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The Impact of Toothbrushing Practices and the Use of Oral Health Products on Unmet Dental Care Needs

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ABSTRACT

The purpose of this study is to investigate the impact of daily toothbrushing habits, and the number of oral health products used on unmet dental care needs after controlling for other variables. Improving the oral health level of the population is linked to overall health promotion, so it is essential to analyze the specific factors related to unmet dental care needs. Understanding the causes of unmet dental care and exploring the direction for oral health care are crucial to reduce the occurrence rate of unmet dental care. In this study, we analyzed data from the 7th year (2016-2017) of the Korea National Health and Nutrition Examination Survey. The results of the analysis showed that individuals who did not brush their teeth yesterday had an unmet dental care rate 0.835 times lower (OR: 0.835, 95% CI: 0.555-1.256, P-value: 0.386) than those who brushed their teeth. Regarding the number of oral health products used, compared to those using 3 or more products, individuals using 1-2 products had an unmet dental care incidence rate 1.975 times higher (OR: 1.975, 95% CI: 1.443-2.702, P-value: <.0001), and those using no products had a 2.664 times higher incidence rate (OR: 2.664, 95% CI: 1.942-3.653, P-value: <.0001). Based on the research results, it emphasizes the need to increase public interest in oral health and address socioeconomic inequalities. As a solution, the study suggests strengthening preventive policies through public health programs.

1. Introduction

The term “unmet dental care needs” refers to situations in which individuals subjectively desire or objectively need medical services according to healthcare professionals’ standards but are unable

to access them (Song, 2011; Donabedian, 1973). Among various types of unmet medical needs, unmet dental care specifically pertains to dental treatment. Oral diseases, while having a lower frequency of severe outcomes and requiring less hospitalization compared to other medical areas, are often neglected. However, if highly infectious or life-threatening diseases occur in the oral cavity, it can restrict individuals' daily activities and personal freedoms. Therefore, reducing unmet dental care is not only essential for ensuring the right to health but also crucial for the overall well-being of the population (Choi et al., 2021).

Oral diseases typically progress gradually, and once they occur, natural recovery is challenging. Prevention and early treatment are crucial. To enhance prevention, individuals need to improve their oral health management abilities, especially since oral diseases are influenced by various oral health management behaviors such as regular dental visits, dietary habits, and toothbrushing habits (Chen, 1984). These behaviors are deeply connected to socioeconomic conditions, with income level being a significant factor. Individuals with higher incomes tend to have fewer instances of dental caries or tooth loss, as they have the means to access preventive-focused dental care. On the contrary, those with lower incomes face barriers to timely dental care, making it difficult to receive both timely and preventive dental treatments (Lee, 2009).

The issue of unmet dental care is exacerbated by the low coverage of dental care in the current healthcare system, with dental care being one of the least covered areas in health insurance. Dental care services often fall under non-covered items or have insufficient reimbursement for special items, leading to higher out-of-pocket expenses. This economic burden hinders access to dental care and increases the occurrence of unmet dental care (Lee, 2020).

Improving the oral health status of the population is crucial for overall health promotion. Analyzing the current status of unmet dental care and its related factors requires specific research. While existing domestic studies provide an overall understanding of unmet medical needs and health status (Han, 2021), there is a scarcity of research on specific diseases or medical services, especially in the context of dental care.

Therefore, this study aims to analyze the association between daily toothbrushing habits, the number of oral health care products used, and the occurrence of unmet dental care using raw data from the 7th Korea National Health and Nutrition Examination Survey. Additionally, the study seeks to identify the causes of unmet dental care, explore the necessity of oral health management to reduce the occurrence of unmet dental care, and determine the directions for focusing on oral health management.

2. Materials and Methods

2.1 Data source

This study utilized data from the 7th Korea National Health and Nutrition Examination Survey conducted in the years 2016-2017. The research targeted 9,299 adults aged 19 and above. The Korea National Health and Nutrition Examination Survey is a nationwide survey conducted annually

in accordance with the National Health Promotion Act. It assesses the health status, health-related awareness and behaviors, and food and nutrition intake of 10,000 Korean citizens each year, producing national-level statistics. The results are not only utilized for evaluating the health status of the population to develop or improve health policies but are also employed for international comparisons of health levels among countries and various studies on health promotion and disease prevention required by the World Health Organization (WHO) and the Organization for Economic Co-operation and Development (OECD). The survey underwent a transition from a three-year cycle with short-term surveys conducted every 2-3 months for the 1st (1998) to 3rd (2005) cycles to a continuous survey system from the 4th cycle (2007-2009). This change introduced a rolling sampling survey method to ensure that each of the three years could independently represent the entire nation as three separate rotating samples. The survey samples 192 regions and selects 25 households as a random sample, surveying approximately 10,000 individuals aged one or older from each household. Based on the life cycle characteristics of the subjects, the survey applies relevant items for children (1-11 years old), adolescents (12-18 years old), and adults (19 years and older). A dedicated survey team conducts weekly surveys in four regions (192 regions in a year), with each survey area taking three days. Mobile examination vehicles visit the designated regions to conduct health examinations and surveys.

2.2 Independent variables

This study has two primary independent variables: whether the participant brushed their teeth yesterday and the number of oral health care products used. The information on daily toothbrushing habits was obtained through the question, “Did you brush your teeth (or use dental floss) yesterday?”. Respondents who answered “yes” were asked to indicate the times they brushed their teeth (or used dental floss) among seven options (e.g., before and after breakfast, before and after lunch). The number of oral health care products used was calculated by asking, “Aside from toothpaste and a toothbrush, do you use any other products for your oral health?”. Respondents were presented with five options (dental floss, interdental brush, mouthwash, electric toothbrush, water flosser, and tongue cleaner) and asked to select multiple options.

2.3 Dependent variables

The dependent variable in this study is the occurrence of unmet dental care needs. The data on unmet dental care needs and the main reasons for it have been collected since the 4th cycle (2007-2009) through the oral health section of the Korea National Health and Nutrition Examination Survey. Respondents were asked, “In the past year, have you ever needed dental care (examination or treatment) but did not receive it?”. Those who answered “yes” were presented with eight reasons for unmet dental care needs (e.g., lack of time, mild symptoms, economic reasons, transportation issues, waiting time at dental clinics, difficulty making appointments, fear of dental treatment, and others) and asked to select one or more reasons.

2.4 Control variables

General characteristics were set as control variables, including region, gender, age, income, education level, marital status, subjective health status, alcohol consumption experience, smoking status, and the number of days walking in the past week. Regions were classified as Seoul, metropolitan cities, and other regions. Age groups were defined as 29 years and below, 30-39 years, 40-49 years, 50-59 years, 60-69 years, and 70 years and above. Income was categorized as low, lower-middle, upper-middle, and high based on the information provided in the Korea National Health and Nutrition Examination Survey. Education levels were divided into elementary school or below, middle school, high school, and college or above. Marital status was classified as married or unmarried. Subjective health status was categorized as poor, fair, or good. Alcohol consumption experience was classified as yes or no, and smoking status was categorized as current smoker, former smoker, or non-smoker. The number of days walking in the past week was classified as none, 1-2 days, 3-4 days, 5-6 days, and every day.

2.5 Analytical approach and statistics

The statistical analysis employed logistic regression to examine the relationship between oral health management, daily toothbrushing habits, the number of oral health care products used, and the occurrence of unmet dental care needs, while controlling for sociodemographic variables, health status, and health behaviors of the study participants. Data cleaning and statistical analyses were performed using SAS ver. 9.4 (SAS Institute Inc., Cary, NC, USA). Statistical significance was tested at a 5% significance level.

3. Results

3.1 General characteristics of study participants and their association with unmet dental care needs

Table 1 presents the results of the analysis of the general characteristics of study participants and their association with unmet dental care needs. Out of the 9,299 participants, 6,275 (68.6%) reported experiencing unmet dental care needs. Additionally, 9,123 participants (98.4%) indicated that they brushed their teeth yesterday. Among those who brushed their teeth, 6,164 (68.6%) reported experiencing unmet dental care needs. Among the 176 participants (1.6%) who did not brush their teeth yesterday, 111 (65.9%) reported experiencing unmet dental care needs. Furthermore, out of the 409 participants (4.7%) who used three or more oral health care products, 332 (83.4%) reported unmet dental care needs. Among the 4,632 participants (51.2%) who used 1-2 products, 3,295 (71.4%) reported experiencing unmet dental care needs.

Table 1. General characteristics of study participants and their association with unmet dental care needs

	Unmet dental medical needs									
	TOTAL			NO			YES			
	N	%	%*	N	%	%*	N	%	%*	P-value
Whether you brushed your teeth yesterday										0.528
No	176	1.9	1.6	65	36.9	34.1	111	63.1	65.9	
Yes	9,123	98.1	98.4	2,959	32.4	31.4	6,164	67.6	68.6	
Products used for oral health (units)										<.0001
0	4,258	45.8	44.1	1,610	37.8	36.3	2,648	62.2	63.7	
1-2	4,632	49.8	51.2	1,337	28.9	28.6	3,295	71.1	71.4	
Over 3	409	4.4	4.7	77	18.8	16.6	332	81.2	83.4	
Region										0.041
Seoul	1,814	19.5	19.8	527	29.1	28.6	1,287	71.0	71.4	
Metropolitan region	2,415	26	27.6	760	31.5	30.6	1,655	68.5	69.4	
Etc	5,070	54.5	52.6	1,737	34.3	32.9	3,333	65.7	67.1	
Sex										<.0001
Male	3,990	42.9	48.7	1,169	29.3	28.5	2,821	70.7	71.5	
Female	5,309	57.1	51.3	1,855	34.9	34.3	3,454	65.1	65.7	
Age										<.0001
Under 29 years	1,013	10.8	16.7	268	26.5	24.4	745	73.5	75.6	
30-39 years	1,433	15.4	17.3	501	35.0	35.3	932	65.0	64.7	
40-49 years	1,753	18.9	20.9	550	31.4	31.1	1,203	68.6	68.9	
50-59 years	1,871	20.1	21.4	595	31.8	30.9	1,276	68.2	69.1	
60-69 years	1,653	17.8	13.2	556	33.6	33.2	1,097	66.4	66.9	
Over 70 years	1,576	17	10.5	554	35.2	35.8	1,022	64.9	64.2	
Income										<.0001
Low	1,821	19.6	15.9	709	38.9	38.2	1,112	61.1	61.8	
Middle-low	2,222	23.9	22.8	850	38.3	38.6	1,372	61.8	61.4	
Middle-high	2,506	27	28.9	804	32.1	31.6	1,702	67.9	68.4	
High	2,750	29.5	32.4	661	24.0	22.9	2,089	76.0	77.1	
Educational level										<.0001
Under elementary school	1,961	21.1	14.8	795	40.5	40.5	1,166	59.5	59.5	
Middle school	959	10.2	9.1	357	37.2	36.8	602	62.8	63.2	
High school	2,906	31.3	34.4	934	32.1	31.7	1,972	67.9	68.3	
College	3,473	37.4	41.7	938	27.0	26.9	2,535	73.0	73.1	
Marital status										0.000
Married	7,881	84.7	78.2	2,614	33.2	32.6	5,267	66.8	67.4	
Unmarried	1,418	15.3	21.8	410	28.9	27.3	1,008	71.1	72.7	
Self-rated health										<.0001
Low	2,543	27.3	28.8	616	24.2	23.7	1,927	75.8	76.3	
Middle	4,836	52	52.7	1,557	32.2	31.3	3,279	67.8	68.7	
High	1,920	20.7	18.5	851	44.3	43.9	1,069	55.7	56.1	
Experience of alcohol intake										0.424
No	1,098	11.8	9.5	365	33.2	32.7	733	66.8	67.3	
Yes	8,201	88.2	90.5	2,659	32.4	31.3	5,542	67.6	68.7	

	Unmet dental medical needs									
	TOTAL			NO			YES			
	N	%	%*	N	%	%*	N	%	%*	P-value
Smoking status										<.0001
Smoker	1,642	17.7	21.3	624	38.0	35.9	1,018	62.0	64.1	
Past-smoker	1,992	21.4	21.5	561	28.2	27.4	1,431	71.8	72.6	
Non-smoker	5,665	60.9	57.2	1,839	32.5	31.3	3,826	67.5	68.7	
Weekly walking exercise										<.0001
Never	1,759	18.9	17	694	39.5	39.2	1,065	60.6	60.8	
1-2	1,547	16.6	16.8	527	34.1	33.1	1,020	65.9	66.9	
3-4	1,886	20.3	20.6	585	31.0	30.5	1,301	69.0	69.5	
5-6	1,542	16.6	17.6	489	31.7	30.3	1,053	68.3	69.7	
Every	2,565	27.6	28	729	28.4	27.2	1,836	71.6	72.8	
	9,299	100.0	100.0	3,024	32.5	31.4	6,275	67.5	68.6	

3.2 Association between brushing habits, number of oral health care products used, and unmet dental care needs

Table 2 presents the results of assessing the association between brushing habits, the number of oral health care products used, and unmet dental care needs after adjusting for covariates. Participants who did not brush their teeth yesterday had an unmet dental care rate 0.835 times lower (OR: 0.835, 95% CI: 0.555-1.256, P-value: 0.386) than those who did, but this difference was not statistically significant. Additionally, participants using 1-2 oral health care products had a 1.975 times higher rate of unmet dental care needs (OR: 1.975, 95% CI: 1.443-2.702, P-value: <.0001), while those using no products had a 2.664 times higher rate (OR: 2.664, 95% CI: 1.942-3.653, P-value: <.0001). This indicates a statistically significant inverse relationship between the number of oral health care products used and the likelihood of unmet dental care needs.

Table 2. Association between brushing habits, number of oral health care products used, and unmet dental care needs

	Unmet dental medical needs			
	OR	95%CI		P-value
Whether you brushed your teeth yesterday				
No	0.835	0.555	1.256	0.386
Yes	1.000			
Products used for oral health (units)				
0	2.664	1.942	3.653	<.0001
1-2	1.975	1.443	2.702	<.0001
Over 3	1.000			
Region				
Seoul	0.964	0.828	1.122	0.632
Metropolitan region	0.903	0.781	1.043	0.165
Etc	1.000			

	Unmet dental medical needs			
	OR	95%CI		P-value
Sex				
Male	1.000			
Female	0.666	0.574	0.773	<.0001
Age				
Under 29 years	0.959	0.695	1.324	0.800
30-39 years	1.668	1.305	2.133	<.0001
40-49 years	1.342	1.070	1.683	0.011
50-59 years	1.226	0.992	1.515	0.060
60-69 years	1.097	0.914	1.317	0.320
Over 70 years	1.000			
Income				
Low	1.596	1.321	1.928	<.0001
Middle-low	1.820	1.556	2.128	<.0001
Middle-high	1.395	1.203	1.617	<.0001
High	1.000			
Educational level				
Under elementary school	1.261	1.021	1.556	0.031
Middle school	1.198	0.941	1.524	0.141
High school	1.122	0.986	1.276	0.080
College	1.000			
Marital status				
Married	0.997	0.808	1.230	0.977
Unmarried	1.000			
Self-rated health				
Low	1.000			
Middle	0.494	0.419	0.582	<.0001
High	0.649	0.566	0.745	<.0001
Experience of alcohol intake				
No	0.891	0.743	1.070	0.215
Yes	1.000			
Smoking status				
Smoker	1.471	1.237	1.748	<.0001
Past-smoker	1.056	0.885	1.259	0.546
Non-smoker	1.000			
Weekly walking exercise				
Never	1.351	1.143	1.598	0.001
1-2	1.195	1.015	1.407	0.033
3-4	1.112	0.938	1.319	0.222
5-6	1.123	0.954	1.321	0.162
Every	1.000			

3.3 Association between brushing habits, number of oral health care products used, and unmet dental care needs by gender

Table 3 analyzes the association between brushing habits, the number of oral health care products used, and unmet dental care needs by gender. In males, compared to those using three or more oral health care products, participants using 1-2 products had a 2.699 times higher unmet dental care rate (OR: 2.699, 95% CI: 1.555-4.685, P-value: 0.001), and those using no products had a 3.239 times higher rate (OR: 3.239, 95% CI: 1.853-5.660, P-value: <.0001). Similarly, in females, participants using 1-2 products had a 1.670 times higher unmet dental care rate (OR: 1.670, 95% CI: 1.165-2.395, P-value: 0.005), and those using no products had a 2.505 times higher rate (OR: 2.505, 95% CI: 1.736-3.615, P-value: <.0001). These findings highlight a statistically significant relationship between oral health care practices, gender, and unmet dental care needs.

Table 3. Association between brushing habits, number of oral health care products used, and unmet dental care needs by gender

	Unmet dental medical needs							
	Male				Female			
	OR	95%CI		P-value	OR	95%CI		P-value
Whether you brushed your teeth yesterday								
No	0.858	0.508	1.450	0.566	0.770	0.411	1.442	0.413
Yes	1.000				1.000			
Products used for oral health (units)								
0	3.239	1.853	5.660	<.0001	2.505	1.736	3.615	<.0001
1-2	2.699	1.555	4.685	0.001	1.670	1.165	2.395	0.005
Over 3	1.000				1.000			
Region								
Seoul	1.024	0.816	1.285	0.839	0.904	0.762	1.073	0.249
Metropolitan region	0.891	0.725	1.095	0.273	0.919	0.774	1.091	0.335
Etc	1.000				1.000			
Age								
Under 29 years	1.127	0.719	1.765	0.602	0.845	0.540	1.322	0.459
30-39 years	1.970	1.384	2.804	0.000	1.452	1.035	2.038	0.031
40-49 years	1.703	1.231	2.356	0.001	1.065	0.770	1.474	0.702
50-59 years	1.613	1.189	2.189	0.002	0.956	0.711	1.284	0.763
60-69 years	1.394	1.030	1.886	0.032	0.910	0.711	1.166	0.457
Over 70 years	1.000				1.000			
Income								
Low	1.735	1.295	2.323	0.000	1.479	1.182	1.849	0.001
Middle-low	1.955	1.556	2.456	<.0001	1.698	1.382	2.086	<.0001
Middle-high	1.376	1.089	1.739	0.008	1.400	1.164	1.685	0.000
High	1.000				1.000			

	Unmet dental medical needs							
	Male				Female			
	OR	95%CI		P-value	OR	95%CI		P-value
Educational level								
Under elementary school	1.269	0.923	1.743	0.142	1.198	0.898	1.599	0.219
Middle school	1.156	0.829	1.611	0.393	1.205	0.877	1.655	0.250
High school	1.118	0.915	1.365	0.276	1.136	0.943	1.368	0.180
College	1.000				1.000			
Marital status								
Married	0.955	0.724	1.258	0.741	1.072	0.777	1.478	0.673
Unmarried	1.000				1.000			
Self-rated health								
Low	1.000				1.000			
Middle	0.576	0.439	0.754	<.0001	0.434	0.351	0.537	<.0001
High	0.691	0.543	0.880	0.003	0.626	0.524	0.748	<.0001
Experience of alcohol intake								
No	1.046	0.675	1.621	0.839	0.823	0.680	0.995	0.045
Yes	1.000				1.000			
Smoking status								
Smoker	1.471	1.180	1.833	0.001	1.435	1.056	1.951	0.021
Past-smoker	1.044	0.826	1.320	0.717	1.134	0.841	1.529	0.407
Non-smoker	1.000				1.000			
Weekly Walking exercise								
Never	1.714	1.354	2.168	<.0001	1.065	0.851	1.332	0.582
1-2	1.347	1.047	1.734	0.021	1.067	0.874	1.301	0.523
3-4	1.351	1.066	1.712	0.013	0.926	0.747	1.149	0.484
5-6	1.227	0.965	1.560	0.095	1.038	0.840	1.284	0.727
Every	1.000				1.000			

4. Discussion

Unmet dental care needs serve as an indicator that is widely used to assess the performance of healthcare insurance systems, aiming to understand and provide high-quality healthcare services to meet the demands of the population (Choi & Hwang, 2016; Shin, 2013). While timely and appropriate healthcare services can prevent unmet healthcare needs, dental care, with many non-covered items, poses equity issues, especially for low-income groups. Disparities in oral health are influenced by both socioeconomic factors and physical environments, emphasizing the importance of understanding relevant socioeconomic factors for preventing oral diseases (Johnson, 1991; Jin et al., 2015). According to previous studies (Moon, 2016), unmet dental care needs were highest in the 'low' income category at 31.6%, with 'economic burden' being the most significant contributing factor at 58.1%. The unmet dental care rate was 1.27 times higher in the 'low' income category compared

to the ‘high’ income category, indicating that individuals with lower income levels are less likely to receive dental care (Baldani et al., 2011; Boggess et al., 2010; Weich, Lewis, & Jenkins, 2002).

Continuous increases in out-of-pocket medical expenses can lead to economic hardships for low-income individuals. Thus, policies are needed to alleviate this issue (Lee et al., 2013). A long-term solution involves improving overall coverage rates. High out-of-pocket expenses can further burden the healthcare costs of low-income groups (Kawabata, Xu, & Carrin, 2002; Wagstaff & Van Doorslaer, 2001). Therefore, a review of overburdened medical expenses and the level of unmet healthcare needs within income brackets among health insurance beneficiaries is essential (Lee et al., 2013). Potential measures to alleviate the burden on low-income groups within health insurance include reducing insurance premiums (Shin et al., 2010) and integrating national health insurance and medical aid systems (Shin, 2015). Defining a new category of low-income individuals for health insurance, accompanied by creating fundamental data on the healthcare protection level of low-income groups, can inform revised policies and strengthen healthcare safety nets (Choi, 2017).

Oral health is crucial for an individual’s daily activities, impacting their ability to eat, speak, and engage in social activities without discomfort. Poor oral health not only affects internal bodily functions but also has external consequences (WHO, 2003; Kim et al., 2004). Individuals with unhealthy oral conditions may face limitations in communication and social life due to difficulty in pronunciation. Moreover, it can lead to negative aesthetic impressions, resulting in lowered self-esteem and psychological stress (Park, 2015). Oral health is closely linked to overall health, significantly impacting the quality of life (Petersen, 2003).

As the perception of poor oral health increases, anxiety about oral health management grows. Anxiety about dental care can lead to delayed or avoided dental visits (Jeon, Chung, & Kim, 2012). The high prevalence of unmet dental care, despite a desire for dental treatment, indicates a lack of knowledge and awareness regarding oral health. Higher awareness of oral health has been associated with a lower incidence of periodontal tissue disorders and increased experience of dental caries, with lower frequencies of toothache (Lee, 2009). People with an interest in oral health tend to engage in more frequent tooth brushing (Kim, 2006), undergo more frequent oral examinations (Sabbah, 2009), and experience.

lower levels of unmet dental care in recent times (Song & Yoon, 2019). The efficient enhancement of oral health programs and strengthening preventive policies through public health initiatives are imperative (Kim & Lim, 2018). Encouraging regular dental check-ups and early treatment through professional dental visits, along with providing guidance on proper at-home oral health management, is essential for raising public awareness of the importance of oral health (Kim, 1987; Song, 2000).

This study is based on a portion of the 7th Korea National Health and Nutrition Examination Survey data, which has limitations in explaining clear causal relationships between variables. The reasons for unmet dental care needs may vary among respondents, making the relationship between independent and dependent variables not entirely independent. Several issues exist in data compilation. Firstly, as it is a self-administered survey, objective measurement may be challenging. Secondly, information on participants’ oral health status, their usual interest in oral health, and management practices cannot be determined solely from whether they brushed their teeth yesterday. Thirdly, while explanations for males and females separately are provided in the results, a direct comparison

of differences between genders is not possible. Nevertheless, this study integrates and analyzes data over three years from a nationally representative sample in South Korea, offering valuable insights into the unequal patterns of unmet dental care among adults based on their perception and interest in oral health, as well as their socioeconomic status. It lays the foundation for proposing measures to enhance access to dental care for low-income populations in the future.

5. Conclusion

This study aimed to investigate the impact of toothbrushing, and the number of oral care products used on unmet dental care needs. The results indicate that as the frequency of toothbrushing and the number of oral care products increase, the likelihood of experiencing unmet dental care needs decreases. Therefore, the study sought to understand the level of awareness and interest in oral health and proposed measures such as strengthening preventive policies through public health initiatives. Additionally, the study explored ways to mitigate healthcare inequalities based on socioeconomic status by adjusting medical expenses and enhancing the accessibility of dental care services.

Conflicts of Interest

No author has any other conflict of interest to declare.

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