
CLINICAL PRACTICE GUIDELINES

LIGNES DIRECTRICES DE PRATIQUE CLINIQUE

Periodic health examination, 1994 update:

1. Obesity in childhood

Canadian Task Force on the Periodic Health Examination

Objective: To update the 1979 Canadian Task Force on the Periodic Health Examination recommendation on screening for childhood obesity by reviewing any new evidence concerning health risks in childhood and adulthood, and effective preventive or therapeutic interventions.

Options: Detection: routine measurement of height and weight, use of skinfold thickness measurements, calculation of body mass index (BMI). Intervention: diet, exercise, behaviour modification and comprehensive family-based weight-reduction programs. Components of these interventions could be offered routinely or reserved for children and families who perceive obesity to be a present or potential problem.

Outcomes: The task force reviewed the probability of obese children become obese adults as a risk factor for adult heart disease and overall related illness and death in adult life as well as obesity as a risk factor for physical and psychologic illness in childhood.

Evidence: A MEDLINE search for relevant articles published between January 1981 and February 1991 was undertaken.

Values: The task force's evidence-based rules for recommendations were used.

Benefits, harms and costs: If weight reduction in childhood were shown to prevent physical or psychologic illness in childhood, or illness and death in adult life, screening and treatment should be recommended. Screening for obesity may cause anxiety on the part of the child and family; malnutrition in children as a result of parents becoming overly anxious about the health risks of obesity has been reported. Most weight reduction programs have limited long-term effectiveness and can be costly.

Recommendations: There is insufficient evidence of short-term or long-term benefits from screening for or treatment of childhood obesity to recommend such screening or recommend against it. There is fair evidence to recommend against very-low-kilojoule diets for preado-

Chairman: Dr. Richard Goldbloom, professor, Department of Pediatrics, Dalhousie University, Halifax, NS. **Vice-chairman:** Dr. Renaldo N. Battista, director, Division of Clinical Epidemiology, Montreal General Hospital, Montreal, Que. **Members:** Drs. Geoffrey Anderson, assistant professor, Department of Health Services Research and Development, University of British Columbia, Vancouver, BC; Marie-Dominique Beaulieu, professor and director of research, Department of Family Medicine, University of Montreal, Montreal, Que.; R. Wayne Elford, associate professor and chairman of research, Department of Family Medicine, University of Calgary, Calgary, Alta.; John W. Feightner, associate professor and research director, Department of Family Medicine, McMaster University, Hamilton, Ont.; William Feldman (*principal author*), professor of pediatrics, University of Toronto, and head, Division of General Pediatrics, Hospital for Sick Children, Toronto, Ont.; Alexander G. Logan, professor, Faculty of Medicine, University of Toronto, Toronto, Ont.; Brenda Morrison, associate professor, Department of Health Care and Epidemiology, University of British Columbia, Vancouver, BC; David Offord, professor, Department of Psychiatry, McMaster University, Hamilton, Ont.; Christopher Patterson, professor and head, Division of Geriatric Medicine, Faculty of Health Sciences, McMaster University, Hamilton, Ont.; Walter O. Spitzer, professor and chairman, Department of Epidemiology and Biostatistics, McGill University, Montreal, Que.; and Elaine Wang, assistant professor, Department of Pediatrics, Faculty of Medicine, University of Toronto, Toronto, Ont. **Resource people:** Dr. Phillip Mickelson, medical consultant, health standards, Health Services Directorate, Health Canada, Ottawa, Ont.; Ms. Jennifer Dingle, coordinator, Canadian Task Force on the Periodic Health Examination, Department of Pediatrics, Dalhousie University, Halifax, NS; and Ms. Brenda Beagan, research associate, Canadian Task Force on the Periodic Health Examination, Department of Pediatrics, Dalhousie University, Halifax, NS.

Copies of this and other task force reports are available from the Health Services Directorate, Health Services and Promotion Branch, Health Canada, Tunney's Pasture, Ottawa, ON K1A 1B4.

lescents. There is insufficient evidence to recommend for or against exercise programs or intensive family-based programs for most obese children.

Validation: These recommendations are similar to those of the American Academy of Pediatrics and the US Preventive Services Task Force.

Sponsor: These guidelines were developed and endorsed by the Canadian task force, which is funded by Health Canada.

Objectif : Mettre à jour la recommandation de 1979 du Groupe d'étude canadien sur l'examen médical périodique au sujet du dépistage de l'obésité chez l'enfant en examinant toute preuve nouvelle sur les risques pour la santé dans l'enfance et à l'âge adulte et sur les interventions préventives ou thérapeutiques efficaces.

Options : Détection : mesure routinière de la taille et du poids, utilisation des mesures d'épaisseur du pli cutané, calcul de l'indice de masse corporelle (IMC). Intervention : régime alimentaire, exercice, modification du comportement et programme familial complet d'amaigrissement. Des éléments constitutifs de ces interventions pourraient être offerts de routine ou réservés aux enfants et aux familles qui perçoivent l'obésité comme un problème actuel ou éventuel.

Résultats : Le groupe d'étude a examiné la probabilité que des enfants obèses deviennent des adultes obèses comme facteur de risque lié aux cardiopathies chez les adultes, ainsi qu'aux maladies connexes en général et à la mort au cours de la vie adulte, ainsi que l'obésité comme facteur de risque lié à des maladies physiques et psychologiques chez l'enfant.

Preuve : Recherche dans MEDLINE d'articles publiés sur la question entre janvier 1981 et février 1991.

Valeurs : On a utilisé les règles fondées sur la preuve adoptées par le groupe d'étude pour présenter les recommandations.

Avantages, préjudices et coûts : Si l'on a démontré que l'amaigrissement chez l'enfant prévient des maladies physiques ou psychologiques au cours de l'enfance ou la maladie et la mort au cours de l'âge adulte, il faudrait recommander le dépistage et le traitement. Le dépistage de l'obésité peut provoquer l'anxiété chez l'enfant et les membres de sa famille. On a signalé des cas de malnutrition chez des enfants après que des parents soient devenus trop inquiets au sujet des risques posés pour la santé par l'obésité. La plupart des programmes d'amaigrissement ont une efficacité à long terme limitée et peuvent être coûteux.

Recommandations : Les preuves relatives aux avantages à court terme ou à long terme que présentent le dépistage ou le traitement de l'obésité chez l'enfant ne suffisent pas pour qu'on puisse se prononcer en faveur d'un tel dépistage ou contre celui-ci. Il semble y avoir assez de preuves pour qu'on puisse se prononcer contre les régimes très faibles en kilojoules chez les pré-adolescents. Il n'y a pas suffisamment de preuves pour qu'on puisse se prononcer pour ou contre les programmes d'exercice ou les programmes familiaux intensifs dans le cas de la plupart des enfants obèses.

Validation : Ces recommandations ressemblent à celles de l'American Academy of Pediatrics et du US Preventive Services Task Force.

Commanditaire : Ces lignes directrices ont été élaborées et approuvées par le groupe d'étude, qui est financé par Santé Canada.

In 1979 the Canadian Task Force on the Periodic Health Examination concluded that there was no justification for seeking childhood obesity in a periodic health examination (grade C recommendation).^{1,2} This position was based on the lack of an effective program to prevent or treat obesity in children. However, it was considered advisable to record height and weight on standard growth charts and identify any deviations from normal growth.^{1,2}

Since 1979 several studies have investigated the consequences of childhood obesity, particularly the probability that an obese child will become an obese adult. Also, there have been several published randomized controlled trials of the effectiveness of treatment programs based on nutrition and exercise education

and family-based behaviour modification. In light of these developments, the task force reviewed the new evidence and reconsidered its recommendations.

Literature review

We conducted a MEDLINE search of articles published between January 1981 and February 1991 with the use of the MeSH terms "child" and "obesity." We also searched for additional references from articles retrieved. The levels of evidence based on study design and methodologic strength, and the grades of recommendations based on the strength of the evidence were established according to the task force protocol.³ The articles were retrieved, collated and reviewed by a research asso-

ciate working for the task force and by the principal author. All members of the task force reviewed the draft report, evaluated the evidence and agreed on the recommendations and reported findings.³

Prevalence

Estimates of the Canadian prevalence of childhood obesity have ranged from 7%⁴ to 43%,⁵ depending on whether obesity was defined on the basis of self-reports or objective measures and on what measure of obesity was used — skinfold thickness or body mass index (BMI), also called Quetelet's index, which is weight divided by height squared. There is some evidence that among adults Canadian obesity rates fall between US and British rates, the rate among older adults being closer to the US rate and the rate among those 20 to 24 years being closer to the British rate.⁶ A national survey in Britain in 1974 showed that 7.3% of children and adolescents 7 to 16 years of age were obese.⁷

In the United States it has been estimated that 10% to 15% of children are obese.^{8,9} One US study, the second National Health and Nutrition Examination Survey, showed that 27.1% of children 6 to 11 years of age and 21.9% of adolescents 12 to 17 years of age were obese (triceps skinfold measurements in the 85th percentile).¹⁰ However, there is an inherent difficulty with studies based on earlier population norms. If the sample is large and representative, it indicates that the normative data should be changed; if 27% of children in a given year exceed the 85th percentile determined some years earlier, it may be that the entire population has a higher weight and that the previous percentiles defining "normality" are no longer valid.

Low socioeconomic status is a risk factor for childhood obesity. An inverse relation has been shown between social class and prevalence of obesity in children 3 to 18 years of age: rates range from 25% in low-income families to 5% in high-income families.¹¹⁻¹³

Causes

The most convincing evidence in the "nature-versus-nurture" debate has come from recent studies involving adoptees and twins. A Danish study involving 540 adoptees showed a strong relation between the BMIs of the adoptees and their biologic parents but no relation with the BMIs of their adoptive parents.¹⁴ The researchers concluded that family environment alone has no apparent effect on obesity.

Evidence from studies involving twins is even more persuasive. Evaluation of the intrapair variance in BMI or skinfold thickness between sets of identical and fraternal twins reared together or apart allows estimation of the relative contributions of genetic factors, shared environmental factors and unshared individual environmental factors. Genetic factors appear to predominate.¹⁵⁻¹⁷

In earlier studies involving twins reared together it was difficult to account for the effects of the shared environments. However, in the most recent twin study Stunkard and associates¹⁸ assessed the relative contributions of genetic and environmental factors on adult weight by examining not only same-sex identical and fraternal twin pairs reared together (154 and 208 pairs respectively) but also those reared apart (93 and 218 pairs respectively). These samples, selected for the Swedish Adoption/Twin Study of Aging, combined the designs of previous studies involving adoptees and twins; thus, the effects of the environment could be estimated through a comparison of the correlations between identical twins reared apart and those reared together. One estimate of the heritability of BMI was the intrapair correlation between identical twins reared apart, 0.70 for men and 0.66 for women. A comparison of the intrapair correlations showed that the BMI of twins reared together was no more similar than that of twins reared apart; this indicated that shared rearing environment had no effect on BMI.

In a recent Canadian study of long-term overfeeding in identical twins 12 pairs of young men were given an excess of 4184 kJ daily for 84 days.¹⁹ The participants' weight gain ranged from 4.3 to 13.3 kg. However, the difference in weight gain and fat gain between pairs was about six times greater than the variance within pairs. The authors concluded that genetic factors influenced the effect of environmental factors such as overeating on weight.

Fewer than 5% of obese children have an underlying disease that causes obesity; most simply have an imbalance between energy expenditure and intake.²⁰ However, several diseases can cause obesity, including diseases of the endocrine and central nervous systems as well as specific congenital syndromes (e.g., Prader-Willi syndrome).¹⁴

Burden of suffering

Childhood obesity is not a disease. Studies of the risks of childhood obesity have focused on the probability of subsequent obesity, which may lead to health problems. Several studies have investigated the relation between obesity in young children and in older children, adolescents and adults. It is difficult to compare studies on the persistence of obesity because of differences in samples, study periods, definitions of obesity and means of measurement. However, some patterns have emerged.^{21,22} Infants and children who are obese are at somewhat increased risk of becoming obese adults. That is, relative weight and skinfold thickness tend to "track" over time. However, the correlations are low, and the probability that an individual obese infant will be an obese adult is likewise low. Furthermore, the longer the interval in ages studied, the weaker the relation. In a comprehensive review of the evidence, Garn²² concluded

that the probability of an obese child becoming an obese adult decreases with increasing time intervals but increases with greater degree of childhood obesity, higher age of the obese child and greater numbers of obese family members.

There are few known physical health risks to obese children. There is some indication of an association between obesity and hypertension in children; however, false-positive readings of high blood pressure due to the use of cuffs that are too small for oversized arms are not uncommon.²⁰ Also, many studies may use unreliable or invalid methods of estimating body fat.²¹ The commonly used weight-for-height measures do not distinguish between excess body fat and lean body mass.

Obese children have been observed to have high levels of low-density lipoprotein (LDL) cholesterol and low levels of high-density lipoprotein (HDL) cholesterol.²³ Obesity in adults, however, is not a strong independent risk factor for heart disease in the absence of other risk factors.²⁴ Nevertheless, the same circumstances that cause obesity may also increase the likelihood of other risk factors. It is unclear, then, whether obesity is a cause of heart disease or simply correlated with it.

In the Bogalusa Heart Study 3503 subjects 5 to 24 years of age with different weights showed significant ($p < 0.001$) clustering of three risk factors for cardiovascular disease: high systolic blood pressure, high fasting levels of insulin and high ratios of LDL to HDL cholesterol.²⁵ However, when lipid risk factors were correlated with subscapular skinfold thickness, the relation was not clear-cut; for example, it was not statistically significant for white or black boys 5 to 9 years of age or men 20 to 24 years of age.

An earlier report from the Bogalusa Heart Study also indicated that there was an association between childhood obesity and cardiovascular risk factors.²⁶ However, investigators included only the children whose weight category "tracked" over the 6-year study period, a group constituting only 18% of the original sample (although 38% of the most obese children remained in that category). This group tended to have high blood pressure and high triglyceride and cholesterol levels. Unfortunately data on the children who did not "track" (i.e., who became leaner) were not provided. It would be interesting to know whether their weight reduction was accompanied by lowered levels of these cardiovascular risk factors.

Evidence from the Muscatine Ponderosity Family Study is somewhat ambiguous.²⁷ Again, the study followed a "heavy group" consisting of children in the top quintile of relative weight on each of three surveys over the 4-year study period and a "heavy-gain group" of children who had gained weight. However, there were no data for children who became less obese. The consistently heavy group had significantly lower HDL cholesterol levels, higher total triglyceride levels and higher

systolic blood pressure readings than the other groups. However, there was no significant difference from normal ranges in levels of total cholesterol, LDL cholesterol, apolipoprotein A-1 or apolipoprotein B or of diastolic blood pressure. The heavy-gain group had high levels for all risk factors, although only the levels of total and LDL cholesterol were statistically significant.

These studies²⁵⁻²⁷ do not prove that obesity increases the risk of cardiovascular disease; they also fail to answer the most important question: does prevention or treatment of childhood obesity decrease the risk of adult coronary artery disease?

In a retrospective cohort study of the relation between childhood weight status and illness in adulthood Abraham, Collins and Nordsieck²⁸ examined 902 men and their childhood weight and health records. The study showed no association between weight status in childhood and adult cholesterol status or a relation between childhood weight and adult cardiovascular disease, renal disease, atherosclerosis or diabetes. In a follow-up study 30 to 40 years later, about half of the original subjects were examined (the high proportion lost to follow-up probably did not affect the outcome significantly, since the distribution of subjects in the weight categories was identical for those available and unavailable for follow-up). Those at highest risk of hypertensive vascular and cardiovascular renal disease were overweight adults who had been below average weight as children. However, this study did not assess the smoking status of adults. It is possible that adult-onset obesity is associated with more cigarette smoking and that the smoking is related to cardiovascular disease.

Two recently published reports did not address whether the prevention or treatment of childhood obesity lowers the incidence of illness in adulthood, but they did suggest that both childhood and adolescent weight affect later death rates. Nieto, Szklo and Comstock²⁹ reviewed more than 13 000 medical charts of people who were between 5 and 18 years of age between 1933 and 1945. These charts were linked with census and death certificate records. The age-adjusted adult mortality odds ratio of the 20% who were heaviest during prepuberty and adolescence was significantly greater than that of the 20% with the lowest weight. Adjustment for education or smoking status produced very small changes in the estimated odds ratios. Must and collaborators³⁰ conducted a follow-up study involving 508 people who were adolescents between 1922 and 1935 and for whom detailed body measurements were available. In 1968 the researchers gathered data on the subjects' smoking status and adult height and weight, and in 1988 they obtained data on living subjects through interviews and for deceased subjects from a variety of sources. Overweight status in adolescence (BMI in the top 25th percentile) was associated with an increased risk of death from all causes and of death from specific causes among men but not among women. (The lean comparison group con-

sisted of those who as adolescents had a BMI between the 25th and 50th percentile).

Two studies showed an association between infant or childhood obesity and increased incidence of acute respiratory infection, even when data were adjusted for family environment factors such as social class, smoking and overcrowding.^{31,32} The direction of causality in this relation, however, was not clearly determined; although Somerville, Rona and Chinn³² suggested it is more plausible that obesity causes respiratory symptoms, hyper-reactive airways may preclude active participation in sports and other exercise. Some of the evidence supporting an association between obesity and respiratory infection is flawed by the inclusion of only severely obese infants or only infants whose parents had reported illness to physicians; furthermore, some studies did not examine the incidence of respiratory illness in other family members.^{31,33}

Severe obesity in childhood has been linked to higher age-adjusted death rates among adults, but there is no association between moderate childhood obesity and higher death rates unless other risk factors are present.²³

Although there are few clear physical health risks to obese children, they may suffer significant social and psychologic difficulties. In the Western world, there is strong cultural prejudice against obesity and an obsession with thinness, which can lead to stigmatization of and discrimination against obese people in schools, the workplace and social settings.³⁴ Obese children may be teased and harassed by their peers, socially ostracized and treated as stupid and inferior by teachers and other adults.³⁵ Children share these negative cultural views about obesity; they acquire these opinions very early, possibly as young as 7 years of age.³⁶ Obese children therefore often have a very negative body image and low self-esteem.^{23,35} One consequence of this poor self-image may be an eating disorder such as anorexia nervosa in adolescence.^{35,36}

Manoeuvres

Detection

The assessment of obesity in children requires reliable and valid measures of obesity. Body weight alone fails to allow for differences in height and stature. For adults there are accepted tables (e.g., the Metropolitan Life weight charts) of desirable weight for height based on the lowest death rates in an insured population. However, there is no equivalent for children.³⁷ There are some tables giving average weight for age, height and sex, and several indices such as the BMI have been developed to standardize weight for height. Although such tables and indices do not directly measure obesity, it is assumed that variation in the index closely reflects variation in fatness. The most desirable quality in a weight-

for-height index is a strong positive correlation with both weight and direct measures of fatness.³⁸

Triceps or subscapular skinfold thickness is a more direct measure of adiposity, and it can distinguish adiposity from weight due to muscularity or to very large or very small stature better than the BMI. The correlation of multiple skinfold measures with total body fatness ranges from 0.7 to 0.8.²⁰ However, the accuracy of skinfold measures decreases among very obese children. An alternative measure of childhood weight, the Eid Index, is the difference, expressed as a percentage, between the child's weight and the 50th percentile weight for the age at which the child's height is in the 50th percentile.³⁹

Early intervention

The benefits of early detection depend on the availability of effective means to reduce body fat and the feasibility of maintaining a lower fat level, the result being an improvement in health and survival rates.

The more drastic methods of fat reduction, such as surgery, pharmacotherapy and the use of gastric balloons, are not appropriate for children, and very-low-kilojoule diets may impair their growth and development.^{33,40-42} The main methods of treating childhood obesity are modification of diet, exercise, diet and exercise together, and child-oriented or family-based behaviour modification programs, which may be provided in a clinical or school setting. There are major problems with most studies investigating approaches to treatment; they have tended to use very small samples, many have used no control group or an inappropriate one, and the follow-up time has rarely been sufficient to evaluate the long-term success of the treatment. For example, in a review of school-based interventions, only 6 of 13 studies examined had study groups of more than 30 subjects, and only 1 had more than 100.⁴³ Also, such studies have investigated obese children as a homogeneous group and have failed to take into account that the causes of their obesity may differ.

There is no evidence that traditional methods of fat reduction — low-kilojoule diets or increased exercise or both — succeed in the long term.⁴⁰ In one of the few intervention trials with adequate follow-up time 21 children who were overweight by at least 30% and as much as 144% lost on average 33% of their weight on very-low-kilojoule diets.⁴⁴ On re-examination 4 to 10 years later 10 had maintained a reduced weight, from 3% to 61% over the ideal weight; the other 11 children had gained back all the weight they had lost plus an additional 5% to 86% of excess weight.

Two types of exercise programs — lifestyle and aerobic — have been evaluated. The evidence about whether diet with exercise of either type improves results over diet alone is ambiguous (level II-2). In one study Epstein and colleagues⁴⁵ found that diet with exercise was effective, but in an earlier study the same re-

searchers found it did not.⁴⁶ The exercise portion of the treatment program was unsupervised in the earlier study, and there may have been a problem with compliance. Reybrouck and coworkers⁴⁷ compared low-kilojoule diet alone and such a diet with aerobic exercise for 4 months. The group treated with exercise lost significantly more weight. However, whether the weight loss was maintained in the long term is unknown, and the sample comprised only 25 children.

In light of the lack of long-term success of treatment programs based on dieting or programmed exercise, the most recent treatment programs have added behaviour modification techniques. Rather than simply educating children to change their eating and exercise behaviours (and subsequently their level of adiposity) such programs use specific techniques to bring about the desired behavioural changes.³⁷

Epstein and associates conducted a series of trials, two involving children under 8 years of age, to investigate the effectiveness of behavioural modification in reducing weight. In a randomized controlled trial involving 19 girls 5 to 8 years of age, those in a family-based treatment program lost almost twice as much as excess weight as control girls in a health education program ($p < 0.005$; level I evidence).⁴⁸ In a later study 17 children 1 to 6 years of age showed significant change in excess weight in a 12-month family-based treatment program (level II-3 evidence).⁴⁹ However, the maximum weight loss was achieved at 6 months, followed by slow but steady increases in weight at 12 and 24 months, although these increases were still significantly below baseline values. There was considerable variation in the amount of weight lost, with percentage overweight at baseline ranging from 17.5% to 59.6% and at 24 months ranging from 6.7% to 48.9%. Also, at no point did the mean of the group decline to below obesity status (20% overweight).

There have been several studies involving preadolescent children of about 8 to 12 years of age. At least three of these have been controlled trials, in which control groups were not treated (level I and level II-1 evidence). In all cases the children in the control group gained weight and the children receiving treatment lost 6% to 20% of their excess weight.^{46,50,51} The control group in each case was composed of children on a waiting list to get into the treatment program; there is no way to know whether the prospect of the treatment program had any effect on the weight status of these children.

Some studies have examined the effect of including parents in treatment programs, and there is some evidence that doing so improves the success of both weight loss and maintenance of the loss. However, this evidence is equivocal. In one trial Epstein and collaborators⁵² compared the importance of child self-control and parent control of therapy, randomly assigning 37 obese children to two groups (level I evidence). There was no signifi-

cant difference in weight status after 5 years; all groups had returned to approximately baseline levels.

In another small study, involving 30 children, Kirschenbaum, Harris and Tomarken⁵¹ found no evidence of superior results from including parents in the treatment programs (level I evidence). Similarly, there were no significant differences in weight loss between groups in a randomized controlled trial in which black adolescent girls entered a 16-week treatment program either alone, in sessions with their mothers or with their mothers attending separate but concurrent sessions.⁵³ However, a study by Israel and colleagues⁵⁰ showed that equivalent weight loss in self-selected groups in which parents were also losing weight and those in which parents were simply helping their children lose weight was superior to weight loss in a waiting-list control group.

In a series of trials of programs using behavioural modification therapy with the "traffic-light diet" (green = low kilojoules, yellow = moderate kilojoules, red = high kilojoules), Epstein and coworkers⁵⁴⁻⁵⁶ showed that including parents in the program improved maintenance of weight loss. Children 6 to 12 years of age were randomly assigned to one of three treatment groups (diet and exercise information plus behaviour modification for the child alone, such a program for the parent and child or information without behaviour modification for the child alone). All groups attended eight weekly meetings and six additional meetings over the next 6 months.

The investigators recently published the results of a 10-year follow-up of this approach involving 61 of the original families;⁵⁶ 6 children had psychiatric problems and were excluded. Although initial amounts of weight lost were similar in all three treatment groups, after 5 years and 10 years members of the group in which both parents and children were targeted for behaviour modification were significantly less obese than members of the other two groups. None of the programs had completely prevented obesity: even subjects of the more successful parent-child information and behaviour modification group were on average 35% overweight at the 10-year follow-up. However, children in the information only group were on average 60% overweight after 10 years. This is the first evidence that the effects of treatment for obesity in childhood can persist into young adulthood. Moreover, the treatment does not appear to have had adverse effects, especially on ultimate height. Given the intensity of the intervention and the high motivation of these families caution in generalizing these results is indicated; they are nevertheless encouraging.

In all studies, although children in treatment groups may have reduced their weight, they did not generally reach nonobese status (20% or less overweight).⁵⁷ This raises the question of defining the proper outcome measure: is it some weight loss, maintenance of some weight loss, change from obese to nonobese status and maintenance of that status, or reduction of immediate health problems and risk factors, such as high blood pressure and

cholesterol levels, for later health problems? Should improved self-esteem be one long-term outcome measure?

Adverse effects

There is little evidence regarding potential risks of treatment; it is generally assumed that weight control efforts are safe for children and infants. There is, however, some evidence that dietary restrictions at this age may have adverse effects. Mallick³³ reviewed several early studies showing that dietary restriction in infants and young children may retard growth and development, both physical and mental, and that these effects may be permanent. She suggested that even a minimum amount

of catabolism at this age is unacceptable. Other recent reviews also suggest that it is not safe to restrict the energy intake of adolescents at any point during their growth spurt.^{8,58}

In contrast, Epstein and associates⁵⁹ argued that previous research showing a reduction in the speed of growth after restriction of energy intake failed to consider the height of the children upon entry into the weight-loss programs. They found that obese children were taller than their leaner peers before losing weight and remained taller than the norm even after weight loss. However, the average height of the obese children declined from the 74th percentile before treatment to the 65th percentile afterward; although these children were

Table 1: Summary of manoeuvres, effectiveness, levels of evidence and recommendations for the prevention of childhood obesity

Manoeuvre	Effectiveness	Level of evidence*	Recommendation*
Detection			
Measurement of height and weight	Insufficient evidence that screening for obesity leads to improved outcome. Effect of obesity on adult obesity, illness and death is unclear	Cohort studies ^{21,22,27-31} (level II-2)	Insufficient evidence to include in or exclude from periodic health examination of children to prevent obesity (C). Physicians should continue to measure height and weight to screen for failure to thrive.
Measurement of skinfold thickness or body mass index	Insufficient evidence that screening for obesity leads to improved outcome. Effect of obesity on adult obesity, illness and death is unclear	Cohort studies ^{20-22,25,30} (level II-2)	Insufficient evidence to include in or exclude from periodic health examination to prevent obesity (C)
Intervention			
Very-low-kilojoule diets	Weight loss achieved through such diets is poorly maintained	Cohort studies ^{40,44} (level II-2)	Fair evidence to exclude from routine treatment of preadolescent obese children (D)
Exercise	Ambiguous evidence concerning the role of exercise in losing weight or maintaining weight loss	Cohort studies ^{38,43-45} (level II-2)	Insufficient evidence to include in or exclude from routine treatment of obese children (C)
Family-based nutrition and exercise education and behaviour modification	Weight loss was maintained at 10-year follow-up in obese children 6 to 12 years of age. Children were still on average 35% overweight. High cost of these programs, lack of availability and the high motivation of the families involved in the study may limit generalization of the results. Other outcome measures of interest (general health, self-esteem) were not measured. These programs are not readily applicable to primary care practices	Randomized controlled trials ^{48-51,55,56} (level I)	Insufficient evidence to include in or exclude from routine treatment of obese children (C)†

*For descriptions of the levels of evidence and classification of recommendations see Appendix 1 in part 1 of the 1992 update (*Can Med Assoc J* 1992; 147: 443).

†There is evidence from one study⁵⁴⁻⁵⁶ that moderate weight reduction can be achieved in two-parent, wealthy, well-motivated families through an intensive family-based instruction and behaviour modification program. Whether this weight reduction confers health benefits is unknown.

still taller than average, this is a significant decrease in their relative height.

Recommendations from other organizations

The American Academy of Pediatrics recommends that children's height and weight be measured throughout infancy, annually from 1 to 6 years of age and biennially thereafter.⁶⁰ The US Preventive Services Task Force recommends that height and weight be measured regularly and plotted on a growth chart throughout infancy and childhood.⁶¹ Although the US task force makes recommendations concerning nutrition and exercise counselling for adults, there are no recommendations specifically for children.⁶¹

Recommendations (Table 1)

1. Detection: Physicians should continue to plot the height and weight of infants and children during a periodic health examination, primarily to identify children who are failing to thrive. There is insufficient evidence to support screening children for obesity; however, there is no evidence that screening for obesity is harmful (grade C recommendation).

2. Intervention: There is insufficient evidence to include counselling about nutrition and exercise in or exclude it from the routine treatment of severely obese children (grade C recommendation). There is fair evidence to exclude very-low-kilojoule diets from the routine treatment of preadolescent obese children (grade D recommendation).^{40,44} There is conflicting evidence concerning the inclusion or exclusion of exercise in the routine treatment of obese children (grade C recommendation).^{40,45-48}

Research priorities

1. Do family-based instruction and behaviour modification programs for childhood obesity improve the child's self-esteem in the long term?

2. If so, can these results be obtained in disadvantaged and possibly less-motivated patients and their families?

3. Is there an increased incidence of eating disorders among adolescents who were involved in physician-initiated weight reduction programs as children?

4. If childhood obesity can be prevented or treated in childhood, what are the long-term physical and emotional benefits and risks?

References

1. Report of a Task Force to the Conference of Deputy Ministers of Health (cat no H39-3/1980E), Health Services and Promotion Branch, Department of National Health and Welfare, Ottawa, 1980: 43-44
2. Canadian Task Force on the Periodic Health Examination: The periodic health examination. *Can Med Assoc J* 1979; 121: 1193-1254
3. Woolf SH, Battista RN, Anderson GM et al: Assessing the clinical effectiveness of preventive maneuvers: analytic principles and systematic methods in reviewing evidence and developing clinical practice recommendations. *J Clin Epidemiol* 1990; 43: 891-905
4. King AJC, Robertson AS, Warren WK: *Summary Report: Canada Health Attitudes and Behaviours Survey: 9, 12 and 15 Year Olds, 1984-1985*, Social Program Evaluation Group, Queen's University, Kingston, Ont., 1985: 29
5. Stephens T, Craig CL: *The Well-Being of Canadians: the 1988 Campbell's Survey on Well-Being in Canada*, Canadian Fitness and Lifestyle Research Institute, Ottawa, 1990: 34, 74
6. Millar WJ, Stephens T: The prevalence of overweight and obesity in Britain, Canada and United States. *Am J Public Health* 1987; 77: 38-41
7. Peckham C, Stark O, Moynihan C: Obesity in school children: Is there a case for screening? *Public Health* 1985; 99: 3-9
8. Paige DM: Obesity in childhood and adolescence: special problems in diagnosis and treatment. *Postgrad Med* 1986; 79: 233-245
9. Foreyt JP: Issues in the assessment and treatment of obesity. *J Consult Clin Psychol* 1987; 55: 677-684
10. Gortmaker SL, Dietz WH, Sobol AM et al: Increasing pediatric obesity in the United States. *Am J Dis Child* 1987; 141: 535-540
11. Stunkard A, d'Aquili E, Fox S et al: Influence of social class on obesity and thinness in children. *JAMA* 1972; 221: 579-584
12. Ginsberg-Fellner F, Jagendorf LA, Carmel H et al: Overweight and obesity in preschool children in New York City. *Am J Clin Nutr* 1981; 34: 2236-2241
13. Saltzer EB, Golden MP: Obesity in lower and middle socioeconomic status mothers and their children. *Res Nurs Health* 1985; 8: 147-153
14. Stunkard AJ, Sorensen TIA, Hanis C et al: An adoption study of human obesity. *N Engl J Med* 1986; 314: 193-198
15. Brook CGD, Huntley RMC, Slack J: Influence of heredity and environment in determination of skinfold thickness in children. *BMJ* 1975; 2: 719-721
16. Björjeson M: The aetiology of obesity in children: a study of 101 twin pairs. *Acta Paediatr Scand* 1976; 65: 270-287
17. Stunkard AJ, Foch TT, Hrubec Z: A twin study of human obesity. *JAMA* 1986; 256: 51-54
18. Stunkard AJ, Harris JR, Pedersen NL et al: The body-mass index of twins who have been reared apart. *N Engl J Med* 1990; 322: 1483-1487
19. Bouchard C, Tremblay A, Després JP et al: The response to long-term overfeeding in identical twins. *Ibid*: 1477-1482
20. Merritt RJ: Obesity. *Curr Probl Pediatr* 1982; 12: 1-58
21. Johnston FE: Health implications of childhood obesity. *Ann Intern Med* 1985; 103: 1068-1072
22. Garn SM: Continuities and changes in fatness from infancy through adulthood. *Curr Probl Pediatr* 1985; 15: 1-47

23. Leung AK, Robson WLM: Childhood obesity. *Postgrad Med* 1990; 87: 123-133
24. Williams CL: Nutrition intervention and health risk reduction in childhood: creating healthy adults. *Pediatrician* 1985; 12: 97-101
25. Smoak CG, Burke GL, Webber LS et al: Relation of obesity to clustering of cardiovascular disease risk factors in children and young adults. *Am J Epidemiol* 1987; 125: 364-372
26. Aristimuno GG, Foster TA, Voors AW et al: Influence of persistent obesity in children on cardiovascular risk factors: the Bogalusa Heart Study. *Circulation* 1984; 69: 895-904
27. Burns TL, Moll PP, Lauer RM: The relation between ponderosity and coronary risk factors in children and their relatives: the Muscatine Ponderosity Family Study. *Am J Epidemiol* 1989; 129: 973-987
28. Abraham S, Collins G, Nordsieck M: Relationship of childhood weight status to morbidity in adults. *Public Health Rep* 1971; 86: 273-284
29. Nieto FJ, Szklo M, Comstock GW: Childhood weight and growth rate as predictors of adult mortality. *Am J Epidemiol* 1992; 136: 201-213
30. Must A, Jacques PF, Dallal GE et al: Long-term morbidity and mortality of overweight adolescents: a follow-up of the Harvard growth study of 1922 to 1935. *N Engl J Med* 1992; 327: 1350-1355
31. Tracey VV, De NC, Harper JR: Obesity and respiratory infection in infants and young children. *BMJ* 1971; 1: 16-18
32. Somerville SM, Rona RJ, Chinn S: Obesity and respiratory symptoms in primary school. *Arch Dis Child* 1984; 59: 940-944
33. Mallick MJ: Health hazards of obesity and weight control in children: a review of the literature. *Am J Public Health* 1983; 73: 78-82
34. Klesges RC, Klem ML, Hanson CL et al: The effects of applicant's health status and qualifications on simulated hiring decisions. *Int J Obes* 1990; 14: 527-535
35. Wadden TA, Stunkard AJ: Social and psychological consequences of obesity. *Ann Intern Med* 1985; 103: 1062-1067
36. Feldman W, Feldman E, Goodman JT: Culture versus biology: children's attitudes toward thinness and fatness. *Pediatrics* 1988; 81: 190-194
37. Epstein LH, Wing RR: Behavioral treatment of childhood obesity. *Psychol Bull* 1987; 101: 331-342
38. Ballew C, Liu K, Levinson S, Stamler J: Comparison of three weight-for-height indices in blood pressure studies in children. *Am J Epidemiol* 1990; 131: 532-537
39. Storlien LH, Bird JE, Silva PA: Assessment of obesity in early childhood. *Aust Paediatr J* 1987; 23: 131-135
40. Committee on Nutrition: Nutritional aspects of obesity in infancy and childhood. *Pediatrics* 1981; 68: 880-883
41. Dietz WH, Hartung R: Changes in height velocity of obese preadolescents during weight reduction. *Am J Dis Child* 1985; 139: 705-707
42. Amador M, Ramos LT, Morono M et al: Growth rate reduction during energy restriction in obese adolescents. *Exp Clin Endocrinol* 1990; 96: 73-82
43. Ward DS, Bar-Or O: Role of the physician and physical education teacher in the treatment of obesity at school. *Pediatrician* 1986; 13: 44-51
44. Ginsberg-Fellner F, Knittle JL: Weight reduction in young obese children. I. Effects on adipose tissue cellularity and metabolism. *Pediatr Res* 1981; 15: 1381-1389
45. Epstein LH, Wing RR, Penner B et al: Effect of diet and controlled exercise on weight loss in obese children. *J Pediatr* 1985; 107: 358-361
46. Epstein LH, Wing RR, Koeske R et al: Effects of diet plus exercise on weight change in parents and children. *J Consult Clin Psychol* 1984; 52: 429-437
47. Reybrouck T, Vinckx J, Van den Berghe G et al: Exercise therapy and hypocaloric diet in the treatment of obese children and adolescents. *Acta Paediatr Scand* 1990; 79: 84-89
48. Epstein LH, Wing RR, Woodall K et al: Effects of family based behavioral treatment on obese 5-8 year old children. *Behav Ther* 1985; 16: 205-212
49. Epstein LH, Valoski A, Koeske R et al: Family-based behavioral weight control in obese young children. *J Am Diet Assoc* 1986; 86: 481-484
50. Israel AC, Stoltmaker L, Sharp JP et al: An evaluation of two methods of parental involvement in treating obese children. *Behav Ther* 1984; 15: 266-272
51. Kirschenbaum DS, Harris ES, Tomarken AJ: Effects of parental involvement in behavioral weight loss therapy for preadolescents. *Ibid*: 485-500
52. Epstein LH, Wing RR, Valoski A et al: Long-term effects of parent weight loss on child weight loss. *Behav Ther* 1987; 18: 219-226
53. Wadden TA, Stunkard AJ, Rich L et al: Obesity in black adolescent girls: a controlled clinical trial of treatment by diet, behavior modification, and parental support. *Pediatrics* 1990; 85: 345-352
54. Epstein LH, Wing RR, Koeske R et al: Child and parent weight loss in family-based behavioral modification programs. *J Consult Clin Psychol* 1981; 49: 674-685
55. Epstein LH, Wing RR, Koeske R et al: Long-term effects of family-based treatment of childhood obesity. *J Consult Clin Psychol* 1987; 55: 91-95
56. Epstein LH, Valoski, Wing RR et al: Ten-year follow-up of behavioral, family-based treatment for obese children. *JAMA* 1990; 264: 2519-2523
57. Varni JW, Banis HT: Behavior therapy techniques applied to eating, exercise, and diet modification in childhood obesity. *Dev Behav Pediatr* 1985; 6: 367-372
58. Kneebone GM: Childhood obesity — the diagnosis and management. *Aust Fam Physician* 1990; 19: 367-370
59. Epstein LH, McCurley J, Valoski A et al: Growth in obese children treated for obesity. *Am J Dis Child* 1990; 144: 1360-1364
60. Committee on Practice and Ambulatory Medicine, American Academy of Pediatrics: *Guidelines for Health Supervision*, American Academy of Pediatrics, Elk Grove, Ill, 1987: 155-159
61. US Preventive Services Task Force: *Guide to Clinical Preventive Services: an Assessment of the Effectiveness of 169 Interventions*, Williams & Wilkins, Baltimore, 1989: 111-114, 297-314