

RESEARCH ARTICLE

# Food Availability in School Stores in Seoul, South Korea After Implementation of Food- and Nutrient-Based Policies

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## ABSTRACT

**BACKGROUND:** To improve school store food environments, the South Korean government implemented 2 policies restricting unhealthy food sales in school stores. A food-based policy enacted in 2007 restricts specific food sales (soft drinks); and a nutrient-based policy enacted in 2009 restricts energy-dense and nutrient-poor (EDNP) food sales. The purpose of the study was to assess how the 2 policies have changed the school store food environment.

**METHODS:** Foods sold in school stores in Seoul, South Korea were observed before (2006, 15 stores) and after (2013, 12 stores) implementation of the school store policies. Food availability in school stores in 2006 and 2013 was compared and EDNP food availability in 2013 was examined.

**RESULTS:** When controlling the total number of foods sold in school stores and school characteristics, the mean number of soft drinks sold in a school store in 2013 (0.3 items) was significantly lower than in 2006 (1.9 items,  $p = .032$ ). Soft drinks were still available in 50% of school stores observed in 2013, with all school stores selling EDNP foods in 2013.

**CONCLUSIONS:** South Korean policies have had a modest influence on availability of unhealthy school store foods. Alternative strategies to improve school store food environments are needed.

**Keywords:** health policy; nutrition and diet; school food services; child and adolescent health.

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School food environments affect students' dietary behaviors since students are in school most of the time they are awake, having at least 1 meal or snack while there.<sup>1,2</sup> Efforts to improve school food environments have been mostly focused on the school meal service and foods sold in school stores or vending machines. Increasingly, countries have attempted to regulate foods offered outside of the school meal program, in particular, because those foods are often energy-dense and nutrient-poor (EDNP). Consumption of unhealthy foods outside of the school meal program affects students' diets during school hours.<sup>3-5</sup>

Policies targeting foods outside of the school meal program attempt to either limit specific food items or

set a standard for nutrient content of the food. The first type of policy, the food-based policy, is most often used to restrict sales of soft drinks or fried foods. The second type of policy, the nutrient-based policy, is more often used to limit foods with high energy, fat, sugar, or sodium. Both types of policy can decrease the availability of the unhealthy foods in schools,<sup>6,7</sup> although the reduction in unhealthy food availability varies across studies.<sup>6,8,9</sup> Less is known about which type of policy most improves school food environments and whether policy impacts differ by school characteristics. Knowing policy impacts and the conditions under which they are most effective could help in developing and implementing more effective

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policies in the future. Two South Korean policies enacted to improve the nutritional quality of foods in school stores provide an opportunity to compare the 2 types of policy.

In South Korea, school children can obtain foods from school meal services, school stores, and outside of school. All elementary, middle, and high schools in South Korea hire registered dietitians, thus school meals are provided under the supervision of dietitians. In contrast, there was a lack of supervision over school store foods, which students themselves choose, until the early 2000s. Since public discomfort with unhealthy foods in school stores and students' unhealthy food choices had been growing, the Korean government implemented 2 national policies to improve the quality of foods sold in school stores. The Korean Ministry of Education announced a food-based policy in February 2007 (hereafter 2007 policy). The 2007 food-based policy forbade soft drink sales and recommended to stop selling instant noodles and fried food in schools including vending machines and school stores by the onset of the 2007 school year (hereafter 2007 policy). A second comprehensive nutrition policy, the Special Act on Safety Management of Children's Dietary Life, targeted multiple nutritional problems of Korean children and was implemented beginning in March 2009 (hereafter 2009 policy). One component of the 2009 policy is a nutrient-based policy that restricts EDNP foods sales in school stores. The 2009 policy set a nutrient standard for energy, protein, saturated fat, sugar, and/or sodium to define EDNP foods and beverages, forbidding their sale in school stores after March 2009 (the beginning of the 2009 school year).

Previous studies regarding school nutrition policies mostly focused on the implementation of policy in public schools.<sup>5-8</sup> Public and private schools often have different school management systems, including operation of school stores. In South Korea, 80% of public schools contract with school stores through a public competitive bidding process, whereas 63% of private schools have private contracts.<sup>10</sup> For schools using public competitive bidding, the right of operation is sold to the highest bidder who pays the school the most for school food sales rights. The right of operation expires every year, thus the current school store owner needs to participate in the bidding annually. Store owners in public schools report that high bidding prices are overly burdensome.<sup>11</sup>

These differences in school store management systems may affect school store owners' selection of foods sold in school stores. School store owners who already paid a high cost for the right to the store need to make more profits; they may want to sell high-profit products regardless of the nutritional quality of the food. Thus, we hypothesized that school stores in public and private schools sell different types of foods

and different numbers of foods that policies banned to sell. Since public and private high schools in South Korea have the same tuition (excluding specialized schools; tuition for middle schools is free), attendance in private or public schools does not reflect students' wealth. Thus, comparison of food availability between public and private schools in South Korea could provide an example of impact of school management systems on food availability in school stores.

The purpose of the study was to assess how 2 different types of national school store policies changed school store food environments. We compared foods and beverages sold in school stores in 2006 and 2013 to assess if the 2007 food-based policy affected availability of foods and beverages in school stores. EDNP food availability in 2013 was examined to assess impacts of the 2009 nutrient-based policy. We also examined differences in food availability in school stores by school characteristics that might affect foods sold in school stores. We hypothesized that students' age, sex, and their household income are related to eating behaviors and snack purchase,<sup>12,13</sup> and that the school management type (public or private) could be related to foods sold in school stores.

## METHODS

### Participants and Procedure

School stores in middle and high schools located in Seoul, South Korea were observed before (school year 2006) and after (school year 2013) implementation of school store policies. In 2006, 1 middle school and 1 high school were randomly selected from each school district among 11 school districts in Seoul. Of the 22 schools, 15 agreed to observation of their school store. In 2013, 6 school stores each from 1 high-income school district and 1 low-income school district were purposefully selected to make selected schools have various characteristics in terms of students' sex, school level, and school type (private or public). Among the 12 school stores observed in 2013, 2 were also observed in 2006. The observations were conducted from December 2006 to February 2007 and from October 2013 to December 2013.

Four observers conducted school store observations in 2006. In 2013, 1 observer, who also participated in the observation in 2006, conducted all school store observations with the same materials and methods in 2006. When an observer visited school stores, all types of foods sold in the school stores were recorded. Product name, manufacturer, size, and flavor (if varied) were recorded. When school store owners allowed, the observer took photographs of school stores and food items. For foods in school stores observed in 2013, nutrient content was recorded from the nutrition label of products, including calories, protein, saturated fat, sugar, and sodium content per

**Table 1. Criteria of the Energy-Dense Nutrient-Poor (EDNP) Foods**

A. Criteria for snacks among children's favorite foods\*

- 1 Foods containing over 250 kcal and less than 2 g of protein per serving.
- 2 Foods containing over 4 g of saturated fat and less than 2 g of protein per serving.
- 3 Foods containing over 17 g of sugar and less than 2 g of protein per serving.
- 4 Foods containing over 500 kcal or over 8 g of saturated fat or over 34 g of sugar per serving among foods that do not meet criteria of 1 ~ 3.

- For foods which the serving size is less than 30 g, the criteria are applied to 30 g of the foods instead of the actual serving size.

B. Criteria for meal substitutes among children's favorite foods

- 1 Foods containing over 500 kcal and less than 9 g of protein per serving.
- 2 Foods containing over 500 kcal and over 600 mg of sodium per serving. For deep-fried noodles and noodles among noodles (only applied to noodles in containers), over 1000 mg of sodium is applied to as criteria of EDNP.
- 3 Foods containing over 4 g of saturated fat and less than 9 g of protein per serving.
- 4 Foods containing over 4 g of saturated fat and over 600 mg of sodium per serving. For deep-fried noodles and noodles among noodles (only applied to noodles in containers), over 1000 mg of sodium is applied to as criteria of EDNP.
- 5 Foods containing over 1000 kcal or over 8 g of saturated fat per serving among foods that do not meet criteria of 1 ~ 4.

\*Children's favorite foods are defined as "Foods that children prefer or eat frequently among foods under the Food Sanitation Act or the Livestock Products Sanitary Control Act, which are prescribed by Presidential Decree" (Special act on safety management of children's dietary life. Act no. 119882013).

one serving. In most cases, it was not possible to record nutrient content for all foods during the school store observation, because school store owners did not want the observer to stay in their stores for a long time. If nutrient information was not obtained by on-site observation, the information was obtained from the manufacturers' websites or by purchasing the product.

### Data Analysis

All foods and beverages were categorized into soft drinks, fruit and vegetable juice, tea, coffee, sports drinks, bottled water, other beverages, chips and cookies, candy, ice cream, bread, hamburger and pizza, fruit, other foods, yogurt, milk, and flavored milk. Milk and flavored milk were further categorized based on the fat content (full- or reduced-fat). Based on the criteria for EDNP (Table 1), all food and beverage items available in school stores in 2013 were determined to be either EDNP or not.

Descriptive statistics for school characteristics, including school level (middle school, high school), school type (private, public), students' sex (coeducational, boys only, girls only), and income level of school district (high-income, low-income), were computed

using Fisher's exact test to compare characteristics of school stores observed in 2006 and 2013. Crude numbers of all types of foods sold in school stores and of foods in each category were compared between 2006 and 2013 using Student's *t* tests. To compare the number of foods between 2006 and 2013 controlling for school characteristics, mixed models were fitted with school districts as random effects. Then, the total number of foods sold in school stores was included in the models in addition to school characteristics, to examine food composition in school stores in 2006 and 2013. Student's *t* test was used to compare crude number of total foods and EDNP foods, and percentage of EDNP in 2013 by school level, school type, students' sex, and income level of school district. Mixed models with school districts as random effects were used to control school characteristics. The  $\alpha$  level of 0.05 was used to determine statistical significance. All statistical analyses were conducted using SAS 9.4 (SAS Institute, Inc., Cary, NC).

### RESULTS

On average, 40.7% of school stores observed were located in middle schools and 33.3% were in private schools (Table 2). Most school stores observed in 2006 were located in public schools (86.7%) while 41.7% of school stores observed in 2013 were located in public schools ( $p=.037$ ). More than half, 55.6%, of the school stores were located in coeducational schools, 33.3% in boys' schools, and 11.1% in girls' schools. About half of the school stores were located in low-income school districts.

The mean number of food and beverage types sold in school stores was significantly higher in 2013 (102.3 items) than in 2006 (41.1 items;  $p<.001$ ), even after adjusting for school characteristics ( $p=.022$ , Table 3). Within most food categories, mean numbers of food types sold in school stores observed in 2013 were significantly higher than those sold in school stores observed in 2006 ( $p<.05$ ). After adjusting for school characteristics, the mean number of some foods that can be considered healthy or low-calorie foods, such as tea, bottled water, other beverages, fruit, yogurt, and reduced-fat nonflavored milk, and high-calorie foods including chips and cookies and hamburger and pizza, sold in 2013 was significant higher than in 2006 ( $p<.05$ ). When controlling for school characteristics and total number of food items, only the mean number of other beverages and hamburger and pizza sold was significantly higher in 2013 ( $p=.037$  and  $p=.005$ , respectively), and the number of soft drinks, the target food of the 2007 policy, was significantly lower in 2013 ( $p=.032$ ).

All school stores observed in 2013 sold EDNP foods that were restricted by the 2009 policy. On average, 7.0 items out of 102.3 items (7.6%) sold in a school

Table 2. Characteristics of School Stores Observed in 2006 and 2013

	Total (N = 27)	School Year		p-Value
		2006 (N = 15)	2013 (N = 12)	
School level				
Middle school	11 (40.7)	6 (40.0)	5 (41.7)	>.99
High school	16 (59.3)	9 (60.0)	7 (58.3)	
School type				
Private	9 (33.3)	2 (13.3)	7 (58.3)	<b>.0037</b>
Public	18 (66.7)	13 (86.7)	5 (41.7)	
Students' sex				
Coeducational	15 (55.6)	10 (66.7)	5 (41.7)	.110
Boys only	9 (33.3)	5 (33.3)	4 (33.3)	
Girls only	3 (11.1)	0 (0.0)	3 (25.0)	
School district				
Low-income district	14 (51.9)	8 (53.3)	6 (50.0)	.863
High-income district	13 (48.2)	7 (46.7)	6 (50.0)	

Bold indicates  $p < .05$ .

store were EDNP products (Table 4). School stores located in high schools and in private schools sold significantly higher number of food items (130.9 items for high schools and 130.0 items for private schools) than those located in middle schools and in public schools (62.4 items for middle schools, 63.6 items for public schools;  $p = .012$  and  $p = .016$ , respectively). The number of EDNP foods was slightly higher for school stores in private schools than for those in public schools ( $p = .070$ ). School stores in high-income school districts sold more food items than those in low-income school districts ( $p = .076$ ), but there was no difference in number of EDNP foods. After controlling for school characteristics, the differences in the total number of foods, total number of EDNP foods, and percentage of EDNP foods by school characteristics became smaller. The total number of food items and total number of EDNP foods sold in school stores were higher in those located in private schools than in public schools after adjusting for other school characteristics ( $p = .042$  and  $p = .060$ , respectively). Although the number of EDNP foods was slightly higher in school stores located in private schools ( $p = .060$ ), when school characteristics were adjusted, the percentages of EDNP foods did not differ by school level, school type, students' sex, or income level of the school district.

## DISCUSSION

We examined changes in the foods available in school stores before and after implementation of the school store policies. The school stores observed in 2013, after the implementation of the 2007 policy that restricts soft drink sales, had significantly less soft drinks than those in 2006. Nevertheless, half of the school stores observed in 2013 still sold soft drinks. Although the 2009 policy forbids EDNP foods sales in school stores, EDNP foods were found in all school

stores observed in 2013, representing about 7.6% of foods sold.

Whereas the quantity of food types sold in school stores has increased, the quality of school store foods did not change much between 2006 and 2013. Despite the implementation of policies intending to improve school store food environments, there was no significant difference in the foods offered in school stores between 2006 and 2013, when the total number of food in school stores was adjusted, with 1 exception: the decrease of soft drinks. This change was likely the result of the 2007 policy that bans sales of soft drinks. The increased number of other types of beverages may be due in part to substitution for soft drinks. On the other hand, the number of hamburger and pizza options sold in school stores was significantly higher in 2013 than in 2006, even after adjusting for the total number of food items sold in school stores. Hamburger and pizza products that were observed in 2013 in this study had the highest energy and sodium content per serving among all food categories (data not shown). All hamburger and pizza foods, however, had higher protein and lower energy, saturated fat, and sugar per serving than the EDNP criteria of the 2009 policy, and thus were allowed to be sold. Previous studies have reported that schools tend to remove only the least healthy foods that school nutrition policies require, but not replace those unhealthy items with healthy items.<sup>6,9,14</sup> Thus policies regulating unhealthy food sales may not contribute to increase of healthy food availability in schools.<sup>8,15</sup> The increased availability of hamburger and pizza products which are not restricted by the policies, but are still unhealthy, and insignificant increase of availability of healthy foods such as bottled water, fruit, and reduced-fat milk, shown in this study indicate that South Korean policies also have not eliminated all unhealthy items while healthy food availability is not increased.



Table 3. Mean Number of Foods and Beverages Sold in School Stores in 2006 and 2013

School Year											Adjusted for School Characteristics and Total Number of Food and Drink Items <sup>†</sup>			
	Crude					Adjusted for School Characteristics*								
	2006		2013		p-Value	2006		2013		p-Value	2006		2013	
	Number of Schools <sup>‡</sup>	Mean ± SD	Number of Schools <sup>‡</sup>	Mean ± SD		Mean ± SE	Mean ± SE	Mean ± SE	Mean ± SE		Mean ± SE	Mean ± SE		
Total	15	41.1 ± 27.1	12	102.3 ± 50.7	.001	59.7 ± 12.5	98.5 ± 10.7	.022						
Soft drinks	9	1.8 ± 1.9	6	0.8 ± 0.9	.070	1.5 ± 0.5	0.7 ± 0.9	.433			1.9 ± 0.5	0.3 ± 0.5	.032	
Fruit and vegetable juice	14	3.2 ± 2.3	12	7.1 ± 5.6	.041	5.9 ± 1.2	6.7 ± 1.0	.590			6.5 ± 1.0	4.8 ± 0.9	.249	
Tea	6	0.7 ± 1.1	11	4.3 ± 3.3	.004	1.4 ± 0.8	4.1 ± 0.6	.007			1.7 ± 0.7	3.0 ± 0.6	.143	
Coffee	4	0.4 ± 0.8	2	0.2 ± 0.4	.345	0.3 ± 0.3	0.2 ± 0.3	.728			0.4 ± 0.3	0.0 ± 0.4	.356	
Sports drinks	14	1.9 ± 1.1	11	3.5 ± 2.9	.087	1.7 ± 0.6	2.9 ± 0.7	.196			1.9 ± 0.5	2.2 ± 0.6	.783	
Bottled water	2	0.1 ± 0.4	8	0.8 ± 0.6	.003	0.2 ± 0.2	0.7 ± 0.1	.031			0.2 ± 0.2	0.5 ± 0.2	.211	
Other beverages	12	1.9 ± 1.8	12	8.3 ± 4.9	.001	2.5 ± 1.2	7.9 ± 1.1	.002			3.2 ± 0.8	5.5 ± 0.7	.037	
Chips and cookies	15	12.4 ± 8.7	12	34.3 ± 19.6	.003	18.0 ± 5.2	33.5 ± 3.9	.020			21.2 ± 2.0	21.9 ± 1.9	.808	
Candy	12	6.5 ± 6.3	12	16.4 ± 10.0	.004	8.9 ± 3.1	15.7 ± 3.3	.133			11.0 ± 1.2	8.8 ± 1.1	.198	
Ice cream	10	4.2 ± 4.5	11	11.8 ± 7.6	.004	8.2 ± 1.9	11.2 ± 1.5	.204			8.9 ± 1.7	8.9 ± 1.6	.982	
Bread	13	2.6 ± 1.4	11	3.0 ± 2.2	.573	3.2 ± 0.7	3.0 ± 0.5	.793			3.3 ± 0.7	2.8 ± 0.7	.622	
Hamburger and pizza	11	1.4 ± 1.4	12	4.7 ± 2.9	.003	1.3 ± 0.7	4.5 ± 0.5	.001			1.3 ± 0.7	4.5 ± 0.7	.005	
Fruit	0	0.0 ± 0.0	2	0.2 ± 0.4	.108	−0.1 ± 0.1	0.2 ± 0.1	.042			−0.1 ± 0.1	0.0 ± 0.1	.468	
Other foods	6	1.7 ± 2.7	8	1.3 ± 1.3	.549	2.1 ± 1.0	1.2 ± 1.8	.653			2.4 ± 0.9	0.4 ± 1.6	.288	
Yogurt	1	0.1 ± 0.3	7	1.1 ± 1.2	.003	0.4 ± 0.3	1.1 ± 0.2	.041			0.5 ± 0.2	0.7 ± 0.2	.529	
Milk	5	0.3 ± 0.5	8	0.8 ± 0.6	.062	0.6 ± 0.2	0.7 ± 0.1	.690			0.6 ± 0.2	0.6 ± 0.2	.827	
Flavored milk	13	1.8 ± 1.1	12	4.3 ± 2.4	.002	3.0 ± 0.6	4.1 ± 0.5	.130			3.2 ± 0.5	3.6 ± 0.5	.547	
Milk categorization														
Nonflavored milk, full-fat	5	0.3 ± 0.5	6	0.6 ± 0.7	.272	0.7 ± 0.2	0.5 ± 0.2	.507			0.7 ± 0.2	0.5 ± 0.2	.528	
Nonflavored milk, reduced-fat	0	0.0 ± 0.0	2	0.2 ± 0.4	.108	−0.1 ± 0.1	0.2 ± 0.1	.042			2.4 ± 0.5	2.9 ± 0.6	.563	
Flavored milk, full-fat	11	1.2 ± 1.0	11	3.0 ± 1.9	.004	2.4 ± 0.5	2.9 ± 0.6	.485			−0.1 ± 0.1	0.0 ± 0.1	.468	
Flavored milk, reduced-fat	8	0.6 ± 0.6	9	1.3 ± 1.1	.058	0.7 ± 0.4	1.2 ± 0.3	.224			0.8 ± 0.3	0.9 ± 0.3	.870	

\* Adjusted for school level (middle, high school), school type (public, private), students' sex (coeducational, boys only, girls only), and income level of the school district. School districts were considered as random effects.

† Same as above but with additional adjustment for total number of food items in the school store.

‡ Number of schools sold the food item.

Bold indicates  $p < .05$ .

EDNP foods were still available after implementation of the 2009 policy, suggesting that the 2009 nutrient-based policy was ineffective in removal of restricted foods in school stores. There are 2 possible explanations. First, school store owners may not know which foods are EDNP due to a lack of information about the policy or to the complexity of applying EDNP criteria. Indeed, school store owners often do not know specific EDNP criteria and have difficulties discerning EDNP foods.<sup>6,11</sup> The Korea Ministry of Food and Drug Safety (MFDS) has posted the list of EDNP products on their website monthly and developed a smart phone application that identifies foods as EDNP using the barcode on product packaging.<sup>16,17</sup> Most school store owners did not know about the MFDS's materials, however, and the materials did not include information of all foods sold in school stores or new food products.<sup>11</sup>

Another possible explanation for the lack of compliance that this study found is the different contract system for the school store operation between public and private schools. School stores in private schools sold more EDNP foods than those in public schools. In contrast to public schools that have an annual public bidding for school store operation, most private schools make private contracts with school store owners and the duration of the contract is usually multiple years. Even for some private schools, school store owners are relatives of the people from the school foundation. Because of their close relationship and a long history of operation, school stores of private schools are expected to experience less monitoring compared to those in public schools.<sup>11</sup> School stores in public schools also sold EDNP foods. With consideration of the total number of food types sold in school stores, the percentage of EDNP foods

Table 4. Availability of Energy-Dense Nutrient-Poor (EDNP) Foods in School Stores in 2013

	Crude						Adjusted for School Characteristics*					
	Total Number of Foods		Number of EDNP Foods		% EDNP Foods <sup>†</sup>		Number of Foods		Number of EDNP Foods		% EDNP Foods <sup>†</sup>	
	Mean ± SD	p-Value	Mean ± SD	p-Value	Mean ± SD	p-Value	Mean ± SE	p-Value	Mean ± SE	p-Value	Mean ± SE	p-Value
All schools	102.3 ± 50.7		7.0 ± 3.6		7.6 ± 2.8		102.7 ± 23.9		7.8 ± 1.9		7.8 ± 1.8	
School level												
Middle school	62.4 ± 21.8	<b>.012</b>	5.2 ± 1.6	.150	9.1 ± 2.6	.114	77.4 ± 20.8	.147	5.7 ± 1.6	.402	8.8 ± 1.6	.354
High school	130.9 ± 46.1		8.3 ± 4.2		6.5 ± 2.6		122.2 ± 14.6		7.6 ± 1.1		6.7 ± 1.1	
School type												
Private	130.0 ± 47.2	<b>.016</b>	8.6 ± 3.7	.070	7.1 ± 2.5	.478	121.0 ± 14.5	<b>.042</b>	8.5 ± 1.1	.060	7.8 ± 1.1	.986
Public	63.6 ± 22.7		4.8 ± 2.2		8.3 ± 3.4		70.1 ± 16.5		4.8 ± 1.3		7.8 ± 1.2	
Students' sex												
Coeducational	72.6 ± 33.4	.197	6.2 ± 3.1	.176	9.3 ± 2.6	.109	91.5 ± 17.4	.819	7.2 ± 1.3	.127	8.6 ± 1.3	.287
Boys only	113.3 ± 62.2		5.5 ± 2.9		5.4 ± 2.7		89.3 ± 18.8		4.1 ± 1.5		5.9 ± 1.4	
Girls only	137.3 ± 42.7		10.3 ± 4.0		7.8 ± 1.5		105.8 ± 23.6		8.7 ± 1.9		8.8 ± 1.8	
School district												
Low-income district	76.7 ± 40.5	.076	5.8 ± 4.3	.281	8.0 ± 3.4	.598	85.0 ± 14.1	.316	6.4 ± 1.2	.737	7.7 ± 1.2	.947
High-income district	128.2 ± 49.2		8.2 ± 2.6		7.1 ± 2.4		109.8 ± 17.0		7.1 ± 1.5		7.9 ± 1.4	

\*Among school level (middle, high school), school type (public, private), students' sex (coeducational, boys only, girls only), and income level of the school district, school characteristics except the analytic characteristic were adjusted. School districts were considered as random effects.

<sup>†</sup>Percentage of EDNP foods may differ the result of calculation that number of EDNP foods divided by total number of foods since only specific food groups are eligible to be determined EDNP or non-EDNP foods.

Bold indicates  $p < .05$ .

among all foods in school stores was not different between public and private schools. If EDNP foods are high-selling and high-profit products, school store owners would not want to remove the items from their stores. Since the winning bid through the public competitive bidding is increased every year, school store owners of public schools need to earn more money to apply for the next year's right of operation. Under these circumstances, it would be hard to convince school store owners to halt specific food sales.

Given that all school stores observed in 2013 sold EDNP foods, it is questionable whether monitoring on school store foods is conducted well. During the school store observation in 2013, school store owners stated that irregular monitoring of school store foods is conducted by public officials or school staff, but they have not been caught due to violation of the policy. A qualitative study reported that one of the possible reasons of lack of compliance with the 2009 policy is inadequate monitoring of school store foods, such as no monitoring by school staff and decreased frequency of monitoring by public officials due to budget limitation.<sup>11</sup>

This study shows that the 2 different types of policies in South Korea had different influences in food availability in school stores. There was a significant decrease in soft drinks which the 2007 food-based policy required, but no difference in availability of other foods in school stores between

2006 and 2009 was found despite of implementation of the 2009 nutrient-based policy. The 2007 food-based policy, however, did not completely eliminate the restricted items from the observed school stores. California's competitive food policy that included both food-based (beverage standards) and nutrient-based (energy, energy from fat and saturated fat, and sugar) policies also showed that compliance was easier to achieve with food-based than nutrient-based food policies.<sup>6,8,9</sup> The greater compliance with food-based policies may be because they are easier to interpret than nutrient-based policies.<sup>6,9</sup> No prior policy evaluation has reported complete elimination of restricted foods, regardless of whether the restriction was made by food- or nutrient-based policies. Other factors, however, such as concerns about revenue loss, inadequate monitoring system, and students' preferences, may hinder 100% compliance of the policies.<sup>18</sup> Observation of school stores before and after the implementation of the school store policies allowed us understanding of the contexts in which these policies were implemented and helps to identify possible reasons for noncompliance with the policies. We were also able to identify where more efforts are needed for better achievement of policy intention.

### Limitations

The findings of this study should be interpreted with caution due to different school stores observed over time, small sample sizes, and different characteristics

of selected school stores between 2006 and 2013. Although only 2 school stores were observed both in 2006 and 2013, changes in the 2 school stores were similar with changes in overall samples; for example, the 2 school stores sold increased number of foods (1.9 times and 2.7 times each), less soft drinks, and more hamburger and pizza and other beverages in 2013 than in 2006. Significantly, more stores in private schools were observed in 2013 than in 2006. The different contract systems may affect school store owners' food selection, but we did not find significant difference in type of foods sold in school stores between private and public schools. We did not obtain contract information, although there is a possibility that some of stores in private schools made a contract through the public competitive bidding. Future research needs to follow changes in food availability in same school stores using a larger sample size in order to track the impacts of policies.

Because of the 7-year gap between 2 observations, we had different data in 2006 and 2013. In 2006, nutrition labeling policy in South Korea did not require labeling of saturated fat and sugar content of food products. Thus, we were unable to compare EDNP food availability in school stores between 2006 and 2013, and it was impossible to know whether EDNP food availability changed after the 2009 policy. School store observations were conducted only in 1 city; thus foods in school stores in other cities may differ. Although this study may not represent availability of foods in school stores in the entire country, it informs policy decisions by having compared 2 different kinds of school store policy.

## Conclusions

The 2 school store policies in South Korea have had a modest influence on the improvement of school store food environments. Both policies are restrictive in terms of forbidding sales of specific items. Restrictive policies may not change food environments much if unhealthy foods that meet the policy criteria are sold in school stores. A policy that requires sales of healthy foods with the restriction of unhealthy foods could be an alternative. An increase of healthy food availability and a decrease of unhealthy food availability at the same time could improve school store food environments as well as students' diet. Future studies need to investigate how to increase healthy foods and reduce unhealthy foods in school stores and how to encourage students to buy healthy foods instead of unhealthy foods.

In addition, increased benefits for school stores may help to reduce EDNP food availability in school stores. Current policies have only restrictions that may reduce revenue of school stores, but there is no incentive for compliance to the policy. If school store owners

perceive more benefits from complying with the policy than not complying, then they will be more likely to comply. Financial incentives or advantages in renewal of the school store contract could increase school store owners' perceived benefits to comply with the policy. With the direct incentives, strategies to promote school store owners' understanding of why they should not sell specific foods and how to avoid revenue loss when they comply with the policy would be helpful to improve school store food environments.

## IMPLICATIONS FOR SCHOOL HEALTH

School store food environments may not be improved by governmental policies if schools do not implement the policies. School stores in the United States, as well as in South Korea, sell restricted food items after implementation of competitive food policies that restrict sales of unhealthy food and beverage items outside of school meal programs.<sup>6,8,9</sup> School administrators in the United States are often concerned about loss of school food revenue if they stop selling foods that are unhealthy but popular among students.<sup>11,19</sup> Contrary to their concerns, recent studies conducted in the United States showed that implementation of the competitive food policy does not have a significant impact on the total school food revenue. School food revenue may decrease at the beginning of the implementation of healthier standards for school food, but then the revenue recovers by increasing participation in the school meal program, especially among students who are eligible for free- or reduced-school meals, which compensates for revenue loss from competitive food sales.<sup>9,20-22</sup> In addition, competitive food sales compete with school meal programs, thus competitive food revenue is negatively associated with the overall school food revenue.<sup>23,24</sup> Competitive food policies have no or insignificant impact on school food revenue while these policies have potential to improve school food environments and students' diets.

School administrators and governmental officials at school district, state, and federal levels can seek to implement competitive food policies that use strategies to benefit students and minimize financial risk. The strategies include marketing healthy lifestyles, increasing healthy alternatives, and pricing healthy items attractively.<sup>25</sup> In addition, governmental officials could help school service directors to understand the policies by providing educational materials, holding regular workshop, and offering tailored assistance. Involvement of school members—food service directors, administrators, teachers, students, and parents—in implementing competitive food policies could help improve school food environments. A lack of monitoring of school foods has been reported in the United States and South Korea as one of challenges to

ensuring compliance with competitive food policies.<sup>9</sup> Schools can use their dietitians or school nurses to inform and encourage students to make healthy food choice. Schools should play a proactive role to make healthier food environments for their students.

### Human Subjects Approval Statement

The protocol of the school store observation in 2006 was approved by the Institutional Review Board at the Graduate School of Public Health, Seoul National University. The protocol of the observation in 2013 was reviewed and deemed exempt by the Institutional Review Board at the University of South Carolina.

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