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Relationship between Obesity and Dental Caries in Primary Teeth in Iksan city

Jeongeun Lee, Soyoun An, Jihyun Song, Jiyoung Ra

Department of Pediatric Dentistry, College of Dentistry, Wonkwang University

Abstract

The purpose of this study was to evaluate the relationship between obesity and dental caries in young children. The subjects were 769 children aged 3 to 6 years, in Iksan, Korea. Body mass index (BMI) and decayed and filled primary teeth (dft) were recorded. Children were classified into four groups (underweight, normal, obese at risk, and obese) according to their BMI percentile. The data of 754 participants, excluding 15 underweight children, were analyzed. The mean dft index was 3.39. There were no significant differences in the number of caries according to gender. The dft index increased significantly with age, with a sharp increase between ages 4 and 5. Children in the obese at risk and obese groups had more caries than those in the normal group. However, there were no statistically significant differences in dft index values between BMI-categorized groups except in 3-year-olds. These findings suggest that there is no significant connection between obesity and dental caries in primary teeth.

Key words : Obesity, Dental caries, Primary teeth

Ⅰ. Introduction

Dental caries is the most prevalent dental disease, ultimately causing tooth loss. It is a chronic disease in all age groups, but especially in children and adolescents[1]. Obesity is also a chronic disease that can affect all ages; its prevalence has increased steadily for many years[2]. Obesity in childhood is prone to affect physical condition in adulthood[3-8]. Dental caries and obesity have something in common that early care and education from childhood are required to prevent those diseases and ensure a healthy adulthood. According to the 5th Korean National Health and Nutrition Examination Survey (KNHANES) in 2012, the prevalence of obesity increased from 26.5% in 1998 to 31.3% in 2005, and then was maintained at around 31-32% until 2012[9]. The prevalence in children and adolescents, aged 2-18 years, amounted to 9.6%. This represented a lower rate than that of Americans in a similar age group; a prevalence of 16.9% was seen in those aged 2-19 years in the US National Health and Nutrition Examination Survey (NHANES) in 2009-2010[9]. However, the prevalence of obesity in Korea is predicted to rise due to the more Westernized diet of Korean children today.

Obesity and dental caries are multifactorial diseases influenced by various factors, and interest in associations between them has increased. According to a systematic review published in 2006, several studies have shown associations between obesity and dental caries, whereas others have not[10]. Moreover, the methods for

Corresponding author : Jiyoung Ra
Department of Pediatric Dentistry, College of Dentistry, Wonkwang University, 895 Moowang-ro, Iksan, Jeollabuk-do, 54538, Korea
Tel: +82-63-850-6633 / Fax: +82-63-851-5324 / E-mail: pedojy@wku.ac.kr
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evaluating obesity and dental caries in the samples have been different in each study. Although a systematic review and meta-analysis in 2013 demonstrated a relationship between obesity and caries, it considered only permanent teeth[11]. Many studies have targeted adolescents and mostly permanent teeth; there has not been enough research on primary teeth. There are few national studies on children under 7 years old.

In this study, the relationship between obesity and dental caries of primary teeth was assessed in children aged 3-6 years.

Ⅱ. Materials and Method

1. Subjects

In total, 769 children aged 3 to 6 years in Iksan city were examined from May to August, 2014 (Table 1).

2. Clinical examination

Dental examination of the subjects was performed under natural light by two investigators. The caries experience of primary teeth (dft index) were recorded according to WHO criteria[12].

3. Education and training of examiners

Two trained dentists examined 30 random subjects separately twice, and then again after 1 week. The intraclass correlation coefficients (ICCs) for inter-examiner and intra-examiner agreement were above 0.9 (Table 2).

4. Classification of obese groups

The height and weight of the children were measured using a height/weight scale (DS-102, Dong Shan Jenix Co. Ltd., Seoul, Korea), and the body mass index (BMI) was calculated for each child. Subjects were then classified into four groups (underweight, normal, obese at risk, and obese) according to BMI, considering gender and age in months. This was based on BMI percentiles from the Korean Growth Charts of Children and Adolescents 2007, published by the Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention (KCDC), and the Korean Pediatric Society[13] (Table 3). Fifteen children who were underweight were excluded.

Table 1. Distribution of gender and age

Characteristics	Classification	N	%
Gender	Male	379	49.3
	Female	390	50.7
Age	3 (36 months ~ < 48 months)	116	15.1
	4 (48 months ~ < 60 months)	251	32.6
	5 (60 months ~ < 72 months)	286	37.2
	6 (72 months ~ < 84 months)	116	15.1

Table 2. Inter-rater reliability

	Intraclass correlation coefficient (Absolute agreement)	95% Confidence interval
dft index	0.901**	0.803 - 0.952

dft index = the number of decayed and filled primary teeth
**$p < 0.01$

Table 3. The assessment of children's obesity for gender-age-specific BMI

Obesity degree	BMI (Percentile)
Underweight	< 5th
Normal	≥ 5th and < 85th
Obese at risk	≥ 85th and < 95th
Obese	≥ 95th

Body mass index (BMI)
= weight (kg) / (height (m) × height (m))

5. Statistical analysis

All statistical analyses were performed using the SPSS software (ver. 18.0; IBM, USA). Pearson's χ^2, one-way ANOVA, and *post hoc* tests were conducted to determine differences in dental caries according to gender, age, and obesity. The Kruskal-Wallis test was also used where data sets failed the normality test. Pearson's and Spearman's coefficients were also determined. The significance level was set below 0.05.

6. Approval of Institutional Review Board

This study was approved by the institutional review board of Wonkwang University Dental Hospital (WKDIRB201403-01).

Ⅲ. Results

1. Distribution of subjects

The mean dft index value of the 754 subjects was 3.39. In total, 501 (66.4%) had caries and 253 (33.6%) did not (Table 4).

2. Distribution of caries experience rate according to gender and obese status

There were no significant differences in caries experience between boys and girls (Table 5). Children in the obese at risk and obese groups had more caries experience than did those in the normal group (Table 6).

3. Distribution of dft index according to age and BMI category

The older the children were, the higher their dft index values. The increase was especially significant between 4 and 5 years (Table 7). There was a significant difference in dft index values between BMI groups (one-way ANOVA and Kruskal-Wallis test). However, a *post hoc* test did not show significant differences between groups (Table 8); dft did not differ significantly between BMI categories at each age, except in the group of 3-year-olds (Table 9).

Table 4. The distribution of 754 children

Characteristics	Classification	N	%
Gender	Male	370	49.1
	Female	384	50.9
Age	3 (36 months ~ < 48 months)	115	15.3
	4 (48 months ~ < 60 months)	246	32.6
	5 (60 months ~ < 72 months)	280	37.1
	6 (72 months ~ < 84 months)	113	15.0
Obesity degree	Normal	547	72.6
	Obese at risk	133	17.6
	Obese	74	9.8
Caries experience	dft > 0	501	66.4
	dft = 0	253	33.6

Table 5. Distribution of caries experience according to gender

Gender	Any caries experience (N), (%) (dft index > 0)		No caries experience (N), (%) (dft index = 0)		*p*-value
Male	247	66.8	123	33.2	.859
Female	254	66.1	130	33.9	
Total	501	66.4	253	33.6	

Pearson chi-square test

Table 6. Distribution of caries experience according to BMI categories

Body Mass Index (BMI) Category	Any caries experience (N), (%) (dft index > 0)		No caries experience (N), (%) (dft index = 0)		*p*-value
Normal	349	63.8	198	36.2	.012
Obese at risk & Obese	152	73.4	55	26.5	

Pearson chi-square test

Table 7. Distribution of dft index according to age

Age	N	dft index Mean ± SD	95% C.I. for Mean	*p*-value
3	115	2.42 ± 3.10 [a]	1.85 - 2.99	.004
4	246	2.82 ± 3.32 [a]	2.40 - 3.24	
5	280	4.05 ± 3.88 [b]	3.59 - 4.50	
6	113	4.02 ± 3.78 [b]	3.31 - 4.72	
Total	754	3.39 ± 3.63	3.13 - 3.65	

One-way ANOVA test followed by Scheffé *post-hoc* analysis, $F = 9.226$, $p < 0.05$

a,b : Scheffé grouping, which means the same letter are not significantly different

Kruskal-Wallis test, $\chi^2 = 9.226$, $p < 0.01$

C.I. = Confidence interval

Table 8. Distribution of dft index according to BMI categories

BMI Category	N	dft index Mean ± SD	95% C.I. for Mean	*p*-value
Normal	547	3.24 ± 3.62 [a α]	2.94 - 3.55	.035
Obese at risk	133	3.45 ± 3.29 [a α]	2.89 - 4.02	
Obese	74	4.41 ± 4.19 [a α]	3.43 - 5.38	
Total	754	3.39 ± 3.63	3.13 - 3.65	

One-way ANOVA test followed by Scheffé *post-hoc* analysis, $F = 3.378$, $p < 0.05$

a,b : Scheffé grouping, which means the same letter are not significantly different, $p < 0.017$

Kruskal-Wallis test followed by Mann-Whitney *post-hoc* analysis, $\chi^2 = 6.045$, $p = 0.049$

α,β : Mann-Whitney grouping, which means the same letters are not significantly different, $p > 0.017$

C.I. = Confidence interval

Table 9. Distribution of dft index according to BMI categories and age

	Age 3	Age 4	Age 5	Age 6
Normal	1.88 ± 1.75 *[a]	2.66 ± 3.28	3.81 ± 3.86	4.02 ± 3.71
Obese at risk	2.17 ± 3.14 [a]	2.89 ± 3.27	4.70 ± 3.42	3.22 ± 3.56
Obese	4.38 ± 3.85 *[b]	4.21 ± 3.58	4.46 ± 4.73	4.64 ± 4.72
Total	2.42 ± 3.10	2.82 ± 3.32	4.05 ± 3.88	4.02 ± 3.78
p-value in 3 groups	.004	.843	.139	.200
p-value in 2 groups	.016	.053	.418	.615

One-way ANOVA test followed by Scheffé *post-hoc* analysis, $F = 3.995, p < 0.05$

a,b : Scheffé grouping, which means the same letter are not significantly different

Kruskal-Wallis test, $\chi^2 = 7.242, p < 0.05$

T-test in two groups (*: significantly different in two groups), $p < 0.05$

Table 10. Correlation between obesity and dft index

	Correlation coefficient	*p*-value
Pearson's correlation	.083	$p < 0.05$
Spearman's correlation	.089	$p < 0.05$

4. Correlation coefficient

The correlation coefficients between obesity and caries experience in primary teeth were 0.083 and 0.089 using Pearson's and Spearman's analyses, respectively (Table 10). They showed an extremely weak linear correlation.

Ⅳ. Discussion

It was found that dental caries is a relatively common disease in young children from the results. The average dft index value of the subjects was 3.39, higher than that of children of the same age generally[14-16]. Most subjects were within the normal BMI category, and nearly a quarter of the subjects were in the obese at risk or obese groups. Few children were classified into the underweight group. There were significant differences in numbers of caries between the normal and obese (including obese at risk) groups. Mean dft index values tended to increase with obesity, but the difference was not significant. Moreover, the correlation coefficient for these two factors was below 0.1, indicating little direct association between the two diseases. The post hoc analysis after one-way ANOVA and Kruskal-Wallis tests also showed no significant association between them.

Similarly, Hong et al.[14] reported that there was no significant relationship between obesity and dental caries in a study of US children aged 2-6 years. However, a significant association was found in children aged 5-6 years only. It was explained that the connection became more relevant in the older group because both diseases were linked closely with age.

Macek and Mitola[17] indicated that age may be a significant confounding variable for obesity and dental caries. For example, older children tend to watch more television, which is associated with an unhealthy diet and increased meal frequency and snack consumption. That is, a physically inactive lifestyle for older children, not age, may increase obesity and caries. This means that caries itself could be a moderating factor in evaluating the relationship between obesity and caries. In fact, several studies have reported a significant association between obesity and caries in permanent teeth, but there have not been enough studies on primary teeth. A few studies on primary teeth have suggested no significant association.

Another factor that could explain conflicting results on the potential relationship between obesity and caries is differences in evaluation methods. Many studies that classified children by physical state used BMI percentiles from national growth charts, while others have used international standards of obesity in childhood established by the International Obesity Task Force (IOTF)[18-20], which may be inappropriate for children of certain races. Z scores (Z-value, standard score) of BMI have also been used[21,22]. If a BMI range is used to evaluate obesity, a BMI percentile that considers age and gender should be used, because children with the same BMI can sometimes be classified into different obesity groups.

Furthermore, the weight of small children can change rapidly, particularly in young and small children, which can affect the stability of results. This study used BMI percentiles from standard growth charts in Korea and found that dft index values differed significantly among BMI groups only among 3-year-olds.

There might also be imprecise standard of caries assessment for statistical figures in different studies. In this study, missing primary teeth were excluded from statistical data. This means some decayed or filled teeth that were removed were excluded from the analysis, but the effect of this on the results would not be significant. Werner et al.[23] reported that caries reflect past oral care and diet, where active caries are indicative of a diet that causes caries, such as one with many refined carbohydrates. The dft index stands for total experience of past caries; including advanced and restored cavities, as well as present caries, whereas obesity is comparatively a current status that is a variable condition in growing children. Because obese status reflects relatively recent diet and habits, the methods used to evaluate caries should be modified to present current dental status. For example, increases in caries numbers between two or more examinations while obese, caries activity based on bacterial assessment of saliva, or numbers of active caries excluding primary teeth with arrested caries or filled cavities.

In addition, caries are a multifactorial disease. Various factors, such as diet, snacking habits, and oral hygiene, among many others, can cause or prevent caries. Obesity is also influenced by different factors. It has been suggested that some common factors influence the two diseases. Marshall et al.[24] reported that obesity does not increase the risk of caries, and caries does not increase the risk of obesity. It was explained that common risk factors increase the risk of both obesity and caries, and Marshall[25] and Mobley et al.[26] reported diet as one of these factors in another study.

In this study, children in the obese at risk and obese groups tended to have higher dft indices than those in the normal group, but the results were not significant. It seems that some risk factors may affect both diseases to different degrees. However, to determine the interrelations between them is complex and difficult.

It was also found that there was no significant difference in dft index values according to gender, but they increase with age. In particular, there was a large increase from 4 to 5 years old. Kim et al.[27] reported similar results. Most children start communal feeding in kindergarten at around that age and undergo changes in diet and oral healthcare behavior. Furthermore, initial caries in proximal areas are often difficult to detect at first; they take time to develop, and rates of detection vary.

The height and weight of growing children also change. Evaluating obesity in growing children is not easy, and assessing caries risk during periods of obese status is not simple.

These confounding factors may have affected our results. Another potential limitation is the possibility of sampling bias, because the sample sizes of the 3-year and 6-year age groups were smaller than the other groups.

Future research should include appropriate evaluations of obesity and caries, analyses controlling other variables, and larger sample sizes to obtain more conclusive results. Dentists, parents, teachers, and other healthcare providers should help children to maintain good oral and physical condition.

Ⅴ. Conclusions

This study found no statistically significant relationship between obesity and dental caries in primary teeth. Further research is needed to support programs of obesity management and oral healthcare in young children.

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국문초록

익산시 어린이들의 비만과 유치의 우식 간의 관련성

이정은 · 안소연 · 송지현 · 라지영

원광대학교 치과대학 소아치과학교실

본 연구는 3-6세 어린이의 비만과 치아우식 사이의 관련성을 알아보고자 하였다.

익산시 소재의 어린이집과 유치원 아동 769명을 대상으로 우식경험유치지수(dft index)를 조사하고, 신장과 체중을 측정하여 체질량지수(body mass index)를 계산하였다. 표준성장도표의 체질량지수 백분위수를 이용하여 저체중, 정상, 비만위험, 비만의 4개 군으로 분류하였고, 저체중인 15명을 제외한 754명을 대상으로 분석하였다.

평균 dft index는 3.39였고, 남녀간의 유의한 차이는 없었다. 연령에 따라 dft index는 증가하였으며, 4세에서 5세에서 증가폭이 가장 컸다. 비만위험군과 비만군은 정상군보다 더 많은 우식경험률을 보였다. 그러나 3세 집단을 제외한 모든 연령군에서 정상, 비만위험, 비만 집단간의 통계적으로 유의한 차이를 보이지 않았다.

결론적으로 비만과 유치열의 우식경험에는 유의한 관련성이 없음을 알 수 있었다.

주요어: 비만, 치아우식, 유치