Multi-Site Randomized Controlled Trial of a Child-Centered Physical Activity Program, a Parent-Centered Dietary-Modification Program, or Both in Overweight Children: The HIKCUPS Study

Anthony D. Okely, EdD, Clare E. Collins, PhD, Philip J. Morgan, PhD, Rachel A. Jones, PhD, Janet M. Warren, PhD, Dylan P. Cliff, PhD, Tracy L. Burrows, PhD, Kim Colyvas, PhD, Julie R. Steele, PhD, and Louise A. Baur, MBBS, PhD

Objective To evaluate whether a child-centered physical activity program, combined with a parent-centered dietary program, was more efficacious than each treatment alone, in preventing unhealthy weight-gain in overweight children.

Study design An assessor-blinded randomized controlled trial involving 165 overweight/obese 5.5- to 9.9-year-old children. Participants were randomly assigned to 1 of 3 interventions: a parent-centered dietary program (Diet); a child-centered physical activity program (Activity); or a combination of both (Diet + Activity). All groups received 10 weekly face-to-face sessions followed by 3 monthly relapse-prevention phone calls. Analysis was by intention-to-treat. The primary outcome was change in body mass index *z*-score at 6 and 12 months (n = 114 and 106, respectively).

Results Body mass index *z*-scores were reduced at 12-months in all groups, with the Diet (mean [95% confidence interval]) (−0.39 [−0.51 to 0.27]) and Diet + Activity (−0.32, [−0.36, −0.23]) groups showing a greater reduction than the Activity group (−0.17 [−0.28, −0.06]) ($P = .02$). Changes in other outcomes (waist circumference and metabolic profile) were not statistically significant among groups.

Conclusion Relative body weight decreased at 6 months and was sustained at 12 months through treatment with a child-centered physical activity program, a parent-centered dietary program, or both. The greatest effect was achieved when a parent-centered dietary component was included. *(J Pediatr 2010;157:388-94)*.

See editorial, p 357

Overweight and obesity in childhood have been described as a global epidemic, with 10% of the world's children currently affected and the prevalence increasing.[1] Obesity in children is associated with a range of immediate and long-term comorbidities.[2,3] The development and implementation of prevention and treatment strategies presents a formidable challenge for researchers and practitioners.[4]

This challenge has been articulated in recent systematic reviews of treatment interventions, which showed poor long-term and, at best, modest short-term success.[5-7] Many of the studies had methodologic limitations such as small sample sizes, high attrition rates, limited outcome data, no intention-to-treat analyses, and insufficient follow-up periods. Furthermore, many were highly resource-intensive and performed in tertiary environments, limiting their potential reach and subsequent impact on regional/national child obesity prevalences.

In response to this, our research team has developed 2 group programs. These were designed to be of modest intensity and suitable for delivery in community settings. The first focused on changing family eating behaviors through a dietary modification program targeted at parents. The second aimed to promote physical activity and reduce sedentary behaviors by enhancing the obese child's movement skill proficiency, social support, and self-esteem. Given the minimal resources required to implement each program, it was also of interest to examine whether combining the 2 was more efficacious. The aim of this study was to assess the efficacy of each community-based program, separately and combined, for improving clinical outcomes among overweight and obese prepubertal, school-aged children. Our primary hypothesis was that a combined program would be more efficacious than either program alone for improving adiposity and metabolic profiles among overweight and obese children.

BMI	Body mass index

From the Child Obesity Research Centre and Faculty of Education (A.O. R.J., D.C.) and the Biomechanics Research Laboratory, School of Health Sciences (J.S.), University of Wollongong, Wollongong, the Schools of Health Sciences (C.C., T.B.), Education (P.M.), and Mathematical and Physical Sciences (K.C.), The University of Newcastle, University of Sydney Discipline of Paediatrics & Child Health, Clinical School, The Children's Hospital at Westmead (L.B.), Australia, and the MRC Human Nutrition Research, Elsie Widdowson Laboratory, Cambridge, United Kingdom (J.W.)

Funded by the National Health and Medical Research Council of Australia. The authors declare no conflicts of interest.

Trial Registration: clinicaltrials.gov (NCT00107692)

0022-3476/$ - see front matter. 10.1016/j.jpeds.2010.03.028

Methods

The HIKCUPS (Hunter and Illawarra Kids Challenge Using Parent Support) study was a 3-arm parallel group, randomized controlled trial conducted at the Universities of Wollongong and Newcastle, New South Wales, Australia. These community venues were chosen to maximize accessibility for all participants. Participants were provided with parking vouchers for the face-to-face sessions, and travel costs were reimbursed for those who did not have private transport. Eligibility criteria included the child being overweight or obese (referred to hereafter as "overweight") according to International Obesity Task Force cut points,[8] aged 5.5 to 9.9 years, prepubertal (Tanner Stage I) and generally healthy. Exclusion criteria included extreme obesity (body mass index [BMI] *z*-score >4), known syndromal obesity, a chronic illness, following a therapeutic diet, and taking medications associated with weight gain or long-term steroids. Participants were recruited from the local communities, primarily through print media and advertisements placed in school newsletters. The Human Research Ethics Committees at both sites approved the study protocol. Written informed consent was obtained from each child's parent or care provider, as well as child assent. The study was registered at clinicaltrials.gov (NCT00107692).

Eligible participants were randomized to 1 of 3 intervention arms described below, using a computer-based random number–producing algorithm. Randomization was stratified by sex and site. To ensure concealment, the sequence was generated by a statistician and given to only one researcher at each site, who assigned participants to their groups and informed a member of the research team at each site (who enrolled participants) of group allocation.

HIKCUPS involved 3 intervention arms: a Dietary-Modification Program (Diet), a Physical Activity Skill Development Program (Activity), and a combination of the Dietary-Modification and Physical Activity Skill Development Programs (Diet + Activity). Details of these interventions have been previously published.[9] Briefly, each intervention was designed to be inexpensive and sustainable in a community setting and was conducted on a separate, predesignated afternoon of the week. Each had 3 major components: (1) a weekly 2-hour face-to-face session for 10 weeks; (2) homework activities, designed to be completed in between each face-to-face session; and (3) a 3-month relapse prevention program where short- to medium-term goals set by parents were reviewed over the phone following a standard study procedure,[9] by a trained facilitator once a month for 3 months.

Outcome measures were assessed at baseline and at 6 and 12 months by trained assessors who were blinded to group assignment. Primary outcome was BMI *z*-score at 12-month follow-up. Other outcomes reported here include waist circumference, metabolic profiles, and blood pressure.

Height, weight, and waist circumference were measured by use of standardized procedures.[9] To enhance the quality of the anthropometric measurements, 2 assessors were involved and each measurement was taken in an entire sequence once (height, weight, waist), then the sequence was repeated. The *z*-scores for BMI were calculated by use of reference data from the United Kingdom.[10]

Blood pressure was measured by use of an automated blood pressure monitor (Critikon, Tampa, Florida) following standardized procedures. Blood was collected after the children had fasted overnight and was analyzed for glucose, insulin, lipids (total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides) and high sensitivity C-reactive protein at a single accredited pathology service (National Association of Testing Authorities, Australia, accredited).

To have an 80% chance of detecting as significant (at the 2-sided 5% level), a 0.26 standard deviation difference from baseline to 12-months (initial end point) in BMI *z*-score, with an anticipated loss to follow-up of 20%, 72 participants in each of the 3 groups (216 in total) were required to be recruited.

The χ^2 tests and *t*-tests were used to assess differences in BMI and BMI *z*-score between the dropout and continuation groups. Linear mixed models were used to assess all outcomes for the impact of group, time, and the group-by-time interaction, with these 3 terms forming the base model. This approach was preferred to use of baseline scores as covariates, because the baseline scores for subjects who dropped out at 6 months or 12 months were retained to be consistent with an intention-to-treat analysis. The adjusted models contained any additional significant effects due to main effects and two-way interactions between base model terms of sex, site, and age (treated as continuous). Mixed models were fitted by use of SAS PROC MIXED[11] (SAS Institute, Cary, North Carolina) and restricted maximum likelihood estimation with an unstructured covariance structure and the Kenward-Roger adjustment for downward bias in the variance-covariance matrix. The effects of lack of normality and influential observations were evaluated but were not severe enough to impact the results. Differences of means and 95% confidence intervals were estimated by use of the mixed models.

Results

The flow of participants is shown in the **Figure** (available at www.jpeds.com). Anthropometric data were collected for 165 children at baseline (**Table I**) and 114 (69%) and 106 (64%) children at 6- and 12-month follow-ups, respectively. There was no difference in retention rates among the 3 groups at 6-month follow-up, although at 12 months more participants from the Diet + Activity group (72%) and Diet group (71%) were retained compared with the Activity group (52%), ($\chi^2 = 6.24$, $P = .04$).

There were no differences between participants who were followed up compared with those who were not with regard to sex, age, or BMI *z*-score ($P > .05$). For waist circumference,

Table I. Baseline characteristics of children (n = 165) randomized to the Diet, Activity or Diet + Activity obesity intervention groups*

Characteristic	Diet (n = 42)	Activity (n = 63)	Diet + Activity (n = 60)
Sex			
Boy, no. (%)	16 (38)	25 (40)	27 (45)
Girl, no. (%)	26 (62)	38 (60)	33 (55)
Age (years)	8.2 (1.2)	8.3 (1.0)	8.1 (1.2)
Weight (kg)	46.3 (8.6)	48.0 (10.8)	45.5 (12.2)
Height (cm)	136.8 (8.1)	137.4 (7.6)	135.1 (10.0)
BMI (kg/m^2)	24.6 (3.0)	25.2 (4.1)	24.4 (3.7)
BMI category			
Overweight, n (%)	10 (24)	14 (22)	12 (20)
Obese, n (%)	32 (76)	49 (78)	48 (80)
BMI *z*-score	2.8 (0.6)	2.8 (0.7)	2.8 (0.7)
Waist circumference (cm)	76.4 (6.3)	77.6 (9.9)	75.8 (10.6)
Waist circumference *z*-score	3.1 (0.7)	3.2 (1.0)	3.1 (1.0)
Blood pressure (mm Hg)			
Systolic	97.2 (9.1)	101.2 (8.8)	96.8 (9.2)
Diastolic	54.8 (5.3)	57.5 (6.5)	55.6 (5.5)
Cholesterol (mmol/L)			
Total	4.4 (1.0)	4.3 (0.7)	4.2 (0.6)
HDL	1.3 (0.2)	1.3 (0.3)	1.2 (0.3)
LDL	2.6 (0.8)	2.5 (0.7)	2.5 (0.5)
Triglycerides (mmol/L)	1.0 (0.6)	1.1 (0.6)	1.1 (0.7)
Glucose (mmol/L)	4.1 (0.4)	4.2 (0.5)	4.2 (0.5)
Insulin (mU/mL)	10.0 (6.3)	11.7 (8.3)	13.7 (16.3)
High-sensitivity C-reactive protein (mg/L)	4.6 (8.8)	4.3 (5.2)	3.1 (3.6)

BMI, Body mass index; *HDL*, high-density lipoprotein; *LDL*, low-density lipoprotein.
*Data are mean (SD) unless otherwise indicated.

there were no differences at baseline between those not followed up at 6 months (P = .27), although those followed up at 12 months had a smaller mean waist circumference at baseline (75.4 [SD 8.8] cm vs 78.8 [SD 10.1] cm, P = .03).

All 3 groups reduced their BMI *z*-score and waist circumference *z*-score at 6 months, and reductions were maintained at 12 months, with tests of the 6-month to 12-month differences for all groups for both variables being non-significant (Table II). The mean (95% CI) reduction in BMI *z*-score at 12 months from baseline was as follows: Diet group −0.39 (−0.51, −0.27), Activity group −0.17 (−0.28, −0.06), and Diet + Activity group −0.32 (−0.42, −0.22). Compared with the Activity group, participants in the Diet group and the Diet + Activity group had a greater reduction in BMI *z*-score. For waist circumference *z*-score at 12-months, the reduction was averaged over the 3 groups because the group-by-time interaction was not significant: −0.24cm (−0.34, −0.15).

There were generally no differences between groups at 6 or 12 months on any of the metabolic outcomes (Table III). The exceptions were that, compared with those in the Diet + Activity group, those in the Activity group had a greater reduction in systolic blood pressure at 12 months, and compared with those in the Diet + Activity group, those in the Diet group had a smaller decrease in insulin at 6 months, although this was not maintained at 12 months. Over 12 months, the LDL-cholesterol increased by an average of 0.19 mmol/L (0.25, 0.31) and insulin decreased by an average of -3.4 mU/mL (−5.0, −1.8) in all participants. There were no adverse events reported in any of the groups throughout the intervention or during the follow-up phase.

Discussion

This study has demonstrated that a child-centered physical activity program and a parent-centered dietary-modification program, both in isolation and combined, were efficacious in reducing relative BMI in overweight prepubertal children at 1-year follow-up. Furthermore, the 2 programs that included the dietary component resulted in approximately twice as great a reduction in BMI *z*-score, compared with the Activity program in isolation. Interestingly, the retention rates for the Activity program were lower at 1-year follow-up compared with the other groups, which should be acknowledged when interpreting the intervention effects. It is unclear why the retention rates for the Activity group were lower; however, we suggest that because parents were not directly involved in the program, they may have been less committed to encourage their child to attend the face-to-face and follow-up sessions. Additionally, it is possible that because participating families were not allowed to be financially compensated for travel to and from assessments or for their time, this may have provided enough of a barrier to prevent less-committed parents of Activity program participants from attending follow-ups after the completion of the face-to-face programs.

Our primary hypothesis, that the Diet + Activity program would be more efficacious than the Activity and Diet programs in isolation, was not met. Interestingly, it was the 2 programs with a diet component that performed significantly better than the physical activity–only group. These programs may have been more efficacious because dietary changes were targeted and parents were the key agents of change.[12] The focus on parental behavior change strategies to manage child eating, including problem-solving, goal-setting, role modeling, and positive reinforcement, may have resulted in parents taking greater responsibility to target changes in the family environment to achieve a reduction in relative energy intake.

Reductions in BMI or BMI *z*-score in this study are either larger[13,14] or similar[15,16] to other recently published trials, with all 3 groups achieving significant reductions in BMI *z*-score over 6 months and maintenance of this reduction at 12 months. Compared with Hughes et al[13] and McCallum et al,[14] the larger intervention effects reported in our study may be attributed to the greater face-to-face intervention contact hours, the presence of a program for the children and the intervention setting. The studies by both Hughes et al[13] and McCallum et al[14] involved fewer than 8 face-to-face contact hours, only intervened with parents, and were delivered in clinical settings rather than a community setting. We found a similar intervention effect to Golley et al[15] and Savoye et al.[16] These studies were similar to our study in that they had greater face-to-face contact hours, were delivered in community settings, and provided a program for

Table II. Changes in anthropometric outcome variables by treatment group, for children (n = 165) participating in an obesity intervention, from baseline to 6 months and baseline to 12 months, and differences in outcomes among the treatment groups at 6 and 12 months*

		Treatment group					Differences between groups†			
Outcome variable	Month	Diet n = 42	Activity n = 63	Diet + Activity n = 60	All groups	Time *P* value	Diet − Activity	Diet + Activity − Activity	Diet + Activity − Diet	Group* Time *P* value
Height (cm)						<.001				.56
	6	2.7 (2.3, 3.1)	2.6 (2.2, 2.9)	2.9 (2.6, 3.3)	2.7 (2.5, 2.9)		0.1 (−0.4, 0.7)	0.4 (−0.1, 0.9)	0.3 (−0.3, 0.8)	
	12	6.2 (5.6, 6.8)	6.1 (5.5, 6.6)	6.6 (6.1, 7.1)	6.3 (6.0, 6.6)		0.1 (−0.7, 0.9)	0.6 (−0.2, 1.3)	0.4 (−0.3, 1.2)	
Weight (kg)						<.001				.09
	6	0.4 (−0.5, 1.3)	1.3 (0.5, 2.1)	0.1 (−0.6, 0.9)	0.6 (0.1, 1.1)		−0.9 (−2.1, 0.3)	−1.2 (−2.2, −0.1)	−0.3 (−1.4, 0.9)	
	12	3.3 (1.9, 4.7)	5.1 (3.9, 6.4)	3.9 (2.7, 5.0)	4.1 (3.4, 4.8)		−1.9 (−3.7, 0.0)	−1.2 (−2.9, 0.5)	0.6 (−1.2, 2.4)	
BMI (kg/m^2)						<.001				.04
	6	−0.8 (−1.2, −0.4)	−0.3 (−0.6, 0.1)	−0.9 (−1.3, −0.6)	−0.6 (−0.9, −0.4)		−0.5 (−1.1, 0.0)	−0.7 (−1.2, −0.2)	−0.1 (−0.7, 0.4)	
	12	−0.5 (−1.1, 0.1)	0.4 (−0.1, 1.0)	−0.2 (−0.7, 0.3)	−0.1 (−0.4, 0.2)		−0.9 (−1.8, −0.1)	−0.6 (−1.4, 0.1)	0.3 (−0.5, 1.1)	
BMI *z*-score						<.001				.02
	6	−0.31 (−0.39, −0.22)	−0.16 (−0.24, −0.09)	−0.31 (−0.38, −0.24)	−0.26 (−0.31, −0.22)		−0.14 (−0.26, −0.03)	−0.15 (−0.25, −0.05)	−0.01 (−0.12, 0.10)	
	12	−0.39 (−0.51, −0.27)	−0.17 (−0.28, −0.06)	−0.32 (−0.42, −0.22)	−0.29 (−0.36, −0.23)		−0.22 (−0.38, −0.06)	−0.15 (−0.29, 0.00)	0.07 (−0.08, 0.23)	
Waist circumference (cm)						.05				.12
	6	−1.1 (−2.8, 0.5)	0.2 (−1.3, 1.7)	−0.6 (−2.0, 0.8)	−0.5 (−1.4, 0.3)		−1.3 (−3.5, 1.0)	−0.8 (−2.8, 1.3)	0.5 (−1.7, 2.7)	
	12	−1.1 (−2.9, 0.7)	2.3 (0.6, 4.0)	1.0 (−0.5, 2.5)	0.7 (−0.3, 1.7)		−3.4 (−5.9, −0.9)	−1.3 (−3.6, 1.0)	2.1 (−0.3, 4.5)	
Waist circumference *z*-score						<.001				.18
	6	−0.31 (−0.47, −0.16)	−0.13 (−0.26, 0.01)	−0.20 (−0.33, −0.07)	−0.21 (−0.30, −0.13)		−0.19 (−0.40, 0.02)	−0.08 (−0.27, 0.11)	0.11 (−0.09, 0.31)	
	12	−0.40 (−0.57, −0.23)	−0.14 (−0.29, 0.02)	−0.19 (−0.34, −0.05)	−0.24 (−0.33, −0.15)		−0.26 (−0.50, −0.03)	−0.06 (−0.27, 0.15)	0.20 (−0.02, 0.43)	

*Data are mean (95% confidence intervals).
†Time differences were calculated as (6 month – baseline) and (12 month – baseline).

Table III. Changes in metabolic outcome variables by treatment group, for children (n = 165) participating in an obesity intervention, from baseline to 6 months and baseline to 12 months and differences in outcomes among the treatment groups at 6- and 12-months*

		Treatment Group					Differences between groups†			
Outcome	Month	Diet n = 42	Activity n = 63	Diet + Activity n = 60	All groups	Time *P*	Diet − Activity	Diet + Activity − Activity	Diet + Activity − Diet	Group* Time *P*
Systolic BP (mm Hg)						.07				.03
	6	−2.0 (−5.5, 1.4)	−2.9 (−5.9, 0.1)	0.8 (−2.1, 3.6)	−1.4 (−3.2, 0.4)		0.9 (−3.7, 5.4)	3.7 (−0.5, 7.8)	2.8 (−1.7, 7.2)	
	12	0.9 (−2.4, 4.2)	−2.9 (−6.4, 0.5)	4.4 (1.6, 7.2)	0.8 (−1.0, 2.6)		3.9 (−0.9, 8.6)	7.4 (3.0, 11.8)	3.5 (−0.8, 7.8)	
Diastolic BP (mm Hg)						.05				.23
	6	−1.1 (−4.2, 1.9)	−0.5 (−3.2, 2.1)	−2.0 (−4.6, 0.5)	−1.2 (−2.8, 0.4)		−0.6 (−4.7, 3.4)	−1.5 (−5.2, 2.2)	−0.9 (−4.9, 3.1)	
	12	1.4 (−1.0, 3.7)	−0.9 (−3.3, 1.5)	1.7 (−0.3, 3.6)	0.7 (−0.6, 2.0)		2.3 (−1.0, 5.6)	2.6 (−0.5, 5.7)	0.3 (−2.8, 3.3)	
Cholesterol (mmol/L)						.19				.70
	6	−0.07 (−0.34, 0.21)	0.07 (−0.18, 0.32)	0.07 (−0.16, 0.31)	0.03 (−0.12, 0.17)		−0.14 (−0.51, 0.23)	0.00 (−0.34, 0.35)	0.14 (−0.22, 0.51)	
	12	−0.03 (−0.26, 0.20)	0.18 (−0.05, 0.41)	0.17 (−0.03, 0.38)	0.11 (−0.02, 0.24)		−0.21 (−0.54, 0.11)	−0.01 (−0.32, 0.30)	0.20 (−0.10, 0.51)	
HDL Cholesterol (mmol/L)						.21				.43
	6	0.04 (−0.05, 0.13)	0.06 (−0.02, 0.15)	0.03 (−0.05, 0.11)	0.04 (0.00, 0.09)		−0.02 (−0.15, 0.10)	−0.03 (−0.15, 0.08)	−0.01 (−0.13, 0.11)	
	12	−0.01 (−0.08, 0.07)	−0.02 (−0.10, 0.07)	0.06 (−0.01, 0.13)	0.01 (−0.03, 0.06)		0.01 (−0.10, 0.12)	0.08 (−0.03, 0.19)	0.07 (−0.03, 0.17)	
LDL Cholesterol (mmol/L)‡						.02				.56
	6	−0.09 (−0.33, 0.14)	0.10 (−0.11, 0.31)	0.03 (−0.18, 0.24)	0.01 (−0.12, 0.14)		−0.19 (−0.50, 0.12)	−0.07 (−0.36, 0.23)	0.12 (−0.18, 0.43)	
	12	0.04 (−0.19, 0.28)	0.20 (−0.04, 0.43)	0.26 (0.04, 0.48)	0.17 (0.02, 0.31)		−0.15 (−0.47, 0.16)	0.06 (−0.24, 0.37)	0.22 (−0.08, 0.52)	
Triglycerides (mmol/L)						.10				.08
	6	−0.03 (−0.25, 0.19)	−0.13 (−0.33, 0.08)	0.00 (−0.19, 0.19)	−0.05 (−0.17, 0.07)		0.10 (−0.20, 0.40)	0.13 (−0.15, 0.41)	0.03 (−0.26, 0.32)	
	12	−0.02 (−0.27, 0.22)	0.28 (0.02, 0.54)	0.00 (−0.22, 0.22)	0.09 (−0.05, 0.22)		−0.31 (−0.66, 0.05)	−0.28 (−0.62, 0.05)	0.02 (−0.30, 0.35)	
Glucose (mmol/L)						.47				.60
	6	0.07 (−0.12, 0.27)	−0.08 (−0.26, 0.11)	−0.11 (−0.28, 0.06)	−0.04 (−0.14, 0.07)		0.15 (−0.11, 0.42)	−0.03 (−0.28, 0.22)	−0.18 (−0.44, 0.07)	
	12	0.11 (−0.07, 0.29)	0.04 (−0.15, 0.23)	−0.03 (−0.19, 0.13)	0.04 (−0.06, 0.14)		0.07 (−0.19, 0.33)	−0.07 (−0.32, 0.18)	−0.14 (−0.38, 0.10)	
Insulin (MU/mL)‡						<.001				.08
	6	0.1 (−2.1, 2.4)	−2.1 (−4.2, 0.0)	−2.9 (−4.9, −0.8)	−1.6 (−2.9, −0.3)		2.3 (−0.8, 5.3)	−0.8 (−3.7, 2.1)	−3.0 (−6.0, 0.0)	
	12	−4.5 (−7.0, −2.0)	−2.4 (−5.0, 0.2)	−3.4 (−5.8, −1.1)	−3.4 (−5.0, −1.8)		−2.1 (−5.5, 1.3)	−1.1 (−4.4, 2.2)	1.0 (−2.2, 4.2)	
High sensitivity C-reactive protein (mg/L)						.85				.39
	6	−1.7 (−5.1, 1.8)	−0.7 (−3.9, 2.5)	1.5 (−1.4, 4.4)	−0.3 (−2.1, 1.6)		−1.0 (−5.7, 3.7)	2.2 (−2.2, 6.5)	3.2 (−1.4, 7.7)	
	12	−2.1 (−5.2, 1.1)	1.3 (−2.0, 4.5)	−0.7 (−3.5, 2.2)	−0.5 (−2.3, 1.3)		−3.3 (−7.9, 1.2)	−1.9 (−6.2, 2.4)	1.4 (−2.8, 5.6)	

*Data are mean (95% confidence intervals).
†Time differences were calculated as (6-month – baseline) and (12-month – baseline).
‡Adjusted for age. Adjustments were applied to both 6-month and 12-month data.

both parents and children. For all studies, including ours, the intervention content focused on behavioral strategies to modify diet, physical activity, and sedentary behaviors. Golley et al[15] also incorporated a parenting component.

A further reduction in adiposity was achieved in the Diet group, from 6 to 12 months, despite expectations of some rebound, as shown in a recent meta-analysis of dietary interventions in overweight children.[6] The Activity group was still efficacious in reducing adiposity at 6 months and maintaining this at 12 months, albeit to a lesser degree relative to the Diet and Diet + Activity groups. This suggests that dietary changes and behavior management skills learned by parents in the diet groups may be particularly important for relapse prevention. Future trials should test whether greater parent involvement in the Activity program can increase its treatment effect size. The efficacy of all 3 programs may be explained by the focus on behavioral skills underlying the programs, on creating supportive social environments where children and parents receive encouragement for efforts, and providing enjoyable activities where participants experience success and thereby increase self-efficacy.

We did not find any consistently significant effects either within or between groups on any of the metabolic outcomes. The exception was plasma insulin, where all groups achieved reductions at 12 months, with the largest being in the Diet and Diet + Activity groups. This lack of change in metabolic outcomes may be due to the children having baseline values within normal laboratory ranges. Other studies[16-18] have shown similar results, although Savoye et al[16] found significant reductions in total cholesterol, possibly because of an increased intervention time (90 hours versus 20 hours per program in this study). Given the lower intensity of HIKCUPS relative to previous studies,[16,18] it is promising that 12-month changes in some variables (such as systolic and diastolic blood pressure and insulin) were comparable with other published studies.

The wide confidence intervals for some of the secondary outcomes suggest that the sample size may not have been adequate to detect statistically significant differences between groups at follow-up. Approximately 30% to 35% of the sample were unable to be followed up at 6 and 12 months. These retention rates are in the mid to lower range of those reported in a systematic review of child obesity treatment studies (1% to 43%).[19] We recommend researchers consider use of 30% as a dropout rate for future trials with obese children.

We believe the study results can be generalized to healthy overweight children. Only a small proportion of participants had extreme obesity or comorbidities that excluded them from the study. Such children would require a more intensive intervention. However, because the sample comprised mostly middle-class families from English-speaking backgrounds, the results may not be generalizable to all families, especially those from other sociodemographic groups. Furthermore, the Activity program was specifically developed for overweight children aged 5.5 to 9.9 years and may not be appropriate for children outside these ages. In contrast, the Diet program worked exclusively with parents and targeted changes in a family context, making it potentially generalizable among families with children of varying ages and weight categories. Finally, the interventions were facilitated by trained research staff with physical activity and nutrition expertise. They were standardized across both sites and followed strict guidelines as for a randomized controlled trial. Accordingly, there is a need to follow-up with effectiveness studies to determine the impact of the program delivered under different conditions. ■

We thank the participating children and parents, local schools in the Hunter and Illawarra regions of New South Wales and the Universities of Wollongong and Newcastle. We also thank The Sanitarium Health Food Company for supplying breakfast cereal for the children post-fasting assessments.

Submitted for publication Nov 6, 2009; last revision received Feb 18, 2010; accepted Mar 19, 2010.

Reprint requests: Anthony D Okely, EdD, Faculty of Education, University of Wollongong, Wollongong NSW 2522 Australia. E-mail: tokely@uow.edu.au.

References

1. Lobstein T, Baur L, Uauy R. Obesity in children and young people: a crisis in public health. Obes Rev 2004;5(Suppl 1):4-104.
2. Ebbeling CB, Pawlak DB, Ludwig DS. Childhood obesity: public health crisis, common sense cure. Lancet 2002;360:473-82.
3. Reilly JJ, Methven E, McDowell ZC, et al. Health consequences of obesity. Arch Dis Child 2003;88:748-52.
4. Devi S. Progress on childhood obesity patchy in the USA. Lancet 2008; 371:105-6.
5. Atlantis E, Barnes EH, Fiatarone Singh MA. Efficacy of exercise for treating overweight in children and adolescents: a systematic review. Int J Obes 2006;30:1027-40.
6. Collins CE, Warren J, Neve M, McCoy P, Stokes BJ. Measuring effectiveness of dietetic interventions in child obesity: a systematic review of randomised trials. Arch Pediatr Adolesc Med 2006;160:906-22.
7. Summerbell CD, Ashton V, Campbell KJ, Edmunds L, Kelly S, Waters E. Interventions for treating obesity in children. Cochrane Library 2003;4: 1-57.
8. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 2000;320:1-6.
9. Jones RA, Okely AD, Collins CE, et al. The HIKCUPS trial: a multi-site randomized controlled trial of a combined physical activity skill-development and dietary modification program in overweight and obese children. BMC Public Health 2007;7:15.
10. Cole TJ, Freeman JV, Preece MA. Body mass index references curves for the UK, 1990. Arch Dis Child 1995;73:25-9.
11. SAS Institute. SAS Version 9.1 (TS1M2). Cary, NC: SAS Institute; 2002.
12. Golan M, Weizman A, Apter A, et al. Parents as the exclusive agents of change in the treatment of childhood obesity. Am J Clin Nutr 1998;67: 1130-5.
13. Hughes AR, Stewart L, Chapple J, et al. Randomized, controlled trial of a best-practice individualized behavioural program for treatment of childhood overweight: Scottish Childhood Overweight Treatment Trial (SCOTT). Pediatrics 2008;93:614-9.
14. McCallum Z, Wake M, Gerner B, et al. Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity. Int J Obes 2007;31:630-6.
15. Golley R, Magarey AM, Baur L, et al. Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: a randomized, controlled trial. Pediatrics 2007;119: 517-5.

16. Savoye M, Shaw M, Dziura J, et al. Effects of a weight management program on body composition and metabolic parameters in overweight children: a randomized controlled trial. JAMA 2007;297:2697-704.
17. Sung RYT, Yu CW, Chang SKY, Mo SW, Woo KS, Lam CWK. Effects of dietary intervention and strength training on blood lipid level in obese children. Arch Dis Child 2002;86:407-10.
18. Johnston CA, Tyler C, McFarlin BK, et al. Weight loss in overweight Mexican American children: a randomized controlled trial. Pediatrics 2007;120:e1450-7.
19. Oude Luttikhuis H, Baur L, Jansen H, et al. Interventions for treating obesity in children. Cochrane Database of Systematic Reviews 2009, Issue 1. Art. No.: CD001872.

50 Years Ago in *THE JOURNAL OF PEDIATRICS*

Editor's Column: In Defense of Pediatrics, the Case for the 2-Year Residency Training Program in Pediatrics, and Further Thoughts on Preparation for Pediatric Practice

Hill LF. J Pediatr 1960;57:305-12.
McK. Mitchell J. J Pediatr 1960;57:312-4
Nelson WE. J Pediatr 1960;57:314-6.

"It's déjà vu all over again," remarked Yogi Berra once in the early 1960s after seeing Mickey Mantle and Roger Maris hit back-to-back home runs. Who knows what Yogi would have quipped if he now read the Editor's Column of *The Journal* from 50 years ago? Debates regarding the optimal training for pediatrics residency appear timeless.

We are all well served to reexamine comments made in 1960 by former American Board of Pediatrics (ABP) President Lee Forest Hill, ABP Executive-Secretary John McK. Mitchell, and *The Journal* Editor Waldo E. Nelson. They argued whether preparation for pediatrics practice required 2 or 3 years of residency. Three years did become the ABP requirement in 1974. In their colloquy, the gentlemen all posited remarks that, although spoken from authority, are myopic in hindsight. For instance, Mitchell stated, "There is no doubt, however, that for a period of years immediately following its adoption (i.e., three years), the number starting practice would be decreased materially and I personally fear that the number of physicians entering residency training in pediatrics might be reduced significantly." In 1958 there were 5900 boarded pediatricians; by 2008, the ABP had granted 93 694 general pediatrics certificates.[1] Nelson added "I do believe a third year of training in an adequate setting is distinctly worth while for the man of excellent potential for the practice of pediatrics." Nelson did not foresee that well more than half of today's residents would be female.

We must recognize that any sweeping remarks about pediatrics training are, like a current ABP certificate—time-limited. Changes loom on the horizon. The Institute of Medicine is scrutinizing the 80-hour resident work-week. Graduate Medical Education funding is in jeopardy as Congress fights about health care reform. The ABP is implementing Maintenance of Certification to continue forever after residency. We should pay close attention to the Notes from the Association of Medical School Pediatric Department Chairs, Inc., in *The Journal*, bookmark the ABP web site as a favorite, and heed Yogi's other aphorism, "It ain't over till it's over."

Paul Graham Fisher, MD
Departments of Neurology, Pediatrics, Neurosurgery, and Human Biology
Stanford University
Palo Alto, California
10.1016/j.jpeds.2010.02.059

Reference

1. American Board of Pediatrics. www.abp.org. Accessed March 26, 2010.

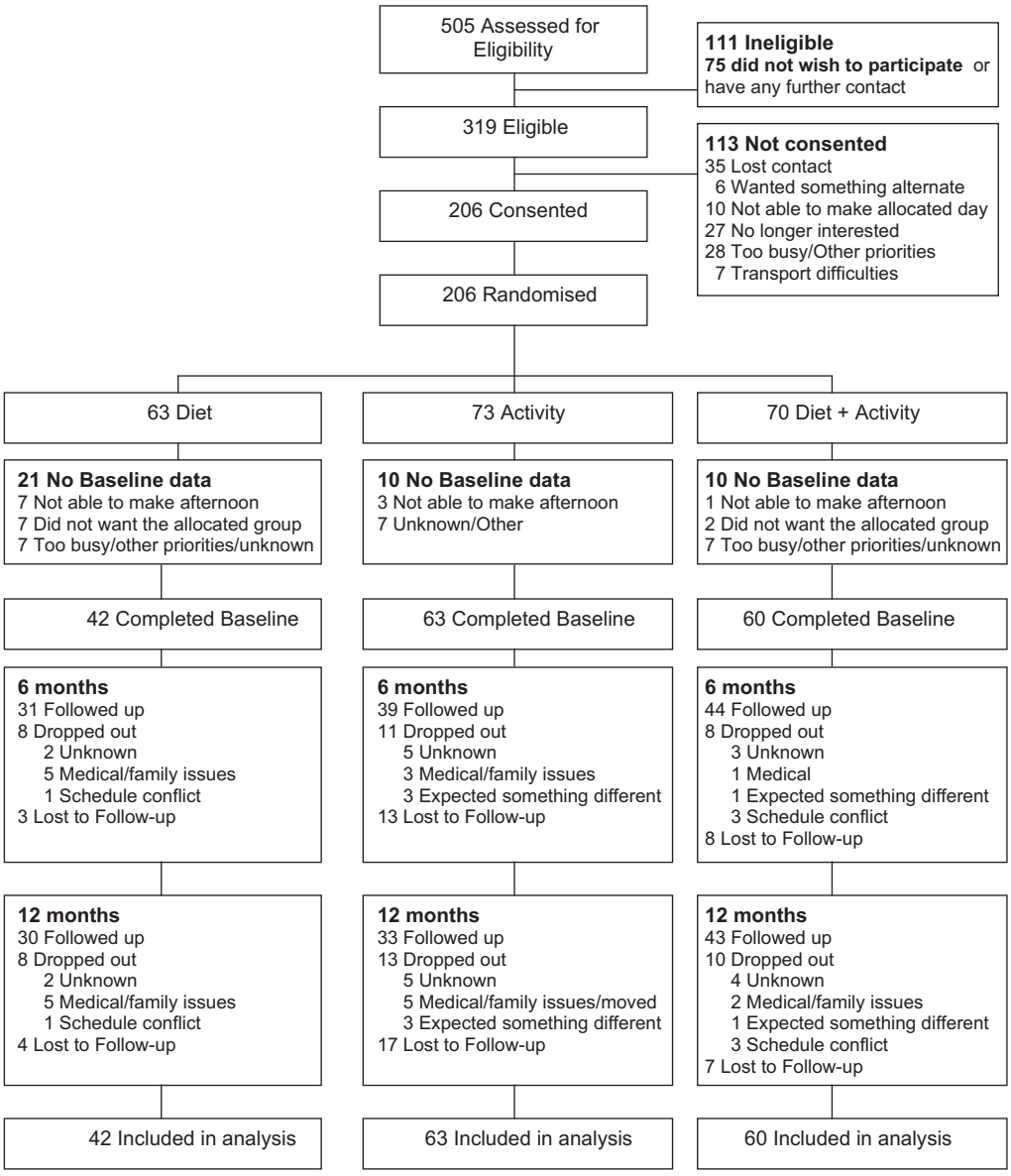

Figure. Flow of participants through the trial and the number analyzed for primary outcome (BMI *z*-score).