Mouthwash Use in General Population: Results from Adult Dental Health Survey in Grampian, Scotland

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ABSTRACT

Objectives: The purpose of this study was to determine the pattern of mouthwash use and to investigate the associated factors in general population.
Material and Methods: An Adult Dental Health Survey was conducted on 3,022 residents of Grampian region of Scotland (adjusted participation rate 58.2%). Participants received a questionnaire consisting of questions on oral health and behavioural factors.
Results: The majority of participants (38.1%) have never used mouthwash, 17.5% used mouthwash less than once a month, 19.4% used mouthwash once every few days and 25.1% used mouthwash daily.
Prevalence of use decreased with age ($P < 0.001$). Woman were more likely to use mouthwash than men ($P = 0.004$). Mouthwash use decreased with decrease in the level of deprivation ($P < 0.001$). Never-smokers were less likely to use mouthwash (40.3%) compared to smokers (53.1%) or those who stopped smoking (46.5%) ($P < 0.001$). Mouthwash was used by smaller proportion of people drinking alcohol on daily basis (36.6%), than by abstainers (42.2%) ($P = 0.012$).
There was a positive relationship between flossing or brushing pattern and mouthwash use ($P < 0.001$). There was statistically significant relationship between mouthwash use and reasons for the last dental visit ($P = 0.009$).
When compared to healthy individuals, mouthwash was used by higher proportion of people reporting that they had gum disease ($P = 0.001$), ulcers ($P = 0.001$), oral infections or swelling ($P = 0.002$) or other problems ($P = 0.025$).
Conclusions: Mouthwash use in general population is associated with socio-demographic, health and behavioural factors.

Keywords: mouthwashes; oral hygiene; dental plaque; epidemiology; dental health survey; population groups.

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INTRODUCTION

Inadequate oral hygiene has an important role in aetiology of plaque growth. Plaque constitutes the primary factor responsible for dental diseases, ranging from caries to gum disease (gingivitis and periodontitis). Daily tooth brushing is the main mechanical method of plaque removal and therefore reduces the risk of development of dental diseases [1]. A toothbrush (powered or manual) cannot access dental surfaces underneath the contact zone between teeth. Interdental brush or floss is recommended to supplement toothbrushing to remove the accumulated material from between teeth more efficiently [2]. The interdental area is one of the most frequent sites of plaque accumulation, caries development, and the beginning of periodontitis. The standard of oral hygiene is particularly affected in patients who do not possess manual dexterity or motivation for mechanical plaque disruption [3]. Mouthwashes can be valuable aids in reduction of the supragingival plaque levels and prevention of gingivitis.

Mouthwashes have little penetrating abilities to the subgingival environment [3,4]. They should be treated as an adjunct to the primary mechanical methods of cleaning, but not regarded as their substitute [3]. Mouthwash effectiveness relies on the patient's ability to rinse properly. The products are therefore not suitable for utilization by patients who cannot understand simple instructions or who are physically unable to rinse. In these types of patients directly applied anti-plaque agents may be more applicable [4].

Before use of a particular mouthwash, the following factors should be taken into account: person's capability of delivering good oral hygiene (e.g. brushing, flossing), the state of their periodontal health, teeth and oral mucosa as well as the mechanism of mouthwash activity with its potential side effects [5].

In addition to use for oral hygiene, mouthwashes have been utilized for many pathological conditions, for instance gum disorders [4]. They are, similar to toothpaste, formulated to exert additional diverse, beneficial effects such as reduction of dental sensitivity or decrease of halitosis by the inclusion of specific combination of active ingredients. Ethanol is utilized in many mouthwashes and functions as solvent and preservative [4]. It possesses wide antimicrobial activity. It has been suggested that use of alcohol-containing mouthwash may increase risk of oral cancer [6]. However critical review of published data showed that this link was not supported by epidemiological evidence [7]. It has been suggested that mouthwash use might be more prevalent in people with oral inflammatory conditions and pre-cancerous lesions, and also that confounding due to underreported exposure to alcohol and tobacco could result in a spuriously elevated odds ratio for mouthwash use [8]. Few studies reported factors associated with mouthwash use [9,10].

The purpose of this study was to determine the prevalence of mouthwash use and to investigate the associated factors in general population.

MATERIAL AND METHODS

The Grampian Adult Dental Health Survey was conducted in the Grampian region of Scotland between October 2009 and January 2010 and aimed to evaluate current state of oral health, access to dental care and a range of related behaviours. The use of human subjects in this study has been approved by the Grampian National Health Service (NHS) Board. Age, gender and area stratified random sample of 6,000 people aged 25 years and over was selected from the Community Health Index (CHI) database (http://www.shsc.scot.nhs.uk/shsc/default.asp?p=108). The CHI database contains details of all Scottish residents registered with a General Medical Practitioner. NHS Grampian had recently undertaken a youth and young people lifestyle survey (http://www.hi-netgrampian.org/hinet/file/4388/GrampianYouthLifestyleSurveyreport2007final.doc), and therefore 16 - 24 year olds were not sampled. Each selected individual received a postal questionnaire. The questionnaire consisted of 51 questions on socio-demographic characteristics (age, gender, education), oral health, health related behaviours and dental services utilisation. A follow-up of non-responders was performed initially with a reminder postcard, a further questionnaire and finally where necessary, a short questionnaire (10 questions). Information was collected on a range of socio-demographic characteristics (age, gender, education, social class), oral health and health related behaviours. The short questionnaire consisted of 10 key questions on age, gender, dental services utilisation and number of teeth. Deprivation was measured using the Scottish Index of Multiple Deprivation (SIMD) (http://www.scotland.gov.uk/Topics/Statistics/SIMD/) which was obtained from the participants' postcodes. The SIMD gives a relative measure of deprivation by providing a relative ranking, with most deprived ranked as "1".

The specific question that was asked about mouthwash use was as follows: "How often do you rinse with a mouthwash?". The options for response were: daily; once every few days; less than once a month or never. For the purpose of the data analysis, mouthwash users were defined as using every day or once every few days and

non-users as using mouthwash less than once a month or never.

Statistical analysis

Initial statistical analysis consisted of descriptive tables (tabulation by age, gender and area). Chi-square test was used for univariate analysis in order to compare between users and non-users. For multivariate analysis, Cox regression [11] was used to estimate relative risk adjusted for potential confounders. The magnitude of association between a factor and mouthwash use was described by the Relative Risk (RR). This is a more meaningful effect measure for representative cross-sectional studies than the Odds Ratio [12]. The RR was considered significantly different from "1" if the 95% confidence interval did not include "1". All factors were grouped as following: socio-economic and behavioural factors; behavioural factor related to oral health; and heath factors. The subset of variables that best predict mouthwash use, was determined using backward stepwise procedure. Significance level was set to 0.05. All analysis was done using PASW Statistics 18 (Release 18.0.2, April 2, 2010, http://www.spss.com/).

RESULTS

A total 3,022 full and 331 short questionnaires were returned. Of the remainder, 250 subjects were assumed not to have received the questionnaire, either because notification was received from the occupants or post office that the subject had moved (n = 205), they were severely disabled/terminally ill (n = 2) or had died (n = 30). This resulted in an adjusted participation rate of 58.2%. Participation rate was the highest in the age group 55 - 64 (68.5%) and the lowest in 25 - 34 (47.3%). Women were more likely to reply than men (61.9% and 54.6%, respectively). The lowest participation rate was among the most deprived participant (SIMD Quintile 1,

Table 1. Relationship between socio-demographic and behavioural factors and mouthwash use

Factor	Number in group	Mouthwash user (%)[a]	X^2 test P-value
Age (years)			
25 - 34	450	56.0	< 0.001
35 - 44	585	48.9	
45 - 54	432	42.6	
55 - 64	473	39.3	
65 - 74	396	36.4	
75 +	239	38.9	
Gender			
Female	1348	47.2	0.004
Male	1227	41.5	
Scottish Index of Multiple Deprivation (SIMD Quintile)			
1 (most deprived)	89	50.6	< 0.001
2	265	53.2	
3	654	48.6	
4	850	41.1	
5	717	40.7	
Education level			
Secondary school	1053	44.8	< 0.001
Technical College	712	50.1	
University/Postgraduate	741	39.0	
Other	48	33.3	
Smoking			
Currently smoking or have stopped within the last 12 months	471	53.1	< 0.001
Stopped smoking over 12 months ago	626	46.5	
Never smoked	1364	40.3	
Alcohol consumption			
Almost everyday	295	36.6	0.012
Once or twice a week	946	46.5	
Less than once a week	876	46.2	
Do not drink	396	42.2	

[a]User: every day or once every few days; non-user: less than once a month or never.

44.6%) and the highest in more affluent (60.7% in quintile 4 and 60.4% in quintile 5).

The question on mouthwash use was answered by 2,575 participants. A large proportion of adults (38.1%) had never used mouthwash, 17.5% used mouthwash occasionally - less than once a month, 19.4% used mouthwash once every few days and 25.1% used mouthwash daily.

The relationship between socio-demographic and behavioural factors is presented in Table 1. Prevalence of use decreased with age from 56% in 25 - 34 age group to 36.4% in 65 - 74 age group ($P < 0.001$). Woman were more likely to use mouthwash than men (47.2% and 41.5%, respectively) ($P = 0.004$). Mouthwash use decreased with decrease in the level of deprivation: people living in most deprived areas were more likely to use mouthwash than participants from affluent areas (50.6% and 40.7%, respectively) ($P < 0.001$). Never-smokers were less likely to use mouthwash (40.3%) compared to smokers (53.1%) or those who stopped smoking (46.5%) ($P < 0.001$). Mouthwash was used by a smaller proportion of people drinking alcohol on a daily basis (36.6%), than by abstainers (42.2%) ($P = 0.012$). Although the relationship between education level and mouthwash use was also statistically significant ($P < 0.001$) and no consistent pattern could be observed.

The results obtained supported a positive relationship between flossing and brushing frequency and mouthwash ($P < 0.001$) (Table 2). The proportion of people who used mouthwash was highest among those flossing daily and brushing two or more times a day (59.9% and 48.7% respectively). Mouthwash use was the lowest amongst people who never floss or brush their teeth (37.3% and 27.8% respectively). There was no relationship between mouthwash use and type of regular dental care received or time since last check-up. There was statistically significant relationship between mouthwash use and reasons for the last dental visit ($P = 0.009$).

There was no relationship between self-reported general and dental health, current number of natural teeth, dental decay, possession of a bridge, dental implants, dentures and mouthwash use (Table 3). When compared to healthy individuals, mouthwash was used by higher proportion of people recording they suffered from gum disease (55.7% vs 43.5%; $P = 0.001$), ulcers (59.0% vs 43.7%; $P = 0.001$), oral infections or swelling (63.2% vs 44.0%, $P = 0.002$) or other oral problems (51.2% vs 43.8%, $P = 0.025$).

Table 2. Relationship between behavioural factors related to oral health and mouthwash use

Factor	Number in group	Mouthwash user (%)[a]	X^2 test P-value
Type of regular dental care received			
NHS (State Healthcare)	1169	44.6	
Private	329	48.3	0.365
Unable to get a dentist	989	43.9	
Time since last dental check-up			
Less than a year	1945	43.5	
1-2 years	241	44.8	
2-5 years	133	54.9	0.128
5-10 years	132	47.7	
Have not visited a dentist for over 10 years	111	43.2	
Reasons for the last dental visit			
Emergency treatment needed for teeth or gums	372	50.3	
Non-urgent treatment for teeth or gums	373	43.7	
Dental check-up	1610	42.4	0.009
Can't remember	96	52.1	
Other	105	53.3	
Flossing frequency			
Daily	339	59.9	
Once every few days	617	51.9	
Less than once a month	515	39.6	< 0.001
Never	1083	37.3	
Tooth brushing frequency			
Twice or more a day	1726	48.7	
Once a day	742	36.8	
Less than daily	86	31.4	< 0.001
Never	18	27.8	

[a]User: every day or once every few days; non-user: less than once a month or never.

Table 3. Relationship between health factors and mouthwash use

Factor	Number in group	Mouthwash user (%)[a]	X^2 test P-value
General health			
Excellent	622	42.9	0.735
Good	1498	45.5	
Fair	343	44.0	
Poor	59	44.1	
Dental health			
Excellent	299	40.5	0.098
Good	1365	44.3	
Fair	659	45.4	
Poor	191	51.8	
Current number of natural teeth			
Fewer than 10	217	43.3	0.628
Between 10 and 19	512	46.3	
20 or more	1825	44.1	
Dental decay			
No	2145	43.8	0.116
Yes	430	47.9	
Gum disease			
No	2365	43.5	0.001
Yes	210	55.7	
Ulcers			
No	2453	43.7	0.001
Yes	122	59.0	
White or red patches			
No	2505	44.2	0.094
Yes	70	54.3	
Oral infection or swelling			
No	2507	44.0	0.002
Yes	68	63.2	
Other problems			
No	2331	43.8	0.025
Yes	244	51.2	
Possession of bridge			
No	2390	44.2	0.378
Yes	185	47.6	
Possession of dental implants			
No	2438	44.6	0.489
Yes	137	41.6	
Possession of dentures			
No	1945	44.3	0.792
Yes	630	44.9	

[a]User: every day or once every few days; non-user: less than once a month or never.

Multivariate model for group one, apart from age and gender, included education and smoking. Multivariate model for group two included reason for the last dental visit, toothbrush frequency and flossing frequency.
Multivariate model for the third group included gum disease and ulcers. The final model for all variables included seven variables: age, education, smoking, reason for the last dental visit, toothbrushing, flossing and gum disease (Table 4).
Table 5 shows how well the factors entered into the final model described the prevalence of mouthwash use. The proportion of users increased with the increase in number of factors reported to be positive, with 93.8% of those reporting exposure to all six factors using mouthwash.

DISCUSSION

The findings indicate that pattern of mouthwash use is associated with demographic, socio-economic, behavioural and health-related factors in a large

Table 4. Multivariate model for mouthwash use

Variable	RR (95% CI) of mouthwash use[a]
Age (years)	
75 +	1.00
65 - 74	0.91 (0.68, 1.22)
55 - 64	0.95 (0.72, 1.25)
45 - 54	1.06 (0.81, 1.40)
35 - 44	1.20 (0.93, 1.56)
25 - 34	1.44 (1.11, 1.88)
Education level	
University/Postgraduate/Other	1.00
Secondary school or Technical College	1.27 (1.10, 1.46)
Smoking	
Never smoked	1.00
Stopped smoking over 12 months ago	1.17 (1.01, 1.36)
Currently smoking or have stopped within the last 12 months	1.22 (1.05, 1.43)
Reasons for the last dental visit	
Non-urgent treatment for teeth or gums or Dental check-up	1.00
Emergency treatment needed for teeth or gums, can't remember or other	1.23 (1.07, 1.41)
Tooth brushing frequency	
Never or less than daily	1.00
Once a day	1.21 (0.83, 1.76)
Twice or more a day	1.53 (1.06, 2.22)
Flossing frequency	
Never or less than once a month	1.00
Once every few days	1.34 (1.17, 1.55)
Daily	1.55 (1.31, 1.84)
Gum disease	
No	1.00
Yes	1.21 (0.99, 1.48)

[a]From Cox regression model; all variable are entered simultaneously.

Table 5. Percentage of mouthwash users by the number of factors in the final model

Number of factors in the final model[a]	% mouthwash users	Total number in group
0 factors	27.1	48
1 factor	25.7	307
2 factors	33.5	744
3 factors	50.5	750
4 factors	57.4	423
5 factors	71.9	128
6 factors	93.8	16

[a]Age (25 - 34 years); education (secondary school or technical college); ever smoker; reason for last dental visit (emergency treatment, can't remember or other); tooth brushing frequency (twice or more a day); flossing frequency (once every few days or daily); gum disease.

population sample of over 2,500 individuals. Personal hygiene is a substantial factor influencing public health [13]. However, health related behaviours are often difficult to change. Investigation of health-related behaviours is important to improve preventive strategies [14].

The results showed the decline of mouthwash use with age. This might be associated with decrease in number of natural teeth which an individual possesses. However, the use of mouthwash in people above 74 years old maybe related to increasing difficulty in cleaning teeth by other means due to physical disability. The more common use of mouthwash among females (47.2%) than males (41.5%) reported in the current study is in agreement with the results of research by Winn et al. [10]. Tada and Hanada [15] also reported higher prevalence of better oral health behaviours in women. While the current study found statistically significant relationship between use of mouthwash and education level, it is not clear why the highest prevalence of use is among participants with technical college education (50%) while prevalence of use among university graduates is much lower (38.9%). For example, Neamatollahi and Ebrahimi [16] reported that doctorate and master level students tend to use dental floss more often than bachelor students.

Mouthwashes constitute a common method of eliminating halitosis [17]. According to the present study, smokers used mouthwash more often than non-smokers. This could be associated with attempts by smokers to reduce oral tobacco odour, halitosis or aftertaste caused by tobacco.

Amongst the group of behavioural factors related to oral health, type of dental care received (Private or National Health Service), date of last dental check-up and reason for the last dental appointment were not related to the pattern of mouthwash use. Frequency of both toothbrushing and flossing were showed to be positively related to the frequency of mouthwash use. Participants concerned about their oral health were more likely to supplement their mechanical removal of dental plaque with a toothbrush or floss by using a mouthwash frequently. Dumitrescu et al. [18] suggest that there is an association between degrees of self-liking, body investment and patterns of dental visits, flossing as well as mouthwash use.

In the group of health-related factors, presence of inflammation, ulcers or gum disease was demonstrated to be related to pattern of mouthwash use. This confirms research by Jones [19] and Farah et al. [5] where such conditions seem to be sufficient stimuli, for affected patients, to initialize mouthwash which possesses antibacterial and antifungal properties. Mouthwash might in these cases constitute an easily accessible (no prescription) remedy to treat a minor oral problem.

Mouthwash use was not related to overall self-rated general health and overall self-rated dental and oral health. Possession of dental bridges, implants, dentures or the presence of white/red patches was not an important factor determining the pattern of mouthwash use. This may contradict expectations that a significant percentage of people with dental bridges or implants would use mouthwash to facilitate cleaning those places inaccessible to toothbrush or floss.

The adjusted participation rate achieved of 58.2% is relatively low. Every effort was made to increase participation. A press release was published, resulting in radio and newspaper interviews. Non-respondents after the first two weeks were sent a reminder postcard, a further full questionnaire after another two weeks, which was followed by a final short questionnaire in the case of non-response. Previous studies in this geographical area have reported participation rates of 82.3% [20], 38% [21] and 25% [22]. It is important to consider the possible influence of non-participants on the results. This study primarily investigated relationship of various factors with mouthwash use. In order to influence the results, non-responders would need to demonstrate different relationships between these factors and mouthwash use: this seems very unlikely.

This study investigated neither the type of mouthwashes used, direct reasons for use, nor people's beliefs concerning mouth rinsing and therefore it would be a next step for future research.

To summarize, mouthwash use in general population is associated with socio-economic, health and behavioural factors. Although certain factors were demonstrated to be clearly related to the pattern of mouthwash use, the roles of others remain inconclusive and their determination would require further investigation.

CONCLUSIONS

Mouthwash use in general population is associated with socio-demographic, health and behavioural factors.

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The authors report no conflict of interest related to this study.

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