Original article

School and Neighborhood Nutrition Environment and Their Association With Students' Nutrition Behaviors and Weight Status in Seoul, South Korea

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A B S T R A C T

Purpose: We examined the association between the school and neighborhood nutrition environments and adolescent nutrition behaviors and weight status.
Methods: We conducted a cross-sectional survey with 1,342 fourth to ninth graders in 15 schools on their food-eating behaviors. Participants were randomly selected from eight predetermined districts in Seoul, South Korea. Height and weight data from the school annual health check-ups were obtained. Dietitians from each school completed questionnaires on the school nutrition environment. Types of food outlets in a 500-meter radius of the schools were recorded. Healthy eating index was created based on 10 questions on students' eating behaviors, such as breakfast skipping, fruit consumption, and ramen noodle consumption (possible score range 0–10). Generalized estimating equation method was used for statistical modeling.
Results: Higher density of supermarkets and traditional markets in the school neighborhoods was associated with a greater likelihood of child obesity after controlling for individual-level covariates (odds ratio = 1.37, 1.21–1.54). The school nutrition environment was not associated with student's healthy eating habits and weight status. Students who were younger, female, from more affluent families, who had less weekly screen time, or had stay-at-home mothers had higher scores on the healthy eating index. There was a gender difference in the associations between environmental factors and students' eating behaviors and obesity status.
Conclusions: These findings suggest that the relationship between environmental factors and individual factors and weight status may be more complicated than previously reported in other parts of the world.

IMPLICATIONS AND CONTRIBUTION

The findings of this study contribute to a better understanding of the individual- and environmental-level influences on childhood obesity in this or in other similar settings. Future childhood obesity prevention programs may benefit from this study by considering adolescents' age, gender, and other modifiable environmental influences.

The traditional Korean diet, rich in grains and vegetables, is in the process of becoming a diet higher in animal products and dietary fat [1,2]. The westernization of the Korean diet has affected children and adolescents, which makes the population vulnerable to weight gain [3,4]. The data showed that the prevalence of childhood overweight and obesity has increased in South Korea between 1997 and 2005: for overweight (13.3%–19.0%) and for obesity (5.8%–9.7%) [5]. The more alarming figures for childhood obesity in South Korea are the disproportionately higher increase among children from low-income households than children from high-income households [6].

It has been argued that overabundance and easy access to high-fat and high-sugar snacks at food stores within and outside

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of schools and a lack of physical activity may contribute to the increased prevalence of obesity in South Korean children [3]. In some studies in the United States, a high density of fast food restaurants coupled with the lack of supermarkets have been targeted as one factor contributing to the disproportionately higher prevalence of obesity among economically disadvantaged populations [7,8]. However, studies on the role of the environment in childhood obesity in South Korea are limited.

Environmental factors can include various physical and social elements in people's surroundings that influence their choices for diet and physical activities. School and nearby neighborhood environments are of interest because children spend at least 5–7 hours daily within school boundaries during weekdays and make various health choices while at school. In previous studies, a higher availability and accessibility of certain food items in schools increases students' consumption [9,10] and even increases body weight [11]. Moreover, research shows interventions modifying school environment via nutrition policies could reduce overweight [12] and fat consumption [13] among U.S. students.

To design and implement public health interventions targeting childhood obesity, it is essential to understand the associations and interactions between environmental factors and individual factors. As we begin to observe disproportionately higher obesity prevalence in lower socioeconomic status (SES) population, identifying modifiable policy and environmental factors that can be implemented to prevent childhood obesity become more urgent. The present study examined the relationships of school and neighborhood nutrition environments and individual sociodemographic factors with adolescents' nutrition behaviors and weight status in urban South Korea.

Methods

Study design and study procedure

Among 1,342 participants, the data from 939 students with complete information were used in the analyses. Participants were from the fourth to ninth grade in seven elementary and eight middle schools in Seoul, South Korea. We used cluster-sampling method in recruiting participants. Eight districts were purposefully selected from 25 administrative districts based on mean housing prices, residents' education levels, and geographical characteristics to enhance heterogeneity. The Seoul Office of Education, the local collaborator, randomly selected one elementary and one middle school in eight districts. Study invitation letters were sent to 16 schools; 15 schools agreed to participate in the school survey. The entire students in class number one of each grade were invited to participate in the survey. All the selected schools were public and coeducational schools.

The informed consent forms and survey questionnaires for teachers and students were sent to the health teachers or nutritionists at the selected schools by mail. All the participating school nutritionists were registered dietitians and certified nutrition teachers. The teachers were asked to submit the school lunch menus for the 2 months before the survey (April and May 2011) and the participating students' weight and height information from the recent school health checkups. In South Korea, students are not allowed to go outside of school to buy food during lunchtime and all the participating grades (fourth to ninth) had the full-day classes. Most of the measurements were taken between April and July 2011 (95.2% of participants; the rest of the anthropometric measurements were taken from August to November 2011). The

school survey was conducted in June and July 2011. A school neighborhood environmental audit on available food outlets in a 500-meter radius of the schools was conducted in October and November 2011. Because of the time lag between environmental measures and anthropometric measurements, we confirmed whether there have been any drastic changes in the neighborhood when we conducted the school survey. All the participating schools reported that there were no noticeable changes in the neighborhood food environments.

Written consent forms were obtained from the participants (teachers and students) and the students' guardians. All study protocols were approved by the institutional review boards of the Johns Hopkins Bloomberg School of Public Health and the Seoul-Paik Hospital of Inje University.

Measures

The major foci of the used tools were to assess the nutrition environments in and around schools (Appendices A and B, which can be found in the online edition of this article). The survey questionnaires for students were composed of 70 questions on basic demographic and family affluence measures, nutrition, and physical activity behaviors (Appendix C, in the online edition of this article). The questions regarding family affluence measures, nutrition, and physical activity behaviors were from the validated questionnaires used in the Korea Youth Risk Behavior Web-based Survey [14,15]. The questionnaire for measuring school nutrition environment was based on the extensive formative research and we checked content and face validity with local and international experts.

Dependent variables

Nutrition behaviors. The consumption frequencies for eight key food groups (fruit, vegetables, milk, carbonated beverages, fast food [hamburger and pizza], instant noodles, chips and crackers, and deep-fried foods) and six food intake habits (frequency per week of skipping breakfast, eating dinner at home, eating snacks between meals, eating away from home, eating late night snacks, and selective eating of the school lunch) were measured in individual adolescents using a self-completed structured questionnaire.

Healthy eating index. A composite variable was made based on 10 items that summarize students' eating patterns. The items were selected according to the proven health benefits and nutrition quality [16–20]. The composite index for students' healthy eating behaviors consisted of 10 items: skipping breakfast, selective eating habits at school lunch, and consumption of fruits, vegetables, milk, soda, fast food, instant noodles, chips and crackers, and deep-fried foods. For eating breakfast, nonselective eating at school lunch, and fruit, vegetable, and milk consumption, students who met the recommendation received 1 point for each item. On the contrary, for soda, fast food, instant noodles, sweets, and deep-fried food, students who consumed these items fewer than three times per week received 1 point for each item.

Weight status. Recently measured height and weight data were used to calculate students' body mass index (BMI; kg/m^2). These measurements were taken either from local clinics or from school health centers by nurses or medical assistants using a standardized protocol [21]. Most participants (95%) had their body measurements taken 1–2 months before or after the survey