

# Long-Term Effects of Family-Based Treatment of Childhood Obesity

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This study was a 5-year follow-up of obese children who participated in a family-based behavioral weight-control program targeting and reinforcing children and parents for weight loss (Epstein, Wing, Koeske, Andrasik, & Ossip, 1981). Children in the parent-plus-child group showed significantly greater weight reductions after 5 years (-12.7% overweight) than did children in a child-alone target group or in a no-target control group (4.3% and 8.2% overweight, respectively). One third of children in the parent-plus-child group were within 20% of normal weight in comparison with 5% of the children in the no-target control group. Height percentile decreased from the 72nd to the 60th percentile; these changes were negatively related to weight change. These children remained taller than the average child after weight loss, and children of short and medium-height parents were still relatively taller than their parents after 5 years.

Obesity is a prevalent disorder in children that increases the risk of adult obesity (Stark, Atkins, Wolff, & Douglas, 1981). Because the prognosis for long-term weight control in obese adults is poor (Stunkard & Penick, 1979), treatments to prevent adult obesity should be developed.

Behavioral treatment programs for the treatment of childhood obesity have shown decreases in percentage of overweight maintained for up to 21 months after treatment was initiated (Epstein, Wing, Koeske, Andrasik, & Ossip, 1981). However, there have been no long-term evaluations of behavioral treatment. This report provides a 5-year follow-up in order to determine the long-term effects of including the parents in family-based treatment for childhood obesity (Epstein et al., 1981). Parents were included in treatment for two reasons. First, parent weight is strongly related to childhood obesity (Garn & Clark, 1976), which may be mediated by parent modeling and support for overeating and underexercising. In addition, strong relations have been observed between parents' weight loss and children's weight loss when parents and children are treated together in behavioral weight-control programs (Epstein et al., 1981; Epstein, Wing, Koeske, & Valoski, 1983; Kirschenbaum, Harris, & Tomarken, 1984), which suggests similarities in the habit changes of the parents and children. On the basis of these results, we predicted that children who were treated with their parents would show better maintenance of weight loss than would children treated without their parents.

Another important reason for long-term follow-up in child weight-control programs is to assess the effects of dieting during development on growth (Mallick, 1983). Negative relations have been shown between weight loss and growth for intervals of 6 months to one year (Dietz & Hartung, 1985; Wolff, 1955). How-

ever, obese children tend to be taller than the norm (Garn, Clark, & Guire, 1974), and hence decreases in height percentile may be expected readjustments in growth. Children's height percentiles were compared with parental height percentiles, insofar as children resemble their parents in height (Tanner, Goldstein, & Whitehouse, 1970). We predicted that obese children would be taller than the norm (Dietz & Hartung, 1985; Wolff, 1955), that the relative heights of these children would be related to their parents' heights (Tanner et al., 1970), and that after weight loss, children would experience a decrease in height percentile so that they would resemble the attained height percentile of their parents.

## Method

### *Subjects*

Subjects were obese parents and obese 6- to 12-year-old children from 77 intact families applying for treatment in fall of 1978. After completing treatment, one child was removed from the data set for an unreported history of psychiatric contact, one of the exclusion criteria. After five years, 71 of the 76 families could be contacted; follow-up data were collected on 67 of these families (94% of the contacted sample, 88% overall). This represents 12 more subjects than were available at the previous 21-month follow-up. Children were all in grades that were appropriate for their ages.

### *Procedure*

Families were assigned to treatment groups via a stratified random assignment procedure. There were three groups: parent and child together, child alone, and nonspecific target. All subjects were seen for a 14-session treatment program distributed over 8 months, with follow-up at 21 months (Epstein et al., 1981) and 60 months. Parents and children were seen separately at each meeting, in accordance with recent research (Brownell, Kelman, & Stunkard, 1983). The specifics of the diet (Red, Yellow, Green Traffic Light Diet), exercise, and behavior management components of the three treatments were presented previously (Epstein et al., 1981).

### *Measurement*

We obtained weight and height data 5 years after the initiation of the study by direct measurement in the laboratories, in the offices of the

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subjects' personal physicians, or through school nurses in 86% of the cases. The remainder had moved, were unable to come to our laboratories, or had no personal physician, and their follow-up was obtained by self-report. There were no differences in distribution of self-report data across groups. Although direct measurement of weight and height are preferable, correlations between reported and actual weight of between .91 and .99 have been reported (Stunkard & Albaum, 1981). In addition, to minimize error, we adjusted self-reports by using separate parent and child regression equations that were developed on reported and actual heights and weights in over 100 families who had completed 3–5 years of follow-up. All heights and weights for the interim analyses (2, 8, and 21 months) were directly measured. Using the Metropolitan Life Insurance Company (1959) standards for adults and Iowa research station norms for children (Robinson, 1968), we determined percentage overweight.

At the 5-year measurement, both parents and children completed retrospective questionnaires by which we assessed the use of the behavior change techniques taught during the program (including self-monitoring, stimulus control, eating, and exercise habit change) and participation in other weight-control programs between treatment and the 5-year follow-up.

## Results

### Weight Change

Table 1 shows relative weights, and absolute weights and heights for parents and children at baseline and 5 years. A multivariate analysis of variance (MANOVA) on children's changes across the three groups in weight, height, and percentage overweight was significant,  $F(6, 124) = 3.30, p = .005$ . Significant univariate changes were shown for percentage overweight,  $F(2, 64) = 7.22, p = .001$ , but not for weight or height. Over 5 years, the percentage overweight in children in the parent-plus-child group decreased (–12.7%), whereas that of children in the other two groups increased (4.3% and 8.2%, respectively). A MANOVA on the parent variables showed no changes from baseline to 5-year follow-up; weights returned to baseline for all groups.

We assessed the prediction of relative weight change by first calculating the univariate correlations between relative weight change and age, sex, baseline height, baseline relative weight, midparent standardized height (average of mother's and father's heights), treatment group, and child height percentile change. Two variables were related to relative weight change: group  $r(65) = .41, p < .001$ , and age,  $r(65) = -.27, p < .05$ . Entering these two variables in a linear regression produced a multiple correlation of .50, accounting for 25% of the variance.

At 5 years the percentage of children in the parent-plus-child, child-alone and nonspecific-target groups who were not obese (less than 20% over average weight for height, age and sex) were 33% (8 of 24), 19% (4 of 21) and 4.5% (1 of 22), respectively,  $\chi^2(2, N = 67) = 6.09, p = .048$ . Three one-tailed Fisher exact tests in which the groups were compared two at a time via the Bonferroni adjustment for multiple analyses showed significant differences between the parent-plus-child and nonspecific-target groups,  $\chi^2(1, N = 46) = 6.05, p = .01$ .

Differences in the use of behavioral techniques by parents and children were analyzed in one-way analyses of variance (ANOVAs) in which we compared technique use across the three groups and technique use as a function of final percentage overweight (less than 20%, 20–40%, and more than 40% overweight). Children in the parent-plus-child group were different

( $p < .05$ ) from children in the other two groups for three behaviors: selecting lower calorie foods, graphing weight, and keeping high-calorie (RED) foods out of the home. Children differed in the use of two techniques as a function of final percentage overweight; the lighter children planned ahead and participated in exercise programs. The number of other obesity programs that children entered did not differ across the three groups or as a function of final weight.

Thirty-four subjects had data at 2, 8, 21, and 60 months and thus could be used to evaluate the pattern of change in percentage overweight over time. A two-way analysis of covariance with group as the between-subjects factor and time (0, 2, 8, 21, 60 months) as the within-subjects factor controlling for baseline percentage overweight showed a significant Group  $\times$  Time interaction,  $F(8, 124) = 3.20, p = .002$ . No between-group differences were shown for months 0–21, but between months 21 and 60, children in the parent-plus-child group had maintenance of treatment effects, whereas subjects in the other two groups returned to baseline levels (see Figure 1).

### Height Change

Significant increases ( $p < .0001$ ) in height of 22.8 cm (9 in.) and significant decreases ( $p < .0001$ ) in height percentile (Hammill, Drizd, Johnson, Reed, & Roche, 1977; National Center for Health Statistics, 1979) from the 72nd to the 60th percentile were observed.<sup>1</sup> No differences were observed between groups in height change, and subsequent height analyses are based on the total sample (see Table 1). The change in height percentile was related to weight change,  $r(65) = .35, p < .01$ . Age, sex, baseline height and relative weight, midparent standardized height, and treatment group were not related to height change.

Although there was a decrease in height percentile, these children were above average height for their age and sex at baseline. Because obese adults are not taller than nonobese adults (Lew & Garfinkel, 1979), and because obesity is not related to height in adults (Abraham & Clifford, 1980), these obese children are not likely to be taller than other children when they reach adulthood. Because the best estimate of children's height is their parents' height (Tanner et al., 1970), children's standardized height was analyzed in terms of midparent height, which correlates as well with child height as with the heights of either the mother or father (Tanner et al., 1970).

Children were categorized in tertiles on the basis of midparent height (short, average, tall); percentiles for the parent height groups were  $26.2 \pm 9.9\%$ ,  $48.7 \pm 7.2\%$ , and  $74.4 \pm 7.2\%$ , respectively. There were no significant differences in age or distribution of boys to girls for children in the three parent groups (see Table 2). Comparison of parents' and children's standardized height at baseline and after 5 years in separate one-way ANOVAs for each parent height group showed that at baseline, children with short ( $p < .001$ ) and average-height ( $p < .001$ ) parents had significantly greater standardized heights than their parents, whereas the heights of those with tall parents were not signifi-

<sup>1</sup> We established child and midparent height percentiles by first converting the absolute heights to Z scores based on population norms and then determining the percentiles from these Z scores. Analyses in which we used Z scores produced similar findings to those in which we used percentiles.

Table 1  
Percentage Overweight, Weight, and Height Changes Over 5 Years

Characteristic	Parent + child		Child alone		Nonspecific	
	Pretreatment	Posttreatment	Pretreatment	Posttreatment	Pretreatment	Posttreatment
Children						
N (male/female)	24 (7/17)		21 (11/10)		22 (6/10)	
Age	9.5		9.9		9.6	
% overweight						
M	41.0	28.3	39.7	44.0	45.5	53.7
SD	15.8	19.6	15.2	26.0	16.1	24.0
Weight (kg)						
M	47.7	69.3	51.0	80.6	52.6	83.1
SD	12.0	14.5	13.2	22.2	13.7	18.5
Height (cm)						
M	139.0	163.3	143.2	166.4	142.4	163.2
SD	11.2	10.5	11.0	9.5	11.4	7.1
Parents						
N (male/female)	24 (5/19)		21 (5/16)		22 (6/16)	
% overweight						
M	34.8	34.2	35.1	39.2	36.5	42.7
SD	19.8	20.6	19.7	27.5	18.2	22.1
Weight (kg)						
M	82.4	82.0	82.2	84.4	85.4	89.3
SD	16.5	15.7	14.3	18.0	16.5	17.0
Height (cm)						
M	165.6	165.6	165.4	165.4	167.6	167.6
SD	7.8	7.8	10.1	10.1	9.5	9.5

cantly different from the parents' ( $p = .095$ ). After 5 years, the standardized heights for children of short ( $p = .007$ ) and average-height parents ( $p = .021$ ) were still significantly greater than the standardized heights of their parents.

### Discussion

The results show that targeting both the parent and child during childhood obesity treatment resulted in lower relative

weight for those children after 5 years than for children treated without their parents. There was a greater percentage of children in the parent-plus-child group who became nonobese than there was in the no-target control group. In addition, decreases in relative height were observed after 5 years. Although the children had not completed full growth, their height was still at the 60th percentile after the decrease in relative height, and final height percentile was equal to or greater than expected on the basis of parent height.

Parents in this study showed a typical pattern of weight loss for adults (Stunkard & Penick, 1979). Parents in all groups showed significant short-term weight change; parents targeted for weight loss showed significantly better changes at 8 months than did parents in the other two groups. However, between-group differences were not observed at 21 months, though all parents were still below baseline (Epstein et al., 1981). By 60 months, parents in each group had returned to baseline percentage overweight.

Children showed a different pattern of change. Children in all groups showed significant and persistent decreases in percent overweight up to 21 months (Epstein et al., 1981). Children targeted for weight loss with their parents maintained the changes in relative weight achieved at 21 months, whereas children treated without their parents returned to baseline percentage overweight. One possible reason for the absence of differences among the three groups during the initial phases of the study was that the two comparison groups represented powerful treatments that were associated with large behavior and weight changes. This interpretation is supported by the amount of change in percentage overweight for these control conditions, which are greater than many primary

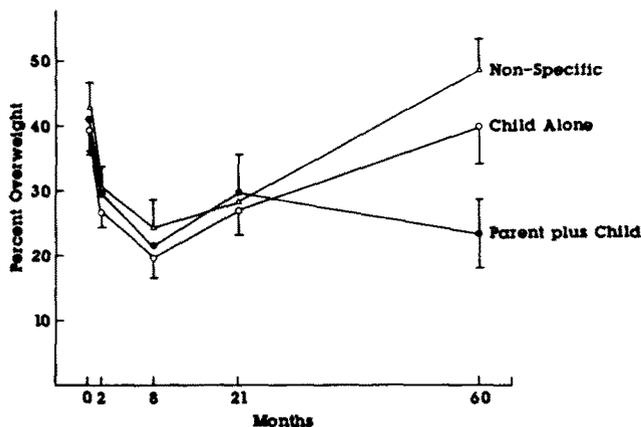


Figure 1. Average percentage overweight in obese children at 0, 2, 8, 21, and 60 months for children in groups in which parent and child were both targeted and reinforced for weight loss, the child alone was targeted and reinforced for weight loss, or neither parent nor child was targeted or reinforced for weight loss.

Table 2  
Height Percentiles Before and After 5 Years

Variable	Short <sup>a</sup>		Average <sup>b</sup>		Tall <sup>c</sup>	
	Pretreatment	Posttreatment	Pretreatment	Posttreatment	Pretreatment	Posttreatment
<i>N</i> (male/female)	22 (9/13)		23 (5/18)		22 (10/12)	
Age at entry						
<i>M</i>	9.9		9.5		9.2	
<i>SD</i>	1.5		1.9		2.2	
Height percentile						
<i>M</i>	59.4	46.7	76.2	60.3	81.6	74.4
<i>SD</i>	22.7	30.4	19.8	22.0	20.1	26.1

<sup>a</sup> Midparent height percentile =  $26.2 \pm 9.9$ . <sup>b</sup> Midparent height percentile =  $48.7 \pm 7.2$ . <sup>c</sup> Midparent height percentile =  $74.4 \pm 7.2$ .

treatments in other childhood obesity research (Epstein & Wing, in press). Likewise, parents who were not targeted for weight loss showed changes that were consistent with the magnitudes of change observed in treatments designed specifically for adults (Wing & Jeffery, 1979). However, these treatments may not have had treatment components necessary for the long-term maintenance of weight loss.

The differential weight changes for children across groups at 5 years may be attributable to treatment variables in the parent-plus-child groups that promoted maintenance. Contracting for parents' and children's behavior change was designed both to provide parental models for child behavior change and to increase parental support for child behavior change by teaching the parent new management techniques and by increasing reciprocal social reinforcement (Bandura, 1978). It is unlikely that modeling has a role in maintenance, insofar as parents in the parent-plus-child group returned to their initial weight and thus probably did not continue to model appropriate behavior, but their children maintained their weight loss. On the other hand, parental support for children's behavior change may be operative. Parental management skills that could be used to support children's behavior change were provided only in the parent-plus-child group and could be used even if the parents were unsuccessful in regulating their own behavior. The three things that children in the parent-plus-child group reported differently than children in the other groups—selecting lower calorie foods, graphing weight, and keeping high-calorie (RED) foods out of the home—may require parental support for their long-term maintenance. However, because measures of parent/child interactions were not obtained throughout the follow-up period, potential mechanisms must remain speculative.

Decreases in standardized height from the 72nd to the 60th percentile were observed after 5 years. These decreases were not attributable to a lack of weight gain or undernutrition resulting from prolonged dieting. Rather, the average weight gain of 27 kg was 6 kg greater than expected for children of similar age over a 5-year period (expected on the basis of cumulative whole-year weight velocity increases for a 5-year period; Tanner, Whitehouse, & Tahaishi, 1966).

The best predictor of the standardized height change was weight change, which was consistent with previous findings (Dietz & Hartung, 1985; Wolff, 1955). Whereas the changes in height observed in this study may be a necessary consequence

of regulating weight during pre- and early adolescence, Dietz and Hartung (1985) speculated that the decrease in relative height may be attributable to regression to the mean. They observed that obese children had height velocities of 2.3 standard deviations above the mean in the year before dieting, and they were still 0.6 standard deviations above the average height velocity during weight reduction. Thus although the children were not able to keep up the accelerated rate of growth in relation to their high initial relative height before treatment, and though their height velocity decreased, the growth was still above average.

The decrease in height percentile in this study makes the height of the children more consistent with the height of their parents. After 5 years, when the average 14.5-year-old boy and girl have completed 94.6% and 99.5%, respectively, of his or her growth (Tanner et al., 1966), children of short and average-height parents were still taller than would be expected on the basis of parent height. Thus overweight children of short and average-height parents may continue to show a decrease in height change in relation to their nonobese peers, whereas children of tall parents should maintain their height percentiles.

Our analysis of growth is limited in two ways. First, a sample of obese nontreated children was not available for direct pre- and posttreatment comparisons of growth, which would have been superior to the use of population norms. Changes in children's height over time may make the use of earlier standards difficult to interpret. Second, parental height was used to provide an estimate of the progress of children's growth. Perhaps the most important assessment is the effect of dieting on final height achieved, which would require a long period of additional follow-up. Until more data on this topic are available, careful attention should be paid to the diets of obese children who are losing weight; particular attention should be paid to assessing children's height in terms of parental height (Tanner et al., 1970).

Future research is likely to show the mechanism for treatment success probably involves an interaction of such treatment variables as parental modeling, parental social reinforcement, environmental support, children's self-control, and such individual difference variables as age. Future studies are needed in order to develop a better understanding of how to change childhood health habits because this process is important for the successful treatment of childhood obesity.

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