



# Dietary habits and gastroesophageal reflux disease in preschool children

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**Purpose:** To identify the relationship between dietary habits and childhood gastroesophageal reflux disease (GERD) in preschool children.

**Methods:** We performed a questionnaire study to analyze the relationship between dietary habits and GERD in 85 preschool children with GERD and 117 healthy children of the same age.

**Results:** Irregular and picky eating were more prevalent in the GERD group than in the control group (odds ratio [OR], 4.14; 95% confidence interval [CI], 1.37–12.54 and OR, 4.96; 95% CI, 1.88–13.14, respectively). The snack preferences and the late night eating habits were significantly more prevalent in the GERD group than in the control group (OR, 3.83; 95% CI, 1.23–11.87 and OR, 9.51; 95% CI, 2.55–35.49, respectively). A preference for liquid foods was significantly more prevalent in the GERD group (OR, 9.51; 95% CI, 2.548–35.485). The dinner-to-bedtime interval was significantly shorter in the GERD group than in the control group ( $157.06 \pm 48.47$  vs.  $174.62 \pm 55.10$ ,  $P=0.020$ ). In addition, the time between dinner and bedtime was shorter than 3 hours in 47 children (55.3%) of the GERD group and 44 (37.6%) of the control group. This difference was statistically significant ( $P=0.015$ ).

**Conclusion:** Dietary habits such as picky and irregular eating, snack preference, a preference of liquid foods, late night eating, and a shorter dinner-to-bedtime interval had a significant correlation with GERD. Further large-scale studies are necessary to confirm our results.

**Key words:** Dietary habits, Gastroesophageal reflux, Preschool child, Child

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## Introduction

Gastroesophageal reflux disease (GERD) is a chronic condition that occurs the most commonly in children of all ages<sup>1-3</sup>. Although the clinical course of childhood GERD is unclear, previous studies have shown that childhood GERD is a significant risk factor of GERD in adolescents and young adults<sup>1,4,5</sup>. To date, however, few clinical studies have clarified risk factors of developing childhood GERD in a pediatric population<sup>6</sup>. There are a few well known risk factors of GERD that included neurologic disorders, congenital malformation and severe chronic pulmonary disorders during childhood<sup>4,6</sup>.

Treatment modalities for childhood GERD include pharmacological treatments (e.g., proton pump inhibitors, antacids, H-2 blockers, and prokinetics), antireflux endoluminal therapies, fundoplication surgery and lifestyle modification<sup>7,8</sup>. But there is a possibility that children with GERD are vulnerable to relapse even after the treatment unless risk factors are removed, in contrast with infantile gastroesophageal reflux that spontaneously resolves without treatments by the second year of life<sup>4</sup>. Moreover, pharmacological treatments are not effective in completely treating long-term complications. It is therefore imperative that childhood GERD be prevented before its progression to adolescent or adult cases<sup>6,9</sup>.

Childhood GERD may be influenced by numerous lifestyle factors<sup>4</sup>, there particularly

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include dietary habits that may strongly affect, other lifestyle factors after being settled during childhood. Also wrong dietary habits such as preference of snack or drink contribute to overweight or obesity that impact as risk factor of GERD in adulthood<sup>10,11</sup>. We have therefore speculated that childhood GERD would be prevented if there are efforts to correct wrong dietary habits considering that there is a possible relationship between children's dietary habit and childhood<sup>11</sup>. Given the above background, we conducted this case-control study to identify the relationship between dietary habits and childhood GERD in preschool children.

## Materials and methods

### 1. Study design

Between January 1, 2010 and December 31, 2013, 101 preschool children (between 3 and 6 years old) were diagnosed as GERD through esophagogastroduodenoscopy (EGD), or esophageal pH or multichannel intraluminal impedance test (n=20)<sup>11,12</sup>. The endoscopic assessment of esophageal change was performed according to the Los Angeles (LA) classification for endoscopic grading of esophagitis: grade A, one (or more) mucosal break no longer than 5 mm, that dose not extend between the tops of 2 mucosal folds; grade B, 1 (or more) mucosal break more than 5 mm long, that dose not extend between the tops of 2 mucosal folds; grade C, 1 (or more) mucosal break that is continuous between the tops of two or more mucosal folds but which involves less than 75% of the circumference; grade D, 1 (or more) mucosal break which involves at least 75% of the esophageal circumference<sup>13</sup>, and patients who had GERD with class A to D of LA classification were included (n=81). Data from esophageal pH or multichannel intraluminal impedance test was interpreted by the symptom association probability (SAP) that is the statistical relation between reflux and symptoms by Fisher exact test or reflux index (RI [% time pH<4]), and a SAP>95% or an RI>7% is considered positive<sup>14,15</sup>. We excluded patients with concurrently gastrointestinal diseases (e.g., gastric or duodenal ulcer, *Helicobacter pylori* infection, and eosinophilic esophagitis), food allergy, congenital problem, severe chronic health conditions (e.g., epilepsy, growth failure, allergic disease, or chronic lung problem such as bronchopulmonary dysplasia or tracheomalacia).

We therefore enrolled a total of 85 preschool children with GERD in the current study and then assigned them to the GERD group (n=85). Among 85 children, 74 of them were diagnosed through EGD (LA class A=61, B=11, and C=2), 11 through esophageal pH metry (n=5) or multichannel intraluminal impedance test (n=6). In addition, we also evaluated 117 healthy preschool children who visited us for a regular medical check-up in Korea national health screening program during the same period by

physical examination and questionnaire and then assigned them to the control group. Children who were assessed to have gastrointestinal or respiratory symptoms or signs of GERD were excluded in control group. The children with GERD or healthy controls submitted a written informed consent that was waived due to the retrospective nature for the current study.

### 2. Questionnaire study

We performed a questionnaire study to examine demographic characteristics (e.g., age and body mass index [BMI], dietary habits and sleep habits). Our questionnaire was based on a nutrition questionnaire and guidelines for the Korea national health screening program for infants and children that were developed by Korean national health insurance cooperation, and customized for preschool children<sup>16</sup>.

### 3. Statistical analysis

We analyzed the data using the chi-square test and independent *t* test. Moreover, we also performed a multivariate logistic regression analysis to compare the data between the 2 groups. All continuous variables were expressed as mean±standard deviation (SD).

BMI was calculated as weight in kilograms divided by height in square meters (kg/m<sup>2</sup>) and BMI percentile for age was assessed using the Center for Disease Control growth charts<sup>17</sup>. Overweight and obesity were defined as a BMI at or above the 85th percentile and below the 95th percentile and at or above 95th percentile for children of the same age and sex. A *P* value of <0.05 was considered statistically significant. Statistical analysis was performed using the IBM SPSS Statistics ver. 20.0 (IBM Co., Armonk, NY, USA). The current study was approved by the Institutional Review Board of Bundang CHA medical center (approval number: BD2014-200). Written informed consent was obtained from all subjects.

## Results

### 1. Baseline characteristics

In the current study, we enrolled a total of 202 preschool

**Table 1.** Baseline characteristics of pediatric GERD patients in preschool

| Characteristic         | GERD (n=85) | Control (n=117) | <i>P</i> value |
|------------------------|-------------|-----------------|----------------|
| Sex                    |             |                 | 0.946          |
| Male                   | 44 (51.8)   | 60 (51.3)       |                |
| Female                 | 41 (48.2)   | 57 (48.7)       |                |
| BMI percentile for age | 50.75±30.13 | 52.56±28.85     | 0.655          |
| Overweight and obesity | 14 (16.5)   | 16 (13.7)       | 0.581          |

Values are presented as number (%) or mean±standard deviation. GERD, gastroesophageal reflux disease; BMI, body mass index.

**Table 2.** Relationship between dietary habits and gastroesophageal reflux disease

| Variable                 | Odds ratio | 95% CI       | P value |
|--------------------------|------------|--------------|---------|
| Food refusal or anorexia | 20.270     | 5.126–80.154 | <0.001  |
| Preference of liquids    | 9.510      | 2.548–35.485 | <0.001  |
| Late-night snack         | 7.121      | 1.595–31.795 | 0.010   |
| Picky eating             | 4.964      | 1.875–13.142 | <0.001  |
| Regularity of meal       | 4.143      | 1.369–12.540 | 0.012   |
| Preference of snack      | 3.827      | 1.234–11.872 | 0.020   |
| Fatty foods              | 2.501      | 0.770–8.125  | 0.127   |

CI, confidence interval.

Adjusted with age, sex, and body mass index.

children (104 boys [51.4%] and 98 girls [48.6%]). Baseline characteristics of the subjects are represented in Table 1. The mean age was  $5.01 \pm 1.02$  years in the GERD group and  $4.09 \pm 0.98$  years in the control group, and this difference reached statistical significance ( $P < 0.001$ ; odds ratio [OR], 1.13; 95% confidence interval [CI], 1.076–1.18, respectively). There was no significant difference in the male-to-female ratio and BMI percentile for age between the 2 groups. Moreover, appetite and the frequency of meal were significantly less prevalent and lower, respectively, in the GERD group as compared with the control group ( $P < 0.001$ ).

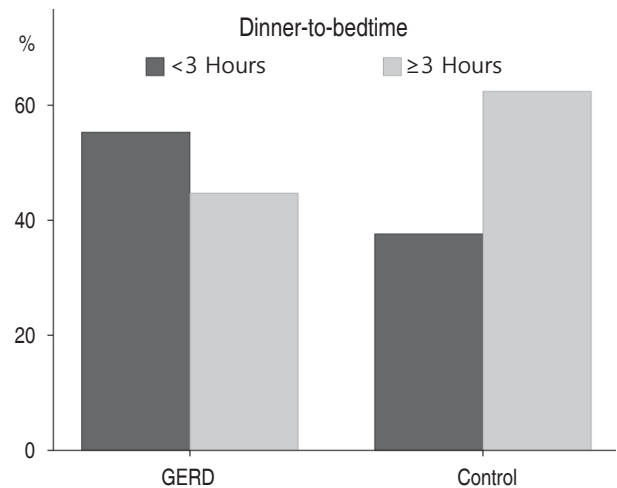
As shown in Table 2, irregular eating and picky eating were more prevalent in the GERD group as compared with the control group (OR, 4.14; 95% CI, 1.37–12.54 and OR, 4.96; 95% CI, 1.88–13.14, respectively). But these trends were not seen for fatty food ( $P = 0.127$ ). The snack preference and the late night eating habit were significantly more prevalent in the GERD group as compared with the control group (OR, 3.83; 95% CI, 1.23–11.87 and OR, 9.51; 95% CI, 2.55–35.49, respectively). A multivariate analysis showed that a preference of liquid foods, such as milk product or sweet beverage was significantly more prevalent in the GERD group (OR, 9.51; 95% CI, 2.548–35.485). But these trends were not seen for the total amount of liquid or solid foods.

## 2. Correlation between the amount or speed of eating and GERD

There was no significant correlation between the small amount of eating and GERD. With regards to the length of meal time, the number of the children who responded that it was longer than 30 minutes was 18 (21.2%) in the GERD group and 1 (0.9%) in control group. There was a significant correlation between the length of meal time and GERD ( $P < 0.001$ ).

## 3. Correlation between dietary habits and GERD

The dinner-to-bedtime interval was shorter in the GERD group as compared with the control group ( $157.06 \pm 48.47$  vs.  $174.62 \pm 55.10$ ,  $P = 0.020$ ). In addition, as shown in Fig. 1, the number of the children with a dinner-to-bedtime of shorter than 3 hours was 47 (55.3%) in the GERD group and 44 (37.6%) in the control



**Fig. 1.** Percentage of children whose dinner-to-bedtime was more or less than 3 hours when comparing gastroesophageal reflux disease (GERD) and control groups. In GERD patients, 55.3% of patients went to bed within 3 hours after dinner ( $n = 47$ ), compared with 37.6% in the control group ( $n = 44$ ).

group. This difference reached statistical significance ( $P = 0.015$ ).

## Discussion

This is the first study to examine the relationship between dietary habits and GERD in preschool children. Although many studies have been conducted in this series, there is a paucity of data regarding the above relationship<sup>4,6</sup>. Our results showed that GERD had a significant correlation with irregular and picky eating, the small amount of eating, snack preference, a preference of liquid foods and a shorter dinner-to-bedtime interval in preschool children.

Previous adult studies have shown that risk factors of developing GERD include Caucasian race, male sex, obesity or overweight, *H. pylori* infection and lifestyle factors (e.g., smoking, alcohol, dietary fat or drugs such as nonsteroidal anti-inflammatory drugs)<sup>11,18-21</sup>. Our results showed that the age was one of the risk factors of developing GERD (OR, 1.13; 95% CI, 1.076–1.18), which is consistent with studies in older children or adults<sup>10,20</sup>. But male sex and BMI were not risk factors of developing GERD. With regards to the BMI, it had a significant correlation with GERD. In this study, however there were no significant differences in BMI percentile for age and the number of overweight or obese children between our GERD and healthy preschool children. Presumably, this might be because there is no great sex-related variability in lifestyle and environmental factors, such as smoking or drinking, in children as compared with adults, furthermore BMI usually decreases during preschool period and increases into adulthood<sup>17</sup>. In more detail, obese adult men are at

increased risks of developing GERD possibly due to wrong dietary habits during preschool days and a frequent exposure to smoking or drinking<sup>20</sup>.

Despite many previous reports in this series, our results showed that overeating or fat intake were not risk factors of developing GERD in preschool children. In the current study, food refusal or anorexia rather than overeating were risk factors of developing GERD ( $P < 0.001$  vs.  $P = 0.317$ ). In addition, irregular eating and a prolonged meal time were more prevalent in the GERD group as compared with the control group. It is unclear, however, whether these findings are risk factors of developing GERD or its outcomes; an irregular, prolonged meal intake might induce the reflux of gastric juice and thereby cause a prolonged duration of gastric acid secretion and a shortened gastric emptying time<sup>22,23</sup>.

There was a significant correlation between snack preference and GERD. Picky eating had a significant correlation with GERD. It is noteworthy that there was a larger number of the children who preferred milk product or sweet beverage to solid foods. It is generally known that it takes 12–24 months for childhood GERD to disappear in up to 95% of total cases<sup>21</sup>. By that time, infants undergo maturation of gastrointestinal tract and begin to wean and to eat solid foods<sup>3</sup>. Moreover, by the preschool age, children form dietary habits with the switch from liquid to solid foods<sup>10,24</sup>. Consequently, the preschool age of 3–6 years old is a period characterized by the lowest prevalence of GERD across all ages<sup>6</sup>. Until that time, however, liquid foods would lead to the increased occurrence of GERD.

With regards to late night eating habits, there was a significant correlation between late night eating habits and GERD; the children with GERD had a shorter dinner-to-bedtime as compared with the control group. Recent adult studies have shown that a short dinner-to-bedtime had a significant correlation with not only occurrence but also recurrence of GERD<sup>7,19</sup>. In association with this, according to the guidelines from the American College of Gastroenterology, it is recommended that the dinner-to-bedtime interval be longer than three hours<sup>25</sup>. This is consistent with our results.

There are several limitations of the current study. First, we failed to consider objective criteria for determining dietary habits. In addition, there might be a bias arising from the caregivers. Next, in the current study, we enrolled a relatively smaller number of the children. Finally we assigned the healthy children who visited us for a general health check-up. We cannot therefore completely rule out the possibility that we might have assigned the children with asymptomatic GERD to the control group.

Our results showed that dietary habits, such as picky and irregular eating, snack preference, a preference of liquid foods, late night eating habit and a shorter dinner-to-bedtime interval, had a significant correlation with GERD. But further large-scale studies are warranted to establish our results. Therefore, in order

to decrease the likelihood of GERD progressing to persistent GERD or Barrett's esophagus, caregivers of preschoolers should refrain from providing late-night snack; should provide a balance of solid and liquid foods; and should maintain a satisfactory time interval of at least three hours from dinner to bedtime.

## Conflict of interest

No potential conflict of interest relevant to this article was reported.

## References

- Gupta SK, Hassall E, Chiu YL, Amer F, Heyman MB. Presenting symptoms of nonerosive and erosive esophagitis in pediatric patients. *Dig Dis Sci* 2006;51:858-63.
- Forbes D. Mewling and puking: infantile gastroesophageal reflux in the 21st century. *J Paediatr Child Health* 2013;49:259-63.
- Nelson SP, Chen EH, Syniar GM, Christoffel KK. Prevalence of symptoms of gastroesophageal reflux during infancy. A pediatric practice-based survey. Pediatric Practice Research Group. *Arch Pediatr Adolesc Med* 1997;151:569-72.
- El-Serag HB, Gilger M, Carter J, Genta RM, Rabeneck L. Childhood GERD is a risk factor for GERD in adolescents and young adults. *Am J Gastroenterol* 2004;99:806-12.
- Eisen GM, Sandler RS, Murray S, Gottfried M. The relationship between gastroesophageal reflux disease and its complications with Barrett's esophagus. *Am J Gastroenterol* 1997;92:27-31.
- Gilger MA, El-Serag HB, Gold BD, Dietrich CL, Tsou V, McDuffie A, et al. Prevalence of endoscopic findings of erosive esophagitis in children: a population-based study. *J Pediatr Gastroenterol Nutr* 2008;47:141-6.
- Fujiwara Y, Machida A, Watanabe Y, Shiba M, Tominaga K, Watanabe T, et al. Association between dinner-to-bed time and gastro-esophageal reflux disease. *Am J Gastroenterol* 2005;100:2633-6.
- Lee JH, Kim MJ, Lee JS, Choe YH. The effects of three alternative treatment strategies after 8 weeks of proton pump inhibitor therapy for GERD in children. *Arch Dis Child* 2011;96:9-13.
- Rudolph CD, Mazur LJ, Liptak GS, Baker RD, Boyle JT, Colletti RB, et al. Guidelines for evaluation and treatment of gastroesophageal reflux in infants and children: recommendations of the North American Society for Pediatric Gastroenterology and Nutrition. *J Pediatr Gastroenterol Nutr* 2001;32 Suppl 2:S1-31.
- Nicklas T, Johnson R; American Dietetic Association. Position of the American Dietetic Association: dietary guidance for healthy children ages 2 to 11 years. *J Am Diet Assoc* 2004;104:660-77.
- Kim N, Lee SW, Cho SI, Park CG, Yang CH, Kim HS, et al. The prevalence of and risk factors for erosive oesophagitis and non-erosive reflux disease: a nationwide multicentre prospective study in Korea. *Aliment Pharmacol Ther* 2008;27:173-85.
- Sherman PM, Hassall E, Fagundes-Neto U, Gold BD, Kato S, Koletzko S, et al. A global, evidence-based consensus on the definition of gastroesophageal reflux disease in the pediatric population. *Arch Pediatr* 2010;17:1586-93.
- Lundell LR, Dent J, Bennett JR, Blum AL, Armstrong D, Galmiche

- JP, et al. Endoscopic assessment of oesophagitis: clinical and functional correlates and further validation of the Los Angeles classification. *Gut* 1999;45:172-80.
14. Vandenplas Y, Rudolph CD, Di Lorenzo C, Hassall E, Liptak G, Mazur L, et al. Pediatric gastroesophageal reflux clinical practice guidelines: joint recommendations of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition (NASPGHAN) and the European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN). *J Pediatr Gastroenterol Nutr* 2009;49:498-547.
  15. Weusten BL, Roelofs JM, Akkermans LM, Van Berge-Henegouwen GP, Smout AJ. The symptom-association probability: an improved method for symptom analysis of 24-hour esophageal pH data. *Gastroenterology* 1994;107:1741-5.
  16. Moon JS, Kim JY, Chang SH, Hae CK, Yang HR, Seo JK, et al. Development of a nutrition questionnaire and guidelines for the Korea National Health Screening Program for Infants and Children. *Korean J Pediatr Gastroenterol Nutr* 2008;11:42-55.
  17. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al. 2000 CDC Growth Charts for the United States: methods and development. *Vital Health Stat* 11 2002;(246):1-190.
  18. Nocon M, Labenz J, Willich SN. Lifestyle factors and symptoms of gastro-oesophageal reflux: a population-based study. *Aliment Pharmacol Ther* 2006;23:169-74.
  19. Yang JH, Kang HS, Lee SY, Kim JH, Sung IK, Park HS, et al. Recurrence of gastroesophageal reflux disease correlated with a short dinner-to-bedtime interval. *J Gastroenterol Hepatol* 2014;29:730-5.
  20. Dore MP, Maragkoudakis E, Fraley K, Pedroni A, Tadeu V, Realdi G, et al. Diet, lifestyle and gender in gastro-esophageal reflux disease. *Dig Dis Sci* 2008;53:2027-32.
  21. Robertson EV, Derakhshan MH, Wirz AA, Lee YY, Seenan JP, Ballantyne SA, et al. Central obesity in asymptomatic volunteers is associated with increased intrasphincteric acid reflux and lengthening of the cardiac mucosa. *Gastroenterology* 2013;145:730-9.
  22. Caldaro T, Garganese MC, Torroni F, Ciofetta G, De Angelis P, di Abriola GF, et al. Delayed gastric emptying and typical scintigraphic gastric curves in children with gastroesophageal reflux disease: could pyloromyotomy improve this condition? *J Pediatr Surg* 2011;46:863-9.
  23. Estevão-Costa J, Campos M, Dias JA, Trindade E, Medina AM, Carvalho JL. Delayed gastric emptying and gastroesophageal reflux: a pathophysiologic relationship. *J Pediatr Gastroenterol Nutr* 2001;32:471-4.
  24. Sakashita R, Inoue N, Kamegai T. From milk to solids: a reference standard for the transitional eating process in infants and preschool children in Japan. *Eur J Clin Nutr* 2004;58:643-53.
  25. DeVault KR, Castell DO; American College of Gastroenterology. Updated guidelines for the diagnosis and treatment of gastroesophageal reflux disease. *Am J Gastroenterol* 2005;100:190-200.