JTS

The Journal of Transdisciplinary Studies, 5(2): 75-86, 2021
https://doi.org/10.22685/JTS.2021.5.2.75

A Relationship Between Oral Health and Obesity of Cardiovascular Disease for Those Aged 40 or Older

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ARTICLE INFO

Article history:
Received 26 Jul 2021
Revised 03 Sep 2021
Accepted 03 Sep 2021

Keywords:
Cardiovascular Disease,
Obesity,
Oral Health Behavior,
Oral Health Status

ABSTRACT

This study has analyzed the relationship between the oral health status, oral health behavioral status, and obesity targeting 2,110 adults aged 40 years or older who were diagnosed with the cardiovascular disease, and identified the need for a proper weight management and healthy oral care practice for the oral health behavior, with a view to prepare the basic data thereto by analyzing the raw data of the 8th annual raw data for the National Health and Nutrition Examination Survey (2019). As for the oral health behavior of the subjects, the frequency of brushing per day for the obesity group turned out to be the highest at 51.6% ($p<0.01$), and as for the oral care product other than toothbrush or toothpaste, the use of toothpaste solution turned out to be high at 54.6% ($p<0.01$). The probability of becoming obese among the obesity group without drinking experiences turned out to be 0.198 times higher than among the obesity group with drinking experiences. Considering the results of this study, there were no significant differences found in terms of the oral health status and oral health behavior status among the patients with cardiovascular disease belonging to the obesity group, yet it was found to be related to the differences according to the lifelong drinking experience. Hence, it is determined that the obesity management among the patients with cardiovascular disease is required via the systemic and oral health behaviors and appropriate physical activities in daily life.

1. Introduction

Today, chronic diseases such as high blood pressure and diabetes are rapidly increasing given numerous changes taking place in the lifestyle and diet (Park et al., 2013). Chronic diseases are a risk factor for the cardiovascular and cerebrovascular disease (Korea Centers for Disease Control and Prevention, 2020), and it turned out that more than half of the patients with chronic kidney

disease and diabetes have had cardiovascular disease (Kim & Kwak, 2011).

Cardiovascular disease is the second largest cause of death, excluding cancer, among all the deceased in Korea in 2019 (Statistics Korea, 2020), and prevention and management are very important. In particular, in connection with obesity, which is one of the risk factors for the cardiovascular disease (Korea Centers for Disease Control and Prevention, 2020), it has been reported that the higher the percentage of the fat accumulated in the body, the higher the probability of contracting such diseases as hypertension and hyperlipidemia (Park et al., 2013). According to the National Health and Nutrition Examination Survey, and from 2014 until 2019, the prevalence of obesity among the adults aged 30 or older has increased from 39.5% to 42.4% for men and from 25.7% to 27.7% for women (Korea Centers for Disease Control and Prevention, 2019). In connection with obesity, the high body mass index and waist and ratio not only increase the risk of cardiovascular disease (Park et al., 2013; Lee & Park, 2013; Kim at al., 2018; Park, 2018; Song & Jung, 2018), but also cause oral diseases such as periodontal disease directly or indirectly given the irregular lifestyle and the negligence in the oral health behavior following less physical activities undertaken relative to normal people (Song & Jung, 2018; Lee & Choi, 2017; Kim, 2016). Periodontal disease can act as a systemic risk factor such as tooth loss, oral tooth extraction, and diabetes among the senior citizens, yet it may be controlled with prevention and treatment via regular dental visits and oral health behaviors (Choi & Kim, 2009; Kang, 2019; Moon et al., 2020), and hence, weight control is required for the healthy oral health behavior as well.

Kim et al. (Kim et al., 2013) reported that the most obese they are, the higher the risk of oral disease contraction, such as 2.26±2.125 for the dental caries relate experiences, while Nelson et al. (Nelson et al., 2003) reported that the higher the obesity index, the higher the probability of inducing periodontal disease. Saito (Saito et al., 2001), etc., reported that the higher the body mass index, the higher the number of experienced permanent dental caries and gingival bleeding. Many previous studies have reported that there is a close relationship between the cardiovascular disease and obesity, obesity, and oral health (Kim et al., 2018; Kim, 2018; Song & Jung, 2018), yet the studies on oral health and obesity for the adults aged 40 or older with the cardiovascular disease are inadequate.

Accordingly, this study has analyzed the relationship between the oral health status, oral health behavior status, and obesity for the adults aged 40 or older, who were diagnosed with the cardiovascular disease to spread the awareness of the need for a proper weight management for the oral health behavior and promote the healthy oral health, while using them as the basic data for the healthy oral care practice.

2. Research Method

2.1 Research subject

Based on the 8th annual raw data of the National Health and Nutrition Examination Survey (2019), a total of 2,110 people diagnosed with cardiovascular diseases (hypertension, dyslipidemia,

myocardial infarction or angina pectoris and stroke) were selected as the final research subjects among the subjects of 4,808 adults aged 40 or older whose health questionnaire survey and oral examination were completed, excluding missing values.

2.2 Survey variable

2.2.1 Cardiovascular disease and the body mass index

The structure of those with cardiovascular disease was categorized into those diagnosed with hypertension, dyslipidemia, myocardial infarction or angina pectoris, and stroke by physicians, and as for obesity, it was restructured with "Underweight" for less than 18.5 kg/㎡ based on the body mass index (BMI, kg/㎡), "Normal" for 18.5 kg/㎡ or more and less than 25 kg/㎡, and "Obese" for 25 kg/㎡ or more. General characteristics were structured with gender (male and female), age (40-49 years old, 50-59 years old, 60-69 years old, and 70-80 years old), smoking experiences (yes or no), lifelong drinking experiences (yes or no), subjective health status (good, average, or bad), daily activity restrictions (yes or no), depression related diagnosis (yes or no), and whether weight has changed over a year.

2.2.2 Oral health status and the characteristics of oral health behavior status

In connection with the oral health of the study subjects, the oral health status was restructured with subjective oral health status (good, average, or bad), speaking and chewing problems (uncomfortable or not uncomfortable), presence of implants in the oral cavity (none or 1 or more), and whether dentures were needed (none or 1 or more). The oral health behavior includes whether one has visited dental clinic in the past year (yes or no), how many times a day one brushed yesterday (once or less, twice, 3 times or more), and whether toothbrushes and interdental brushes, gargling solution, others, and oral care products other than toothpaste are used (used or not used).

2.3 Analytical method

As for the collected data, the SPSS Statistics 20.0 (IBM Co., Armonk, NY, USA) was used, and a complex sample design was performed by applying the stratified colony variables and weighted values. The complex sample cross analysis (Chi-square test) was performed to examine and understand the differences in obesity according to the subjects' general characteristics, oral health status, and oral health behavior. As for the related factors affecting obesity among the cardiovascular disease patients, a complex sample logistic regression analysis was performed with general characteristics, oral health status, and oral health behavior status as the independent variables, with obesity as the dependent variable. The statistical significance level was set to $\alpha<0.05$.

3. Research Results

3.1 General characteristics

As a result of analyzing the general characteristics of the subjects, the men who were diagnosed with the cardiovascular disease were the most with 64.6% among those aged 40-49 ($p<0.001$), and turned out to have had experiences of smoking (89.7%) and drinking (52.4%) ($p<0.001$). 54.4% of the men perceived that their health status was good ($p<0.01$), and it turned out that they have not had restrictions in daily life due to health issues (48.0%) ($p<0.05$) and have not been diagnosed with depression by physicians (48.5%).

The females aged 70-80 turned out to be the most at 63.4% ($p<0.001$), and have had no experience of smoking (87.1%) and drinking (84.1%) ($p<0.001$). 60.0% of the women perceived that their health status was bad ($p<0.01$), and it turned out that they were diagnosed with depression by physicians (74.6%) as well as being restricted in daily life due to health issues (60.2%) ($p<0.05$) ($p<0.001$). In the past year, 64.1% of the women have demonstrated weight gains ($p<0.01$), and 48.7% of the men have demonstrated no change in their body weight ($p<0.01$) Table 1.

Table 1. General characteristics of subjects

Unit: N(%)

Characteristics	Division	Men	Women	*p**
Age(yr)	40-49	99(64.6)	70(35.4)	0.000***
	50-59	180(51.2)	240(48.8)	
	60-69	294(46.4)	391(53.6)	
	70-80	325(36.6)	511(63.4)	
Smoking status	Yes	735(89.7)	100(10.3)	0.000***
	No	147(12.9)	1086(87.1)	
Alcohol experience (whole life)	Yes	832(52.4)	856(47.6)	0.000***
	No	51(15.9)	333(84.1)	
Perceived health status	Good	204(54.4)	190(45.6)	0.002**
	Moderate	461(47.5)	584(52.5)	
	Bad	187(40.0)	357(60.0)	
Restriction of usual activity	Yes	96(39.8)	168(60.2)	0.049*
	No	754(48.0)	959(52.0)	
Diagnosis of depression	Yes	34(25.4)	101(74.6)	0.000***
	No	816(48.5)	1028(51.5)	
Weight change(1 year)	No	641(48.7)	778(51.3)	0.002**
	Weight loss	139(48.6)	184(51.4)	
	Weight gain	103(35.9)	225(64.1)	

*by chi-square test, *$p<0.05$, **$p<0.01$, ***$p<0.001$

3.2 Obesity according to general characteristics

As a result of analyzing the extent of obesity according to the general characteristics of the subjects, among the obesity group, the ratio of men was 50.5% and that of women was 41.1% ($p<0.01$), and in terms of age group, those aged 40-49 were the most at 58.0% ($p<0.01$). The obesity group with smoking experiences and lifelong drinking experience were 50.0% and 45.9%, each respectively ($p<0.01$), and the obesity group, which gained weight in the past year were the most at 63.9%, and those who lost weight was 44.3%, and those with no change in body weight turned out to be 40.9% ($p<0.001$) Table 2.

Table 2. Obesity according to general characteristics

Unit: N(%)

Characteristics	Division	Underweight	Normal	Obese	*p**
Gender	Men	12(1.2)	454(48.4)	414(50.5)	0.001**
	Women	22(1.8)	662(57.1)	492(41.1)	
Age(yr)	40-49	3(1.2)	72(40.8)	92(58.0)	0.004**
	50-59	6(1.5)	211(49.8)	194(48.7)	
	60-69	7(1.0)	365(55.2)	296(43.8)	
	70-80	18(2.1)	468(57.9)	324(40.0)	
Smoking status	Yes	12(1.2)	420(48.8)	384(50.0)	0.002**
	No	22(1.8)	678(56.8)	501(41.4)	
Alcohol experience (whole life)	Yes	22(1.1)	889(53.1)	740(45.9)	0.009**
	No	12(4.0)	211(54.2)	147(41.8)	
Perceived health status	Good	3(0.6)	211(54.9)	175(44.5)	0.007**
	Moderate	12(0.9)	562(54.4)	450(44.7)	
	Bad	16(3.1)	279(49.3)	231(47.6)	
Restriction of usual activity	Yes	7(3.0)	136(51.3)	108(45.7)	0.303
	No	24(1.2)	910(53.4)	745(45.4)	
Diagnosis of depression	Yes	2(1.5)	65(52.3)	66(46.2)	0.838
	No	29(1.4)	983(53.3)	787(45.3)	
Weight change (≤ 1 year)	No	20(1.2)	815(57.9)	546(40.9)	0.000***
	Weight loss	12(3.8)	169(51.9)	134(44.3)	
	Weight gain	2(0.6)	116(35.6)	205(63.9)	

* by chi-square test, **$p<0.01$, ***$p<0.001$

3.3 Obesity according to oral health status and oral health behaviors

As a result of analyzing the obesity according to the subjects' oral health status and oral health behavioral status, 45.8% of the obesity group did not feel discomfort when chewing, and 44.5% felt discomfort ($p<0.05$). The frequency of brushing per day turned out to be the highest once at 51.6% ($p<0.01$), and as an oral care product other than toothbrush or toothpaste, the use of gargling solution turned out to be the highest at 54.6% ($p<0.05$) Table 3.

Table 3. Obesity according to oral health status and oral health behaviors

Unit: N(%)

Characteristics	Division	Underweight	Normal	Obese	*p**
Perceived oral health status	Good	7(2.5)	128(53.7)	103(43.7)	0.634
	Moderate	13(1.2)	431(54.5)	349(44.2)	
	Bad	13(1.5)	448(52.0)	368(46.5)	
Speaking state	Comfortable	12(1.6)	273(50.3)	236(48.1)	0.350
	Uncomfortable	22(1.5)	825(54.2)	649(44.3)	
Chewing difficulty	Comfortable	26(2.5)	551(53.1)	439(44.5)	0.013*
	Uncomfortable	8(0.7)	547(53.5)	446(45.8)	
Implant	No	29(2.0)	726(53.8)	582(44.2)	0.057
	≥1	4(0.2)	281(52.0)	238(47.5)	
Denture needs	No	27(1.4)	919(53.7)	729(44.9)	0.230
	≥1	6(2.7)	88(49.3)	91(48.0)	
Dental visit experience (≤1 year)	Yes	26(1.9)	676(53.2)	560(44.9)	0.219
	No	8(0.8)	422(53.5)	325(45.7)	
Toothbrushing frequency (/day)	≤1	3(1.4)	106(47.0)	102(51.6)	0.002**
	2	13(1.1)	423(49.0)	388(49.6)	
	≥3	16(1.9)	533(58.1)	366(40.0)	
Use of dental floss	No	30(1.5)	919(52.1)	768(46.3)	0.212
	Yes	4(1.5)	179(59.4)	117(39.1)	
Use of proxabrush	No	28(1.5)	788(51.8)	676(46.7)	0.190
	Yes	6(1.6)	310(57.0)	209(41.4)	
Use of mouth rinse	No	3191.7)	968(54.8)	745(43.5)	0.013*
	Yes	3(0.7)	130(44.7)	140(54.6)	
Use of other products	No	29(1.4)	985(54.3)	772(44.3)	0.119
	Yes	5(2.4)	113(45.5)	113(52.0)	

* by chi-square test, *p<0.05, **p<0.01

3.4 Relationship between obesity and health status and oral health behaviors

As a result of the logistic regression analysis performed to examine the relationship between the oral health status and oral health behavioral status and obesity, women turned out to be 0.660 times more likely to be obese than men, and in terms of age group, 60-69 years olds relative to the 70-80 years olds were 0.957 times more likely to be obese, and relative to the obesity group without smoking experiences, the obesity group with smoking experience turned out to be 0.828 times more likely to be obese, yet were not statistically significant (p>0.05).

Relative to the obesity group with drinking experiences, the probability of becoming obese in the obesity group without drinking experience turned out to be 0.198 times (p<0.01), and the probability of becoming obese was 2.767 times among the obesity group which perceived their health status was good relative to the obesity group which perceived their health status was bad (p>0.05). It turned out to be 3.794 times higher for the obesity group, which demonstrated weight loss relative to the obesity group, which demonstrated no change in their body weight in the past year (p>0.05).

Relative to the obesity group, which did not feel discomfort when chewing, the probability of becoming obese was 1.153 times for the obesity group, which felt uncomfortable when chewing, and 2.175 times for the obesity group, which brushed twice or more, relative to the obesity group, which brushed more than 3 times a day, and it turned out to be 2.519 times higher for the obese group using a toothbrushing solution than the obese group not using a toothbrushing solution ($p>0.05$) Table 4.

Table 4. Relationship between obesity and health status and oral health behaviors

Characteristics	Obese
	OR (95% Cl)
Gender/Men	
Women	0.660(0.189-2.308)
Age(yr)/70-80	
40-49	0.556(0.102-3.038)
50-59	0.623(0.216-1.793)
60-69	0.957(0.361-2.536)
Smoking status/No	
Yes	0.828(0.254-2.702)
Alcohol experience/Yes	
No	0.198(0.068-0.575)**
Perceived health status/Bad	
Moderate	2.506(1.006-6.243)
Good	2.767(0.596-12.855)
Weight change(1 year)/No	
Weight gain	0.480(0.201-1.146)
Weight loss	3.794(0.604-23.826)
Chewing difficulty/Uncomfortable	
Comfortable	1.153(0.339-3.918)
Toothbrushing frequency(/day)/≥ 3	
≤ 1	1.304(0.366-4.640)
2	2.175(1.035-4.571)
Use of mouth rinse /No use	
Use	2.519(0.698-9.094)

* by logistic regression analysis, **p<0.01, ***p<0.001

4. Consideration

This study sought to examine the relationship between the oral health status, oral health behavior status and obesity targeting the adults aged 40 or older who were diagnosed with the cardiovascular disease (hypertension, dyslipidemia, myocardial infarction or angina pectoris, and stroke) by using the 8th annual raw data of the National Health and Nutrition Examination Survey (2019).

As for the demographic characteristics according to the BMI classification of subjects, the ratio of males (50.5%) in the obesity group was higher than that of females (41.1%). This is consistent with the results of a study which reported that males were significantly more obese than females (Song & Jung, 2018; Park, 2018; Kim & Lee, 2015). As for the reasons as to why, the pattern of obesity among men and women is slightly different, and among men, drinking is often the cause, and among women, they are affected by life cycles such as childbirth, menopause and aging (Korean Society for the Study of Obesity, 2015). The major risk factors for the cardiovascular disease may be divided into non-intermediable risk factors including age, sex, and family history (genetics) and interventionable risk factors such as lifestyle or diet. Lifestyle factors which are risk factors which may be controlled by intervention include obesity, drinking alcohol, lack of activity, and unhealthy diet (Grundy et al., 1999).

If the middle-aged in their 40s and 50s continue unhealthy lifestyles into their old age, they are highly likely to become a high risk group for the cardiovascular disease when they become old (Grundy et al., 1999; Park & Hwang, 2015). Hence, a complex analysis and the study of various factors according to gender are required in consideration of the correlation with such factors, and a thorough management of obesity, which is one of the high risk factors for the cardiovascular disease subjects, would be required.

In terms of the relationship between obesity and oral health behavioral status, the frequency of brushing per day turned out to be the highest in the obesity group (51.6%), and as an oral care product other than toothbrush or toothpaste, the use of toothbrushing solution turned out to be significantly higher. The dental plaque management using toothbrush and toothpaste is an important self-care method for the oral health behavior and maintenance (Chapple et al., 2015), and brushing twice per day is a social norm across many countries (Kumar et al., 2016). On top of brushing, the use of products to manage between teeth is important for the periodontal management (Chapple et al., 2015), and typical care products include dental floss, interdental toothbrushes, toothpicks, water picks, and advanced toothbrushes. Furthermore, there is a toothbrush solution which can manage the entire oral cavity, such as teeth, gums, tongue, and oral mucosa. A study by Song and Jung (Song & Jung, 2018) also reported that those who brushed less frequently and did not use oral care products had higher instances of obesity, and that as they gained more weight, their interest and practice in the oral health behavior decreased, which was partially consistent with the results of this study. In the obesity group diagnosed with cardiovascular disease, it would be necessary to increase the number of brushing and reinforce education on the application of a customized brushing method considering the periodontal condition for each tooth area. Furthermore, it is considered that the education for recommending and using appropriate oral care products for cleaning between teeth and gingival sulcus will be required.

The probability of becoming obese among the obesity group without drinking experience turned out to be 0.198 times higher than among the obesity group with drinking experiences. In a study by Park (Park, 2018), as for the alcohol consumption, which is a predictor of the cardiovascular disease risk according to agegroup, it was reported that the subjects who drank heavily among those aged 30-44 had a 1.4 times increase in the cardiovascular disease risk compared to the subjects who did not drink excessively, which were opposite to the results of this study. However,

some studies have reported that drinking alcohol of a less quantity of lowers the cardiovascular disease (Chiva-Blanch et al., 2013), whereas heavy drinking increases the risk of cardiovascular disease (Park & Hwang, 2015; Brien et al., 2011), and hence, the relationship between the cardiovascular disease and alcohol consumption is controversial. Hence, it is estimated that the relationship between the alcohol consumption and obesity is affected by the high fat diet and food intake rather than the calories from alcohol itself. Furthermore, since the lifestyle of young adults tends to be maintained even when they age, it is considered necessary to maintain the healthy drinking habits of young adults. It is also considered that future studies considering various variables will be required.

Obesity is known to increase the inflammatory TNFa and also change the infection pathway caused by the microRNAmiR, making the periodontal tissues vulnerable to infections even in the oral cavity (Nam & Kim, 2018). Hence, the obesity management is very important for the systemic and oral health behaviors of the patients with cardiovascular disease, and the proper dietary control, regular exercise, and the lifestyle control are required.

In this study, as a cross sectional study using the data from the National Health and Nutrition Examination Survey, the data on the periodontal disease and oral status were inadequate, and hence, there were limitations in identifying the causal relationship between the oral health status, oral health behavior status, and obesity, while various variables were not considered. It is also determined that future research through follow up surveys will be required. Furthermore, since only the obesity index was used, additional studies using other obesity indicators such as the waist, hip ratio and the waist circumference, which demonstrate obesity, would be needed.

Through this study, there was no significant difference in the oral health status and oral health behavioral status among the patients with cardiovascular disease corresponding to the obesity group, yet it was apparent that they were related to the drinking experiences. Hence, it is considered that the formation of a correct daily lifestyle among those obese having the cardiovascular disease should be considered.

5. Conclusion

This study analyzed the relationship between the oral health status, oral health behavioral status, and obesity among 2,110 patients with cardiovascular disease aged 40 or older based on the 8th annual raw data of the National Health and Nutrition Examination Survey (2019), which are as follows.

1. In the cardiovascular obesity group, males accounted for 50.5% and females 41.1%, and those in their 40s and 50s accounted for the most at 58.0%, respectively. The ratio of weight gains during the past year (63.9%) turned out to be higher than the rate of no change in their body weight (40.9%) ($p<0.01$), ($p<0.001$), respectively.
2. As for the oral health behavioral status of the subjects, the frequency of brushing per day among the obesity group turned out to be the highest at 51.6%, and as an oral care product

other than a toothbrush or toothpaste, the use of toothbrushing solution turned out to be high at 54.6% ($p<0.01$), ($p<0.05$), respectively.

3. The probability of becoming obese among the obesity group without drinking experiences turned out to be 0.198 times greater than among the obesity group with drinking experiences.

As a result of this study, no significant difference turned out in terms of the oral health status and oral health behavioral status among the patients with cardiovascular disease in the obesity group, yet the frequency of brushing, flossing, and interdental toothbrush turned out to be low, which demonstrated the need for a more active professional management and intervention for the oral health management practice. It was apparent that there was a relationship between the difference and the lifelong drinking experiences. Hence, it is determined that the obesity management for the patients of cardiovascular disease would be needed through the professional management interventions for the healthy daily living habits, appropriate physical activities, and the oral care.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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