The prevalence of obesity and the level of adherence to the Korean Dietary Action Guides in Korean preschool children

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Abstract
The objective of this study was to investigate the associations between the prevalence of overweight and obesity and the degree of adherence to the Korean Dietary Action Guides for Children (KDAGC). In a cross-sectional study based on a child care center-based survey in Seoul, Korea, we collected parental-reported questionnaires (n = 2,038) on children’s weight and height, frequency of fruit and vegetable consumption, and the quality of dietary and activity behaviors based on the 2009 KDAGC Adherence Index (KDAGCAI) which was developed as a composite measure of adherence to the KDAGC. Overweight and obesity were determined according to age- and sex-specific BMI percentile from the 2007 Korean national growth chart. Associations were assessed with generalized linear models and polytomous logistic regression models. Approximately 17.6% of Korean preschool children were classified as overweight or obese. Obese preschoolers had lower adherence to the KDAGCAI compared to those with lean/normal weight. Preschoolers with a high quality of dietary and activity behaviors had a 51% decreased odds ratio (OR) of being obese (highest vs. lowest tertile of KDAGCAI-score, 95% CI 0.31, 0.78; P = 0.001); the associations were more pronounced among those who were older (P = 0.048) and lived in lower income households (P = 0.014). A greater frequency of vegetable consumption, but not fruit, was associated with a borderline significant reduction in the prevalence of obesity. Our findings support the association between obesity prevention and high compliance with the Korean national dietary and activity guideline among preschool children.

Key Words: Preschool children, obesity, dietary guideline

Introduction
The prevalence of overweight or obesity in preschool children has steadily increased worldwide over a decade, from 4.2% in 1990 to 6.7% in 2010 [1]. Consistent with the worldwide trend, the overweight or obesity epidemic in Korea has progressed gradually among children of ages 2 to 6 years, reaching an estimated 14.4% in 1997 and 16.3% in 2005 [2], highlighting a new public health concern. Obesity at an early age has serious implications not only for the short-term but also for long-term health consequences, given that childhood obesity typically persists into adulthood [3] and has been identified as important predictors of cardiovascular disease [4], type 2 diabetes mellitus [5], and early death [6] in adulthood. Such implications suggest that the prevention of early onset obesity may be critical in delaying the initiation of chronic disease processes throughout life.

Dietary habits are established during early childhood and may persist throughout childhood and beyond [7,8]. Similarly, levels of physical activity and sedentary behaviors persist over time [9,10]. Together, these trends suggest that the preschool period could be crucial to the lifelong effects of positive energy balance, presumably induced by high energy intake and low physical activity, and to the likelihood of becoming obese adults. However, relatively few epidemiologic studies have focused on obesity in preschool children, and studies are even sparser for Korean preschool children. Previous studies have identified plausible contributors to overweight and obesity in preschoolers, including the following: diets high in animal products [11], a high proportion of total energy intake from fat [12], low fruit and vegetable consumption [13], high levels of sugar-sweetened beverage consumption [14,15], skipping breakfast [16], insufficient

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physical activity, prolonged TV viewing [17,18], and infrequent family meals [19,20]. However, the available literature is insufficient to confirm existing evidence from other countries because most of the studies from Korea have included small sample sizes and did not adjust for important confounding factors. Koreans have still retained dietary patterns low in saturated fat and high in vegetables, while they have substantially increased their levels of animal protein consumption over the past few decades that accompany the rapid economic development and the adoption of Western-style foods [21].

The 2009 Korean Dietary Action Guides for Children (KDAGC) [22], a dietary and activity guideline for children aged 3-12 years, issued by the Korea Ministry of Health and Welfare, provides recommendations to promote healthy eating and physical activity choices. However, few efforts have been initiated to evaluate the degree of adherence to this national guideline and the subsequent health outcomes among preschool children. We thus created a measure to evaluate the level of adherence to all 19 practice recommendations of the 2009 KDAGC to rate the overall quality of dietary and activity behaviors. We named this measure the Korean Dietary Action Guides for Children Adherence Index (KDAGCAI).

Considering all the above factors, understanding Korean children’s overall quality of dietary or activity behaviors could promote a comprehensive and strategic approach to developing intervention programs and policy initiatives for the prevention of childhood obesity. The present study aimed to examine the relationships between the prevalence of overweight or obesity and the quality of dietary and activity behaviors, as measured by the 2009 KDAGCAI-score, and the frequency of fruit and vegetable consumption in a representative sample of children aged 4-7 years attending 400 child care centers in Seoul, Korea.

Subjects and Methods

Study participants

A cross-sectional survey was conducted in Seoul between November 2010 and January 2011 to assess dietary behaviors and related factors of preschool children. To obtain a representative sample, a multi-stage stratified cluster sampling design was used in which we performed stratifications first by districts, then by types of care centers, and last by the density of children enrolled in child care centers. The Seoul metropolitan area is divided into a total of 25 administrative districts, and of these districts, we excluded 2 for which there was no information on the age of the preschool children. We then excluded centers in which no children aged 4-7 years were enrolled or that were classified neither as a private nor as a public center, leaving a total of 1939 centers. Children were recruited from 400 of 1939 child care centers (private, n = 295; public, n = 105) within 23 districts.

We mailed survey packages to the participating child care centers. Each package contained invitation letters, consent forms, survey instructions, and self-administered parent questionnaires concerning demographics, children’s dietary and activity behaviors, and frequency of fruit and vegetable consumption. Completed survey questionnaires were obtained for a total of 3,096 children. Of 3,096 children, we excluded those for whom there was no information on sex (n = 393), height or weight (n = 560), or who had an implausible height (< 50 or > 170 cm, n = 6) or weight value (< 3 or > 80 kg, n = 2). We also excluded children for which at least one question on the KDAGCAI components (n = 97) was left blank. After all the exclusions, the remaining 2,038 children constituted the primary analyses. For frequency of fruit and vegetable consumption, we separatedly excluded participants if they had missing information regarding fruit (n = 131) or vegetable consumption (n = 99), including 2,004 children for fruit and 2,036 children for vegetable consumption. The Institutional Review Board of the Sungshin Women's University approved the protocol for this study, and all parents of participating children provided signed informed consent.

The Korean Dietary Action Guides for Children Adherence Index (KDAGCAI)

A set of behavioral qualities related to diet and activity were assessed with the parental involvement questionnaire derived from the 2009 KDAGC [22]. In 2003, the Korea Ministry of Health and Welfare issued the first dietary guidelines for Koreans (DGK) [23] to promote health and to reduce the risk for preventable diet-related disease by promoting healthy eating and physical activity throughout the life cycle. The revised edition of the 2003 DGK was released in 2009 and has the same basic principles as the previous version, with more emphasis on the average daily serving sizes of food groups, snacking frequency, and healthy activity (both physical activity and sedentary behavior). The current guidelines were developed in collaboration with expert committees in the fields of nutrition, preventive medicine, and health promotion, as well as the various agencies from the Ministries of Health and Welfare, Agriculture and Forestry, Education and Human Resources Development, and the Environment; these are based on an in-depth review of the research evidence from the Korea National Health and Examination Survey (KNHANES 2005 and 2007) [24,25] representing current nutritional status, population-level health problems, and the changing patterns of chronic disease prevalence. In this cross-sectional analysis, we used a 5-point Likert scale to determine the extent to which children adhere to the 19 practice recommendations based on the primary 5 guideline messages of the 2009 KDBGC and named it the Korean Dietary Action Guides for Children Adherence Index (KDAGCAI). Each index item was scored using the following 5-point Likert scale: 1 = not met; 2 = minimally met; 3 = modestly met; 4 = well met; and 5 = fully met. For a measure of the overall quality of an individual’s dietary habits and level of activity, we averaged a total of 19