ORIGINAL ARTICLE

Relationship Between Pediatric Obesity and Otitis Media With Effusion

Jong Bin Kim, MD; Dong Choon Park, MD, PhD; Chang Il Cha, MD, PhD; Seung Geun Yeo, MD, PhD

Objective: To investigate the relationship between pediatric otitis media with effusion and obesity, as determined by body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) and serum triglyceride (TG) and total cholesterol (TC) concentrations.

Design: A prospective, nonrandomized, case-control study.

Setting: University-affiliated hospital.

Subjects: The experimental group comprised 155 children aged 2 to 7 years, who received unilateral or bilateral ventilation tube insertion for the treatment of otitis media with effusion. The control group comprised 118 children with no history of otitis media with effusion, who underwent operations for conditions other than ear diseases. Based on BMI and serum TG and TC concentrations, we divided the experimental group into 2 subgroups, those who were and were not obese.

Main Outcome Measures: We determined the difference between the experimental and control groups in BMI and serum TG and TC concentrations and the difference between the obese and nonobese subgroups in frequency of ventilation tube insertion.

Results: Mean ± SD BMI (22.0 ± 3.4 vs 16.3 ± 2.4) (P = .01) and mean ± SD TC level (195.0 ± 31.0 mg/dL vs 159.3 ± 26.9 mg/dL [5.05 ± 0.80 mmol/L vs 4.13 ± 0.70 mmol/L]) (P = .04), but not mean serum TG level (109.4 ± 40.4 mg/dL vs 90.0 ± 52.3 mg/dL [1.24 ± 0.46 mmol/L vs 1.02 ± 0.59 mmol/L]) (P = .13), were significantly higher in the experimental group than in the control group. Frequency of ventilation tube insertion, however, did not differ significantly between the obese and nonobese subgroups, whether divided by BMI (P = .10) or serum TG (P = .12) or TC (P = .07) concentration.

Conclusion: Childhood obesity may be associated with the occurrence of otitis media with effusion.

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Author Affiliations:
Department of Otorhinolaryngology, College of Medicine, Kyung Hee University, Seoul, Korea (Drs Kim, Cha, and Yeo), and Department of Obstetric and Gynecology, College of Medicine, Catholic University, Suwon, Korea (Dr Park).

DESPITE THE DEVELOPMENT of antibiotics and surgical techniques, the frequency of otitis media with effusion (OME) has been increasing,[1] and the association between OME and age, sex, seasons, lifestyle, nutrition, environment, and allergy have been characterized. The incidence of childhood overweight and obesity has also been increasing, but the association between childhood obesity and OME has not yet been determined. Obesity occurs from the excessive accumulation of fat in various tissues, particularly in hypodermal tissues. Obesity is generally defined by body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) and accompanied by elevated serum triglyceride (TG) and total cholesterol (TC) concentrations.[2] To determine whether obesity has an effect on the development of OME, we compared BMI and TG and TC concentrations in children with and without OME; and to evaluate whether the severity of chronic OME is associated with childhood obesity, we determined the frequency of ventilating tube insertion in obese and nonobese children with OME.

METHODS

The experimental group comprised children aged 2 to 7 years with OME who visited the Department of Otorhinolaryngology at Kyung Hee University, Seoul, Korea, from March 2004 to February 2006, for unilateral or bilateral ventilating tube insertion. The control group comprised children with no history of OME who underwent surgery for conditions other than ear diseases. The purpose of the experiment was explained to parents or guardians, and only subjects who agreed to participate in the study in advance were included. Children with head and neck anomalies, systemic diseases, chronic diseases, or suspected of having AIDS were excluded from this study.

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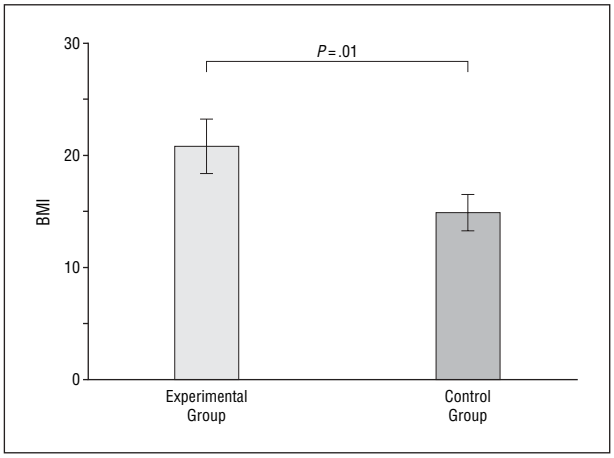

Figure 1. Mean±SD body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) of the experimental and control groups. The difference between the 2 groups was statistically significant (*P*=.01).

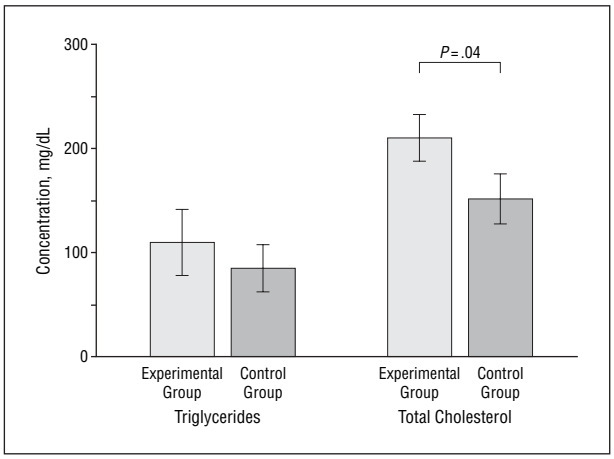

Figure 2. Mean±SD serum triglyceride and total cholesterol concentrations of the experimental and control groups. The difference between the 2 groups was statistically significant only for serum total cholesterol concentrations (*P*=.04). To convert triglycerides to millimoles per liter, multiply by 0.0113; to convert cholesterol to millimoles per liter, multiply by 0.0259.

Body mass index and TG and TC concentrations were measured in each child and compared between the groups. To measure serum TG and TC values, a 4-mL blood sample was drawn from each child in the morning under fasting conditions and centrifuged at 3000 rpm for 15 minutes at 4°C. Serum was decanted, and serum TG and TC concentrations were determined biochemically using a serum automated analyzer (Hitachi 7600; Hitachi Ltd, Tokyo, Japan).

In addition, the experimental group was divided into obese and nonobese subgroups, based on BMI according to age and sex and TG and TC concentrations, and the frequency of ventilating tube insertion in the 2 subgroups was compared. Body mass index was compared with normal values according to age and sex, and children with a BMI higher than the 95th percentile were defined as obese in Korea. Serum TG and TC concentrations were compared with normal values according to age and sex, and children with TG and TC concentrations higher than normal were defined as obese in Korea.[3]

Statistical analysis was performed using SPSS version 11 (SPSS Inc, Chicago, Ill), and groups were compared using the Mann-Whitney test, with the significance level set at $P<.05$.

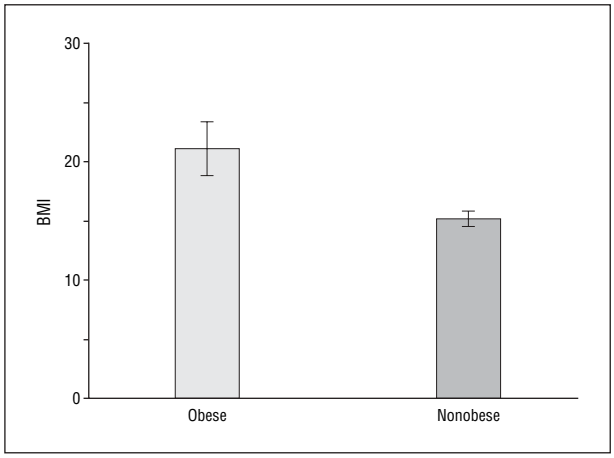

Figure 3. Mean±SD body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) of the obese and nonobese subgroups of the experimental group.

RESULTS

The experimental group comprised 155 children (85 boys and 70 girls), all of whom underwent ventilating tube insertion for chronic OME, while the control group comprised 118 children (76 boys and 42 girls), all of whom underwent surgery for conditions other than ear diseases and had no history of OME. The mean±SD BMI was significantly higher in the experimental group than in the control group (22.0±3.4 vs 16.3±2.4) (*P*=.01) (**Figure 1**), as was the mean±SD serum TC (195.0±31.0 mg/dL vs 159.3±26.9 mg/dL [5.05±0.80 mmol/L vs 4.13±0.70 mmol/L]) (*P*=.04) but not the mean±SD serum TG concentration (109.4±40.4 mg/dL vs 90.0±52.3 mg/dL [1.24±0.46 mmol/L vs 1.02±0.59 mmol/L]) (*P*=.13) (**Figure 2**).

When we divided the experimental group into obese (65 children [41.9%]) and nonobese (90 children [58.1%]) subgroups according to BMI, we found that their mean±SD BMI was 22.0±3.4 and 15.7±1.3, respectively (**Figure 3**). When serum TG concentration was used to subdivide the experimental group into obese (54 children [34.8%]) and nonobese (101 children [65.2%]) subgroups, the mean±SD serum TG concentrations were 149.9±49.2 mg/dL (1.79±0.55 mmol/L) and 69.0±19.6 mg/dL (0.78±0.22 mmol/L), respectively. When we divided the experimental group into obese (30 children [19.2%]) and nonobese (125 children [80.8%]) subgroups based on serum total TC concentration, we found that their mean±SD TC concentrations were 226.0±15.9 mg/dL (5.85±0.41 mmol/L) and 164.0±19.8 mg/dL (4.25±0.51 mmol/L), respectively (**Figure 4**). The frequency of ventilating tube insertion in the experimental group was not related to obesity, whether measured by BMI or TG or TC concentration (**Figure 5**).

COMMENT

Otitis media with effusion is a condition in which fluid is retained in the middle ear cavity, but without otalgia, fever, and other symptoms.[4] This condition has been

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shown to be caused by complex reactions involving the dysfunction of the eustachian tubes, infection, infection in the mucosa, immune deficiency, and allergy, among others.[5] The incidence of OME varies widely, being reported as 50% in British children,[6] 33% in children residing in Pittsburgh, Pa,[7] 8.7% in Japanese children,[8] 8% in Nigerian children,[9] and 4.5% to 16.4% in Korean children, with the latter differing according to surveyed regions.[10-12]

Among the factors thought to influence the effects of OME are age, sex, race, season of the year, hereditary factors, number of family members, smoking status of parents, diseases experienced by children, and nursing methods. Factors shown to predispose to OME include upper respiratory tract infection, age, race, and attendance in day care center nurseries, whereas factors that do not significantly influence OME include bronchitis, cystic fibrosis, socioeconomic status, smoking by parents, and antibiotic abuse.[13] Factors investigated, but not definitively shown to predispose to OME, include hypertrophic tonsils, sex, geographical living area, housing conditions, and genetic predisposition, whereas factors not fully investigated include immotile ciliary syndrome, immunodeficiencies, and swimming. In particular, attendance at various types of day care centers, which include many children, increases the risk of OME, and the risk of this condition is particularly associated with younger age at time of admission.[14]

Obesity is a collection of symptoms rather than a disease, and it appears to be due to the excess accumulation of adipose tissues, particularly hypodermal fat, in the body. The risk of adult obesity is associated with obesity during childhood and adolescence, with 50% to 75% of adult obesity shown to originate from juvenile obesity.[15] In childhood and adolescent obesity, both the size and number of adipocytes are increased, making it more difficult to treat than adult obesity, with a high likelihood of recurrence after treatment.[16]

Obesity is usually diagnosed by methods involving height and weight, with BMI being the most commonly used. For children, those with a BMI higher than the 95th percentile by age and sex are defined as obese. Using these criteria, we found that obesity was significantly correlated with hypodermal fat and body fat, and, among those children who underwent ventilating tube insertion for OME, 41.9% were obese and 58.1% were not.

Among the factors used to screen for the health risks of obesity, serum TG and TC concentrations have been used to predict the risk of development of cardiovascular diseases. Although serum TG and TC concentrations were found to be significantly higher in obese than in nonobese individuals,[17] the definite standards for obesity have not yet been established. For both TG and TC, we defined obesity as values not within the normal range for age and sex. Using serum TG concentration as the standard, we found that 34.7% of children who underwent ventilating tube insertion were obese, whereas with serum TC concentration as the standard, only 19.2% were obese.

Obesity is associated with mild systemic inflammation, accompanied by increases in the concentrations of C-reactive protein, interleukin 6, and other markers of inflammation.[18]

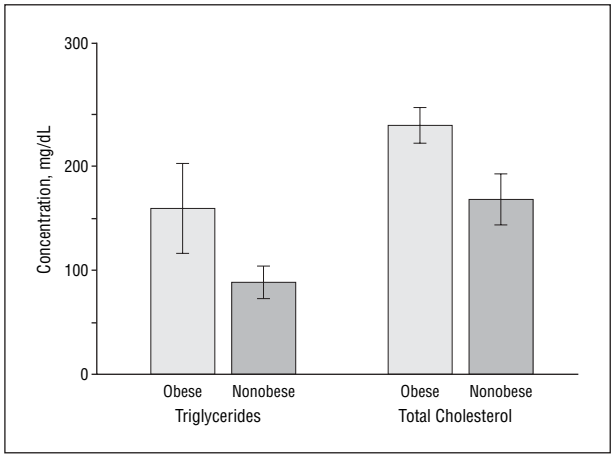

Figure 4. Mean serum triglyceride and total cholesterol concentrations of the obese and nonobese subgroups of the experimental group. To convert triglycerides to millimoles per liter, multiply by 0.0113; to convert cholesterol to millimoles per liter, multiply by 0.0259.

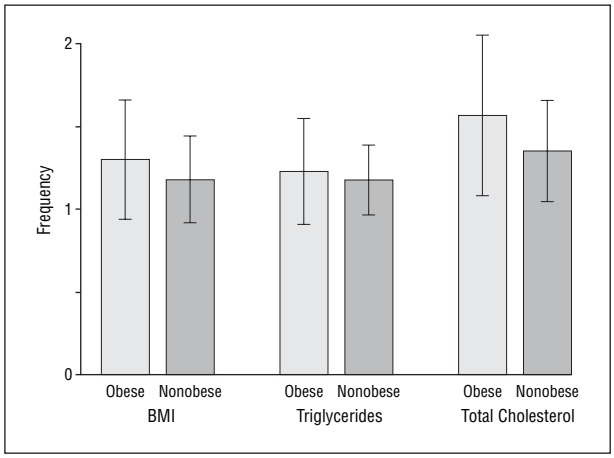

Figure 5. Mean frequency of ventilation tube insertion for treatment of otitis media with effusion in the experimental group. The differences between the obese and nonobese subgroups, as classified by body mass index (calculated as weight in kilograms divided by height in meters squared) and serum triglyceride and total cholesterol concentrations, were not significant ($P>.05$).

The incidence of asthma is increased in obese patients, with 75% of patients visiting the emergency department for treatment of asthma being obese or overweight.[19] Longitudinal studies have shown that obesity precedes asthma, and the relative risk of developing asthma is increased with increased obesity.[20] In addition, obesity is a risk factor for airway hyperresponsiveness. In this condition, tumor necrosis factor α reacts with tumor necrosis factor receptors on smooth muscles in the airway, increasing airway constriction. In addition to tumor necrosis factor α, leptin, adiponectin, and plasminogen activator inhibitor-1 have been shown to induce airway hyperresponsiveness.[21]

Various factors have been used to evaluate the severity of OME, including the frequency of ventilation tube insertion[22] and the number of hospital visits because of OME.[23] Using the former criteria, we found that in obese children, as defined by BMI and TG and TC concentrations, the incidence of OME, while high, was not associated with the frequency of ventilating tube insertion.

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In comparing children with and without OME, we found that childhood obesity was significantly higher in children with OME. This finding suggests that childhood obesity could have an effect on the development of OME.

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Correspondence: Seung Geun Yeo, MD, PhD, 1 Hoegi-dong, Dongdaemun-gu, Seoul 130-702, Korea (yeo2park@yahoo.co.kr).
Author Contributions: Drs Kim, Park, and Yeo had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Kim, Park, and Yeo. *Analysis and interpretation of data:* Cha and Yeo. *Drafting of the manuscript:* Yeo. *Critical revision of the manuscript for important intellectual content*: Park, Cha, and Yeo. *Statistical analysis:* Kim and Yeo. *Study supervision:* Park, Cha, and Yeo.
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