Childhood Obesity and Insulin-Resistant Syndrome

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Childhood obesity has become a national concern, health threat, and is increasing at an alarming rate. Obesity is associated with many comorbidities that last into adulthood. Insulin-resistant syndrome (IRS) is developing in growing numbers of obese children. Pediatric nurses play a unique and important role in identifying which children are at risk for obesity and IRS. This article gives current information on what tools to use, how to identify those children, and the interventions needed.

INTRODUCTION

CHILDHOOD OBESITY AND its complications have become a very serious public health concern and threat. The American public has become more obese and less active (Centers for Disease Control and Prevention [CDC], 2002). Along with childhood obesity, insulin-resistant syndrome (IRS) has begun to emerge. Insulin resistance is aggravated by obesity and inactivity. IRS consists of hyperinsulinemia (elevated insulin level), obesity, hypertension, and dyslipidemia. Prevalence, epidemiology, obesity pathophysiology, risk factors, assessment, prevention, treatment, and resources will be included for discussion in this article.

PREVALENCE/EPIDEMIOLOGY

Childhood obesity has become an ever-increasing problem and is now considered to be a disease of epidemic proportions. It is the most common nutritional problem among children in the United States. It has been estimated that one in five school children meet the criterion for obesity. A child who weighs more than 25% of the ideal weight for their height and age is considered obese. Since the 1960s, the incidence of childhood obesity has increased by 54% for children 6 to 11 years of age and almost 40% for ages 12–17 years, which has resulted in a large number of major health risks for children (Nelms, 2001). Once a child has become obese, treatment is more difficult and usually becomes a lifelong condition (Vessey, 2000). Early childhood obesity enhances its adulthood risk. Obesity is associated with long lasting physical and mental health consequences resulting in, or related to, hypertension, dyslipidemia, increased incidence of noninsulin-dependent diabetes, cholelithiasis, some types of adult cancer, dermatologic disorders, pulmonary and orthopedic conditions, menstrual abnormalities, and psychosocial morbidities (Vessey, 2000).

Type 2 diabetes is also reaching epidemic proportions in children and adolescents, along with obesity. One out of three newly diagnosed Type 2 diabetics are adolescents (Shaman Pharmaceuticals, 2001). It is not completely clear what relationship exists between the components of insulin resistance and Type 2 diabetes. Studies demonstrate that insulin resistance is a precursor to Type 2 diabetes (Williams et al., 2002).

Many individuals with Type 2 diabetes, hypertension, obesity, and cardiovascular disease are insulin resistant. In countries with improved economic status such as the United States, these diseases and conditions are found at a higher rate. In the United States, these conditions are some of the

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leading contributors to mortality and morbidity. Of the healthy population, 20–25% may be insulin resistant (Senior Indian, 2002).

OBESITY: PATHOPHYSIOLOGY

The presence of excess adipose tissue defines obesity. The percentage of body tissue that is adipose varies in normal individuals by gender and age. The percentage of adiposity is greater in postpubertal females than males. The percentage of adipose tissue in children is around 12% at birth, increasing to 25% around 5 months, and then decreasing to 15% to 18% during puberty (Roche, Siervogel, Chumlea, & Webb, 1981). When percentages of adipose tissue exceed 40%, a child is at risk for being overweight or obese (Rudolph, Rudolph, Hostetter, Lister, & Siegel, 2003).

Obesity results from an energy imbalance. When energy intake exceeds energy expenditure, weight increases; in contrast, when energy expenditure exceeds energy intake, weight loss results. Controversies exist over the specific mechanisms that lead to this imbalance.

The data are inconsistent on whether obese children consume more calories or expend fewer calories than non-obese children (Rudolph, Hoffman, & Rudolph, 1996). Obese children may be more efficient in the consumption of their calories; therefore, with the same energy expenditure and intake of calories, one child may gain weight while the other does not (Rudolph, Rudolph, Hostetter, Lister, & Siegel, 2003).

Two genetic contributors that may influence childhood obesity are low metabolic rate and increased fat cell number (Hernandex, Uphold, Graham, & Singer, 1998). Metabolic rates have been studied, and it has been found that the resting metabolic rate made up 60–70% of daily energy expenditure. The study concluded that those individuals who had a low resting metabolic rate might gain more weight than those individuals with a normal or elevated resting metabolic rate (Brownell and Wadden, 1992).

The fat cell (adipocyte) number develops prenatally, increasing in size during infancy and childhood and by adolescence reaches adult levels. The onset of childhood obesity is associated with an increased number of adipocytes. When caloric intake is increased, the number of adipocytes increases. The size of the adipocyte may be involved in appetite control and weight loss maintenance as an adult, if the adult had childhood onset obesity (Hernandex, Uphold, Graham, & Singer, 1998).

RISK FACTORS

Obesity is a complex condition that is influenced and affected by the interaction of genetic, behavioral, and environmental factors. Family studies together with genetic understandings of obesity have indicated that genetic factors do predispose some individuals to obesity and its comorbidities (Comuzzie & Allison, 1998).

Obesity appears to be familial. Studies have demonstrated that there is a 70% chance the child will be obese if both parents are obese, a 50% chance of childhood obesity if one parent is obese, and a 10% chance if neither parent is obese (Myers & Vargas, 2000). Children between the ages of 3 and 10 years, who have two obese parents, are twice as likely to be obese as compared with children of the same ages whose parents are not obese. Studies have found that children of parents with cardiovascular disease were often overweight in childhood and had elevated lipids, as well as elevated fasting insulin levels (Valente, Strong, & Sinaiko, 2001). Therefore, obesity in childhood places children at risk for heart disease and insulin resistance as well as other life-threatening illnesses.

Studies have found that environmental factors such as race, lower socioeconomic status, uneducated parents, and single-mother households may play a factor in childhood obesity (Hernandex, Uphold, Graham, & Singer, 1998). The many variables influencing obesity are illustrated in Figure 1.

The Nielsen Media Statistics show that children spend 3 years of their waking time watching TV between the ages of 2 and 17 years. This does not include watching videos, playing video games, or Internet time (Valente et al., 2001). It is thought by some that increased sedentary activities and lower resting metabolic rates may be associated with obesity, but more research is needed to be conclusive (Gidding, Leibel, Daniels, Rosenbaum, Van Horn, & Marx, 1996). Other factors that may contribute to obesity are the high-fat, large-size, convenience foods, as well as the inexpensive high-energy density foods, and the decreased opportunity for physical exercise such as playing outdoors or physical education in schools (MacKenzie, 2000; Myers & Vargas, 2000).

There is added concern for children from ethnically diverse backgrounds due to cultural barriers including attitudes, language, and health beliefs. African-American, Native-American, Alaskan Native-American, and Hispanic children are at specific risk for childhood obesity and its complica-

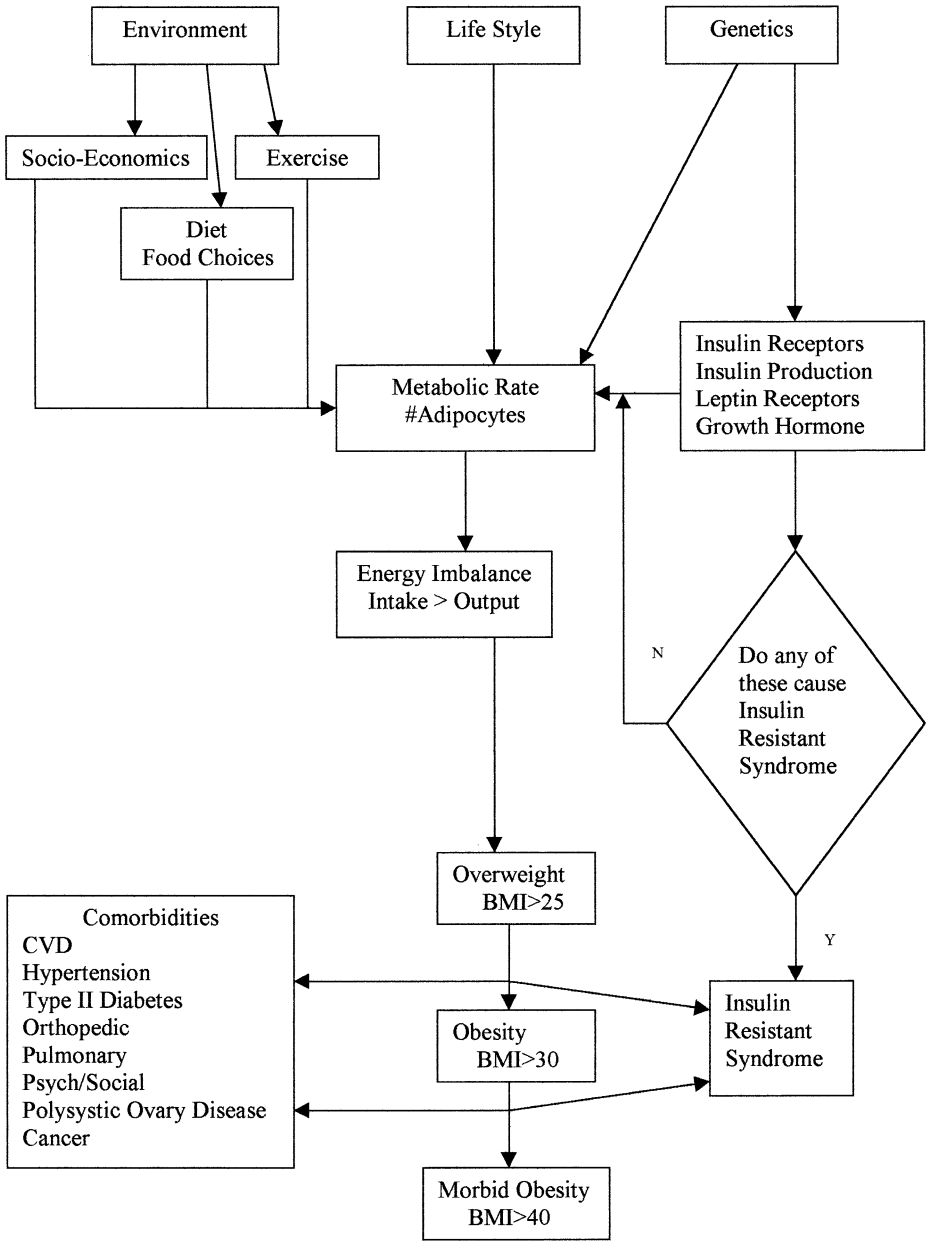

Figure 1. Relationship of obesity and insulin-resistant syndrome.

tions due to the lack of resources and appropriate medical care. Studies have shown that these groups are at a greater risk for obesity, Type 2 diabetes, increased lipid levels, and poorer nutrition with a greater chance of developing chronic diseases into adulthood such as cardiovascular disease (Myers & Vargas, 2000).

Inactivity and obesity influence insulin resistance. Some indications that may worsen IRS are the increase of adiposity and decreased exercise. As specific genes for insulin resistance have not been identified, it appears likely that a change in lifestyle can affect insulin resistance (Rao, 2001).

Studies assessing the impact and management of childhood obesity have been difficult to interpret. There has been no standard to differentiate obesity from overweight, where in body size may be increased, without an increase in accumulation of body fat, but an increased lean body mass. Excess weight and body fat have been associated with increased plasma insulin levels, increased blood lipid and lipoprotein levels, increased serum leptin

levels, and increased blood pressure (Behrman, Kleigman, & Jenson, 2000). All of these factors have been associated with adult obesity and related morbidities. Leptin is a protein hormone that is produced by adipocytes. In persons with obesity, there is an increased secretion of leptin due to the increased fat mass (Rudolph et al., 2003).

INSULIN-RESISTANT SYNDROME: PATHOPHYSIOLOGY

IRS also known as Syndrome X is defined by a quartet of hyperinsulinemia, obesity, hypertension, and dyslipidemia and develops long before any of these diseases appear (Rao, 2001). The metabolism of fats, proteins, and carbohydrates depends on insulin, and it facilitates them into the cell. Insulin has to be present for glucose to enter the muscle and fat cells. It is needed for storage of glucose as gylcogen in the liver and muscle cells and prevents mobilization of fats from fat cells. However, insulin is not needed for glucose to enter the nerve cells and vascular tissue. The cell membrane has receptor sites for insulin. Once the receptor site has been established, a chemical reaction results and glucose enters the cell. When there is an inadequate amount of insulin, glucose cannot enter the cell (Wong, Hockenberry-Eaton, Wilson, Winkelstein, Ahmann, & DiVito-Thomas, 2001).

In an attempt to respond to the elevated glucose levels, the pancreas will increase production of insulin resulting in hyperinsulinemia. When the pancreas is no longer able to lower the blood glucose level and overcome insulin resistance by hypersecretion, diabetes develops. Type 2 diabetics remain hyperinsulinemic until they are in advanced stages of the disease. Normal fasting insulin level is <15 m/U/L. Hyperinsulemia, fasting insulin level, is >20 m/U/L (Rao, 2001; Williams et al., 2002).

Hypertension accelerates the development of coronary artery disease and contributes to cerebrovascular accidents, heart failure, and renal failure. Insulin resistance also affects blood pressure. Systolic or diastolic blood pressures that are above the 95th percentile persistently in children are considered elevated (Williams et al., 2002).

Patients with insulin resistance have decreased high-density lipoprotein (HDL) cholesterol levels, increased serum very-low-density (VLDL) lipoprotein cholesterol, increased triglyceride levels, and increased or sometimes decreased low-density lipoprotein (LDL) cholesterol levels (Rao, 2001). Acceptable levels for total cholesterol is <170mg/dL, LDL cholesterol is <110mg/dL, HDL cholesterol is >35mg/dL, and triglyceride levels are <200mg/dL (Williams et al., 2002) (Table 1). Established guidelines for screening children greater than 2 years of age with risk for cardiovascular disease have been set by the National Cholesterol Education Program (NCEP) (Buiten & Metzger, 2000). Screening guidelines include (1) family history for early cardiovascular disease; (2) parent with cholesterol level of 240mg/dl; and (3) diets high in fat and cholesterol, hypertension, obesity, smoking, and steroid medication use (Diller, Huster, Leach, Laslarzewski, & Sprecher, 1995).

Some children with hypercholesterolemia have demonstrated central abdominal obesity, which is the measure of the waist/hip ratio and is directly related to the percentage of body fat. Central abdominal obesity is positively associated with insulin resistance or Syndrome X (Buiten et al., 2000).

ASSESSMENT: ESTABLISHING BASELINE DATA

As health care providers, pediatric nurses must identify those children at risk for becoming obese and insulin resistant. Those children at greatest risk are those with single mothers, low socioeconomics, cultural barriers, and one or both parents who are obese. Once these children are identified, appropriate health promotion activities and education must be initiated.

Beginning with the newborn visit, infants must have their weight and height plotted on the appropriate Centers for Disease Control and Prevention (CDC) U.S. growth charts, along with their weight-for-height or a body mass index (BMI) and followed at each visit throughout their childhood development. The BMI is used after the age of 3 years, and weight-for-height is used prior to this age. If the child's weight and height are crossing two-percentile ranges or their BMI is greater than

Table 1. Lab Values

Insulin-Resistant Syndrome Lab Values	Acceptable Values for Children 2-19 years
Decreased high-density lipoprotein (HDL) cholesterol levels	HDL cholesterol >35 mg/dl
Increased very-low-density lipoprotein (VLDL) cholesterol levels	Triglycerides 5
Increased triglyceride levels	Triglycerides <200 mg/dl
Increased or could be decreased low-density lipoprotein (LDL) cholesterol levels	LDL cholesterol <110 mg/dl Total cholesterol <170 mg/dl
(Rao, 2001)	(Williams et al., 2002)

the 85th percentile, then a closer evaluation needs to be done.

The most useful tool to screen for obesity is the BMI. The BMI is a measure that shows the ratio of weight to height. It is a mathematical formula that takes a person's body weight in kilograms and is divided by the square of his or her height in meters. A BMI greater than 25 is considered overweight and greater than 30 is considered obese (CDC, 2003a). The BMI correlates significantly with both subcutaneous and total body fat, especially in those with the greatest proportion of body fat. An elevated BMI also correlates with blood pressure, blood lipid levels, and lipoprotein concentrations that are also predictors for adult elevated BMI, blood pressure, blood lipid levels, and lipoprotein concentrations that result in obesity-related morbidity and mortality (Behrman et al., 2000).

The BMI is recommended for clinical use to measure relative weight. The Centers for Disease Control and Prevention has recently published age- and gender-specific BMI standards for percentile growth curves for the U.S. population. These growth curves should be used in place of the older weight-for-height curves. The 85th percentile is used to identify those mild-to- moderately overweight and who are at risk for obesity. The 95th percentile is used to identify those more significantly overweight and who need additional assessment and treatment (Kushner, 2002) (Table 2). Children in both groups are at greater risk for obesity, which has a great probability of continuing into adulthood. It is extremely important to calculate BMI in children at each well-child visit to screen for obesity tendency and trends (Williams et al., 2002).

Blood pressures should be measured based on gender, age, and height using the blood pressure tables developed by the National High Blood Pressure Education Program. Height is measured, and the percentile is determined using the standard growth chart. Blood pressures greater than the 95th percentile are considered to be high. To determine if hypertension exists, a resting blood pressure needs to be done at three consecutive visits. If the blood pressure stays at the 95th percentile further evaluation needs to be completed. Blood pressures need to be started at the age of 3 years, at the well-child visit. The appropriate cuff size needs to be used to avoid false readings and should be done at resting (Williams et al., 2002).

A food and activity diary should be kept by the family and by the child, if old enough. This information should then be evaluated to see what the child is eating and how much the child is exercising. An endocrine evaluation may be needed to rule out any metabolic cause. Genetic causes such as Prader-Willi must also be ruled out. Referrals to a registered dietitian for diet management may be necessary. A referral to a pediatric obesity treatment center may be needed if nothing else is successful.

Table 2. Weight Parameters and Classifications for Children Ages 2-20 Years

	BMI Percentiles For Age	BMI Scores For Age
Underweight	<5th%	<15
At Risk for Overweight	85th-95th%	25-30
Overweight (CDC, 2003)	>95th%	>30

PREVENTION AND TREATMENT OF IRS

Rao (2001) states that insulin resistance precedes its consequences by years; therefore, identifying and treating it early is beneficial in establishing and developing healthy habits. To avoid unhealthy behaviors associated with insulin resistance beginning in late childhood and adolescence, healthy habits need to be established early in childhood.

The prevention and treatment of IRS has many implications for the pediatric nurse. The plan must include identifying those children at risk, along with health promotion specific to exercise, diet, and ongoing monitoring through follow-up visits (Table 3).

Exercise is an important lifestyle habit to establish early in life. Children should never have long periods of inactivity. Children should have 10–15 minutes or more of moderate-to-vigorous activity each day. Elementary school-aged children should experience physical activities that accumulate at least 30–60 minutes up to several hours most days of the week. Adolescents should be engaged in at least 20 minutes or more of moderate-to-vigorous activities at least three times a week (CDC, 2000). Moderate exercise such as walking 30 minutes everyday at least 5 days a week, with 7 days being ideal, will improve insulin sensitivity and decrease insulin resistance. Exercise is an important healthy habit to establish early. It is unclear how much weight loss is needed for sustained decreases in insulin resistance, but insulin sensitivity improves in a few days with caloric restriction, even if there has been no weight loss. Insulin levels are in-

Table 3. Plan for IRS Treatment

Screening	Treatment	Monitoring
• Height • Weight • BMI • Weight for Height >128% • Crossing of percentile • Family History Obesity Premature Cardiovascular Disease Diabetes Hypertension	• Diet American Diabetic Diet (ADA) American Heart Association (AHA) Step I Low Carbohydrate Restricted Supplements • Exercise Child, 10-15 minutes most days Elementary school age, 30-60 minutes most days Adolescents, at least 20 minutes 3 times a week 30 minutes 5-7 days per week Increased activity at school including Physical Education Classes Participate in after school activities Limit TV hours • Lifestyle Changes Family Time Activities Exercise	• Frequent Visits • Vital Signs Monitoring Blood Pressure • Blood Tests Fasting Insulin Level HbA1C Lipid Panel • Weight, Height, BMI

versely related to the amount of dietary fiber consumed.

Dietary fiber has been shown to be beneficial in lowering hypertension, hyperlipidemia, and cardiovascular disease. High fiber foods from natural sources help reduce insulin resistance (Rao, 2001). Some dietary fiber foods include raw fruits and vegetables, whole grains, and beans.

The recommended diet to prevent weight gain and obesity is the American Heart Association Step I Diet. It is low in saturated fat and cholesterol, includes 5 or more servings of vegetables and fruits along with 6 to 11 servings of whole-grain and complex-carbohydrate foods, and protein. An example to use for families is a plate that is one half full of vegetables and fruits, one fourth with starches such as potatoes or rice, and one fourth with protein such as meat, chicken, or fish (Williams et al., 2002).

COST

Vessey (2000) states that the rise in obesity is associated with long lasting physical and mental health consequences and a cost of approximately $100 billion a year in the United States. With the prevalence of overweight and obesity increasing in the United States, so have the indirect and direct health care costs. Indirect costs are those related to lost wages due to premature death and disability, or illness resulting in about $52 billion or 5.7% of the U.S. health expenditure. Direct costs are those related to prevention, diagnoses, and treatments resulting in about $48 billion comparable with the economic costs of cigarette smoking (National Institute of Health [NIH], 2000).

The CDC (2003c) estimates that the yearly hospital costs during 1997–1999 related to obesity and chronic diseases in children and adolescents were $127 million. The costs for this same age group were $35 million during 1979–1981(CDC, 2003c).

Preud'Homme and Stolfi (2002) state that due to the lack of coverage by third-party payers, evaluation and therapy for obesity are not routinely performed. It was found that most third-party payers covered hypertension, non-insulin-dependent diabetes, and cardiovascular disease treatment and management. Only a few plans covered evaluation and diet treatment of obesity. With this in mind, there is a great likelihood that obesity management in the pediatric and adult population may not occur; therefore, morbidity and mortality will result.

RESOURCES

Nurses need to be aware of national programs and initiatives that have been established to prevent and manage obesity (Nelms, 2001). Shape Up America is an anti-obesity initiative developed by Dr. C. Everett Koop. Healthy People 2010 has a goal of promoting health and reducing chronic disease associated with diet and weight. Objectives to achieve this goal include (1) focusing on prevention of chronic disease associated with diet and weight, beginning in youth; (2) strengthening the link between nutrition and physical activity in health promotion; and (3) improving accessibility of nutrition information, nutrition education, nutrition counseling and related services, as well as healthful foods in a variety of settings for all population groups as stated by Healthy People 2010.

Table 4. Websites on Obesity and Related Topics

Nutrition
www.schoolmenu.com
www.consumer.gov/weighloss
www.niddk.nih.gov/health/nutrit/cnruon.htm
Exercise and Physical Activity
www.trails.com
www.parks.net
www.walking.about.com
www.healthylearning.com
General Medical and Health
www.niddk.nih.gov
www.cdc.gov
www.obestiy.org
www.naaso.org

Information regarding resources can be found through government and other websites (Table 4). Awareness of local community resources is very helpful for the nurse and family. Education resources for the family and child need to be readily available and used.

IMPLICATIONS FOR NURSING PRACTICE: A CASE STUDY

A 12-year-old African-American female comes to the primary care setting for her well-child visit. She has a BMI of 30, blood pressure of 130/85, nigracans acanthosis on her neck, and is otherwise well appearing with no complaints. She states she loves reading and cooking and does not participate in any extracurricular activities. An initial nursing care plan might include the following:

Nursing Diagnosis: Altered nutrition: more than body requirements related to dysfunctional eating patterns, hereditary factors.

Patient (Family) Goal 1: Will identify eating patterns.

Nursing Interventions: Keeps a food diary, including times food eaten, amounts and types of food eaten, when and where food is eaten. Assess diary.

Expected outcome: Adolescent's eating patterns, amounts and types become apparent.

Patient (Family) Goal 2: Will demonstrate how to control food stimuli.

Nursing Interventions: Encourage to eliminate "junk" food in the house, identify food cues then find ways to minimize them, be aware if hungry when eating or is it an emotional response, prepare and serve only amounts of food to be eaten at that meal, serve food from the stove not family style.

Expected outcome: Adolescent (Family) demonstrates understanding of eating patterns and strategies to alter destructive patterns.

Patient (Family) Goal 3: Will change eating patterns.

Nursing Interventions: Encourage to never stand to eat, never eat in front of the television, use smaller plates to serve food on, always sit at a designated place for eating, have established meal times, have healthy nutritious snacks available.

Expected outcome: Adolescent (Family) alters eating behaviors.

Patient (Family) Goal 4: Will alter activity patterns.

Nursing Interventions: Encourage daily activity to include at least 20 minutes of moderate to vigorous activity. Explore with parents and child what types of activity that are enjoyable. Limit such activities as television and computer and video games to 2 hours per day. Walk around the house during television commercials.

Expected outcome: Adolescent is less sedentary.

Nursing Diagnosis: Self-esteem disturbance related to perception of physical appearance, internalization of negative feedback.

Patient (Family) Goal 1: Will have opportunities to discuss feelings and concerns.

Nursing Interventions: Encourage discussion of feelings and concerns to help facilitate coping, reinforce accomplishments to help avoid discouragement, be nonjudgmental in your approach, be supportive and listen.

Expected Outcomes: Adolescent (Family) expresses feelings and concerns regarding problems, maintains a positive attitude.

Patient (Family) Goal 2: Will recognize ways to improve appearance.

Nursing Interventions: Encourage good grooming, hygiene, and posture to enhance appearance and to promote a positive self-esteem.

Expected Outcome: Adolescent will show and demonstrate efforts to improve appearance by following good grooming, hygiene, and posture.

Patient Goal 3: Will exhibit signs of improved self-esteem.

Nursing Interventions: Relate to adolescent in a positive supportive manner to encourage and develop a positive self-esteem. Encourage activities to avoid boredom, encourage to set small attainable goals, encourage interaction with peers to avoid isolation and loneliness.

Expected Outcomes: Adolescent (Family) will set realistic attainable goals that are specific for

them or self, voices a positive self attitude, engages in activities, interacts with peers.

Nursing Diagnosis: Altered family processes related to management of an obese adolescent.

Patient (Family) Goal 1: Will be involved in adolescent's weight-loss and behavior modification program.

Nursing Interventions: Educate family about all aspects of the weight-loss management and behavior modification. Encourage family involvement and support for the weight-loss and behavior modification changes to achieve success.

Expected Outcomes: Family will be involved, be supportive, and knowledgeable with and about the weight-loss management and behavior modification.

Pediatric nurses have a great potential for identifying at-risk children for obesity and IRS in a variety of settings. Public health nurses, school nurses, and Women Infants & Children (WIC) nurses observe children in the nontraditional setting and can be an educational resource for the families. Nurses in the primary care setting can use the BMI with each well-child visit to determine if the child is within the normal range. Subspecialty nurses such as Orthopedics, Endocrinology, Pulmonology, Genetics, and ENT can recognize obese children and help determine if obesity is the underlying cause for the referral to the specialty. Once at-risk children are identified, education on diet and exercise should be started. If referral to a pediatric specialist in obesity is indicated, the pediatric nurse should initiate this plan.

CONCLUSION

Childhood obesity is an increasing health problem, which results in long-term complications. The causes have not been well identified to date. There are many hypotheses for why this is occurring at an alarming rate, and many studies have been done with conflicting results. An apparent solution to childhood obesity is not present. The relationship of risk factors between obesity and insulin resistance syndrome is not well understood and it needs further research. Effective therapeutic approaches to reducing childhood obesity and its causes need further investigation.

No discussion of the issue would be complete without recognition of the integral role of the family. Parents are the gatekeepers for a child's access to programs, activities, and the cookie jar. Anticipatory guidance with the family must include the parent as well as the child. Children with increasing independence are faced with daily decisions for what to buy in the cafeteria line, choice of playground activities to pursue at recess, and whether to join extramural activities, such as sports, scouting, or web surfing. Parents may set the stage with teaching and modeling good eating habits, providing access to health care, and supporting the child's appropriate choices. But the child is the ultimate actor, free to choose or not to choose the optimal health promotional path.

The best treatment for childhood obesity is prevention. Adopting healthy lifestyles early in childhood can avoid serious health problems in youth and adulthood. The goal for treatment in childhood obesity is to decrease the rate of weight gain while increasing and or maintaining linear growth (Myers et al., 2000). The goal is to improve the child's health by either stopping weight gain or by minimizing weight gain and by improving body image. If childhood obesity is prevented, comorbidities will not develop in adulthood. Insulin resistance can be decreased and insulin sensitivity increased by changing health habits with increasing exercise, decreasing weight, and eating a more healthy diet.

Obesity represents a chronic disease, not a lifestyle choice, or a lack of willpower or not having the desire to exercise. Frequent visits, continuous monitoring, and continuous reinforcement will be needed for success, although they will not guarantee it (Barlow & Dietz, 1998).

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