Prevention and Early Diagnosis of Oral Carcinoma in Construction Workers in Italy: A Pilot Project

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Abstract

Objectives: A research project on occupational exposure in relation to oral carcinoma was periodic compulsory check-ups, oral examinations were performed to detect pathologies and the prevalence of potentially neoplastic oral conditions and a self-assessment questionnaire was administered to all of the subjects. The questionnaire was structured to collect information regarding demographic and clinical characteristics, risk habits (tobacco and alcohol consumption) and oral health habits, and to allow an assessment of knowledge about oral cancer, related risk factors and early signs. Results: The study cohort included people with different ethnicities, and there were significant differences in clinical characteristics between Italians and other Europeans. The subjects showed a good knowledge about oral cancer and related risk factors (with correct answers provided to >50% of the questions) but insufficient knowledge about the early signs of oral carcinoma (correct-answer rates of 16–42%). There were high rates of habits that are potentially harmful to oral health, such as smoking (43.8%) and alcohol consumption (57%). The daily habit of brushing teeth was present in 92.6% of the subjects, but they had a low propensity to undergo regular dental examinations. The percentage of subjects with pathologies of the oral cavity was 18.6%. Conclusions: Despite the smallness of the sample, this pilot project could facilitate the acquisition of valid and cost-effective data for the primary prevention of oral cancer through information and educational campaigns on the related risk factors.

Key Words: Cohort study, Mouth neoplasms, Occupational exposure, Construction industry, Oral cancer, Construction workers

Introduction

Oral squamous-cell carcinoma represents approximately 90% of all malignant tumours that are diagnosed in the oral cavity [1]. This cancer originates from the oral mucosa, can occur in all parts of the mouth as an ulcer, a nodule or an exophytic mass, and strikes mainly between the fifth and seventh decades of life. Worldwide an estimated 324,398 new cancers of the lip and oral cavity (215,283 in men and 109,115 in women, with a sex ratio of 1.97:1) and 157,111 related deaths (105,953 men and 51,158 women) have been reported in 2015 [2]. Relative to previous estimates [3], in recent years there has been a continuous increase in the incidence of this neoplasia, a lowering of the average age at onset and a greater involvement of the female population, whose epidemiological data are progressively becoming more similar to those of the male population.

With respect to previous data [4], in 2012 there was an increase in the total number of cases in Italy, but decreases in the standardized incidence (4.1 per 100,000 men and 2.1 per 100,000 women) and mortality (1.5 per 100,000 men and 0.6 per 100,000 women) [2].

The most-important risk factors for oral carcinoma are smoking and alcohol consumption [5–7]. Other risk factors include infection by the human papilloma virus, which is the main reason for the increased incidence of oral cancer in young people [8], and sun exposure (ultraviolet rays), which is important in the genesis of lower lip cancer [9]. Ill-fitting dentures, sharp tooth edges and poor oral hygiene can also play a role in the development of potentially dysplastic lesions [10]. Finally, a sedentary lifestyle and dietary deficiencies, especially of vitamins and antioxidants, resulting from a diet low in fruits and vegetables or from certain malabsorption diseases, were found to be correlated with the risk of carcinogenesis [11]. If factors extrinsic to the human body are the most-important causes of the development of oral cancer, it is plausible that also the work environment affects the onset of this neoplasia.

The first epidemiological study of possible associations of occupational risk factors and occupational exposures with cancer was conducted in the US by Doll and Peto in 1981 [12]. Their data analysis showed that 4% of all neoplasms are associated with occupational factors (8% for men and 1% for women), especially for lung cancer. A survey carried out in 2001 in Finland found that 8% of tumours were of occupational origin (14% for men and 2% for women) [13].

According to the CAREX (CARcinogen EXposure) database [14], which is an information system for estimating workers exposed to known and suspected carcinogens in the countries of the European Union, about 32 million workers (23%) were potentially exposed to carcinogenic substances during 1990–1993. In Italy about 4.2 million employed people (24%) were estimated to be potentially exposed to agents listed in CAREX, corresponding to a total of 5.5 million exposures. The most-common exposures were related to passive smoking (n=770,000), solar radiation (n=550,000), diesel exhaust (n=550,000), asbestos (n= 350,000), wood dust (n=300,000), crystalline silica (n=260,000), lead and inorganic compounds (n=220,000), benzene (n=180,000), hexavalent chromium and related compounds (n=130,000), and polycyclic aromatic hydrocarbons (n=130,000). The International Agency for Research on Cancer has already identified more than 400 human carcinogens or potential carcinogens [15].

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With regard to oral cancer, only a few scientific studies have attempted to identify the occupational factors implicated in the incidence of this cancer and the classes of workers at greater risk, and some of these analyses have produced contradictory results.

The only study in the literature of the possible association between oral cancer and occupational exposures conducted in Italy dates back to 1991 [16]. Among the various carcinogens examined, a statistically significant association with oropharyngeal cancer was found only for asbestos and formaldehyde. This is probably due to the smallness of the sample (103 cases) preventing other potential correlations from being identified, such as that between oral carcinogenesis and wood dust. Identifying the occupational etiology of certain cancers plays an important role when developing programs for prevention and health safety in the workplace, although for many neoplasms it is still difficult to correlate their onset with specific occupational activities. Based on the above-described situation, a research project on occupational exposure related to oral carcinoma was proposed that involved collaboration between the Department of Oral and Maxillofacial Sciences of "Sapienza" University of Rome, the Italian National Institute for Occupational Injury Insurance and Joint Body for Training and Security in Construction workers of Rome and its Province.

This pilot project, aimed at the prevention and early diagnosis of carcinoma of the oral cavity in construction workers, had the following three purposes:

- To inform and educate the workers—through an information and training campaign—about the risk factors for oral cancer, with particular reference to the importance of lifestyle factors and periodical dental follow-ups.
- To obtain a snapshot of the oral health status of subjects exposed to potential carcinogens and possibly make early diagnoses in them.
- To quantify the prevalence of potentially neoplastic conditions in the oral cavity.

Methods

Subjects

The study cohort comprised 677 construction workers recruited in Rome and its surrounding province. During periodic compulsory check-ups, oral examinations were performed and a self-assessment questionnaire was administered to all of the subjects on a voluntary basis. All of the eligible workers agreed to participate fully in the study. The participants signed informed-consent forms, and the study was performed in accordance with the Declaration of Helsinki after approval was obtained from the local Ethics Committee. The data used in the study were recorded on a special form.

Self-assessment questionnaire

The questionnaire was divided into five sections. The first section collected information regarding demographic and clinical characteristics (place of birth, age, sex, level of education, working period) of the sample cohort. The second section comprised a series of 10 questions with answers of "yes," "no," or "don't know" regarding the primary prevention of oral cancer. These questions assessed their knowledge about oral cancer and its prevention.

The third section also comprised a series of five questions also with answers "yes," "no," or "don't know" regarding the secondary prevention of oral cancer. These questions assessed their knowledge about the early signs of cancer. The fourth section collected detailed information on risk habits (tobacco and alcohol consumption). Specifically, the subjects were asked the following questions: "Do you smoke?" "What do you usually smoke?" "How many cigarettes do you smoke a day?" "If you are an ex-smoker, for how long did you smoke?" "Do you chew tobacco or betel?" "Do you drink wine, beer or spirits?" and "If you drink alcohol, how many glasses do you consume a week?"

The fifth section collected information regarding oral health habits. The subjects were asked the following questions: "Do you have dentures?" "Do you brush your teeth every day?" "What do you use to brush your teeth?" "Do you rinse your mouth?" "How often do you go to the dentist?" and "Did you receive dental care in the past year?"The answers were checked by a dentist in consultation with each respondent in order to reduce misunderstandings and incomplete answers. The responses were collected anonymously, and the questionnaire was structured and validated by experts in oral health.

Oral examination

Oral examinations were conducted at stationary or mobile clinics by trained dentists to detect pathologies and the prevalence of potentially neoplastic oral conditions, and medical records were obtained from all of the subjects investigated.

Statistical Analysis

Continuous data were analyzed by analysis of variance followed by Fisher's protected least-significant-difference post-hoc test. Categorical data were analyzed using frequency distributions and descriptive statistics. The frequency of lesions according to risk-factor categories was analyzed using the chi-square test ($\chi 2$ test). The cut-off for statistical significance was set at $p<0.05$, and statistical analyses were performed using Stat View software (SAS Institute).

Results

The study cohort comprised people with different ethnicities who could be subdivided into four groups: 58.49% Italians, 40.46% other Europeans (mostly Romanians and Albanians), 0.2% Asians and 0.83% Africans.

The demographic and clinical characteristics of the sample cohort are reported in *Table 1*. The age, working period and level of education differed significantly between Italians and other Europeans (*Figure 1*).

Specifically, the level of education was higher in other Europeans than in Italians ($p<0.001$), while the Italian

population was older and had a longer working period (both p<0.001).

Table 1. *Data are expressed as mean ± standard deviation. F = female; M = male*

Number	677
Age	41.9 ± 11.1 years
Sex	23F / 654 M
Education	10.2 ± 3:35 years
Length of service	20.0 ± 11.6 years
Number of individuals with prosthesis	14%
Number of individuals with implants	1.50%

Regarding knowledge about oral cancer and its prevention (primary prevention), the studied population showed a good knowledge, with a percentage of correct answers in excess of 50% (range 45–80%) (*Figure 2*).

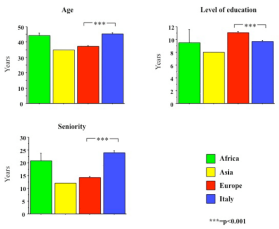

Figure 1. *Demographic characteristics of the sample.*

On the other hand, the degree of knowledge about the early signs of oral cancer (secondary prevention) was insufficient, with the percentage of correct answers ranging from 16% to 42% (*Figure 3*).

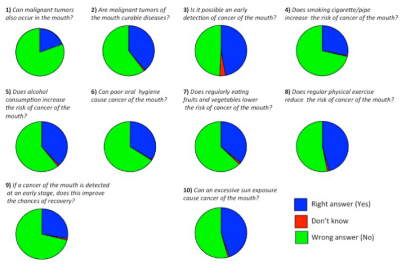

Figure 2. *Distribution of answers on knowledge and prevention of oral cancer.*

The difference in the percentage of correct answers between the first and second groups of questions was statistically significant (p<0.05). Moreover, it should be emphasized that these results were not influenced by the level of education, as indicated by the percentage of correct answers actually being slightly higher for Italian workers with a lower level of education.

Concerning the risk factors (*Table 2*), in the studied population we observed high rates of habits that are potentially harmful to oral health, such as smoking (43.8%) and alcohol consumption (57%).

Table 2. *Risk lifestyles of the sample.*

Habits	Categories		
Smoke	Smoker	Non smoker	Ex-smoker
(%)	43.8	27.4	28.7
Alcohol	Drinker	Non-drinker	Occasional drinker
(%)	-57.4	15.5	27.1
Tabacco	Chewing	Non-chewing	
(%)	0.2	99.8	

Moreover, these percentages increased when ex-smokers (72.5% of the total) and occasional drinkers (84.5% of the total) were included in the above categories. Conversely, the number of individuals with the habit of chewing tobacco was inconsistent.

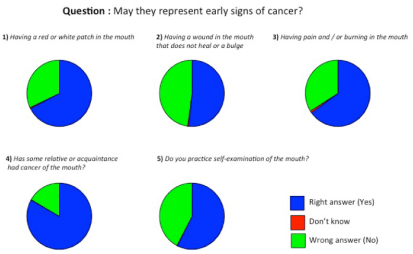

Figure 3. *Distribution of answers on knowledge of the early signs of oral cancer.*

As for attitudes toward oral health (*Table 3*), a habit of brushing teeth (i.e., at least once a day) was present in the vast majority of the sample (92.6%), as was the use of a toothbrush and toothpaste (90%). The use of mouthwashes was much less common (29.7%). The long-term propensity to undergo regular dental examinations was poor, as reflected by the low rate of professional dental care during the past year (43.6%). Most of the workers (55.8%) reported that they only visited a dentist for a dental examination when they were in pain.

Pathologies of the oral cavity were encountered in 18.6% of the subjects. The most-common oral lesions found was labial actinic keratosis (2.9%), followed by habitual biting of the oral mucosa (2.5%), nicotinic stomatitis (2.3%), fissured tongue (1.88%), traumatic fibroma (1.46%) and traumatic ulcer (1.46%).

The prevalence of the oral lesions in the Italians (20.5%) and in the Europeans (16.1%) did not show statistically significant differences ($\chi 2$ test: p = 0.203). Whether the prevalence of the oral lesions was associated with the two main risk factors (smoking and alcohol consumption) was assessed using the $\chi 2$ test.

However, the results for smoking ($\chi 2$ test: p = 0.908) and alcohol consumption ($\chi 2$ test: p = 0.957) did not show

statistically significant associations for the groups at risk with respect to the studied population.

Table 3. Oral health habits of the sample.

Habits	Categories				
Brushing teeth	No	1 time / day	2 time / day	more than 2 times / day	3-4 times / week
(%)	0.24	52.9	39.7	6.37	0.24
For brushing teeth	Toothbrush and toothpaste	Toothbrush, toothpaste and dental floss	Toothbrush, toothpaste and proxabrush	Electric Toothbrush	
(%)	90.8	3.84	1.06	4.27	
mouthwashes	No	yes	1 time / day	2 time / day	more than 2 times / day
(%)	58	29.7	9.36	1.91	0.85
Dental examination	Never	6 months	1 year	2 years	Pain
(%)	5.49	13.9	20.5	4.22	55.8
Dental care in the last year	No	Professional hygiene	Fillings	Tooth Extraction	Dental prosthesis
(%)	43.6	20	16.4	6.68	13.1

The results showed a significant association ($\chi 2$ test: $p = 0.0232$) between smoking and the presence of oral lesions, which remained significant even after including the category of ex-smokers ($\chi 2$ test: $p = 0.0407$). As for the consumption of alcohol, the association with the presence of oral lesions was not significant, both in comparisons between drinkers and non-drinkers ($\chi 2$ test: $p = 0.349$) and between drinkers/ occasional drinkers and non-drinkers ($\chi 2$ test: $p = 0.509$).

Discussion

Despite the smallness of the sample, the data collected related to d, risk habits and prevalence of oral diseases have provided useful information on oral health and oral cancer awareness among construction workers living in Rome and its surrounding province.

The satisfactory level of knowledge, indicated by the responses to the questionnaire, about malignant tumors of the mouth, related risk factors (smoking, alcohol consumption, poor oral hygiene, low dietary intake of fruits and vegetables, sedentary lifestyle, and prolonged exposure to the sun) and the importance of early diagnosis could have been due to the numerous national and international information campaigns that have promoted this topic. This type of awareness plays a key role in the primary prevention of oral cancer, because knowledge about risk factors-leading to the adoption of a healthy lifestyle-can help prevent the onset of cancer and improve the health status. Therefore, it is advisable to implement psychological and psychosocial interventions that promote health education in order to change incorrect behaviors and attitudes.

The respondents exhibited a high prevalence of habits that are potentially harmful to oral health, such as smoking and alcohol consumption, which is not reflected by the low prevalence of oral diseases (18.6%) and the absence of oral cancer. These results are not in agreement with those reported in the literature on the possible associations between smoking, alcohol consumption and oral cancer [5–7]. This discrepancy might have been due to the smallness of the sample, since demonstrating such associations might require a numerically large epidemiological population.

It is particularly noteworthy that the studied population, despite exhibiting at-risk lifestyles, adopted essentially correct daily oral hygiene practices, which in itself is a positive factor in help to reduce the occurrence of neoplasms of the oral cavity. This is supported by Velley et al. [10] clearly demonstrating a significant association between the frequency of tooth brushing and the risk of cancer of the tongue and in other areas of the mouth.

On the other hand, the level of secondary prevention was less satisfactory, since the subjects showed limited knowledge about the initial signs of a tumor and a low propensity to undergo dental visits, except in the presence of pain. This attitude, together with the lack of dental care in the previous year, can be attributed to both cultural and (especially) socio-economic factors. The level of secondary prevention needs to be improved, by taking advantage of appropriate education on both the nature of potentially neoplastic conditions and the benefits of periodic dental check-ups. It should not be forgotten that secondary prevention because both early diagnosis and early intervention reduce the morbidity and mortality associated with oral cancer, and consequently the need for only conservative treatments.it is the best approach for, since this facilitates

Finally, in our sample we found no correlations between work activity and the onset of oral cancer, which contrasts with numerous epidemiological studies highlighting the role of occupational factors in the etiology of cancer of the oral cavity and pharynx in many categories of workers [1,16–20], including construction workers (e.g., carpenters, roof builders, steel-structures installers and road workers) [12–14]. Few scientific studies have investigated the risk of oral cancer due to exposure to certain typical carcinogens associated with construction activities, namely exhaust fumes, paints and powders, and exposure to solar radiation, (which is

particularly important in outdoor working activities), and these studies have produced sometimes with controversial and contradictory results.

Weak associations between exposure to exhaust fumes and lip and tongue cancer have been found by Van Den Eeden and Friedman [21], with a relative risk (RR) of 1.82 (95% confidence interval [CI] = 1.02–3.32), and between diesel fumes and oral cancer (with the exclusion of the lip and tongue) by Lynge et al. [22], with a standardized incidence ratio (SIR) of 1.7 (95% CI = 0.8–3.0). However, both of these studies had limitations. In the former [21], information related to occupation was collected using a self-report questionnaire, and data on the dose and duration of exposure to the agent under investigation were lacking. In the latter [22], the authors did not take into account the habits and lifestyles of the workers and their possible exposure to other carcinogens such as benzene vapors and exhaust fumes.

No significant association between oral cancer and the types of dust arising from construction (e.g., cement, concrete and rock wool) was found by Purdue et al. in a study of occupational exposure to workplace dusts, and this finding did not change materially after adjusting for the amount of smoking quantified in cigarette pack-years [19]. A cohort study of 33,668 concrete workers in the construction industry by Knutsson et al. [23] found an increased incidence of lip cancer (SIR = 1.79, 95% CI = 1.34–2.34), although other possible causes such as sunlight exposure, which is typical of outdoors working activities, lower social class and smoking behavior could have at least partially contributed to this increase.

Indeed, increased risks of lip carcinogenesis for medium (RR = 1.4, 95% CI = 0.9–2.1) and high (RR = 1.8, 95% CI = 0.8–3.7) doses of UV light exposure, scaled for smoking habit, age and potential exposure to magnetic fields, were found in a cohort of 323,860 Swedish construction workers [24]. The risk increased slightly (RR = 2.2, 95% CI = 1.0–4.5) when asphalt workers and roofers were excluded from the studied population, because they were all categorized into the high-sunlight-exposure group.

A cohort of 22,362 northern Europe asphalt workers (mainly road pavers) employed for more than one season in jobs entailing exposure to bitumen were specifically analyzed by Randem et al., [25] who found that the incidence of lip cancer was increased in Denmark (SIR = 2.08, 95% CI = 1.19–3.38) but not in the other countries analyzed. This higher incidence may have been due to chance or to lifestyle factors such as cigar or pipe smoking, because information was lacking on (i) off-season employment during the time when their main employment was in the asphalt industry, (ii) occupational histories outside the asphalt industry, and (iii) tobacco consumption habits.

An increased risk of cancer among those employed in the building industry (odds ratio = 2.4 for the lip and 1.9 for the oral cavity) was also found by Haguenoer in a retrospective case–control study in the north of France, although the findings were not statistically significant due to the smallness of the sample [26].

When the whole working class, including workers in the fields of construction, art and decoration, were considered, no significant association between occupational use of paints and varnishes and oral cancer were found [17,27,28]. Discordant results were found by Skov et al. in an epidemiological study conducted in Sweden, Norway, Finland and Denmark [29]. They found that only Danish workers exhibited an increased risk (RR = 2.26), which was attributed to a higher percentage of solvent content in products used by workers in Denmark and/or the presence of bias associated with alcohol consumption and smoking.

Significant associations between carcinoma of the oral cavity and male wood lacquerers (SIR = 2.1, 95% CI = 1.0–3.9) and female glaziers and lacquerers (SIR = 4.6, 95% CI = 1.2–11.8) and 3.8 (95% CI = 1.0–9.7) were reported by Brown et al. [30]. However, these data should be viewed with caution because, in addition to the study not considering smoking and alcohol consumption habits, wood lacquerers are exposed to other possible carcinogens, such as formaldehyde and wood dust, and in the female population the results were strongly influenced by the sample size.

Data collected in the present pilot project—despite the smallness of the sample analyzed—represent a significant contribution to the knowledge about the possible association between the onset of oral cancer and environmental exposures by construction workers. These data provide useful information on working conditions and preventive measures against occupational diseases in Italy, especially considering that no similar researches have been performed previously in this country.

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