

Nutritional Counseling for Obese Children with Obesity-Related Metabolic Abnormalities in Korea

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Child obesity has become a significant health issue in Korea. Prevalence of obesity in school-age children in Korea has been alarmingly rising since 2008. Prevalence of obesity among infants and preschool-age children in Korea has doubled since 2008. Obese children may develop serious health complications. Before nutritional counseling is pursued, several points should be initially considered. The points are modifiable risk factors, assessment for child obesity, and principles of treatment. Motivational interviewing and a multidisciplinary team approach are key principles to consider in managing child obesity effectively in the short-term as well as long-term. Nutritional counseling begins with maintaining a daily log of food and drink intake, which could possibly be causing obesity in a child. Several effective tools for nutritional counseling in practice are the Traffic Light Diet plan, MyPlate, Food Balance Wheel, and 'Food Exchange Table'. Detailed nutritional counseling supported by a qualified dietitian is an art of medicine enabling insulin therapy and hypoglycemic agents to effectively manage diabetes mellitus in obese children.

Key Words: Obesity, Child, Prevalence, Nutrition, Counseling

INTRODUCTION

Obesity is a state of excessive fat accumulation in a body. Obesity is diagnosed when body mass index (kg/m^2) is more than 95 percentile per sex and age or the percentage of actual weight compared to standard weight for height more than 120% [1]. Body mass index is also referred to as BMI. The prevalence of childhood obesity in United States (US) from 2 to 19 years old was 16.9% in 2011-2012 [2]. According to

estimates from the World Health Organization's Childhood Obesity Surveillance Initiative, approximately 1 in 3 children in the European Union age 6-9 were overweight and obese in 2010 [3]. The prevalence of obesity in school-age children age 7 to 18 in Korea has been steadily rising from 8.36% in 2008 to 14.3% in 2016 (Fig. 1) [4]. Prevalence of obesity in infants and preschool-age children in Korea was 2.8% in 2015, double the rate compared to 1.4% in 2008 (Fig. 2) [5]. Obese children may develop serious health

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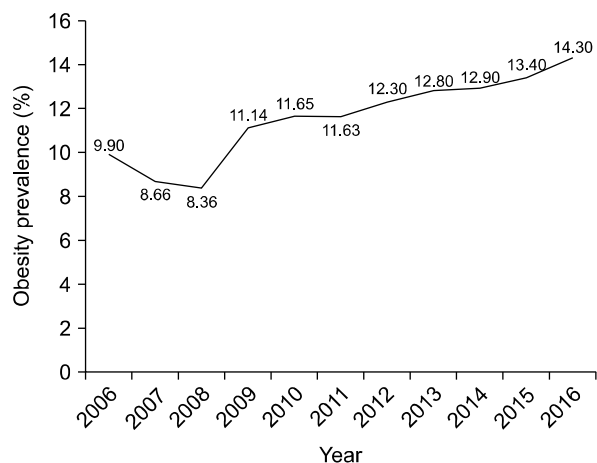


Fig. 1. Obesity prevalence of school-age children in Korea. Obesity prevalence of school-age children in Korea is steadily rising from 8.4% in 2008 to 14.3% in 2016 [4].

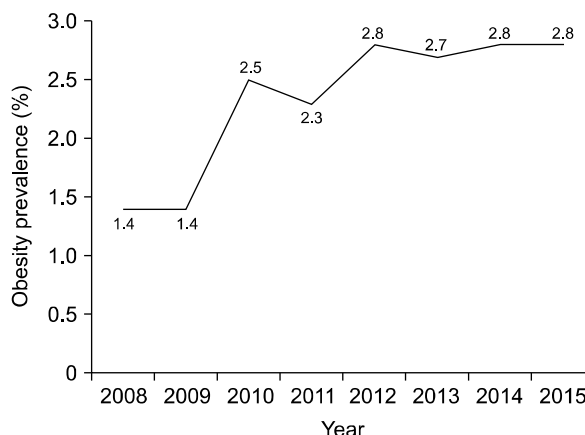


Fig. 2. Obesity prevalence of preschool-age children in Korea. Obesity prevalence of infants and preschool-age children in Korea was 2.8% in 2015, double the rate compared to 1.4% in 2008 [5].

complications including hypertension, insulin resistance, non-alcoholic fatty liver disease, and metabolic syndrome [6]. Obesity also progresses to non-insulin dependent diabetes mellitus (type 2 DM) and liver disease such as liver cirrhosis in the long-term prognosis [6]. In this article, the author reviews the benefits of nutritional counseling for obese children with obesity-related metabolic abnormalities.

BEFORE NUTRITIONAL COUNSELING

Modifiable risk factors

Before initiating nutritional counseling for obesity, the physician should collect and analyze information pertinent to risk factors that caused obesity in a patient. When health care providers effectively motivate obese children and their parents to modify risk factors, children may gradually recover from obesity. Modifiable risk factors for obesity are diet, exercise, lifestyle, psychological issues and family and school environment surrounding obese children [7]. Health care providers must induce obese children and their parents to modify unhealthy habits linked with diet, exercise and lifestyle. If a child has serious psychologic issues causing obesity, the child and his or her parents must be counseled by a pediatric psychiatrist. Parental obesity must also be

managed, because it is a major risk factor of child obesity [8]. Schools must provide healthy lunches, beverages and exercise periods to promote a healthy environment for children [9,10].

Assessment of child obesity

In addition to maintaining a daily log of food and drink intake for modifiable risk factors of an obese child, health care providers must assess a child's medication history including use of corticosteroid and symptoms suggesting an organic disease. Health care providers need to collect anthropometric data and conduct a physical examination of a child [7]. Obese children tend to be in a higher percentile of height. If an obese child has a lower height percentile, some endocrine or genetic disorders may be suspected. The physical examination of a child should assess sexual maturation rate, neck pigmentation (acanthosis nigricans) suggesting insulin resistance, and orthopedic issues in the lower extremities. Laboratory parameters for an obese child are necessary for evaluation of insulin resistance, hepatitis associated with fatty liver and dyslipidemia [7,11]. Parameters are fasting glucose, fasting insulin, hemoglobin A_{1c}, aspartate aminotransferase, alanine aminotransferase, fasting lipid battery including total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglyceride in

the serum [11]. X-ray for bone age and liver ultrasonography for fatty liver evaluation.

In obese children, the presence of metabolic syndrome can be identified from clinical and laboratory findings. When an obese child has multiple risk factors for cardiovascular disease, metabolic syndrome may be suspected. Although there is no global standard for the diagnosis of metabolic syndrome, diagnostic criteria include obesity, blood pressure, triglyceride, high density lipoprotein, fasting glucose, and fasting insulin [12-15].

Principles of treatment for child obesity

The principle treatment for child obesity is changing unhealthy behavior associated with diet, exercise, and life style, through motivational interviewing [16]. Treatment should be based on a family-based approach that consists of “parent-child” and “parent-only” treatment [16,17]. Behavior modification can be successfully achieved by specifying target behavior, self-monitoring, goal setting, stimulus control, and promotion of self-efficacy and self-management skills. However, treatment of child obesity is difficult because a child must change fixed, long-term unhealthy behavior that is the cause of

obesity. School-based, community-participating, and hospital-participating strategies are also necessary for effective treatment of child obesity. Therefore, a multi-disciplinary team approach is critical [6]. The team should include obesity professionals, school and local education boards, preventive medicine, public health offices, media, and authorities for an obesity plan (Fig. 3). Obesity professionals are physicians, psychiatrists, dietitians, physical activity (PA) trainers, coordinators and clinical psychologists.

When community-based lifestyle programs are planned, barriers and facilitators of programs should be considered [18]. Especially, barriers such as stigma associated with obesity and accessibility to the site, where the program will be conducted, are critical to success of the program.

NUTRITIONAL COUNSELING FOR CHILD OBESITY

Maintaining a log of daily food and drink intake

The information about unhealthy diet habits should be collected from obese children and their parents [19-21]. Unhealthy diet habits consist of irregular meals or skipping meals, eating too much, refusing to eat vegetables, drinking too many beverages containing sugar, eating too much high trans-fat foods, candy and chocolate, eating before sleeping at night, and so forth. The frequency of the above mentioned unhealthy diet habits is another critical point in maintaining a daily log of food and drink intake. Dietitians can estimate daily calorie intake of obese children using a diet diary or 24 hours recall method [22,23].

Dietary reference intake of energy has been well established by the Institute of Medicine of National Academics in the US (Table 1) [24]. Age groups include 0-36 months, 3-8 years and 9-18 years. The 0-36-month group is classified into four subgroups for calculation of estimated energy requirement (EER). The 3-8 years group has different equations for EER according to sex. The 9-18 years group also has a different equation for EER according to sex. The types of PA included in the equation are sedentary, low active, active, and very active. Dietary refer-

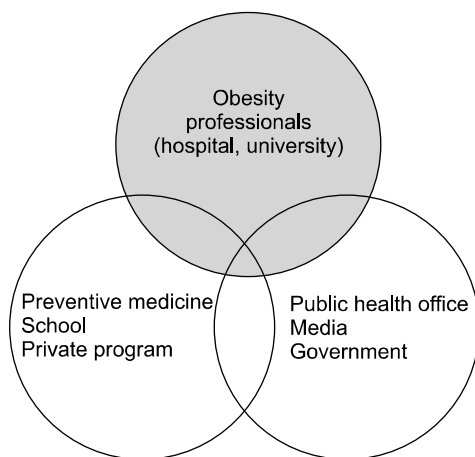


Fig. 3. Multidisciplinary team for the treatment of obese children. The team includes obesity professionals, school and local education board, preventive medicine, public health office, media, and authorities for an obesity plan. Obesity professionals are physician, psychiatrist, dietitian, physical activity trainer, coordinator, and clinical psychologist.

Table 1. Dietary Reference Intake of Energy in Childhood

Age	Subgroup	Estimated energy requirements (EER, kcal)
0-36 mo	0-3 mo	$(89 \times \text{weight [kg]} - 100) + 175 \text{ kcal}$
	4-6 mo	$(89 \times \text{weight [kg]} - 100) + 56 \text{ kcal}$
	7-12 mo	$(89 \times \text{weight [kg]} - 100) + 22 \text{ kcal}$
	13-36 mo	$(89 \times \text{weight [kg]} - 100) + 20 \text{ kcal}$
3-8 y	Boys	$88.5 - (61.9 \times \text{age [y]}) + \text{PA} \times (26.7 \times \text{weight [kg]} + 903 \times \text{height [m]}) + 20 \text{ kcal}$
	Girls	$135.3 - (30.8 \times \text{age [y]}) + \text{PA} \times (10.0 \times \text{weight [kg]} + 934 \times \text{height [m]}) + 20 \text{ kcal}$
9-18 y	Boys	$88.5 - (61.9 \times \text{age [y]}) + \text{PA} \times (26.7 \times \text{weight [kg]} + 903 \times \text{height [m]}) + 25 \text{ kcal}$
	Girls	$135.3 - (30.8 \times \text{age [y]}) + \text{PA} \times (10.0 \times \text{weight [kg]} + 934 \times \text{height [m]}) + 25 \text{ kcal}$

Physical activity [PA] (boys)=1 (sedentary), 1.13 (low active), 1.26 (active), 1.42 (very active); PA (girls)=1 (sedentary), 1.16 (low active), 1.31 (active), 1.56 (very active).

Modified from Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids [24].

ence intake of calories in Korean children is simplified in Table 2 [25]. The guideline was established by the Ministry of Health and Welfare and The Korean Nutrition Society. Dietitians can recommend calorie intake appropriate for each obese child, according to the dietary reference intake established by their home country.

Traffic Light Diet

The Traffic Light Diet is a useful method of nutritional counseling for obese children [11]. It is a simple and easy method to understand. The Traffic Light Diet consists of green, yellow and red light food (Table 3). Each color food should be considered in three aspects such as quality, types of food and quantity. Green light food is low-calorie, high-fiber, low-fat, and nutrient-dense. Fruits and vegetables represent green light food. The intake of green light food is unlimited. Yellow light food is nutrient-dense, but higher in calories and fat. There are meats with low fat, dairy, starch, and grain in food. The intake of yellow light food must be an appropriate amount for a child. Red light food is high in calories, sugar, and fat. Such food includes fatty meats, sugar, sugar additive beverages, and fried meals. The intake of red light food should be infrequent or avoided.

MyPlate, food pyramid or Food Balance Wheels

For ideal calorie intake and a healthy diet, appropriate food composition is imperative. The US De-

Table 2. Dietary Reference Intake of Calorie in Korean Children

Sex	Age	Calorie(kcal/d)
Infant	0-5 mo	550
	6-11 mo	700
Toddlers	1-2 y	1,000
	3-5 y	1,400
School age (boy)	6-8 y	1,700
	9-11 y	2,100
	12-14 y	2,500
	15-18 y	2,700
School age (girl)	6-8 y	1,500
	9-11 y	1,800
	12-14 y	2,000
	15-18 y	2,000

Adapted from Ministry of Health and Welfare, The Korean Nutrition Society. Dietary reference intakes for Koreans 2015 [25].

partment of Agriculture (USDA) published the nutrition guide, MyPlate. It depicts a place setting with a plate and glass divided into five food groups. MyPlate replaced the USDA's MyPyramid guide June 2, 2011 [26]. The Irish food pyramid is also a well-established food-based dietary guideline [27]. In Korea, food can be classified into six groups including grains, meat-fish-egg-bean, vegetables, fruits, milk-dairy and oil-sugar group (Fig. 4) [25]. The area of each group in the figure shows the relative size of each food group that should be ingested. Every meal should contain essential components from the grain group, meat-fish-egg-bean group and vegetable group. Children should eat food from the fruit group and milk-dairy group one or two times daily.

Table 3. Traffic Light Diet Plan [11]

Feature	Green light foods	Yellow light foods	Red light foods
Quality	Low-calorie, high-fiber, low-fat, nutrient-dense	Nutrient-dense, but higher in calories and fat	High in calories, sugar, and fat
Types of food	Fruits, vegetables	Lean meats, dairy, starches, grains	Fatty meats, sugar, sugar-sweetened beverages, fried foods
Quantity	Unlimited	Limited	Infrequent or avoided

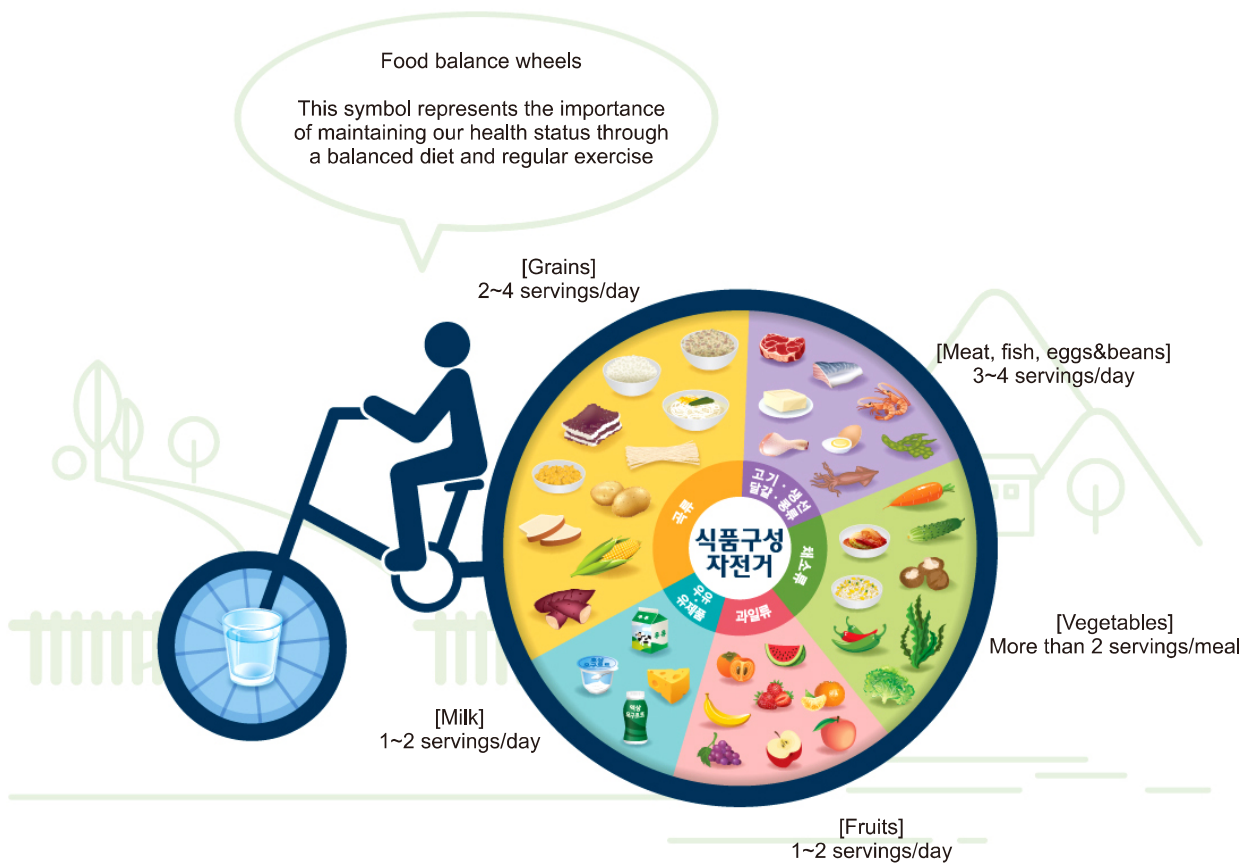


Fig. 4. Food Balance Wheels. Foods can be classified into 6 groups including grains, meat-fish-egg-bean, vegetables, fruits, milk-dairy, and oil-sugar group. Adapted from Ministry of Health and Welfare, The Korean Nutrition Society. Dietary reference intakes for Koreans 2015 [25].

Appropriate and adequate water consumption is imperative to “ride” the Food Balance Wheels well and maintain a healthy diet.

‘Food Exchange Table’ or The Diabetic Exchange List

To practice ideal calorie intake for every meal, the specific amount of food for the standard calorie unit is

nominated to ‘1 exchange unit’ (Table 4) [28,29]. Each group of the six food groups has the standard calorie unit and specific amount of food in each group. ‘1 exchange unit’ can be only substituted in the same group. For example, a one-third full bowl of rice can be substituted with a piece of bread, but not with a 40-gram meat ball. Using the Food Exchange Table, dietitians can easily suggest an example of a menu

Table 4. Example of ‘Food Exchange Table’

Food group		Calorie (kcal)	Carbohydrate (g)	Protein (g)	Fat (g)	Example of food
Grains		100	23	2	-	Rice 70 g (1/3 bowl), soup 140 g (2/3 bowl), bread 35 g (1 piece), rice cake 50 g, boiled noodle 90 g, sweet potato 70 g, potato 140 g
Fish, meats	Low fat	50	-	8	2	Lean meat 40 g (a ping-pong ball size), flatfish/frozen pollack/yellow corbina 50 g (1 piece, small), anchovy 15 g, oyster 70 g (1/3 cup), big river 50 g (3 rivers)
	Medium fat	75	-	8	5	Beef (sirloin) 40 g (a ping-pong ball size), mackerel/saury /Spanish mackerel/hairtail 50 g (1 piece, small), egg 55 g (1 ea), black bean 20 g (2 large spoon), tofu 80 g
	High fat	100	-	8	8	Kalbi/pork belly 40 g, sausage 40 g, fish can 50 g, cheese 39 g (1.5 ea)
Vegetables		20	3	2	-	Green vegetables 70 g (1/3 boiled cup), radish/cucumber/young pumpkin/bean sprouts 70 g, laver 2 g (1 ea), mushroom 50 g, balloon flower 40 g, kimchi 50 g
Fruits		50	12	-	-	Apple 80 g, pear 110 g, mandarin 120 g, strawberry 150 g, sweet persimmon 50 g, watermelon 150 g, oriental melon 150 g
Milk	Milk	125	10	6	7	Milk 200 mL (1 cup), soybean milk 200 mL (1 cup), formula 25 g (5 large spoons)
	Low fat milk	80	10	6	2	Low fat milk 200 mL (1 cup)
Oil-fat		45	-	-	5	Vegetable oil 5 g (1 small spoon), nut (peanut/almond/walnut/pine nuts) 8 g, butter 5 g, mayonnaise 5 g, dressing 10 g

Modified from Korean Diabetes Association. User guidelines of food exchange table for diabetes [28].

plate consisting of ideal calories for each meal for obese children. ‘Food Exchange Table’ is useful for nutritional counseling relative to DM in obese children. In the US, the diabetic exchange list issued by the American Diabetes Association is being used [30].

Nutritional counseling in obese children with diabetes mellitus

There are two types of DM including type 1 and type 2. The 24% of type 1 DM and 96% of type 2 DM patients are known to be obese children [31]. Because of beta-cell destruction by autoantibody, type 1 DM patients cannot expect auto-regulation of insulin concentration in their blood. In obese children with DM, principles of nutritional counseling are to promote best compliance, to approach step by step, to continue normal growth and development, to maintain ideal blood glucose level and appropriate nutritional state [32]. For children with type 2 DM, households with a lack of understanding about healthy eating habits are a primary cause of the dis-

ease [33]. Unhealthy diet behavior includes over-snacking and skipping meals. Adolescents often engage in non-appetite-based eating (i.e., emotional eating, television-cued eating, boredom) and cyclic dieting [33]. Type 2 DM children have poor compliance histories, because they are already obese and have been engaging in long-term unhealthy diet habits [34].

Every meal and snack significantly impacts blood glucose management in patients [32]. Obese children must be educated about healthy diet habits [35]. Regularity and consistency of calorie intake for every meal and snack are critical for patients with DM. With these factors and appropriate exercise, insulin therapy or a hypoglycemic agent can enable patients to effectively manage their blood glucose. Therefore, maintaining a daily DM management diary is critical for controlling blood glucose effectively (Supplementary Table 1). A daily DM management diary can be more effective, if the diary includes glucose intake before meals, the menu and frequency of meal and snacks,

exercise according to the time food is processed daily. For consistency of calorie intake, dietitians may suggest ideal menus and calculate calorie intake in a daily diary using the 'Food Exchange Table'.

Hypoglycemia can significantly impact compliance of DM treatment in obese children. Therefore, preventing hypoglycemia is a critical component of DM control. The patient with hypoglycemia should be able to eat food easily such as candy or drink orange juice which would increase blood glucose rapidly.

CONCLUSION

The obesity prevalence of children has alarmingly increased in Korea in the last 10 years. Before beginning nutritional counseling for obese children, analysis of modifiable risk factors, assessment of obese children and principles of obesity treatment should be considered. Specifically, a multi-disciplinary team approach to obesity treatment is critical. Nutritional counseling can be successfully conducted by requiring parents of obese children to maintain a daily log of food and drink intake and ensure that their children engage in a sensible dieting lifestyle using effective counseling tools such as the Traffic Light Diet, 'Food Exchange Table', and Food Balance Wheels. Nutritional counseling relative to obese children with DM can be more effective if parents of obese children with DM judiciously maintain a 'DM management diary'.

SUPPLEMENTARY DATA

Supplementary data can be found with this article online at <http://www.pghn.org> and at <https://doi.org/10.5223/pghn.2017.20.2.71>.

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