Received date: 13-Dec-2015
Revised date: 10-Jan-2016
Accepted date: 10-Jan-2016
Article type: Original Article
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Title: Knowledge of oral cancer risk factors amongst high risk Australians: findings from the "LESIONS" program.

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Acknowledgements

We thank the patients who contributed to this study. We thank staff at the Aboriginal and Torres Strait Islander Community Health Service (ATSICHS), the Logan-Beaudesert Oral Health Clinics, and the Southbank Institute of Technology for supporting this research and encouraging patients to undergo oral mucosal screening. We particularly thank Professor Cindy Shannon UQ Pro Vice-Chancellor Indigenous Education, Mr Adrian Carson CEO Institute for Urban Indigenous Health (IUIH), and Dr Trevor Holcombe and Ms Kathryn Plonka for facilitating this research project and providing necessary resources. We thank Ms Sandra Stein for assistance with ethical clearance. We thank Najith Amarasena for assistance with statistical analysis. We acknowledge the screening examiners who contributed to this study; Nirav Bhatia, Yastira Lalla, An Vu, Sarah Chaw, Kelsey Moore, Bonita Garton, William Fogarty, Krista Peek, Andrea Maguire and Borjana Simanovic.

This study was funded by a grant from Cancer Australia with support from the Queensland Government Smart Futures Co-Investment Fund awarded to CSF.

Abstract

Background: Patient awareness of risk factors associated with cancer has been shown to increase patient presentation for screening and early detection. This study aims to identify the level of awareness of oral cancer risk factors in a high risk Australian population.

Methods: Participants were recruited from the LESIONS program between April 2012 and April 2014. Demographics were collected via semi-structured interview. A self-administered questionnaire was provided, listing a number of possible oral cancer risk factors. Participants were requested to indicate their level of agreement on a three point scale. Bivariate and multivariable analysis was performed.

Results: A total of 1498 participants took part in the LESIONS program and were invited to complete the questionnaire. The most common risk factors thought to be associated with oral cancer were smoking (87.5%), poor oral hygiene (67.9%) and family history (61.1%). Only 50.2% of respondents were aware of alcohol consumption as a risk factor.

Conclusions: While most participants were aware of the association between smoking and oral cancer, only half were aware of the significant risk alcohol consumption poses. A significant portion of participants also held a number of inaccurate beliefs in relation to oral cancer risk. These findings can benefit both clinicians and public health policy makers in targeting oral cancer education.

Key words: Oral cancer, knowledge, awareness, Australia, high risk

Introduction

Oral cancer is the sixth most common cancer worldwide.[1, 2] The greater majority are squamous cell carcinoma and may be preceded by a range of mucosal lesions manifesting dysplastic changes.[3] Mortality rates of oral cancer are estimated at 50% five years after diagnosis, however this may be as high as 90% for late stage tumours.[4, 5] In contrast, five year mortality rates for early stage tumours may be as low as 15%.[4] Early detection results in improved mortality and morbidity rates and overall improved health outcomes, which has prompted recommendations for prevention and early detection.[6]

Globally, the strongest risk factors for oral cancer include betel quid chewing, tobacco exposure and alcohol consumption, with a synergistic effect occurring between the latter two.[3] In Australia, the role of UV radiation in lip cancer development has been well established also, and public health initiatives over several decades have reduced the incidence of these subset of oral cancers.[6] A number of other risk factors also exist, however they only contribute to a smaller subset of cases. Such other factors include human papillomavirus infection, genetic predisposition and high alcohol-containing mouthrinses.[7-11] Other factors have been reported to have a positive impact on general cancer prevention, including diets high in vegetables and micronutrients, although the evidence for this in relation to cancer of the oral cavity specifically is weak.[12, 13]

Awareness of cancer development in the oral cavity varies significantly between populations, with studies reporting less than 40% up to 90%.[6, 14-17] Poorer still, is recognition of risk factors most highly associated with oral cancer; while tobacco is most commonly reported by patients, many fail to recognise the role of alcohol consumption.[14-18] Furthermore, a number of inaccurate factors such as poor oral hygiene are often thought to contribute to oral cancer risk.[15, 18] While patient awareness of risk factors may not necessarily lead to a cessation of risky habits, a number of studies have shown that awareness is associated with a greater likelihood to present for oral cancer screening, promoting early detection.[19, 20] An understanding of the level of patient knowledge regarding oral cancer can inform public health policy and may help practitioners target prevention and education.

The aim of this study was to identify the level of knowledge in relation to oral cancer risk factors in a high risk Australian population.

Methods

Participants for this study were recruited between April 2012 and April 2014 through the LESIONS (Lesion Evaluation, Screening and Identification of Oral Neoplasia Study) program.[16] The program aimed to screen patients from a number of dental and health clinics in high risk populations for oral mucosal disease. Patient recruitment was conducted throughout ten clinics including three public dental clinics, two dental teaching clinics, three indigenous health clinics and a community pharmacy located in a highly disadvantaged area. Attendance to the majority of the clinics required eligibility for public dental care (which includes low income, pension or disability status), indigenous status or only partial payment for services, however the program was open to all participants irrespective of background. Additionally, screening was also conducted in a private dental practice in a high socioeconomic setting.

Patient demographics, including age, gender, socioeconomic indices, tobacco, alcohol and mouthrinse exposure and dietary consumption was collected via semi-structured interview, conducted by one of eleven trained and calibrated dentists and oral health therapists. Oral mucosal examination was performed and dentition status and presence and characteristics of oral lesions noted. At the end of examination, the patient was provided with a self-administered questionnaire investigating their knowledge of potential oral cancer risk factors. Risk factors included in the questionnaire included smoking, alcohol consumption, poor oral hygiene, having a family history of cancer, poor diet, having an infection, suffering from a lot of stress and having a vitamin deficiency. This variety of responses were included in an attempt to reduce acquiescence bias.

During the initial piloting phase, participants were given the option to agree or disagree with each given variable as a risk factor; however following feedback from several participants and examiners, an unsure option was included in the questionnaire.

SAS 9.3 version was used for analysis of data. Bivariate associations among knowledge and 13 independent factors were assessed using chi-squared tests. Statistical significance was fixed at $p<0.05$. Given that each knowledge factor as an outcome variable had three response categories, multinomial regression was the choice of multivariable analytical technique. For each outcome variable (knowledge factor) a model was constructed using disagreement with the risk factor as a reference category. Odds ratios (OR) with their 95% confidence intervals were computed for each independent variable. Due to the large number of independent variables, it was decided only to consider knowledge factors which had significant associations with three or more independent variables at bivariate level ($P<0.05$) for multinomial regression analysis. Despite the inclusion of an "unsure" category, some questions were left blank by patients. Partial responses were included in analysis and values for these have been included in the relevant tables.

Results

A total of 1498 patients participated in the LESIONS program and were offered an opportunity to complete the self-directed questionnaire (Table 1). Complete demographics of the sample have been reported in full elsewhere.[16] In brief, the mean age was 48.1 years (SD=16.7) and over half (n=832; 55.5%) were female. The median pack year of tobacco exposure was 12.5 (Interquartile range (IQR) = 4.2-26.0) and for alcohol the mean number of standard drinks consumed daily was 2.0 (SD=4.4).

The three most common factors thought to be associated with oral cancer were smoking, poor oral hygiene and familial history (Figure 1). Only half of respondents agreed that alcohol consumption was associated with higher risk of oral cancer. The most common factors reported by patients not to be associated with higher risk of oral cancer were suffering from high levels of stress, having an infection and suffering from vitamin deficiency. Agreement that both smoking and alcohol consumption increased oral cancer risk was reported by 615 participants (41.1%). Furthermore, 6.5% (n=97) of participants reported agreement with all eight factors provided.

Bivariate analysis was performed for all outcomes and patient variables (Table 2) and multinomial regression models were produced for knowledge of family history, poor diet, smoking, alcohol consumption and suffering from stress (Table 3). Knowledge of smoking was associated on bivariate analysis with a number of features of high socio-economic status, including a higher annual income, reporting non-Indigenous status, residing in an area of low disadvantage and having greater than 20 teeth. On multivariable analysis, the latter two were no longer significant and annual income appeared to be the most significant indicator of smoking knowledge, with an income of over 80K having an odds ratio of 8.6 of agreement. Current smokers were also significantly less likely to report disagreement with smoking as an oral cancer risk factor. Furthermore, Indigenous Australians were more likely to report uncertainty in relation to smoking, with an odds ratio of 4.4 compared to reporting disagreement.

In general, younger age groups were significantly more likely to report agreement that smoking and alcohol consumption were risk factors for oral cancer, however this was no longer significant on multivariate analysis. Younger participants were on bivariate analysis

more likely to disagree with family history, however on multivariate analysis, it appeared older age groups were more likely to agree. Older age groups were more likely to believe stress contributed to oral cancer risk. A belief that stress was associated with oral cancer was significantly more likely amongst participants from a background of low socioeconomic status in both bivariate and multivariate analysis.

For all remaining factors, only bivariate analysis was performed. Agreement that poor oral hygiene contributed to oral cancer risk was associated being born in Australia and being a current alcohol consumer. No significant differences appeared between any groups for agreement or disagreement with vitamin deficiency, which found the highest number of participants reporting uncertainty (38.2%). Agreement with an infection being a risk factor of oral cancer was significant only amongst Indigenous Australians.

Discussion

This large population-based study suggests a lack of awareness of certain risk factors for oral cancer. The study also reports a significant variation in the knowledge of oral cancer risk factors between population groups by socioeconomic status and health behaviours. It is essential for general dentists to adopt the role of educator and inform their patients as well as the general public of oral cancer and precancerous pathology.

Oral cancer is a largely preventable disease, given its development is dependent upon lifestyle factors.[3] While genetic predisposition and human papillomavirus infection do contribute, only a small proportion of oral cancers are thought to be directly associated with these factors in isolation from betel quid, tobacco and excessive alcohol consumption.[1, 3] Primary prevention should therefore focus on health behaviour modification, with one of the

most basic techniques being health education. While this may have limited efficacy in modifying health behaviours, it is a simple and feasible approach and may act as a cue to action for mucosal screening, as higher levels of oral cancer knowledge have been associated with improved likelihood to present for screening.[20]

In the present study, the association between smoking and oral cancer was very well known, with almost 90% agreement. Amongst current smokers, higher rates of agreement were found. This may be due to the impact of graphic health warnings on all cigarette packages sold in Australia. From 2006, legislation required all cigarette packages to display one of 14 images and messages as part of a public health strategy to increase rates of smoking cessation. A cross sectional study of Australian smokers interviewed before and after implementation found increased awareness of tobacco-associated disease for conditions specified on packaging, one of which is oral cancer.[17]

This finding may also be due to targeted health advice offered by health practitioners towards smokers. A recent survey of Australian dentists reports over 70% of clinicians target oral cancer screening to high risk patients, which may prompt discussion of oral cancer risk.[21] However surveys have demonstrated that as few as 3% of patients receive oral cancer education from their dentists, with the greater majority being educated by the media or their general practitioners;,[22] this may represent a lack of communication between dentists and their patients during soft tissue examination. Furthermore, in the present study, over 70% of participants were seen in public dental clinics,[16] often presenting for emergency treatment, where, given time and financial constraints, it is unlikely dentists have an opportunity to discuss oral cancer with their patients.

In contrast, knowledge of alcohol consumption as a risk factor for oral cancer was surprisingly poor, with only half of participants reporting agreement and approximately a quarter each reporting disagreement and uncertainty (50.2%; 22.0%; 27.8%). Similar findings have been reported by others, with agreement ranging from 7% to 64%.[22-25] Elango et al, who report the highest level of alcohol knowledge (64%), surveyed a high risk population of India, and therefore moderate rates of knowledge were noted, similar to the present study.[24] Another survey of patients with a history of either oral cancer or an associated early lesion attending an oral medicine clinic, reported alcohol as the second most likely cause of oral cancer, however exact rates were not reported.[14] Other studies reporting lower rates were non-targeted populations. Similarly with tobacco, this supports that high risk patients are better informed of risk factors for oral cancer.

While alcohol is considered a risk factor for many cancers, including other regions of the aerodigestive tract, liver, bowel and female breast,[2, 26] surveys have shown patients do not often associate it with cancer.[26, 27] A possible explanation for the lack of awareness may be media influence, which often purports the health benefits of moderate alcohol consumption, thereby potentially misleading the public.

Poor oral hygiene was the second most commonly reported risk factor associated with oral cancer in the present survey. It is thought that this misconception may be due to a belief that cleanliness is associated with good health. Interestingly, Australian-born participants were more likely to report agreement compared to overseas born. This may be due to differing cultural attitudes towards dental care and oral hygiene practices.[28] These cross cultural differences in opinion can also be appreciated in our finding that Indigenous Australians were the most likely to believe having an infection could increase the likelihood of oral cancer.

Unfortunately, the authors are unable to account for the level of response bias. While providing close ended questions provide clear perceptions on patient awareness, open ended questions are less likely to suffer from response bias. Furthermore, the questionnaire was presented to patients following oral mucosal screening and for patient convenience, the questionnaire was limited to only eight risk factors. Patient awareness of other risk factors such as smokeless tobacco, human papillomavirus and sun exposure are not known.

Understanding the current level of patient awareness of oral diseases is the first step in instituting oral health education and public health promotion. This study clearly demonstrates that oral health practitioners should be communicating better with their patients about risk factors for oral cancer and potentially malignant mucosal pathology. It is envisaged that more widespread adoption of oral mucosal screening and comprehensive head and neck cancer examination and risk assessment may facilitate this.

Conclusion

The public is aware of smoking as a risk factor for oral cancer, and this is largely due to broader anti-tobacco health campaigns. For other risk factors, patients are poorly informed. Dentists have a role to play in educating the public about oral cancer and its associated risk factors, ensuring alcohol is acknowledged as a major risk factor and that other misconceptions are dispelled. The findings of this study are easily integrated into clinical practice by way of communication with patients during oral mucosal examinations and risk assessment.

Conflict of interest

The authors declare they have no conflict of interest

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Table 1: Summary of patient demographics

Characteristic	n (%)
Age	
≤45	672 (44.9)
≥46	825 (55.1)
Gender	
Female	832 (55.5)
Male	666 (44.5)
Ethnicity	
Non-indigenous Australian	642 (43.1)
Indigenous Australian	378 (25.3)
Overseas-born	471 (31.6)
Income	
≥80K	218 (15.0)
40-80K	153 (10.6)
20-40K	559 (38.6)
≤20K	519 (35.8)
Socioeconomic disadvantage*	
Low	378 (26.9)
Moderate	410 (29.2)
High	616 (43.9)
Tobacco use	
Never	619 (41.5)
Past	423 (28.4)
Current	449 (30.1)
Alcohol status	
Never	439 (29.3)
Past	186 (12.4)
Current	873 (58.3)

Mouthrinse use	
Never	742 (49.5)
Past	101 (6.7)
Current	592 (39.5)
Fruit consumption[#]	
High	692 (48.4)
Low	739 (51.6)
Vegetable consumption[+]	
High	103 (7.2)
Low	1328 (92.8)
Meat consumption[‡]	
High	360 (25.1)
Low	1073 (74.9)
Dentition status[∏]	
Adequate	1039 (70.8)
Inadequate	429 (29.2)
Lesions detected	
Absent	834 (55.7)
Present	664 (44.3)

% indicate column percent* Index of relative socioeconomic disadvantage: high disadvantage deciles 1-3; moderate disadvantage deciles 4-7; low disadvantage deciles 8-10).
# As per Australian Dietary Guidelines, low = <2 servings per day; high = ≥ 2 servings per day
+ As per Australian Dietary Guidelines, low = <5 servings per day; high = ≥ 5 servings per day
‡ As per Australian Dietary Guidelines, low = <1 serving per day; high = ≥ 1 serving per day
∏ Adequate = ≥21; inadequate = < 21
Numbers may not add up to the total number of participants due to missing data

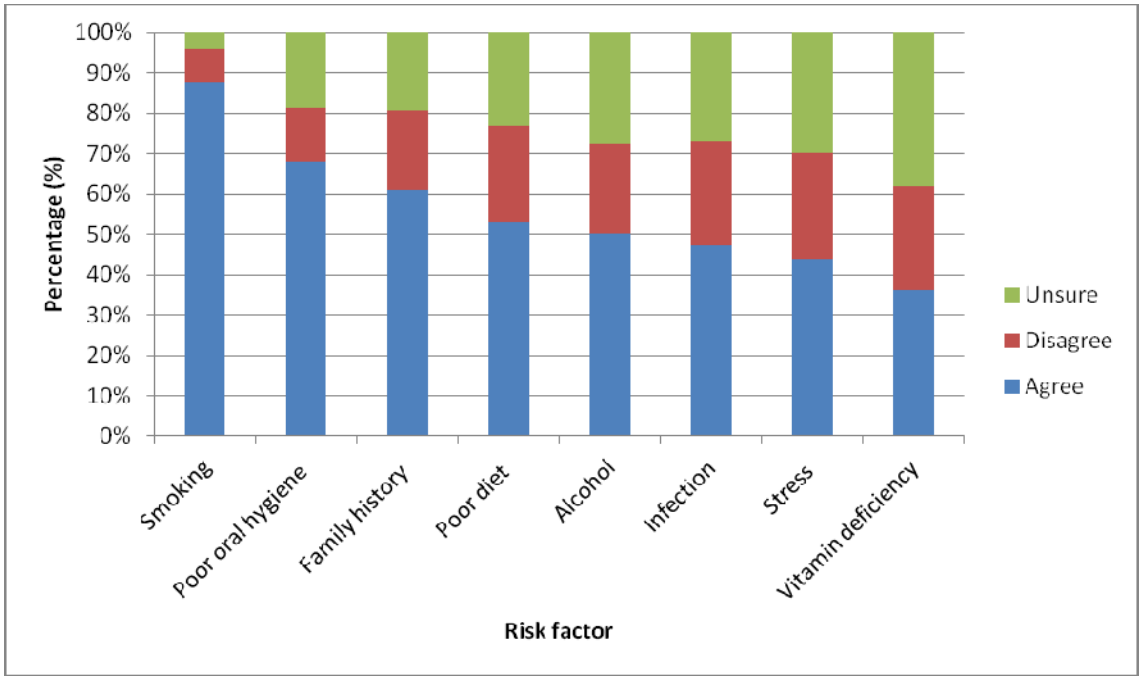

Figure 1: Percentage of participant agreement between risk factors and oral cancer development

Table 2: Bivariate analysis of socio-demographics with questionnaire responses (only statistically significant findings reported)

			No	Yes	Unsure
		Total (%)	% (95% CI)	% (95% CI)	% (95% CI)
	Total	1320	8.3 (6.8-9.8)	87.5 (85.7-89.3)	4.2 (3.1-5.2)
	Age				
	≤45	589 (44.6)	5.8 (3.9-7.7)	**91.5 (89.3-93.8)***	2.7 (1.4-4.0)
	>45	731 (55.4)	10.4 (8.2-12.6)	84.3 (81.6-86.9)	5.3 (3.7-7.0)
	Ethnicity				
	Non-Indigenous Australian	581 (44.2)	4.1 (2.5-5.8)	**92.3 (90.1-94.4)***	3.6 (2.1-5.1)
	Indigenous Australian	318 (24.2)	6.9 (4.1-9.7)	87.1 (83.4-90.8)	6.0 (3.4-8.6)
	Overseas-born	415 (31.6)	15.4 (11.9-18.9)	81.0 (77.2-84.7)	3.6 (1.8-5.4)
	Annual income				
	>80K	200 (15.7)	1.5 (0.0-3.2)	**95.0 (92.0-98.0)***	3.5 (1.0-6.1)
	40-80K	329 (25.7)	4.3 (2.1-6.4)	92.7 (89.9-95.5)	3.0 (1.2-4.9)
	20-40K	316 (24.7)	7.0 (4.2-9.8)	89.2 (85.8-92.7)	1.5 (1.7-5.9)
	<20K	433 (33.9)	14.3 (11.0-17.6)	80.8 (77.1-84.5)	4.8 (2.8-6.9)
	Socioeconomic disadvantage				
	Low	350 (28.0)	5.1 (2.8-7.5)	**90.9 (87.8-93.9)***	4.0 (1.9-6.1)
	Moderate	362 (29.0)	6.6 (4.1-9.2)	89.5 (86.3-92.7)	3.9 (1.9-5.9)
	High	537 (43.0)	11.5 (8.8-14.3)	84.2 (81.1-87.3)	4.3 (2.6-6.0)
Smoking	Tobacco use				

	Never	550 (42.1)	10.2 (7.7-12.7)	86.5 (83.7-89.4)	3.3 (1.8-4.8)
	Current	404 (30.9)	**4.2 (2.2-6.2)***	89.9 (86.9-92.8)	5.9 (3.6-8.2)
	Former	352 (27.0)	10.5 (7.3-13.7)	86.1 (82.5-89.7)	3.4 (1.5-5.3)
	Dentate status				
	Adequate	931 (71.2)	6.7 (5.1-8.3)	**90.1 (88.2-92.0)***	3.2 (2.1-4.4)
	Inadequate	376 (28.8)	12.5 (9.2-15.8)	80.9 (76.9-84.8)	6.6 (4.1-9.2)
Poor oral hygiene	Total	1306	13.3 (11.5-15.2)	67.9 (65.4-70.5)	18.8 (16.6-20.9)
	Ethnicity				
	Non-Indigenous Australian	573 (44.1)	11.5 (8.9-14.1)	**70.0 (66.2-73.7)***	18.5 (15.3-21.7)
	Indigenous Australian	318 (24.5)	11.3 (7.8-14.8)	**75.8 (71.1-80.5)***	12.9 (9.2-16.6)
	Overseas-born	409 (31.5)	17.4 (13.7-21.0)	58.9 (54.2-63.7)	23.7 (19.6-27.8)
	Alcohol use				
	Never	380 (30.3)	16.6 (12.8-20.3)	61.8 (57.0-66.7)	21.6 (17.4-25.7)
	Current	729 (58.1)	11.1 (8.8-13.4)	**71.1 (67.8-74.4)***	17.8 (15.1-20.6)
	Former	146 (11.6)	17.1 (11.0-23.2)	66.4 (58.8-74.1)	16.4 (10.4-22.5)
Family history	Total	1297	19.7 (17.5-21.8)	61.1 (58.4-63.7)	19.3 (17.5-21.8)
	Age				
	≤45	579 (44.6)	**15.9 (12.9-18.9)***	65.1 (61.2-69.0)	19.0 (15.8-22.2)
	>45	718 (55.4)	22.7 (19.6-25.8)	57.8 (54.2-61.4)	19.5 (16.6-22.4)
	Ethnicity				
	Non-Indigenous Australian	569 (44.1)	**14.1 (11.2-16.9)***	65.9 (62.0-69.8)	20.0 (16.7-23.3)
	Indigenous Australian	317 (24.6)	22.1 (17.5-26.7)	58.7 (53.2-64.1)	19.2 (14.9-23.6)
	Overseas-born	405 (31.3)	25.7 (21.4-29.9)	55.8 (51.0-60.6)	18.5 (14.7-22.3)
	Annual income				
	>80K	197 (15.7)	12.2 (7.6-16.8)	68.0 (61.5-74.5)	19.8 (14.2-25.4)
	40-80K	323 (25.7)	14.2 (10.4-18.1)	69.7 (64.6-74.7)	16.1 (12.1-20.1)
	20-40K	310 (24.7)	16.8 (12.6-20.9)	61.0 (55.5-66.4)	22.3 (17.6-26.9)
	<20K	426 (33.9)	**28.4 (24.1-32.7)***	52.1 (47.4-56.9)	19.5 (15.7-23.2)
	Socioeconomic disadvantage				
	Low	341 (27.8)	**12.0 (8.6-15.5)***	69.8 (64.9-74.7)	18.2 (14.1-22.3)
	Moderate	359 (29.3)	20.3 (16.2-24.5)	63.5 (58.5-68.5)	16.2 (12.3-20.0)
	High	525 (42.9)	22.9 (19.3-26.5)	55.2 (51.0-59.5)	21.9 (18.4-25.4)
	Fruit consumption				
	Low	668 (51.6)	21.7 (18.6-24.8)	57.3 (53.6-61.1)	21.0 (17.9-24.0)
	High	626 (48.4)	17.4 (14.4-20.4)	**65.2 (61.4-68.9)***	17.4 (14.4-20.4)
	Vegetable consumption				
	Low	1200 (92.7)	20.1 (17.8-22.4)	60.1 (57.3-62.9)	19.8 (17.6-22.1)
	High	95 (7.3)	14.7 (7.6-21.9)	**73.7 (64.8-82.6)***	11.6 (5.1-18.0)
	Dentate status				
	Adequate	914 (71.1)	16.8 (14.4-19.3)	**64.2 (61.1-67.3)***	18.9 (16.4-21.5)
	Inadequate	371 (28.9)	27.0 (22.4-31.5)	52.8 (47.7-57.9)	20.2 (16.1-24.3)
	Lesion detected				
	No	607 (46.8)	19.1 (16.0-22.2)	**64.6 (60.8-68.4)***	16.3 (13.4-19.3)
	Yes	690 (53.2)	20.1 (17.1-23.1)	58.0 (54.3-61.7)	21.9 (18.8-25.0)
Poor diet	Total	1285	23.7 (21.3-26.0)	53.1 (50.3-55.8)	23.3 (21.0-25.6)
	Ethnicity				
	Non-Indigenous Australian	564 (44.1)	**19.7 (16.4-23.0)***	54.6 (50.5-58.7)	25.7 (22.1-29.3)
	Indigenous Australian	318 (24.9)	24.5 (19.8-29.3)	57.9 (52.4-63.3)	17.6 (13.4-21.8)
	Overseas-born	397 (31.0)	28.2 (23.8-32.6)	47.1 (42.2-52.0)	24.7 (20.4-28.9)
	Mouthrinse use				
	Never	678 (52.8)	25.1 (21.8-28.3)	49.4 (45.6-53.2)	25.5 (22.2-28.8)
	Current	518 (40.3)	23.7 (20.1-27.4)	54.6 (50.3-58.9)	21.6 (18.1-25.2)
	Former	89 (6.9)	12.4 (5.5-19.2)	**71.9 (62.6-81.3)***	15.7 (8.2-23.3)
	Fruit consumption				
	Low	658 (51.3)	26.7 (23.4-30.1)	49.4 (45.6-53.2)	23.9 (20.6-27.1)
	High	624 (48.7)	**20.2 (17.0-23.3)***	57.1 (53.2-60.9)	22.8 (19.5-26.1)
A1	Total	1287	22.0 (19.7-24.3)	50.2 (47.5-52.9)	27.8 (25.4-30.3)

	Age				
	≤45	579 (45.0)	20.4 (17.1-23.7)	**56.5 (52.4-60.5)***	23.1 (19.7-26.6)
	>45	708 (55.0)	23.3 (20.2-26.4)	45.1 (41.4-48.7)	31.6 (28.2-35.1)
	Mouthrinse use				
	Never	683 (53.1)	22.1 (19.0-25.2)	46.9 (43.1-50.6)	31.0 (27.6-34.5)
	Current	513 (39.9)	22.2 (18.6-25.8)	52.6 (48.3-57.0)	25.1 (21.4-28.9)
	Former	91 (7.0)	19.8 (11.6-28.0)	**61.5 (51.5-71.5)***	18.7 (10.7-26.7)
	Dentate status				
	Adequate	912 (71.5)	20.3 (17.7-22.9)	**52.5 (49.3-55.8)***	27.2 (24.3-30.1)
	Inadequate	363 (28.5)	26.4 (21.9-31.0)	44.1 (39.0-49.2)	29.5 (24.8-34.2)
Infection	Total	1269	25.8 (23.4-28.2	47.1 (44.4-49.9)	27.1 (24.7-29.6)
	Ethnicity				
	Non-Indigenous Australian	553 (43.8)	22.8 (19.3-26.3)	42.7 (38.5-46.5)	34.5 (30.6-38.5)
	Indigenous Australian	317 (25.1)	25.6 (20.7-30.4)	**57.1 (51.6-62.6)***	17.4 (13.2-21.5)
	Overseas-born	393 (31.1)	30.3 (25.7-34.8)	44.8 (39.9-49.7)	24.9 (20.7-29.2)
Stress	Total	1284	26.3 (23.9-28.7)	43.8 (41.1-46.6)	29.8 (27.3-32.3)
	Age				
	≤45	580 (45.2)	32.6 (28.8-36.4)	37.1 (33.1-41.0)	30.3 (26.6-34.1)
	>45	704 (54.8)	21.2 (18.1-24.2)	**49.4 (45.7-53.1)***	29.4 (26.0-32.8)
	Socioeconomic disadvantage				
	Low	342 (28.2)	**20.2 (15.9-24.4)***	47.7 (42.4-53.0)	32.2 (27.2-37.1)
	Moderate	354 (29.2)	24.3 (19.8-28.8)	44.4 (39.2-49.5)	31.4 (26.5-36.2)
	High	518 (42.7)	30.1 (26.2-34.1)	41.1 (36.9-45.4)	28.8 (24.9-32.7)
	Fruit consumption				
	Low	661 (51.6)	**30.3 (26.8-33.8)***	41.0 (37.2-44.8)	28.7 (25.3-32.2)
	High	620 (48.4)	21.9 (18.7-25.2)	46.9 (43.0-50.9)	31.1 (27.5-34.8)

*p<0.05 (Chi-squared test)
Knowledge of vitamin deficiency not shown due to absence of significant findings

Table 3: Multinomial regression model for selected socio-demographics with selected questionnaire responses

		Smoking OR (95% CI)	Family history OR (95% CI)	Poor diet OR (95% CI)	Alcohol OR (95% CI)	Stress OR (95% CI)
Age						
≥ 46 years	Yes	0.81 (0.46-1.42)	**0.68 (0.47-0.99)***		0.79 (0.58-1.08)	**2.15 (1.61-2.87)***
	Unsure	1.43 (0.57-3.60)	0.71 (0.45-1.10)		1.37 (0.97-1.93)	**1.47 (1.09-2.00)***
≤ 45 years (Ref)						
Ethnicity						
Non-Indigenous	Yes	**4.20 (2.44-7.22)***	**2.41 (1.66-3.52)***	**1.75 (1.27-2.42)***		
	Unsure	**4.85 (1.86-12.64)***	**2.17 (1.38-3.41)***	**1.53 (1.06-2.22)***		
Indigenous	Yes	1.79 (0.99-3.21)	1.24 (0.82-1.85)	**1.61 (1.12-2.32)***		
	Unsure	**4.35 (1.61-11.75) ***	1.17 (0.71-1.92)	0.83 (0.53-1.29)		
Overseas-born (Ref)						

Annual income						
>80K	Yes	**8.16 (2.41-27.62)***	**2.20 (1.24-3.92)***			
	Unsure	**5.79 (1.10-30.64)***	1.77 (0.89-3.53)			
40-80K	Yes	**3.56 (1.80-7.02)***	**2.12 (1.38-3.26)***			
	Unsure	**2.86 (1.01-8.11)***	1.29 (0.76-2.20)			
20-40K	Yes	**2.18 (1.26-3.75)***	**1.68 (1.12-2.50)***			
	Unsure	1.87 (0.76-4.61)				
<20K (Ref)			**1.72 (1.07-2.77)***			
Socioeconomic disadvantage						
Low	Yes	1.77 (0.97-3.25)	**1.82 (1.18-2.80)***			**1.79 (1.25-2.56)***
	Unsure	2.10 (0.82-5.41)	1.41 (0.85-2.34)			**1.66 (1.13-2.44)***
Moderate	Yes	1.69 (0.98-2.89)	1.10 (0.76-1.58)			1.28 (0.91-1.81)
	Unsure	1.50 (0.62-3.63)	0.78 (0.49-1.22)			1.31 (0.91-1.89)
High (Ref)						
Tobacco use						
Current	Yes	**3.40 (1.73-6.66)***				
	Unsure	**3.63 (1.37-9.62)***				
Former	Yes	1.14 (0.69-1.90)				
	Unsure	1.04 (0.42-2.58)				
Never (Ref)						
Fruit consumption						
High	Yes		**1.40 (1.02-1.94)***	**1.62 (1.22-2.14)***		**1.47 (1.10-1.97)***
	Unsure		1.14 (0.77-1.68)	1.27 (0.92-1.76)		**1.41 (1.03-1.92)***
Low (Ref)						
Vegetable consumption						
High	Yes		1.70 (0.86-3.37)			
	Unsure		0.93 (0.39-2.22)			
Low (Ref)						
Mouthrinse use						
Current	Yes			1.20 (0.90-1.76)	1.14 (0.85-1.53)	
	Unsure			0.85 (0.61-1.20)	0.82 (0.59-1.14)	
Former	Yes			**2.94 (1.50-5.75)***	1.55 (0.88-2.73)	
	Unsure			1.15 (0.51-2.61)	0.64 (0.31-1.29)	
Never (Ref)						
Dentate status						
Adequate	Yes	1.53 (0.91-2.57)	1.33 (0.92-1.93)		**1.42 (1.02-1.98)***	
	Unsure	0.71 (0.31-1.64)	1.27 (0.82-1.99)		1.35 (0.94-1.94)	
Inadequate (Ref)						
Lesion detected						
No	Yes		0.98 (0.71-1.36)			
	Unsure		**0.65 (0.44-0.96)***			
Yes (Ref)						

*Statistically significant estimates: 95%CI do not include one.

Disagreement (response "disagree") was used as a reference.