

Biochemical Nutritional Status of Serum Lipids, Protein, and Blood Glucose in School Children in Bucheon

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ABSTRACT

This study was conducted to evaluate nutritional status of school children by biochemical assessment method. Subjects were 308 school children from 4th to 6th grade living in Bucheon city. Their blood glucose, total protein, albumin, total cholesterol, and triglyceride (TG) concentrations were determined. Mean blood glucose concentration was 77.56 mg/dl and 81.2% of children had normal blood glucose concentration. The average proportion of hypoglycemia was 18.8% among the three grades and prevalence of hypoglycemia in 4th grade school children was highest (21.8%). Mean serum total protein and albumin levels were 7.14g/dl and 4.35g/dl, respectively, and all the subjects except only one were in normal range of total protein and albumin. Mean serum TG and total cholesterol concentrations were 145.82mg/dl and 94.50mg/dl. Serum TG and total cholesterol levels showed same pattern that the concentrations decreased in proportion to grade. Especially, there was significant difference between grades in serum total cholesterol. Furthermore, 11.7% of 4th, 6.8% of 5th, and 2.8% of 6th grade school children have borderline hypertriglycemia or hypertriglycemia, risk factors of obesity or cardiovascular disease later in life. Taken together, there was conflict phenomenon that undernutrition of hypoglycemia and overnutrition of hyperlipidemia existed together. Therefore, it is needed to develop discriminating and personalized nutritional feeding, counseling, and education program to cover the children of under- or over- nutritional status. (*J Community Nutrition* 7(1) : 3~7, 2005)

KEY WORDS : children · biochemical assessment · nutritional status · blood glucose · albumin · TG · cholesterol.

Introduction

Adequate nutrition plays an important role during school-age years in assuring that children reach their full potential for growth, development, and health. Nutrition problems can occur during this age such as iron-deficiency anemia, undernutrition, and dental caries. In other aspects, the prevalence of obesity is increasing, but the beginnings of eating disorders can also be detected in some school-age children and adolescents (Mo et al. 1998 ; Brown et al. 2002). Therefore, adequate nutrition and establishment of healthy eating behaviors can help to prevent immediate health problems as well as promote a healthy lifestyle, which may reduce the risk of the

children developing a chronic condition, such as obesity and cardiovascular disease, later in life.

During the past ten years physical development of Korean school children has grown greatly and actual status of nutrient intake has been largely improved in Korea (NIH 2000 ; PEDIATRICS 1995). However, prevalence of obesity and diabetes in children has increased (Kang et al. 1997). Childhood obesity was reported to result in adulthood obesity, hypertension, atherosclerosis, and disorder in lipid metabolism (Burns 1989 ; Lee 1996). Especially hyperlipidemia such as hypertriglycemia and hypercholesterolemia, risk factor of atherosclerosis, was shown to be a major problem in childhood obesity. It is widely known that high blood lipid concentration is closely related to cardiovascular disease.

Recently, studies on the increase in prevalence of childhood obesity according to westernized diet and life style has been reported (Kim et al. 1998). American Health Foundation recommends for follow-up children's serum lipid and cholesterol concentration on the basis of their growth and development

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Table 1. Serum glucose, total protein, albumin, total cholesterol and triglyceride concentration of the elementary school students

Variable	Grade 4 (n = 78)	5 (n = 89)	6 (n = 141)	Total (n = 308)
Glucose (mg/dl)	76.82 ± 7.50	79.39 ± 10.19	76.82 ± 6.60	77.56 ± 8.05*
Total protein (g/dl)	7.09 ± 0.45	7.07 ± 0.40	7.20 ± 0.52	7.14 ± 0.47
Albumin (g/dl)	4.37 ± 0.28	4.29 ± 0.25	4.37 ± 0.36	4.35 ± 0.31
Total cholesterol (mg/dl)	151.86 ± 22.84	147.04 ± 21.73	141.71 ± 21.23	145.82 ± 22.12**
Triglyceride (TG, mg/dl)	106.47 ± 69.60	94.06 ± 57.17	88.22 ± 48.54	94.50 ± 57.23

Values are Mean ± S.D.

Significantly different between grades by t-test, *p < 0.05, **p < 0.01

(Wynder 1989). Therefore, it is important to measure biochemical nutritional parameter to prevent the disease resulting from under- or overnutrition problem.

The studies on nutrition assessment of school children have been conducted mainly with growth status and nutrient intake (Mo et al. 1990 ; Noh 1997 ; Son, Yang 1997). Even though several studies included some biochemical assessment, they focused on iron status or iron deficiency anemia (Kim et al. 1998). Therefore, to investigate nutritional status of school children, biochemical nutritional assessment including blood glucose, total cholesterol, and TG as potent inducing factors for diabetes and coronary heart disease and serum protein concentrations was conducted.

Subjects and Methods

Subjects for this study were three hundred and eight elementary school children in Bucheon City, whose grades were fourth (n = 78), fifth (n = 89), and sixth (n = 141). The children had been chosen as subjects of Health Promotion Project of Bucheon. With a questionnaire regarding their demographic characteristics, the height and weight of the subjects were measured.

Two ml venous blood was obtained in the morning after the children had fasted overnight. Each serum separated by centrifugal separator was stored under -70°C . Blood glucose, total protein, albumin, triglyceride (TG), and total cholesterol concentration were measured by automatic blood analyzer (SP-4420, Arkray Co. Japan).

The evaluation on nutritional status of each child followed the previous study (Chang et al. 1998); blood glucose concentrations of 70 – 120mg/dl and < 70mg/dl were considered as normal and undernutrition, respectively. The standard levels of nutritional status of total protein and albumin were set to 6g/dl and 3.5g/dl. The concentration of TG of under 200mg/dl was considered as normal, 200 – 400mg/dl as bor-

derline hypertriglycemia, and over 400mg/dl as hypertriglycemia. The children having cholesterol level of under 200mg/dl were classified to normal, those of 200 – 240mg/dl to borderline hypercholesterolemia, and those of over 240mg/dl to hypercholesterolemia, respectively.

Mean and standard deviation (SD) for each measurement were calculated and significances were analyzed by t-statistics using SAS (Statistical Analysis System) program.

Results and Discussion

Mean serum glucose, total protein, albumin, total cholesterol, and TG concentrations in the different grade are shown in Table 1. The concentrations of total protein, albumin and TG were not significantly different; however, those of blood glucose and total cholesterol showed significant difference between grades. Frequency of the children in each category of blood glucose, total protein, and albumin levels are shown in Table 2. There were no children classified to hyperglycemia; however, 21.7% of 4th grade, 20.2% of 5th grade, and 16.3% of 6th grade children were hypoglycemia. Although the range of 70 – 120mg/dl of blood glucose are regarded normal, the children in the lower part of normal range (70 – 80 mg/dl) were 47.4% of 4th grade, 33.7% of 5th grade, 56.7% of 6th grade children, which give us considerable concern about undernutrition. Furthermore, remarkable number of these subjects had anemia and usually did not have breakfast as was already reported by Kim et al (1998); therefore, this inadequate nutritional status might affect physical and emotional development.

The concentration of serum total protein and albumin, biochemical nutritional status of protein, were 7.09g/dl and 4.37g/dl in 4th grade, 7.07g/dl and 4.29g/dl in 5th grade, 7.20g/dl and 4.37g/dl in 6th grade, respectively, which did not show significant difference between grades (Table 1). Only one child in 6th grade had protein deficiency as shown in Table 2. Ho-

Table 2. Frequency of the elementary school students in distribution of serum glucose, total protein, and albumin concentration

Grade	Glucose (mg/dl)					Total protein (g/dl)				Albumin (g/dl)		
	60-70 (low)		70-120 (normal)			120< (high)	≤ 6.0 (low)	6.0< (normal)		<3.5 (low)	3.5< (normal)	
	70-80	80-90	90-100	100-120			6.0-6.5	6.5<		3.5-4.0	4.0<	
4	17(21.7)	37(47.4)	23(29.5)	1(1.3)	0(0.0)	0(0.0)	0(0.0)	6(7.7)	72(92.3)	0(0.0)	10(12.8)	68(87.2)
5	18(20.2)	30(33.7)	24(27.0)	16(18.0)	1(1.1)	0(0.0)	0(0.0)	10(11.2)	79(88.8)	0(0.0)	19(21.3)	70(78.7)
6	23(16.3)	80(56.7)	36(25.5)	2(1.4)	0(0.0)	0(0.0)	1(0.7)	6(4.3)	134(95.0)	0(0.0)	9(6.4)	132(93.6)
Total	58(18.9)	147(47.7)	83(26.9)	19(6.2)	1(0.3)	0(0.0)	1(0.3)	22(7.1)	285(92.5)	0(0.0)	38(12.3)	270(87.7)

Values are number of subjects and those in the brackets are percentage of subjects

Table 3. Frequency of the elementary school students in distribution of serum total cholesterol and triglyceride concentration

Grade	Total cholesterol (mg/dl)				TG (mg/dl)				
	<200 (normal)			200-240 (borderline)	≤ 200 (normal)			200-399 (borderline)	400< (hypertriglyceremia)
	<160	160-180	180-200		160<	160-180	180-200		
4	52(66.7)	18(23.1)	8(10.3)	0(0.0)	65(84.4)	2(2.6)	1(1.3)	8(10.4)	1(1.3)
5	60(67.4)	25(28.1)	4(4.5)	0(0.0)	77(87.5)	3(3.4)	2(2.3)	6(6.8)	0(0.0)
6	114(81.4)	21(15.0)	5(3.6)	0(0.0)	133(94.3)	3(2.1)	1(0.7)	3(2.1)	1(0.7)
Total	226(73.6)	64(20.8)	17(5.5)	0(0.0)	275(89.9)	8(2.6)	4(1.3)	17(5.6)	2(0.7)

Values are number of subjects and those in the brackets are percentage of subjects

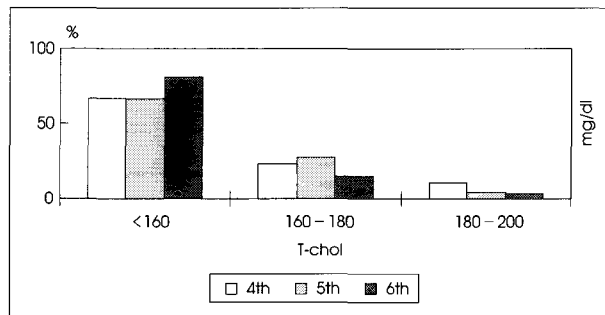


Fig. 1. Distribution of serum total cholesterol concentration in the elementary school students.

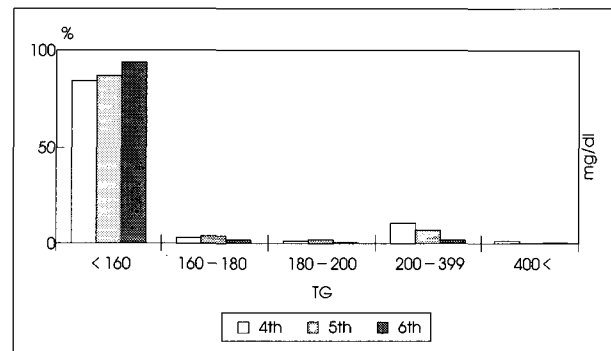


Fig. 2. Distribution of serum triglyceride concentration in the elementary school students.

wever, 7.7% of 4th grade, 11.2% of 5th grade, and 4.3% of 6th grade children were in 6.0 – 6.5g/dl closer to protein deficiency level. Also, 12.8% of 4th grade, 21.3% of 5th grade, and 6.4% of 6th grade children were in 3.5 – 4.0g/dl closer to albumin deficiency level. It is needed much effort to promote nutritional status of protein as well as blood glucose.

Mean serum TG and total cholesterol concentrations were shown in Table 1, and their distributions were shown in Fig. 1 and 2. Mean serum TG concentrations were 106.47mg/dl in 4th grade, 94.06mg/dl in 5th grade, and 88.22mg/dl in 6th grade (Table 1), which did not show significant difference ; however, had a tendency to decrease in proportion to grade. These TG levels in this study are similar to those in Kim et al's study (1992). The TG concentrations were normal in 88.3% of 4th grade, 93.2% of 5th grade, and 97.2% of 6th

grade children (Table 3). The proportions of borderline hypertriglyceremia (200 – 400mg/dl) were 10.4%, 6.8%, and 2.1% in 4th, 5th, and 6th grade, respectively. 1.3% of 4th and 0.7% of 6th grade showed hypertriglyceremia ; therefore, lower grade children were more serious than higher grade children. These observations are in good accord with previous study reporting there was increase in blood lipid concentration in the countries where dietary and lifestyle were becoming westernized (Couch et al. 2000). Inadequate dietary habit and lifestyle may increase the risk of the children developing a chronic condition, such as hyperlipidemia, atherosclerosis, hypertension, diabetes, or obesity, later in life.

Mean serum cholesterol concentrations were 151.86mg/dl, 147.04mg/dl, and 141.71mg/dl in 4th, 5th, and 6th, respecti-

vely (Table 1). The lower grade children revealed to have higher cholesterol levels, which showed statistically significant difference between grades. These serum cholesterol levels in this study were lower than those in previous study on school children in Daejeon City, which reported their mean serum cholesterol concentration had been 160.87mg/dl (Shin, Yoon 1999). On the contrary, the cholesterol levels in this study were higher than those in the study of Sim et al (1994) showing mean value was 185.7mg/dl. The standards of serum TG and cholesterol levels used here might be too high as they are adapted from foreign countries ; therefore, it is needed to develop new criteria which are suitable for Korean situation.

Summary and Conclusion

To investigate the biochemical nutritional status of children, three hundred and eight 4th, 5th, and 6th grade elementary school children were chosen and their blood glucose, serum total protein, albumin, TG, and total cholesterol concentrations were analyzed. The results of this study are summarized as follows.

1) Mean blood glucose concentration was 77.56mg/dl and 81.2% of children had normal blood glucose concentration. The average proportion of hypoglycemia was 18.8% and prevalence of hypoglycemia in 4th grade school children was highest (21.8%).

2) Mean serum total protein and albumin levels were 7.14g/dl and 4.35g/dl, respectively, and there was no significant difference between grades. All the subjects except only one were in normal range of total protein and albumin.

3) Mean serum TG and total cholesterol concentrations were 145.82mg/dl and 94.50mg/dl and there were same pattern that the concentrations decreased by grade. Especially, there was significant difference between grades in serum total cholesterol. It gives us considerable concern that 11.7% of 4th, 6.8% of 5th, and 2.8% of 6th grade school children have borderline hypertriglycemia or hypertriglycemia, risk factors of cardiovascular disease later in life.

In conclusion, about 19% of school children revealed to have hypoglycemia and the percentage of borderline hyperlipidemia or hyperlipidemia reached to nearly 12% in maximum. In other words, there was conflict phenomenon that undernutrition and overnutrition existed together. Therefore, there is need to develop discriminating nutritional feeding program, school feeding counseling, and education program

to cover the children of under- or over- nutritional status.

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