

## Original Article

# The relationship between snack intake and its availability of 4<sup>th</sup>-6<sup>th</sup> graders in Taiwan

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The purpose of this study was to examine the relationship between the snack intake and snack availability of elementary school children. Data analyzed were from 722 4<sup>th</sup> to 6<sup>th</sup> graders' food availability and food intake questionnaires collected in the Nutrition and Health Survey in Taiwan Elementary School Children 2001-2002. The snacks commonly eaten were divided into two groups. Healthy snacks included dairy products, 100% fruit juice and fresh fruits. Unhealthy snacks included high fat/sugar snacks, cookies, candy, carbonated/sugared beverages and fast food. Structural equating modeling was used to test the models that describe the availability and intake of two snack groups. Results indicated that parents' intake and children's preference were major predictors of children intake of both healthy and unhealthy snacks. Other than that, the intake of unhealthy snacks was positively associated with "purchase by children themselves" but not the intake of healthy snacks, which was influenced predominantly by "present in home". The results support the perception that a positive family food environment is important for improving children's diet quality. To build a healthy family food environment, parents have to not only provide healthy snacks but also limit the unhealthy snacks in home. In addition to that, the role modeling of parents as eating healthy snacks instead of unhealthy snacks themselves may help children to develop similar behaviors.

**Key Words:** food availability, snack intake, food frequency, food environment, 4<sup>th</sup>-6<sup>th</sup> graders

## INTRODUCTION

Nutritional intake during childhood is important for growth, long-term health promotion, and the development of life-long eating behaviors. National nutrition surveys indicated that children consume excessive amounts of high-fat, high-calories foods and insufficient amounts of whole grains, fruits, vegetables and dairy food in Taiwan.<sup>1</sup> These dietary patterns place children at the risk for obesity and future chronic disease.<sup>2,3</sup> For improving children's health, it is crucial to know how to modify children's diet and eating behavior. Dietary behavior is complex. Social cognitive theory (SCT) provides a theoretical framework for understanding and describing the multiple influences that have an impact on food behaviors. In Bandura's<sup>4</sup> SCT, a person's behavior interacts with characteristics of personal factors and of the environment. Recently, the interventions for changing eating behavior not only focus on increasing personal knowledge, attitude, and skill, but also focus on environmental change. The most important environment influences on children's eating behavior are the family and school. A school-based dietary change project focused on increasing the availability of targeted foods,<sup>5</sup> (Simons-Morton 1984) GIMME5 and Teach Well projects in USA all proved to improve children's intake through the increasing the availability of fruits and vegetables.<sup>6,7</sup> In Taiwan, researchers found that children's sugared-beverage intake

was influenced by the food availability at home<sup>8</sup> and the convenience of purchasing.<sup>9</sup> Besides sugared beverages, cake, sweet food, candy, chocolate, fried starchy products, soft drinks and milk were popular snacks for Taiwanese children.<sup>10</sup> The frequencies of eating those snacks may influence children's dietary quality. The purpose of this study was to understand the relationship between the availability of healthy and unhealthy snacks in Taiwanese elementary school children's daily life with the frequencies of eating those snacks. Based on the study, proper environmental intervention can be proposed to improve children's diet quality.

## MATERIALS AND METHODS

### Data Collection

This study is part of the Nutrition and Health Survey in Taiwan Elementary School Children 2001-2002 (NAHSIT Children 2001-2002). A multistaged, stratified probability sampling method was used in this study.<sup>11</sup>

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The survey population was stratified into 13 strata in the original design, which comprise 4 strata ("Hakka areas", "Mountain areas", "Eastern areas", "PengHu islands") of particular geographic locations and ethnic groups, and 9 strata of the remaining areas of Taiwan. There were 835 4-6<sup>th</sup> graders children who completed all questionnaires, but only those whose mother or father completed the Parent's Food Frequency Questionnaire were analyzed in this study. In total there were 772 students (412 boys and 360 girls), with 253 4<sup>th</sup> graders, 263 5<sup>th</sup> graders and 256 6<sup>th</sup> graders. Signed informed consent was obtained from one parent of each child that was involved in the study. The study was approved by reviewers from the Department of Health in Taiwan.

### Measures

**Classification of snack.** Data analyzed were from the food availability scale and food frequency questionnaire. In these two scales, the snacks commonly eaten by Taiwanese children were among 13 food items based on their characteristics, 8 of the food items were selected and further grouped as healthy and unhealthy based on their fat and sugar contents for the analysis. The healthy snacks included 100% milk products, 100% fruit juice and fresh fruit, the unhealthy snacks included salty high fat snack (i.e. potato chips), sweet high fat snacks (i.e. cookies), candies, sugared beverages (i.e. carbonated beverage) and Western-style high-fat fast foods.

**The availability of snacks.** The availability of snacks was defined as whether the snack was present in the environment of children's daily life, including: sold in stores near home or on the way to school, sold in school store, present in home, or purchased by children. The availability of the 8 food items stated earlier through the above 4 channels in the past month was answered by children. The response items were of 2-points scale, where 1=yes and 2=no. For sold in the store near home or on the way to school, sold in school store, and present in home, one point was given for each "yes" answer. The frequencies of children who bought those foods by themselves were of 3-point Likert-type format, where 1=often, 2=sometimes, and 3=seldom and three, two and one points were given, respectively. Therefore, higher score means that the snack was available to a greater extent to the children through that channel or the children bought it more frequently.

**The intake of snack.** A Food Frequency Questionnaire (FFQ) was used to measure the food intakes of children and their parents in NAHSIT Children 2001-2002. A total of 33 food items from 4 major food groups (Milk, Vegetable, Fruit, and Meat group) and snacks were included in the questionnaire, 8 food items were selected for the analysis of snack intake. The frequencies (days/week) of each food item consumed in the past month were answered by children and their parents, respectively. The response items ranged from "never", "1-2 days/week", "3-4 days/week", "5-6 days/week" to "every day", and a number marked scale from 0 to 7 using 0.5 as one unit was presented underneath the 5 response items. A corresponding point was given according to "the number of

days" in a week a particular food item was by the subject.

**Food preference.** A 25 food items food preference scale was used to measure the food preference of children in NAHSIT Children 2001-2002, eight of the food items were selected for this study. The food preference scale was of 3-point Likert-type format, where 1=like, 2=neutral, and 3=dislike and two, one and zero points were given to the above responses, respectively.

### Statistics

Structured equation modeling was conducted with LISREL 8.2 for Windows to test the hypothesized models that described the influences of availability, children's preference and parents' eating frequency on intake of the healthy snack group and the unhealthy snack group.

Four indices were used to determine how well the model fits the data: the chi-square test ( $\chi^2$  and  $\chi^2/df$ ), the Good Fit Index (GFI), the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA).<sup>12</sup> The small, nonsignificant ( $p > 0.05$ )  $\chi^2$ , and  $\chi^2/df$  less than 3 indicate little discrepancy between the structure of the observed data and the hypothesized model. The GFI and CFI values  $> 0.90$  (approaching an upper limit of 1) indicate a well-fitting model. The RMSEA reflects how closely the model fit approximates a reasonably fitted model and indicates good model fit with values  $< 0.05$ , acceptable model fit with value  $< 0.08$ .<sup>13</sup>

## RESULTS

### *The availability, preference and consumption of snacks*

Tables 1-2 show the availability of snacks to the Taiwanese 4<sup>th</sup>-6<sup>th</sup> graders, and their preference and frequency of consumption of the healthy and unhealthy snacks.

**Snack Availability.** The data on availabilities of healthy and unhealthy snacks to 4<sup>th</sup>-6<sup>th</sup> graders were provided in Table 1. For unhealthy snacks, 94.4% of children reported that they were sold near home or on the way to school; 47.8% of children reported that school stores sold those foods; and 91.8% of children reported that those unhealthy snacks were present inside the home. For the healthy snacks, 90.3% of the children reported that they were sold near home or on the way to school; 50.3% of the children reported that they were sold in the school store; and almost all children (97.5%) reported that those healthy snacks were present in their home. As for children buying snacks themselves, 21.9%, 68.0%, and 10.1% of children seldom, sometimes, or usually bought unhealthy snacks, respectively. The frequencies of children buying healthy snacks were 46.2% for "seldom", 42.5% for "sometimes", and 11.3% for "often". From the above data we found that both healthy and unhealthy snacks were most available to children in the stores near the children's home or on their way to school, and present in the home; many children bought both healthy and unhealthy snacks themselves, but children in general bought unhealthy snacks more frequently than healthy snacks.

**Snack preference.** More than 80% of the children stated that they like healthy snacks and 0.4% of children dislike them. A total of 71.5% children stated that they like

**Table 1.** Distribution (%) of snack availability and preference of 4<sup>th</sup>-6<sup>th</sup> graders. (N=772)

	Healthy snacks (%)	Unhealthy snacks (%)
<b>Availability</b>		
Sold near home or on the way to school	90.3	94.4
Sold in school store	50.3	47.8
Present in home	97.5	91.8
<b>Purchased by self</b>		
Seldom	46.2	21.9
Sometimes	42.5	68.0
Often	11.3	10.1
<b>Food preference</b>		
Dislike	0.39	0.13
Neutral	16.2	28.4
Like	83.4	71.5

unhealthy snacks; only very few (0.1%) children dislike the unhealthy snacks (Table 1).

**Snack Consumption.** Table 2 shows the intake frequencies of snacks of the children and their parents. The average children's intake of healthy food group was 3.6 days/week, one fourth of the children ate healthy snacks 4 days/week, only 3.1% children ate those healthy snacks everyday. For the unhealthy snacks, the average children's intake was 2.2 days /week. 34.3% children ate unhealthy snacks 2 days/week, and 29.2% 3 days/ week.

As for parents, the average intake of healthy snacks was 3.5 day/week; 26.8% of parents ate healthy snacks 4 days/week, only 2.7% parents ate those healthy foods everyday. For the unhealthy snacks, the average intake of parents was 1.0 day/week; most parents ate 1 day/week (50.1%) or 2 days/week (32.4%).

#### Factors influencing the snack intake of 4<sup>th</sup>-6<sup>th</sup> graders

Structured equation modeling was used to test the hypothesized models which described how the food availability may influences intakes of healthy snacks and unhealthy snacks of 4<sup>th</sup>-6<sup>th</sup> graders.

**Fit statistics for the model.** The result of structural equation modeling was shown in Figure 1 and Figure 2.

The chi-square values were  $\chi^2 = 35.36$  ( $p < 0.05$ ) and 26.20 ( $p < 0.05$ ), and  $\chi^2/df$  were 3.93 and 2.91 for predicting the consumption of healthy snacks and unhealthy snacks respectively. The results indicated there was a significant discrepancy between the structure of the observed data and the hypothesized model. The chi-square value can be affected by the sample size; it may have been magnified by the large sample numbers (N= 772) of the study<sup>14-16</sup> therefore other parameters were selected to corroborate the result. RMSEM was the best index among other indices for the large sample sizes.<sup>17</sup> Using the generally accepted cutoffs (GFI > 0.09, CFI > 0.09, RMSEA < 0.08), the GFI, CFI and RMSEA values obtained for the unhealthy snacks model (GFI = 0.991, CFI = 0.961, RMSEA = 0.049) and the healthy snacks model (GFI = 0.987, CFI = 0.930, RMSEA = 0.06) were consistent in indicating that food availability and food preference model provided good fit to the data. Almost all path coefficients except one (between "sold in school store" and "purchase by self") in the unhealthy snacks model and one (between "purchase by self" and "frequency of intake") in the healthy snacks model were significant, which showed that each made a meaningful contribution to the model.

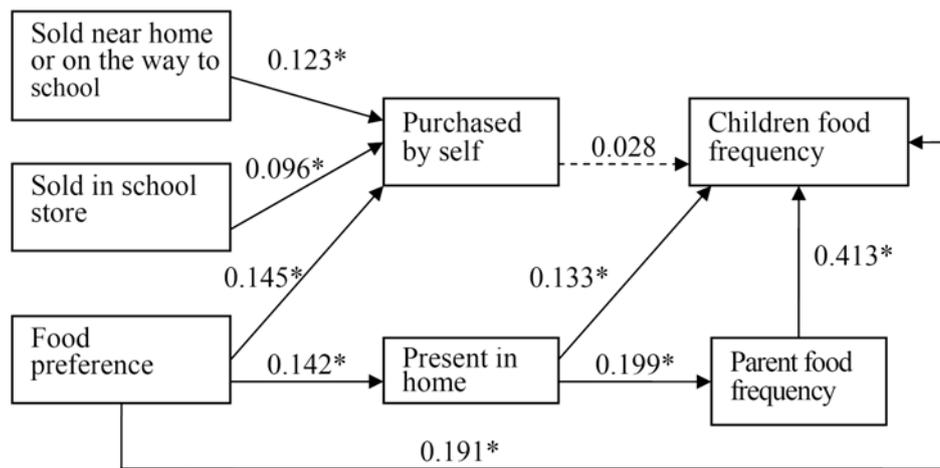
**Description of the model.** The standardized parameter estimates for healthy snacks intake model were shown in Figure 1. The results indicated that the intake (frequency) of healthy snacks was significantly ( $p \leq 0.05$ ) predicted by "parent's intake" ( $\beta = 0.413$ ), "children's preference" ( $\beta = 0.191$ ), and the presence of those snacks in the home ( $\beta = 0.133$ ), but not significantly ( $p > 0.05$ ) predicted by "purchased by self" ( $\beta = 0.028$ ). "Children's preference" has both direct and indirect effect (through "purchased by self" and "present in home") on children's intake of healthy snacks. "Purchased by self" was mainly predicted by preference, but also by "sold near home or on the way to school", and "sold in school store".

As shown in Figure 2, the intake of unhealthy snacks was significantly predicted by "parent's intake", "purchased by self", "present in home", and "children's preference". Similar to healthy snacks, "children's preference" also had both direct and indirect effect (through "purchased by self" and "present in home") on children's intake of unhealthy snacks. "Parent's intake" ( $\beta = 0.237$ )

**Table 2.** Distribution (%) of the frequency of eating snacks of children and their parents

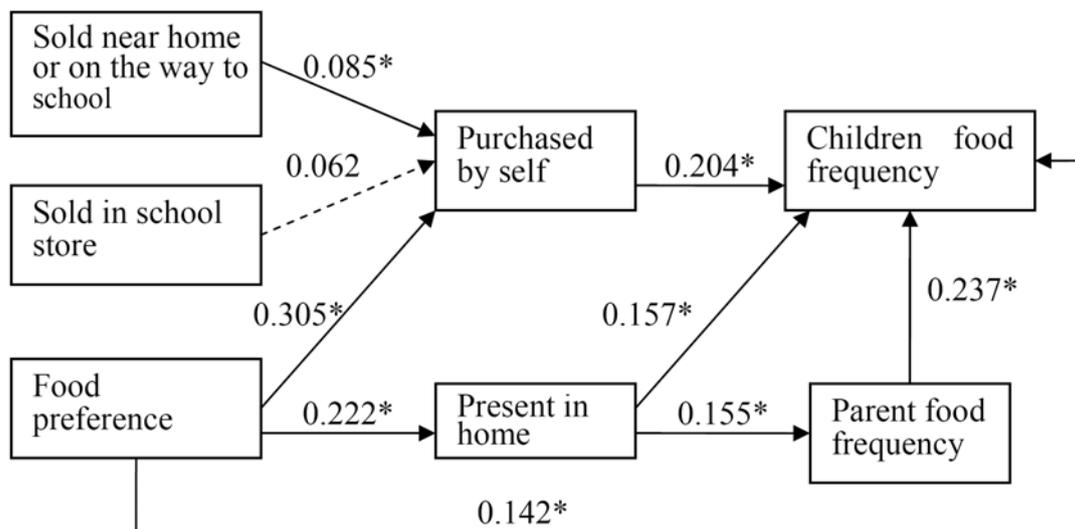
Frequency <sup>†</sup> (day/week)	Children (N=772)		Parent (N=772)	
	Healthy Snacks (%)	Unhealthy Snacks (%)	Healthy Snacks (%)	Unhealthy Snacks (%)
None	0.39	0.65	1.30	7.12
1	3.11	15.3	5.57	50.1
2	14.2	34.3	13.6	32.4
3	18.7	29.2	17.0	7.64
4	25.1	13.9	26.8	2.07
5	17.8	5.18	19.8	0.52
6	17.5	1.42	13.2	0.13
7	3.11	0.13	2.72	0
Average frequency* (day/week)	3.61 ± 1.46	2.16 ± 1.13	3.46 ± 1.51	1.04 ± 0.83

<sup>†</sup>Percentage. \*Mean ± SD



$\chi^2=35.36$  d.f.=9  $R^2=0.261$  GFI=0.987 CFI=0.93 RMSEA=0.061  
 \*  $p < 0.05$

Figure 1. Structure model of healthy snack group



$\chi^2=26.20$  d.f.=9  $R^2=0.190$  GFI=0.991 CFI=0.961 RMSEA=0.049  
 \*  $p < 0.05$

Figure 2. Structure model of unhealthy snack group

was the most significant predictor and “purchase by self” was the second ( $\beta=0.204$ ). “Purchase by self” was predicted by children’s preference” ( $\beta=0.305$ ), “sold near home or on the way to school” ( $\beta=0.085$ ).

**DISCUSSION**

The results showed that parent’s intake and children’s preference were major predictors of children’s intake of both healthy and unhealthy snacks. The influence of these two variables on children’s intakes have been studied by many researchers<sup>18-23</sup> The main purpose of this study was to investigate the influence of snack availability on children’s intake of snacks. The food availability studied here was the presence of food, as recognized by children, in the environment of their daily life, including: “sold in the store near home or on the way to school”, “sold in the school store”, “present in home” or “purchased by children themselves”. From the results of structure equation

modeling, we found that the availability of food had different effects on children’s intake of healthy and unhealthy snacks. The intake of unhealthy snacks was positively associated with “children purchased by self” but not healthy snacks, which was influenced predominantly by “present in home”. Survey results (Table 1) also indicated that children bought unhealthy snacks more often than healthy snacks. The unit cost of unhealthy snacks was usually lower than healthy snacks. In a large study involving 12 high schools, price reductions of 10%, 25%, and 50% on low-fat vending machine snacks increased sales of these items by 9%, 39%, and 93%, respectively.<sup>24</sup> Therefore, the price of the snacks may also influence children’s purchasing behavior beside their preference.

The availability of snacks in stores near home or on the way to school has a small but significant effect on the frequencies of intake for both healthy ( $\beta=0.123$ ) and unhealthy snacks ( $\beta=0.085$ ). Results also indicated that the

presence of snacks in the home has a stronger influence on children's intake of healthy snacks and unhealthy snacks than other availability variables studied. Many studies suggested that the availability of fruits and vegetables at home was positively associated with fruits and vegetables intake of children,<sup>25-27</sup> and serving milk at meals can also increase dairy intake of children.<sup>23,28</sup> These findings all support the importance of availability of healthy food to the diet quality of children. Unfortunately, the presence of unhealthy foods in the home also had significant influence on children's diets, and it can not only increase the intake of unhealthy snacks but also decrease the intake of healthy snacks. A study showed that soft drink availability at home was inversely associated with dairy intake.<sup>22</sup> Therefore, which type of foods present in home has a very important impact on children's diet. Researchers pointed out that food availability in the home is strongly associated with maternal education and nutrition knowledge.<sup>29,30</sup> Other family food environmental factors which may influence children's eating behavior included parental food preference and beliefs, role modeling and child-parent interactions around foods.<sup>31</sup> From the structure equation modeling for healthy (Fig 1) and unhealthy snacks (Fig 2), we found that although parent's intake had significant influence on children's intakes of both healthy and unhealthy snacks, a stronger influence was found in healthy snacks' intake ( $\beta=0.413$ ) than unhealthy snacks' intake ( $\beta=0.237$ ). As mentioned earlier, the intake of unhealthy snacks was best explained by children's self-purchasing behavior, which, on the other hand, was not a significant predictor of children's healthy snacks intake. Since the availability at home was also an important predictor of parent's intake and has similar impact on healthy and unhealthy snacks' intake, the results may suggest the importance of parent's role modeling on children's dietary intake, especially for eating healthy food including milk, fresh fruit and pure fruit juice. Therefore enhancing parent's nutrition knowledge, food belief and eating behavior may improve the family food environment, thereafter improve the quality of children's diet.

In this study we found that the purchasing behavior of children can be predicted mainly by their preference and also by the environmental factors studied but with a weaker power. "Sold near home or on the way to school" was more important than "sold in school store". The latter is a significant predictor for healthy snacks but not unhealthy snacks. Despite the classification of urban and rural areas in this study, the convenience store is very popular and accessible to children in both areas in Taiwan. These can be proved by the high percentage of availability (as indicated by "sold near the home or on the way to school) of healthy (H) and unhealthy (UH) snacks reported by both urban (H: 96.1%, UH: 93.3%) and rural area (H: 92.4%, UH: 86.5%) children. According to "Regulations regarding food sold in elementary and junior high school campuses" established by Ministry of Education and Department of Health in Taiwan in 2005, candy, carbonated/sugared beverages, and high-fat food (fat calorie > 30% total calorie), and high-sugar food (added sugar calorie > 10% total calorie) were forbidden in stores of elementary and middle schools. But the sur-

vey results showed that nearly half of the school children stated that unhealthy snacks, which were either high fat or high sugar content, were sold in the school stores of both urban (46.8%) and rural areas (49.1%). On the other hand, the availability of healthy snacks in school was similar to unhealthy snacks; 50.2% of urban and 50.3% of rural area school children stated they were sold in the school store. Researchers pointed out that the school food environment has a large impact on children's food choices, and the availability of juice drinks, carbonated beverages, fruit juice, candy bars, candy, and cookies in school stores and vending machines in school were strongly associated with the consumption of those snacks.<sup>22,32</sup> In this study, the relationship between "sold in school store" and children's purchasing behavior of unhealthy snacks was not supported in the final model (Fig 2). It may due to the high accessibility and varieties of unhealthy snacks sold in the convenience stores near home or on the way to school. The availabilities of unhealthy and healthy snacks within home were all above 90% for urban and rural areas. Since those unhealthy snacks were highly available in Taiwanese homes and convenience stores nearby or on the way from home to school, the influence of school stores on Taiwanese children's purchasing behavior may therefore be weakened.

## CONCLUSIONS

The results showed that parent's intake and children's preference were major predictors of children intake of both healthy and unhealthy snacks. Other than that, the intake of unhealthy snacks was positively associated with "children purchased by self" but not the intake of healthy snacks, which was influenced predominantly by "present in home". Although parent's intake had significant influence on children's intakes of both healthy and unhealthy snacks, a stronger influence was found in healthy snacks' intake. The results support the perception that positive family food environment is important for improving children's diet quality. Home availability and parent's role modeling both play important roles for children's snack intake, especially for healthy snacks. To build a healthy family food environment, parents must not only provide healthy snacks but also limit unhealthy snacks. In addition, the role modeling of eating healthy snacks instead of unhealthy snacks is crucial. All these afore-mentioned factors should be considered to shape up children's snacking behaviours.

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**AUTHOR DISCLOSURES**

Chi-Ming Hang, Wei Lin, Hsiao-Chi Yang, and Wen-Harn Pan, no conflicts of interest.

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## Original Article

**The relationship between snack intake and its availability of 4<sup>th</sup>-6<sup>th</sup> graders in Taiwan**Chi-Ming Hang MS<sup>1</sup>, Wei Lin PhD<sup>2</sup>, Hsiao-Chi Yang BS<sup>1</sup> and Wen-Harn Pan PhD<sup>3,4,5</sup><sup>1</sup> Program of Nutritional Science and Education, Department of Human Development and Family Studies, National Taiwan Normal University, Taipei, Taiwan, ROC<sup>2</sup> Department of Food, Health and Nutrition Science, Chinese Culture University, Taipei, Taiwan, ROC<sup>3</sup> Institute of Biomedical Science, Academia Sinica, Taipei, Taiwan, ROC<sup>4</sup> Institute of Microbiology and Biochemistry, National Taiwan University, Taipei, Taiwan, ROC<sup>5</sup> College of Public Health, National Taiwan University, Taipei, Taiwan, ROC**國小高年級學童點心攝取與其可獲性之相關**

本研究探討臺灣地區國小高年級學童點心攝取與可獲性的相關性。以「臺灣地區國小學童營養健康狀況調查 2001-2002」之四至六年級、居住於北、中、南地區的 722 位學童資料分析。根據食物可獲性問卷及食物攝取頻率問卷，將學童經常攝取的點心分為有利於健康的點心和不利於健康的點心兩類，以 SEM 分別檢視兩組的攝食頻率與可獲性間之相關性。結果發現學童攝取有利於健康的點心與「家中有」成正相關，而攝食不利於健康的點心則與「自己購買」有關。建議家中增加有利於健康的點心之供應；並減少學童購買不利於健康的點心食物之機會，將有助於改善學童點心攝取的品質。

關鍵字：可獲性、食物頻率、國小高年級學童、食物環境。