

## A Comparison of Obesity Prevalence between Korean-American Children and Korean Children

Young-Ja Sim,<sup>1)</sup> Eun-Kyung Kim,<sup>2)†</sup> Kye-Wol Park,<sup>2)</sup> Hee-Sun Kim<sup>2)</sup>

*Food Protein Research & Development Center,<sup>1)</sup> Texas A & M University, College Station, Texas, USA*

*Department of Food Science,<sup>2)</sup> Kangnung National University, Kangwondo, Korea*

### ABSTRACT

This study is to compare the prevalence of obesity between Korean-American children and Korean children, and to investigate the role of environmental factors in obesity development. Prevalence of child obesity is compared by their residence, parents' anthropometric data, education and occupation, and the length of immigration, and birth place of the children. A total of 593 children between the ages of 9 and 12 were examined. 262 Korean-American children (KcUS group) from New Jersey, USA and 331 Korean children (KcK group) from Seoul, Korea were compared. KcUS group showed a higher obesity rate (male: 12.6% and female: 8.2%), compared to KcK group (male: 8.0% and female: 5.1%). KcK male children showed lower weight and prevalence of obesity than Korean-American male children who lived in the United States for more than three years. Korean-American female children had higher weight and obesity rate than Korean female children. Waist circumference and hip circumference were also higher in obese children in both KcK and KcUS groups. The children who live in America had an odds ratio of 1.69 to be obese compared to KcK, while those born in America and those who have lived in America for more than 3 years had odds ratios of 1.53 and 1.25 to be obese, respectively. This study found that environmental factors, immigration to America for instance, could play a bigger role in child obese development than the genetic factor. (*J Community Nutrition* 8(1): 31~37, 2006)

**KEY WORDS:** Korean-American children · childhood obesity.

---

### Introduction

---

An obese child has a greater risk to become an obese adult which is linked to many chronic diseases (Laskarzewski 1980; Newman 1986). Childhood obesity has become very common in South Korea. It has been reported that 17% of children in this country were obese. Hypertension, hyperlipidemia and diabetes mellitus were also shown in many of those obese Korean children. And they were experiencing social and psychological difficulties at school and/or in relationship with their peers (Kim 1982).

Genetic and environmental factors have been studied to verify their influences on obese development (Council on Scientific Affairs of the American Medical Association 1988).

To understand which plays the bigger role in obese etiology, a study on twins who have grown in separate families having a totally different life style would be ideal. But the method is nearly unrealistic and studies on immigrants are more widely used for the same purpose (Stern 1991; Stephen 1991).

Stern et al. (1991) reported that Mexican-Americans consume more calories, fat and sugar and less complex sugar and they move less after they immigrate to America. They are more obese than their counterparts in Mexico and it is related to higher diabetic morbidity. Stephen et al. (1991) compared traditional Western Samoan females to those who moved to Hawaii and found that the latter has 80% obesity rate which is 2 times higher than the formal 46%.

During the critical growing period in childhood, moving into a new country with a different culture, life style and food choices could have a great impact on the course of the child's whole life. Especially immigration to a country where half of the population is reportedly obese and consuming higher fat and calorie per capita is well known, could demonstrate well the powerful role of environmental factors on

---

† Corresponding author: Eun-Kyung Kim, Department of Food Science, Kangnung National University, 120 Kangnung University Ave. Kangnung, Kangwondo 210-702, Korea  
Tel: (033) 640-2336, Fax: (033) 640-2330  
E-mail: ekkim@kangnung.ac.kr

child obese development. In this study, the effort was to report the prevalence of obesity between Korean children who live in Korea and the United States and to investigate the role of environmental factors in obesity development.

## Subject

593 Korean children, between the ages of 9 and 12 (4<sup>th</sup> to 6<sup>th</sup> grade at school) were included in this study (Table 1). 262 of the children were living in the New Jersey, USA (KcUS group). 128 were male and 134 were female. They were recruited from four different Korean schools in the area. A total of 305 questionnaires were distributed, forty-three were incomplete and 262 were used in this study.

The other 331 children were living in Gangnam, Seoul, South Korea. 151 were male and 180 were female. The residents of the area are considered rich and of the upper class. 400 questionnaires were distributed originally, 371 were collected and forty of the returned were incomplete. Only 331 complete questionnaires were included in this study.

## Methods

Survey questionnaires were handed out to children at school. The children were instructed to ask their mother to fill in the survey. The questions included education and occupation of parents, and height, weight, waist and hip circumference of the child and his parents. Guidance to measure anthropometric data was also included in the questionnaire. Questions about birth place and length of residence in the USA were added to the Korean-American child.

### 1. Statistical analysis

Statistical analysis was performed using SAS software (Statistical Analysis system). The results compared male and female separately, because the 9 to 12 yr age group may

show sexual characteristics and differences.

Percent ideal body weight was used to diagnose obesity. 50<sup>th</sup> percentile weight-for-age of the Korean growth chart (Korean Pediatric Society 1998) was used as ideal body weight for the children and Broca's method was used to determine the parents' ideal body weight.

KcUS was further divided into 2 groups of less or more than 3 years according to the residential duration in the USA to show the changes having occurred during the acculturation. Analysis of covariance (ANOVA) was used to compare the results among three group and Tukey's method was done as a post-hoc test.

## Results

### 1. Participation

Both KcUS and KcK showed similar demographic characteristics (Table 2). Ages in both groups were equally spread out. 66% of KcUS children were born in Korea, and 34% were born in America. KcUS was further divided into two groups according to the length of residence in the United States. Those who lived in the United States for less than 3 years comprised of 53.8% of KcUS. 20.8% of KcUS had lived in the United States for more than 3 years and less than 6 years. 17.0% of KcUS had lived in the United States for more than 6 years and less than 9 years. Finally, 7.5% of children of the KcUS had lived in the United States for more than 9 years and less than 12 years.

The average years of education of the fathers in both groups did not show a significant difference;  $16.3 \pm 1.74$  years and  $16.4 \pm 1.20$  years, respectively. As for the educational level of mothers, there were some differences. The mother's average years of education of KcUS ( $15.7 \pm 1.51$  year) was higher than KcK ( $15.3 \pm 1.88$  year).

The occupation of the fathers in the 2 groups showed a

**Table 1.** Distribution of subjects by age, sex and residence

Age (years)	Number of Korean (%)			Number of Korean-American (%)		
	Male	Female	Total	Male	Female	Total
9	33 ( 21.9)	39 ( 21.7)	72 ( 21.8)	32 ( 25.0)	33 ( 24.6)	65 ( 24.8)
10	37 ( 24.5)	51 ( 28.3)	88 ( 26.6)	32 ( 25.0)	32 ( 23.9)	64 ( 24.4)
11	46 ( 30.5)	48 ( 26.7)	94 ( 28.4)	32 ( 25.0)	36 ( 26.9)	68 ( 26.0)
12	35 ( 23.2)	42 ( 23.3)	77 ( 23.3)	32 ( 25.0)	33 ( 24.6)	65 ( 24.8)
Total	151 (100.0)	180 (100.0)	331 (100.0)	128 (100.0)	134 (100.0)	262 (100.0)
	$\chi^2 = 0.872$ df = 3 p = 0.832			$\chi^2 = 0.129$ df = 3 p = 0.988		

**Table 2.** Demographic characteristics of subjects

		Number of Korean (%)	Number of Korean-American (%)		
Sex	Male	151( 45.6)	128( 48.9)		
	Female	180( 54.4)	134( 51.1)		
	Total	331(100)	262(100)		
Place of birth	Korea	331(100)	173( 66.0)		
	America		89( 34.0)		
Duration of immigration (yr)	< 3		93( 53.8)		
	3 - 6		36( 20.8)		
	6 - 9		31( 17.9)		
	9 - 12		13( 7.5)		
Father's education	High school	34( 10.6)	8( 3.1)	$\chi^2 = 18.156$ df = 2 p = 0.001	
	College · University	175( 54.5)	179( 68.8)		
	Graduate school	112( 34.9)	73( 28.1)		
	Total	331(100)	260(100)		
	Duration of education (yr)	16.3 ± 1.74	16.4 ± 1.20	p = 0.1790(NS)	
Mother's education	High school	76( 23.1)	32( 12.2)	$\chi^2 = 21.6111$ df = 2 p = 0.003*	
	College · University	223( 67.8)	204( 77.9)		
	Graduate school	30( 9.1)	26( 9.9)		
	Total	329(100)	262(100)		
	Duration of education	15.3 ± 1.88	15.7 ± 1.51	p = 0.0012	
Father's job	Office work	143( 44.1)	142( 54.6)	$\chi^2 = 12.116$ df = 3 p = 0.007*	
	Production/salesman	10( 3.1)	14( 5.4)		
	Professor/student	64( 19.8)	30( 11.5)		
	Self employed	107( 33.0)	74( 28.5)		
	Total	324(100)	260(100)		
Mother's job	Office work	33( 10.8)	28( 10.7)	$\chi^2 = 3.369$ df = 2 p = 0.338	
	Production/salesman	22( 7.2)	23( 8.8)		
	Professor/student	31( 10.2)	16( 6.1)		
	No job	219( 71.8)	195( 74.4)		
	Total	305(100)	262(100)		

significant difference. In KcK 44.1% of the fathers were office workers, 33.0% were self-employed, 19.8% were professional and 3.1% were in production/sales. As for KcUS, 54.6% of the fathers were office workers, 28.5% were self-employed, 11.5% were professional and 5.4% worked in production/sales. The mother's occupation in those two groups shows no significant difference. Each group showed a very high rate of homemaker, 71.8% and 74.4%, respectively. In KcK 10.8% of mothers were office workers, and 7.2% were in production/sales. As for KcUS 10.7% were office workers, 6.1% were professional, and 8.8% were in production/sales.

## 2. Anthropometric measurements of parents

The results of anthropometric measurements of parents are in Table 3. Fathers showed no difference through the acculturation and residential length in the United States did

**Table 3.** Anthropometric measurements of subjects' parents

Variables	Korean	Korean-American		
		Duration ≤ 3 years	Duration > 3 years	
Father	Height (cm)	172.5 ± 4.6	171.8 ± 4.8	172.4 ± 3.9
	Weight (kg)	71.0 ± 8.0 <sup>a</sup>	68.6 ± 7.1 <sup>b</sup>	69.3 ± 7.3 <sup>b</sup>
	%IBW (%) <sup>1)</sup>	109.0 ± 10.8 <sup>a</sup>	106.3 ± 9.6 <sup>b</sup>	106.5 ± 10.8 <sup>b</sup>
	BMI (kg/m <sup>2</sup> ) <sup>2)</sup>	23.9 ± 2.3 <sup>a</sup>	23.2 ± 2.1 <sup>b</sup>	23.3 ± 2.3 <sup>b</sup>
	RI (kg/m <sup>3</sup> ) <sup>3)</sup>	138.5 ± 14.1	135.4 ± 12.8 <sup>b</sup>	135.4 ± 14.3
Mother	Height (cm)	159.9 ± 4.4	160.2 ± 4.2	160.6 ± 4.0
	Weight (kg)	53.9 ± 5.4	54.0 ± 5.9	52.7 ± 5.5
	%IBW (%)	99.8 ± 9.1 <sup>a</sup>	99.8 ± 9.8 <sup>a</sup>	96.9 ± 9.1 <sup>b</sup>
	BMI (kg/m <sup>2</sup> )	21.0 ± 1.9 <sup>a</sup>	21.0 ± 2.0 <sup>a</sup>	20.4 ± 1.9 <sup>b</sup>
	RI (kg/m <sup>3</sup> )	131.5 ± 12.4	131.4 ± 13.1 <sup>a</sup>	127.4 ± 2.2 <sup>b</sup>

<sup>1)</sup>%IBW: percent ideal body weight, <sup>2)</sup>BMI: body mass index, <sup>3)</sup>RI: Röhler index, Values in the same row with different super-script are significantly different at p < 0.05.

not change the fathers' body composition. However it showed that KcK group fathers have higher weight, %IBW, and BMI than KcUS group fathers.

Among KcUS mothers, who lived less than 3 years showed a higher rate of %IBW, BMI, and RI than those who lived more than 3 years. KcK mothers showed significantly higher anthropometric values than mothers who lived in the United States more than 3 years. As a whole, KcK parents showed higher anthropometric values than KcUS group parents.

### 3. Anthropometric measurements of children

The results of anthropometric measurements of children are in Table 4. For male children, there was no significant difference among the 3 groups in weight at the time of birth. A comparison of the anthropometric results between KcK and KcUS children who lived in the USA less than 3 years showed no significant difference, but there was a significant difference with KcUS children who lived in the United States more than 3 years. The weight of the KcUS children who lived in the USA more than 3 years was  $45.5 \pm 10.2$ kg, which is significantly higher than KcK ( $40.4 \pm 8.7$ kg). Percent ideal body weight, body mass index (BMI) and Röhler

index (RI) were also higher in the KcUS children who lived in the United States for more than 3 years. Within KcUS, children who lived in the United States more than 3 years showed higher height, weight, %IBW, BMI, and RI level than children who lived in the United States less than 3 years.

For female children, the height ( $148.8 \pm 8.6$ cm), and weight ( $41.7 \pm 7.1$ kg) of the KcUS children who lived in the United States for more than 3 years were significantly higher than KcK,  $146.0 \pm 8.3$ cm and  $38.1 \pm 7.5$ kg, respectively. Also BMI ( $18.8 \pm 2.4$ kg/m<sup>2</sup>) of the KcUS children who lived in the United States for more than 3 years were higher than KcK ( $17.7 \pm 2.4$ kg/m<sup>2</sup>). Within KcUS, children who lived in the United States for more than 3 years showed significantly higher height and weight than children who lived in the United States less than 3 years.

Waist/hip circumference ratio did not show any difference among male children in the 3 groups. But among the female children, waist/hip circumference ratio was significantly higher in KcUS who lived in the United States for less than 3 years ( $0.83 \pm 0.07$ ) than KcK female children ( $0.80 \pm 0.07$ ). Within KcUS, male children showed higher waist circumference, and female children showed a higher hip circumfe-

**Table 4.** Anthropometric measurements of subjects

Variables	Korean	Korean-American	
		Duration $\leq$ 3 years	Duration $>$ 3 years
<b>Male</b>			
Weight at birth (kg)	$3.38 \pm 0.39$	$3.26 \pm 0.40$	$3.34 \pm 0.48$
Height (cm)	$146.4 \pm 8.7^{ab}$	$144.7 \pm 9.5^b$	$148.5 \pm 8.8^a$
weight (kg)	$40.4 \pm 8.7^b$	$39.9 \pm 8.6^b$	$45.5 \pm 10.2^a$
%IBW (%) <sup>1)</sup>	$98.4 \pm 13.8^b$	$100.4 \pm 13.2^b$	$107.0 \pm 20.0^a$
BMI (kg/m <sup>2</sup> ) <sup>2)</sup>	$18.7 \pm 2.8^b$	$18.9 \pm 2.7^b$	$20.6 \pm 3.7^a$
RI (kg/m <sup>3</sup> ) <sup>3)</sup>	$128.0 \pm 18.2^b$	$130.8 \pm 17.7^b$	$138.8 \pm 25.8^a$
Waist circumference (cm)	$67.3 \pm 8.3^{ab}$	$65.2 \pm 6.7^b$	$67.9 \pm 7.8^a$
Hip circumference (cm)	$78.8 \pm 7.3$	$78.0 \pm 7.1$	$79.8 \pm 9.1$
Waist/hip	$0.86 \pm 0.08$	$0.84 \pm 0.4$	$0.85 \pm 0.04$
<b>Female</b>			
Weight at birth (kg)	$3.23 \pm 0.43^b$	$3.44 \pm 0.50^a$	$3.28 \pm 0.43^b$
Height (cm)	$146.0 \pm 8.3^b$	$143.2 \pm 10.1^c$	$148.8 \pm 8.6^a$
weight (kg)	$38.1 \pm 7.5^b$	$37.8 \pm 6.7^b$	$41.7 \pm 7.1^a$
%IBW (%)	$94.1 \pm 13.0^b$	$99.6 \pm 14.3^a$	$97.1 \pm 14.1^{ab}$
BMI (kg/m <sup>2</sup> )	$17.7 \pm 2.4^b$	$18.3 \pm 2.1^{ab}$	$18.8 \pm 2.4^a$
RI (kg/m <sup>3</sup> )	$121.6 \pm 16.2^b$	$128.8 \pm 18.7^a$	$126.6 \pm 18.0^{ab}$
Waist circumference (cm)	$61.5 \pm 6.94^b$	$63.8 \pm 6.9^a$	$65.9 \pm 6.0^a$
Hip circumference (cm)	$76.7 \pm 7.97^b$	$77.4' \pm 6.7^b$	$80.7 \pm 7.1^a$
Waist/hip	$0.80 \pm 0.07^b$	$0.83 \pm 0.07^a$	$0.82 \pm 0.04^a$

<sup>1)</sup>%IBW: percent ideal body weight, <sup>2)</sup>BMI: body mass index, <sup>3)</sup>RI: Röhler index. Values in the same row with different superscript are significantly different at  $p < 0.05$

rence who lived in the United States for more than 3 years.

#### 4. Distribution of %IBW

Distribution of percent ideal body weight is in Table 5. The distribution of obesity in male and female children between KcUS and KcK showed a significant difference (male:  $p = 0.011$ , female:  $p = 0.007$ ). In males, the percentage of underweight children among KcK (32.7%) was 2 times higher than KcUS children (16.5%), whereas the percentage of overweight children was higher in KcUS (12.6%) than KcK (8.0%). In females, the percentage of underweight children among KcK (43.8%) was higher than KcUS children (26.1%), whereas the percentage of overweight children was higher in KcUS (8.2%) than KcK (5.1%).

#### 5. Odds ratio for the obesity risk

The odds ratio of KcUS to develop obesity was 1.69 (0.93 – 3.06) when compared to KcK. But it was not statistically significant (Table 6).

Among the children in KcUS, odds ratio of those children born in America was 1.53 (0.93 – 3.06) compared to the

children born in Korea. Children who lived in the United States for more than 3 years showed odds ratio of 1.25 (0.55 – 2.84) compared to children who lived in the United States for less than 3 years.

When the mothers have jobs, the odds ratio for the children to develop obesity were 0.66 (0.28 – 1.55) in KcUS and 1.41 (0.45 – 4.40) in KcK but not statistically significant (Table 7).

There was no relationship between birth weight of the children and developing obesity in both groups. The waist circumference and hip circumference were highly related with obesity. Also the father's percent ideal body weight showed significantly higher odds ratio to develop obesity in children.

## Discussion

This study showed that the prevalence of obesity in children living in Seoul, Korea is 8.0% for males and 5.1% for females (Table 5). Child obesity is increasing in Korea and westernized food consumption and sedentary life style is believed as major contributors (Cho et al. 1989; Moon 1992; 1996).

Especially school-aged children and teenagers have shown higher prevalence of obesity. A research conducted in 1974 on elementary students in Seoul had shown only 2.0% obesity rate, but a research in 1992 showed 14.5%. In 1996, a study including elementary, middle, and high school students in Seoul revealed (Kang et al. 1997) obesity rate 23.0% in male students and 15.5% in female students. Those studies in 1992 and 1996 show higher obesity prevalence than this report. It is not because the trend has stopped but because the recently revised growth curves are used as a standard in this study, which suggests that Korean children in general are gaining weight and there are several studies supporting that (Son, Lee 1997; Park et al. 1997; Lee et al. 1997).

Korean-American children showed obesity prevalence of 12.6% in males and 8.2% in females (Table 5). In American children between 6–11yr, the obesity rate has increased in the last 15 years from 18% to 30% for males and from 17% to 25% for female children (Aluli 1991). And it has also been reported that the incidence of obesity in female children was higher than male children, and race and age affected the incidence (American College of Medicine 1991; Broussard 1991).

**Table 5.** Distribution of percent ideal body weight of subjects

	Classification	Korean	Korean-American	$\chi^2$ -test
Male	Underweight <sup>1)</sup>	49 ( 32.7)	21 ( 16.5)	$\chi^2 = 11.234$ df = 3 $p = 0.011$
	Normal <sup>2)</sup>	67 ( 44.7)	74 ( 58.3)	
	Overweight <sup>3)</sup>	22 ( 14.7)	16 ( 12.6)	
	Obesity <sup>4)</sup>	12 ( 8.0)	16 ( 12.6)	
	Total	150 (100)	127 (100)	
Female	Underweight	78 ( 43.8)	35 ( 26.1)	$\chi^2 = 12.158$ df = 3 $p = 0.007$
	Normal	76 ( 42.7)	79 ( 59.0)	
	Overweight	15 ( 8.4)	9 ( 6.7)	
	Obesity	9 ( 5.1)	11 ( 8.2)	
	Total	178 (100)	134 (100)	

<sup>1)</sup>Underweight: percent ideal body weight below 90%

<sup>2)</sup>Normal: percent ideal body weight between 90 – 110%

<sup>3)</sup>Overweight: percent ideal body weight between 110 – 120%

<sup>4)</sup>Obesity: percent ideal body weight above 120%

**Table 6.** Odds ratio for the risk of obesity by residence, place of birth and duration of immigration

			Odds ratio	95% CI
Total	Residence	America	1.69	0.93 – 3.06
		Korea	1.00	
Korean-American	Place of birth	America	1.53	0.93 – 3.06
		Korea	1.00	
	Duration of immigration	Duration > 3years	1.25	0.55 – 2.84
		Duration ≤ 3years	1.00	

**Table 7.** Odds ratio for the risk of obesity by demographic and anthropometric data

		Korean		Korean-American	
		Odds ratio	95% CI	Odds ratio	95% CI
Father's education	> High school	0.70	0.19 – 2.50	0.33	0.06 – 1.73
	≥ High school	1.00		1.00	
Mother's education	> High school	1.30	0.42 – 3.60	0.57	0.20 – 1.64
	≥ High school	1.00		1.00	
Mother's job	Yes	1.41	0.45 – 4.40	0.66	0.28 – 1.55
	No	1.00		1.00	
Father's %IBW	High	2.02	0.70 – 5.83	3.20	1.22 – 8.37
	Normal	1.00		1.00	
Mother's %IBW	High	1.83	0.22 – 15.38	1.76	0.20 – 15.66
	Normal	1.00		1.00	
Children's waist circumference	High	10.52	3.95 – 27.97	4.04	1.73 – 9.46
	Normal	1.00		1.00	
Children's hip circumference	High	7.33	2.71 – 19.84	3.03	1.29 – 7.13
	Normal	1.00		1.00	

Interestingly, KcK parents showed higher weight, percent ideal body weight and body mass index than KcUS parents whereas their children showed the opposite. This suggests that environmental changes introduced to children with immigration, such as availability of high-calorie food and eating habits of peer group, may play major roles in childhood obesity development.

In the cohorts study on Pima Indians by Price et al. (1993), which included 1,128 males and 1,372 females that were born in between the years of 1901 and 1965, reported that the increase of obesity caused by increased fat intake and decreased physical activities, especially those who were born in 1945 after the World War II, had been exposed to the westernized eating habit.

Franco's study (1996) on Japanese-Brazilians between the ages of 40 – 79ys, provides assuring clues on understanding the influences of genetic and environmental factors on diabetes mellitus development. The first generation of Japanese-Brazilian (male 127, female 111) and second generation of Japanese-Brazilian (male 136, female 156) showed higher prevalence of insulin dependent diabetes mellitus (NIDDM) than Japanese who live in Japan. Also the second generation of Japanese-Brazilians had higher prevalence of diabetes (16.2%) than the first generation (12.8%), which suggests diabetes morbidity can be amplified by western acculturation.

Though it is not significant, the country they live, place of birth and resident length were related with child obesity. Those who live in the United States showed odds ratio of 1.69 to become obese children, those who were born in the

United States showed odds ratio of 1.53, and those who have lived in the United States longer than 3 years have odds ratio of 1.25.

From the research (Huang et al. 1996) on relationship between westernized life style and diabetes morbidity in 8,006 Japanese-Americans in Hawaii, it is reported that more westernized Japanese-Americans have higher rates of diabetes. And the obesity occurred by increased calories, fat and animal protein intakes and decreased physical activity caused the people to become diabetic. Another study (Reed et al. 1982) on Japanese-Americans in Hawaii showed that they have higher coronary artery disease risk factors, such as higher blood cholesterol, and uric acid levels, higher obesity incidents less physical activities and heavy smoking habit compared to Japanese.

## Conclusion

Incidents of obesity in Korean children who live in the United States are higher than the children who live in Korea. Among Korean children living in the United States, the longer they had lived in the United States, the heavier they are. The results emphasize the importance of the environmental factors on developing childhood obesity. In child obesity prevention controlling the environment surrounding a child seems to be very effective.

In Korea, it has been reported (Kwak et al. 1994; Kwak et al. 1991) that children favored instant food and fast food

very heavily, but these foods are high in fat and low in nutrients essential for child growth. It has been pointed out (Smoak et al. 1987; Zark, Harlen 1979) that increased intake of these foods could lead to childhood obesity and nutritional unbalance and can be related to occurrence of various metabolic diseases.

Hence, it would be necessary to provide school lunch carefully, planned according to their nutrition needs, not to their taste preferences, and to include nutrition education programs in their curriculum.

---

### References

---

- Aluli NE (1991): Prevalence of obesity in Native Hawaiian population. *Am J Clin Nutr* 53: 1556s-1560s
- American College of Medicine (1991): Guidelines for exercise testing and prescription, 4<sup>th</sup> ed, Lea & Febiger
- Bray GA (1979): Obesity in America. NIH publ 79-359, Washington D.C., Public Health Service 1-19
- Broussard BA (1991): Prevalence of obesity in American Indians and Alaska Natives. *Am J Clin Nutr* 53: 1535s-1542a
- Cho KB, Park SB, Park SC, Lee DHH, Lee SC (1989): The prevalence and trend of obesity in children and adolescents. *J Kor Ped Soc* 32 (5): 597-605
- Council on Scientific Affairs of the American Medical Association (1988): Treatment of obesity in adults. *JAMA* 260: 2547-2551
- Franco LJ (1996): Diabetes in Japanese-Brazilians influence of the acculturation process. *Diabetes Res Clin Pract* 34 suppl: S51-S57
- Huang B, Rodriguez BL, Burchfiel CM, Chyou PH, Curb JD, Yano K (1996): Acculturation and prevalence of diabetes among Japanese-American men in Hawaii. *Am J Epidemiol* 144: 674-681
- Kang YJ, Hong CH, Hong YJ (1997): The prevalence of childhood and adolescent obesity over the last 18 years in Seoul area. *Kor J Nutr* 30 (7): 832-839
- Kim KN (1982): A study on relationship between food habits and personality in Chungbuk National University. *Korean J Nutr* 15 (3): 194-201
- Korean Pediatric Society (1998): Physical growth of children in Korea, Committee on health and Statistics
- Kwak TK (1994): Foodservice management practice in fast foods franchisors and their development strategies. *J Korean Society Dietary Culture* 9 (2): 189-207
- Kwak TK, Rew ES, Nam SR, Lee HS, Kim SH, Moon HK, Joo SY (1991): Nutritional concerns for fast foods by consumer and fast foods franchisors and evaluation of nutrient adequacy. *Kor J Soc Food Sci* 7 (3): 37-46
- Laskarzewski P, Morrison JA, Mellies MF (1980): Relationship of measurements of body mass to plasma lipoproteins in school children and adults. *Am J Epidemiol* 111: 395-406
- Lee DH (1996): Assessment and treatment of children obesity. *J Kor Ped Soc* 39 (8): 1055-1065
- Lee NS, Im Ys, Kim BR (1997): The study on the food habits and preferences of elementary school children. *Kor J Commu Nutr* 2 (2): 187-196
- Moon HN, Hong SJ, Suh SJ (1992): The prevalence of obesity in children and adolescents. *Kor J Nutr* 25 (5): 413-418
- Newman WP, Freedman DS, Voors AW (1986): Serum lipoproteins and systolic blood pressure are related to atherosclerosis in early life: the Bogalusa Heart Study. *N Eng J Med* 314: 138-143
- Park JK, Ahn HS, Lee DH (1997): Nutrient intake and eating behavior in mid and severely obese children. *J Korean Society Study Obesity* 4: 43-50
- Price RA, Charles MA, Pettitt DJ, Knowler WC (1993): Obesity in Pima Indians: large increases among post-World War II birth cohorts. *Am J phys Anthropol* 92 (4): 473-479
- Reed D, McGee D, Cohen J, Yano K, Syme SL, Feinleib M (1982): Acculturation and coronary heart disease among Japanese men in Hawaii. *Am J Epidemiol* 114: 894-905
- SAS/STAT guide for personal computer, version 6.03 edition. SAS Institute Inc: (1987)
- Smaok CG, Burke GL, Webber LS, Harsha DW, Srinivasan SS, Berenson GS (1987): Relation of obesity to clustering of cardiovascular disease risk factors in children and young adult: the Bogalusa Heart Study. *Am J Epidemiol* 125: 364-372
- Son SM, Lee J (1997): Obesity, serum lipid and related eating behaviors of school children. *Kor J Commu Nutr* 2 (2): 141-150
- Stephen TM (1991): Obesity in Samoans and perspective on its etiology in Polynesians. *Am J Clin Nutr* 53: 1586-1594
- Stern MP, Knapp JA, Hazuda HP, Haffner SM, Patterson JK, Mitchell BD (1991): Genetic and environmental determinants of type II diabetes in Mexican Americans. *Diabetes Care* 14 (7): 649-654
- Zark PM, Harlen WR (1979): Longitudinal study of body fatness in childhood and adolescence. *J Pediatr* 95 (1): 126-130