



Original research article

Associations between oral hygiene habits, diet, tobacco and alcohol and risk of oral cancer: A case–control study from India

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ABSTRACT

Objective: This study examines the association between the incidence of oral cancer in India and oral hygiene habits, diet, chewing and smoking tobacco, and drinking alcohol. We also assessed the effects of oral hygiene habits with oral cancer risk among chewers versus never chewers.

Methods: A hospital-based case–control study was conducted in Pune, India, based on face-to-face interviews, anthropometry, and intra-oral examinations conducted for 187 oral cancer cases and 240 controls.

Results: Poor oral hygiene score was associated with a significant risk of oral cancer (adjusted OR = 6.98; 95%CI 3.72–13.05). When stratified by tobacco-chewing habit, the poor oral hygiene score was a significant risk factor only among ever tobacco chewers (adjusted OR = 14.74; 95%CI 6.49–33.46) compared with never chewers (adjusted OR = 0.71; 95%CI 0.14–3.63). Dental check-ups only at the time of pain by ever-chewers with poor oral hygiene was associated with an elevated risk (adjusted OR = 4.22; 95%CI 2.44–7.29), while consumption of green, yellow, and cruciferous vegetables and citrus fruits was protective. A linear dose–response association was observed between oral cancer and chewing tobacco in terms of age at initiation, duration, and frequency of chewing per day ($P < 0.001$). Smoking more than 10 bidis/cigarettes per day (adjusted OR = 2.74; 95%CI 1.28–5.89) and for a duration > 25 years (adjusted OR = 2.31; 95%CI 1.14–4.71) elevated the risk of oral cancer.

Conclusion: Good oral hygiene habits – as characterized by healthy gums, brushing more than once daily, use of toothpaste, annual dental check-ups, and a minimal number of missing teeth – can reduce the risk of oral cancer significantly. In addition to refraining from chewing/smoking tobacco, a diet adequate in fruits and vegetables may protect against the disease.

1. Introduction

Oral cavity and pharyngeal cancers are the sixth most common cancers in the world [1]. Two thirds of the global burden of oral cancer occurs in low- to middle-income countries, with the Indian sub-continent accounting for one third of the total burden [2]. Oral cancer (neoplasms of the lip, tongue and mouth) are a serious health challenge in a number of countries undergoing economic transition, notably South Asia. In India, the disease is the most common malignancy amongst men and the third most common amongst women.

There is a wide variation in the global incidence and mortality due to significant variations in exposure to behavioural and environmental risk factors linked to subsites of the oral cavity and pharynx. Major risk factors include tobacco consumption (both chewing and smoking),

betel quid chewing, excessive alcohol consumption, and sustained viral infections including human papillomavirus (HPV) and some types of human herpesviruses [3–6]. However, susceptibility to these high-risk exposures may be modified by other factors, including status of oral hygiene habits and deficiencies in consumption of fresh fruit and vegetable [6–9].

Although the role of tobacco and alcohol as major risk factors for oral cancer are well established, the possible role of oral hygiene habits and diet are increasingly postulated as independent risk determinants. Both factors have been implicated in a number of epidemiological studies, although most of these have not adequately addressed possible confounding due to chewing tobacco [9–18]. The possibility of an interaction between tobacco chewing (as a major risk factor for oral cancer) and oral hygiene habits have significant implications for

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targeted interventions through risk factor modification using advocacy and educational campaigns.

This study therefore sought to quantify the associations between oral hygiene habits, dietary factors, chewing/smoking tobacco, and alcohol drinking on the risk of the occurrence of cancers of the oral cavity in an Indian setting. We also evaluated the extent to which chewing tobacco modifies the association between oral hygiene habits and oral cancer, hypothesizing that elevated risk of the disease is independently associated with poor oral hygiene habits.

2. Materials and methods

2.1. Study base and design

This study utilized data previously collected in a hospital-based case-control study on upper aero-digestive tract (UADT) cancers diagnosed between June 2014 and May 2015 at Pune, Maharashtra, India [19–21]. As oral cancer is the commonest form of UADT cancer in our study population, we separately analysed data on risk factors for oral cancer, thus avoiding the need for additional resources if a new case-control study assessing similar exposures were to be conducted.

2.2. Recruitment of cases and controls

The details of ascertainment and recruitment of cases and controls has been described elsewhere [19–21]. Patients ranging in age from 30 to 80 years were enrolled from two different multidisciplinary hospitals in Pune: Sadhu Vaswani Mission's Medical Complex and Command Hospital. These two hospitals provide tertiary care facilities (including oncological care) to residents of Pune city and nearby villages within the state of Maharashtra. We recruited a total of 187 incident oral cancer cases with histopathologically confirmed diagnosis of squamous-cell carcinoma of the oral cavity. They were enrolled irrespective of sex, age, and stage of cancer. Oral cancer subsites were coded using the International Classification of Diseases (ICD-10 C01-06) [22].

A total of 240 randomly selected controls with non-neoplastic diseases unrelated to tobacco or alcohol consumption, attending or hospitalized at the study sites, were recruited within the same time frame as the cases. Controls were frequency-matched to cases by sex and 5-year age group. Potential cases and controls were excluded if they were unable to speak or write due to their state of health or to provide consent in the presence of a witness.

This study and the documenting of consent was approved by Griffith University Human Research Ethics Committee (Reference No: DOH/10/14/HREC) and by the ethics committee of both the participating hospitals in India. Verbal informed consent was obtained from all the patients in the presence of a witness on the date of interview.

2.3. Exposure assessment/data collection

Data in the study was collected using several methods. Medical records were used to extract relevant diagnostic information, including the incidence date and basis of the diagnosis, the histological type, and the site and stage of the cancer. Face-to-face interviews using a questionnaire and a life grid were used to collect patient's self-reported information. The life grid is an interview tool used to visualize lifetime data and to improve the reliability of retrospective data in a case-control study [23]. Patients' self-reported information included their sociodemographic profile, oral hygiene habits (bleeding gums, frequency of cleaning teeth, instrument and substance used for cleaning, use of dentures, and dental check-ups), dietary habits, and lifetime history (late childhood to adulthood) of behavioural risk factors (chewing/smoking tobacco, use of 'mishri', alcohol drinking) prior to the diagnosis of cancer or other diseases, as well as their medical comorbidities and family history of any type of cancer. Both oral hygiene and dietary habits were recorded from the patients' attaining adulthood

(18 years and thereafter) until the date of interview for cases as well as controls. Anthropometry included measurements of height (cm) and weight (kg) to compute the body mass index (BMI) for all the patients participating in the study. Intra-oral examinations were undertaken to record the number of missing teeth. The primary author of this research (BG, an epidemiologist) collected all the information through medical records, face-to-face interviews, anthropometry and intra-oral examinations. All the putative risk factors were initially classified into 'never', 'yes' and 'yes only in the past' categories. As there were very few patients in the last category, these were combined with affirmative grouping leading to the dichotomy of 'ever (yes)' and 'never' categories in analysing and presenting the results. The definition of ever or never users of tobacco and alcohol and the assessment of the spiciness of food and temperature have been described in detail previously [19]. In brief, ever tobacco chewers/smokers were defined as those who self-reported as having smoked bidis or cigarettes, chewed any form of tobacco (including mishri) at least once a day for a minimum of 6 months prior to the diagnosis of cancer. Ever alcohol drinkers were defined as those who drank alcoholic beverages at least once a week for a minimum period of 6 months. Study subjects who had abstained or self-reported as infrequent users of smoked or chewing tobacco and alcohol in their lifetime were recorded as never users of the respective habits. On a Likert scale, spiciness in food and temperature of drinking tea were dichotomized as 'less spicy' and 'warm' (1–5) and 'very spicy' and 'very hot' (≥ 6).

2.4. Oral hygiene score

Due to a lack of availability of a previously validated scoring system, we created a composite oral hygiene score to evaluate the association between overall oral hygiene habits and risk of oral cancer and the influence of chewing tobacco on oral hygiene habits as a risk factor for oral cancer. The composite oral hygiene score, ranging from 0 to 6 (with a score of 4 or more indicating poor oral hygiene), aimed to capture oral hygiene habits and intra-oral examination findings for each study participant by summing up the following states: bleeding gums (no = 0, yes = 1); frequency of cleaning teeth (> 2 times a day = 0, ≤ 1 times a day = 1); instrument used for cleaning (toothbrush = 0, tree stick or finger = 1); substance used for cleaning (toothpaste/toothpowder = 0, mishri = 1); wearing dentures (no = 0, yes = 1); dental check-ups (rare = 0, only when in pain = 1); missing teeth ($\leq 5 = 0$, $> 5 = 1$).

2.5. Statistical analysis

Differences between cases and controls in the distribution of covariates were tested using the Pearson's χ^2 test for categorical variables and *t*-tests for continuous variables. Unconditional logistic regression model was used to derive fully adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) for the risk of oral cancer associated with oral hygiene habits, dietary factors, chewing/smoking tobacco, and alcohol drinking after adjusting for potential confounders (age, education, family income per month, smoking/chewing tobacco and alcohol drinking habits (never/ever) and diet (vegetarian/non-vegetarian). The effect modification of oral hygiene habits with risk of oral cancer was assessed by stratifying the tobacco chewers as never or ever chewers. Two-sided *P*-values < 0.05 were considered statistically significant. The Hosmer–Lemeshow index was used to assess the overall model fit. Cumulative years of smoking were calculated by multiplying the number of bidis/cigarettes smoked per day with the duration of smoking (years) for every individual patient. All the statistical analyses were performed using the Statistical Package for Social Sciences (version 22, II, USA).

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