

# Assessment of Obese Children and Adolescents: A Survey of Pediatric Obesity-Management Programs

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## KEY WORDS

children, overweight, clinical evaluation

## ABBREVIATIONS

NACHRI—National Association of Children's Hospital and Related Institutions

BP—blood pressure

CDC—Centers for Disease Control and Prevention

BIA—bioelectrical impedance analysis

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## abstract

This article provides descriptive information on the assessments conducted in stage 3 or 4 pediatric obesity-management programs associated with National Association of Children's Hospital and Related Institutions hospitals enrolled in FOCUS on a Fitter Future. Eighteen institutions completed a survey that considered the following assessments: patient/family medical history; physical examination; blood pressure; body size and composition; blood chemistry; aerobic fitness; resting metabolic rate; muscle strength and flexibility; gross motor function; spirometry; sedentary behavior and physical activity; dietary behavior and nutrition; and psychological assessments. Frequency distributions were determined for each question. Overall, the results indicate that most programs that participated in this survey were following 2007 Expert Committee assessment recommendations; however, a variety of measurement tools were used. The variation in assessment tools, protocols, etc is partially caused by the program diversity dictated by personnel, both in terms of number and duties. It also shows the challenges in standardizing methodologies across clinics if we hope to establish a national registry for pediatric obesity clinics. In addition to providing a better understanding of the current assessment practices in pediatric obesity-management programs, the results provided herein should assist other clinics/hospitals that are developing pediatric obesity programs. *Pediatrics* 2011;128:S51–S58

In 1998, the Maternal and Child Health Bureau (Health Resources and Services Administration, Department of Health and Human Services) convened a committee of pediatric obesity experts to develop recommendations for the evaluation and treatment of childhood obesity.<sup>1</sup> These recommendations were noted to be for primary care physicians, nurse practitioners, and nutritionists to guide them in the evaluation and treatment of overweight children and adolescents. In 2007, the Expert Committee recommendations<sup>2</sup> regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity described how the chronic care model encompasses the necessary components for a health care system to be effective in caring for childhood obesity. One critical component within the chronic care model is the use of practice guidelines in each of the areas of prevention, assessment, and treatment. In terms of assessment, 2 major categories—medical and behavioral assessment—were considered, and it was emphasized that accurate and appropriate assessment is important.<sup>3</sup> The article was written to provide a comprehensive approach to assessment based on available evidence to support the assessment of key constructs.

Following the 1998 Expert Committee article, Barlow et al<sup>4</sup> published the results of a survey of 940 providers (203 pediatricians, 293 pediatric nurse practitioners, and 444 dieticians), which examined the attitudes and practices related to the recommendations. More specifically, information was provided on the attitudes toward, barriers to, perceived skill level in, and methods used for the identification of the degree of overweight and associated medical conditions outlined in the 1998 recommendations. It was found that, in general, the medical evaluation

of the obese patient fell short of the recommendations. Given that their survey (1) targeted primary care offices and personnel and (2) did not provide information about specific measurement protocols or the assessment of physical activity and dietary behaviors and (3) that there are now updated recommendations for assessment, it is important to examine how pediatric obesity-management programs are following the 2007 recommendations and what specific assessment practices occur in these programs. The aim of this article is to provide descriptive information on the assessments conducted in stage 3 or 4 pediatric obesity-management programs associated with National Association of Children's Hospital and Related Institutions (NACHRI) FOCUS on a Fitter Future hospitals. The staged approach to child obesity treatment was outlined in the 2007 Expert Committee recommendations. Stage 3 and 4 programs are considered comprehensive, multidisciplinary interventions conducted in a weight-management specialty clinic. Stage 4 programs often treat severely obese patients and involve medications, meal replacements, very low calorie diets, and/or bariatric surgery. Stage 1 and 2 programs are conducted by primary care providers; stage 1 includes monthly visits that include dietary and physical activity counseling, whereas stage 2 includes more specific behavioral counseling by a health care professional with specific training in weight management (eg, dietician).

## METHODS

### Survey Development and Administration

The Childhood Obesity Assessment Survey was developed by the subcommittee on Assessment in Pediatric Obesity Programs from November 2008 through April 2009. Survey develop-

ment centered around capturing information on the assessment of key variables in 4 domains (medical, physical activity, nutrition, and psychological) related to instrumentation, personnel, protocol, and timing of the measurements (baseline, monthly, etc). On May 1, 2009, the survey was fielded to 47 NACHRI member hospitals (both hospitals that participated [ $n = 15$ ] and did not participate [ $n = 31$ ] in the FOCUS group) via the NACHRI survey center. Twenty-eight of 47 (60%) institutions completed the hospital profile (15 of 15 [100%] NACHRI FOCUS group members and 12 of 32 [38%] others). If the hospital administered a pediatric obesity-management program at different stages as defined in the Expert Committee recommendations, then they completed a survey for each stage. The sample size for each stage was 9 (stage 1), 13 (stage 2), 16 (stage 3), and 6 (stage 4). For the purpose of this article, only data from stage 3 and 4 clinics were analyzed ( $n = 18$ ). The total number of hospitals that offered stage 3 or 4 programs was not determined; thus, the response rate for this level of programs cannot be determined. Frequency distributions for each question are based on this sample size.

### Components of the Survey

The following assessments were considered in the survey: patient/family medical history; physical examination; blood pressure (BP); body size and composition; blood chemistry; aerobic fitness; resting metabolic rate; muscle strength and flexibility; gross motor function; spirometry; sedentary behavior and physical activity; dietary behavior and nutrition; and psychological assessments. In addition, respondents were asked about program description and personnel and were able to add comments after each section to clarify or expand on various responses.

**Statistical Analysis**

Because the intent of this survey was to provide descriptive information on the current assessment practices in pediatric obesity-management programs, frequency distributions for each question were determined by using SPSS 17.0 (SPSS Inc, Chicago, IL).

**RESULTS AND DISCUSSION**

In pediatric obesity, assessment of clinical variables hinges on the key feature used in the diagnosis of obesity (excess fat) and its associated etiologic risk factors and medical consequences. As stated in the Expert Committee report, the primary goal of obesity treatment is “improvement of long-term physical health through permanent healthy lifestyle habits.”<sup>2</sup> If this is the goal and treatment programs are developed around accomplishing this goal, then reliable and valid assessments are necessary to determine if this goal is met. However, given the time demands of clinical practice, feasibility also becomes an important consideration in choosing assessments. A summary of key survey results is shown in Table 1 and discussed below according to various components of the survey (indicated by the subheading).

**Body Size and Composition**

BMI is the currently recommended screening tool for child obesity,<sup>3,5</sup> and as expected, all (100%) programs that participated in this survey measured standing height and weight and calculated BMI. A variety of personnel are responsible, but most often it is a nurse or medical assistant who takes the measurements. It should be noted that the proper methodology for measuring height and weight are important for accurate measurements, including equipment for and technical aspects of measurement. In this sur-

**TABLE 1** Summary of Survey Results on Assessments in Pediatric Obesity Clinics

	%
Body size and composition	
Assess height, weight, and calculate BMI	100
Measure height and weight on hard (noncarpeted) surface	83
Assess body mass with patient in gown (eg, nude body mass)	56
Percentiles derived from CDC BMI growth chart	100
Utilize International Obesity Task Force cut points	0
Assess body fatness/body composition	56
Assess waist circumference	83
Provide anthropometric training	78
Key etiologic risk factors	
Determine parental weight	100
Assess physical activity	100
Assess screen time	100
Assess diet/nutrition	100
Nontraditional etiologic risk factors	
Birth weight	94
Maternal gestational diabetes	94
Breastfeeding	94
Pregavid weight and pregnancy weight gain	17
Aspects of comorbidities	
Physical examination	100
Family history	100
BP	100
Blood cholesterol	100
Triglycerides	100
Glucose and insulin	100
Liver enzymes	94
Other physiological measures	
Resting metabolic rate	17
Aerobic fitness	44
Muscle strength	67
Gross motor function	56
Flexibility	56
Spirometry	27
Psychological	
Depression	100
Anxiety	100
Sense of competence	100
Family dynamics	94
Self-esteem	100
Overall behavior and emotion	94
Eating disorders	94
Quality of life	56
Readiness for change	100

vey, a variety of instrument models were used, and most (83%) programs measured the patient on tile or a hard surface, but not all of them did so (eg, some measured the patient on a carpet). In addition, measured weight can

be affected by clothing. It was reported that approximately half of the programs measured body mass while the patient was in a gown. However, there are feasibility issues with having the patient wear a gown (eg, time, comfort of the patient, etc). If weight is measured in typical clothing, clinicians should ask about objects in the patient’s pockets and ask the patient to remove bulky clothing (jackets, sweaters, etc), if appropriate. Once BMI is calculated, it is important to evaluate appropriately. The results indicate that BMI is expressed several ways, including raw BMI (kg/m<sup>2</sup>).

The Expert Committee<sup>3</sup> recommends deriving percentiles on the basis of the Centers for Disease Control and Prevention (CDC) growth charts ([www.cdc.gov/growthcharts](http://www.cdc.gov/growthcharts)). All (100%) the programs we surveyed used this approach. To eliminate plotting errors directly on the CDC growth chart, it is encouraged to use software programs or Web sites that calculate the specific percentiles. In compliance with the Expert Committee recommendations, none of the programs we surveyed used the International Obesity Task Force cut points.<sup>6</sup>

Because BMI is considered a proxy for adiposity, additional measures of adiposity can be considered. In this survey, approximately half of the programs assessed body fatness, and most programs (56%) assessed waist circumference as a surrogate of abdominal fatness. Body fatness can be determined by a variety of techniques,<sup>7,8</sup> and several methods (including skinfold-thickness measurements, bioelectrical impedance analysis [BIA], and dual-energy radiograph absorptiometry) were used by individual programs. The Expert Committee did not recommend the routine use of skinfold-thickness measurements in the clinical assessment of pediatric obesity. The basis for this recommen-

dation was threefold: (1) lack of readily available reference data on skinfold thicknesses; (2) concern for measurement error; and (3) lack of criteria/cut points. It should also be noted that it is difficult to locate the appropriate skinfold site in obese patients, and this procedure introduces a level of psychological discomfort for the patient.

The other method of assessing body fatness that was more common among the programs surveyed is BIA. One important issue related to BIA is the specific device. There are several BIA devices available that range in functionality (arm-to-arm; foot-to-foot; tetrapolar) and price.<sup>9</sup> It is important to carefully choose among these devices, because the validity of some of them is unknown. Another important consideration is subject preparation, because several factors are known to influence results, including hydration status and previous exercise. Related to both skinfold thickness and BIA is the prediction equation used to generate estimated percentage body fat. There are several prediction equations for both methods, and there is no consensus on which prediction equation is most suitable for obese children or adolescents. Furthermore, some BIA devices do not provide the prediction equation housed within the unit. Finally, to reiterate 2 of the concerns of the Expert Committee regarding reference standards and clinical cut points, it is important to consider what is done with these values once they have been obtained, because there are no widely accepted reference standards or clinical cut points for skinfold thicknesses or percentage body fat. In addition, when examining change in these values, it is important to recognize that the measurement error may be 2% to 5%; thus, observed changes may be within measurement error. Further re-

search is warranted to develop clinically appropriate methodologies and evaluation of body fatness.

Although waist circumference is a surrogate of visceral adipose tissue,<sup>10</sup> and some studies have shown its implications beyond BMI alone for cardiovascular disease risk factors,<sup>11</sup> the Expert Committee withheld recommendation of the routine use of it in the clinical assessment of pediatric obesity. The basis for this recommendation was incomplete information on its utility in predicting risk and a lack of specific guidelines for clinical application. Despite this recommendation, most of the programs we surveyed (83%) assessed waist circumference, and most of them measured it at the border of the iliac crest (recommended in the Expert Committee report and by the National Institutes of Health National Cholesterol Education Program) or the level of the umbilicus, and others measured at the midpoint between the lowest rib and the iliac crest (as recommended by the World Health Organization). However, an important consideration for some obese patients, especially those who are severely obese, is the difficulty of finding these anatomic locations.

The Expert Committee stated the importance of accurate measurements of height and weight; thus, it is encouraging that most of the respondents (78%) provided training in anthropometry. However, the methodology or effectiveness of such training remains unknown. Besides anthropometric reference manuals,<sup>12</sup> the CDC provides good information on anthropometric training, which includes interactive training modules ([www.cdc.gov/growthcharts/educational\\_materials.htm](http://www.cdc.gov/growthcharts/educational_materials.htm)). Documentation of intrareliabilities and interreliabilities is also encouraged, as is the calibration of anthropometric equipment on a regular schedule.

### **Determination of Key Etiologic Risk Factors: Parent Weight, Physical Activity, Screen Time, and Diet**

Understanding the etiologic risk factors of pediatric obesity is important when determining the cause of obesity and for focusing intervention efforts on target behaviors. Parental weight status has been shown to be a major risk factor for child obesity. All (100%) programs assessed parental weight; however, the method (self-report or measured) was not ascertained.

Physical activity level, sedentary behavior, and diet are considered key behavioral factors in pediatric obesity.<sup>13</sup> Although all (100%) the programs assessed these key constructs, there was considerable variation in their assessment procedures. For example, several methods were reported for assessing physical activity, including both self-report/interviewer-assisted and objective measures. There is considerable inconsistency in the self-report instruments being used, and some programs reported the use of home-grown tools. In general, the reliability of self-report tools is good, whereas validity is moderate at best.<sup>14,15</sup> Of those using objective assessment tools, approximately half used pedometers, whereas others used accelerometers or heart rate monitors ( $n = 2$ ). For those using pedometers, it is important to understand that not all pedometers provide accurate values and that some pedometers have not been tested for validity; however, we did not ascertain information about the pedometer model.<sup>16</sup> It is not surprising that few used accelerometers because of the costs (approximately \$400) and labor required for data management. One program reported using the SenseWear Pro armband ([www.sensewear.com](http://www.sensewear.com)). This armband is a pattern-recognition activity monitor that integrates motion-sensor data with a variety of heat-



related sensors to estimate the energy cost of free-living activity. In contrast to accelerometry, it offers user-friendly software that calculates total energy expenditure, activity energy expenditure, and time spent in moderate-to-vigorous physical activity and reports actual wear time (thereby avoiding the considerable challenge in determining if a monitor was worn as directed). Recent articles have documented its validity in children and adolescents.<sup>17,18</sup> It is encouraging that all programs captured screen time by inquiring about television, video-game, and computer use. This information is nearly always captured by child or parent interview or questionnaire response.

Several programs assessed diet through 24-hour recall, 3-day food diaries, and/or food-frequency questionnaires despite the Expert Committee stating that these tools were impractical for use in most clinical settings; however, most programs we surveyed used a dietician, which might have influenced the inclusion of this dietary assessment tool. None of the programs responded that they used any of the instruments mentioned in the Expert Committee article (eg, WAVE, REAP, You're Your Plate). All the programs inquired about breakfast, fruit and vegetable intake, sweetened beverages, fast-food intake, family meals, and food insecurity or food assistance. We found it somewhat surprising from a clinical nutrition standpoint that resting energy expenditure or metabolic rate was not determined by more programs (only 3 [17%] programs did so). Although not addressed in the Expert Committee recommendations, resting metabolic rate has a long history in the assessment of the obese patient, because it provides a basis for nutritional counseling of energy intake and weight loss. Resting metabolic rate is measured by the exercise spe-

cialist or dietician using either a prediction equation or indirect calorimetry. A variety of prediction equations are used. In addition to gathering information on physical activity, sedentary behavior, and diet, it is also important to be informed about the context and patterns of these behaviors (access to space, equipment, who buys food, etc).

The Expert Committee article on assessment commented that an ideal tool would capture both components of energy balance. Recently, such tools have been developed (eg, Patient-Centered Assessment and Counseling for Exercise,<sup>19</sup> Family Nutrition and Physical Activity,<sup>20</sup> Home Environment Survey<sup>21</sup>). However, the utility of these screening tools in pediatric obesity clinics has not been investigated. Caution should be advised for the parental proxy of physical activity and diet; however, it is recognized that reliable and valid reporting of these behaviors in children younger than 10 years is challenging. All (100%) the programs also determined the health behavior stage of change, which is critical to the success of the intervention programs.

### Determination of Other Etiologic Risk Factors

Beyond physical activity and diet, there has been increased recognition and emphasis on "nontraditional" risk factors, because it has been realized that obesity is a complex multifactorial condition.<sup>22,23</sup> Nontraditional risk factors surveyed included prenatal aspects, breastfeeding, stress, and sleep. Most programs also collected information on birth history, patient sleep history, and depression/anxiety. In terms of the birth history, most (94%) of the programs considered maternal gestational diabetes, birth weight, and infant feeding history. In contrast, few (17%) of them considered the mother's weight before

pregnancy or weight gain during pregnancy. Several recent reports indicated a significant relationship between these 2 prenatal factors and child obesity.<sup>24-29</sup>

### Assessment of Comorbidities: BP, Blood Chemistry, and Physical Examination

Assessing the consequences of pediatric obesity is also important, because a plethora of comorbidities accompany child obesity.<sup>30</sup> Cardiovascular disease risk factors, type 2 diabetes, hypertension, and/or the metabolic syndrome get much of the attention. As expected, all (100%) the programs screened for blood cholesterol, triglyceride, glucose, and insulin levels, BP, and a family history of cardiovascular disease and type 2 diabetes. In screening for type 2 diabetes, all or most of the programs assessed blood glucose and insulin levels as noted above; approximately half of them calculated homeostasis model assessment of insulin resistance (HOMA-IR) as an indicator of insulin resistance, and a few (17%) of the programs conducted oral glucose-tolerance tests. Other blood-chemistry indicators of cardiovascular and metabolic health used by some programs include measuring uric acid, apolipoproteins, microalbumin, and C-reactive protein level. No program considered fibrinogen or cortisol. Most programs (94%) also measured liver enzyme levels (aspartate aminotransferase and alanine transaminase) to screen for fatty liver disease. There is no preferred method of assessing BP. Manual, automated, or a combination of the 2 methods are used, and a variety of clinicians (eg, physician, exercise specialist, nurse) assess it. Automated and manual devices should be checked for accuracy and calibrated periodically. Good intertester reliability is important, because several members of the clinical team measure BP. All the programs

compared BP values to age-, gender-, and height-specific percentiles to determine hypertension. Half of the programs assessed ambulatory BP.

As for the remainder of the physical examination and review of systems, it is assumed that all other aspects noted in the Expert Committee article were considered, although we did not ask about each specific component (eg, sleep disorders, menstrual irregularities, abdominal pain). It was stated that although this information is included in all the programs, some programs reported that they rely on obtaining this information from the primary care physician.

### Other Physiologic Measures

Tests for other physiologic measures are more variable than the others discussed. None of these tests were mentioned in the Expert Committee article. About half of the programs (44%) assessed aerobic fitness with an exercise specialist conducting the test. A variety of tests were used, but submaximal treadmill tests were most common. A few used the bicycle ergometer, and a few also conducted maximal-effort tests. Similarly, muscle strength, flexibility, and gross motor function were determined by a variety of methods (eg, push-up, handgrip, isokinetic device, sit-n-reach, goniometer, etc). Most programs (72%) assessed flexibility via sit-n-reach, whereas others use a goniometer for joint-specific flexibility measures. An exercise specialist usually measured these traits. Approximately one-quarter of the programs (27%) assessed spirometry as part of the routine clinical examination. Other programs reported that this is performed in the sleep or pulmonary laboratory.

### Psychological Aspects

It is well known that obesity presents with several psychological problems

**TABLE 2** Recommendations for Best-Practice Assessment of the Obese Patient

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Calculate decimal age from observation date and birth date
Provide anthropometric training for clinical personnel
Measure height and weight on hard surface using calibrated equipment
Record BMI (including past BMI pattern)
Calculate BMI percentile according to CDC BMI growth chart
Determine body composition by BIA or air-displacement plethysmography (skinfolds should not be assessed in the obese patient)
Track resting metabolic rate via prediction equation or calorimetry
Inquire about parental obesity and family medical history
Evaluate weight-related problems
Assess diet and physical activity
Assess eating behavior to examine
Self-efficacy and readiness to change
Frequency of eating outside the home at restaurants or fast-food establishments
Excessive consumption of sweetened beverages
Consumption of excessive portion sizes for age
Excessive consumption of 100% fruit juice
Breakfast consumption (frequency and quality)
Excessive consumption of foods high in energy density
Low consumption of fruits and vegetables
Meal frequency and snacking patterns (including quality)
Conduct physical activity assessment to determine
Self-efficacy and readiness to change
Reliable and valid self-report physical activity instruments
Environment and social support and barriers to physical activity
Whether the child is meeting recommendations of 60 min of at least moderate physical activity per day
Level of sedentary behavior, which should include hours of behavior using television, video games, and computer, and comparison to a baseline of <2 h/d
Routine activity patterns, such as walking to school or performing yard work
Assess practical resources and barriers (eg, neighborhood parks, grocery stores, recreation centers, and neighborhood children with whom to play can all support a healthier lifestyle)
Inquire about family cultural values, ethnicity, religion, and educational background

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and that obese patients have a lower quality of life.<sup>31</sup> Nearly all the programs (94%–100%) that participated in the survey assessed the following psychological traits: depression; anxiety; sense of competence; self-esteem; family dynamics; overall behavior and emotion; and eating disorders. The most inconsistencies in assessment were observed in the psychological domain. Approximately half of the programs (56%) assessed quality of life, of which half used the pediatric quality-of-life survey.

### Calculation of Chronological Age

Calculation of chronological age should be considered, because it influences the interpretation of all of the previously described measurements. Although simple, it is important to measure accurately in pediatrics, be-

cause growth and maturation reference standards (eg, BMI, BP) are age-specific. Although we found that a majority of the programs (83%) calculated age as decimal age (observation date minus birth date), some did not (eg, age at last birth date) and, thus, considered age as a whole number. Approximating ages can lead to erroneous determination of centiles and, in turn, diagnosis.

### SUMMARY AND CONCLUSIONS

The results of this survey indicate the diversity of pediatric obesity-management programs. The variation in assessment tools, protocols, etc is probably a result of the diversity of programs, which in turn may be dictated by personnel, both in terms of number and duties and experience with assessment techniques. Hospi-

tals face myriad challenges related to overweight services, including limited resources.<sup>32</sup> These results also reveal the difficulty/challenges in standardizing methodologies across clinics if we hope to compare outcomes across clinics or establish a national registry. A more general comment about assessment is the importance of selecting valid instruments. We found that some instruments used were not reliable or valid. Use of appropriate tools is important for obtaining “good” data that can be used in patient evaluation and assessment. Nonetheless, most programs that participated in this survey followed 2007 Expert Committee assessment recommendations (eg, using CDC reference values, assessing readiness to change, diet, physical activity, lipid profile, glucose level, liver

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**TABLE 3** Future Directions for Research: Assessment in Pediatric Obesity-Management Programs

Use bioelectric impedance analyzers to determine body composition with accurate devices and prediction equations
Determine waist-circumference centiles that confer elevated risk of cardiovascular disease risk factors
Assess physical activity and diet with reliable, valid, and feasible clinical instruments
Understand the clinical utility of behavioral instruments that comprehensively assess the combined factors of diet, physical activity, and lifestyle in the child, family, and environment

enzyme levels).<sup>3</sup> In addition to providing a better understanding of the current assessment practices in pediatric obesity-management programs, these results should assist other clinics/hospitals that are developing clinics and provide information that will better inform and equip clinicians to assess pediatric obesity. On the basis of the previous recommendations of the 2007 Expert Committee and the results of this survey, the considerations in Table 2 should also be taken into ac-

count. Future directions for research are provided in Table 3.

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