가정의학회지 2008;29:939-947

J Korean Acad Fam Med

◇ Original Article ◇

Childhood Obesity and Familial Environmental Factor according to the Developmental Stages: the Korea NHANES Study

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Background: To investigate the association between childhood obesity and its risk factors according to specific childhood developmental stages.

Methods: We performed an analysis of data for 1922 children and adolescents aged 2 to 18 years obtained from the Third Korea National Health and Nutrition Examination Survey conducted in 2005. Weight and height were measured by trained interviewers. Childhood obesity was defined as BMI ≥95th percentile of the BMI cut-off point based on the Korean child growth curve. Data on socioeconomic characteristics such as age, education, occupation, income, physical activity and time spent watching television were collected using a well-established questionnaire and/or interview.

Results: The prevalence of obesity defined by using the Korean child growth curve was 4.1% in children aged 2 to 6, 6.3% in children aged 7 to 12, and 8.7% in adolescents aged 13 to 18. In the multiple logistic regression model, parental obesity, and time spent watching television were associated with increased risk of obesity in children aged 2~6. Parental obesity, family income level, birth weight, and time spent watching television were positively associated with obesity in children aged 7~12. In adolescents aged 13~18, participation in vigorous physical activity and attempts to control weight were associated with adolescent obesity.

Conclusion: The prevalence and risk factors of childhood obesity vary substantially according to developmental stage. Differential approaches are needed for effective control of childhood obesity.

Key words: childhood obesity, developmental stage, television viewing, parental obesity, working mother, birth weight, risk factor

INTRODUCTION

Epidemiological data indicate a dramatic increase in childhood obesity worldwide.[1] Glucose intolerance and insulin resistance are highly prevalent in obese children.[2,3] Growing evidence suggests that the pathological processes of type 2 diabetes and cardiovascular disease (CVD) begin during early childhood.[4] A substantial proportion of childhood obesity tracks into adulthood, and this tracking increases with age.[5,6] These findings foretell of the upcoming burdens of obesity. Therefore, controlling childhood obesity is a public health issue of the highest priority.

Obesity is a multifactor disease that results from multiple interactions between genetics and the environment. Many candidate genes for obesity have been identified. Available evidence indicates that obesity-related genes do not directly cause weight gain in general, but they increase the susceptibility to weight gain in subjects exposed to specific environments.[7] Therefore, the correction of high-risk environments for obesity is a key factor in preventing and controlling childhood obesity.

Some high-risk obesity factors have been suggested, e.g., television (TV) viewing[8], sugar-sweetened beverages[9], and parental obesity.[10] However, evidence for these associations is mixed, and controversy remains regarding the effectiveness of controlling these risk factors.[11] Many previous studies accounted for various risk factors of Korean childhood obesity,

Received October 14, 2008, Accepted December 3, 2008
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the results for large representative sample are limited. Another weakness that has often been overlooked is the lack of consideration of the developmental stages of children. Children have different life-styles, parental dependencies, and exposure to their environment at different developmental stages. These differences might result in differential effects of risk factors on obesity and might explain some of the heterogeneity in previous study results. To address these issues, we investigated childhood obesity and its risk factors using a recent representative sample of Koreans: the third Korea National Health and Nutrition Examination Survey (KNHANES III), conducted in 2005.

METHODS

1. Study subjects

The KHANES III is a nationally representative survey conducted by the Korea Ministry of Welfare and Korea CDC (Centres for Disease Control and Prevention). The survey has a multistage stratified clustered probability sampling design. The stratification was conducted based on the 13 areas of Korea (seven metropolitan cities and six provinces), the administrative unit (dong or eup-myeon; Korean units), and the dwelling type (apartment or other). There were approximately 246,000 primary sampling units, each of which contained about 60 households (total of 14,311,807 households). For the Health Interview Survey, 600 units were randomly sampled from the primary sampling units. For the Behavioural Survey, the Nutrition Survey, and the Health Examination Study, 200 units were randomly sampled. For each unit, 20 households were selected randomly.

The KNHANES III is divided into four parts: the Health Interview survey, the Behavioural Survey, the Health Examination Survey, and the Nutrition Survey. The anthropometric data used to define obesity were measured in the Health Examination Survey. The response rate for the Health Examination Survey was 70.2% (7,597 of 10,816). We analysed data from 1922 children and adolescents aged 2～18 years (580 children aged 2～6 years, 790 children aged 7～12 years, and 552 adolescents aged 13～18 years) for whom the Health Examination survey was completed.

2. Anthropometric measurements

Height and body weight were measured by trained examiners during the Health Examination Study. Height was measured to the nearest 0.1 cm on a stadiometer (SECA 225, Germany) with the subject standing barefoot. For 2 aged babies and toddlers, a suitable instrument (SECA 210, Germany) was used to measure height in the supine position. Body weight was measured to the nearest 0.1 kg on a balanced scale (GL-6000-20, Cas, Korea) with the subject wearing a lightweight gown or underwear. The body mass index (Quetelet's BMI) was calculated as BMI=(weight in kilograms)/(height in metres)^2.

3. Socioeconomic characteristics

The Health Interview and Health Behaviour survey used well-established questions to determine the demographic and socioeconomic characteristics of subjects, e.g., age, education level, occupation, income, marital status, and disease status. The surveys were conducted by well-trained interviewers. For the children aged under 12 years, their parents response to questionnaires instead of. The Health Interview Survey was filled out by parents instead of children. Adolescents aged 12 years or more themselves, however filled out the Health Behavioral Survey.

Data were also collected on the amount of time spent watching TV and using a computer.

Monthly household income was measured in units of Korean won (1,030 won=US 1$ in 2005) and categorised into three classes: low, $<300\times10^4$; intermediate, $300\sim500\times10^4$; and high, $\geq500\times10^4$. Parental education level was categorised into three classes: <middle school, middle to high school, and ≥ college. The amount of time spent watching TV or using a computer per day was divided into three classes: <2 h, 2～4 h, and >4 h. Adolescents who participated in vigorous activities defined those activities based on an increase in the rate of breathing; for example running, jogging, bicycling, climbing, and playing soccer, basketball, tennis, or squash for ≥20 min three or more times per week was categorised as vigorous physical activity (VPA). For adolescents, the attempt to control weight was also examined.

4. Dietary factors

Daily energy and nutrient intake were assessed using a 24-h recall method in the Nutrition Survey. We estimated total caloric intake in kilocalories per day and total fat intake in grams per day. The amount of fat intake was expressed as (g of fat intake)/(100 kcal of total caloric intake). The frequency of dining out was divided into three classes: never to once or

more per month, once or more per week, and once or more per day. The breakfast consumption status was also assessed.

5. Definition of obesity

Obesity during childhood and adolescence was defined according to the BMI cut-off point for age and the gender-based growth curve. The growth curve was constructed by the Korean Association of Paediatrics in 2007,[12] and childhood obesity was defined as BMI ≥ the 95th percentile.[13] For international comparison, we also estimated the prevalence of childhood obesity using the definition for obesity of the International Obesity Task Force (IOTF).[14] The IOTF standards define obesity as BMI ≥ age-sex specific BMI cut-off that corresponds to a BMI of 30 kg/m^2 at age 18. Adults who had a BMI ≥25 kg/m^2 were categorised in the obese group.

6. Statistical analysis

The complex survey design that was used for KNHANES III data collection and the weighting of samples were incorporated into the statistical analyses. The sampling frame was based on the 2000 Korea National Census Registry. The weighting of samples was calculated to take into account unequal selection probabilities resulting from the cluster design and oversampling of some groups. All analyses were conducted using STATA statistical software version 9.2 SE (Stata corporation, College Station, TX, USA), with svy (survey) commands to allow for the cluster sampling design and to obtain robust standard errors. The prevalence of childhood obesity was estimated by the calculation of weighted prevalence and its 95% confidence interval (CI). The chi-square test was used for simple categorical data analyses. The t-test was used to compare the means of continuous variables such as birth weight and the amount of fat intake between obese children and non-obese children. Logistic regression analyses were conducted to assess the association of each childhood or parental risk factor with childhood obesity. After testing several models using a hierarchical approach, we constructed a final multiple logistic regression model for each developmental stage. Tests for linear trends were performed for each of the ordinal variables in the final models. We considered $P<0.05$ to be statistically significant.

RESULTS

1. Prevalence of childhood obesity

The prevalence of obesity according to Korean BMI standards was 4.1% (95% CI, 2.7～6.2%) in children aged 2～6 years, 6.3% (95% CI, 4.5～8.7%) in elementary school children aged 7～12 years, and 8.7% (95% CI, 6.2～12.2%) in adolescents aged 13～18 years. The prevalence of obesity according to IOTF criteria was 2.8% (95% CI, 1.7～4.4%), 6.3% (95% CI, 4.5～8.8%), and 9.5% (95% CI, 6.9～12.9%), respectively (Figure 1).

2. Risk factors for obesity in 2～6-year-olds (pre-schoolers)

The weighted prevalence of obesity was higher in children aged 2～6 years (preschoolers) who had at least one obese parent (7.2% vs. 2.2%), and whose father's education level was low (8.2% vs. 1.9%; Table 1). There were no differences in the weighted prevalence of obesity according to the mother's education level across developmental stages. The prevalence of obesity in preschoolers was 1.3%, 6.0%, and 4.6%, for those who watched <2 h, 2～4 h, and ≥4 h of TV per day, respectively (P=0.06). The amount of time spent using a

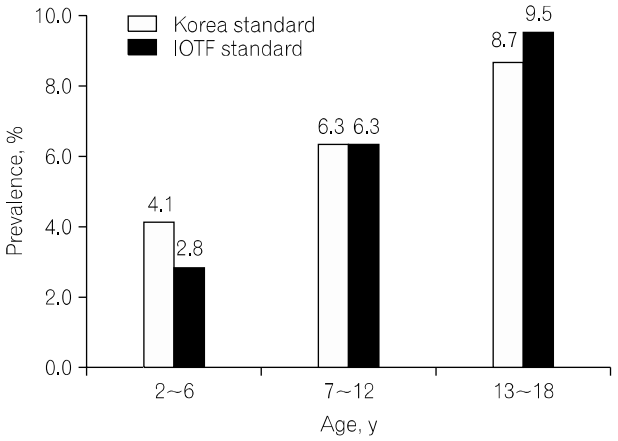

Figure 1. The prevalence of childhood obesity in Korea by child developmental stage using Korean standards and International Obesity Task Force (IOTF) criteria. The Korean standard define obesity as BMI ≥ age-specific BMI 95th percentile derived by the Korean Association of Paediatrics in 2007. The IOTF standards define obesity as BMI ≥ age-sex specific BMI cut-off that corresponds to a BMI of 30 kg/m2 at age 18.

Table 1. The prevalence of childhood obesity in Korea according to the child developmental stages.

Variable*		2～6 yrs	P‡	7～12 yrs	P‡	13～18 yrs	P‡
		Obesity% (95% CI)†		Obesity% (95% CI)†		Obesity% (95% CI)†	
Gender	Male	3.1 (1.7, 5.6)	0.20	5.5 (3.5, 8.5)	0.36	8.5 (5.2, 13.7)	0.89
	Female	5.1 (2.9, 8.7)		7.2 (4.6, 11.0)		9.0 (5.6, 14.0)	
Parental obesity	BMI <25 (kg/m^2)	2.2 (1.1, 4.4)	0.00	2.0 (1.0, 3.9)	<0.001	8.2 (4.6, 14.4)	0.73
	BMI ≥25 (kg/m^2)	7.2 (4.3, 11.9)		11.8 (8.3, 16.5)		9.3 (6.2, 13.8)	
Paternal education	<Middle school	8.2 (1.1, 42.0)	0.01	8.6 (2.4, 26.0)	0.58	10.9 (4.9, 22.4)	0.62
	Middle-high school	6.7 (3.8, 11.6)		5.1 (3.3, 7.9)		9.8 (5.3, 17.3)	
	≥College	1.9 (1.0, 3.3)		7.1 (4.0, 12.1)		7.0 (3.9, 12.3)	
Maternal education	<Middle school	0	0.73	8.2 (2.7, 22.4)	0.93	10.7 (5.3, 20.5)	0.68
	Middle-high school	4.2 (2.1, 8.1)		6.5 (4.1, 10.0)		7.5 (4.4, 12.4)	
	≥College	4.4 (2.5, 7.7)		6.5 (3.3, 12.3)		7.5 (3.8, 14.4)	
Maternal employment	Housewife/no	3.3 (1.9, 5.7)	0.21	3.9 (2.3, 6.6)	0.02	6.9 (3.9, 11.9)	0.52
	Yes	5.7 (2.9, 10.8)		9.2 (6.0, 14.0)		8.9 (5.5, 14.0)	
Family income	<300×10^4 won	4.0 (2.4, 6.5)	0.89	4.7 (3.0, 7.5)	0.21	9.5 (5.8, 15.1)	0.76
	300～500×10^4 won	4.7 (2.3, 9.2)		8.3 (5.2, 13.1)		7.5 (4.3, 12.8)	
	≥500×10^4 won	3.4 (0.8, 12.8)		8.2 (3.3, 19.0)		9.6 (4.6, 19.0)	
Breast fed	No	4.1 (1.8, 9.3)	0.93	6.6 (3.5, 12.0)	0.89	2.8 (0.8, 8.7)	0.07
	Yes	4.3 (2.6, 6.9)		6.9 (4.7, 10.0)		8.1 (5.7, 11.2)	
Breakfast skipping	No	4.3 (2.6, 6.8)	0.80	6.3 (4.2, 9.2)	0.74	6.4 (3.8, 10.8)	0.15
	Yes	4.9 (1.9, 12.1)		7.2 (3.5, 14.1)		10.8 (6.9, 16.3)	
Dining out	None to once or more per month	4.1 (2.0, 8.4)	0.80	6.6 (2.1, 18.9)	0.35	7.9 (2.5, 22.0)	0.60
	Once or more per week	3.1 (0.9, 10.0)		1.8 (0.3, 9.8)		13.9 (4.2, 37.2)	
	Once or more per day	4.8 (2.6, 9.0)		6.8 (4.7, 9.7)		7.5 (5.0, 11.0)	
TV watching per day	<2 h	1.3 (0.4, 3.8)	0.06	3.8 (2.1, 6.8)	0.05	9.7 (5.9, 15.4)	0.09
	2～4 h	6.0 (3.7, 9.6)		7.7 (5.1, 11.4)		4.8 (2.4, 9.4)	
	≥4 h	4.6 (1.4, 14.0)		10.4 (5.2, 19.7)		15.2 (6.9, 30.2)	
Computer use per day	<2 h	4.1 (2.6, 6.4)	0.89	6.4 (4.4, 9.3)	0.33	8.8 (5.3, 14.2)	0.32
	2～4 h	4.4 (1.3, 14.4)		5.4 (2.9, 9.8)		7.2 (4.0, 12.6)	
	≥4 h	0		15.1 (3.6, 45.6)		14.2 (7.5, 25.4)	
VPA	No	NA		NA		8.2 (5.1, 13.0)	0.62
	Yes					9.9 (5.7, 16.5)	
Attempt to control weight	No	NA		NA		5.2 (2.7, 9.7)	0.001
	Yes					16.8 (11.7, 23.5)	
Birth weight (kg)	Normal [m, (s.e.m)]	3.27 (0.02)	0.42	3.25 (0.02)	0.04	3.26 (0.02)	0.34
	Obese [m, (s.e.m)]	3.37 (0.13)		3.41 (0.08)		3.32 (0.07)	
Fat intake (g 100 kcal)	Normal [m, (s.e.m)]	3.48 (0.13)	0.19	4.63 (0.11)	0.82	5.62 (0.18)	0.43
	Obese [m, (s.e.m)]	4.07 (0.41)		4.72 (0.38)		5.18 (0.52)	

*Number of subgroups varies slightly because of missing data for some indices, †Prevalence of obesity with adjustment using sampling weights to represent the Korean population, ‡P-value was obtained by t-test for continuous outcomes and χ^2 test for binary outcomes. N: number of subjects, CI: confidence interval, BMI: body mass index, VPA: vigorous physical activity, NA: not available, s.e.m: standard error of mean.

computer was not associated with obesity.

The final model for preschoolers contained the variables of gender, parental obesity, father's educational level, mother's occupation, and time spent watching TV. The associations between parental obesity and the risk of obesity were statistically significant (Table 2). Preschoolers who watched TV

Table 2. The associations between obesity and risk factors for 2～18-year-olds.

		2～6 yrs	P for trend	7～12 yrs	P for trend	13～18 yrs	P for trend
		aOR* (95% CI)		aOR* (95% CI)		aOR* (95% CI)	
Gender	Male	1.00		1.00		1.00	
	Female	1.61 (0.64～4.06)		1.15 (0.60～2.19)		0.46 (0.20～1.11)	
Parental obesity	BMI<25 (kg/m^2)	1.00		1.00		1.00	
	BMI≥25 (kg/m^2)	4.79 (1.70～13.48)		4.40 (2.03～9.41)		1.91 (0.85～4.30)	
TV watching	<2 h	1.00	0.03	1.00	0.01	1.00	0.64
	2～4 h	7.01 (1.58～31.16)		2.18 (1.06～4.50)		0.24 (0.08～0.71)	
	≥4 h	2.47 (0.33～18.57)		3.08 (0.95～9.96)		2.27 (0.88～5.87)	
Father education	<Middle school	1.00	0.18	1.00	0.91	1.00	0.07
	Middle-high school	1.02 (0.10～10.18)		0.77 (0.20～2.95)		0.59 (0.20～1.72)	
	≥College	0.52 (0.05～5.39)		0.69 (0.18～2.74)		0.40 (0.13～1.27)	
Mother occupation	Housewife/no	1.00		1.00		ND	
	Others	1.81 (0.73～4.51)		1.84 (0.92～3.61)			
Family Income*	<300×10^4 won	ND		1.00	0.03	ND	
	300～500×10^4 won			2.68 (1.25～5.76)			
	≥500×10^4 won			3.39 (1.17～9.80)			
Birth weight	kg	ND		2.28 (1.20～4.71)		ND	
Breakfast skipping	No	ND		ND		1.00	
	Yes					1.93 (0.88～4.27)	
VPA	No	NA		NA		1.00	
	Yes					2.20 (1.00～4.87)	
Attempt to control weight	No	NA		NA		1.00	
	Yes					8.58 (3.60～20.41)	

cOR: crude odds ratio, aOR: adjusted odds ratio, CI: confidence interval, BMI: body mass index, VPA: vigorous physical activity, ND: not done, NA: not available. *Odds ratio and 95% CI was estimated after adjustment using sampling weights.

for 2 to 4 h/day had a greater than sevenfold increase in the risk of obesity compared to those who watched TV for <2 h/day (odds ratio, 7.01; 95% CI, 1.58～31.16). There was a statistically significant positive trend across the amount of time spent watching TV (P for trend=0.03).

3. Risk factors for obesity in 7～12-year-olds (elementary school children)

Of the children aged 7～12 years (elementary school children), the weighted prevalence of obesity was higher in those with an obese parent (11.8% vs. 2.0%), those with a working mother (9.2% vs. 3.9%) and those with a higher birth weight compared to their counterparts. The prevalence of obesity was 3.8%, 7.7%, and 10.4%, for those who watched <2 h, 2～4 h, and ≥4 h of TV per day, respectively (P=0.05) (Table 1).

The final adjusted model for elementary school children contained the variables of gender, parental obesity, father's educational level, mother's occupation, family income level, birth weight, and time spent watching TV. In the final model, elementary school children with an obese parent (odds ratio, 4.40; 95% CI, 2.03～9.41) had significantly high odds ratios for the risk of obesity, and birth weight was positively associated with the risk of obesity (odds ratio, 2.28; 95% CI, 1.20～4.71). Those who watched TV for 2 to 4 h/day had a 2-times greater risk of obesity that did those who watched TV for <2 h/day (odds ratio, 2.18; 95% CI, 1.06～4.50). There were statistically significant positive trends between obesity and family income (P for trend=0.03) and time spent watching TV (P for trend=0.01; Table 2).

4. Risk factors for obesity in 13～18-year-olds (middle to high school adolescents)

In children aged 13～18 years (middle school or high school adolescents), the weighted prevalence of obesity was higher for those who had attempted to control their weight than for those

who had not (16.8% vs. 5.2%, P<0.001; Table 1). The final model contained the variables of gender, parental obesity, father's educational level, breakfast skipping, time spent watching TV, VPA, and attempt to control weight (Table 2). The adjusted odds ratio of participation in VPA was 2.20, with marginal significance (95% CI, 1.00～4.87). The attempt to control their weight (odds ratio, 8.58; 95% CI, 3.60～20.41) was positively associated with adolescent obesity.

DISCUSSION

Although the definition of childhood obesity differs among epidemiological studies, making direct comparisons difficult, evidence suggests that childhood obesity is increasing worldwide and could have a dramatic negative effect on health in adulthood. However, the management of childhood obesity remains largely ineffective.[1] Therefore, it is important to understand the specific risk factors and mechanisms of the development of obesity in childhood.

Using representative data for Koreans for 2005, we investigated the prevalence of childhood obesity in Korea and its risk factors across specific childhood developmental stages. The prevalence of childhood obesity by Korean standards was 4.1% in preschool children 2～6 years old, 6.3% in elementary school children 7～12 years old, and 8.7% in middle and high school adolescents 13～18 years old (Figure 1). According to the Health Survey for England (HSE) 2006, 17% of boys and 15% of girls aged 2～15 years were considered obese by UK National BMI percentile classification.[15] For comparison with this data, we calculated the prevalence of obesity in Korean children aged 2～15 using the IOTF criteria and found a prevalence of 8.8% (95% CI, 6.7～11.4) in boys and 4.4% (95% CI, 2.9～6.6) in girls. Because of a lack of adequate representation of and insufficient validation for Korean children in the IOTF criteria, we examined childhood obesity using the child growth curve that was constructed by Korean Association of Paediatrics and approved by the Korea CDC.

Different risk factors were associated with obesity depending on the specific age group of children. In children of preschool and elementary school age, parental obesity was significantly associated with an increased risk of childhood obesity; however, this was not a significant predictor in adolescents. These results are consistent with previous findings that parental obesity is a risk factor for obesity in children aged 5～7 years[10], and that the association between parental BMI and the child's BMI is important in children <10 years old.[5] Parental obesity may be an important risk factor of children at risk for obesity and could be a target for managing children with obesity.[16] Thus, parents with younger children have important role to influence their children's activity and diet patterns.

Consistent with previous studies[17], we found that the prevalence of obesity was higher in those with a working mother for elementary school children aged 7～12 years. Childhood obesity increased with age regardless of the presence of mother's occupation, but comparing between aged 2～6 years and 7～12 years old, the increasing rate of obesity was higher in those with a working mother (5.7 → 9.2%) compared to their counterparts (3.3 → 3.9%). Between aged 7～12 years and 13～18 years old, childhood obesity in those with a working mother did not show any increasing tendency (9.2 → 8.9%) while sustained increase was seen in their counterparts (3.9 → 6.9%). We assumed that the prevalence of childhood obesity increased earlier between preschool and elementary school age and then showed plateau afterwards when mother had some occupations, while the prevalence increased consistently with age especially in school age when mother was a housewife, which can explain the statistically significant difference of childhood obesity between groups of mother's occupation only found at children aged 7～12 years old.

Possible explanations for the association between a working mother and childhood obesity include differences in familial environment and attitudes about restricting high-energy fat intake or encouraging physical activity.[18] Mothers usually spend more time with their children than fathers and are more responsible for the diet and physical activity of their children. Mothers who work outside the home might spend less time with their children, and unsupervised children may have more opportunity to consume high-caloric fast food or to spend more time performing sedentary activities.[19]

There was a significant positive relation between childhood obesity and the amount of time spent watching TV in both preschoolers and elementary school children. However, the amount of time spent using a computer was not associated with the prevalence of childhood obesity (Table 1). Some previous studies have suggested that watching TV may reduce the resting energy expenditure[20], cause more sedentary behaviour, and displace physical activity. Although other studies have reported inconsistent associations between time spent watching TV and childhood obesity[21,22], a recent meta analysis

indicated a small, but statistically significant, association.[23] Another explanation is that TV watching could increase a child's exposure to high-caloric food via advertisements and marketing[24], and food can be consumed easily while watching TV. In contrast, computer use requires the use of both hands, which may reduce concurrent food consumption.

The positive association between childhood obesity and birth weight was significant only in elementary school children (aged 7～12 years). Every 1 kg of birth weight increased the risk for obesity up to 2-fold in this age group. Both low[25] and high[26] birth weight have been suggested as risk factors for later childhood or adult obesity; however, this relationship was mainly inconclusive and attenuated with adjustment for other child or parental risk factors.[27] Birth weight may be one predictor of later obesity; however, it should be considered along with other various risk factors.

Middle and high school adolescents (aged 13～18 years) who attempted to control their weight had higher odds ratios for obesity. The participation in VPA was associated with obesity with statistically marginal significance (odds ratio, 2.20; 95% CI, 1.00～4.87; Table 2) in final model. The positive association between VPA, attempt to control weight and adolescent obesity suggests that adolescents tend to try to control their weight through dieting or exercise. However, these methods may be both unsupervised and inefficient. Adolescents spend relatively little time at home with their parents, and much time at school with their friends. The effects of parental factors on the risk of obesity are limited in this age group. Thus, school-based educational programs will be effective in addressing obesity.

Our results show that the association between childhood obesity and various risk factors differs with the childhood developmental stage.

Our study has several limitations. First, we used a cross-sectional design, which did not allow for the determination of concrete causal relationships over a specific time interval. Further longitudinal or interventional studies are required to ascertain the relationship between childhood obesity and various risk factors for a wide range of ages. Second, our results might have been affected by recall bias because some data were collected using direct or self-reported interviews. Therefore, we cannot completely rule out the possibility that some measures such as demographic variables and physical activity level were over or underestimated. However, the main strengths of our study are that the data were derived from representative population-based surveys and the anthropometric data were obtained from direct measurements using standardised methods.

Despite these limitations, we analysed various risk factors for childhood obesity across a wide range of age groups using a representative nationwide database. Our results provide important information about age-dependent risk factors for childhood obesity, as well as specific key points to help prevent or treat obesity according to specific childhood developmental stages.

In conclusion, the prevalence of childhood obesity and its predictive factors vary greatly among child developmental stages. Therefore, it is important to identify age-specific risk factors and manage these factors while considering environmental contributions. For preschool and elementary school children, both parental and child factors were important for obesity. It is necessary to inform both the parents and the child about the associations between childhood obesity and TV watching and the home environment. School- and community-based educational programs[28] to help children combat obesity are necessary for a positive outcome to help both the parents and child. To prevent or treat obesity during adolescence, intervention can be made based on specific factors according to developmental stages. It is necessary to inform adolescents directly about a healthy lifestyle, including food habits, physical activity, and the ability to change their beliefs about dieting to control their weight.

ACKNOWLEDGMENTS

We thank the Centres for Disease Control (Korea CDC) for providing the third Korea National Health and Nutrition Examination Survey data.

요 약

발달 시기에 따른 소아비만의 유병률과 비만과 관련된 환경인자: 2005년 국민건강영양조사 자료를 이용하여

고 정 아

서울대학교병원 가정의학과

연구배경: 소아비만은 당뇨, 심혈관계 질환을 동반하며, 성인 비만으로 이행될 수 있어 중요성이 높아졌으나, 유전, 환경 요인간의 다양한 상호관계를 통해 유발되므로 관리가

어려웠다. 본 연구는 국민건강영양조사에서 소아비만의 유병률과, 발달시기별 위험요인을 조사하여 효과적인 비만 관리에 도움이 되고자 시행되었다.

방법: 2005년 국민건강영양조사 자료 중 2～18세 사이의 소아 및 청소년 1,922명을 대상으로 발달시기별 위험인자에 따른 비만 유병률과, 위험인자와 비만 간의 관련성을 분석하였다. 비만은 한국 소아성장곡선의 BMI 분별점의 95 백분위수 이상인 경우로 정의하였다. 교육수준, 직업, 가계소득, 신체활동, TV 시청시간 등이 구조화된 설문지를 통해 수집되었다.

결과: 소아비만의 유병률은 2～6세에서 4.1%, 7～12세에서 6.3%, 13～18세에서 8.7%였다. 다중회귀분석모델에서, 2～6세 학령 전 시기에는 부모가 비만일 때[교차비: 4.79, 95% 신뢰구간(1.70～13.48)]와 TV 시청시간이 길수록(P for trend: 0.03) 비만 위험이 증가하였다. 7～12세에서는 부모가 비만할수록[교차비: 4.40, 95% 신뢰구간(2.03～9.41)], 출생체중이 높을수록[교차비: 2.28, 95% 신뢰구간(1.20～4.71)], TV 시청시간이 길수록(P for trend: 0.01), 가계수입이 높을수록(P for trend: 0.03) 비만위험도가 증가하였다. 13～18세 그룹은 격렬한 신체활동 참여[교차비: 2.20, 95% 신뢰구간(1.00～4.87)]와 체중 조절 경험이[교차비: 8.58, 95% 신뢰구간(3.60～20.41)] 관련 있었다.

결론: 발달시기에 따라 소아 비만에 중요한 영향을 미치는 위험인자가 다르게 나타났다. 소아 비만을 예방하고 조절하기 위해서는 소아의 각 발달 시기에 따른 다양한 접근방법을 고려해야 한다. **(J Korean Acad Fam Med 2008; 29:939-947)**

중심 단어: 소아 비만, 발달 시기, 텔레비전 시청, 부모 비만, 유병률, 위험 요인

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