# Association of Children and Caregiver Perceptions on Policy with Children's Snack Eating Patterns in South Korea.

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## Abstract

**Background: Investigations of the association between children's snack food and beverage consumption and related policy are limited.**

**Objective: The present study assessed children's eating patterns of snack foods and beverages and investigated any association with children and their caregiver perceptions on food environment policy.**

**Participants and methods: A cross-sectional study included 1,132 fourth-grade students and 1,132 of their caregivers. All children completed a questionnaire on the consumption frequencies of 31 items of snack foods and beverages. All children and their caregivers completed questions evaluating whether they perceive food environment policies. A multivariate logistic regression model was used to analyze the association between policy perceptions and eating patterns derived from factor analysis.**

**Results: Two major eating patterns were obtained: a healthy pattern and an unhealthy pattern. Awareness of both children and caregivers regarding 7 policy questions was significantly associated with the healthy eating pattern, whereas unawareness regarding 4 policy questions was associated with the unhealthy eating pattern. In particular, caregivers who were unaware of the policies regarding designation of children's food safety protection zones and food quality certification display on packaging had a two-fold or a 1.5-fold higher odds ratio (p-value<0.05) for having children with the unhealthy eating pattern compared with the reference group (positive respondent pairs to policy awareness), regardless of children's policy perception.**

**Conclusion: Children and their caregivers should be educated on food environment policies to establish healthy eating habits of snack foods and beverages in children.**

**Keywords**: Children, Snack and beverage, Eating pattern, Policy.

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## Introduction

Although children aged 6 to 12 years have relatively slow and steady growth, they need to store calorie and nutrients for growth spurts that occur during puberty. Children are exposed to food environments around school, which can play a role in the development of eating attitudes and behaviours that influence the entire life [1]. An earlier report revealed unhealthy eating behaviours among school-age children in Korea. Among school-age children, almost 10% skip breakfast or have insufficient nutrient intake, one fourth consume excess calories, and one third reported eating out more than once a day [2]. Irregular meal times and imbalanced diet, including consumption of fast foods and processed foods containing high amounts of fat, sugar, and sodium, may contribute to nutritional problems [3,4]. The prevalence of obesity, an emerging nutritional problem in Korea, has gradually increased among children [5]. Data have shown that certain food environments, such as fast-food restaurants and convenience stores, are associated with obesity [6]. Other research has suggested that interventions through school food environment policies can promote healthy eating behaviour in children [7].

In 2008, the South Korean government enacted 'The Special Act on Safety Management of Children's Dietary Lifestyle'. This law includes articles related to school food environments, such as designating children's food safety protection zones and prohibiting the sale of high-calorie and low-nutrient (HCLN) foods [8]. While this law has been enforced since 2009, data are limited on whether food environment policy based on this law influences children's eating behaviours. A previous study observed a significant correlation between children's perceptions of food environment policy and the consumption frequency of some healthy foods and beverages, but it found no correlation with HCLN food intake [9]. Such null results might be partly due to uncontrolled confounding factors. Dietary patterns may reflect dietary habits and behaviours better than consumption of each food item [10]. Therefore, the eating patterns of snack foods and beverages may be more suitable to indicate children's snack eating behaviours.

In the present study, we identified eating patterns of a wide variety of snack foods and beverages, including HCLN foods. We evaluated whether perceptions of children and their caregivers on the food environment policy are associated with the derived eating patterns.

## Methods

### *Study design and participants*

This study included elementary students and their caregivers who participated in a nationwide cross-sectional survey [11]. For this survey, an eligible population was selected from elementary, middle, and high schools located in major cities and districts of South Korea, including Seoul, Daegu, Daejeon, Gyeonggi, Chungnam, Jeonbuk, and Gyeongnam, using a stratified two-stage cluster approach. A total of 57 elementary schools were selected, including 6 schools each from 3 large cities and 4 small/medium cities and 5 schools each from 3 small villages; 45 schools participated in the present study. The study population was comprised of 4th-grade students and one of their caregivers, such as a parent, grandparent, relative, or other guardian. Among 1,947 student and caregiver pairs who returned the questionnaire, those who did not complete the questionnaire thoroughly (n=668) and children who were not 4th grade students (n=147) were excluded. Finally data of 1,132 pairs were used for analysis. All procedures performed in the study involving human participants were in accordance with the ethical standards of the Sungshin Women's University IRB committee (Ethical Committee Permission: SSWUIRB 2016-031) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All participants signed an informed consent form approved by the IRB.

### *Survey questionnaire*

The questionnaire used in this study was drafted and completed based on law [8], literature review, and expert advice and opinions [11]. The questionnaire for children inquired about demographic characteristics, body weight, height, lifestyle information, policy perception questions, consumption of snack foods and beverages, and related consumption information (eating place, attitude, etc.). The questionnaire for children's caregivers inquired about demographic characteristics, policy perception questions, attitudes toward food purchase, and opinions on the food environment status of their children's school. Children were asked to pick a consumption frequency (rarely, 1-3 occasions per month, 1-3 occasions per week, 4-6 occasions per week, once a day, 2 or more occasions per day) for 31 items of snack foods and beverages consumed within the last month. Sweet snacks (e.g. candy and jelly, chocolate product, cookie and biscuit, sweet bread and cake, sweet rice cake), salty snacks (e.g. potato chip), cereal products, fast foods and convenience foods (e.g. dumpling, fried chicken and fries, grilled skewered foods, hamburger, kimbap, meat or fish-based sausage and hotdog, pizza, ramen, tteokbokki), ice cream and frozen desserts, fruits, nuts, sandwiches, beverages (e.g. carbonated soft drink, caffeinated beverage, fruit-based beverage, fruit-flavoured beverage, vegetable-based beverage, other beverages), and dairy products (e.g. fermented milk, processed milk, soybean milk, white milk) were listed. Except for fruits, nuts, soybean milk, and white milk, these food and beverage items have been referred to as 'Children's Favourite Foods' (CFF) in the Special Act on Safety Management of Children's Dietary Lifestyle [8].

The questionnaire included questions regarding 10 policies listed in the law; Policy 1) designation of children's food safety protection zones; Policy 2) designation of HCLN foods; Policy 3) designation and display of high-caffeine foods on packaging; Policy 4) display of food quality certification on packaging; Policy 5) designation of exemplary business places in which HCLN foods and high-caffeine foods are not available; Policy 6) restriction on advertising HCLN foods and high-caffeine foods from 5 pm to 7 pm; Policy 7) prohibition of advertisement of HCLN foods and high-caffeine foods offering free toys; Policy 8) display of nutrition information in stores or on websites selling snacks and fast foods; Policy 9) providing regular education on food safety and nutrition in elementary schools; Policy 10) prohibition of sale of foods detrimental to children's emotional health. The policy perception questions inquired whether children and their caregivers are aware of the 10 policies (policy awareness) and whether they perceive these policies as useful for children's healthy eating habits (policy usefulness).

### *Statistical analysis*

General characteristics of children and their caregivers were calculated and presented as means and standard deviations or proportions. The consumption frequencies of snack foods and beverages were calculated and used for factor analysis to derive eating patterns. Eigenvalue computation and scree test were used to determine the number of factors, and then the varimax rotation method was used for clear interpretation of the derived factors (eating patterns). Each of eating patterns was labelled according to the major snack foods and beverages contributing to the pattern, and factor scores were calculated for each eating pattern. A difference in factor scores between positive and negative respondents to policy questions was evaluated using t-test. To analyse the association between children's and their caregivers' responses to policy questions and the top quartile of factor scores for eating patterns, a logistic regression analysis was used. In multivariate logistic regression models adjusted for child's age, sex, and residence region and caregiver's age and number of children, the top quartile of factor loading scores for each of the eating patterns was treated as a dependent variable, and odds ratios (ORs) and its 95% confidence interval (CI) were estimated. The SAS program (SAS 9.1.3, 2008, SAS Institute, Cary, NC, USA) was used for statistical analysis, and the statistical significance level was set at 0.05 in the two-sided test.

## Results

General characteristics of 1,132 students and their caregivers are presented in Table 1. Female caregivers were dominant while the sex proportions of children were similar. Most participants were living in cities.

The results of factor analysis identifying the eating patterns of selected items with consumption frequencies are shown in Table 2. High consumption items that were consumed once a week include white milk, fruits, ice cream and frozen dessert, fermented milk, cookies and biscuits, fruit-based beverage, ramen, nuts, carbonated soft drinks, sweet bread, and cake. Two factors were derived, and eating patterns were labeled as unhealthy and healthy based on items with high factor loading scores. The unhealthy eating pattern is characterized by frequent consumption of high calorie foods and beverages with low nutritional value, such as candy and jelly, chocolate products,

***Table 1.*** *General characteristics of 1,132 pairs of children and their caregivers.`*

| Characteristics | Children | Caregivers |
|---|---|---|
| Age, year | 9.9±0.5 | 40.7±4.7 |
| Females, n(%) | 581(51.3) | 1,018 (89.9) |
| **Region of residence*, n(%)** | | |
| Metropolitan city | 424(37.5) | - |
| Small and middle-sized city | 562(49.6) | - |
| Town or village | 146(12.9) | - |
| Allowance, dollar/month | 8.0±10.1 | - |
| Body weight, kg | 36.8±8.3 | - |
| **Relationship with children** | | |
| Mother | - | 1,006(88.9) |
| Father | - | 111(9.8) |
| Others | - | 15(1.3) |
| Number of children | - | 2.1±0.7 |
| **Note:***Same for children's caregivers | | |

***Table 2.*** *Results of rotated factor loading matrix for eating patterns of snack food and beverage consumption.*

| Snack foods and beverages | Consumption frequency/week Mean±S.D. | Factor loading score# | |
|---|---|---|---|
| | | Factor 1: Unhealthy eating pattern | Factor 2: Healthy eating pattern |
| Candy and jelly | 0.98±1.93 | 60* | -7 |
| Cereal product | 0.86±1.82 | 40 | 8 |
| Chocolate product | 0.81±1.67 | 65* | -6 |
| Cookie and biscuit | 1.67±2.52 | 58* | -4 |
| Dumpling | 0.55±1.14 | 55* | 12 |
| Fried chicken | 0.66±1.29 | 47* | 24 |
| Fried foods, except fried chicken | 0.34±0.90 | 48* | 9 |
| Grilled skewered food | 0.29±1,00 | 45* | 23 |
| Hamburger | 0.45±0.93 | 56* | 5 |
| Kimbab (dried seaweed roll) | 0.64±1.10 | 50* | 31 |
| Meat or fish-based sausage | 0.77±1.51 | 49* | 9 |
| Pizza | 0.35±0.86 | 48* | 15 |
| Potato chip | 0.97±1.79 | 61* | 5 |
| Ramen | 1.27±1.68 | 63* | 7 |
| Sandwiches | 0.34±1.01 | 16 | 40 |
| Sweet bread and cake | 1.02±1.78 | 44* | 5 |
| Sweet rice cake | 0.48±1.28 | 35 | 33 |
| Tteokbokki (spicy rice cake) | 0.76±1.35 | 41* | 30 |
| Ice-cream and frozen dessert | 2.70±3.09 | 45* | 3 |
| Fruit | 5.26±4.33 | -4 | 43* |
| Nut | 1.08±2.41 | 1 | 50* |
| Carbonated soft drink | 1.04±1.96 | 53* | 11 |
| Caffeinated beverage | 0.08±0.58 | 9 | 27 |
| Fruit-based beverage | 1.45±2.56 | 8 | 74* |
| Fruit-flavoured beverage | 0.88±1.91 | 39 | 40 |
| Vegetable-based beverage | 0.70±1.94 | -5 | 69* |
| Other beverages | 0.87±1.88 | 46* | 32 |
| Fermented milk | 1.75±2.62 | 22 | 38 |
| Processed milk | 0.77±1.93 | 47* | 19 |
| Soybean milk | 0.49±1.68 | 12 | 42* |
| White milk | 5.65±4.60 | -3 | 38 |
| **Note:** #Presented as values multiplied by 100 and rounded to the nearest integer; values greater than 40 are flagged by an asterisk | | | |

cookies and biscuits, fried foods, hamburgers, potato chips, ramen, sweet breads and cakes, and carbonated soft drinks. The healthy eating pattern is characterized by consumption of fruit- and vegetable-based beverages, nuts, fruits, and soybean milk.

Table 3 demonstrates the numbers and proportions of children who provided positive responses to questions regarding awareness and perceived usefulness of the 10 policies. Overall, the proportions of positive responses were higher for policy usefulness questions than for awareness questions. When factor loading scores of unhealthy and healthy eating patterns were compared between positive and negative respondents according to these policy questions, more significance was found for policy awareness questions. Children who answered positively for policy awareness questions had higher factor loading scores of the healthy eating pattern and lower scores of the unhealthy pattern than negative respondents. Children who were unaware of 4 particular policies, including designation of children's food safety protection zones, prohibition of advertisement of HCLN

***Table 3.*** *Comparison of factor scores for positive and negative child respondents regarding awareness and perceived usefulness of food environment policies.*

| Policy perception | N (%) of positive respondents | Factor loading score of unhealthy eating pattern | | | Factor loading score of healthy eating pattern | | |
|---|---|---|---|---|---|---|---|
| | | Positive respondents | Negative respondents | p-value | Positive respondents | Negative respondents | p-value |
| **Awareness** | | | | | | | |
| Policy 1 | 381 (33.7) | -0.1094±0.9093 | 0.0555±1.0392 | <0.01 | 0.1169±1.1139 | -0.0593±0.9321 | <0.01 |
| Policy 2 | 463 (40.9) | -0.0448±0.9948 | 0.0310±1.0031 | 0.21 | 0.1576±1.1467 | -0.1091±0.8686 | <0.001 |
| Policy 3 | 449 (39.7) | -0.0124±1.0418 | 0.0082±0.9722 | 0.74 | 0.0891±1.0804 | -0.0586±0.9396 | <0.05 |
| Policy 4 | 760 (67.1) | -0.0173±1.0041 | 0.0354±0.9920 | 0.41 | 0.0750±1.0754 | -0.1532±0.8048 | <0.001 |
| Policy 5 | 527 (46.6) | -0.0256±1.0377 | 0.0223±0.9663 | 0.42 | 0.1201±1.0717 | -0.1046±0.9213 | <0.001 |
| Policy 6 | 164 (14.5) | -0.0464±0.9010 | 0.0079±1.0160 | 0.52 | 0.3114±1.3625 | -0.0528±0.9151 | <0.001 |
| Policy 7 | 249 (22.0) | -0.1488±0.7851 | 0.0420±1.0493 | <0.01 | 0.2424±1.2328 | -0.0684±0.9131 | <0.001 |
| Policy 8 | 463 (40.9) | -0.0686±0.9817 | 0.0475±1.0105 | 0.05 | 0.1202±1.1363 | -0.0832±0.8850 | <0.001 |
| Policy 9 | 713 (63.0) | -0.0775±0.9372 | 0.1318±1.0872 | <0.01 | 0.0173±0.9874 | -0.0294±1.0216 | 0.45 |
| Policy 10 | 433 (38.3) | -0.1328±0.7512 | 0.0822±1.1195 | <0.001 | 0.1249±1.1144 | -0.0774±0.9143 | <0.001 |
| **Usefulness** | | | | | | | |
| Policy 1 | 826 (73.0) | -0.0254±0.9888 | 0.0686±1.0282 | 0.16 | -0.0116±1.0090 | 0.0314±0.9763 | 0.52 |
| Policy 2 | 871 (76.9) | -0.0304±0.9814 | 0.1013±1.0555 | 0.06 | 0.0018±1.0251 | -0.0061±0.9133 | 0.91 |
| Policy 3 | 841 (74.3) | -0.0383±0.9106 | 0.1106±1.2173 | 0.06 | 0.0092±1.0410 | -0.0265±0.8718 | 0.57 |
| Policy 4 | 954 (84.3) | -0.0289±0.9512 | 0.1546±1.2206 | 0.06 | 0.0096±1.0263 | -0.0523±0.8459 | 0.39 |
| Policy 5 | 912 (80.6) | -0.0273±0.9668 | 0.1131±1.1228 | 0.09 | 0.0104±1.0271 | -0.0431±0.8795 | 0.43 |
| Policy 6 | 771 (68.1) | -0.0430±0.9028 | 0.0919±1.1772 | 0.05 | 0.0226±1.0597 | -0.0483±0.8581 | 0.23 |
| Policy 7 | 812 (71.7) | -0.0408±0.9547 | 0.1035±1.1016 | <0.05 | 0.0205±1.0095 | -0.0520±0.9750 | 0.27 |
| Policy 8 | 860 (76.0) | -0.0214±0.9934 | 0.0677±1.0196 | 0.20 | 0.0226±1.0311 | -0.0715±0.8926 | 0.15 |
| Policy 9 | 962 (85.0) | -0.0306±0.9782 | 0.1733±1.1026 | <0.05 | 0.0207±1.0302 | -0.1169±0.8009 | <0.05 |
| Policy 10 | 879 (77.7) | -0.0413±0.8800 | 0.1435±1.3279 | <0.05 | 0.0020±1.0298 | -0.0068±0.8904 | 0.89 |

**Note:** Policy 1, designation of children's food safety protection zones; Policy 2, designation of high-calorie and low-nutrient (HCLN) foods; Policy 3, designation and display of high-caffeine foods on packaging; Policy 4, display of food quality certification on packaging; Policy 5, designation of exemplary business places in which HCLN foods and high-caffeine foods are not available; Policy 6, restriction on advertising for HCLN foods and high-caffeine foods from 5 pm to 7 pm; Policy 7, prohibition of advertisement of HCLN foods and high-caffeine foods offering free toys; Policy 8, display of nutrition information in stores or on websites selling snacks and fast foods; Policy 9, providing regular education on food safety and nutrition in elementary schools; Policy 10, prohibition of sale of foods detrimental to children's emotional health.

***Table 4.*** *Comparison of factor scores for positive and negative caregiver respondents regarding awareness and perceived usefulness of food environment policies.*

| Policy perception | N (%) of positive respondents | Factor loading score of unhealthy eating pattern | | | Factor loading score of healthy eating pattern | | |
|---|---|---|---|---|---|---|---|
| | | Positive respondents | Negative respondents | p-value | Positive respondents | Negative respondents | p-value |
| **Awareness** | | | | | | | |
| Policy 1 | 738 (65.2) | –0.0247±1.0388 | 0.0462±0.9224 | 0.24 | 0.0578±1.0702 | -0.1083±0.8438 | <0.01 |
| Policy 2 | 761 (67.2) | –0.0277±0.9807 | 0.0568±1.0375 | 0.18 | 0.0714±1.0852 | -0.1464±0.7783 | <0.001 |
| Policy 3 | 775 (68.5) | -0.0263±0.9917 | 0.0572±1.0168 | 0.19 | 0.0205±1.0522 | -0.0445±0.8758 | 0.28 |
| Policy 4 | 794 (70.1) | -0.0266±1.0001 | 0.0625±0.9986 | 0.17 | 0.0390±1.0549 | -0.0915±0.8517 | <0.05 |
| Policy 5 | 571 (50.4) | –0.0115±1.0299 | 0.0117±0.9694 | 0.70 | 0.0612±1.0517 | -0.0623±0.9414 | <0.05 |
| Policy 6 | 285 (25.2) | -0.1409±0.7165 | 0.0474±1.0750 | <0.001 | 0.0696±1.0778 | -0.0234±0.9720 | 0.20 |
| Policy 7 | 358 (31.6) | -0.0594±0.8610 | 0.0275±1.0575 | 0.14 | 0.0447±1.0661 | -0.0207±0.9679 | 0.32 |
| Policy 8 | 917 (81.0) | -0.0207±0.9334 | 0.0881±1.2434 | 0.23 | 0.0197±1.0225 | -0.0841±0.8949 | 0.14 |
| Policy 9 | 842 (74.4) | -0.0270±0.9889 | 0.0783±1.0294 | 0.12 | 0.0180±1.0012 | -0.0521±0.9965 | 0.30 |
| Policy 10 | 696 (61.5) | –0.0442±0.9714 | 0.0705±1.0412 | 0.06 | 0.0647±1.0902 | -0.1032±0.8268 | <0.01 |
| **Usefulness** | | | | | | | |
| Policy 1 | 776 (68.6) | –0.0130±1.0219 | 0.0284±0.9514 | 0.52 | 0.0140±1.0227 | -0.0305±0.9494 | 0.49 |
| Policy 2 | 817 (72.2) | –0.0414±0.9488 | 0.1074±1.1165 | <0.05 | –0.0156±0.9980 | 0.0405±1.0057 | 0.40 |
| Policy 3 | 844 (74.6) | –0.0219±0.9668 | 0.0642±1.0908 | 0.23 | –0.0111±0.9799 | 0.0326±1.0578 | 0.52 |
| Policy 4 | 909 (80.3) | 0.000032±1.0191 | -0.00013±0.9203 | 1.00 | 0.0178±1.0105 | -0.0724±0.9546 | 0.23 |
| Policy 5 | 765 (67.6) | 0.00931±1.0533 | -0.0194±0.8796 | 0.63 | –0.00353±1.0132 | 0.00736±0.9733 | 0.86 |
| Policy 6 | 689 (60.9) | –0.0462±0.9589 | 0.0719±1.0579 | 0.06 | –0.0476±0.9404 | 0.0741±1.0832 | 0.05 |
| Policy 7 | 792 (70.0) | –0.00276±1.0352 | 0.00643±0.9141 | 0.88 | –0.0103±0.9631 | 0.0240±1.0822 | 0.61 |
| Policy 8 | 899 (79.4) | 0.00564±1.0095 | -0.0218±0.9641 | 0.71 | –0.00011±1.0200 | 0.000417±0.9207 | 0.99 |
| Policy 9 | 976 (86.2) | –0.00994±1.0063 | 0.0622±0.9604 | 0.40 | 0.00552±1.0050 | -0.0346±0.9703 | 0.64 |
| Policy 10 | 885 (78.2) | 0.00437±1.0391 | -0.0157±0.8467 | 0.76 | -0.00533±0.9826 | 0.0191±1.0620 | 0.73 |

**Note:** Policy 1, designation of children's food safety protection zones; Policy 2, designation of high-calorie and low-nutrient (HCLN) foods; Policy 3, designation and display of high-caffeine foods on packaging; Policy 4, display of food quality certification on packaging; Policy 5, designation of exemplary business places in which HCLN foods and high-caffeine foods are not available; Policy 6, restriction on advertising for HCLN foods and high-caffeine foods from 5 pm to 7 pm; Policy 7, prohibition of advertisement of HCLN foods and high-caffeine foods offering free toys; Policy 8, display of nutrition information in stores or on websites selling snacks and fast foods; Policy 9, providing regular education on food safety and nutrition in elementary schools; Policy 10, prohibition of sale of foods detrimental to children's emotional health.

foods and high-caffeine foods offering free toys, providing regular education on food safety and nutrition in elementary schools, and prohibition of sale of foods detrimental to children's emotional health, were more likely to display the unhealthy eating pattern (p-value<0.01).

Table 4 shows the numbers and proportions of children's caregivers who provided positive responses to questions regarding awareness and perceived usefulness of the 10 policies. Caregivers who answered positively for policy awareness questions were more likely to have children with the healthy eating pattern. Caregivers who were unaware of the restriction policy on advertising for HCLN foods and high-caffeine foods from 5 pm to 7 pm had children with the unhealthy eating pattern (p-value<0.001). No differences between positive and negative respondents were found in most questions on policy usefulness, except for the policy regarding designation of HCLN foods.

Table 5 presents joint analysis results of children and their caregiver responses and the association with unhealthy and healthy eating patterns. In the multivariate logistic model, negative responses of either children or their caregivers regarding policy awareness questions were significantly associated with the top quartile of factor scores for the unhealthy eating pattern. In particular, caregivers who were unaware of the policy regarding designation of children's food safety protection zones had a two-fold higher OR (p-value<0.05) for having children with the unhealthy eating pattern compared with the reference

***Table 5.*** *Associations of children and caregiver policy awareness with top quartile of factor scores for eating patterns.*

| Policy | Response of respondents | | N of | Odds ratio* (95% confidence interval) | |
|---|---|---|---|---|---|
| | Children | Caregivers | pairs | Unhealthy eating pattern | Healthy eating pattern |
| Policy 1 | Positive | Positive | 309 | reference | 1.66 (1.14, 2.41) |
| | Negative | Positive | 429 | 2.01 (1.38, 2.92) | 1.37 (0.96, 1.95) |
| | Positive | Negative | 72 | 2.08 (1.14, 3.81) | 1.90 (1.07, 3.36) |
| | Negative | Negative | 322 | 2.32 (1.57, 3.43) | reference |
| Policy 2 | Positive | Positive | 353 | reference | 1.65 (1.13, 2.40) |
| | Negative | Positive | 408 | 1.15 (0.83, 1.61) | 1.03 (0.70, 1.50) |
| | Positive | Negative | 110 | 1.26 (0.77, 2.06) | 1.25 (0.74, 2.10) |
| | Negative | Negative | 261 | 1.13 (0.78, 1.65) | reference |
| Policy 3 | Positive | Positive | 336 | reference | 1.16 (0.79, 1.70) |
| | Negative | Positive | 439 | 1.04 (0.74, 1.45) | 0.94 (0.65, 1.36) |
| | Positive | Negative | 113 | 1.30 (0.80, 2.12) | 1.28 (0.78, 2.12) |
| | Negative | Negative | 244 | 1.10 (0.75, 1.61) | reference |
| Policy 4 | Positive | Positive | 577 | reference | 1.76 (1.12, 2.77) |
| | Negative | Positive | 217 | 1.11 (0.77, 1.61) | 1.24 (0.73, 2.10) |
| | Positive | Negative | 183 | 1.55 (1.06, 2.25) | 1.65 (0.98, 2.80) |
| | Negative | Negative | 155 | 1.47 (0.98, 2.19) | reference |
| Policy 5 | Positive | Positive | 323 | reference | 1.72 (1.20, 2.45) |
| | Negative | Positive | 248 | 1.15 (0.77, 1.70) | 1.22 (0.82, 1.81) |
| | Positive | Negative | 204 | 1.33 (0.89, 2.00) | 1.87 (1.26, 2.79) |
| | Negative | Negative | 357 | 1.24 (0.87, 1.77) | reference |
| Policy 6 | Positive | Positive | 56 | reference | 2.01 (1.14, 3.56) |
| | Negative | Positive | 229 | 1.31 (0.58, 2.99) | 1.02 (0.72, 1.45) |
| | Positive | Negative | 108 | 1.96 (0.82, 4.68) | 1.40 (0.90, 2.19) |
| | Negative | Negative | 739 | 2.32 (1.08, 5.01) | reference |
| Policy 7 | Positive | Positive | 110 | reference | 1.77 (1.15, 2.74) |
| | Negative | Positive | 248 | 1.24 (0.72, 2.15) | 0.98 (0.69, 1.40) |
| | Positive | Negative | 139 | 1.07 (0.58, 1.98) | 1.35 (0.89, 2.04) |
| | Negative | Negative | 635 | 1.40 (0.86, 2.30) | reference |
| Policy 8 | Positive | Positive | 415 | reference | 1.44 (0.94, 2.22) |
| | Negative | Positive | 502 | 1.39 (1.02, 1.90) | 1.10 (0.72, 1.67) |
| | Positive | Negative | 48 | 2.31 (1.22, 4.35) | 1.21 (0.57, 2.57) |
| | Negative | Negative | 167 | 1.26 (0.82, 1.94) | reference |
| Policy 9 | Positive | Positive | 580 | reference | 1.07 (0.70, 1.62) |
| | Negative | Positive | 262 | 1.73 (1.24, 2.42) | 1.24 (0.78, 1.96) |
| | Positive | Negative | 133 | 1.44 (0.93, 2.22) | 1.12 (0.65, 1.93) |
| | Negative | Negative | 157 | 1.59 (1.06, 2.37) | reference |
| Policy 10 | Positive | Positive | 308 | reference | 1.53 (1.06, 2.19) |
| | Negative | Positive | 388 | 1.32 (0.92, 1.89) | 1.13 (0.79, 1.61) |
| | Positive | Negative | 125 | 1.16 (0.70, 1.91) | 0.77 (0.45, 1.30) |
| | Negative | Negative | 311 | 1.49 (1.03, 2.17) | reference |

**Note:** Policy 1, designation of children's food safety protection zones; Policy 2, designation of high-calorie and low-nutrient (HCLN) foods; Policy 3, designation and display of high-caffeine foods on packaging; Policy 4, display of food quality certification on packaging; Policy 5, designation of exemplary business places in which HCLN foods and high-caffeine foods are not available; Policy 6, restriction on advertising for HCLN foods and high-caffeine foods from 5 pm to 7 pm; Policy 7, prohibition of advertisement of HCLN foods and high-caffeine foods offering free toys; Policy 8, display of nutrition information in stores or on websites selling snacks and fast foods; Policy 9, providing regular education on food safety and nutrition in elementary schools; Policy 10, prohibition of sale of foods detrimental to children's emotional health.

*Adjusted for child's age, sex, and residence region and caregiver's age and number of children.

group, regardless of children's policy perception. Similarly, those who were unaware of the policy regarding food quality certification display on packaging had a 1.5-fold higher OR (p-value<0.05) for having children with the unhealthy eating pattern compared with the reference group. In contrast, when both children and their caregivers provided positive responses to policy awareness questions, children were likely to have the healthy eating pattern.

When similar logistic regression analyses were conducted for policy usefulness questions, no significance was observed for the association between responses and the healthy eating pattern. In the multivariate association between responses and the unhealthy eating pattern, negative respondent pairs to the HCLN food designation policy and the regular education policy showed significantly higher ORs (1.81[95% CI:1.16,2.80] and 2.32[1.22, 4.41], respectively) compared with the positive respondent pairs (data are available upon request).

## Discussion

A cross-sectional study including 1,132 pairs of children and their caregivers was conducted to analyze the associations of awareness and perceived usefulness of food environment policies with children's eating patterns. When both children and their caregivers were aware of the policies, children were more likely to have a healthy eating pattern. When caregivers were unaware of the policies, children were likely to have an unhealthy eating pattern regardless of the child's policy perceptions. These findings suggest that the awareness of both children and their caregivers regarding food environment policy plays an important role in children's eating patterns of snack foods and beverages.

Children are now considered independent consumers that make decisions based on their own desires and preferences. Children are likely to spend their own pocket money to purchase snacks, beverages, and fast foods [11-13], which are notoriously less nutritious and obesogenic. Previous studies explored food environmental factors and their association with consumption of HCLN foods among children [13-17]. Although more data are warranted for some factors, HCLN food consumption was associated with food accessibility [13,14], price [15], advertisements [16], and exposure to media [11,17].

In South Korea, 'The Special Act on Safety Management of Children's Dietary Lifestyle' has been enforced over 10 years. Its purpose declared in Article 1 is: 'The purpose of this Act is to contribute to promoting children's health by prescribing matters necessary for supplying safe and nutritionally balanced foods in order to help children acquire proper dietary habits' [8]. This law was expected to improve food environments, support policies regarding children's food safety protection zones, limit retail, marketing, and advertisement of HCLN foods and high-caffeine foods, improve nutrition fact labels, regulate food safety and quality certificates, and decree regular nutritional education in schools. The present study evaluated whether children and their caregivers are aware of these policies and their perception of policy usefulness. In addition, we investigated whether their perceptions are associated with children's eating habits. An earlier study observed correlations between total frequency of consumption of HCLN foods and total scores of policy perception [9]. Eating pattern approach provides information on overall eating and may be useful for understanding healthy and unhealthy behaviors [10]. In the present study, more policies were significantly associated with the healthy eating pattern than with the unhealthy eating patterns in both children and their caregivers. These findings suggest that food environment policies may be helpful to establish healthy eating patterns of snack food and beverage consumption. In particular, policy awareness was more strongly associated with the healthy eating pattern than perceived usefulness. This is partly because children with the unhealthy eating pattern might consider the policies useful if they were previously unaware of them. Previous studies investigated the association between food environment policies and competitive food consumption [7,18-20]. While most studies evaluated implementation of school-based policies and practices [7], some studies that focused on state-level policies showed promising outcomes [18-21].

The present study suggests that policy awareness of caregivers may play an important role in establishing healthy eating habits of snack foods and beverages in children. These results may be due to the availability of healthy foods and beverages purchased by caregivers who were aware of the policies. Conversely, the availability of unhealthy foods and beverages at home may be related to the unhealthy eating pattern [22]. Accordingly, the findings suggest that caregivers should have knowledge of food environment policy and should be involved in school-based nutrition education with their children to acquire this knowledge [23].

The present study has several limitations, including its cross-sectional study design that inhibits inference of causality for the association. In addition, the study only included 4th grade elementary school students and information on consumption amounts of snack foods and beverages were unavailable. However, a beverage and snack questionnaire investigating only frequency consumption demonstrated acceptable validity in an earlier study [24]. The strengths of our study include the use of nationwide sampling, a large sample size, and the use of an eating pattern approach. Further studies that overcome the limited generalizability of the findings are warranted.

## Conclusion

A cross-sectional study including 1,132 pairs of children and their caregivers observed that awareness of both children and their caregivers regarding food environment policy was associated with snack food and beverage eating pattern. These findings suggest that both children and their caregivers should be educated on food environment policies to establish healthy eating habits in children.

## Conflict of Interest

The author declares no potential conflicts of interests.

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