk factors still remain unknown [22, 23]. Cancer affects the patients' life because of its severe clinical course and the proper treatment, such as radiotherapy, chemotherapy and surgical therapy that can lead to serious side-effects.

A few researchers have investigated the possible role of PD as an etiological or risk factor in cancer development in several locations such as in the oral tissues, oesophagus, stomach, lungs and pancreas [5, 24-29],with conflicting outcomes, even after controlling for possible known and unknown potential confounders such as smoking status, socioeconomic level, etc. In contrast to the mentioned reports, very few studies have been focused on the oral conditions or the periodontal health status in patients who suffer from various types of cancer.

Cancer types with extremely poor prognosis, such as lung or breast cancer could affect dramatically the patients' life quality and it is possible those patients to be more susceptible to the destruction and progression of periodontal tissue than non-cancer individuals [30].

The aim of the present research was to investigate the incidence of the most frequent types of cancer in pre-treatment patients referred to a private dental clinic for periodontal treatment and to explore possible correlations between those and the severity of PD in this population.

MATERIAL AND METHODS

Sample of the study

The study population consisted of 550 individuals, 271 males and 279 females, aged 45-72 years.197 individuals suffered from the most frequent types of cancer, 60 from lung cancer (LC),40 from breast cancer (BC), 34 from prostate cancer (PRC), 22 from colorectal cancer (CRC), 16 from pancreatic cancer (PC),13 from hepatocellular cancer (HC) and 12 from gastric cancer (GC). All participants were patients of two private medical practices and referred to a private dental practice for periodontal treatment, completed a medical and a dental health questionnaire and underwent an oral clinical examination. The study was carried out from November 2016 to June 2018.

Selection criteria

Participants included in the study if they fulfilled the following inclusion criteria : at least a mean of 20 natural teeth-in order to minimize the influence of tooth number on the total number of periodontal pockets, ought not to be treated for any type of PD during a period of the previous six months and ought not to be received anti-inflammatory medication, antibiotics or other systemic medication for a period of the previous six weeks and should meet the criteria of clinically established periodontitis, given by two measures: number or % of one diseased site with PPD ≥ 5.0 mm and with CAL ≥ 6.0 mm in two or more teeth [31]. Exclusion criteria also included CVD, rheumatoid arthritis, DM, liver cirrhosis, immuno-suppressive treatment or medi-cation for the mentioned conditions or glucocorticoids. Cancer patients should meet additional exclusion criteria included: any type of treatment after initial diagnosis, advanced cancer under radiotherapy or che-

motherapy, distant or recurrent disease, metastases due to a different initial focus.Those conditions could have potential effects on the periodontal tissues and excluded in an effort to eliminate potential effects by known and unknown confounders [32]. Cancer diagnosis was confirmed by histopathological examinations.

Oral clinical examination and questionnaire

All periodontal measurements (PPD, CAL) were assessed at six sites (mesio-facial, facial,disto-facial, mesio-lingual, lingual and disto-lingual) of all teeth in all quadrants and the worst values of the indices recorded. All measurements were performed with a periodontal probe (PCP 10-SE, Hu-Friedy) and the readings were recorded to the nearest 1.0 mm. Remaining roots and 3rd molars were not recorded. In case a tooth cervix was destructed by abrasion, erosion, decay or another lesion, or the cement-enamel junction (CEJ) was covered by a filling or prosthetic restoration its location was recorded by extrapolating the CEJ location from the adjacent teeth, whereas if its location could not be determined, the sites were not recorded.

From the medical and dental records, the following variables were recorded: age, gender, smoking status (current/ previous smokers and never smokers) number of remaining teeth, number of periodontally diseased sites with a probing depth ≥ 5.0 mm , CAL ≥ 6.00 mm in two or more teeth and self-reported presence of cancer in organs such as lung, breast, colon-rectum, prostate, liver, stomach and pancreas and data that concerned their medical history with reference to the mentioned conditions and medication. PD severity was given by the above indices determined.

A randomly selected sample of 110 individuals (20%), 73 non-cancer individuals and 37 cancer patients were re-examined clinically by the same dentist during a period of three weeks after the first examination for each individual to assess the intra-examiner variance and no differences were recorded between 1st and 2nd clinical examinations (Cohen's Kappa= 0.95).

Statistical analysis

In the analysis, the variables smoking for non-smokers or former smokers, female gender and absence of all self-reported types of cancer were coded 0, as dichotomous variables.

Descriptive statistics and statistical analysis were carried out with SPSS statistical package (SPSS PC19.0, SPSS, Inc., Chicago, IL, USA).

Pearson's correlation coefficient was calculated to examine the correlation among the variables examined. Forward stepwise multiple linear regression analysis was used to assess partial correlations, and to research the influence of the independent variables on the three dependent ones, the number of remaining teeth, the relative frequency of PPD ≥5.00 mm and the relative frequency of CAL ≥6.00 mm. Results were considered to be statistically significant at $p<0.05$.

Kolmogorov-Smirnov test was carried out to control the normality of dependent variables distribution as the normality is a precondition for the application of multiple linear regression analysis model.

The current retrospective study did not review and approve by authorized Greek committees (Greek Dental Associations, Ministry of Health, etc.) As was not an experimental one. The performance of the study was in full accordance with the World Medical Association Declaration of Helsinki. Individuals who accepted the invitation to participate in the study protocol signed an informed consent form.

RESULTS

The mean age of the sample was 57.4 ± 3.8 years. 49.3% were males and 50.7% females, 52% of the participants reported current smoking, 52% were males and 51.9% females.

Table 1 presents the self-reported types of cancer. The most frequent types were LC (10.9%) followed by BC (7.3%) and PRC (6.2%).

Table 1: Self-reported types of cancer.

Cancer type	Males N (%)	Females N (%)	Total N (%)
Lung Cancer	38 (14.0)	22 (7.9)	60 (10.9)
Breast Cancer	0 (0.0)	40 (14.3)	40 (7.3)
Prostate Cancer	34 (12.5)	0 (0.0)	34 (6.2)
Colorectal Cancer	10 (3.7)	12 (4.3)	22 (4.0)
Pancreatic Cancer	10 (3.7)	6 (2.2)	16 (2.9)
Hepatocellular Cancer	7 (2.6)	6 (2.2)	13 (2.4)
Gastric Cancer	8 (3.0)	4 (1.4)	12 (2.2)

The mean number of remaining teeth and the mean frequencies of sites with PPD ≥ 5 mm and CAL ≥ 6 mm in cancer and non-cancer individuals are shown in Table 2.

Table 2: Means (standard deviation) for number of remaining teeth, relative frequencies (standard deviation) of periodontal pockets ≥ 5.0 mm and CAL ≥6.0mm

Sig (2-tailed) in bold: Statistically-significant difference
LC: Lung cancer, CRC: Colorectal cancer, PRC: Prostate cancer, BC: Breast cancer, HC: Hepatocellular cancer PC: Pancreatic cancer, GC: Gastric cancer, Numb Teeth: Number of remaining teeth, PPD val: Probing Pocket

Independent variable	Presence Absence	N N	Number of teeth mean (SD)	PPD≥5mm mean (SD)	CAL≥6mm mean (SD)
Lung Cancer	Presence	60	23.8 (5.42)	5.6 (2.77)	6.1 (1.43)
	Absence	490	24.2 (5.52)	5.1 (2.53)	6.5 (1.62)
Breast Cancer	Presence	40	22.7 (5.57)	5.0 (2.30)	6.1 (1.53)
	Absence	510	22.9 (5.38)	5.1 (2.20)	6.7 (1.81)
Prostate Cancer	Presence	34	22.4 (5.24)	5.2 (2.42)	6.3 (1.40)
	Absence	516	23.1 (5.38)	5.1 (2.19)	6.6 (1.43)
Colorectal Cancer	Presence	22	21.1 (5.41)	5.4 (2.39)	6.0 (1.43)
	Absence	528	23.7 (5.45)	5.6 (2.50)	5.6 (1.24)
Pancreatic Cancer	Presence	16	22.4 (5.75)	5.3 (2.06)	6.1 (1.38)
	Absence	534	22.9 (5.12)	5.6 (2.37)	6.3 (1.44)
Hepatocellular Cancer	Presence	13	24.2 (5.82)	5.3 (2.32)	6.2 (1.64)
	Absence	537	24.9 (5.42)	5.5 (2.20)	6.4 (1.53)
Gastric Cancer	Presence	12	20.5 (5.29)	5.8 (2.73)	6.6 (1.71)
	Absence	538	23.8 (5.41)	5.1 (2.21)	5.8 (1.41)

Kolmogorov-Smirnov test showed values *p=0.201,0.126* and *0.365* for number of remaining teeth, PD and CAL, respectively, and consequently the basic precondition for the application of the statistical model was fulfilled, as *p* value must be greater than *0.05*.

Table 3: Pairwise bivariate correlations between investigated variables.

Control Variables		LC	CRC	PRC	BC	HC	PC	GC	Numb teeth	PPD val	CAL val	Age	Smok stat	Gender
LC	Correlation	1,000	,071	,049	,058	,054	,061	,052	-,103	,172	,084	,071	,071	,015
	Sig(2-tailed)		,094	,135	,062	,202	,156	,221	**,051**	**,000**	**,048**	,095	,063	,109
CRC	Correlation		1,000	,052	,057	,032	,035	,030	,057	,027	,042	,061	,010	,051
	Sig(2-tailed)			,220	,181	,457	,408	,476	,104	,093	,107	,085	,808	,234
PRC	Correlation			1,000	,072	,040	,044	,038	,043	,088	,060	,035	,035	,028
	Sig(2-tailed)				,092	,350	,298	,370	,314	,058	,160	,409	,082	,070
BC	Correlation				1,000	,044	,048	,042	,042	,008	,065	,039	,011	,049
	Sig(2-tailed)					,308	,256	,328	,322	,854	,074	,363	,793	,129
HC	Correlation					1,000	,027	,023	,018	,027	,056	,049	,018	,018
	Sig(2-tailed)						,529	,587	,674	,525	,077	,110	,070	,065
PC	Correlation						1,000	,026	,013	,047	,059	,077	,089	,723
	Sig(2-tailed)							,545	,754	,072	,170	,063	,504	,586
GC	Correlation							1,000	-,104	,101	,104	,085	,019	,043
	Sig(2-tailed)								**,049**	**,027**	**,045**	,061	,658	,319
Numb	Correlation								1,000	-,127	-,113	-,162	-	-,101
Teeth	Sig(2-tailed)									**,003**	**,046**	**,000**	,354	**,018**
PPD	Correlation									1,000	,117	,141	**,000**	,171
val	Sig(2-tailed)										**,041**	**,001**	,223	**,000**
CAL	Correlation										1,000	,083	**,000**	,096
val	Sig(2-tailed)											**,050**	,132	**,025**
Age	Correlation											1,000	**,002**	,076
	Sig(2-tailed)												,061	,075
Smok	Correlation												,153	,107
stat	Sig(2-tailed)													**,012**
Gender	Correlation												1,000	1,000
	Sig (2-tailed)													

Depth, CAL val: Clinical Attachment Loss, Smok stat: Smoking status

The pairwise bivariate correlations among the variables examined are shown in Table 3. After performance of the forward stepwise multiple linear regression analysis model, using the PD parameters as the dependent variables, recorded that the number of remaining teeth was negatively significantly correlated with the presence of LC (*p=0.000*) and GC (*p=0.031*), PPD was significantly correlated with the presence of the same cancer types, (*p=0.007*) and (*p=0.007*) respectively, and CRC (*p=0.*044), whereas CAL was significantly correlated with the same cancer types (*p=0.003*) and (*p=0.015*), respectively, and with the presence of CRC (*p=0.036*). (Table 4). After adjustment for age, gender and smoking the mentioned correlations remained. (Table 5).

Table 4. Results of forward stepwise regression analysis using number of remaining teeth PPD and CAL as the dependent variables.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
5. (Constant)	22,495	,519		43,365	,000**	21,476	23,514
smokstat	-3,863	,418	-,356	9,247	,000**	-4,683	-3,042
age	-1,150	,205	-,217	-5,602	,000**	-1,554	-,747
lungca	-,3006	1,068	-,181	-4,688	,000**	-5,103	-2,908
gender	-1,235	,440	-,113	-2,806	,005*	-2,099	-,370
gastrca	-1,943	,901	-,086	-2,157	,031*	-3,712	-,174

a. Dependent Variable: Number of remaining teeth.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
6. (Constant)	4,329	,120		35,984	,000**	4,093	4,565
smokstat	,496	,097	,206	5,096	,000**	,305	,687
age	,182	,048	,155	3,800	,000**	,088	,276
gender	,335	,099	,138	3,400	,001*	,142	,529
lungca	,424	,157	,110	2,698	,007*	,115	,733
gastrca	,787	,288	,115	2,730	,007*	,221	1,353
colorectalca	,613	,248	,106	2,472	,044*	,126	1,101

a. Dependent Variable: PPD

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
4. (Constant)	5,705	,138		41,401	,000**	5,434	5,975
smokstat	,364	,120	,127	3,042	,002*	,129	,598
lungca	1,163	,395	,124	2,944	,003*	,387	1,939
gastrca	,558	,230	,102	2,430	,015*	,107	1,010
colorectal-caage	,654	,103	,116	2,275	,036*	,489	1,216
	,130	,059	,093	2,213	,027*	,015	,245

a. Dependent Variable: CAL

* P ≤ 0.05, ** p ≤ 0.001

Table 5: Results of forward stepwise regression analyses after adjustment for age, gender and smoking, using number of remaining teeth, PPD and CAL as the dependent variables

Control Variables			LC	CRC	PRC	BC	HC	PC	GC	Numb teeth	PPD val	CAL val
Age & Smok	LC	Correlation	1,000	,057	,143	,064	,061	,065	,051	-,126	,117	,125
		Sig(2-tailed)	.	,187	,121	,136	,152	,130	,231	,012	,025	,006

stat & Gender	CRC	Correlation		1,000	,032	,081	,019	,025	,042	-,049	,078	,105
		Sig(2-tailed)		.	,450	,060	,652	,563	,324	,120	,082	,041
	PRC	Correlation			1,000	,044	,043	,045	,047	,067	,031	,069
		Sig(2-tailed)			.	,935	,315	,291	,272	,074	,475	,087
BC	Correlation					1,000	,043	,050	,039	,013	,045	,071
	Sig(2-tailed)					.	,312	,239	,363	,755	,297	,063
HC	Correlation						1,000	,038	,011	,046	,017	,033
	Sig(2-tailed)						.	,371	,796	,896	,697	,092
PC	Correlation							1,000	,015	,048	,052	,072
	Sig(2-tailed)							.	,729	,856	,065	,092
GC	Correlation								1,000	-,109	,115	,098
	Sig(2-tailed)								.	,044	,010	,034
Num teeth	Correlation									1,000	,008	,029
	Sig(2-tailed)									.	,849	,502
PPD val	Correlation										1,000	,043
	Sig(2-tailed)										.	,068
CAL val	Correlation											1,000
	Sig(2-tailed)											

Sig (2-tailed) in bold: Statistically-significant difference.

DISCUSSION

In the present retrospective study, the correlations between the most frequent cancer types and PD indices in terms of number of remaining teeth , PPD and CAL investigated using the cross-sectional data of 550 participants referred to a dental clinic from two private medical practices. Retrospective studies have limitations that should be taken into account when interpreting the results. Those studies do not have high reliability as the prospective ones because of the presence of systemic biases during the sample selection, recall biases and known and unknown con-founders. In addition, the current results were based on self-reported data of a serious disease and the response outcomes to the questionnaire items, therefore maybe not quite accurate as the participants may under- or overestimate their ability to give a honest response or choose not to respond, and this can affect the validity during the results interpretation. However, the medical files of participants could solve that problem. The last limitation is that the study population was not randomly selected from a representative population but consisted of PD patients that referred for periodontal treatment.

In the current study, the presence of LC was significantly correlated with an increased frequen-cy of lost teeth, finding that cannot be confirmed by previous or recent studies as similar studies have not been carried out. Smoking, male gender and advanced age are known risk factors for LC development [33], were also significantly correlated with a decreased frequency of remaining teeth, however, after adjustment for the known confounders the mentioned correlation remained.

Although previous studies, prospective and retrospective, have recorded a possible association between PD indices and the risk for LC development [5, 28, 31, 34], the possible link between PD and risk for LC development still remains unknown and is not considered as a bidirectional.

Similarly, GC patients were significantly correlated with an increased frequency of lost teeth.

Only one recent study has investigated the relationship between LG patients and PD indices such as Gingival Index (GI), PPD, CAL and Bleeding on Probing (BOP) [30]. In the current study after adjustment for smoking, gender and age the correlation also remained.

The decision to be included in the current study older individuals who have at least 20 natural teeth would lead to underestimate those individuals with previous PD who may have had teeth extracted for periodontal reasons. A crucial question is whether the number of remaining teeth, represents a valid PD index. Previous reports have recorded that PD is one of the most frequent causes of tooth loss at ages beyond 40 [35-37]. In addition, the number of remaining teeth is significantly related to alveolar bone height (ABL) [38]. Consequently, the variable of remaining teeth might be considered as an approximate index of the degree of periodontal bone loss.

Possible explanations can interpret the mentioned correlation between tooth loss and various cancer types. The principle reason for tooth extractions among older individuals in Greece was found to be advanced periodontitis [36]. Howev-

er, increased correlations between PD and tooth loss have been reported [39, 40], as well as a higher rate of tooth extractions caused by periodontitis with increasing age [41, 42]. The correlations between cancer types and number of remaining teeth may have been even stronger if individuals with a limited number of remaining teeth had been included. In addition, it has been recorded that tooth mortality was correlated with an increased CAL and ABL in individuals with little or no periodontal disease at baseline [43].

Another possible explanation for tooth loss could be oral behaviorally related factors [44], such as lifestyle factors and the frequency of dental follow-ups. It has also been shown that PD may be associated with poor general health [45], whereas, an increased risk of all-cause mortality has been recorded for individuals who suffer from PD [46,47].

The results also revealed that LC, GC and CRC patients showed significantly higher values of PPD and CAL indices, compared with non-cancer individuals, observation that cannot be confirmed by previous reports except for one that concerned GC patients in which no correlationas found between GC patients and PPD,whereas a significant correlation was recorded between GC patients and CAL [30].

Smoking is a main risk factor for PD and LC initiation and progression and often acts as a con-founder in researches that investigate the possible association between PD and various types of cancer in which smoking is associated with cancer development [48,49]. The significant correla-tion between smoking and PD indices was also demonstrated in the present study, however, after adjustment it was not found that acted as a confounder.

As already has mentioned in the literature few studies have been performed regarding the oral or periodontal health status in cancer patients. One of those, recorded that patients who suffered from head and neck cancer patients showed poor oral health at the time of diagnosis when PD and DMFT used for oral and periodontal tissues examined [50]. In a similar prospective cross-sectional study found that patients who suffered from oral or oropharyngeal cancer, showed PPD 6.00 mm or greater of 76% of the patients examined, whereas only 10% in non-cancer patients showed the same disease severity. Another finding was an association between more severe PD and cancer [51]. In another study oral health conditions, based on DMFT and OHI-S indices, investigated in LC patients who underwent chemotherapy and it was showed that LC patientswith good oral hygiene showed a lower incidence of oral mucositis during the cycles of chemo-therapy, whereas the use of chemotherapy agents showed a deleterious effect on the condition of their oral mucosa [52].It has been suggested that PD and cancer initiation and development is associated with chronic inflammation and possible abnormalities in cellular signaling pathways, therefore PD treatment, could reduce the levels of circulated inflammatory mediators and biomarkers that are implicated and promote an aberrant chronic inflammation, focusing on the application of a strict oral care program and preventive dentistry of cancer and non-cancer patients [53].

Oral and periodontal tissue lesions in cancer patients could be attributed to psychological burdenmainly and in a lower rate to possible alterations in the quantity/quality of saliva or disorders in nutritional status or abnormalities in the immunological and microbiological balance factors in the oral cavity that are caused by the chemotherapy, radiotherapy or targeted treatment [51, 54].

That was the principal reason and pre-treatment cancer patients were collected for the current study as it was expected that post-treatment cancer patients would show worst PD indices.

The present results suggest various prevalence rates of the cancer types examined. Those prevalence rates based on the frequency of the mentioned cancer types in Greece according to WHO [23]. However, comparisons of prevalence rates of disorders between different studies maybe biased due to factors such as different age groups and data collection methods.

CONCLUSIONS

In conclusion, the present observations support correlations between various cancer types such as LC, GC and CRC and PD severity as expressed in terms of number of remaining teeth, number of deep periodontal pockets and CAL.

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