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The Study of Factors Affecting Oral Health in a Sample from NHANES Survey in the United States

Estudio de los factores que afectan la salud oral en una muestra de las encuestas NHANES en los Estados Unidos

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RESUMEN

Objetivos: Los problemas de salud oral incluyen la caries dental, las enfermedades de las encías, la pérdida de los dientes naturales y otras enfermedades de las mucosas. El presente estudio tuvo como objetivo examinar los factores que afectan la salud periodontal en los residentes de los Estados Unidos de América. Este estudio examinó si había diferencias significativas en la salud de los dientes y de las encías con respecto a la última visita al dentista, ingesta de gotas o tabletas de flúor, género y nivel educativo.

Materiales y Métodos: El estudio se analizó con datos provenientes de la Encuesta y Examinación Nacional de Salud y Nutrición NHANES del 2017-2018. Este estudio examinó una población de 9.254 residentes de 1 año o de mayor edad. Se usó la prueba de independencia Chi-Cuadrado para probar la significancia entre variables como la última visita al dentista, ingesta de gotas o tabletas de flúor, sexo y nivel educativo.

Resultados: El estudio no encontró diferencias estadísticamente significativas en la salud de los dientes y de las encías con respecto a la ingesta de gotas o tabletas de flúor, sexo y nivel educativo. Sin embargo, el estudio encontró una diferencia estadísticamente significativa en la salud de los dientes y de las encías con respecto a la última visita al dentista entre los residentes de los Estados Unidos. Las personas que visitaron al dentista en los últimos seis meses calificaron la salud de sus dientes y encías como excelente en comparación con quienes no visitaron al dentista en los últimos 6 meses.

Conclusiones: Los estudios futuros deberían revisar otros factores que afectan la salud bucal como la ingesta de alto contenido de azúcar, la diabetes, al igual que las enfermedades crónicas y factores de genética. Se debe hacer énfasis en la identificación de inequidades asociadas con la salud periodontal entre diversas culturas y grupos étnicos en los Estados Unidos.

Palabras Claves: Salud Oral, Enfermedad Periodontal, Encuesta NHANES, Estados Unidos de América.

ABSTRACT

Aims: Oral health problems include dental caries, gum diseases, loss of natural teeth, and other mucosal diseases. The present research aimed to study the factors affecting periodontal health in the residents of the United States of America. This study examined if there were significant differences in the health of teeth and gums with respect to last visit to the dentist, intake of fluoride drops or tablets, gender, and educational level.

Materials & Methods: The study analyzed secondary data from the National Health and Nutrition Examination Survey 2017-18. This study examined a population of 9,254 residents aged 1 and older. The Chi-Square Test of Independence was used to test significance among the variables of last visit to the dentist, received fluoride drops or tablets, gender, and educational level.

Results: The study found no statistically significant differences in health of teeth and gums with respect to intake of fluoride drops or tablets, gender, and educational level. However, the study did find a statistically significant difference in the health of teeth and gums with regard to the last visit to the dentist among residents of the US. Individuals who have visited the dentist in the last six months have rated their health of teeth and gums as excellent as compared to those who did not visit the dentist in the last six months.

Conclusions: Future studies should review other factors affecting oral health such as high sugar intake, diabetes, chronic diseases, and genetics. Emphasis should be given to the identification of inequities associated with periodontal health among various cultural and ethnic groups in the United States of America.

Keywords: Oral Health, Periodontal Disease, NHANES Survey, United States of America.

INTRODUCTION

Oral health is greatly affected by various kinds of oral infections, such as dental caries, periodontal diseases, lesions in HIV/AIDS, mucosal and salivary gland diseases, orofacial pain and clefts, and, occasionally, oral cancer (1). Tooth loss weakens mastication and causes poor diet, nutrition, and eating behavior leading to high mortality rates (2). Also, poor oral health and periodontal diseases are predisposing factors for pneumonia, chronic obstructive pulmonary diseases, and has adverse- effects on diabetes patients (3). These oral diseases have a great impact on masticatory functions, nutritional intake, speech, swallowing, standard of living, and socialization (1). The US Surgeon General called dental caries a “silent epidemic”, and it is the root cause of loss of teeth in children and can result in severe health outcomes, and even mortality (1).

The predisposing factors causing oral infections include older age, poor nutrition, tobacco and/or alcohol use, immunodeficiencies, poor dental hygiene, unfavorable social conditions, and diabetes (4). It is found that untreated periodontal disease contributes to tooth loss among adults and is known to compromise mastication, esthetics, self-esteem, and standard of living (5). There are various complications associated with untreated tooth decay such as pain, poor appearance, dysfunction, irre-

gular school attendance, and low concentration on daily life achievements (6). In the United States, untreated dental caries is observed in 53 million people in the permanent dentition, and 25% of adults aged 65 years or older have lost their natural teeth due to untreated oral conditions (7).

According to the World Health Organization (WHO), fluoride toothpaste is the most popular and accepted source of fluoride use worldwide, and it is most effective to decline the prevalence of dental caries (8). Duijster et al. (9) showed that children from families that do not practice regular tooth brushing are more prone to experience dental caries (9). In Norway, data from a cohort study has confirmed that brushing teeth of children with a fluoride toothpaste twice in a day reduces the chances of development of cavities from 2 to 5 years of age (10).

For years, the recommended age of first visit to the dentist for children was around twelve months of age, but, recently, it has changed to a time span between 6 months of age and the development of the first tooth (11). The reasons for this recommendation are to prevent Early Childhood Caries (ECC) and to discover and assess the progression of any dental pathology (11). In addition, early visits to a dentist would educate caregivers about the importance of practicing healthy oral habits, teach them about fluoride use, teething management, and the co-relation between diet and oral health (11).

The occurrence of oral diseases is more prevalent among marginalized population groups, such as people with less education, living in poor conditions, and negligent oral habits. In the United States, 35-44 years aged Hispanic Whites are twice more likely to have untreated tooth decay than non-Hispanic Whites, mainly due to lower access of minorities to dental care and low socio-economic status (12). In addition, the prevalence of dental caries is most commonly observed in individuals with poor dietary habits, high consumption of sugar, and limited access to oral healthcare (8). In 2018, oral cavity cancers rank among the top 15 most common cancers worldwide with a total of 354,864 incident cases (13).

MATERIALS AND METHODS

Ethical considerations

This study was an analysis of secondary data collected from National Health and Nutrition Examination Survey (NHANES), 2017- 2018. Permission to use NHANES public data was obtained from (CDC). The Human Subjects Approval Letter to proceed with secondary data analysis was obtained from the Committee of the Protection of Human Subjects at California State University, Fresno.

Study Population

In the original NHANES survey, the data were collected from the US residents selected from 30 different survey locations, aged 1 to 80 years and older, in 2017-2018. This study will focus on oral health among all age groups from 1 year and older. Of those, 9,254 participants completed the interview and 8,704 were examined. For this study, the population was examined by using the NHANES, 2017-2018. The NHANES data comprised two questionnaires: a demographic questionnaire and an oral health questionnaire. Both the questionnaires were asked at the residence of the participants using the Computer-Assisted Personal Interview (CAPI) system. A proxy was present for participants who were 16 years or under. Data were obtained on many topics regarding the individual demographics, lifestyle, and oral health status.

Variables

The dependent variable used in this study was: Rate the health of your teeth and gums. The four independent variables used in this study were: last visit to a dentist, whether you received fluoride Rx drops or tablets, Gender, and the educational level for adults 20+ years.

Data collection

This study was an analysis of secondary data collected from NHANES 2017- 2018. The study examined data from individuals aged 1 and older and total participants in this age group were 9,254. This study determined periodontal health-related factors such as last visit to the dentist, fluoride intake, rate of health of teeth and gums, gender, and educational level. Variables were analyzed using SPSS (Statistical Package for the Social Sciences).

Hypotheses

The following null hypothesis were identified to emphasize the purpose of this study:

- *Hypothesis 1:* There is no statistically significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months.
- *Hypothesis 2:* There is no statistically significant difference in the rate of health of teeth and gums between those receiving fluoride drops or tablets and those not receiving fluoride drops or tablets.

- *Hypothesis 3:* There is no statistically significant difference in the rate of health of teeth and gums according to gender.
- *Hypothesis 4:* There is no statistically significant difference in the rate of health of teeth and gums according to educational level.

Data analysis

Secondary data from NHANES 2017-2018 survey was used and inputted into SPSS to test the hypothesis using the Chi-Square Test of Independence. The Chi-Square Test of Independence was used because it provides a test to determine whether there is a significant difference between two categorical variables. The significance level of 0.05%, marginal error of 5% and C.I. (Confidence Interval) of 95% was used for data analysis. The sample size calculated for this study was 369. The dependent variable was the rate of health of your teeth and gums. The independent variables were gender, educational level, last visit to a dentist, and if fluoride drops or tablets were received. The dependent and independent variables were analyzed using SPSS 25 edition statistical software.

RESULTS

Table 1 presents a detailed description of demographic variables. Regarding gender, a total of 9,254 participated and most respondents were females (50.8%). For educational level 20+ adults, 5,569 respondents' answers were recorded and were categorized as less than 9th grade (5.2%), 9-11th grade (6.9%), High school graduate (14.3%), Some college or AA degree (19.2%), College graduate or above (14.4%), Refused (.0%) and Don't know (.1%).

Table1. NHANES Survey Demographics for Gender and Educational level for Adults

Category	N	%
Gender		
Male	4557	49.2
Female	4697	50.8
Educational level 20+ Adults		
Less than 9 th grade	479	5.2
9-11 th grade	638	6.9
High school graduate	1325	14.3
Some college or AA degree	1778	19.2
College graduate or above	1336	14.4
Refused	2	.0
Don't know	11	.1

Source: the authors.

Last Visit to a Dentist and Health of Teeth and Gums

The NHANES survey asked the residents about their last visit to the dentist. The responses were recorded to include: 6 months or less, more than 6 months ago, more than 1 year ago, more than 2 years ago, more than 3 years ago, more than 5 years ago, never, don't know (see Table 2). The first hypothesis stated that there is no statistically significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. The Pearson Chi-Square value was 1121.787, $df= 21$, and p -value was < 0.001 . Since the p -value was less than 0.05, it can be concluded that there was a significant difference between the health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months.

Table 2. Rate the Health of Your Teeth and Gums and When Did You Last Visit a Dentist

Category		6 mo or less	More than 6 mo ago	More than 1 yr ago	More than 2 yrs ago	More than 3 yrs ago	More than 5 yrs ago	Never	Don't Know	Total
Excellent	Count	1006	202	101	40	31	76	226	5	1687
	%	11.3	2.3	1.1	0.5	0.3	0.9	2.5	0.1	19.0
Very Good	Count	1191	350	204	88	72	124	103	2	2134
	%	13.4	3.9	2.3	1.0	0.8	1.4	1.2	0.0	24.0
Good	Count	1258	451	360	192	149	269	133	8	2820
	%	14.2	5.1	4.1	2.2	1.7	3.0	1.5	0.1	31.7
Fair	Count	612	355	335	207	219	443	62	13	2246
	%	6.9	4.0	3.8	2.3	2.5	5.0	0.7	0.1	25.3
Total	Count	4067	1358	1000	527	471	912	524	28	8887
	%	45.8	15.3	11.3	5.9	5.3	10.3	5.9	0.3	100.0

Chi-Square is 1121.787, $df= 21$ and p -value is <0.001

Source: Elaborated by authors.

Received Rx Fluoride Drops or Tablets and Health of Teeth and Gums

The survey asked the residents about their intake of fluoride drops or tablets. The answers were recorded as Yes, No, Refused, Don't Know (see Table 3).

Table 3. Rate the Health of Your Teeth and Gums and Received Rx Fluoride Drops or Tablets

Category		Yes	No	Don't Know	Total
Excellent	Count	71	651	0	722
	%	3.1	28.8	0.0	32.0
Very Good	Count	64	501	6	571
	%	2.8	22.2	0.3	25.3
Good	Count	79	622	4	705
	%	3.5	27.5	0.2	31.2
Fair	Count	31	228	1	260
	%	1.4	10.1	0.0	11.5
Total	Count	245	2002	11	2258
	%	10.9	88.7	0.5	100.0

Chi- Square value is 8.784, df= 6 and p-value is .185

Source: Elaborated by authors.

The second hypothesis stated that there is no statistical difference in the rate of health of teeth and gums between those receiving fluoride drops or tablets and those not receiving fluoride drops or tablets. The Pearson Chi-Square value was 8.784, df= 6, and the p-value was 0.185. Since the p-value was greater than 0.05, it can be concluded that there was no significant difference in the rate of health of teeth and gums between those receiving fluoride drops or tablets and those not receiving fluoride drops or tablets. The results of this test fail to reject the null hypothesis.

Gender and Health of Teeth and Gums

The survey asked the participants about their gender. The answers were recorded as Male and Female (see Table 4). The third hypothesis stated that there is no statistically significant difference in the rate of health of teeth and gums according to gender. The Pearson Chi-Square value was 5.391, df= 3, and the p-value was .145. Since the p-value was greater than 0.05, it can be concluded that there was no significant difference in the rate of health of teeth and gums according to gender. The results of this test fail to reject the null hypothesis.

Table 4. Rate the Health of Your Teeth and Gums and Gender

Category		Male	Female	Total
Excellent	Count	818	869	1687
	%	9.2	9.8	19.0
Very Good	Count	1020	1114	2134
	%	11.5	12.5	24.0
Good	Count	1372	1448	2820
	%	15.4	16.3	31.7
Fair	Count	1147	1099	2236
	%	12.9	12.4	25.3
Total	Count	4357	4530	8887
	%	49.0	51.0	100.0

Chi- Square value is 5.391, df= 3 and p- value is .145

Source: Elaborated by authors.

Educational Level and Health of Teeth and Gums

The survey asked the residents about their educational level for 20 years and above adults. The answers were recorded as Less than 9th grade, 9-11th grade, High school graduate, some College or AA graduate, College graduate or above, Refused, and Don't know (see Table 5).

Table 5. Rate the Health of Your Teeth and Gums and Educational Level for Adults 20+

Category		Less than 9th grade	9-11th-grade	H.S. graduate	Some college or AA college	College graduate or above	Refused	Don't Know	Total
Excellent	Count	96	108	232	311	271	1	1	1020
	%	1.8	2.0	4.3	5.8	5.1	0.0	0.0	19.1
Very Good	Count	108	155	306	405	301	1	2	1278
	%	2.0	2.9	5.7	7.6	5.6	0.0	0.0	23.9
Good	Count	145	209	401	514	414	0	3	1686
	%	2.7	3.9	7.5	9.6	7.8	0.0	0.0	31.6
Fair	Count	116	142	325	464	305	0	4	1356
	%	2.2	2.7	6.1	8.7	5.7	0.0	0.1	25.4
Total	Count	465	614	1264	1694	1291	2	10	5340
	%	8.7	11.5	23.7	31.7	24.2	0.0	0.2	100.0

Chi- Square value is 17.133. df= 18 and p-value is .514

Source: Elaborated by authors.

The fourth hypothesis stated that there is no statistically significant difference in the rate of health of teeth and gums according to the educational level. The Pearson Chi-Square was 17.133, $df=18$, and p-value was .514. Since the p-value was greater than 0.05, it can be concluded that there was no significant difference in the rate of health of teeth and gums according to the educational level. The results of this test fail to reject the null hypothesis.

DISCUSSION

Periodontal health is defined as a state of being free from inflammation associated with gingivitis or periodontitis clinically (14). This study was an analysis of secondary data collected from NHANES 2017- 2018. This study found a significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. The findings of this study showed that 1,006 residents rated their health of teeth and gums as excellent, having last seen a dentist in 6 months or less. According to the findings of this study, the health of teeth and gums significantly deteriorated for those who did not visit the dentist in more than 2 years. The findings of this research question were similar to studies discussed in the literature review. The literature shows that dental caries in children can be prevented if they visit a dentist before or soon after the eruption of their first tooth (11). At the same time, literature also suggests that children with high family income and lower mean of caries experience were more likely to visit the dentist (15).

This study did not find a significant difference in the rate of health of teeth and gums between those receiving drops or tablets and those not receiving drops or tablets among children aged 3-15 years in the US. The findings of this study suggest that 71 children who received fluoride drops or tablets rated the health of their teeth and gums as excellent, and 651 children who did not receive fluoride drops or tablets also rated the health of their teeth and gums as excellent. The findings of this research question were different from the reviewed literature. The literature suggests that higher fluoride concentration in drinking water in the US is associated with lower dental caries (16). Also, the literature highlights that children who do not consume tap water that contains fluoride were more likely to experience dental caries in their lifetime (16).

This study found no significant difference in the rate of health of teeth and gums according to gender among participants aged 1 and older. The results of this study showed that 869 females

rated the health of teeth and gums as excellent, and 818 males rated the health of teeth and gums as excellent. Also, 1,114 females rated the health of their teeth as very good as compared to 1,020 males. In this study, the number of participating females tended to rate the health of their teeth and gums higher than males. However, there was no significant difference between gender and the rate of health of their teeth and gums. The literature shows mixed results, some literature suggests that females having lower levels of protective IgA as compared to males, pregnancies, and being more prone to harbor *S. mutants* can lead them to develop dental caries (17). The growing literature suggests that both men and women are equally aware of oral hygiene, and both have equal chances of developing dental caries (18).

This study found no significant difference in the rate of health of teeth and gums according to educational level among participants aged 20 years and above. The findings suggest that participants who have some college or AA degree have reported better health of their teeth and gums as compared to participants who are less educated than them. But the numbers are not very significant to conclude an association between educational level and health of teeth and gums. The findings of this research question are different from the reviewed literature. The literature suggests that in a study conducted by Kuter & Uzel in 2020, the results showed that a mother's educational level is directly related to children's tooth brushing but not related to the number of cavities in a child's mouth (19).

In conclusion, this study demonstrated that there were significant differences among one of four hypotheses. There was a significant difference in the rate of health of teeth and gums between those who visited the dentist in the last 6 months and those who did not visit the dentist in the last 6 months. This study concludes that individuals who have visited the dentist in 6 months or less have rated their health of teeth and gums as excellent as compared to those who did not visit the dentist in the last 6 months. Overall, the results of the study suggest further and advanced research regarding factors affecting oral health in the US residents.

Although the results of the secondary data analysis presented in this manuscript found no statistically significant differences in the health of teeth and gums in association with intake of fluoride drops or tablets, gender, and educational level, it is important to test these differences across diverse groups, as significant differences may be present by ethnicity.

The results of this study underscored the importance of consistent visits to the dentist as a protective factor for periodontal health. Educational interventions need to be promoted to emphasize the value of regular check-ups according to oral health guidelines. Further studies should be conducted to identify inequities associated with periodontal health among various cultural and ethnic groups in the US and to design interventions to effectively deal with the identified areas of concern.

The current study supplements information available on the oral health status of children and adults in the American continent. The most common risk factors causing periodontal disease in Latin America are poor oral hygiene and low socioeconomic status. Limited access to oral health care, especially in rural and low socioeconomic status areas contribute to high prevalence of periodontal diseases in Latin America (20). The two main preventive approaches used in Latin America are at a) individual level and b) the population/community level. The prevention of dental diseases is important in terms of public health and should not be concentrated on dentists alone but must include interdisciplinary groups working together (21). The prevention of periodontal diseases in Latin America has been focused on oral hygiene instructions for reducing plaque by means of motivational techniques, increasing patient's awareness about the disease, patient empowerment, and providing adequate oral hygiene instructions and knowledge (21).

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