



Otitis media exposure associates with dietary preference and adiposity: A community-based observational study of at-risk preschoolers

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ABSTRACT

Chronic exposure to otitis media (OM) has been linked to risk of overweight/obesity. Here we tested if dietary behaviors explained some of the OM–adiposity relationship among 485 racially-diverse, low-income preschoolers (253 girls, mean age = 45 ± 7 months) enrolled in government-supported urban preschool programs. From measured weight/height, 4% were underweight, 17% were overweight and 13% were obese. OM exposure according to parent report varied across nearly equal quartiles—low (never, once) to high (3–5 times, 6+ times) exposure categories. Boys were more likely to be in the high exposure categories. Parents rated their child's liking/disliking of foods (high-fat/added sugar, fruits/juice, vegetables) and non-food activities. In analysis of covariance (ANCOVA), mean liking for vegetables and fruits/juice fell as OM exposure increased, with significant differences between lowest and highest exposure categories ($p < .05$). Food neophobic versus non-neophobic preschoolers also liked vegetables and fruits less ($p < .001$). In a two-way ANCOVA, main effects of OM and food neophobia independently predicted vegetable and fruit liking; preschoolers with more OM exposure and neophobia had the lowest liking. Although ANCOVA failed to reveal OM effects on mean liking for fat/sugar foods, the relative ranking of liking for these foods differed by OM category. Fat/sugar foods were ranked as most preferred for the high OM children, particularly the boys, surpassing the ranking of pleasurable non-food items. Conversely, low OM children ranked pleasurable non-food items and fruits/juice as more pleasurable than high OM children. BMI percentile varied with OM exposure, but not neophobia: preschoolers with the greatest exposure averaged the highest percentiles. In multiple regression analyses, liking for vegetables or fruits failed to associate significantly with BMI percentile. There was a small but significant association between greater fat/sugar liking and higher BMI percentile. Overall these findings confirm associations between high OM exposure and elevated adiposity in preschoolers. They also suggest this relationship is explained through lower affinity for vegetables and fruits and greater affinity for fat/sugar foods.

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1. Introduction

Substantial effort is mounting to prevent obesity and associated health risks from developing in children and perpetuating into adulthood. According to the U.S. Centers for Disease Control and Prevention [1], prevalence rates of obesity (Body Mass Index above the 95th percentile) in preschool children (2 to 5 years of age) doubled from 5% in 1976–1980 to 10.4% in 2007–2008 [2]. Low-income minority preschoolers are disproportionately affected by obesity, with obesity rates that exceeded national rates (12.4% in 1998 and 14.6% in 2008) [3]. Diets high in fruits and vegetables but low in total fat and added sugars promote energy balance for obesity prevention and assure attaining essential nutrients for health, according to a critical review that served as the basis of the 2010 Dietary Guidelines [4]. The present study examines the association

between exposure to otitis media, a common childhood ailment, preferences for foods and alternative reinforcers (i.e., pleasurable non-food activities), and adiposity. The overall hypothesis for this investigation is that a significant exposure to otitis media may influence the tastes and oral sensations from foods, and thus affect body weight through food liking and dietary selection. Understanding of factors that influence food preferences early in life is critical to promotion of healthy eating throughout life [5] to decrease the risk of diet-related chronic diseases.

Otitis media (OM) involves inflammation and/or infection of the structures of the middle ear, which can occur at any age, but are considerably more common in children [6] with peak incidence from 6 to 18 months of age [7]. From cohort studies, 75% percent of children experience at least one episode of OM [8] with increasing rates among young children [9]. Prevalence of OM is greater among boys than girls [6], bottle versus breastfed infants [10] and children of lower socioeconomic status [10,11].

Exposure to OM is linked with taste and oral sensation through the chorda tympani branch of cranial nerve VII. The chorda tympani nerve (CTN) innervates taste buds within fungiform papillae on the

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anterior two-thirds of the tongue; these papillae are also innervated by the trigeminal nerve. The CTN leaves the anterior tongue and travels through the middle ear where it is vulnerable to damage from infection and inflammation associated with OM. Counterintuitively, damage to (or anesthesia of) the CTN increases taste sensations from other areas of taste nerve innervation [12,13] and increases oral somatosensations (touch, temperature, pain) [14] due to release of inhibition of cranial nerves V, IX and X. Pathology-associated taste damage from the CTN could release inhibition of other sensory nerves that innervate the mouth, increasing taste sensations from taste-related fibers in cranial nerves VII and IV as well as somatosensory input [15]. Preliminary studies on children found reduced bitterness from quinine but enhanced responses to citric acid on the tongue tip in children with chronic OM (citric acid is both a tastant and an irritant) [16]. Interestingly, a recent study found lower electrogustometry thresholds (more sensitive) in children with OM exposure than those without this exposure [17]. Electrogustometry does not reflect chemical taste stimulation (i.e., sweet, sour, bitter, salty sensations) [18], may not detect taste disturbances [19], and could reflect somatosensation that could actually be heightened in those with CTN taste loss [15]. Variation in CTN taste can explain differences in diet and nutrition outcomes in adults; those with lower CTN taste alone or relative to whole mouth functioning report for less preference for and intake of vegetables [20], consume more alcoholic beverages [21] and have greater central adiposity [22] than do adults without this response pattern.

Prior evidence supports the existence of a relationship between OM exposure and body weight and/or dietary behaviors. History of recurrent OM treated with tympanostomy tube treatment was associated with increased risk of being overweight in children up to the age of 2 [23] and children from 2 to 7 years old [24]. In older children, exposure to OM has been linked to overweight risk from a small community-based study [25] and unpublished preliminary data analysis of a nationally-representative longitudinal sample [26], although the relationship was not found in children recruited from an otolaryngology practice [17]. Based on survey responses, adults with greater history of OM also reported greater liking for high-fat foods and were heavier [27]. A pilot study by our team found that children with reported OM history show greater sweet intakes (candy, baked goods, sweetened drinks) and lower vegetable intakes [28].

The goal of the present study was to examine the association between reported exposure to OM, dietary behaviors and body weight among a community-based sample of preschoolers who would have high-risk of OM and obesity. The first aim was to test whether the frequency of OM exposure was related to liking for vegetable, fruits, and foods high in fat and added sugar. Since preschoolers can exhibit neophobia due to a variety of factors (e.g., parent feeding practice, personality, social influences) [29] and neophobia has been associated with lower consumption of fruits and vegetables in preschoolers [30], we assessed the interaction between OM exposure and neophobia on the preschooler's liking as reported by the parent. The second aim was to assess if OM exposure was associated with adiposity among the children, and showed a relationship to liking for vegetables, fruits, and foods high in fat and added sugar.

2. Methodology

2.1. Study design and participants

This observational study included 485 children, ages 3–5 years old, who were enrolled in federal (Head Start) and state (School Readiness) supported preschool programs in two urban centers in Connecticut (2005 population estimates between 60,000 and 110,000). The study was approved by the University of Connecticut Institutional Review Board. To participate, parents signed an informed consent for both themselves and their children.

2.2. Data collection

Data were collected in September/October 2008 as part of preschool program enrollment or during mandatory health screening required within the first 45 days of enrollment. The families of the preschoolers were at or close to the U.S. Federal Poverty Guidelines. The preschoolers had a mean age of 45.4 ± 6.7 SD months and, from parent-reports, were primarily Hispanic (56%) or Black (27%) (Table 1). Using surveys in English or Spanish, parents reported participation in government-supported nutrition assistance and their preschooler's dietary behaviors and history of OM. In addition to reported food likes/dislikes (described below), the dietary behaviors included a dichotomous yes/no response about food allergies, constipation, diarrhea, chewing problems, special diets, and asthma. Data on whether or not the preschooler had been breastfed were available on subset of the entire study sample ($n = 279$).

2.2.1. Otitis media exposure and neophobia

Following the format of the National Nutrition and Health Examination Survey III (as described in [10]), parents reported how many times their child had an ear infection or earache (never, once, twice, 3 to 5 times, 6 or more times) and whether or not the first ear infection was before age 1 (yes/no). Parental reports of OM exposure have been shown to have reasonable agreement with the number of OM episodes reported in a child's medical record [31–33]. Neophobia was assessed by a dichotomous yes/no response to a single question, “My child is afraid to eat things s/he has never had before,” from the 6-item Child Neophobia scale [30]. Preschoolers with a “yes” response were categorized as neophobic. The justification for a single question in the present study is based on the reports of the scale developers. Two of the 6 items did not test neophobia, and the Cronbach's alpha across the 6 items was .92, showing that response to one item had a high degree of correlation with response to another item.

2.2.2. Preschool adapted liking survey (PALS)

On a horizontal continuous line scale labeled with five faces, parents/caregivers were asked to report their child's likes or dislikes of 18 food/beverages including: fruits (apple juice, strawberries, watermelon); vegetables (carrots, sweet potato/yam, broccoli, spinach/collard greens, corn, tomatoes); fat/sugar foods (cookies/cake, ice cream, soda pop, candy bar, French fries, snack foods/Cheetos/Pretzels/Doritos, butter/margarine), lunch meat/bologna/hot dogs, and whole milk. Interspersed with the foods/beverages were 4 non-food items: 3 pleasurable activities

Table 1

Sex, ethnicity and BMI percentile (85th to 95th percentiles: overweight; > 95th: obese) categories of children in two urban preschool centers.

	Female		Male	
	Na	Mean or %	N	Mean or %
Sex	232	48.0	253	52.0
Reported race				
White	25	10.8	25	10.5
Black	72	31.0	67	28.2
Latino	129	55.6	137	57.6
Asian	1	0.4	1	0.4
American Indian	1	0.4	0	0.0
Other	4	1.7	8	3.3
BMI percentile—overweight				
2 to <3 years	16	18.8	19	5.0
3 to <4 years	106	18.9	108	18.5
4 to <5 years	85	12.9	102	17.7
All (2–5 years)	207	16.4	229	17.0
BMI percentile—obese				
2 to <3 years	16	12.5	19	10.5
3 to <4 years	106	13.2	108	10.2
4 to <5 years	85	10.6	102	18.6
All (2–5 years)	207	12.1	229	14.0

^a Numbers (N) of preschoolers; the numbers vary due to missing data.

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