The Correlation between Sugar-Containing Food Consumption Type and Dental Clinic Use in Adults

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Objective: This study aimed to investigate the general characteristics of those in their twenties and thirties, determine the association between the frequency and number of sugar-containing food consumptions and dental clinic visit, identify the factors possibly affecting dental clinic use, and suggest the need for a customized oral health program.

Methods: The 2019 raw data from the Korea National Health and Nutrition Examination Survey (KNHANES VIII-1) were used to make a sample of 1,141 respondents aged 20-39, with the exception of missing data. Frequency analysis was performed for variation in the general characteristics, sugar-containing food consumption, and dental clinic use, and descriptive statistics and chi-square test were used to estimate the mean and standard deviation.

Results: As for the effects of the general characteristics, health behavior, and sugar-containing food consumption on dental clinic use, smoking and confectionery and beverage with lactic acid bacteria among the types of sugar-containing food were found to be significant factors.

Conclusion: As for dental clinic use by the frequency of consuming sugar-containing food, the more consumption of processed fruits, confectionery, and beverage with lactic acid bacteria, the higher frequency of dental clinic use; in particular, the larger number of times consuming beverage with lactic acid bacteria, the higher frequency of dental clinic use. It is necessary to investigate and analyze these relevant factors and develop oral health promotion programs and make a plan for oral disease prevention projects with the objective of managing oral health and nutrition efficiently, taking the characteristics of each target into consideration.

Keywords: adult, sugar, food consumption, dental clinic use

Introduction

In South Korea, household type has been changed with the

structural changes in the society as economic growth began. The data from the Population and Housing Census showed that the percentage of single-person and single-generation households increased constantly to form 30.2% and 18.4% of all the households, respectively, by 2019, whereas that of two-generation households decreased, forming 45.3% by 2019 [1]. The increase in the number of single-person households among young people is probably due to the expansion of late marriage and non-marriage and the increase in the single population. The number of single-person households with the house-

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holders in their thirties or younger almost doubled from 1 million in 2000 to 1.99 million in 2017. The number of single-person households with the householders in their thirties or younger is reportedly expected to reach approximately 2.13 million by 2025 and gradually decrease afterward [2].

The number of household members and the increase of single-person households affect all the industries, including housing, food, and domestic appliances, and the effects are especially remarkable in the food market. Home meal replacement in the process of purchasing, cooking, and consuming food has notable advantages of being convenient, time-saving, more inexpensive than eating-out, and tasty. These advantages have played major roles in inducing consumers to make positive consumption [3]. Instead of bearing expenses and inconvenience caused by cooking time, cooking methods, and cleaning, they prefer convenient food consumption and increasingly use a meal kit, such as semi-cooked food or cooked home meal replacement, for a meal.

Meal kits as a means of having a simple meal have been confirmed by the increase in consumption of instant dishes, drinks, sauce, noodles, and dressing [4]. The increase in processed food consumption has one faced with nutritional imbalance due to overconsumption of potassium and sugar rather than balanced consumption of nutrients [5].

While sugar is an important ingredient that can generate large energy even in a small amount and forms cell membranes, it can arouse diverse problems in case of overconsumption. Overconsumption of sugar is known to adversely affect health by causing many different types of adult disease, including obesity and diabetes, and become one of the causes of oral diseases, such as dental caries [6].

The contemporary diet in which at least a half of total sugar intake comes from processed food [7] is a cause of the increased dental caries and periodontal disease and affects dental caries because it is characterized by refinement to remove the need of hard chewing as well as by easy attachment to the surface of teeth [8].

While dental caries has diverse, complex causes, its occurrence can be reduced by controlling sugar intake. Sugar control is to regulate eating habits and diets so that one can reduce the number and amount of sugar consumptions by removing environmental factors [9]. Eating sugar-containing food in several portions exerts more adverse effects on dental caries than eating it all at once. This implies that the number of consumptions or the physical appearance of food has stronger effects than the volume of intake [10].

This study aimed to compare dental clinic visits by sugar intake via food, which became a new social issue, among young adults, who form a large percentage of single-person and

small-sized households, and provide basic data that could help promote oral health and nutritional status.

Materials and Methods

1. Subjects

The 2019 raw data from the relevant items and the survey on food consumption frequency in the Korea National Health and Nutrition Examination Survey (KNHANES VIII-1) were combined to make a final sample of 1,141 respondents aged between 20 and less than 40, with the exception of those containing missing data.

2. Instruments

The respondents' general characteristics included gender, age, education, occupation, and household income, and health behavior involved alcohol intake and smoking status. The criteria for dental clinic use, which is a dependent variable, were limited to the respondents to the questions as to using a dental clinic to take oral examination for treatment, gum disease treatment, simple dental caries treatment, endodontic treatment, preventive treatment, tooth extraction or intra-oral surgery, traumatic tooth loss or broken tooth treatment, prosthesis, and other orthodontic and psychological treatment. Both men and women participated in this study, and the age groups were limited to those in their twenties and thirties. The education levels were divided into high school graduates or lower and college graduates or higher; household income was categorized into high, above-average, below-average, and low levels by financial status. As for occupation, they were categorized into non-blue-collar workers, including professionals, clerks, salespersons, and service providers, and blue-collar workers, including skilled farmers and fishers, technicians, and simple laborers. The respondents, including stay-at-home moms and students, who were not categorized in terms of occupation, were regarded as jobless.

Health behavior probably affecting dental clinic use involved alcohol intake and smoking status; smoking status was determined at the time of the survey and alcohol intake referred to drinking at least once a month for the past year.

Sugar-containing food was divided into sweetened drinks, sweetened coffee, fruits, processed fruits, fruit juice, confectionery, simple sugar, ice cream, candies, sauce, beverage with lactic acid bacteria, vegetable drinks, chocolate, and carbonated drinks; the survey was based on the number of consumptions a day rather than on the intake.

Table 1. General characteristics and health behavior

Variable		n	%	M ± SD (min-max)
Gender	M	529	46.4	30.73 ± 5.79 (20-39)
	F	612	53.6	
Age (yrs)	20-29	474	41.5	
	30-39	667	58.5	
Household Income	High	436	38.2	
	Above-average	342	30.0	
	Below-average	276	24.2	
	Low	87	7.6	
Education	≥ College	745	65.3	
	≤ High school	396	34.7	
Occupation	Other than blue collar	622	54.5	
	Blue collar	131	11.5	
	Jobless	388	34.0	
Alcohol intake	Drinker	756	66.3	30.73 ± 5.79 (20-39)
	Non-drinker	385	33.7	
Smoking	Smoker	236	20.7	
	Non-smoker	905	79.3	
Total		1,141	100.0	

Frequency test & descriptive statistics.

3. Statistical Analysis

Frequency analysis was performed to determine the general characteristics, health behavior, sugar-containing food consumption, and dental clinic use for the respondents; chi-square test was carried out for variation in the effects of the general characteristics, health behavior, and sugar intake type on dental clinic use. With the independent variables controlled, hierarchical logistic regression analysis was performed to identify the factors increasing dental clinic use.

Results

1. General characteristics and health behavior

As for the general characteristics, 529 respondents (46.4%) were male, 612 (53.6%) female; 474 respondents (41.5%) were aged 20-29, 667 (58.5%) aged 30-39. The mean age was 30.73 years (min 30.73 and max 39). As for household income, 436 respondents (38.2%) were at the high level, 342 (30.0%) at the above-average level, 276 (24.2%) at the below-average level, and 87 (7.6%) at the low level. 745 respondents (65.3%) were college graduates or at higher education levels, and 396 (34.7%) high school graduates or at lower education levels. 622 respondents (54.5%) were non-blue-collar workers, 131 (11.5%) were blue-collar workers, and 388 (34.4%) were jobless. As for health behavior, 756 respondents (66.3%) were drinkers, and 385 (33.7%) non-drinkers; 236 (20.7%)

were smokers, and 905 (79.3%) non-smokers (Table 1).

2. Frequency of consuming sugar-containing food

As for consuming sugar-containing food at least twice, 10 respondents (0.9%) consumed sweetened drinks and 75 (6.6%) had sweetened coffee. 307 (26.9%) had fruits. 47 (4.3%) had processed fruits. 16 (1.4%) had fruit juice. 120 (10.5%) had confectionery. 707 (62.0%) had simple sugar. 11 (1.6%) had ice cream. 9 (0.8%) had candies. 217 (19.0%) had sauce; 15 (1.3%) beverage with lactic acid bacteria; 19 (1.7%) vegetable drinks; 5 (0.4%) chocolate; and 60 (5.3%) carbonated drinks (Table 2).

3. Dental clinic use status by general characteristics and health behavior

As for dental clinic use by the general characteristics and health behavior, more women (371; 60.6%) used dental clinics than men (280; 52.9%) ($p=0.005$). The more household income, the more likely to use a dental clinic: 43 (49.4%) at the low level, 147 (53.3%) at the below-average level, 189 (55.3%) at the above-average level, and 272 (62.4%) at the high level ($p=0.027$). College graduates and those at higher education levels were more likely to use a dental clinic: 453 college graduates or higher (60.8%) and 198 high school graduates or lower (50.0%) ($p=0.001$). As for occupation, 379 non-blue-collar workers (60.9%), 62 blue-collar workers (47.3%), and 210 jobless respondents (54.1%) used a dental clinic ($p=0.006$). Non-smokers were more likely to use a dental clinic than

Table 2. Frequency of consuming sugar-containing food

Variable		n	%	M±SD (min-max)
Sweetened drink	≥2	10	0.9	0.07±0.30 (0-3)
	1	60	5.2	
	None	1,071	93.9	
Sweetened coffee	≥2	75	6.6	0.29±0.70 (0-6)
	1	144	12.6	
	None	922	80.8	
Fruit	≥2	307	26.9	1.23±2.09 (0-24)
	1	306	26.8	
	None	528	46.3	
Processed fruit	≥2	49	4.3	0.28±0.65 (0-8)
	1	199	17.4	
	None	893	78.3	
Fruit drink	≥2	16	1.4	0.10±0.37 (0-4)
	1	80	7.0	
	None	1,045	91.6	
Confectionery	≥2	120	10.5	0.48±0.79 (0-7)
	1	264	23.1	
	None	757	66.4	
Simple sugar	≥2	707	62.0	2.89±2.85 (0-21)
	1	180	15.8	
	None	254	22.2	
Ice cream	≥2	11	1.0	0.10±0.38 (0-5)
	1	81	7.1	
	None	1,049	91.9	
Candy	≥2	9	0.8	0.07±0.32 (0-5)
	1	53	4.6	
	None	1,079	94.6	
Source	≥2	217	19.0	0.80±1.29 (0-10)
	1	259	22.7	
	None	665	58.3	
Beverage with lactic acid bacteria	≥2	15	1.3	0.11±0.36 (0-3)
	1	90	7.9	
	None	1,036	90.8	
Vegetable drink	≥2	19	1.7	0.11±0.47 (0-7)
	1	74	6.5	
	None	1,048	91.8	
Chocolate	≥2	5	0.4	0.05±0.27 (0-4)
	1	47	4.1	
	None	1,089	95.5	
Carbonated drink	≥2	60	5.3	0.33±0.64 (0-5)
	1	233	20.4	
	None	848	74.3	
Total		1,141	100.0	

Frequency test & descriptive statistics.

smokers: 109 smokers (46.2%) and 542 non-smokers (59.9%) ($p<0.001$). Neither age nor alcohol intake made any difference in dental clinic use ($p>0.05$) (Table 3).

4. Dental clinic use status by frequency of consuming sugar-containing food

As for dental clinic use by frequency of consuming sug-

ar-containing food, the higher intake of processed fruits, the less likely to use a dental clinic: 23 (46.9%) eating them at least twice, 127 (63.8%) eating them once, and 501 (56.1%) eating none of them ($p=0.048$). The higher intake of confectionery, the more likely to use a dental clinic: 84 (70.0%) eating it at least twice, 156 (59.1%) eating it once, and 411 (54.3%) eating none of them ($p=0.004$). The higher intake of

Table 3. Dental clinic use status by general characteristics and health behavior

Variable	Use of dental clinic	Non-use of dental clinic	χ^2 (p)
Gender			
M	280 (52.9)	249 (47.1)	6.539 (0.011)
F	371 (60.6)	241 (39.4)	
Age (yrs)			
20-29	272 (57.4)	202 (42.6)	0.016 (0.898)
30-39	379 (56.8)	288 (43.2)	
Household Income			
High	272 (62.4)	164 (37.6)	9.192 (0.027)
Above-average	189 (55.3)	153 (44.7)	
Below-average	147 (53.3)	129 (46.7)	
Low	43 (49.4)	44 (50.6)	
Education			
$\geq$ College	453 (60.8)	292 (39.2)	11.884 (0.001)
$\leq$ High school	198 (50.0)	198 (50.0)	
Occupation			
Other than blue collar	379 (60.9)	243 (39.1)	10.236 (0.006)
Blue collar	62 (47.3)	69 (52.7)	
Jobless	210 (54.1)	178 (45.9)	
Alcohol intake			
Drinker	436 (57.7)	320 (42.3)	0.277 (0.599)
Non-drinker	215 (55.8)	170 (44.2)	
Smoking			
Smoker	109 (46.2)	127 (53.8)	13.791 (<0.001)
Non-smoker	542 (59.9)	363 (40.1)	
Total	651 (53.1)	490 (46.9)	

Chi-square test.

beverage with lactic acid bacteria, the more likely to use a dental clinic: 12 (80.0%) drinking it at least twice, 60 (66.0%) drinking it once, and 579 (55.9%) drinking none of it ($p=0.027$) (Table 4).

5. Dental clinic use status by sugar-containing food consumption

Hierarchical logistic regression analysis was performed to identify the factors increasing dental clinic use by sugar-containing food intake; in Model 1, which only covered the general characteristics and health behavior, smoking was a factor for dental clinic use: smokers were more likely to use a dental clinic than non-smokers, with $OR=1.099$ ($p=0.016$). In Model 2, which covered the general characteristics, health behavior, and sugar-containing food intake, smoking, confectionery intake, and beverage with lactic acid bacteria were found to be the factors. Those who were smokers, with $OR=1.095$ ($p=0.021$), who had more confectionery, with $OR=1.049$ ($p=0.009$), and who drank more beverage with lactic acid bacteria, with $OR=1.106$ ($p=0.013$) were more likely to use a dental clinic (Table 5).

Discussion

In the South Korean society, as the number of single-person and small-sized households increases, issues related to health and dietary life become new social ones [11]. The increase of small-sized households leads to the tendency to replace a meal by semi-cooked or cooked food, which requires no personal cooking at home, and this phenomenon is expected to prevent today's people from having a balanced diet due to the change in dietary life and adversely affect oral health. This study was conducted in those aged 20-39 to characterize young adults and aimed to determine association between type and frequency of sugar-containing food consumption and status and frequency of using a dental clinic and provide basic data that could help promote and maintain oral health so that they could consume sugar-containing food correctly.

Women, non-blue-collar workers, those at a higher education level, and those at a higher income level used a dental clinic more frequently. Similar to the results of Park et al. [12], financial status and sufficient time seem to be associated with dental clinic use.

As for oral health behaviors, non-smokers were more likely

Table 4. Dental clinic use status by frequency of consuming sugar-containing food

Variable		Use of dental clinic	Non-use of dental clinic	χ^2 (p)
Sweetened drink	≥ 2	4 (40.0)	6 (60.0)	1.205 (0.547)
	1	34 (56.7)	26 (43.3)	
	None	613 (57.2)	458 (42.8)	
Sweetened coffee	≥ 2	40 (53.3)	35 (46.7)	1.458 (0.482)
	1	77 (53.5)	67 (46.5)	
	None	534 (57.9)	388 (42.1)	
Fruit	≥ 2	184 (59.9)	123 (40.1)	4.283 (0.118)
	1	183 (59.8)	123 (40.2)	
	None	284 (53.8)	244 (40.2)	
Processed fruit	≥ 2	23 (46.9)	26 (43.1)	6.093 (0.048)
	1	127 (63.8)	72 (36.2)	
	None	501 (56.1)	392 (56.1)	
Fruit drink	≥ 2	11 (68.8)	5 (31.3)	2.013 (0.366)
	1	50 (62.5)	30 (37.5)	
	None	590 (56.5)	455 (43.5)	
Confectionery	≥ 2	84 (70.0)	36 (30.0)	11.010 (0.004)
	1	156 (59.1)	108 (40.9)	
	None	411 (54.3)	346 (45.7)	
Simple sugar	≥ 2	418 (59.1)	289 (40.9)	3.756 (0.153)
	1	93 (51.7)	87 (48.3)	
	None	140 (55.1)	114 (44.9)	
Ice cream	≥ 2	6 (54.5)	5 (45.5)	0.596 (0.742)
	1	43 (53.1)	38 (46.9)	
	None	602 (57.4)	447 (42.6)	
Candy	≥ 2	6 (66.7)	3 (33.3)	2.204 (0.332)
	1	35 (66.0)	18 (34.0)	
	None	610 (56.5)	469 (43.5)	
Source	≥ 2	124 (57.1)	93 (42.9)	0.163 (0.922)
	1	145 (55.9)	114 (44.1)	
	None	382 (57.4)	283 (42.6)	
Beverage with lactic acid bacteria	≥ 2	12 (80.0)	3 (20.0)	7.192 (0.027)
	1	60 (66.0)	30 (33.3)	
	None	579 (55.9)	457 (44.1)	
Vegetable drink	≥ 2	14 (73.7)	5 (26.3)	2.241 (0.326)
	1	41 (55.4)	33 (44.6)	
	None	596 (56.9)	452 (43.1)	
Chocolate	≥ 2	3 (60.0)	2 (40.0)	4.701 (0.095)
	1	34 (72.3)	13 (27.7)	
	None	614 (56.4)	475 (43.6)	
Carbonated drink	≥ 2	33 (55.0)	27 (45.0)	0.504 (0.777)
	1	129 (55.4)	104 (44.6)	
	None	489 (57.7)	359 (42.3)	
Total		651 (53.1)	490 (46.9)	

Chi-square test.

to use a dental clinic than smokers. Similarly, Jang et al. [13] found that non-smokers were more likely to get dental check-up regularly and Jeong et al. [14] found that non-smokers aged 20-29 were more likely to visit a dental clinic.

Previous research related to snack intake and oral health primarily focused on childhood and adolescence susceptible to dental caries [6,12,15] and some studies were conducted on

adulthood [16]. The issue of oral health in adulthood remains at a high level and can be accumulated constantly, even affecting oral health in old age; therefore, it is necessary to intervene actively in the risk factors for oral diseases in adulthood.

The rapid industrialization and Westernization process has also brought about a lot of changes in dietary lifestyle in South Korea and, particularly, increased consumption of processed

Table 5. Dental clinic use status by sugar-containing food consumption

Variable	Model 1			Model 2		
	B	OR	p	B	OR	p
(Intercept)	0.112	1.119	0.206	0.110	1.116	0.212
Gender-M (ref: F)	0.037	1.037	0.256	0.033	1.034	0.303
Household Income	0.030	1.031	0.054	0.028	1.029	0.071
Education-College or higher (ref. ≤High school)	0.056	1.057	0.092	0.059	1.061	0.072
Occupation - other than blue collar (ref: Blue collar)	0.074	1.078	0.132	0.058	1.060	0.240
Occupation - Jobless (ref: Blue collar)	0.026	1.026	0.619	0.015	1.015	0.770
Smoking - Non-smoker (ref. Smoking)	0.095	1.099	0.016	0.091	1.095	0.021
Processed fruit				-0.022	0.978	0.314
Confectionery				0.048	1.049	0.009
Beverage with lactic acid bacteria				0.101	1.106	0.013

Hierarchical Logistic Regression Analysis.

foods. The increase in processed food intake causes the problem of overconsumption of fat and sugar [17], which can lead to nutritional imbalance, causing cardiovascular disease, cancer, diabetes, obesity, hypertension, and so on [18].

The main source of sugar intake is beverage among processed foods and most types of beverage consist of water and sugar, which may affect oral health—damage to hard tissues of teeth—as well as general health. Coffee was most frequently consumed: many adults drank 2-3 cups of coffee a day and an average of 11.5 cups of coffee a week. South Korean people consume a total of 58.9 g sugar a day, the highest percentage of which (36.4 g; 61.8%) comes from processed foods [19]. Sweetened coffee drinks are representative sweetened drinks, increased intake of which is reportedly related to obesity, body weight gain, diabetes, and cardiovascular disease outbreak [20,21]. Lee et al. [16] found that both dental caries and periodontal disease were associated with dietary behavior of having sugar-containing snacks three times a day; particularly, frequent consumption of sugar-containing food was significantly associated with the prevalence of periodontal disease even after adjusting the risk factors for periodontal disease, such as tooth-brushing and smoking. 20.7% of those with dental caries in permanent teeth and 25.8% of those with periodontal disease were found to have sugar-containing snacks at least three times a day and the group having snacks at least three times a day had an odds ratio of periodontal disease occurrence 1.51 times higher than the group having them not more than six times a week when the general characteristics and oral health behaviors were adjusted. This finding is consistent with the result of this study that the number of dental clinic uses was larger in the group having sweetened foods at least once a day than in the group having none of them.

The World Dental Federation recommended applying the

combination of the policies covering general health and the area of oral disease and indicated representative dietary habits harmful to health as oral health forms a main axis of general health and healthy life and has risk factors common to non-infectious disease [22].

Conclusion

The 2019 raw data from the Korea National Health and Nutrition Examination Survey (KNHANES VIII-1) were used to make a sample of 1,141 respondents aged 20-39, with the exception of missing data. Dental clinic use by sugar-containing food consumption and oral health behaviors was investigated, obtaining the following results:

1. As for the association between the respondents' general characteristics and dental clinic use, those who were female, who had more household income, who were more educated, and who were non-blue-collar workers were more likely to use a dental clinic. As for health behavior, non-smokers used it more frequently.

2. As for dental clinic use by the frequency of consuming sugar-containing food, the more consumption of processed fruits, confectionery, and beverage with lactic acid bacteria, the higher frequency of dental clinic use; in particular, the larger number of times consuming beverage with lactic acid bacteria, the higher frequency of dental clinic use.

3. Logistic regression analysis of dental clinic use by sugar-containing food consumption showed that non-smokers were more likely to use a dental clinic than smokers, with OR=1.095 (p=0.021). The higher intake of confectionery and beverage with lactic acid bacteria, the more likely to use a dental clinic.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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