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A Study on Weight Control Program for 4th and 5th Grade Obese Children in Elementary School

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ABSTRACT

This study examined the proper roles of dietitian and nurse-teacher in the weight control program (WCP) in schools and the effects of the WCP on subjects with respect to anthropometric measurements, nutrition knowledge, dietary attitude, and behavior changes. The program consisted of six sessions of nutrition education and frequent face-to-face nutrition counseling. Subjects were 22 obese children in the 4th and 5th grade who underwent counseling and 18 obese children in another school who served as a control group. After two months of WCP, obesity index such as relative body weight (RBW, from 135.7 to 132.5), tricep skinfold thickness (TSFT, from 34.9 to 32.8 mm), and body fat content (from 32.0 to 29.8%) had decreased significantly in the experimental group, while the control group showed no significant differences in these indices. The reductions in obesity indices were maintained in the experimental group except for fat content (32.6%), which returned to its original value within six months. The control group significantly increased fat content in the same period (from 31.2% to 36.2%). Both groups decreased RBW, TSFT, and fat content while midarm circumference and waist/hip ratio remained the same after one year. Subjects' nutrition knowledge was improved with average test scores from 15.1 to 16.7 while nutrition attitude and behavior test scores remained unchanged suggesting that behavior modification may require more time than knowledge acquirement. These results suggest that proper nutrition counseling can initiate weight reduction. However, the maintenance of controlled weight requires changes in attitude and behavior which have not been achieved by the present WCP. The role of school dietitian for WCP in this study was limited to assisting the nurse-teacher in nutrition education. Expansion of dietitian's role in nutrition education and counseling is needed.

KEY WORDS : weight control program · obese children · nutrition education · obesity index.

INTRODUCTION

The childhood obesity rate in Korea has increased dramatically during the past 18 years.[1-6] The rate of obesity in 5th grade schoolboys is reported to be 18.2 – 31.2%.[6,7] Obesity in childhood has several implications in childrens lives such as lack of self-confidence, poor achievement in school work, and future adult health problems such as diabetes and cadiovascular diseases.[7-9,12-14] Several recent studies have indicated that in obese children having hyperlipidemia, hypercholesterolemia and fatty liver, these symptoms could be relieved by weight reduction.[14-16] Thus, prior to the clinical treatment of obese children, the development of a proper intervention program in a school setting is urgent to prevent the increase of obesity. Previous reports have shown that nutrition education was effective in reducing the severity of obese state and pathologic problems in obese children.[14-16] However, the authors failed to follow up on how long effects would remain after the end of their education program and also failed to report practical problems of their program.

The most effective nutrition education programs to change dietary practices and daily activities have been based on behavior modification.[17-19] Since primary school children are in a rapid growth period, intervention itself should not interfere with regular growth, and the reduction of obesity needs to be maintained without rebound. To treat obesity, a reduction in caloric intake and an increase in caloric expenditure by physical activity should be properly applied. Weight control with sensible and tolerable eating and activity habits is recommended.[20,21]

Gillspie and Yarbrough developed a model that illustrates many factors involved in how people respond to nutrition education programs.[22] This model accepts individual differences and focuses on a custom-tailored approach to nutrition education. It is based on the acceptance that different people respond differently to the same message and that the same individual responds differently to the different messages.[22] It appears to be most applicable to school weight control programs (WCP) where school children are well-exposed to authority figures such as classroom teacher, nurse-teacher, dietitian. All of these people can help to intervene in the weight gain of obese children.

In this study, the weight control program for obese children focused on the cooperative efforts of school au-

thority figures, especially the nurse-teacher and dietitian. Especially, extension of the school dietitian's role to dietary counseling was tried and evaluated. Since most of previous work focused on the outcomes or results of nutrition education and lacked an evaluation of the program itself and follow-up outcomes of subjects, the process of program was evaluated, and the acceptance and effects of nutrition education were evaluated in cognitive (knowledge), affective (attitude) and behavioral changes of children in this study. Anthropometric measurements were made during a one-year period and obesity indices were examined by comparing the values of the experimental group with those of the counterpart control group. These results should show the applicability of WCP in primary schools and also reveal the barriers to be solved for a better and more practical program.

EXPERIMENTAL METHOD AND SUBJECTS

1. Subjects

Fourth and fifth-grade obese children for control (n=18) and experimental (n=22) groups were separatety selected from two different schools that were both located in middle-size cities in Kyunggi province, Pyungchon and Sanbon. Both cities share similar environmental conditions, thus providing similar socioeconomic status of participating children. The subjects of both groups were greater than 20% over-weight with respect to standard weight for their height.

2. Nutrition education

Children in experimental group received nutrition education as follows : 1) Six nutrition knowledge-oriented lectures with discussion concentrated on calorie concepts and selection of low-calorie foods. Lectures were given by a nurse-teacher and the author of this study, utilizing films, pictures, and food models. 2) Individual counseling with a dietitian for daily dietary practice. Subjects were allowed to mark their favorite foods and asked to evaluate their own food habits and also to keep food-intake diaries. Afterwards the dietitian counseled the children with these materials. Low-calorie cooking classes were held twice with the guidance of a dietitian. 3) Exercise and physical activity were emphasized but no strictly controlled progam was given. Classroom teachers checked children's daily activity to encourage physical fitness. 4) Leaflets were sent to children's parents concerning nutrition knowledge, the cause of obesity, complications with obesity, and cooking methods for low-calorie diets. Frequent telephone interviews were given and parents were encouraged to participate in 'obesity class for parents of obese children' that was held in the education center of Suwon city hall.

3. Evaluation methods

1) Changes in nutrition knowledge, attitude, and behavior were evaluated by self-administered questionnaire which was given to individual children four times, during pre-education, and post-education, and six months and one year after the program. Questionnaires were formulated on the basis of previous studies[15][23][24] and personal communications with other researchers. A general-knowledge test consisted of nutrient function (5 items), food groups (5 items), general nutrition (10 items), and obesity-related knowledge (5 items). Each correct answer was given 1 point with a maximum score of 25.

The nutrition attitude test consisted of items on the children's willingness to take new foods, their respect to other's guidance, motivation for dietary behavior modifications, and desire to acquire nutrition knowledge. Subjects were asked to answer questions using the 5-point Likert-scale (1=very negative, 5=very positive) with a maximum score of 75. The food habit test had 10 items on general healthy food intake and 5 items on the control of obesity-related behavior. Each item had three possible answers, 1=a bad, 2=fair 3=good with a maximum score of 45.

2) Dietary intake evaluations were made at the beginning of the study by identifying 'like-food' of individual children and children were asked to reduce their intake of red (fatty meat and high-fat food) and black (high simple sugar contained food) colored group foods. Food-intake diaries were required to be written once a week, but the children entries were too incomplete to properly collect data.

3) Evaluation on the WCP by subjects was made at the end of the 1-year program concerning various aspects of the program. Items on acquisition of nutrition knowledge, supporters' interest and help, improvement in diet behavior and exercise were evaluated by 5-point Likert scale with 1=least satisfactory, 5=most satisfactory.

4) Anthropometric measurements, including body weight, height, tricep skinfold thickness (TSFT), mid-arm, waist, and hip circumferences were made. Fat contents were estimated by bioelectrical impedence analyzer (Gilwoo Trading). Body weight and height were measured to on accuracy of 0.1 kg and 0.1 cm, respectively, by standing on a digital electronic scale (Dongsin Co.) without shoes. TSFT was measured at the midpoint of the back of upprer

left arm by Lange Caliper (USA). Measurement was made three times and the average value was taken to an accuracy of 1 mm. Subscapular skinfold thickness of obese children was found to be very difficult to measure. All of the other circumferences were measured with plastic tape following the description given in the literature.[25]

4. Statistical analysis

The data were presented as mean±SD. The effect of WCP was evaluated by paired t-Test comparing the values of two time points. The difference in anthropometric measurements between experiment and control groups were analyzed by t-Test. All of the analyses were processed using the SPSS 7.5 for Windows.[26]

RESULTS AND DISCUSSION

1. Demographic profile and family background of the subjects

The average age at the beginning of the study was 9.9 and 10.7 years for the control and experimental group, respectively. Previous studies reported that 11-year-old boy groups had the highest prevalence of obesity, with a range of 1.12-31.2% obesity in the 5th grade depending upon the obesity index and environment of examined subjects.[1-7][10][15][27] The sex and grade of subjects in each group are shown in Table 1, indicating slight differences between the two groups. In this study both schools did not show a high prevalence of obesity (less than 5%) thus it was not possible to select age, sex, and grade matched controls. Both groups shared similar family backgrounds, as less than half (33-45%) of their mothers had jobs, 66-70% of children had obese parents on either side of the family, and 10-17% had obese siblings.

2. Effect on the nutrition knowledge

For nutrition education the communication model suggested by Gillespie and Yarbrough[22] was adopted. The model includes three major components : inputs, intervening process, and outcomes (Fig. 1). Communicator inputs (the contents of WCP in this study) were mainly planned by the researcher as described in experimental method above. Receiver (children) inputs were documented as the predispositions of subjects prior to program implementation by evaluating the questionnaires on nutrition knowledge, attitude, and dietary habit. During the intervening process (nutrition education activities) the nurse-teacher and dietitian utilized this informations in counseling the obese children. As shown in Table 2, the children in this study had good knowledge (15.1 point, over 60% of correct answer) compared to other studies.[15][23][24] In studies by Kim and You,[24] 5th grade children made 42% of correct, by Lim and Kyoung,[23] 5 and 6th grade children 31-44%, and by Kim and Kim[15] 4 and 5th grade children made 58% correct on nutrition test. Reference materials for education were abundant in primary school as films, books, pamphlets, leaflets. But food models were not available in school. Audiovisual aids were very useful but the diversity of content was limited. It appears necessary to organize materials for at least two levels, for lower grades (1-3) and higher grades (4-6) and to convey basic concepts with practical activity descriptions. In addition to the lectures on nutrition knowledge, face-to-face guidance by a dietitian was made. Positive effect of the WCP program on improvement of knowledge (from score 15.1 to 16.7) was evident immediately as shown in Table 2. The improvement effect (17.0 point) remained up to six months after education.

Knowledge on nutrient function and obesity contributed to this improvement (Table 2). All of the nutrition education studies consistently showed significant improvement on knowledge with much greater inprovement in some studies,[15][23] as test scores increased from 20.5/35 to 28.4/35 in the study by Kim and Kim[15] and from 6.3-10.3/20 to 13.6-16.7/20 by Lim and Kyoung[23] who

Table 1. Demographic profiles of subjects

		Experimental group n (%)	Control group n (%)
Sex	Male	13 (59.1)	10 (55.6)
	Female	9 (40.9)	8 (44.4)
Grade	4th	10 (45.5)	5 (27.8)
	5th	12 (54.5)	13 (72.2)
Age	9 year	7 (31.8)	0 (0.0)
	10 year	11 (50.0)	6 (33.3)
	11 year	4 (18.2)	12 (66.7)
	Total	22 (100.0)	18 (100.0)

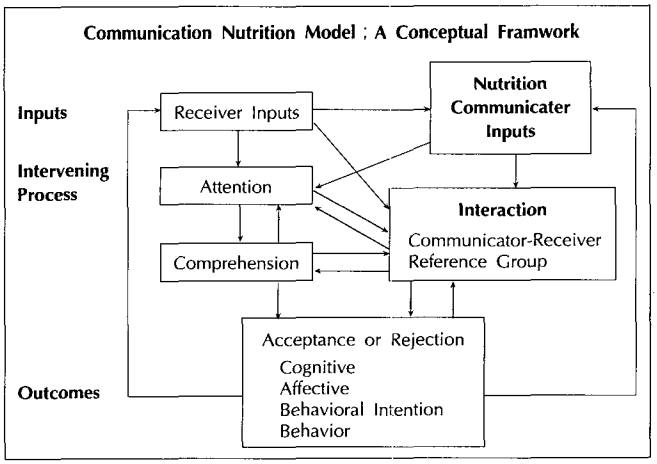

Fig. 1. Nutrition communication model.

Table 2. Effect of WCP on nutrition knowledge (NK) of obese children

	Pre-program	Post-program	After 6 mon.
NK_Total	15.1±2.8	16.7±3.2*	17.0±2.4
Food group	3.6±1.2	3.6±1.9	4.0±1.5*
Nutr func	2.3±0.9	2.8±1.3*	2.6±1.3
Nutr general	6.9±1.3	7.2±1.5	7.4±1.3
Nutr obese	3.1±1.0	3.4±0.8*	3.6±0.9

Data=mean±SD with n=22
*$p<0.05$, by paired t-Test between two time (pre : post and post : after 6 mon.) measurements

Table 3. Effect of WCP on nutrition attitude and behavior of obese children

	Pre-program	Post-program	After 6 mon.
Attitude_Total	50.8±6.0	52.7±5.2	50.7±9.5
Flexibility	16.8±2.9	17.3±3.4	17.0±4.2
Respect	4.9±1.9	5.2±1.6	6.3±2.8
Motivation	14.4±2.2	15.6±1.9*	13.9±3.8
Knowledge	14.5±2.9	14.6±2.9	14.2±2.7
Behavior Total	32.8±2.8	33.9±8.6	33.2±4.6
Diet general	22.1±2.5	22.0±3.9	22.3±3.3
Diet_obese	10.7±1.6	11.1±1.3	10.9±1.5

Data=mean±SD with n=22
*$p<0.05$, by paired t-Test between two time (pre : post and post : after 6 mon.) measurements.

gave follow-up education for obese and unbalanced-diet children. The difference in the degree of improvement might indicate either the intensity and success of neutrition education or differences in the predisposition of subjects in different experimental studies. The evaluation tools (tests) utilized in previous studies also need to be examined for their property of question items.

3. Effect on attitude and behavior

Cognitive acceptance (knowledge) usually precedes affective acceptance (attitude) but not always in the same direction. Improved knowledge can not prove that subjects really internalize the message from communicator inputs. In the present study, no significant difference was observed in total attitude scores (Table 3). The motivation to change dietary habit was improved (from 14.3 to 15.6) immediately after education, but six month later this score was back to the previous score.

This result suggests that communicator inputs are needed to be reinforced to maintain attitude changes for a longer period. The behavior scores in Table 3 show that there was no change in dietary habit. A previous study also reported no improvement (from 12.2/20 to 12.7/20) in behavior immediately after education.[23] On the other hand a study by Kim and Kim[15] showed a significant improvement in obesity-related attitude (from 60.7/90 to 72.2/90) and food habit (from 23.5/34 to 26.8/34) after nutrition education. The correlation between knowledge, attitude, and behavior was not consistent among studies,[15][23][28] and some reports have suggested that the tools (questionnaire) utilized may also contribute to the observed discrepancies. The outcome of behavior acceptance is the most difficult to measure and the most disappointing result. Behaviour acceptance should also be measured after a period of time to allow application of obtained inputs, which is essential especially in weight control programs.

4. Dietary intake

As mentioned above, quantifying the dietary intake records prepared by children was not possible even with the individual counseling of a dietitian. Except for a few children, most subjects could not list all the food items and amounts they had eaten. Instead, food items they liked were checked by marking the signal food group (green, yellow, red, black). This does not give any numerical data related to nutrient intake but was useful for the intervening process to remind them to reduce or to increase specific-colored food groups. Children also well realized the red (stop) or black-colored foods needed to be reduced. Previous nutrition education studies showed changes in caloric and nutrient intake with reduction of caloric intake in the range of 30%. Improvement of the pathologic symptoms accompanying obesity, including fatty liver an hyperlipidemia, were also observed with reduced caloric intake.

However, it would be either erroneous or too much of a burden to analyze 24-hour dierary-intake records of individual children. As a cost-effective evaluation tool in the present school environment, a simple 'like-dislike food list'[29] that can verify the caloric intake change is needed.

5. Changes in anthropometric measurements

The nurse-teacher was familiar with the essential techniques involved in height and weight measurements. Caliper and BEI analyzer were not available in schools. Children were interested in the changes of measurement, which contributed to their motivation to reduce obesity. The changes observed in the one year period are shown in Table 4. During the two-month WCP period, children did not gain body weight while height was increased. As a result, RBW significantly ($p<0.01$) decreased from 135.7 to 132.5, while the control group showed increased body weight with RBW remaining the same (138 - 137). This indicates that there was an immediate effect of WCP on weight control. Six months of after program completion, RBW was maintained at 132.6 in the experimental

group and decreased from 136.5 to 134.9. in the control group. After one year, both groups decreased in RBW (129-130). A previous report by You and Na[27] showed obesity (over 97% of body weight for height with 50% as average for Korean children by Korean Pediatrics Assoc.) rates of 0.85, 1.12, and 0.98% in 10-, 11-, and 12-year olds, respectively, in 1985 and Moon *et al.*[2] reported in 1992 that the severity of obesity (20% over standard weight) peaked (15.8%) at the age of 11 in boys. Usins a different obesity index (30% over standard weight), boys showed the highest prevalence of obesity at the age of 12, [23] then obesity subsided with a rapid growth (4-5 cm/6 month) in height. Thus, it is difficult to claim the reduction in RBW by WCP. The other measures, MAC and WHR, did not change during the 1-year period in both groups. Tricep skinfold thickness significantly decreased without changes in MAC indicating that the fat in this area had reduced and might have contributed to the energy needed for the growth spurt observed in this age group. Estimated fat content (%), shown in Table 4, indicates that children in the experimental group regained their initial body fat within six month after WCP. This proved the rebound tendency of controlled body weight to return to its initial state.

Both groups showed significant decreases in fat content after one year. The obesity indices such BMI, Broca Index, and WHR were computed following the formulae in the literature and are listed in Table 4. BMI and WHR seemed to be stable throughout the period while Broca, RBW, and TSFT appeared to decline especially in the experimental group (Fig. 2). Many studies have utilized different obesity indices and so it is difficult to confirm the prevalence rate and effects of various treatments. The standard values for Korean child development given by the Korean Pediatric Association (1985) are too old, producing an extremely high rate of children obesity. It is urgent to have a proper index and cut-off point for obese Korean children. Except for Broca, which is not appropriate for children, all the other indices confirm that children evidently remained in the obese state, requiring further monitoring.

6. General evaluation by the subjects on the program

Evaluation of the WCP by participating children is summarized in Table 5. Children responded that their kno-

Table 4. Anthropometric measurements of subjects and obesity index over 1 year period¶

		Pre-program	Post-program	After 6 month	After 1 year
Hgt	Control	143.1±8.0	145.2±7.9	146.7±8.5	150.2±8.8**
	Expt	143.7±5.3	144.6±5.4	147.5±5.9	152.2±6.5**
Wgt	Control	53.4±8.8	55.3±8.9*	56.4±8.7	58.4±9.4*
	Expt	53.3±6.9	53.1±6.8	56.7±9.8**	60.5±8.2**
RBW	Control	138.3±9.6	136.5±9.1	134.9±11.2	130.0±12.4**
	Expt	135.7±10.2	132.5±10.5**	132.6±12.6	128.9±9.2*
Waist	Control	81.2±9.3	82.9±7.3	81.6±6.4	81.3±5.9
	Expt	82.1±6.2	80.2±5.6	81.8±6.4	83.3±6.1
Hip	Control	92.3±5.6	91.6±6.2	92.8±4.7	88.9±6.0
	Expt	91.5±4.3	90.6±4.2	92.6±4.3	92.6±5.4
WHR	Control	0.88±0.04	0.90±0.05	0.87±0.04	0.90±0.04
	Expt	0.90±0.05	0.89±0.05	0.88±0.06	0.90±0.06
MAC	Control	28.5±3.6	-	29.6±2.4	29.4±2.6
	Expt	28.7±2.1	28.3±1.8	29.9±2.5	29.8±2.4
Tricep	Control	35.2±3.5	-	32.8±4.4*	28.6±5.1**
	Expt	34.9±4.8	32.8±4.2**	32.3±6.8	30.1±3.2*
Fat(%)	Control	31.2±4.7	-	36.2±6.3**	30.9±7.8**
	Expt	32.0±4.3	29.8±4.4**	32.6±4.9**	31.1±5.0*
BMI	Control	25.9±2.08	26.4±2.00	26.1±3.06	25.8±2.49
	Expt	25.7±2.14	25.3±2.11**	26.6±4.42	26.0±1.97
Broca	Control	123.3±11.2	121.6±10.4	121.5±15.8	115.9±12.8
	Expt	120.6±10.5	117.6±10.5**	121.3±23.4	113.9±9.2

Data=mean±SD with control group (n=18), experimental group (n=22-18)
RBW : [Body wgt (kg)/(Hgt cm - 100)×0.9]×100
Tricep (TSFT) : Tricep Skinfold Thickness (mm)
Broca : [Body wgt (kg)/(Hgt cm - 100)×0.9]×100, If Hgt≥150 cm
[Body wgt (kg)/(Hgt cm - 100)]×100, If Hgt<150 cm
Hgt : height , Wgt : weight
WHR : Waist circumference (cm)/Hip circumference (cm)
BMI : Body wgt (kg)/(Hgt m)^2
*$p<0.05$, $p<0.01$ by paired t-Test between immediate two time measurements.
¶ All the anthropometric measurements and obesity indices in control and experimental groups at the same time point were not significantly different.

wledge related to high caloric food and caloric concepts on activity and exercise had improved. This is consistent with the results of the nutrition knowledge test (Table 2).

The most important supporter for the children's weight control was their own mothers (4.1±0.9) and then in the order of nurse-teacher, school dietitian, classroom teacher, and friends. They acknowledged that their activity had increased and to a lesser degree their high caloric food intake had been reduced. In general, children replied that they found the program beneficial and were apt to recommend the program to others.

7. Overall evaluation of the weight control program

The overall process and subsystems related to the intervention program was examined. As Fig. 3 modified from Gillespie[30] illustrates, there are two major environments outside of school, community and home, that interact with the WCP in school. In Kyunggi province, there was a policy to reduce obesity in primary school so it was easy to settle WCP in this study, while some of the principals in Seoul were very reluctant to accept the program operated in their schools. WCP as an on-going

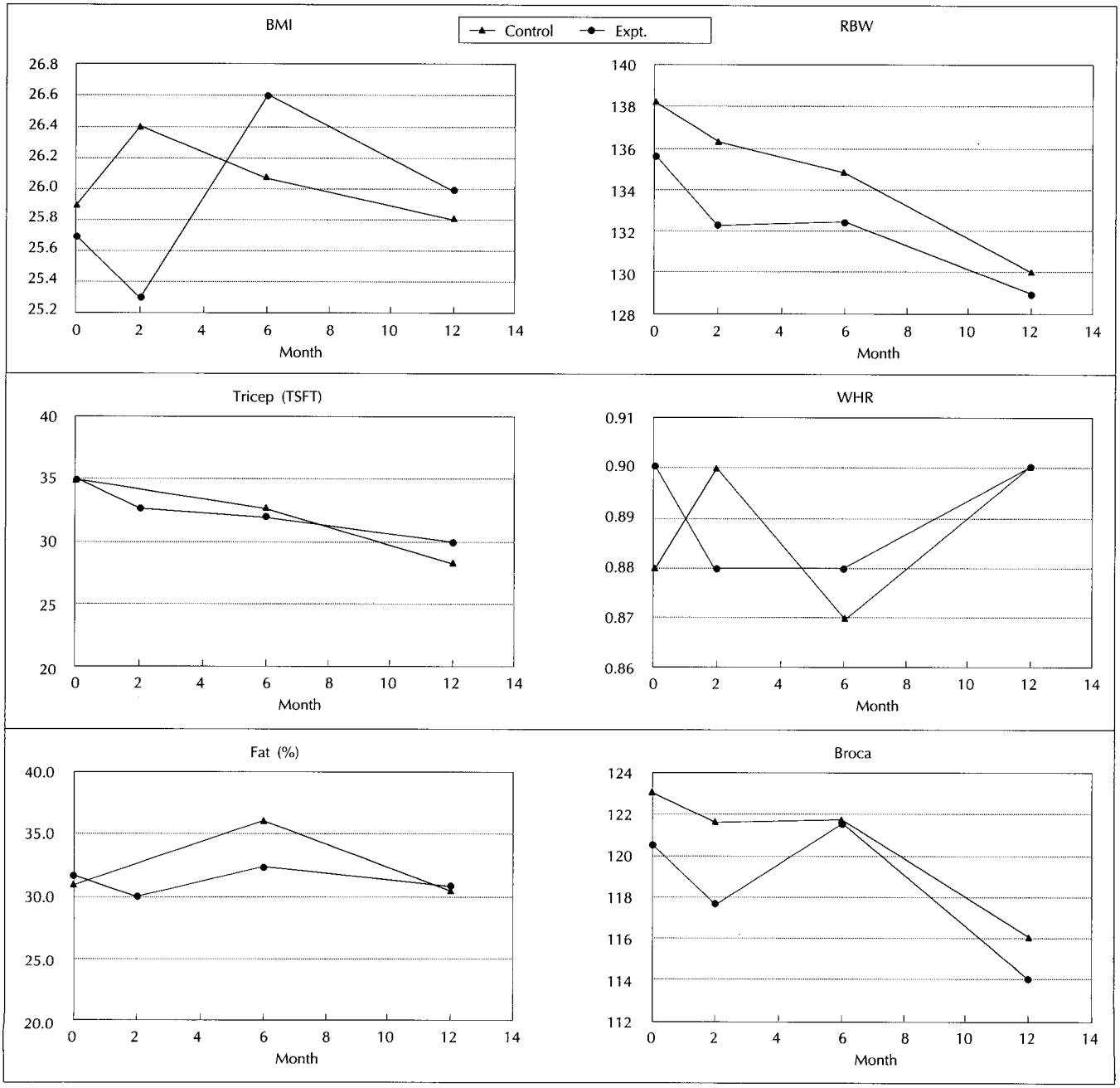

Fig. 2. Comparison of obesity index See Table 4 for the significant difference between two time point measurements.

Table 5. General evaluation on WCP by subjects

	Items	Mean±SD	Average
Knowledge	Food group	3.6±1.1	4.0±0.7
	Nutr. function	3.8±1.0	
	High calorie food	4.2±0.6	
	Activity, exercise	4.5±0.5	
Supporters interest	Mother	4.1±0.7	3.4±0.9
	Classrm teacher	2.8±1.0	
	Nurse-teacher	3.4±1.0	
	Dietitian	3.3±1.4	
	Friends	3.0±1.1	
Supporters help	Mother	4.1±0.9	3.4±0.9
	Classrm teacher	2.7±1.1	
	Nurse-teacher	3.9±0.9	
	Dietitian	3.0±1.2	
	Friends	2.7±1.2	
Improvement	Reduction in high caloric food	3.7±1.1	3.9±0.9
	Increase exercise	4.2±0.9	
	Daily activity	4.4±0.7	
	Attention to wgt control	3.4±1.2	
Approvement of WCP	Reduction in body wgt	3.4±1.2	3.5±1.1
	Beneficial acknowledge	3.6±1.3	
	Recommend to others	3.4±1.3	

Data=mean±SD with 1=very negative, 5=very positive

schoolwide program needs the approval of school principals and this process should be easily solved if the education superintendent in each district has an interest in health education and makes a policy related to obesity control. As community influences the school and home (providing health policy, facilities for health and obesity class, advertisement etc.), it is recommended that the Korean Association of Dietitians and the Korean Society of Nutrition need to make efforts to influence policy makers of the community. The children in the program responded that their own mothers were the most important supporters for weight control and most subjects had at least one obese family member, therefore it is important to educate mothers of obese children. It was found that although the nurse-teachers were limited in nutrition knowledge, the responsibility of obesity control fell upon her and that the school dietitian who is an expert in nutrition education was not allowed to teach the children. It is urgent that the role of dietitian be expanded to nutrition education and dietary counseling.

The greatest barrier to implementing WCP in schools was the time limitation of children, and not the edu-

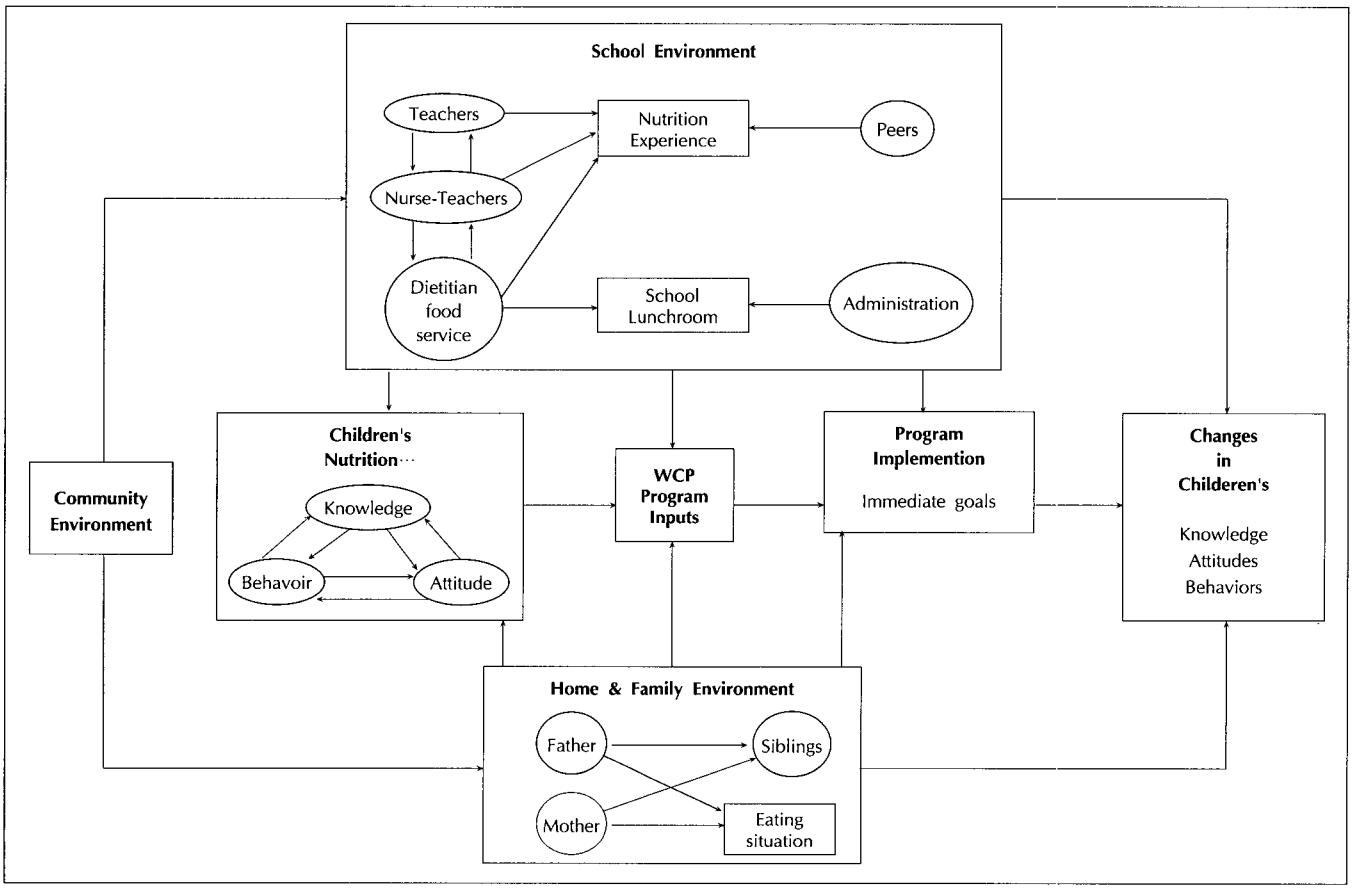

Fig. 3. Framework for studying WCP in school.

cation providers. Since most of the children had extracurricular activities and study classes after school it was very difficult to make a regular class for the weight control program. Tutoring for retarded curricula and extracurricular classes are highly recommended to be provided inside of school, thus to open special classes for obese children as an extracurricular activity is easier than now. Evaluation methods for the changes after WCP need to be re-evaluated. Since previous researchers developed their own evaluation methods, it is difficult to compare the results of nutrition education. For this purpose, researchers in the area should cooperate to develop proper tools that can be efficiently and consistently utilized in similar nutrition programs. The framework shown in Fig. 3 indicates that nutrition education is a multi-faceted field that needs cooperative planning, implementation, and evaluation. This dynamic model can be adjusted by careful consideration and heartful support from those peoples closest to the obese children for the success of school weight control programs.

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