



**Clinical Guidelines on Evaluation and
Management of
Paediatric Overweight and Obesity**

Clinic Nutrition Unit

**Nutrition Section
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Task Force

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1. Introduction

Obesity is now reaching epidemic proportions in both developed and developing countries and is affecting not only adults but also children and adolescents. It has become the most prevalent nutritional problem in the world, and a main contributor to ill health and mortality and a risk factor for many chronic diseases.

In the Kingdom of Bahrain, the prevalence of overweight and obesity has increased over recent decades among both children and adults in all areas of the country. According to the most recent estimates from the 2005 Health Survey on a sample size of 2594 students, 1 in 4 (24%) Bahraini children and adolescents aged 6–18 years were overweight ⁽¹⁾. This high proportion is cause for concern, since there is a tendency for obese children to remain obese as adults. Moreover, obesity-related health problems are now occurring at a much earlier age and continue to progress into adulthood.

Being overweight increases the risk for other health conditions including diabetes, depression, asthma, cardiovascular disease, and cancer in adulthood. In fact, the striking increase in the prevalence of childhood obesity over the past 30 years has been associated with a marked increase in the incidence of type 2 diabetes among adolescents ⁽²⁾. In order to slow or reverse the increase in childhood obesity and the health risks associated with pediatric obesity, it will be necessary to treat obesity as soon as it is detected. Even more appealing would be the prevention of childhood obesity entirely by identifying children at risk and providing interventions designed to prevent inappropriate weight gain.

The cause of obesity is complex and multi-factorial. Within the context of environmental, social and genetic factors, at the simplest level obesity results from long-term positive energy balance — the interaction of energy intake and energy expenditure. With this increase, it seems that environmental and cultural influences rather than genetic factors have greater impact ⁽³⁾.

Therefore, this guidelines focus on the role of the primary care physicians, nurses as well as clinical nutritionist/dietitian in treating overweight. In addition, they provide the effects of treatment on overweight.

2. Obesity Treatment Evidence Based Guidelines

Our guidelines based on a review of a number of published international recommendation for treatment of child and adolescent overweight, and obesity of pediatrics committee (2007) and Guidelines for Adolescent Nutrition Services of School of Public Health, University of Minnesota (2005).

3. Objectives and Benefits

3.1. Objectives

The objectives of clinical guidelines of management of pediatric overweight and obesity are mainly to:

- Reduce prevalence of overweight and obesity among pediatric
- Assess the effectiveness of interventions designed to prevent obesity in pediatric through diet, physical activity and/or lifestyle and social support.
- Improve weight control
- Overall better health and quality of life
- Eliminate the problems caused by obesity
- Establish a process for developing evidence-based recommendations to guide the management and prevention of obesity at the individual and population levels.
- Identify gaps in knowledge and care.
- Disseminate the information to a broad spectrum of health care providers.
- Assist in public health policy development and to inform an agenda for future research to improve the standards of care.

3.2. Benefits

Top five benefits children and young people will gain through the Children's Weight Clinic ⁽⁴⁾

- Happier, livelier, more confident children
- A more active and enjoyable family lifestyle
- More focused and mentally active children
- Lower risk of diseases for the entire family
- Emotionally calmer children who have fewer mood swings.

4. Management

It is a two-step process:

4.1. The clinical assessment

4.2. The treatment

4.1. Clinical Assessment of Overweight and Obesity

The clinical assessment requires determination of the degree of overweight and overall risk status. Therefore, the assessment should include:-

4.1.1. Degree of overweight

4.1.1.1. BMI Calculation

4.1.1.2. Roll out secondary causes

4.1.1.3. Risk Status Determination

4.1.1.4. Assessment of Patient Motivation

4.1.1. BMI Calculation

- **Take accurate measures of height and weight**

- **Calculate BMI**

Anthropometry has been used during school years of children and adolescents in many contexts in relation to nutritional status. It has now well established that the body mass index (BMI) is the most appropriate variable to use to determine nutritional status among school children.

BMI is weight in kilograms (kg) divided by height in meters squared (m²), or kg/m². This value is compared to the recommended value for a child's age (BMI-for-Age).

$$\text{BMI} = \text{Wt (kg)} / \text{Ht (m)}^2$$

Further, BMI values for school children are compared with the appropriate recommended rounded values to different levels of indicators (normal, at risk of overweight, overweight and obese) according to guide for using the new WHO growth charts^(5,6) (Table1)

Table 1: Weight category diagnosis using BMI percentile for age birth-19 years^(5,6)

Parameters	WHO Child Growth Standards	WHO Reference 2007
Age	Birth to 5 years	5-19 years
Underweight Weight-for-age	<3 rd centile (<-2 Z-score)	<3 rd centile
Stunted Length-for-age/ height-for-age	<3 rd centile(<-2 Z-score)	<3 rd centile
Wasted Weight-for-length/ BMI-for-age*	<3 rd centile(<-2 Z-score)	<3 rd centile
Risk of overweight Weight-for-length/ BMI-for-age*	>85 th centile(>1 Z-score)	not applicable
Overweight Weight-for-length/ BMI-for-age*	> 97 th centile(>2 Z-score)	>85 th centile (≥1SD)
Obese Weight-for-length/ BMI-for-age*	>99.9 th centile(>3 Z-score)	>97 th centile (≥2SD)
Sever Obesity BMI-for-age	not applicable	>99.9 th centile

*Weight-for-length from birth-2 years; BMI-for-age ≥ 2 years

4.1.2. Risk Status Determination⁽³⁾

(Adopted from Canadian Diabetes Association 2003 clinical practice guidelines.38)

The initial assessment of the overweight child or adolescent has several components: identification of risk factors for the development of obesity; exclusion of a secondary cause of obesity; and determination of obesity-related comorbidities.

4.1.2.1. Identification of risk factors for the development of obesity

The assessment of an obese child requires a complete history and physical examination. The history should focus on the risk factors for obesity development

- 1- Family history of obesity and obesity-related disorders.
- 2- pregnancy history (maternal diabetes, pregnancy exposures, low birth weight).
- 3- infant feeding history should be ascertained.
- 4- Patterns of physical activity (more than 2 hours per day of television or computer and video games, and low participation in physical activities).
- 5- Nutritional intake (especially high sugared-drink intake, low fruit and vegetable intake, and disordered eating patterns).

4.1.2.2. Exclusion of a secondary cause of obesity

Obesity or overweight is a description of a phenotype rather than a diagnosis. Although endocrine and genetic causes of obesity are known, these are uncommon, and the vast majority of children will not have an identifiable endocrine or genetic cause of obesity. Most children with idiopathic obesity are tall for their age and genetic expectations.

- a- Endocrine causes of obesity in childhood are associated with attenuated linear growth (hypothyroidism, Cushing's disease, growth hormone deficiency). a history of central nervous system (CNS) injury (hypopituitarism). Testing for endocrine disorders is unlikely to be useful unless the child has demonstrated reduced growth velocity, is

- shorter than expected based on the family background or has a history of CNS injury.
- b- Obesity associated with a genetic syndrome is usually of early onset, is often associated with neuro-developmental delay and may be associated with dysmorphic features (e.g., Prader–Willi syndrome and Laurence–Moon syndrome). Referral to a geneticist for the evaluation of an obese child is usually not required unless there is marked obesity of early onset and associated abnormalities.
 - c- Progress in the understanding of appetite control has led to the identification of monogenic disorders resulting in obesity. The most common of these is caused by a mutation of the melanocortin-4-receptor (MC4R) and may be present in up to 10% of children with extreme obesity of early onset. Causal therapy for this disorder is not yet available.
 - d- Leptin deficiency is the only monogenic disorder for which a specific treatment is available (recombinant leptin replacement), but this deficiency is exceedingly rare.

These syndromes are both associated with early-onset obesity and with hyperphagia that may include food craving, waking at night to eat and food-stealing behaviours.

- e- Obesity may arise from the use of some medications, including glucocorticoids and newer antipsychotic drugs (e.g., risperidone and olanzapine).

4.1.2.3. Determination of obesity-related comorbidities

Many of the obesity-related comorbidities recognized in adulthood begin to develop in childhood such as Cardiovascular Comorbidities, metabolic

complications, psychosocial, orthopedic, respiratory, gastrointestinal, reproductive and renal.

Although these disorders are prevalent in childhood, research into screening strategies remains scant or nonexistent. Furthermore, there is a lack of information on optimal interventions in children who have been identified with these comorbidities.

a. Cardiovascular Comorbidities

Cardiovascular risk factors cluster in overweight and obese children⁷ and persist from childhood into adulthood. Furthermore, cardiovascular risk factors in childhood are related to the development of atherosclerosis in adolescence. Childhood obesity is also related to increase carotid intima-media thickness (a noninvasive measure of atherosclerosis) and coronary artery disease in adulthood.

Hypertension is a risk factor for atherosclerotic heart disease in adults and adolescents. Isolated systolic hypertension is the predominant form of hypertension associated with obesity. Because blood pressure in childhood varies with age, sex and height, hypertension is currently defined as systolic or diastolic blood pressure, measured repeatedly with an appropriate size of cuff that is at or above the 95th percentile for age, sex and height. Population- and school-based studies show that blood pressure increases with increased BMI. Hypertension is often associated with other cardiovascular risk factors and with obstructive sleep apnea.

Focal segmental glomerulosclerosis has been reported in obese adolescents, and improvement with weight loss has been described. However, insufficient studies are available to make a recommendation for screening.

b. Metabolic

b.1. Dyslipidemia

Dyslipidemia is reported with increasing frequency among obese children and adolescents. Low levels of high-density lipoprotein (HDL) cholesterol and elevated fasting triglyceride levels are the most common lipid abnormalities identified in obese children. Both are associated with the development of atherosclerosis and with adult cardiovascular disease, particularly when clustered with other cardiovascular risk factors.

Given the increased prevalence of dyslipidemia among obese children and its association with subsequent atherosclerosis, screening obese children over 10 years of age should be considered. Consideration may be given to screening younger children with a family history of premature coronary artery disease (in male relatives < 55 years and in female relatives < 65 years).

Although lipid indices vary somewhat with age, for simplification, cutoff points that indicate abnormal levels for HDL cholesterol (< 0.9 mmol/L), fasting triglycerides (< 1.69 mmol/L) and LDL cholesterol (2.85 mmol/L) have been recommended for boys and girls up to 18 years of age. Although the ideal frequency of repeat screening is unknown, given the influence of puberty on lipid levels, repeat testing in 2 years should be considered if obesity persists.

b.2. Abnormalities of glucose metabolism

Identifiable disturbances in glucose metabolism include abnormal fasting plasma glucose level, disturbed response to a glucose load (impaired glucose tolerance) and type 2 diabetes. All of these conditions are more common in obese children. In addition, hyperinsulinemia, consistent with insulin resistance, has been identified in a large proportion of obese children in population-based.

Impaired glucose tolerance includes as well impaired fasting glucose and is associated with an increased risk of type 2 diabetes in adults. The task force recommends measuring the fasting plasma glucose level to screen for type 2 diabetes in obese children 10 years of age or older who have; family history of type 2 diabetes, especially if in utero exposure; acanthosis nigricans; polycystic ovary syndrome; hypertension; and dyslipidemia (Refer to box)

b.3. Other health consequences of childhood obesity

Obstructive sleep apnea may be 4–5 times more likely to occur in obese children than in lean children. Although no proven effective screening method has been established, recent data suggest that a history of snoring, daytime somnolence and learning disability may predict sleep apnea in obese children.

Gastrointestinal morbidities associated with childhood obesity include nonalcoholic fatty liver disease, cholestatic liver disease and gastro esophageal reflux. Although the prevalence of nonalcoholic fatty liver disease is difficult to determine, magnetic resonance imaging and ultrasound studies suggest that it might be as high as 45% among obese adolescents. Liver transaminase levels are not elevated in all children with nonalcoholic fatty liver disease, but they are usually elevated in those with severe disease.

Polycystic ovary syndrome often accompanies insulin resistance and is seen in obese adolescent females. The presence of polycystic ovary syndrome should be considered in adolescent females with dyslipidemia, dysglycemia and irregular menses or clinical evidence of hyperandrogenemia.

Orthopedic problems in obese children include slipped capital femoral epiphysis, coxa vara, Blount disease (tibia vara), Legg–Calvé–Perthes disease and back pain.

Psychosocial disturbances, including low self-esteem and depression, in children and adolescents with obesity have been reported.

Table 2: Assessment of obesity-related health consequences

obesity-related comorbidities in Children	Condition	Proposed Assessment
Cardiovascular complications	Hypertension (Defined as systolic or diastolic blood pressure \geq 95th percentile based on age)	Serial blood pressure measurements performed in standardized manner
metabolic complications	impaired glucose tolerance type 2 diabetes	If \geq 10 years of age: • Fasting plasma glucose or oral glucose tolerance test if criteria met (see Box)
	dyslipidemia,	Fasting levels of total cholesterol, HDL cholesterol, triglycerides and LDL cholesterol
psychosocial	Depression • Low self-esteem • Binge-eating disorder	History
orthopedic	• Slipped capital femoral epiphysis • Tibia vara (Blount disease) • Spondylolisthesis • arthritis	• History • Physical examination
respiratory	obstructive sleep apnea	History: snoring; sleep-disordered breathing; early morning headaches; excess daytime fatigue • Consider sleep study if history consistent
gastrointestinal	nonalcoholic fatty liver disease, cholelithiasis, gastro esophageal reflux	• History • Physical examination • Consider measuring ALT and AST levels; alkaline phosphatase; albumin as appropriate
reproductive	polycystic ovary syndrome	• History: menstrual irregularity, secondary amenorrhea • Physical examination: hirsutism, acne • Consider measuring levels of free testosterone, luteinizing hormone and follicle stimulating hormone; abdominal ultrasound
renal	focal segmental glomerulosclerosis	

Note: HDL = high-density lipoprotein; LDL= low-density lipoprotein, ALT = alanine aminotransferase, AST = aspartate aminotransferase.

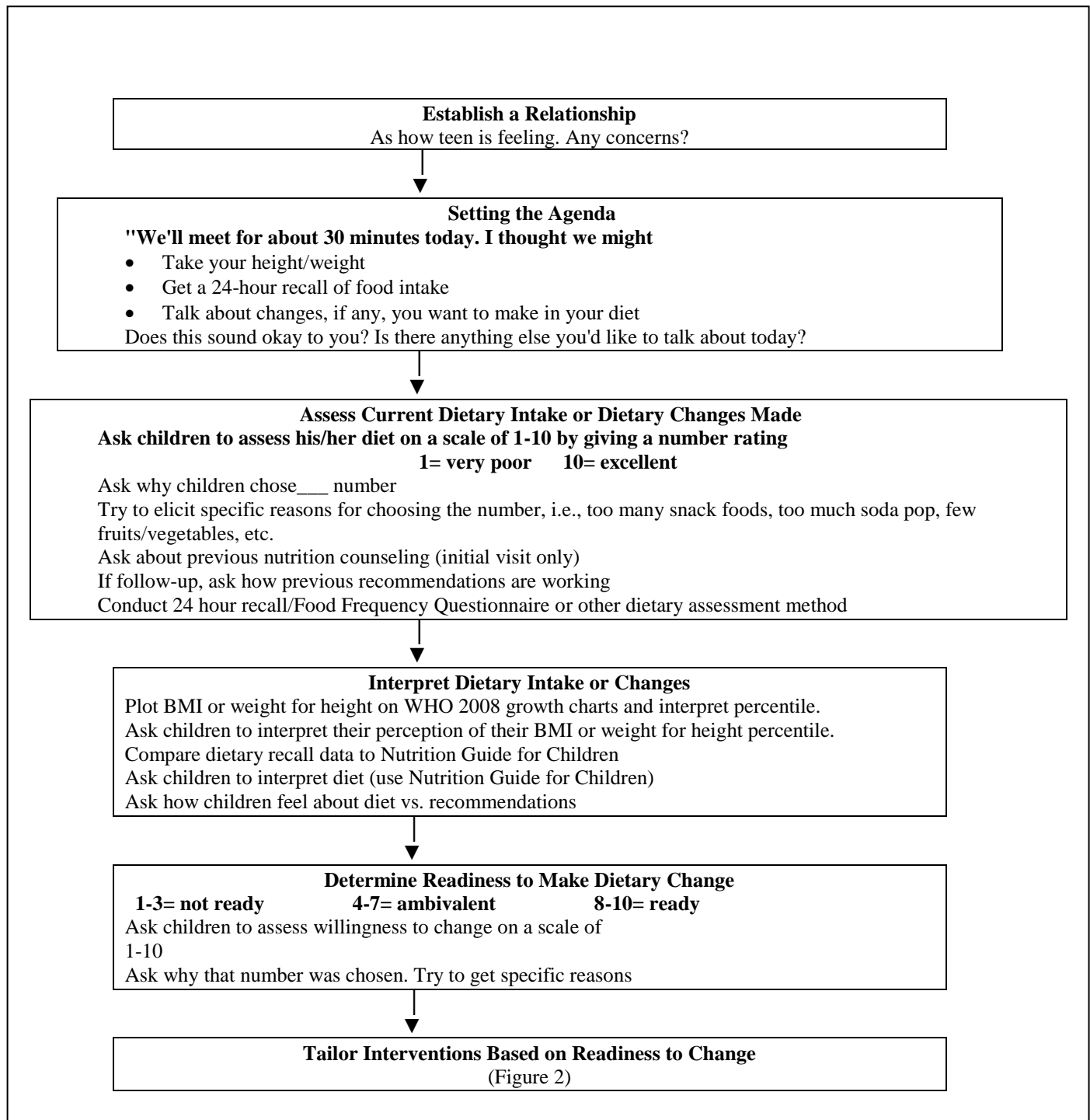
4.1.3. Assessment of Patient Motivation ⁽⁷⁾

Children should be **directly involved** in identifying priority areas for behavior change. Allowing children to review the results of their dietary assessment alongside current recommendations is an excellent way to get them involved.

Targeted questions about how the results of their dietary assessment differ from recommended intakes and the use of an **interactive nutrition evaluating** form can help to guide the adolescent in determining areas for behavior change.

If the teen does not identify specific areas where behavior change could be beneficial, it is appropriate to offer a prepared list of areas of **common concern** among teens and some **suggestions** for priority areas. If the children and adolescent are willing to change then can follow figure (1);

Figure (1): Adolescents willingness to change⁽⁸⁾



Ref: Adopted from Berg-Smith SM, Stevens VJ, Brown KM, et al. A brief motivational intervention to improve dietary adherence in adolescents. Health Education Research: Theory and Practice 1999; 14(3):399-410

Figure (2): Tailored Intervention Stages ⁽⁸⁾

Stage 1. Child is Not Ready To Make Dietary Change	Stage 2. Child is Ambivalent about Dietary Change	Stage 3. Child is Ready to Make Dietary Change
<p>Clinical Nutritionist Goal: To increase child's knowledge need for good nutrition and to educate/motivate.</p> <ul style="list-style-type: none"> ▪ Ask what would be needed to increase child's willingness to make dietary changes. ▪ Ask how you could help child to become ready to change. ▪ Reinforce your respect for child even if child chooses not to make changes. ▪ Offer advice such as "I would recommend you increase your vegetable intake. However it's your choice. If you decide at some time that you might want to eat more vegetables, then I will be glad to help you. In the meantime, may I call you periodically just to see how you're doing?" ▪ Ask open ended questions. ▪ Offer advice (with permission) and emphasize choice and personal responsibility. 	<p>Practitioner Goal: To motivate and empower child and to understand factors related to ambivalence.</p> <ul style="list-style-type: none"> ▪ Explore hesitancy. Ask about likes and dislikes in current diet or request a list of pros and cons of making dietary change. ▪ Ask about "healthy eating" habits or pros of making change first to set positive tone. Then ask cons of unhealthy habits. ▪ Ask what child feels the next step should be. ▪ Offer to maintain contact periodically to check on teen's progress. 	<p>Practitioner Goal: To help child develop a plan and to define and negotiate specific strategies.</p> <ul style="list-style-type: none"> ▪ Ask what child thinks needs to be changed. ▪ Ask for specific ideas or methods. ▪ Help set small, realistic goals for 1-2 changes and make suggestions on how to measure change. ▪ Choose rewards for achieving goals. ▪ Make a follow-up appointment to monitor progress.

Ref: Adopted from Berg-Smith SM, Stevens VJ, Brown KM, et al. A brief motivational intervention to improve dietary adherence in adolescents. Health Education Research: Theory and Practice 1999; 14(3):399-410.

4.1.4. Screening and Assessment:

Figure (3) provides a summary of the components of an initial dietary screening and rationale for a more extensive nutrition evaluation.

Figure (3): Elements of nutrition screening and assessment for children and adolescents. ⁽⁹⁾

<u>Components of an Initial Nutrition Screening</u>	
Medical and psychosocial history <ul style="list-style-type: none">▪ Medical history▪ Psychosocial history▪ Socioeconomic status and history	Dietary and physical activity <ul style="list-style-type: none">▪ Meal and snacking patterns▪ Nutrient and non- nutrient supplement use▪ Special dietary practices▪ Physical activity
Growth and development <ul style="list-style-type: none">▪ Body mass index (BMI)	Routine screenings and laboratory tests <ul style="list-style-type: none">▪ Hemoglobin▪ Blood Pressure▪ Glucose▪ Lipid Profile
<u>Indicators for an In-depth Nutrition Assessment</u>	
Medical and psychosocial history <ul style="list-style-type: none">▪ Chronic disease▪ Eating disorders▪ Body image disorders	Diet and physical activity <ul style="list-style-type: none">▪ Meal skipping▪ Inadequate micronutrient intake▪ Excessive intake of total or saturated fat▪ Use of high-dose vitamin-mineral or non- nutritional supplement▪ Chronic dieting
Growth and development <ul style="list-style-type: none">▪ Underweight▪ Overweight▪ At-risk for overweight▪ Delayed sexual maturation▪ Short stature	laboratory tests <ul style="list-style-type: none">▪ Iron deficiency anemia▪ Lipid profile▪ Fasting glucose

Much of this data can be gathered during a review of medical records; however, some information may need to be gathered from school children (especially ages above 11 years).

4.2. Treatment

Treatment Intensity⁽¹⁰⁾

The Prevention Plus stage may be an appropriate initial treatment intervention for all overweight and obese children 2 to 18 years of age. Obese children and adolescents with significant comorbidities and those with severe obesity may be immediately enrolled in a more-advanced stage of treatment if such services are readily available and if the child demonstrates appropriate motivation and readiness to change.

It may take 3 to 6 months for the lifestyle changes to produce a notable decrease in BMI. In most circumstances, the general goal for all ages is for BMI to deflect downward until it is <85th percentile. Although long-term monitoring of BMI is ideal, short-term (<3-month) weight changes may be easier to measure.

However, children may be advanced to a more-intensive level of treatment at any time if, in the judgment of the health care provider, they are not making adequate progress, their BMI has increased, comorbidities have developed or worsened, or children who are candidates for more-aggressive treatment show appropriate readiness to change.

Stage 1: Prevention Plus

To foster development of a healthful lifestyle, all children 2 to 18 years of age with a BMI percentile in the normal range (5th to 85th percentile) should follow the recommendations for food consumption, activity, and screen time. Children with BMIs in the 5th to 85th percentile possible risk of overweight during adolescence, underscoring the need for providers to address weight management and lifestyle issues with all patients regardless of their presenting weight.

For children 2 to 18 years of age with BMI of >85th percentile, it is recommended that the Prevention Plus stage be introduced. This differs from the prevention stage in that providers need to spend more time and intensity on the recommendations and provide closer follow-up monitoring (3–6 months). However, children in this stage who have BMI value between 85th and 97th percentiles, whose BMI values have tracked in the same percentile over time, and who have no medical risks may have a low risk for excess body

fat. Clinicians may continue obesity prevention strategies and not advance the treatment stage. These recommendations can be implemented by primary care physicians or allied health care providers who have some training in pediatric weight management or behavioral counseling.

a. Stage 1: Interventions

They should be based on the family's readiness to change and include the following:

- 1) Consumption of ≥ 5 servings of fruits and vegetables per day.
- 2) Minimization or elimination of sugar-sweetened beverages.
- 3) Limits of ≤ 2 hours of screen time per day, no television in the room where the child sleeps, and no television viewing if the child is < 2 years of age.
- 4) ≥ 1 hour of physical activity per day.

Physical activity can be increased gradually for sedentary children. Children may be unable to achieve 1 hour of activity per day initially but can gradually increase activity to reach ≥ 1 hour/day. If musculoskeletal pain prevents patients from engaging in activity, then referral to a physical therapist may be warranted.

b. Eating behaviors recommended for Patients and family members

They should be counseled to facilitate the following eating behaviors:

- (1) Eating breakfast daily.
- (2) Limiting meals outside the home, including at fast food venues and other restaurants.
- (3) Eating family meals at least 5 or 6 times per week.
- (4) Allowing the child to self-regulate his or her meals and avoiding overly restrictive behaviors for children < 12 years of age and suggested for those > 12 years of age. Providers should acknowledge cultural differences and help families adapt recommendations to address these differences.

Within this category, the goal should be weight maintenance with growth that results in decreasing BMI as age increases. Monthly follow-up assessments should be performed. If no improvement in BMI/weight status has been noted after 3 to 6 months, then advancement to stage 2 is indicated, on the basis of patient/family readiness to change. Prevention Plus can be implemented by primary care providers or allied health professionals (nurses or nutritionist/dietitians) with additional training in pediatric weight management.

Stage 2: Structured Weight Management

This stage targets the same behaviors as the Prevention Plus stage (food consumption, activity, and screen time) and offers additional support and structure to help the child achieve healthy behaviors. This stage requires additional training in behavioral counseling for primary care providers or other providers. It is characterized by closer follow-up monitoring, more structure, and inclusion of monitoring activities. Eating and activity goals specific to this stage of treatment are described below.

Stage 2

Recommendations include the following:

- (1) Development of a plan for use of a balanced-macronutrient diet, emphasizing small amounts of energy-dense foods.
- (2) Provision of structured daily meals and snacks (breakfast, lunch, dinner, and 1 or 2 snacks per day).
- (3) ≥ 60 minutes of supervised active play per day, to ensure activity.
- (4) ≤ 1 hour of screen time per day (suggest; CE for ≤ 2 hours).
- (5) Increased behavioral monitoring (eg, screen time, physical activity, dietary intake, and restaurant logs) by provider, patient, and/or family.
- (6) Reinforcement for achieving targeted behavior goals (not weight goals).

Within this category, the goal should be weight maintenance that results in decreasing BMI as age and height increase; however, weight loss should not exceed 0.5kg/month

for children 2 to 11 years of age or an average of 0.9kg/week for older overweight/obese children and adolescents. If no improvement in BMI/weight status is observed after 3 to 6 months, then the patient should be advanced to stage 3.

Ideally, a nutritionist/dietitian with expertise in childhood obesity could provide the nutrition and physical activity counseling in conjunction with the primary care provider. Additional training in motivational interviewing/behavioral counseling, monitoring and reinforcement, family conflict resolution, meal planning, and physical activity counseling could help primary care providers implement treatment.

Parents should be involved in behavioral modification for children <12 years of age, with gradual decreases in parental involvement as the child ages. Referral to a physical activity program may be necessary to help some families develop an active lifestyle. Monthly follow-up assessment is recommended for most patients in this stage of treatment.

Stage 3: Comprehensive Multidisciplinary Intervention

The eating and activity goals associated with this stage of treatment are generally the same as those of the preceding treatment stage, that is, structured weight management. The distinguishing characteristics of comprehensive multidisciplinary intervention are increased intensity of behavioral change strategies, greater frequency of patient-provider contact, and the specialists involved in the treatment. At this level of intervention, ideally the patient should be referred to a multidisciplinary obesity care team. The need for formalized behavioral therapy and a multidisciplinary treatment team exceeds the capacity of the services most primary care providers can supply. An individual provider, or several providers, can coordinate and supervise a multidisciplinary care program.

For stage 3, the eating and activity goals are the same as in stage 2

Activities within this category should also include the following:

- (1) Planned negative energy balance achieved through structured diet and physical activity.

- (2) Structured behavioral modification program, including food and activity monitoring and development of short-term diet and physical activity goals.
- (3) Involvement of primary caregivers/families for behavioral modification for children <12 years of age.
- (4) Provision of training for all families to improve the home environment.
- (5) Frequent office visits. Weekly visits for a minimum of 8 to 12 weeks seem to be most efficacious, and subsequent monthly visits help maintain new behaviors. Group visits may be more cost-effective and have therapeutic benefit.

Systematic evaluation of body measurements, dietary intake, and physical activity should be conducted at baseline and at specific intervals throughout the program. Within this category, the goal should be weight maintenance or gradual weight loss until BMI is $\leq 85^{\text{th}}$ percentile. Weight loss should not exceed 0.5kg/month for children 2 to 5 years of age or 0.9kg/week for older obese children and adolescents.

For implementation of the comprehensive multidisciplinary intervention, comprehensive treatment should be provided by a multidisciplinary obesity care team, including a behavioral counselor (for example, social worker, psychologist, other mental health care provider, or trained nurse practitioner), expert nutritionist/dietitian, and exercise specialist (physical activity specialist or other team member with training or a community program prepared to assist obese children). The primary care provider should continue to monitor medical issues and maintain a supportive alliance with the family.

Stage 4: Tertiary Care Intervention

The intensive interventions in this category have been used to only a limited extent in the pediatric population but may be appropriate for some severely obese youths who have been unable to improve their degree of adiposity and morbidity risks through lifestyle interventions. Candidates should have attempted weight loss at the level of stage 3 (comprehensive multidisciplinary intervention), should have the maturity to understand possible risks associated with stage 4 interventions, and should be willing to maintain physical activity, to follow a prescribed diet, and to participate in behavior monitoring. Lack of success with stage 3 treatment is not by itself a qualification for stage 4 treatment.

It is recommended that programs that provide these intensive treatments operate under established protocols to evaluate patients, to implement the program, and to monitor patients.

The components of stage 4 include referral to a pediatric tertiary weight management center that has access to a multidisciplinary team with expertise in childhood obesity and that operates with a designed protocol. This protocol should **include continued diet and activity counseling and consideration of additions such as meal replacement, a very-low-energy diet, medication, and surgery (suggest).**

There are few reports on the use of highly restrictive diets for children or adolescents. A restrictive diet has been used as the first step in a childhood weight management program, followed by a mildly restrictive diet.

Two medications have been approved by the FDA for use in adolescents, that is, **sibutramine, a serotonin reuptake inhibitor that increases weight loss by decreasing appetite, and orlistat, which causes fat malabsorption through inhibition of enteric lipase.** To be effective, these medications must be used in conjunction with diet and exercise. **The FDA has approved sibutramine for patients ≥ 16 years of age and orlistat for patients ≥ 12 years of age.**

Generally, gastric bypass has been used to treat severely obese adolescents who have not improved their weight or health with behavioral interventions. Inge et al⁽¹⁰⁾ proposed criteria for patient selection and qualification criteria, that is, BMI of ≥ 40 kg/m² with a medical condition or ≥ 50 kg/m², physical maturity (generally 13 years of age for girls and ≥ 15 years for boys), emotional and cognitive maturity, and ≥ 6 months of participation in a behavior-based treatment program.

Surgery should be performed only by experienced surgeons associated with a pediatric obesity center. Adolescents who undergo this procedure require careful medical, psychological, and emotional evaluation before surgery and prolonged nutritional and psychological support after surgery; many youths who might otherwise qualify live too far from an adolescent bariatric center.

For implementation of stage 4, the multidisciplinary team should have expertise in childhood obesity and its comorbidities, with patient care being provided by a physician, nurse practitioner, nutritionist/dietitian specialists, a behavioral counselor, and an exercise specialist.

Standard clinical protocols for patient selection should evaluate patient age, degree of obesity, motivation and emotional readiness, previous efforts to control weight, and family support. Standardized clinical protocols for evaluation before, during, and after the intervention should be followed. These evaluations should focus on the physical and emotional effects of the treatment. These protocols should be established by physicians, dietitians, physical activity specialists, and behaviorists familiar with weight management and pediatric care.

Table 4: Summary of Treatment

Provides a treatment summary to help physicians, as well as, nutritionist/dietitian to determine the appropriate weight management stage for each patient, on the basis of his/her age, BMI percentile, and, if applicable, weight-related disease status and former obesity treatment history. Age-appropriate, BMI-dependent, weight goals are also provided for treatment stages 1 to 3. Figures 4, 5, and 6 present this information in a flow algorithm.

TABLE 3 Staged Treatment of Pediatric Obesity According to Age and BMI Percentile ⁽¹⁰⁾

BMI Percentile	Age of 2–5 y	Age of 6–11 y	Age of 12–18 y
5 th -85 th (normal)	Prevention stage	Prevention stage	Prevention Stage
>85 th (Overweight)^a	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if increasing BMI percentile and persistent medical condition or parental obesity. Weight goal is weight maintenance until BMI is normal or slowing of weight gain, as indicated by downward deflection in BMI curve.	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if increasing BMI percentile or persistent medical condition. Weight goal is weight maintenance until BMI of ≤85 th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if increasing BMI percentile or persistent medical condition. Weight goal is weight maintenance until BMI of ≤85 th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
>97 th Obesity	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if not showing improvement. Weight goal is weight maintenance until	Start at Prevention Plus stage. Advance to structured weight management stage depending on responses to treatment, age, degree of obesity, health risks, and motivation. Advance from structured weight	Start at Prevention Plus or structured weight loss stage depending on age, degree of obesity, health risks, and motivation. Advance to more-intensive level of intervention depending on responses to

	BMI is normal; however, if weight loss occurs with healthy, adequate-energy diet, it should not exceed 0.5kg/mo. If greater loss is noted, monitor patient for causes of excessive weight loss. ^b	management stage to comprehensive multidisciplinary intervention stage after 3–6 mo if not showing improvement. Weight goal is weight maintenance until BMI of ≤85 th percentile or gradual weight loss of ~ 0.5kg/mo. If greater loss is noted, monitor patient for causes of excessive weight loss. ^b	treatment, age, health risks, and motivation. Weight goal is weight loss until BMI of ≤85 th percentile, with no more than average of 0.9kg/wk. If greater loss is noted, monitor patient for causes of excessive weight loss. ^b
>99.9th Sever Obesity	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if not showing improvement. Advance from structured weight management stage to comprehensive multidisciplinary intervention stage after 3–6 mo if not showing improvement and comorbidity or family history indicates. Weight goal is gradual weight loss, not to exceed 0.5kg/mo. If greater loss occurs, monitor patient for causes of excessive weight loss. ^b	Start at Prevention Plus stage. Advance to structured weight management stage depending on responses to treatment, age, degree of obesity, health risks, and motivation. Advance from structured weight management stage to comprehensive multidisciplinary intervention stage after 3–6 mo if not showing improvement. After 3–6 mo with comorbidity present and patient not showing improvement, it may be appropriate for patient to receive evaluation in tertiary care center. Weight goal is weight loss not to exceed average of 0.9kg/wk. If greater loss is noted, monitor patient for causes of excessive weight loss. ^b	Start at stage 1, 2, or 3 of treatment depending on age, degree of obesity, health risks, and motivation. Advance to more-intensive levels of intervention depending on responses to treatment, age, health risks, and motivation of patient and family. Advance from comprehensive multidisciplinary intervention stage to tertiary care stage after 3–6 mo with comorbidity present and patient not showing improvement. Patients may warrant tertiary care evaluation to determine next level of treatment. Weight goal is weight loss not to exceed average of 0.9kg/wk. If greater loss is noted, monitor patient for causes of excessive weight loss. ^b

In most circumstances, the general goal for all ages is for BMI to deflect downward until it is <85th percentile. Although long-term BMI monitoring is ideal, short-term (<3-month) weight changes may be easier to measure. Resolution of comorbidities is also a goal.

^a Children in this BMI category whose BMI has tracked in the same percentile over time and who have no medical risks may have a low risk for excess body fat. Clinicians can continue obesity prevention strategies and not advance treatment stages.

^b Because Youth Risk Behavior Surveillance Survey responses indicated that 15% of teens practice some unhealthy eating behaviors, all teens should be evaluated for these symptoms. Providers should be especially concerned if weight loss is >2 lb/week in this age group and should evaluate patients for excessive energy restrictions by the parent or child/teen or unhealthy forms of weight loss (meal skipping, purging, fasting, excessive exercise, and/or use of laxatives, diet pills, or weight loss supplements).

Weight Loss Goals

In most circumstances, the general goal for all ages is for BMI to deflect downward until it is normal weight. With the realization that some children are healthy with BMI values between 85th and 97th percentiles. The long-term monitoring of BMI is ideal, short-term (<3-month) weight changes may be easier to measure. Resolution of comorbidities is also a goal.

Table 5 is considered when the staged treatment plan for children whose BMI is between 85th -97th percentiles, whose BMI has tracked in the same percentile over time, and who have no medical risks may have a low risk for excess body fat. Clinicians can continue obesity prevention strategies and not advance to the next treatment stage.

TABLE 4: Weight Recommendations According to Age and BMI Percentile ⁽¹⁰⁾

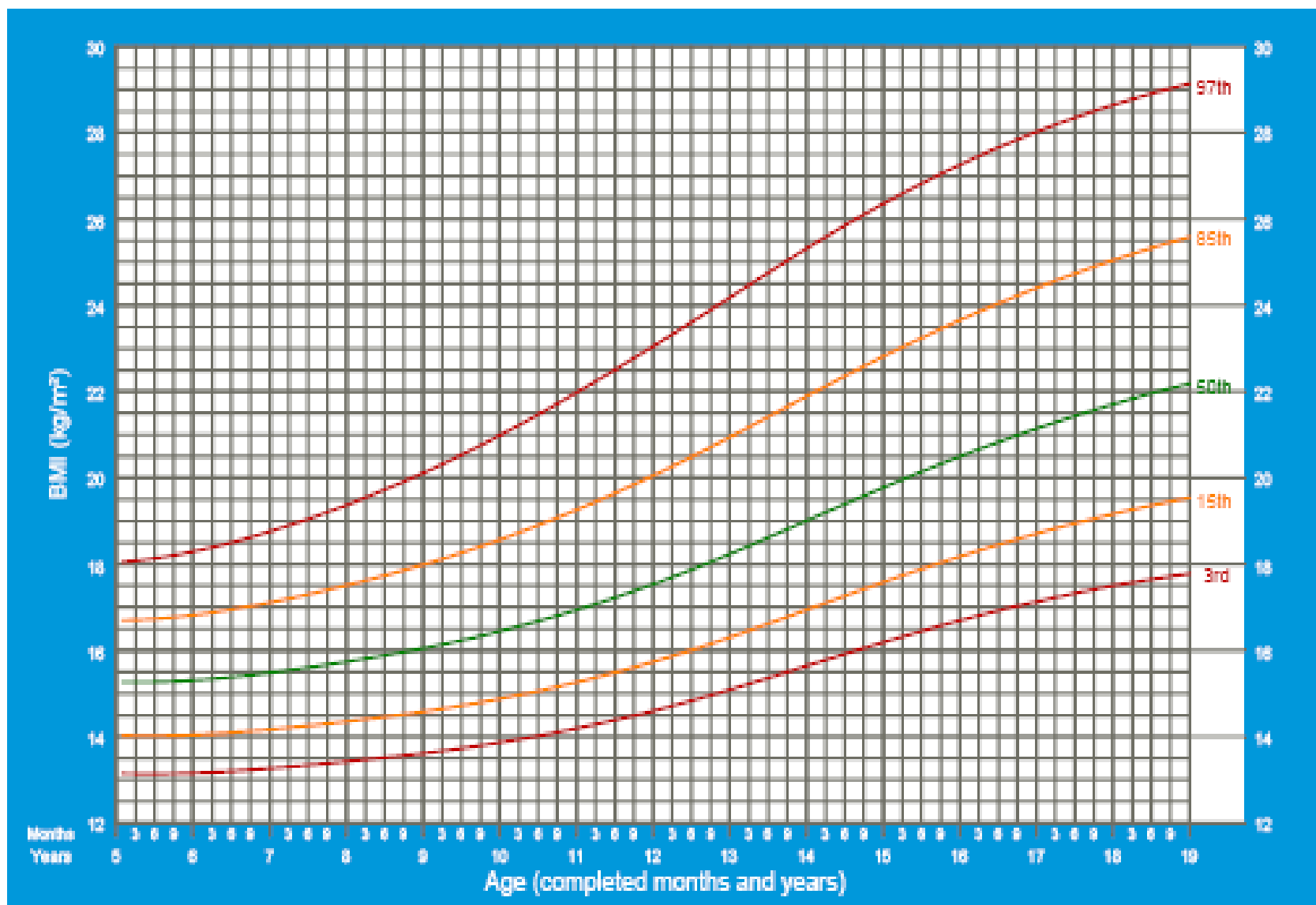
Age	Target
2–5 y	
>97th Overweight	Weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
>99.9th Obesity	Weight maintenance until BMI of <85th percentile; however, if weight loss occurs with healthy, adequate-energy diet, then it should not exceed 0.5kg/mo. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
BMI of > 21 kg/m² (rare, very high)	Gradual weight loss, not to exceed 0.5kg/mo. If greater loss occurs, then patient should be monitored for causes of excessive weight loss.
6–11 y	
>85th Overweight	Weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
>97th Obesity	Weight maintenance until BMI of <85th percentile or gradual weight loss of 0.5kg/mo. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
>99.9th Sever Obesity	Weight loss not to exceed average of 0.9kg/wk. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
12–18 y	
>85th Overweight	Weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
>97th Obesity	Weight loss until BMI of <85th percentile, no more than average of 0.9kg/wk. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
>99.9th Sever Obesity	Weight loss not to exceed average of 0.9kg/wk. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.

Appendix

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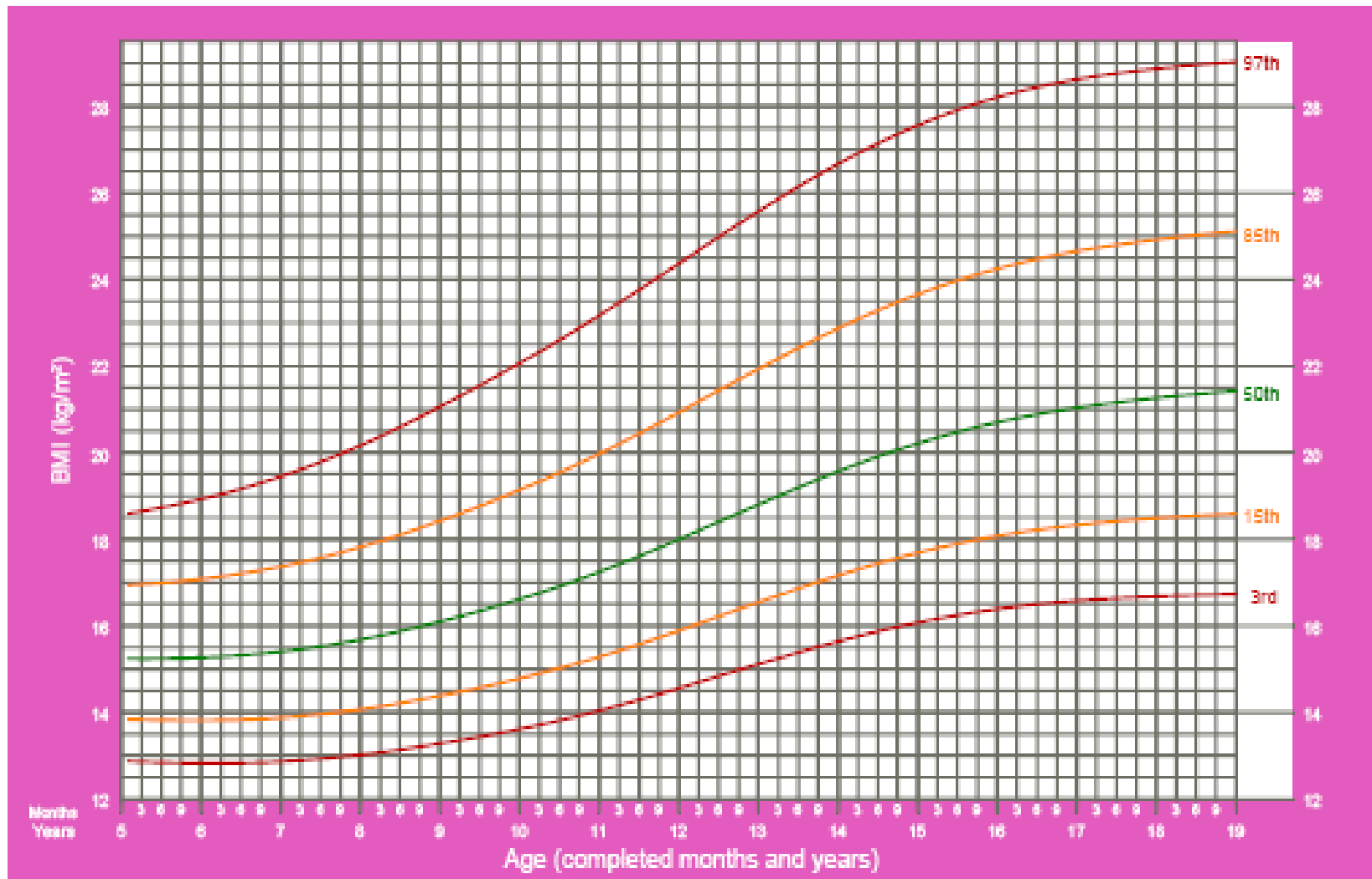
BMI-for-age BOYS

5 to 19 years (percentiles)



BMI-for-age GIRLS

5 to 19 years (percentiles)



2007 WHO Reference

Appendix (2)

Figure (4)⁽¹⁰⁾

Staged Treatment for 2-5 year old children



Suggested staged treatment for 2- to 5-year-old children. The order of the stages and the time in each stage should be tailored to the child's physical and emotional development and the readiness of the child and family to change. SWM indicates structured weight management; CMI, comprehensive multidisciplinary intervention.

Ref: Adopted from Recommendations for Treatment of Child and Adolescent Overweight and Obesity, PEDIATRICS Vol. 120 Supplement December 2007, pp. S254-S288

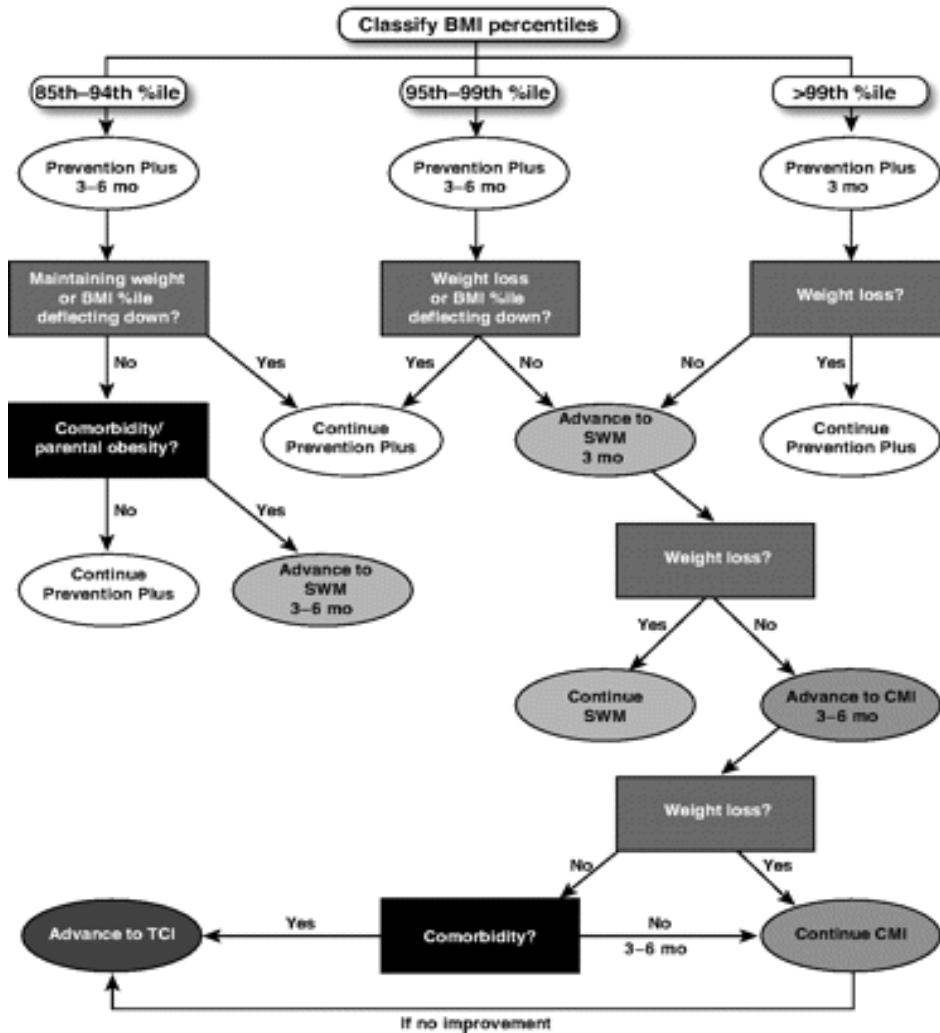
Figure (5)⁽¹⁰⁾
Staged Treatment for 6-11 year old youth



Staged treatment for 6- to 11-year-old youth. The order of the stages and the time in each stage should be tailored to the child's physical and emotional development and the readiness of the child and family to change. SWM indicates structured weight management; Cont, continue; CMI, comprehensive multidisciplinary intervention; TCI, tertiary care intervention.

Ref: Adopted from Recommendations for Treatment of Child and Adolescent Overweight and Obesity, PEDIATRICS Vol. 120 Supplement December 2007, pp. S254-S288

Figure (6) ⁽¹⁰⁾
Staged Treatment for 12-18 year old youths



Staged treatment for 12- to 18-year-old youths. The order of the stages and the time in each stage should be tailored to the child's physical and emotional development and the readiness of the child and family to change. SWM indicates structured weight management; Cont, continue; CMI, comprehensive multidisciplinary intervention; TCI, tertiary care intervention.

Ref: Adopted from Recommendations for Treatment of Child and Adolescent Overweight and Obesity, PEDIATRICS Vol. 120 Supplement December 2007, pp. S254-S288

Appendix (3)

Healthy Lifestyle Recommendations and Strategies for Success ⁽¹²⁾

Eat a nutritious breakfast every day.

- Eating breakfast may reduce snacking and fat intake during the rest of the day.
- Get up a little earlier so that you will have time to prepare and eat breakfast.
- Offer fruits first, then whole grains.
- Don't buy cereals that have added sugar (it's okay to add fruit or a little sugar to cereal).

Eat fewer foods that are high in fat and calories.

- Give overweight and obese children low fat milk after age 1 and nonfat milk after age 2. Low fat and nonfat milk have a little more calcium per cup than does whole milk.
- Foods with high water content, such as soups, fruits and vegetables, tend to have fewer calories per unit and can make children feel satisfied without adding unnecessary calories and fat to the diet.
- Drink less 100-percent fruit juice. While fruit juice contains many important nutrients, it is also high in calories. Drinking too much fruit juice may contribute to weight gain.

Plan healthy snacks and meals.

- Eating regular, healthy meals and snacks is key to a healthy lifestyle.
- Plan ahead and make fruit or raw mixed nuts available for snacking (but do not give nuts to children under 4 years of age because they may choke).
- Eat meals as a family, and don't eat while watching television.

Minimize sugar-sweetened beverages.

- Drinking too many sugar-sweetened beverages, such as soda or juice drinks, can contribute to weight gain. For example, drinking one soda each day adds enough extra calories to result in a 5kg weight gain each year.
- Water is the most important nutrient. Pack water instead of juice boxes for lunches, sports or travel.

Limit meals away from home.

- The more meals you eat at home, the more fruits and vegetables (and the less soda) you will consume. Eating out at fast food restaurants has been linked to obesity in children.
- Plan ahead. Prepare meals over the weekend that can be reheated during the week when you have less time.
- Learn how to prepare your favorite foods with more healthful ingredients.
- Cook with your children and have them help clean up after meals.
- Don't eat in front of the television. To make mealtimes fun, have a collection of conversation-starting questions on hand.

Serve appropriate portion sizes.

- Portion sizes are different for people of different genders and sizes.
- Your fist is approximately the size of one portion of vegetables, fruit or pasta for you. Your palm is about the right size portion of protein for you.

Limit screen time (combined time spent watching television, playing video games and using the computer) to less than 2 hours a day for children over age 2, and to none for children under age 2.

- Time spent watching television, playing video games and using the computer can decrease the amount of time spent on physical activity.
- Remove television sets from children's bedrooms.
- Set a timer to sound when your child's screen time is up.
- Choose what shows to watch as a family, and shut the television off when your show is over.

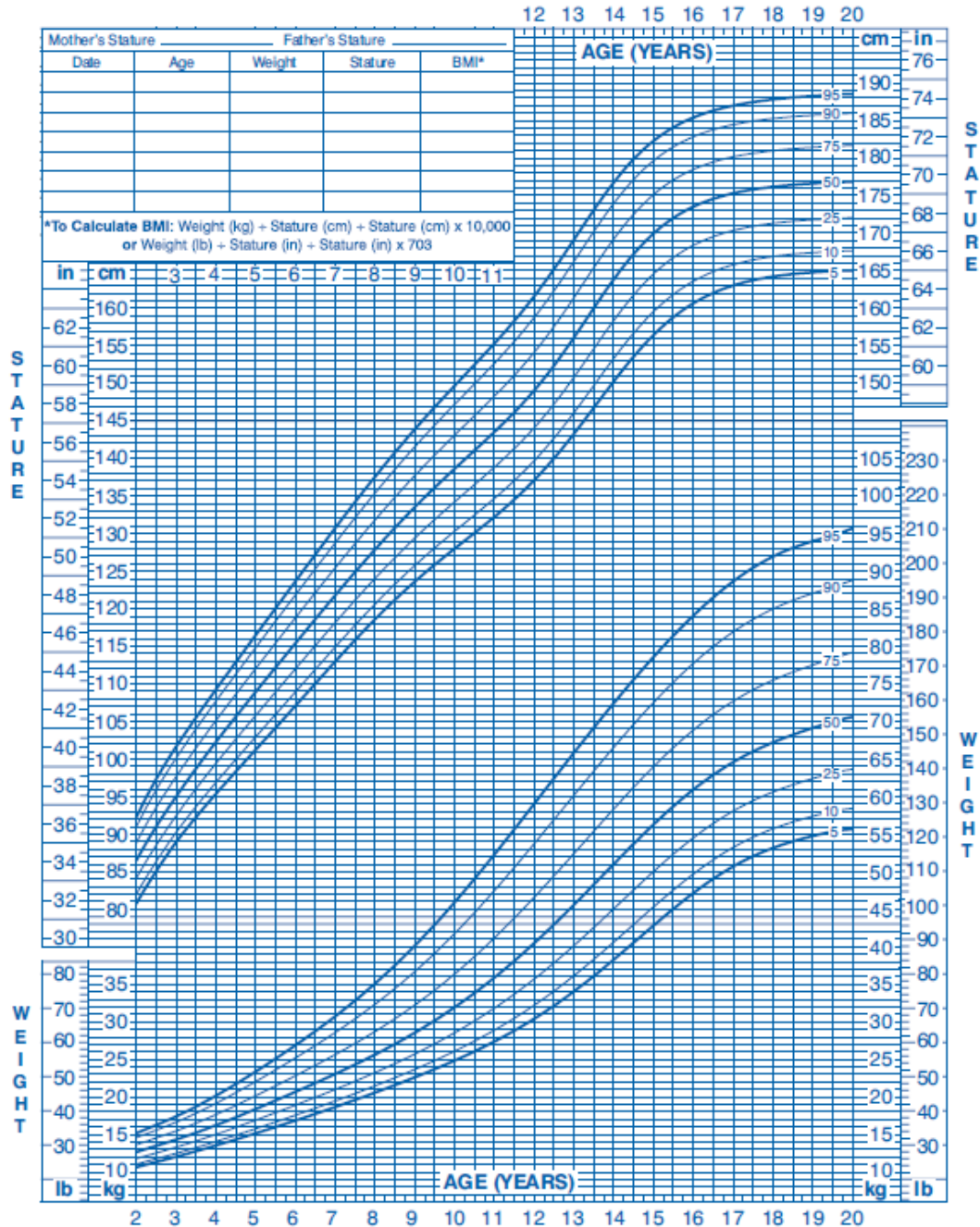
Increase active time for children and families to at least 60 minutes each day (Puff off).

- Incorporate exercise into your daily routine by walking to school, taking the stairs or finding ways to move for fun (dancing, jumping rope, and playing active games).
- Advocate for quality physical education in your school.
- Organize active play dates with friends.
- Physicians should recognize that families from different cultures may need help learning to prepare traditional foods in a more healthful way and direct them to appropriate resources.

2 to 20 years: Boys
Stature-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Published May 30, 2000 (modified 11/21/00).
 SOURCE: Developed by the National Center for Health Statistics in collaboration with
 the National Center for Chronic Disease Prevention and Health Promotion (2000).
<http://www.cdc.gov/growthcharts>

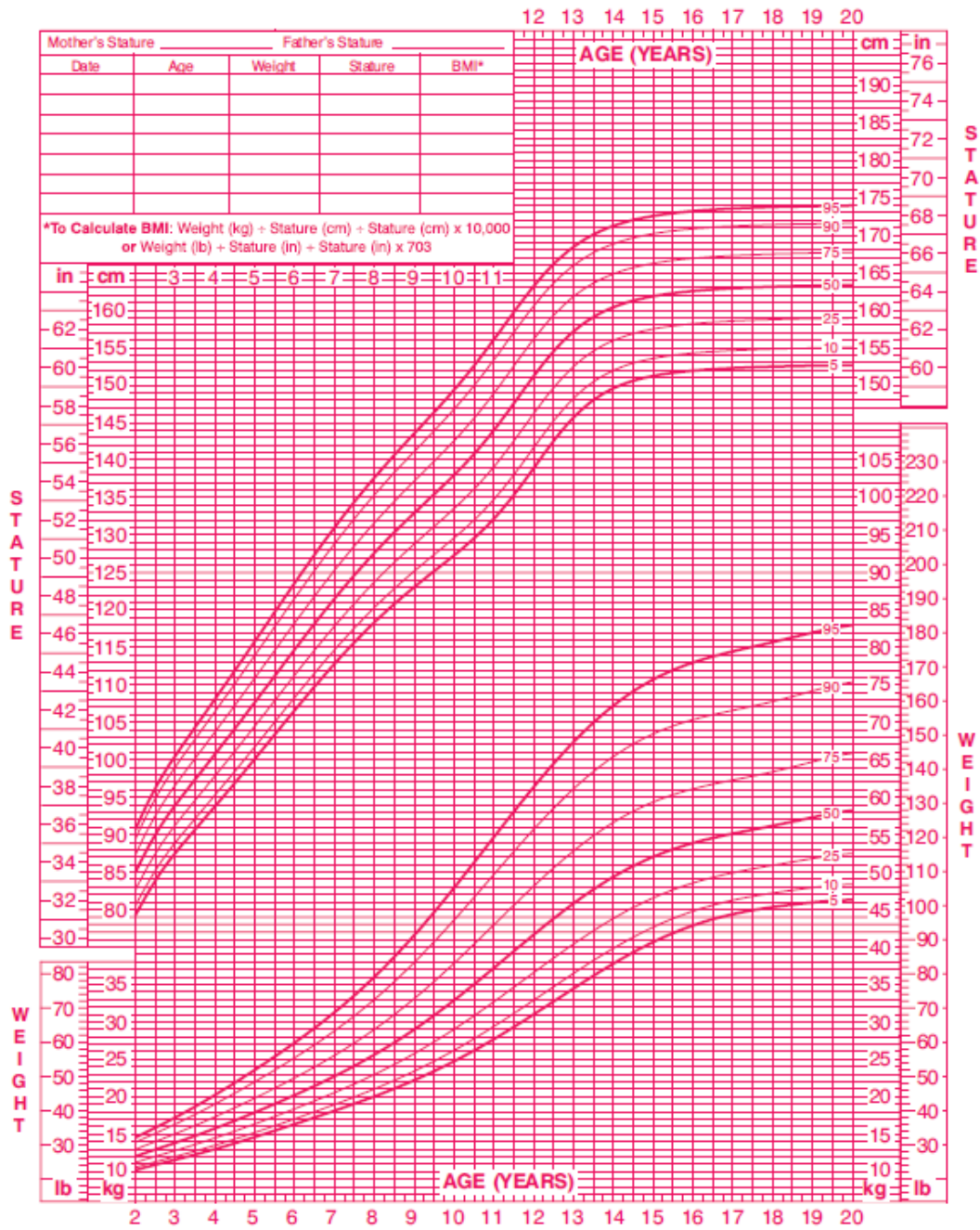


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2 to 20 years: Girls
Stature-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Published May 30, 2000 (modified 11/21/00).

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
<http://www.cdc.gov/growthcharts>



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Blood Pressure Levels for Boys by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	94	95	97	99	100	101	55	55	56	57	58	59	59
	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

Blood Pressure Levels for Boys by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	50th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50th	111	112	114	116	118	119	120	63	63	64	65	66	67	67
	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B-1 allow one to compute BP Z-scores and percentiles for boys with height percentiles given in Table 3 (i.e., the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2-4 described in Appendix B. For children with height percentiles other than these, follow steps 1-4 as described in Appendix B.

Blood Pressure Levels for Girls by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	83	84	85	86	88	89	90	38	39	39	40	41	41	42
	90th	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95th	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99th	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	50th	85	85	87	88	89	91	91	43	44	44	45	46	46	47
	90th	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95th	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99th	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	50th	86	87	88	89	91	92	93	47	48	48	49	50	50	51
	90th	100	100	102	103	104	106	106	61	62	62	63	64	64	65
	95th	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99th	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	50th	88	88	90	91	92	94	94	50	50	51	52	52	53	54
	90th	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95th	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99th	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	50th	89	90	91	93	94	95	96	52	53	53	54	55	55	56
	90th	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95th	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99th	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	50th	91	92	93	94	96	97	98	54	54	55	56	56	57	58
	90th	104	105	106	108	109	110	111	68	68	69	70	70	71	72
	95th	108	109	110	111	113	114	115	72	72	73	74	74	75	76
	99th	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	50th	93	93	95	96	97	99	99	55	56	56	57	58	58	59
	90th	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95th	110	111	112	113	115	116	116	73	74	74	75	76	76	77
	99th	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	50th	95	95	96	98	99	100	101	57	57	57	58	59	60	60
	90th	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95th	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99th	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	50th	96	97	98	100	101	102	103	58	58	58	59	60	61	61
	90th	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95th	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99th	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	50th	98	99	100	102	103	104	105	59	59	59	60	61	62	62
	90th	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99th	123	123	125	126	127	129	129	84	84	85	86	86	87	88

Blood Pressure Levels for Girls by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	100	101	102	103	105	106	107	60	60	60	61	62	63	63
	90th	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99th	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	50th	102	103	104	105	107	108	109	61	61	61	62	63	64	64
	90th	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99th	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	50th	104	105	106	107	109	110	110	62	62	62	63	64	65	65
	90th	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99th	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	50th	106	106	107	109	110	111	112	63	63	63	64	65	66	66
	90th	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95th	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99th	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	50th	107	108	109	110	111	113	113	64	64	64	65	66	67	67
	90th	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	85
	99th	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	50th	108	108	110	111	112	114	114	64	64	65	66	66	67	68
	90th	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99th	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	50th	108	109	110	111	113	114	115	64	65	65	66	67	67	68
	90th	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99th	133	133	134	136	137	138	139	90	90	91	91	92	93	93

BP, blood pressure

* The 90th percentile is 1.28 SD, 95th percentile is 1.645 SD, and the 99th percentile is 2.326 SD over the mean.

For research purposes, the standard deviations in Appendix Table B-1 allow one to compute BP Z-scores and percentiles for girls with height percentiles given in Table 4 (i.e., the 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles). These height percentiles must be converted to height Z-scores given by (5% = -1.645; 10% = -1.28; 25% = -0.68; 50% = 0; 75% = 0.68; 90% = 1.28%; 95% = 1.645) and then computed according to the methodology in steps 2-4 described in Appendix B. For children with height percentiles other than these, follow steps 1-4 as described in Appendix B.

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