

## A Study on the Relationship between Snack Sugar Intake and Dietary Diversity in Elementary School Students

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**ABSTRACT** In this study, sixth grade school children in the Guri area were surveyed via questionnaire regarding their sociodemographic characteristics, snacking patterns, and intakes of different food groups and sugared snacks. Students with employed mothers had more frequent snacking events and were more dependent on store-purchased snacks compared to those having an unemployed mother. A high consumption of snack sugar was associated with a higher dietary diversity score. There was a positive relationship between snack sugar intake and the intakes of meat and dairy products and foods in the oil and nut group, respectively. A high snack sugar intake had a negative effect on fruit intake. Specific nutrient intake data will be required before conclusions can be made on whether nutrient imbalances are a concern in elementary school children having sweet snacks. Yet, the current data indicate that an increased snack sugar intake can decrease fruit intake, which could result in certain nutrient deficits. Specific dietary guidance may be necessary to address the snacking habits of elementary school children.

**KEYWORDS:** snacking patterns, snacking event, dietary diversity, elementary school children

### INTRODUCTION

It is generally accepted that dietary patterns established during childhood continue into adulthood and have implications for the development of chronic diseases (Goran 2003; Sweeting et al 1994). Increased meal frequency, particularly in the form of snacking and fast food, has received considerable attention mainly due to its assumed role in the rise of obesity prevalence observed in children (Kang et al 2004; Manson and Bassuk 2003). The Korean National Health and Nutrition Examination Survey (KNHANES) has suggested that the diets of elementary school children fail to provide the recommended dietary allowance for several nutrients, including calcium, iron, and potassium (KNHANES 2005). Concern has increased about the relationship between children's nutrient intakes and the declining frequency of family meals, the increasing number of skipped meals, and the snacking habits of children (Cho 2004).

The practice of snacking in elementary school children is

of concern because such snacks can be high in calories and low in nutrients (Lee et al 1975). It is debated whether the intake of added sugars displaces micronutrient-rich foods and dilutes the nutrient density of the diet (Rugg-Gunn et al 1991), and furthermore, whether there is a relationship between sugar intake and the increased rate of obesity (Lewis et al 1992). Several researchers have reported a negative effect of sugar intake on dietary nutrient density (Lewis et al 1992; Lyhne and Ovesen 1999). For example, there was an association shown between added sugar intake and the intakes of calcium, vitamin A, iron, and zinc (Johnson and Frary 2001), and Rugg-Gunn reported a decrease in the intake of fruits and vegetables with increasing sugar intake (Rugg-Gunn 1991). The beneficial effects of a high fruit and vegetable intake are well known and a low intake can be negative for health (WCRF/AICR 1997).

Recently, body weight has increased among elementary school children (Kim et al 2007). High intakes of fat, sugar, fast foods, and soft drinks and low physical activity are some factors suggested to have caused this increase. In addition, others have reported that children with an increased intake of added sugar tended to weigh less than children with a moderate consumption of added sugar (Lewis et al 1992). Ludwig et al found that an increased intake of sugar-sweetened drinks was related to increases in BMI and obesity (Ludwig et al 2001).

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The purpose of the present study was to investigate the snacking patterns of elementary school children and evaluate whether total sugar intake affected their dietary diversity.

## METHODS

### Participants

The participants were students attending public elementary schools in Guri City. A total of 246 sixth grade students (128 male and 118 female; response rate 99%) completed a questionnaire in April of 2008. The students completed the questionnaires in their respective classrooms under teacher supervision.

### Survey instruments

The confidential questionnaire was divided into three parts by design. The first part examined the sociodemographic characteristics of the subjects: age, gender, height, weight, mother's employment status, and caregiving situation.

The second part examined snacking. The subjects were asked about how many snacking events per day, who gave them their meals or snacks, their appetite changes after snacking, and reasons for snacking.

The third portion of the questionnaire examined food intake, including sugared snacks, using a semi-quantified food frequency questionnaire. The dietary intake data were collected using an adaptation of the method by Kang and Kim (Kang and Kim 2002). Twenty-eight items were used to assess food intake and 11 items for sugared snack intake. The selected 28 items were adapted from the representative foods within the 6 food groups of the Korean Recommended Dietary Allowances (KRDA). The grain and starch group included rice, noodles, bread, rice cakes, and cereal; the meat and legumes group included beef, pork, chicken, fish, eggs, and tofu; the vegetable group included spinach, soybeans sprouts, kimchi, agaric mushrooms, wet sea mustard, and potatoes; the fruit group included tangerines, apples, tomatoes, and orange juice; the dairy group included milk, liquid and semi-solid yoghurt, ice cream, and cheese; and the fats group included butter and nuts. The questionnaire was modified for measuring total sugar intake from the snacks. To investigate sugared snack intake, an additional 11 items including biscuits, cakes, sweet breads, canned fruit, carbonated beverages, chocolate, sweet candy, sweet milk, sugared cereals, ddukbokki, and sweeten juices were examined. The terms sugared snacks and drinks were exemplified by typical snacks that are available and preferred by young Korean teenagers (KHANES 2005). We investigated the children's dietary diversity using their food intake data. Total dietary diversity was defined as the total number of different food items reported, excluding non-nutrient contributing food items such as water. To avoid giving credit for the consumption of a food group when the amount reported was small, we excluded foods consumed in less

than a minimum amount. For the meat, fruit, and vegetable groups, the minimum reported amount for inclusion in the diversity score was 30 g for all solid foods with a single ingredient, and 60 g for all liquids and mixed dishes. For the dairy and grain groups, the minimum amount was 15 g for all solids and 30 g for all liquids and mixed dishes. This method used for grouping foods and the rationale for decisions regarding the minimum amounts were described in a previous study (Kant et al 1993). Intakes that were higher than the minimum amount for each food item were recorded as 1.0, and others (editor note: define 'others') were not included for the dietary diversity computation.

### Calculation of snack sugar intake

The daily intake of total sugar from snacks was computed using the USDA National Nutrient Database for Standard Reference Release 18 (USDA 2005) and Can Pro 3.0 (Editor note: reference needed for Can Pro). The sugar intake from domestic processed foods was calculated based on the ingredients listed on the label.

### Statistics

The weight, height, and BMI data are presented as mean  $\pm$ SD, and the demographic and snacking data as numbers and percentages. The snacking events were tested against the demographic variables by chi-squared tests. Pearson's correlation coefficient was used to analyze the association between snack sugar intake and dietary diversity. All p-values are two sided, and a 5% level of significance was used. All statistical analyses were performed with SPSS 14.0 (SPSS Inc., Chicago, IL, USA).

## RESULTS

The subjects were 51.6% male and 48.4% female. Table 1 shows the frequency distribution of the subjects by sociodemographic and physical variables. As classified according to BMI, the majority (60.7%) of the subjects were underweight, 35.6% were normal weight, and 3.7% were overweight. 11% of the children's households had mothers who worked full-time, whereas 43.4% of households had mothers who worked part-time.

Table 2 shows the children's snacking patterns. Sixty-three percent of the subjects reported having more than one snacking event per day. Forty percent had snacks supplied by their mother or another family member. Forty-eight percent of the subjects reported their appetite did not change after having snacks, whereas 34.4% had an enhanced appetite and 17.6% had a decreased appetite (Table 2).

The children's mean total snack sugar intake was 114.4  $\pm$ 86.0 g per day (data not shown). Ten percent of the subjects had a total snack sugar intake of less than 50 g per day, whereas 43.4% consumed over 100 g of snack sugar per day (Table 3).

**Table 1.** Selected characteristics of the subjects

|                                      |                        | N(%)       |
|--------------------------------------|------------------------|------------|
| Gender                               | male                   | 126 (51.6) |
|                                      | female                 | 118 (48.4) |
| BMI                                  | <20                    | 137 (56.1) |
|                                      | 20~23.9                | 88 (36.1)  |
|                                      | 24≥                    | 19 ( 7.8)  |
|                                      |                        |            |
| Mother's employment status           | Employed               | 133 (54.5) |
|                                      | full-time              | 27 (11.1)  |
|                                      | part-time              | 29 (11.9)  |
|                                      | irregular              | 77 (31.5)  |
|                                      | Not-employed           | 111 (45.5) |
| Mother's education                   | 6yr                    | 1 ( 0.4)   |
|                                      | >7~9≤yr                | 6 ( 2.5)   |
|                                      | >10~12≤yr              | 121 (49.6) |
|                                      | >12yr                  | 116 (47.5) |
|                                      |                        |            |
| Person in charge of meal preparation | Mother                 | 196 (80.3) |
|                                      | Grandmother            | 24 ( 9.8)  |
|                                      | Other member of family | 12 ( 4.9)  |
|                                      | Self                   | 12 ( 4.9)  |
|                                      |                        |            |
| Meal frequency                       | 3                      | 206 (84.4) |
|                                      | 2                      | 38 (15.6)  |

As shown in Table 4, there was no significant difference in the number of meal events according to maternal employment status. However, snacking frequency per day was greater for children whose mothers were employed. In addition, when the mother was employed, the ratio of subjects who did not have snacks was higher compared to when the mother was unemployed. There were no significant differences with regard to the reason for having snacks according to maternal employment status. However, a significant association was observed between the type of snack and maternal employment status. When the mother was employed, the ratio of the subjects who had self-made or self-bought snacks was greater compared to the responders with unemployed mothers.

As Table 5 shows, there was a significant association between snack sugar intake per day and the number of snacking events per day for the males but not the female subjects.

And as Table 6 shows, there was a significant positive relationship observed between dietary diversity and snack sugar intake for both the male and female subjects.

In table 7, there was a significant positive association between snack sugar intake and the intakes of meats, dairy products, and oils and nuts, respectively. When the subjects had a higher intake of snack sugar, they also had an increased intake of high energy-containing foods such as meats, dairy products, and oils and nuts. In contrast, there was a negative relationship between snack sugar intake and fruit intake.

**Table 2.** Snacking patterns of the subjects

|                         |                                   | N(%)       |
|-------------------------|-----------------------------------|------------|
| Snacking event          | 1 per day                         | 94 (38.5)  |
|                         | 2~3 times per day                 | 52 (21.3)  |
|                         | >4 times per day                  | 7 ( 2.9)   |
|                         | 3~4 times week                    | 26 (10.7)  |
|                         | Almost none                       | 65 (26.6)  |
| Snack type              | Mother or family member made it   | 97 (39.8)  |
|                         | Mother or family member bought it | 57 (23.4)  |
|                         | Self-bought                       | 64 (26.1)  |
|                         | Other                             | 26 (10.7)  |
| Reason for snacking     | Hungry                            | 149 (61.1) |
|                         | Nutrient supplementation          | 34 (13.9)  |
|                         | Desire to buy something to eat    | 28 (11.5)  |
|                         | After watching TV commercial      | 1 ( 0.4)   |
|                         | Others                            | 32 (13.1)  |
| Snacking time           | 5:00 AM-9:59 AM                   | 23 ( 9.4)  |
|                         | 10:00 AM-11:59 AM                 | 4 ( 1.6)   |
|                         | 12:00 PM-4:59PM                   | 129 (52.9) |
|                         | 5:00 PM-7:59PM                    | 76 (31.2)  |
|                         | 8:00 PM-bedtime                   | 12 ( 4.9)  |
| Appetite after snacking | Decreased                         | 43 (17.6)  |
|                         | Increased                         | 84 (34.4)  |
|                         | Not changed                       | 117 (48.0) |

**Table 3.** Total snack sugar intake of the subjects

| Total snack sugar intake | N(%)       |
|--------------------------|------------|
| <50 g                    | 25 (10.2)  |
| 50~100 g                 | 113 (46.3) |
| >100 g                   | 106 (43.4) |

## DISCUSSION AND CONCLUSION

In the present study, 62% of the subjects had more than one snack per day. The results show that maternal employment status was associated with snacking patterns such as snack frequency. For example, children having an employed mother had more frequent snacking or no snack at all compared to those having an unemployed mother. The majority of the subjects with employed mothers had store-bought snacks, which are rich in sodium and sugar, and thus could increase dietary intakes of sodium and sugar. It was observed that frequent snacking resulted in greater total snack sugar intake. Park et al reported that the preferred snack foods of elementary school children were cookies, fruit, beverages, and breads, sequentially (Park et al 2003). Similar results have been reported in KHANES (KHANES 2005) and in research from Paik and Lee (Paik and Lee 2004). These particular snack food items are potential sources contributing to total sugar intake.

The present study found a significant association between increased snack sugar intake and dietary diversity. In addition, there were significant positive relationships between sugar

**Table 4.** Snacking patterns according to maternal employment status

|                     |                                   | Mother's employment status |                      | $\chi^2$      |
|---------------------|-----------------------------------|----------------------------|----------------------|---------------|
|                     |                                   | Employed<br>N(%)           | Non employed<br>N(%) |               |
| Meal event          | 3 per day                         | 110(82.7)                  | 96(86.5)             | 0.7<br>df=1   |
|                     | 2 per day                         | 23(17.3)                   | 15(13.5)             |               |
|                     | Total                             | 133(100)                   | 111(100)             |               |
| Snacking event      | 1 per day                         | 39(29.3)                   | 55(49.6)             | 13.9*<br>df=4 |
|                     | 2-3 times per day                 | 37(27.8)                   | 15(13.5)             |               |
|                     | >4 times per day                  | 3( 2.2)                    | 4( 3.6)              |               |
|                     | 3-4 times per day                 | 14(10.5)                   | 12(10.8)             |               |
|                     | Almost none                       | 40(30.2)                   | 25(22.5)             |               |
| Total               | 133(100)                          | 111(100)                   |                      |               |
| Snack type          | Mother or family member made it   | 37(27.8)                   | 60(54.1)             | 23.7*<br>df=3 |
|                     | Mother or family member bought it | 30(22.6)                   | 27(24.3)             |               |
|                     | Self-made                         | 18(13.5)                   | 8( 7.2)              |               |
|                     | Self-bought                       | 48(36.1)                   | 16(14.4)             |               |
|                     | Total                             | 133(100)                   | 111(100)             |               |
| Reason for snacking | Hungry                            | 85(63.9)                   | 64(57.6)             | 7.7<br>df=4   |
|                     | Balance nutrient intake           | 12(9.1)                    | 22(19.8)             |               |
|                     | Want to buy and eat               | 18(13.5)                   | 10( 9.1)             |               |
|                     | After watching TV commercial      | 0(0)                       | 1( 0.9)              |               |
|                     | Other                             | 18(13.5)                   | 14(12.6)             |               |
| Total               | 133(100)                          | 111(100)                   |                      |               |

\* $p < 0.05$

**Table 5.** Pearson's correlation between snack sugar intake and snacking events

|                 | Gender | Snack sugar intake | Significance |
|-----------------|--------|--------------------|--------------|
| Snacking events | Male   | .201               | .024*        |
|                 | Female | .060               | .519         |

\* $p < 0.05$

**Table 6.** Pearson's correlation between snack sugar intake and dietary diversity score

|                         | Gender | Snack sugar intake | Significance |
|-------------------------|--------|--------------------|--------------|
| Dietary diversity score | Male   | .610               | .000**       |
|                         | Female | .586               | .000**       |

\*\* $p < 0.001$

intake and the intakes of meat, dairy products, and oils and nuts, respectively. Numerous studies have analyzed the impact of sugar intake on macronutrient, micronutrient, fiber, and fat intakes in children. Several researchers have

reported higher intakes of essential nutrients with increasing percentages of energy from sugar (Rugg-Guun 1991) and increasing intakes of sugar (Gibney et al 1995). Bowman, Forshee, and Ballew et al reported significantly lower

**Table 7.** Pearson's correlation coefficients between the intakes of food groups and snack sugar

|                | Snack sugar | Meats  | Vegetables | Fruits | Dairy products | Oils and nuts |
|----------------|-------------|--------|------------|--------|----------------|---------------|
| Snack sugar    | 1           |        |            |        |                |               |
| Meats          | .212**      | 1      |            |        |                |               |
| Vegetables     | .055        | .096   | 1          |        |                |               |
| Fruits         | -.138*      | .095   | .075       | 1      |                |               |
| Dairy products | .548**      | .212** | .055       | .008   | 1              |               |
| Oils and nuts  | .253**      | .146*  | .112       | .090   | .117           | 1             |

\* $p < 0.05$ , \*\* $p < 0.001$

intakes of vegetables, fruits, and dairy products with increasing sugar intake (Bowman 1999; Forshee and Storey 2001; Ballew et al 2000). Johnson et al and Frary reported that children had higher intakes of micronutrients with increasing dietary sugar intake when the subjects had snacks containing added sugar such as flavored milk, including chocolate and strawberry milk, added-sugar dairy products, and sugar coated cereals (Johnson et al 2002; Frary et al 2002). The results of the present study are similar to those from Johnson et al and Frary et al in that sugar intake was positively associated with a higher dietary diversity score. The intakes of several food groups, including meats, dairy products, and oils and nuts, were significantly increased in the high sugar consumers. The subjects reported that their main reasons for snacking were to satisfy hunger and supply nutrients. Eighty-two percent of the subjects reported that snacking did not change their appetite, or that it was increased after snacking. This may be linked to their diverse intake of food items, although the subjects had frequent snacking events with sugar-containing snacks. In addition, we found a negative correlation between snack sugar intake and the intake of fruit. It is well known that a high fruit intake has positive effects on health, especially in relation to cancer and cardiovascular disease (WCRF/AICR 1997; Law 1998). We also found an association between maternal employment status and snacking frequency and the type of snack eaten. The subjects having an employed mother were highly dependent on store-bought snacks.

In conclusion, the present study shows that a high consumption of sugary snacks is positively associated with daily sugar intake and the intakes of meat, dairy products, and fats in elementary school-age children, and that a high snack sugar intake can have a negative effect on fruit intake. This negative association between snack sugar intake and fruit intake is important from a public health perspective since increasing fruits and vegetables in the diet is currently a main component of health promotion. We also found that subjects with employed mothers had a high dependency on store-bought snacks, which tend to be higher in sugar. More studies are required to examine whether snack sugar intake has effects on specific nutrient intakes among young children.

## REFERENCES

- Ballew C, Kuester S, Gillespie C. 2000. Beverage choices affect adequacy of children's nutrient intakes. *Arch Pediatr Adolesc Med* 154: 1148-1152.
- Bowman S. 1999. Diets of individuals based on energy intakes from added sugars. US department of agriculture. Center for Nutrition Policy and Promotion. *Fam Econ Nutr Rev* 12: 31-38.
- Cho KJ, The research study on the food habits according to obesity index of primary school children in Busan. 2004. *Kor J Food Cult*. 19: 106-117.
- Forshee RA, Storey ML. 2001. The role of added sugars in the diet quality of children and adolescents. *J Am Coll Nutr* 20: 32-43.
- Frary CL, Johnsdon FJ, Wang MQ. 2002. Children's choices of foods and beverages high in added sugars impact their diet quality. *FASEB J* 16: A227 (abstr).
- Gibney M, Sigman-Grant M, Stanton JL, Keast DR. 1995. Consumption of sugars. *Am J Clin Nutr* 62: 178s-94s.
- Goran MI, Ball GD, Cruz ML. 2003. Obesity and risk of type 2 diabetes and cardiovascular disease in children and adolescents. *J Clin Endocrinol Metab*. 88: 1417-1427.
- In-depth analysis on the 3<sup>rd</sup> (2005) Korea Health and Nutrition examination Survey
- Johnson RK, Frary C, Wang MQ. 2002. The impact of flavored milk on total milk intake and the diet quality of US school-aged children. *J Am Dietet Assoc* 102: 853-856.
- Johnson RK, Frary C. 2001. Choose beverages and foods to moderate your intake of sugars: the 2000 Dietary guidelines for Americans-What's all the fuss about? *J Nutr*. 131: 2766S-2771S.
- Kang HY and Kim SH. 2002. Effect of living conditions on food intakes of the aged. *Kor J Nutr*. 35: 332-351.
- Kang SA, Lee JW, Kim KE, Koo JO, Park DY. 2004. A study of the frequency of food purchase for snacking and its related ecological factors on elementary school children. *Kor J Commu Nutr* 9: 453-463.
- Kant AK, Schatzkin A, Harris TB, Ziegler RG, Block G. 1993. Dietary diversity and subsequent mortality in the first national health and nutrition examination survey epidemiologic follow up study. *Am J Clin Nutr* 57: 434-440.
- Kim IK, Kang JH, Song JH. 2007. Serum leptin levels and changes in body weight and obesity index in Gwacheon elementary school children. *Kor J Nutr* 40: 736-744.
- Law MR, Morris JK. 1998. By how much does fruit and vegetable consumption reduce the risk of ischaemic heart disease. *Eur J Clin Nutr* 52: 549-555.
- Lee EJ, Hwang IK, Jin BH, Paik DI. 2008. Correlation between snack food intakes and dental caries in elementary school children. *Kor J Food Cookery Sci*. 24: 251-257.
- Lewis CJ, Park YK, Dexter PB, Yetley EA. 1992. Nutrient intakes and body weights of persons consuming high and moderate levels of added sugars. *J Am Dietet Assoc*. 92: 708-713.
- Ludwig DS, Peterson KE, Gortmaker SL. 2001. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet* 357: 505-508.
- Lyhne N, Ovesen L. 1999. Added sugars and nutrient density in the diet of Danish children. *Scand J Nutr* 43: 4-7.
- Manson JE, Bassuk SS. 2003. Obesity in the United States: A fresh look at its high toll. *JAMA* 289: 229-230.
- Paik JJ, Lee HS. 2004. Dietary behaviors, food preferences and its relationships with personality traits in sixth grader's of elementary school. *Kor J Community Nutr*. 9: 135-141.
- Park YS. 2003. Intake of snack by the elementary school children in Hansan-do area. *Kor J Soc Food Cookery Sci*. 19: 96-106
- Rugg-Guun AJ, Hackett AF, Jenkins GN, Appleton DR. 1991. Empty calories-nutrients intake in relation to sugar intake in English adolescents. *J Human Nutr Dietet* 4: 101-111.
- Sweeting H, Anderson A, West P. 1994. Socio-demographic correlates of dietary habits in mid to late adolescence. *Eur J Clin Nutr*. 48: 736-748.
- USDA. 2005. National Nutrient Database for Standard release 18. Available from <http://www.nal.usda.gov/finic/foodcomp>
- World Cancer Research Fund (WCRF)/American Institute for Cancer Research (AICR). 1997. Food, Nutrition and the prevention of cancer: A global perspective. Washington DC:WCRF/AICR