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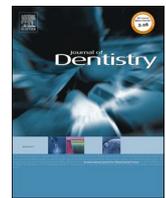
Comparing oral health behaviours of men and women in the United States

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ABSTRACT

Objective: This study used a national database to update and examine current differences in men's and women's oral health and oral health behaviours in the United States.

Methods: Data from the National Health and Nutrition Examination Survey for the 2017–2018 cycle were used to explore the relationship between males and females and their oral health. Multivariate analyses assessed for gender differences in oral health behaviors between genders after controlling for sample demographic characteristics.

Results: The final sample consisted of 4,741 participants. Males tended to have fewer dental visits, worse perception of their gum and tooth health, poorer flossing habits, and more root caries. Females were more proactive in visiting dentists and displayed a greater awareness of oral health. Females were less likely to report discussing oral cancer screening with their dentist even though they were screened more often. On examination, males were more often advised to seek urgent dental care than females. All these differences were statistically significant at $p<0.05$, although the effect size for examination variables was small (Phi <0.1).

Conclusions: Oral health and oral health behaviours demonstrate gender differences with men reporting poorer oral health, poorer oral hygiene habits, and fewer dental visits. These findings suggest gender-targeted strategies have the potential to improve oral health and reduce gender-related disparities.

Clinical Significance: This study found that women exhibit better oral health practices and behaviours. These differences may cause a disproportionate burden of oral disease in men and highlight the need for dentists, hygienists, and those interested in dental public health to develop gender-specific strategies to address these inequalities.

1. Introduction

The oral cavity is often referred to as the window to overall health because of the relationship between oral health and overall health [1]. Oral health can affect general health by causing pain, difficulty eating, and changes in speech that affect the quality of life [2–4]. Poor oral health behaviours also lead to caries, periodontal disease and are associated with oropharyngeal cancers. Periodontitis increases the risk of several systemic conditions including cardiovascular disease [5], endocarditis, and rheumatoid arthritis [6–9]. Furthermore, studies associate good oral health with better mental health [1,10] and poor oral health with depression and low self-esteem [11–14].

Despite the impact of oral health on overall health and well-being, its importance is often overlooked. Gender may play a role in oral health

since men are more likely to ignore their oral health and have poorer oral health habits [15,16]. Research exploring the relationship between gender and the social and psychological impacts of oral health found that compared to men, women generally perceive oral health as having a greater impact on quality of life and that poor oral health causes pain and leads to embarrassment [17–19]. Studies also demonstrate that women exhibit better oral health literacy and more positive attitudes toward dental visits than men [20]. In terms of oral health behaviours, 8% more women brushed their teeth twice a day and were 26% more likely to floss daily [15]. Past studies also found differences in caries and periodontal disease with a higher prevalence of periodontitis in men [21] and more caries in women [22,23].

While these older studies show differences in oral health and behaviours between genders, few recent studies explore whether gender

differences in oral health persist [15,24]. This study is the first to use a national database and comprehensive approach to explore and compare factors related to men's and women's oral health in the United States. Differences in oral health can lead to disparities in clinical indicators of disease, health behaviours, and perceptions of oral health resulting in a disproportionate burden of oral disease between genders [25]. Since oral health is inextricably linked to overall health [26], identifying whether gender disparities in oral health persist and understanding different needs and behaviours can help develop gender targeted messaging and strategies to address disparities that can affect health and wellbeing.

2. Methods

This cross-sectional study used data from the 2017–2018 National Health and Nutritional Examination Survey (NHANES) to explore the relationship between gender and oral health. NHANES assesses the health and nutritional status of the civilian noninstitutionalized population in the United States utilizing a combination of interviews and physical examinations. To develop a nationally representative sample, NHANES uses a stratified, multistage, clustered sampling design. NHANES oversamples subgroups of particular public health interest to increase the reliability and precision of estimates of health status indicators for these population subgroups. For 2017–2018 oversampled groups included: Hispanic persons, non-Hispanic black persons, non-Hispanic Asian persons, non-Hispanic white persons, low-income persons, and Non-Hispanic and other aged 80 years and older. The interviews consist of demographic, socioeconomic, dietary, and health-related questions conducted in participants' homes. The physical examination component includes medical, dental, physiological, and laboratory measurements obtained by trained medical and dental personnel. Data are made publicly available in two-year cycles. More information about NHANES can be found at https://www.cdc.gov/nchs/nhanes/index.htm.

The sample used in this study consisted of NHANES participants who completed the oral health questionnaire and dental examination portions except for cases missing key covariate entries such as income, race, gender, marital status, and general health status. The participants were randomly selected using information obtained from the United States Census [27]. The oral health questionnaire solicits self-reported data about perceived oral health status and oral health behaviours. The dental examination assesses the prevalence of oral conditions and diseases, such as tooth retention, dental caries, sealants for those aged 3 to 19 years, and fluorosis for those aged 6 to 29 years. Because the majority of the NHANES oral health questionnaire items were only applicable to those aged 30 years and over, the study focused on the adult population aged 30 years and over and data for participants under 30 years old was excluded. Thus, the analysis excluded oral health behavioural variables such as sealant and fluorosis data. All questionnaire items are listed in Appendix 1.

2.1. Independent variable and outcome measures

Gender was the independent variable for this study and included those who self-identified themselves as either male or female. Outcomes measures of interest included the oral health-related survey results and consisted of questions related to: time to the last dental visit, reason for last dental visit, access to dental care, oral cancer screenings, mouth pain, self-consciousness because of their teeth or mouth, gum disease, rating of oral health, bone loss, and flossing habits. The study excluded variables related to questions for those under age 30. Additional outcome measures included all variables derived from the dental examination findings which included: the presence of dental implants, tooth count, tooth surface conditions, root caries or lesions, and root restorations. Tooth count was collapsed into two categories based on the World Health Organization's (WHO) criteria of 20 or more teeth for

functional dentition and fewer than 20 teeth for nonfunctional dentition [28]. After completing the dental exam, the examiner gave one of four overall care recommendations: that the individual see a dentist immediately; see a dentist within 2 weeks; see a dentist at the earliest convenience, or continue their routine care.

2.2. Data analyses

Descriptive statistics were utilized to characterize the study population demographics including gender, age, race, marital status, income, and education level. Chi-squared tests were conducted to assess the univariate relationship of the dental examination and oral health behavioural variables by gender. For those oral health variables demonstrating univariate significance across gender, multivariate analyses assessed whether gender differences independently linked to outcome measures after adjusting for sample demographic characteristics such as age, race, marital status, income, and education. Since NHANES used a complex multistage cluster survey methodology, the Centers for Diseases Control and Prevention (CDC) provides guidelines for analysing NHANES data using sampling weights supplied in its database [29]. This study followed the CDC analytic guidelines to report weighted results so that the conclusion can be generalized to the US population since unweighted results were found to be biased [30]. Statistical analyses were performed using SPSS version 28 with statistical significance (p-value) set at 0.05. Effect sizes for all relations were calculated with Phi<0.1 considered as small effect, Phi of 0.3 as medium effect, and Phi>0.5 as large effect.

3. Results

The initial study sample consisted of 9254 participants. After applying the inclusion criteria of age 30 years and above and excluding those participants with missing data, the final sample consisted of 4741 participants. Table 1 summarizes the weighted sample, representing 194,811,183 individuals; of which 47.7% were male. The average age was 53.7 years old (SD = 14.5) and 63.9% were White, and 10.9% Black. About one-third had either some college or an associate degree, 32.4% were college graduates or above, and 60.3% were married. The annual household income ranged from $0–34,999 (24%) to $75,000 and over (43.7%).

Table 2 presents univariate analyses of oral health behavioural variables. There was a significant difference between males and females for their last dental visit, the reason for a dental visit, mouth pain, embarrassment because of their mouth, thinking they might have gum disease, rate of oral health, flossing habits, and oral cancer conversations and screenings ($p<0.05$). Males were more likely to visit the dentist less and for emergency reasons, flossed less, rated their oral health more poorly, and were more likely to be told about the importance of oral cancer screenings but were screened less. Females were more likely to report aching or feeling embarrassed about their mouth. Weighted analyses show that there was a significant difference for the oral health behavioural variables of access to dental care, receiving treatment for gum disease, and being told of bone loss. Table 3 presents univariate analyses of oral examination variables. There was a significant difference between males and females for several oral exam variables. Males had more coronal caries, root caries, and noncarious root lesions such as erosions or abrasions ($p<0.05$). Males were also more likely to be recommended to see the dentist at their earliest convenience or immediately while females were recommended to continue with their regular routine ($p<0.05$). When weighted, a significant difference existed for all oral examination variables. Examination data indicated that females had more dental implants and nonfunctional dentition (less than 20 teeth), while males were more likely to have a root restoration for noncarious reasons ($p<0.05$). However, the effect size for these differences was small (Phi<0.1).

Table 4 shows the results of multivariate linear and logistic

Table 1

Demographic characteristics weighted (N = 194,811,183).

Variable	mean (sd)	Weighted N (%)	Male n (%)	Female n (%)
Age (years)	53.7 (14.5)			
Gender				
Male		92,896,150 (47.7)		
Female		101,915,033 (52.3)		
Race/Ethnicity				
Mexican American		15,310,917 (7.9)	794,690 (8.6)	7,364,127 (7.2)
Other Hispanic		13,035,558 (6.7)	5,943,522 (6.4)	7,092,036 (7.0)
Non-Hispanic White		124,544,201 (63.9)	59,152,412 (63.7)	65,391,789 (64.2)
Non-Hispanic Black		21,258,841 (10.8)	9,415,393 (10.1)	11,843,448 (11.6)
Non-Hispanic Asian		11,270,335 (5.8)	4,962,421 (5.3)	6,307,915 (6.2)
Other Race		9,391,330 (4.8)	5,475,612 (5.9)	3,915,718 (3.8)
Education Level				
Less than 9th grade		8,460,545 (4.3)	4,256,259 (4.6)	4,204,285 (4.1)
9–11th grade		14,521,499 (7.5)	7,237,460 (7.8)	7,284,039 (7.2)
High school graduate/GED or equivalent		49,142,917 (25.3)	23,835,619 (25.7)	25,307,288 (24.9)
Some college or Associate degree		59,315,216 (30.5)	26,858,995 (28.9)	32,456,221 (31.9)
College graduate and above		63,093,584 (32.4)	30,608,231 (33.0)	32,485,353 (31.9)
Marital Status				
Married		117,367,726 (60.3)	59,903,532 (64.5)	57,464,194 (60.3)
Widowed		13,907,103 (7.1)	2,590,361 (2.8)	11,316,742 (7.1)
Divorced		23,685,219 (12.2)	9,841,589 (10.6)	13,843,629 (12.2)
Separated		5,648,925 (2.9)	2,411,906 (2.6)	3,237,019 (2.9)
Never married		19,825,943 (10.2)	10,183,864 (11.0)	9,642,079 (10.2)
Living with partner		14,289,721 (7.3)	7,923,764 (8.5)	6,365,957 (7.3)
Annual Household Income				
Under $34,999		43,490,782 (24.0)	18,895,433 (21.8)	24,595,350 (25.9)
$35,000 to $74,999		50,783,375 (28.0)	24,131,540 (27.9)	26,651,834 (28.2)
$75,000 and Over		79,444,246 (43.7)	39,956,323 (46.0)	39,487,923 (41.6)
$20,000 and Over		7,872,415 (4.3)	3,815,429 (4.4)	4,056,986 (4.3)

regression analyses of outcomes variables (i.e., oral health behaviours and dental exam variables) across gender after adjusting for demographic characteristics. For binary outcome variables, multivariate logistic regression analyses were conducted; otherwise, multivariate linear regression analyses were conducted. When asked about when was their last visit to the dentist, the gender responses differed significantly (*p*<0.05) with 54.3% of women reporting a visit within the past 6 months or less compared to 45.7% for men. More males than females reported their last visit as longer than 1–2 years, 2–3 years, 3–5 years, more than 5 years or never visiting the dentist. A gender difference also emerged for the question about the main reason for the last dental visit. Females were more likely to visit the dentist on their own or for treatment of a condition that the dentist discovered at an earlier examination, while males were more likely to visit the dentist in response to being

Table 2

Univariate analyses of oral health variables (Weighted N = 194,421,129).

Variable	Male n (%)	Female n (%)	p-value
Last dentist visit			<0.001
6 months or less	40,664,701 (43.9)	49,426,076 (48.6)	
6 months to 1 year ago	11,442,730 (12.3)	16,806,284 (16.5)	
1 year to 2 years ago	11,197,879 (12.1)	11,782,225 (11.6)	
2 years to 3 years ago	6,535,146 (7.1)	6,177,559 (6.1)	
3 years to 5 years ago	7,994,340 (8.6)	6,443,070 (6.3)	
More than 5 years ago	13,698,345 (14.8)	10,427,398 (10.2)	
Never have seen	1,144,326 (1.2)	681,048 (0.7)	
Main reason for last dental visit			<0.001
Went in on own for checkup, examination, or cleaning	47,985,849 (52.4)	61,048,680 (60.5)	
Was called in by the dentist for checkup, exam, or cleaning	6,985,271 (7.6)	6,336,586 (6.3)	
Something was wrong, bothering, or hurting	26,021,868 (28.4)	23,171,861 (23.0)	
Went for treatment of a condition that dentist discovered at earlier check up or examination	8,775,844 (9.6)	7,948,860 (7.9)	
Other	1,782,182 (1.9)	2,384,407 (2.4)	
Need dental but couldn't get it past year			<0.001
Yes	16,137,923 (17.6)	16,634,403 (16.4)	
No	75,604,701 (82.4)	84,578,520 (83.6)	
Aching in the mouth last year			<0.001
Very often	2,476,223 (2.7)	2,681,803 (2.6)	
Fairly often	3,380,472 (3.6)	4,885,706 (4.8)	
Occasionally	15,578,617 (16.8)	17,897,579 (17.6)	
Hardly ever	31,638,130 (34.1)	28,540,926 (28.0)	
Never	39,790,252 (42.8)	47,887,956 (47.0)	
Embarrassed because of mouth			<0.001
Very often	4,488,225 (4.8)	7,815,258 (7.7)	
Fairly often	4,164,653 (4.5)	3,294,902 (3.2)	
Occasionally	9,117,967 (9.8)	7,522,597 (7.4)	
Hardly ever	9,764,641 (10.5)	12,796,016 (12.6)	
Never	65,342,894 (70.4)	70,465,197 (69.2)	
Think you might have gum disease			<0.001
Yes	71,197,244 (77.9)	84,716,502 (83.9)	
No	20,199,816 (22.1)	16,310,949 (16.1)	
Rate the health of your teeth and gums			<0.001
Excellent	11,723,756 (12.6)	13,920,849 (13.7)	
Very good	23,020,092 (24.8)	19,425,446 (28.9)	
Good	29,677,882 (32.0)	31,806,804 (31.2)	
Fair	18,979,512 (20.5)	18,108,984 (17.8)	
Poor	9,406,816 (10.1)	8,608,750 (8.5)	
Treatment for gum disease			<0.001
Yes			

Table 2 (*continued*)

Variable	Male n (%)	Female n (%)	p-value
	21,654,932 (23.5)	22,418,565 (22.1)	
No	70,669,860 (76.5)	79,099,855 (77.9)	
Ever been told of bone loss around teeth			<0.001
Yes	15,371,328 (16.7)	17,644,315 (17.4)	
No	76,711,232 (83.3)	83,509,489 (82.6)	
How many days do you use dental floss/device			<0.001
None (0 days)	30,427,643 (32.8)	24,401,811 (23.9)	
Some (1–6 days)	34,125,584 (36.7)	36,550,941 (35.9)	
Daily (7 days)	28,342,922 (30.5)	40,962,281 (40.2)	
Told importance of checking for cancer			<0.001
Yes	49,174,273 (72.4)	66,636,111 (77.6)	
No	18,765,671 (27.6)	19,187,601 (22.4)	
Had oral cancer exam			<0.001
Yes	70,391,165 (76.0)	71,443,016 (70.3)	
No	22,224,904 (24.0)	30,185,348 (29.7)	

called in by the dentist or for dental pain or another dental condition needing treatment. ($p<0.05$). While females were more likely than males to experience dental discomfort and to feel self-conscious or embarrassed because of their teeth, mouth, or dentures ($p<0.05$), after controlling for demographic factors these differences no longer remained significant ($p>0.05$). Females reported flossing for more days in a week than males ($p<0.05$). Males had more coronal caries than females ($p<0.05$) and this difference remained significant after controlling for demographic characteristics. Treatment recommendations for care varied by gender. The NHANES clinical examiners more frequently advised females to continue with their regular routine dental care while they more often advised males to see a dentist for treatment at their earliest convenience or within the next 2 weeks after controlling for demographic characteristics ($p<0.05$) (Table 4).

Males were more likely to self-report poor oral health and more likely to believe they might have gum disease after controlling for demographic characteristics (OR=0.788; $p<0.05$). With regards to oral cancer, when asked if they had a direct conversation about the importance of oral cancer screening with a dental professional in the past year, males experienced more direct conversations (OR=1.398; $p<0.05$), but reported being screened for oral cancer less often than females after controlling for demographic characteristics (OR=0.808; $p<0.05$). Moreover, females were less likely to have root caries present after controlling for demographics (OR=0.658; $p<0.05$) while males were more likely to have noncarious root restorations (OR= 0.795; $p<0.05$).

4. Discussion

This study represents the first comprehensive study to use a national database to explore oral health and hygiene behaviours by gender. It also updates the literature examining differences related to men's and women's oral health conditions in the United States [15]. Similar to earlier studies, our results also rejected the null hypothesis that there were no differences in oral health outcomes and behaviours between genders and found that women exhibit better oral health practices and behaviours for frequency of dental visits, flossing, oral cancer screenings, restorations, and adherence to dentist recommendations.

The American Dental Association recommends regular dental visits

Table 3

Univariate analyses of dental examination variables across gender (Weighted $N = 188,182,830$).

Variable	Male n (%)	Female n (%)	p-value
Presence of dental implants			<0.001
Yes	4,222,828 (4.7)	5,650,987 (5.7)	
No	85,452,573 (95.3)	92,856,442 (94.3)	
Tooth Count			<0.001
Functional dentition (≥20 teeth)	72,423,063 (80.8)	79,455,946 (80.7)	
Nonfunctional dentition (<20 teeth)	17,252,339 (19.2)	19,051,483 (19.3)	
Coronal caries			<0.001
No carious teeth	38,833,063 (47.5)	44,474,636 (50.4)	
1–8 carious teeth	35,785,146 (43.8)	38,291,471 (43.4)	
9–16 carious teeth	5,066,376 (6.2)	4,176,644 (4.7)	
17–24 carious teeth	1,136,699 (1.4)	1,106,257 (1.3)	
25–32 carious teeth	879,564 (1.1)	232,352 (0.3)	
Root caries			<0.001
Yes	11,944,199 (14.1)	11,878,461 (12.9)	
No	72,770,561 (85.9)	80,465,335 (87.1)	
Other non-carious root lesion (erosion or abrasion)			<0.001
Yes	18,366,370 (21.7)	19,579,308 (21.2)	
No	66,348,391 (78.3)	72,764,489 (78.8)	
Root caries restoration			<0.001
Yes	5,386,931 (6.4)	5,889,951 (6.4)	
No	79,327,829 (93.6)	86,453,846 (93.6)	
Root restoration for reasons other than caries			<0.001
Yes	4,585,615 (5.4)	4,138,931 (4.5)	
No	80,129,145 (94.6)	88,204,865 (95.5)	
Overall recommendation for care by NHANES examiner			<0.001
See dentist immediately	149,375 (0.2)	42,387 (0.0)	
See dentist within next 2 weeks	6,014,913 (6.7)	4,491,617 (4.6)	
See dentist at earliest convenience	29,930,850 (33.4)	29,330,414 (29.8)	
Continue your regular routine care	53,580,264 (59.7)	64,643,010 (65.6)	

to prevent and treat dental disease and to check for signs of other diseases [31]. Past studies linked dental visit frequency with income, access to care, dental fear, and male gender to fewer dental visits [32–35]. This study confirmed that men were less likely to visit a dentist but more likely to seek dental care for acute problems such as pain while females visited the dentist more frequently for regular checkups or planned treatments. This parallels research that indicates that in general men use healthcare services less often and are less likely to seek preventive care [36,37]. The differences in dental visits remained significant after controlling for demographic factors. Stereotypical masculine-typed attitudes that negatively impact help-seeking behaviour [38] and the association of illness with a loss of masculinity [39] make it unsurprising that men utilize dental services less often than women. In contrast, women perceive oral health as having a greater impact on their quality of life and enhancing their quality of life, mood, appearance, and well-being [18]. Predictably since women place a greater emphasis on oral health and prevention, they were more likely to visit the dentist and to seek preventative care.

Table 4

Multivariate linear and logistic regression analyses of oral health behaviours and dental examination variables across gender controlling for demographics.

Variable	B*	*p*-value
Last dentist visit#	−0.103	<0.001
Main reason for last dental visit#	−0.061	<0.001
Aching in mouth last year#	0.006	<0.001
Embarrassed because of mouth#	−0.025	<0.001
Rate the health of teeth and gums#	−0.047	<0.001
How many days do you use floss#	0.116	<0.001
Coronal Caries#	−0.040	<0.001
Overall recommendation for care#	0.066	<0.001
Tooth count##	0.003	<0.001
Need dental care but couldn't get it##	0.991	<0.001
Think you might have gum disease##	0.643	<0.001
Treatment for gum disease##	0.892	<0.001
Ever been told of bone loss##	0.045	<0.001
Told importance for checking for oral cancer##	0.724	<0.001
Had oral cancer exam##	0.425	<0.001
Dental implants##	0.961	<0.001
Root caries##	0.819	<0.001
Other non-carious root lesion##	0.893	<0.001
Root restoration##	0.851	<0.001
Root restoration for non-carious##	0.724	<0.001

Note.

multivariate linear regression analysis.

multivariate logistic regression analysis.

* B is the standardized coefficient.

Despite nationally stated goals to reduce oral health disparities [40], our study confirms a persistent gap in preventive and routine dental care between men and women. However, the effect size for differences in the examination variables was small. Perhaps the most striking finding was that among the study group more than one-third of both men and women did not visit a dentist within the last year and less than one-third sought preventive care on their own. These findings suggest the need for better strategies to improve oral health for both sexes. Incorporating gender into care approaches might offer modest improvement in oral health outcomes.

Our findings also indicate that women floss more frequently than men. Along with linking good oral health to overall health [1], women may exhibit better oral health behaviours due to greater oral health knowledge [40]. Higher oral health literacy is associated with better oral hygiene and studies show that women have greater oral health literacy than men [15,41] and have a greater awareness of the importance of oral health. Also, preventive visits and the patterns in conversations during these visits with dental health providers may be contributing factors. With more frequent dental visits and routine prevention, there may be more opportunities for education and reinforcement about the importance of oral health that translates into better oral hygiene practices. Moreover, healthcare providers typically do not spend as much time with men discussing health issues and as a result, may provide men with less health information and advice [37]. Since men visit the dentist less, this highlights the importance for dentists to view each visit as a teachable opportunity to promote positive oral health behaviours and to improve a patient's knowledge about oral health.

Our study found that females were less likely to directly discuss the importance of oral cancer screening with a dental professional but reported being screened more than males. Oral and oropharyngeal cancers are the most common malignancies affecting the head and neck. More males are diagnosed with oral cancer with a male to female ratio of 2:1 [42] and this might explain why dental providers initiate fewer conversations about oral cancer screening with women. In contrast, females report being screened more than males which may be due to underutilization of preventative dental and healthcare services by men [43]. These differences remained after controlling for demographic characteristics, illustrating the role gender plays in discussing and screening for oral cancer. The death rate for oral cancer is higher than other common

cancers such as cervical cancer, Hodgkin's lymphoma, and laryngeal cancer [44] and has a survival rate of about 60% over 5 years [45,46]. Late-stage diagnosis contributes to poor outcomes and early detection and treatment increase oral cancer cure rates to over 80% [47,48], making screening important for reducing mortality [48,49]. Men disproportionately experience oral cancer risk factors such as tobacco use and excessive alcohol intake, underscoring the importance of educating male patients and performing routine oral cancer screenings. Strategies to promote preventive dental visits amongst men can enhance the frequency of oral cancer screening with the goal to increase early detection.

The dental examination section of NHANES revealed that males had more coronal caries, which differs from earlier epidemiologic data that adult-women develop more caries than men [22,23] and suggests the need for additional research to confirm this finding. It may be that newer approaches in dental care account for this change. Studies indicate that with more frequent dental visits, the rate of tooth loss and the number of teeth with active decay decreases although the average number of fillings increases [50]. Finally, post examination more men than women were referred for dental care. While this component of NHANES was designed as a safety measure, it does suggest that men have more unmet dental care needs than women.

4.1. Limitations

NHANES demographic and oral health behaviour data rely on self-reported information and are subject to recall bias. Self-reported dental visits were not verified. In addition, individuals might answer with what they perceive as the correct behaviour rather than their actual behaviour. The dental examination section depends on the examiner and variations in dental provider skills and dental instruments might impact accuracy and sensitivity. Finally, our study did not include all gender identifications. Future research to include transgender and non-binary individuals can provide a more holistic overview. A study strength is that unlike earlier research this study used a national database, examined gender across multiple outcome measures, and used weighted results to be representative of the United States population rather than non-representative samples [51,52].

4.2. Conclusions

Using a national database, our study found differences in oral health and oral hygiene behaviours between men and women. Women are significantly more likely than men to have dental visits, to floss more often, to engage in preventive care, to report being screened for oral cancer and to report good gum health although the size effect for examination outcomes was small.

Credit author statement

All of the authors participated in all aspects of the study.

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Author contributions

Sharon Su: Contributed to conception and design, acquisition, analysis, and interpretation of data, drafted the manuscript, and critically revised the manuscript.

Martin Lipsky: Contributed to conception and design, acquisition, analysis, and interpretation of data, drafted the manuscript, and critically revised the manuscript.

Frank Licari: Contributed to conception and design, acquisition, analysis, and interpretation of data, drafted the manuscript, and

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Man Hung: Contributed to conception and design, acquisition, analysis, and interpretation of data, drafted the manuscript, and critically revised the manuscript.

All authors gave their final approval and agree to be accountable for all aspects of the work.

Declaration of Competing Interest

The authors do not report any conflicts of interest.

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Appendix 1: List of oral health status and oral health behaviours questions

1 About how long has it been since you last visited a dentist?
   a 6 months or less
   b More than 6 months, but not more than 1 year ago
   c More than 2 years, but not more than 3 years ago
   d More then 3 years, but not more than 5 years ago
   e More than 5 years ago
   f Never have been
2 What was the main reason you last visited a dentist?
   a Went in on own for a check-up, exam, or cleaning
   b Was called by the dentist for a check-up, exam, or cleaning
   c Something was wrong, bothering, or hurting
   d Went for treatment of a condition that dentist discovered at an earlier check-up or exam
   e Other
3 During the past 12 months, was there a time when you needed dental care but could not get it at that time?
   a Yes
   b No
4 In the past 12 months, did a dentist, hygienist, or other dental professional have a direct conversation with you about the importance of examining your mouth for oral cancer?
   a Yes
   b No
5 How often during the last year have you had painful aching anywhere in your mouth?
   a Very often
   b Fairly often
   c Occasionally
   d Hardly ever
   e Never
6 How often during the last year have you been self-conscious or embarrassed because of your teeth, mouth, or dentures?
   a Very often
   b Fairly often
   c Occasionally
   d Hardly ever
   e Never
7 Do you think you might have gum disease?
   a Yes
   b No
8 Overall, how would you rate the health of your teeth and gums?
   a Excellent
   b Very good
   c Good
   d Fair
   e Poor
9 Have you ever had treatment for gum disease such as scaling and root planing, sometimes called a "deep cleaning"?
   a Yes
   b No
10 Have you ever been told by a dental professional that you lost bone around your teeth?
   a Yes
   b No
11 In the last seven days, how many days did you use dental floss or any other device to clean between your teeth?
   a 0
   b 1
   c 2
   d 3
   e 4
   f 5
   g 6
   h 7
12 Have you ever had an exam for oral cancer in which the doctor or dentist pulls on your tongue, sometimes with gauze wrapped around it, and feels under the tongue and inside the cheeks?
   a Yes
   b No
13 Do you have a tooth replaced with a surgical implant?
   a Yes
   b No
14 Tooth Count: #1–32
   a Primary tooth (deciduous) present
   b Permanent tooth present
   c Dental implant
   d Tooth not present
   e Permanent dental root fragment present
   f Could not assess
15 Coronal caries: Surface condition #1–32
   a Lingual amalgam restoration
   b Occlusal amalgam restoration
   c Facial amalgam restoration
   d Mesial amalgam restoration
   e Distal amalgam restoration
   f Lingual other restoration
   g Occlusal other restoration
   h Facial other restoration
   i Mesial other restoration
   j Distal other restoration
   k Crown
   l Lingual caries
   m Occlusal caries
   n Facial caries
   o Mesial caries
   p Distal caries
16 Root caries present: whole mouth
   a Yes
   b No
17 Other non-carious root lesions: whole mouth
   a Yes
   b No
18 Root caries restorations: whole mouth
   a Root restoration detected
   b Root restoration not detected
19 Other non-carious root restorations: whole mouth
   a Root restoration detected
   b Root restoration not detected
20 Overall recommendation for care
   a See a dentist immediately
   b See a dentist within the next 2 weeks
   c See a dentist at your earliest convenience

d Continue your regular routine care

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