Characteristics Associated with Successful Weight Management in Youth with Obesity

Michelle C. Gorecki, MD, MPH[1], Joseph M. Feinglass, PhD[1,2,3], and Helen J. Binns, MD, MPH[1,3,4,5,6]

Objective To identify the medical, demographic, and behavioral factors associated with a reduction of body mass index percent of the 95th percentile (BMIp95) after 1 year for patients receiving care at a tertiary care obesity management clinic.

Study design A retrospective review of data from first and 12 ± 3-month follow-up visits of subjects aged 8-17 years with obesity. Data included anthropometrics, demographics, medical/psychological history, reported diet patterns, and participation in moderate/vigorous physical activity. After analyzing factors associated with 1-year follow-up, we used a forward conditional logistic regression model, controlling for subject's sex, to examine associations with a BMIp95 ≥5-point decrease at 1 year.

Results Of 769 subjects, 184 (23.9%) had 1-year follow-up. Boys more often had follow-up (28.4% vs girls, 19.1%; *P* = .003). The follow-up sample was 62.0% male, 65.8% Hispanic, and 77.7% with public insurance; 33.2% achieved a ≥5-point decrease in BMIp95. In regression results, the ≥5-point decrease group was more likely to have completed an initial visit in April-September (OR 2.0, 95% CI 1.1-3.9); have increased physical activity by 1-2 d/wk (OR 3.4, 95% CI 1.4-7.8) or increased physical activity by ≥ 3 d/wk at 1 year (OR 2.7, 95% CI 1.1-6.3); and less likely to have been depressed at presentation (OR 0.4, 95% CI 0.2-0.9). Demographic and dietary factors were not significantly associated with BMIp95 group status.

Conclusions Strategies improving follow-up rates, addressing mental health concerns, and promoting year-round physical activity are needed to increase the effectiveness of obesity management clinics. *(J Pediatr 2019;212:35-43)*.

Over the last decade, the prevalence of pediatric obesity has continued to climb, and in 2016, 18.5% of children in the US were obese.[1] Trends toward increasing body mass index (BMI) are not expected to slow. A recent study projected that 57.3% of today's children will be obese by the age of 35 years.[2] Pediatric obesity has been shown to have many negative effects on children's metabolic, cardiovascular, pulmonary, and psychological health.[3-7]

Without intervention, the majority of children and teens with obesity will have obesity as adults.[2,8] Overall, treatment of pediatric obesity has had limited success even with intensive lifestyle interventions. The Institute of Medicine guidelines recommend at least 26 contact hours for a pediatric obesity intervention to be effective, and this is based on behavioral interventions with a modest drop in BMI z scores ranging from 0.05 to 0.59.[9] Behavioral interventions largely have been successful in stabilizing participants' BMIs, which is unlikely to achieve metabolically beneficial effects.[10-13] The Pediatric Obesity Weight Evaluation Registry (POWER) study of children with obesity found a 5-point reduction in BMI percent of the 95th percentile (BMIp95) to be associated with improved cardiometabolic risk.[14]

The purposes of this study are to identify differences between patients with and without a 1-year follow-up visit for patients initiating care at a tertiary care pediatric obesity management clinic and to identify medical, demographic, and lifestyle factors associated with a ≥5-point decrease in BMIp95 among patients with 1-year follow-up visits.

Although most pediatric obesity research has been conducted using BMI z scores, that approach is not recommended. This study used the newly recommended outcome metric, BMIp95. It has been shown to be more predictive of adiposity than BMI z scores and a better measure to use across ages for obesity outcomes.[4,15-18] Further, this specific BMIp95 cut point is based on the POWER study results, in which a ≥5-point decrease in BMIp95 represented improvement in cardiometabolic measures.[14]

BMI	Body mass index
BMIp95	Body mass index percent of the 95th percentile
ICD	*International Classification of Diseases*
POWER	Pediatric Obesity Weight Evaluation Registry
SSB	Sugar-sweetened beverages

From the [1]Feinberg School of Medicine, [2]Department of General Internal Medicine and Geriatrics, [3]Department of Preventive Medicine, and [4]Department of Pediatrics, Northwestern University; [5]Pediatrics, Ann & Robert H. Lurie Children's Hospital of Chicago; and [6]Mary Ann & J. Milburn Smith Child Health Research, Outreach, and Advocacy Center, Stanley Manne Children's Research Institute, Chicago, IL

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Methods

This study is a retrospective medical record review of subjects aged 8-17 years with an initial visit to the Ann & Robert H. Lurie Children's Hospital of Chicago Wellness and Weight Management Program between July 2014 and December 2016. Children with a <95th BMI percentile for age/sex at their initial visit, or having a genetic or severe cardiac condition that limited physical activity, were excluded from the study. Among 838 potential subjects with a first visit at age 8-17 years in the review period, 769 (91.8%) met inclusion criteria. A total of 43 subjects (5.1%) were excluded for <95th BMI percentile for age/sex and 26 (3.1%) for genetic and cardiac conditions (Down syndrome, Prader−Willi syndrome, achondroplasia, osteogenesis imperfecta, spina bifida, transposition of the great arteries, single ventricle, Shone complex, chronic systolic heart failure). An outcomes evaluation sample of subjects with a follow-up visit at 12 ± 3 months after the initial visit, n = 184 (23.9%), was identified. This study was approved by the Lurie Children's Hospital institutional review board.

This clinic provides individualized care in outpatient clinical settings at 2 sites (Chicago and a Chicago suburb). At each visit, patients were seen by a physician or advanced practice nurse and a dietitian. A social worker was available for referrals from the clinic providers, as needed. Clinicians gathered information on child and family health history, mental health history, family structure, and child dietary and activity habits. They recorded days per week for school gym, sports/organized activities, use of fitness centers, use of home equipment for exercise, and average hours per day of screen time. Dietitians obtained a 24-hour recall of dietary intake, and documented daily beverage, fruit, and vegetable intake and eating schedule. Initial visits last about 2 hours and follow-up visits about 1 hour. At the initial visit, parents/guardians completed an intake form to report family and social history. Parents/guardians completed a clinic-developed health habits form at all visits. The health habits form included 2 questions for parents/guardians to indicate concern about their child's depressive symptoms (modeled after the Patient Health Questionnaire-2),[19,20] along with typical daily servings of various beverages and types of milk consumed, if any. The survey asked for hours per day of screen time on a typical weekday and weekend day.

Based on the providers' assessments of child and family needs, providers counseled and set goals tailored to families. Usual recommendations included eliminating sugar-sweetened beverages (SSB), avoiding juice, using skim or 1% milk, limiting screen time, increasing physical activity, increasing fruit and vegetable intake, and eating on a structured schedule. Families typically were advised to follow-up in clinic every 3 months. At each visit, measurements were obtained by clinic staff members according to hospital protocols. Height (to nearest 0.1 cm) was obtained using a wall-mounted stadiometer, weight (to nearest 0.1 kg) was obtained using digital scales, and percent body fat was obtained using a Tanita SC-331S body composition analyzer (Tanita Corporation of America, Inc, Arlington Heights, Illinois).

Electronic medical record data included demographics, anthropometrics, medications, and problem list and diagnoses codes. Visit documentation and forms collected at the visits were reviewed. Four race/ethnicity groups were defined: Hispanic, non-Hispanic white, non-Hispanic African American, and Asian. Insurance type groups were public (Medicaid) or private insurance. Tanner stage, as documented by the clinician at the initial visit, was grouped into 3 categories: prepubertal (Tanner 1), early puberty (Tanner 2-3), and late puberty (Tanner 4-5). Weight loss−promoting medications in use at the time of the first initial visit were identified, including metformin, stimulant medications, topiramate, and bupropion. Weight gain−promoting psychotropic medications in use at the initial visit also were identified.

Medical conditions were identified using *International Classification of Diseases* (ICD)-9 and ICD-10 diagnosis codes. Subjects with depression and anxiety were identified by ICD-9/ICD-10 codes or significant symptoms documented by the clinician at the initial visit. Developmental concerns (autism spectrum disorder, pervasive development disorder, or any developmental delay) were identified from ICD-9/ICD-10 codes and subjects also were considered as having a developmental concern if the provider documented a learning disorder or difficulties at school (failing grades or having/needing individualized education plans) at the initial visit.

Visit data were used to identify the ounces of daily beverage intake for juice, SSB, and milk, milk type, daily dietary structure, and average number of fruits and vegetables consumed per day at the initial and 1-year visits. "Sugar drinks" were considered to be SSB, juice, and sweetened/flavored milk. Two subjects missing data on beverage intake were assumed to have been consuming some sugary drinks. If the average number of fruits and vegetables was missing, it was extrapolated from the 24-hour dietary recall (n = 6). Visit data also were used to define the number of days per week the subject participated in moderate-to-vigorous physical activity at the initial and one year visits. To assess change in physical activity, the days per week of physical activity reported at the initial visit was subtracted from the 1-year follow-up visit physical activity. Two screen time groups were created those with ≤2 hours per day on both weekdays and weekend days and those who had >2 hours per day. Eight subjects had missing physical activity and screen time data, they were assumed to be sedentary and have >2 hours of screen time per day.

BMI percentiles were calculated using Epi Info 7.2.0.1 (Centers for Disease Control and Prevention, Atlanta, Georgia). BMIp95 was calculated by dividing the subject's BMI by the BMI at the 95th percentile for the subject's age and sex.[21] These data were used to define obesity class: class I (100%-119% BMIp95), class II (120%-139%), and class III (≥140%).[4] The first aim was to test for differences in age, sex, insurance type, maternal education, race/ethnicity, obesity class, initial BMIp95, initial percent body fat, clinic site, and season of initial visit between patients with and without 1-year follow-up visits using χ^2 tests of proportions and *t*-tests, for normally distributed continuous measures.

The second aim was to identify factors associated with a BMIp95 ≥5-point decrease in subjects with a 1-year follow-up visit. Two groups were identified based on change in BMIp95 from baseline to the 1-year follow-up visit: ≥5-point decrease group vs < 5-point decrease group. χ^2 and *t* tests, as appropriate, were used to compare baseline demographic, clinical, and lifestyle characteristics of the groups. In data processing, we assessed dietary factors as continuous variables and present these data for clinical interest.

A forward conditional logistic regression model was estimated to identify statistically significant associations with being in the BMIp95 ≥5-point decrease group vs the <5-point decrease group. Sex was forced into the model and the remaining factors were allowed to enter at $P < .05$ and be retained only if they remained significant. The characteristics significant at $P \leq .10$ in univariate analyses were offered as possible covariates in the model. SPSS (IBM SPSS Statistics Version 25; IBM Corp, Armonk, New York) was used for all analyses.

Results

Among 769 subjects meeting inclusion criteria, 432 (56.2%) subjects had a follow-up visit, including 184 (23.9%) subjects with a follow-up visit at 12 ± 3 months after the initial visit. In total, 28.4% (114/402) of males and 19.1% (70/367) of female subjects completed a 1-year follow-up visit ($P = .003$, **Table I**). No statistically significant differences were found between the subjects with or without a 1-year follow-up visit for age, race/ethnicity, insurance type, maternal education, BMIp95, obesity class, percent body fat, site, or season of visit (**Table I**).

Subjects in the 1-year follow-up group (n = 184) had an average initial age of 12.3 years (SD 2.6), with an initial BMIp95 of 135.7 (SD 26.6). The majority of subjects were Hispanic and enrolled in Medicaid (**Table II**). Age and initial BMIp95 did not differ significantly by BMIp95 change group (**Table III**). The average number of visits was 3.8 (SD 0.95), with a similar percentage in each group having ≥4 visits (**Table II**). At 1 year, mean change in BMIp95 overall was −2.6 (SD 8.8), with 61 (33.2%) subjects achieving a decrease in BMIp95 of ≥5 points. The average BMIp95 decrease was −12.2 (SD 6.9) for subjects in the ≥5-point decrease group vs a rise of 2.2 (SD 4.8) for subjects in the <5-point decrease group. Mean change in percent body fat for boys in the ≥5-point decrease group over 1 year was −3.2% (SD 5.8%, n = 34), and for girls mean change was −2.7% (SD 2.9%, n = 17). The boys in the <5-point decrease group had no change in percent body fat (0.0%, SD 4.1%, n = 57), and the girls increased their percent body fat by 0.7% (SD 2.9%, n = 45, **Table III**).

Six factors reached the significance threshold of $P \leq .10$ for consideration in the logistic regression modeling process. These included initial Tanner stage group (≥5-point decrease group subjects less often late Tanner stages), season of initial visit (≥5-point decrease group subjects more often presented in summer months), subject history of depression (≥5-point decrease group subjects less often had depression), history of developmental concerns (≥5-point decrease group subjects less often had a developmental concern), change in physical activity (≥5-point decrease group subjects more often increased physical activity), and milk type at the 1-year visit (≥5-point decrease group subjects more often using skim or 1% milk). Groups were similar for other demographic and medical concerns (**Table II**). Dietary habits were similar at baseline and the degree of change did not differ significantly between groups. The most significant positive dietary change was both groups decreased consumption of sugar drinks by ~8 oz/d. Neither group varied substantially in fruit/vegetable consumption at 1 year.

The logistic regression model was controlled for subject's sex to offset bias in the 1-year follow-up sample. Among the 6 variables offered for conditional entry, only 3 entered and were retained in the model (**Table IV**). Subjects in the ≥5-point decrease group more often had an initial visit in summer months (between April and September) (OR 2.03, 95% CI 1.05-3.93), lacked a history of depression (OR 0.42, 95% CI 0.20-0.89), and compared with those with no increase in physical activity had increased physical activity by 1-2 d/wk (OR 3.38, 95% CI 1.44-7.79), or ≥3 d/wk (OR 2.66, 95% CI 1.14-6.29).

Discussion

About one quarter of youth initiating care in the tertiary care pediatric obesity management clinic completed a 1-year follow-up visit. In the study population the only significant difference between the patients presenting for an initial evaluation and those who completed a 1-year follow-up visit was their sex. Male subjects were more likely to be in the 1-year follow-up group compared with female subjects; this finding has not been found previously in studies that examined loss to follow-up in obesity programs.[22-26] Although more than one-half of the patients had a follow-up visit, only one-quarter were seen for a 1-year follow-up visit. In 2016 and early 2017, the clinic wait list was overwhelmingly high, so the providers strategized to discharge patients after several follow-up visits. That temporary strategy may have lowered the 1-year follow-up rates.

Approximately one-third of subjects achieved a ≥5-point BMIp95 decrease at 1 year while participating in this program. Overall, few factors were found to be associated with a BMIp95 decrease ≥5 points. Lack of depression and increasing physical activity were key characteristics predicting successful BMIp95 reduction, and demographic and dietary factors did not significantly impact these outcomes. The finding that history of depression or significant depressive symptoms at the first visit predicts the inability to achieve a

Table I. Baseline characteristics of all patients with a first visit to the weight-management clinic

Characteristics	Total sample N = 769 n (%)	Follow-up group: One-year follow-up visit n = 184 (24%) n (%)	Follow-up group: Without 1-year follow-up visit n = 585 (76%) n (%)	*P* value
Sex				
Male	402 (52.3)	114 (62.0)	288 (49.2)	.003
Female	367 (47.7)	70 (38.0)	297 (50.8)	
Age, y, baseline				
8-10	261 (33.9)	69 (37.5)	192 (32.8)	.43
11-13	275 (35.8)	65 (35.3)	210 (35.9)	
14-17	233 (30.3)	50 (27.2)	183 (31.3)	
Race/ethnicity				
Hispanic	475 (61.8)	121 (65.8)	354 (60.5)	.37
Non-Hispanic White	168 (21.8)	40 (21.7)	128 (21.9)	
Non-Hispanic African American	104 (13.5)	20 (10.9)	84 (14.4)	
Asian	22 (2.9)	3 (1.6)	19 (3.2)	
Insurance type				
Public	577 (75.0)	143 (77.7)	434 (74.2)	.34
Private	192 (25.0)	41 (22.3)	151 (25.8)	
Maternal education				
Less than college degree	596 (77.5)	139 (75.5)	457 (78.1)	.47
College graduate	173 (22.5)	45 (24.5)	128 (21.9)	
Obesity class				
Class I	211 (27.4)	48 (26.1)	163 (27.9)	.60
Class II	281 (36.5)	73 (39.7)	208 (35.6)	
Class III	277 (36.0)	63 (34.2)	214 (36.6)	
Initial visit season				
Summer	376 (48.9)	87 (47.3)	289 (49.4)	.62
Winter	393 (51.1)	97 (52.7)	296 (50.6)	
Site				
Chicago	527 (68.5)	126 (68.5)	401 (68.5)	.99
Chicago suburb	242 (31.5)	58 (31.5)	184 (31.5)	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	
Age, y	12.5 (2.7)	12.3 (2.6)	12.6 (2.7)	.19
Initial BMIp95	135.3 (24.4)	135.7 (26.6)	135.2 (23.6)	.81
Initial percent body fat, boys	40.6 (n = 329) (8.4)	39.4 (n = 93) (8.2)	41.0 (n = 236) (8.5)	.12
Initial percent body fat, girls	45.1 (n = 309) (6.4)	44.7 (n = 63) (7.5)	45.2 (n = 246) (6.1)	.60

BMIp95 ≥5-point decrease is new. Multiple studies have found a reduction in depressive symptoms in adolescents with obesity who lose weight following bariatric surgery.[27-29] Presence of depression has been linked to greater risk of having obesity as an adolescent and, similarly, having obesity increases the risk of developing depression.[7,30,31]

Previous studies examining the association with age and reduction in BMI have had mixed results, with the majority of studies finding no association,[23,32-34] although a few have found younger age to be associated with larger BMI reduction.[35-37] These findings lend further support to the lack of association with age, given there was no significant difference between the age groups in terms of ≥5-point BMIp95 decrease. Most of the previous studies that have found that younger patients respond better to lifestyle interventions have used BMI z scores,[35,37] and due to the BMI curve, BMI z scores tend to decrease as younger children become older without a change in BMIp95.[18] Therefore, the choice of outcome metric could also explain the lack of association with age.

The finding that having an initial visit during the summer was associated with successful BMIp95 ≥5-point decrease was unexpected. It is possible that children with a first visit during the summer months found it easier to become more physically active, and this increase in physical activity grew into a year-round habit. Children in the Chicago area may struggle to initiate physical activity during the winter. It is also possible that advice provided during a summertime visit created more structure in a child's life during a time when many children are out of school.[38]

The remaining demographic factors of maternal education, ethnicity, and insurance type were not found to be predictors of BMIp95 ≥5-point decrease. This confirms many previous studies conducted in the US that found socioeconomic status is not predictive of BMI reduction, despite the significant association with the development of obesity.[23,25,33,39,40] Further, although racial and ethnic minorities are at much greater risk of obesity,[1] most studies have not found race or ethnicity to predict reduction in BMI.[23,33,41]

Table II. Baseline characteristics of 1-year follow-up sample and select lifestyle factors at 1 year

		BMIp95 change group		
	Total sample N = 184	≥5-point decrease n = 61 (33.2%)	<5-point decrease n = 123 (66.8%)	
Characteristics	n (%)	n (%)	n (%)	*P* value
Sex				.30
Male	114 (62.0)	41 (67.2)	73 (59.3)	
Female	70 (38.0)	20 (32.8)	50 (40.7)	
Age, y, baseline				.60
8-10	69 (37.5)	26 (42.6)	43 (35.0)	
11-13	65 (35.3)	20 (32.8)	45 (36.6)	
4-17	50 (27.2)	15 (24.6)	35 (28.5)	
Race/ethnicity				.53
Hispanic	121 (65.8)	42 (68.9)	79 (64.2)	
Non-Hispanic	63 (34.2)	19 (31.1)	44 (35.8)	
Insurance type				.88
Public	143 (77.7)	47 (77.0)	96 (78.0)	
Private	41 (22.3)	14 (23.0)	27 (22.0)	
Maternal education				.26
Less than college degree	139 (75.5)	43 (70.5)	96 (78.0)	
College graduate	45 (24.5)	18 (29.5)	27 (22.0)	
Tanner stage, baseline				.08[*]
1	58 (31.5)	21 (34.4)	37 (30.1)	
2-3	67 (36.4)	27 (44.3)	40 (32.5)	
4-5	59 (32.1)	13 (21.3)	46 (37.4)	
Obesity class				.30
Class I	48 (26.1)	13 (21.3)	35 (28.5)	
Class II or III	136 (73.9)	48 (78.7)	88 (71.5)	
Initial visit season				.01[*]
Summer (April-September)	87 (47.3)	37 (60.7)	50 (40.7)	
Winter (October-March)	97 (52.7)	24 (39.3)	73 (59.3)	
Site of initial visit				.45
Chicago	126 (68.5)	44 (72.1)	82 (66.7)	
Chicago suburb	58 (31.5)	17 (27.9)	41 (33.3)	
Total number of visits				.40
2-3 visits	62 (33.7)	18 (29.5)	44 (35.8)	
4 or more visits	122 (66.3)	43 (70.5)	79 (64.2)	
Number of households				.56
1 household	163 (88.6)	53 (86.9)	110 (89.4)	
2-3 households	21 (11.4)	8 (13.1)	13 (10.6)	
Depression[†]				.01[*]
Has depression	62 (33.7)	13 (21.3)	49 (39.8)	
No depression	122 (66.3)	48 (78.7)	74 (60.2)	
Anxiety				.42
Has anxiety	36 (19.6)	14 (23.0)	22 (17.9)	
No anxiety	148 (80.4)	47 (77.0)	101 (82.1)	
Other MH concern[‡]				.41
Has other MH concern	59 (32.1)	22 (36.1)	37 (30.1)	
No other MH concern	125 (67.9)	39 (63.9)	86 (69.9)	
Parent MH concern				.98
Has a parent with MH concern	60 (32.6)	20 (32.8)	40 (32.5)	
No parent MH concern	124 (67.4)	41 (67.2)	83 (67.5)	
ADHD				.67
Has ADHD	27 (14.8)	8 (13.1)	19 (15.4)	
No ADHD	156 (85.2)	53 (86.9)	104 (84.6)	
Developmental delay				.54
Has developmental delay	38 (20.7)	11 (18.0)	27(22.0)	
No developmental delay	146 (79.3)	50 (82.0)	96 (78.0)	
Developmental concern[§]				.02[*]
Has developmental concern	82 (44.6)	20 (32.8)	62 (50.4)	
No developmental concern	102 (55.4)	41 (67.2)	61 (49.6)	
Asthma				.45
Has asthma	55 (29.9)	16 (26.2)	39 (31.7)	
No asthma	129 (70.1)	45 (73.8)	84 (68.3)	
Hypothyroidism				.37
Has hypothyroidism	11 (6.0)	5 (8.2)	6 (4.9)	
No hypothyroidism	173 (94.0)	56 (91.8)	117 (95.1)	
Weight loss promoting medications				.85
Weight loss promoting medication	20 (10.9)	7 (11.5)	13 (10.6)	
No weight loss promoting medication	164 (89.1)	54 (88.5)	110 (89.4)	

(*continued*)

Table II. Continued

Characteristics	Total sample N = 184 n (%)	BMIp95 change group ≥5-point decrease n = 61 (33.2%) n (%)	<5-point decrease n = 123 (66.8%) n (%)	*P* value
Weight gain promoting medications				.20
Weight gain promoting medication	12 (6.5)	6 (9.8)	6 (4.9)	
No weight gain promoting medication	172 (93.5)	55 (90.2)	117 (95.1)	
Lifestyle factors at 1 year	**n (%)**	**n (%)**	**n (%)**	
Activity history				.14
Sedentary (physical activity 0-1 d/wk)	45 (24.5)	10 (16.4)	35 (28.5)	
Physical activity 2-4 d/wk	58 (31.5)	19 (31.1)	39 (31.7)	
Physical activity 5+ d/wk	81 (44.0)	32 (52.5)	49 (39.8)	
Change in physical activity from initial visit				.001*
No change in physical activity or decrease	123 (66.8)	30 (49.2)	93 (75.6)	
Increase physical activity 1-2 d/wk	30 (16.5)	16 (26.2)	14 (11.4)	
Increase physical activity 3+ d/wk	31 (16.8)	15 (24.6)	16 (13.0)	
Screen time				.19
≤2 h/d	52 (28.3)	21 (34.4)	31 (25.2)	
>2 h/d	132 (71.7)	40 (65.6)	92 (74.8)	
Fruits and vegetables				.22
≥2 servings each day	25 (13.6)	11 (18.0)	14 (11.4)	
<2 servings each day	159 (86.4)	50 (82.0)	109 (88.6)	
Milk type				.08*
Skim or 1% milk	101 (54.9)	39 (63.9)	62 (50.4)	
Other milk or no milk	83 (45.1)	22 (36.1)	61 (49.6)	
Beverages				.11
No sugar drinks	47 (25.5)	20 (32.8)	27 (22.0)	
Some sugar drinks	137 (74.5)	41 (67.2)	96 (78.0)	
Structured eating				
Scheduled meals	118 (64.1)	44 (72.1)	74 (60.2)	.11
Unscheduled meals	66 (35.9)	17 (27.9)	49 (39.8)	

ADHD, attention deficit hyperactivity disorder; *MH*, mental health.
*χ^2 *P* value < .1 comparing BMIp95 ≥ 5 point decrease vs < 5-point decrease groups.
†History of depression or significant depressive symptoms at the initial visit.
‡Includes bipolar disorder, oppositional defiant disorder, conduct disorder, post-traumatic stress disorder, adjustment disorder, previous psychiatric hospitalization.
§Includes any developmental delay, autism, learning disorder, failing grades at school, need for individualized education plan or 504 plan.

The subjects in this study reported similar dietary patterns at 1 year, with significant reductions in SSB and consumption of fruit/vegetables at levels lower than recommended.[42] The key differentiating factor between the groups appears to be the addition of physical activity. Even a small increase of physical activity by 1-2 days per week led to being 3.4 times more likely to be in the BMIp95 ≥5-point decrease group. A recent study of Australian children found a significant

Table III. Anthropometrics and lifestyle factors among subjects with a 1-year follow-up visit

Anthropometrics	Total sample N = 184 Mean (SD)	BMIp95 change group ≥5-point decrease n = 61 (33.2%) Mean (SD)	<5-point decrease n = 123 (66.8%) Mean (SD)	*P* value
Age, y, initial visit	12.3 (2.6)	12.0 (2.6)	12.4 (2.6)	.39
Initial BMIp95	135.7 (26.6)	134.9 (20.6)	136.3 (29.4)	.74
Change in BMIp95 at 1 y	−2.6 (8.8)	−12.2 (6.9)	2.1 (4.8)	<.001
Initial percent body fat, boys	39.4 (n = 93) (8.2)	38.9 (n = 34) (8.7)	39.7 (n = 59) (7.9)	.63
Initial percent body fat, girls	44.7 (n = 63) (7.4)	44.7 (n = 17) (6.9)	44.7 (n = 46) (7.7)	.99
Change in percent body fat, boys	−1.2 (n = 91) (5.0)	−3.2 (n = 34) (5.8)	−0.02 (n = 57) (4.1)	.006
Change in percent body fat, girls	−0.2 (n = 62) (3.3)	−2.7 (n = 17) (2.9)	0.7 (n = 45) (2.9)	<.001
Lifestyle factor				
Number of visits	3.8 (1.0)	3.8 (0.9)	3.8 (1.0)	.63
Initial SSB, oz/d	9.5 (13.4)	10.7 (12.3)	8.9 (14.0)	.38
Change in SSB, oz/d	−5.2 (n = 183) (13.8)	−6.3 (n = 61) (12.9)	−4.7 (n = 122) (14.2)	.47
Initial juice, oz/d	5.4 (7.4)	4.8 (6.7)	5.7 (7.8)	.45
Change in juice, oz/d	−2.8 (8.0)	−2.6 (8.5)	−2.9 (7.8)	.78
Fruit servings at 1 y, servings/d	1.7 (n = 183) (1.2)	1.7 (n = 60) (1.2)	1.7 (n = 123) (1.2)	.91
Vegetable servings at 1 y, servings/d	1.1 (n = 183) (0.9)	1.2 (n = 60) (1.0)	1.0 (n = 123) (0.9)	.12

Table IV. Forward conditional logistic regression model examining association of characteristics with ≥5-point decrease in BMIp95

Characteristics	Unadjusted OR	95% CI	aOR (controlling for sex)	95% CI
Season of initial visit				
Summer	2.25	(1.20-4.21)	**2.03**	(1.05-3.93)
Winter	Ref	Ref	Ref	Ref
Mental health				
Depression*	0.41	(0.20-0.83)	**0.42**	(0.20-0.89)
No depression	Ref	Ref	Ref	Ref
Change in physical activity				
No increase in physical activity	Ref	Ref	Ref	Ref
Increase physical activity 1-2 d/wk	3.54	(1.55-8.10)	**3.38**	(1.44-7.79)
Increase physical activity 3+ d/wk	2.91	(1.29-6.57)	**2.66**	(1.14-6.29)
Tanner stage, baseline			NS	
1	Ref	Ref		
2-3	1.19	(0.58-2.46)		
4-5	0.50	(0.22-1.23)		
Developmental concern†			NS	
Has developmental concern	0.48	(0.25-0.91)		
No developmental concern	Ref	Ref		
Milk type			NS	
Skim or 1% milk	1.74	(0.93-3.28)		
All other milk types or no milk	Ref	Ref		

NS, not selected for adjusted logistic regression model; *Ref*, reference.
Bold values are statistically significance.
*History of depression or significant depressive symptoms at the initial visit.
†Includes any developmental delay, autism, learning disorder, failing grades at school, need for individualized education plan or 504 plan.

decrease in fat mass and increase in fat-free mass with as little as 15 more minutes a day of moderate-to-vigorous physical activity.[43]

This study had important limitations. The study population was majority male, Hispanic, and receiving public insurance. The prevalence of obesity is greater in male subjects and Hispanic populations, but not to the extent seen in this sample.[1] The sample population is not representative of all children with obesity because these were patients and families seeking obesity care and their intrinsic motivations may differ from the general population. Further, three-fourths of patients presenting for an initial visit did not have a 1-year follow-up visit. A 50% loss to follow-up after the initial visit is unfortunately fairly standard across tertiary obesity care centers.[13,24,44] Early discharge from clinic after less than 1-year of follow-up is an additional unintended source of bias. An additional limitation is the broad definition of depression used in this study. The presence of significant depressive symptoms is more generous than a diagnosis of a depressive disorder. The lifestyle data relied heavily on self-report, so it is possible patients and their families minimized unhealthy habits while discussing behaviors with healthcare providers. The lack of finding a difference in dietary patterns between the groups may in part be due to the nutrition data relying on self-report. One aspect of lifestyle this study was not able to assess was changes made by the whole family, despite the clinic's counseling on household-wide healthy changes. It has been shown that when parents reduce their BMI, children have improved BMI outcomes.[35,40] It is possible the older children in this study were more able to increase their physical activity independent of their family's lifestyle.

One-third of subjects in the outcomes sample achieved a BMIp95 decrease ≥5-points with relatively few visits (about 4 visits), which would have been about 5 contact hours. The Institute of Medicine currently recommends at least 26 contact hours for an obesity intervention to be effective.[9] Given limited resources and many patients in need of obesity care across a large geographic area, delivery of care will need to continue to identify and focus on effective care strategies that can be delivered efficiently.

On the basis of these findings, both primary care and obesity specialist pediatric providers can more accurately advise patients that a key to BMI reduction involves increased physical activity and perhaps elevate the importance of increases in physical activity during obesity care counseling. In addition, when significant depressive symptoms are noted in a patient with obesity, care should substantially focus on evaluation and treatment of the depression to eliminate this barrier from achieving activity and behavior changes. ■

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Reprint requests: Helen J. Binns, MD, MPH, 225 E. Chicago Ave, Box 157, Chicago, IL 60611-2605. E-mail: hbinns@luriechildrens.org

Data Statement

Data sharing statement available at www.jpeds.com.

References

1. Skinner AC, Ravanbakht SN, Skelton JA, Perrin EM, Armstrong SC. Prevalence of obesity and severe obesity in US children, 1999-2016. Pediatrics 2018;141:e20173459.
2. Ward ZJ, Long MW, Resch SC, Giles CM, Cradock AL, Gortmaker SL. Simulation of growth trajectories of childhood obesity into adulthood. N Engl J Med 2017;377:2145-53.
3. Chung ST, Onuzuruike AU, Magge SN. Cardiometabolic risk in obese children. Ann N Y Acad Sci 2018;1411:166-83.
4. Kelly AS, Barlow SE, Rao G, Inge TH, Hayman LL, Steinberger J, et al. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. Circulation 2013;128:1689-712.
5. Barlow SE , Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. Pediatrics 2007;120(suppl 4):S164-92.
6. Jastreboff AM, Kotz CM, Kahan S, Kelly AS, Heymsfield SB. Obesity as a disease: the Obesity Society 2018 position statement. Obesity (Silver Spring) 2019;27:7-9.
7. Kalarchian MA, Marcus MD. Psychiatric comorbidity of childhood obesity. Int Rev Psychiatry 2012;24:241-6.
8. Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. J Pediatr 2007;150: 12-7 e2.
9. Grossman DC, Bibbins-Domingo K, Curry SJ, Barry MJ, Davidson KW, Doubeni CA, et al. Screening for obesity in children and adolescents: US Preventive Services Task Force recommendation statement. JAMA 2017;317:2417-26.
10. Mead E, Brown T, Rees K, Azevedo LB, Whittaker V, Jones D, et al. Diet, physical activity and behavioural interventions for the treatment of overweight or obese children from the age of 6 to 11 years. Cochrane Database Syst Rev 2017;6:CD012651.
11. Al-Khudairy L, Loveman E, Colquitt JL, Mead E, Johnson RE, Fraser H, et al. Diet, physical activity and behavioural interventions for the treatment of overweight or obese adolescents aged 12 to 17 years. Cochrane Database Syst Rev 2017;6:CD012691.
12. Taveras EM, Marshall R, Kleinman KP, Gillman MW, Hacker K, Horan CM, et al. Comparative effectiveness of childhood obesity interventions in pediatric primary care: a cluster-randomized clinical trial. JAMA Pediatr 2015;169:535-42.
13. Hampl SE, Borner KB, Dean KM, Papa AE, Cordts KP, Smith TR, et al. Patient attendance and outcomes in a structured weight management program. J Pediatr 2016;176:30-5.
14. Kumar S, King EC, Christison AL, Kelly AS, Ariza AJ, Borzutzky C, et al. Health outcomes of youth in clinical pediatric weight management programs in POWER. J Pediatr 2019;208:57-65.e4.
15. Freedman DS, Butte NF, Taveras EM, Lundeen EA, Blanck HM, Goodman AB, et al. BMI z-scores are a poor indicator of adiposity among 2- to 19-year-olds with very high BMIs, NHANES 1999-2000 to 2013-2014. Obesity (Silver Spring) 2017;25:739-46.
16. Flegal KM, Wei R, Ogden CL, Freedman DS, Johnson CL, Curtin LR. Characterizing extreme values of body mass index-for-age by using the 2000 Centers for Disease Control and Prevention growth charts. Am J Clin Nutr 2009;90:1314-20.
17. Freedman DS, Butte NF, Taveras EM, Goodman AB, Ogden CL, Blanck HM. The limitations of transforming very high body mass indexes into z-scores among 8.7 million 2- to 4-year-old children. J Pediatr 2017;188:50-6 e1.
18. Gorecki MC, Binns HJ. Choosing an accurate outcome metric for pediatric obesity care. Pediatr Diabetes 2019;20:152-3.
19. Richardson LP, McCauley E, Grossman DC, McCarty CA, Richards J, Russo JE, et al. Evaluation of the Patient Health Questionnaire-9 Item for detecting major depression among adolescents. Pediatrics 2010;126:1117-23.
20. Gilbody S, House AO, Sheldon TA. Screening and case finding instruments for depression. Cochrane Database Syst Rev 2005;4:CD002792.
21. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al. 2000 CDC growth charts for the United States: methods and development. Vital Health Stat 2002;11:1-190.
22. Cote MP, Byczkowski T, Kotagal U, Kirk S, Zeller M, Daniels S. Service quality and attrition: an examination of a pediatric obesity program. Int J Qual Health Care 2004;16:165-73.
23. Heinberg LJ, Kutchman EM, Berger NA, Lawhun SA, Cuttler L, Seabrook RC, et al. Parent involvement is associated with early success in obesity treatment. Clin Pediatr (Phila) 2010;49:457-65.
24. Zeller M, Kirk S, Claytor R, Khoury P, Grieme J, Santangelo M, et al. Predictors of attrition from a pediatric weight management program. J Pediatr 2004;144:466-70.
25. Jelalian E, Hart CN, Mehlenbeck RS, Lloyd-Richardson EE, Kaplan JD, Flynn-O'Brien KT, et al. Predictors of attrition and weight loss in an adolescent weight control program. Obesity (Silver Spring) 2008;16: 1318-23.
26. Perez AJ, Yaskina M, Maximova K, Kebbe M, Peng C, Patil T, et al. Predicting enrollment in multidisciplinary clinical care for pediatric weight management. J Pediatr 2018;202:129-35.
27. Zeller MH, Reiter-Purtill J, Ratcliff MB, Inge TH, Noll JG. Two-year trends in psychosocial functioning after adolescent Roux-en-Y gastric bypass. Surg Obes Relat Dis 2011;7:727-32.
28. Jarvholm K, Olbers T, Marcus C, Marild S, Gronowitz E, Friberg P, et al. Short-term psychological outcomes in severely obese adolescents after bariatric surgery. Obesity (Silver Spring) 2012;20:318-23.
29. Sysko R, Devlin MJ, Hildebrandt TB, Brewer SK, Zitsman JL, Walsh BT. Psychological outcomes and predictors of initial weight loss outcomes among severely obese adolescents receiving laparoscopic adjustable gastric banding. J Clin Psychiatry 2012;73:1351-7.
30. Mannan M, Mamun A, Doi S, Clavarino A. Prospective associations between depression and obesity for adolescent males and females—a systematic review and meta-analysis of longitudinal studies. PLoS One 2016;11:e0157240.
31. Fox CK, Gross AC, Rudser KD, Foy AM, Kelly AS. Depression, anxiety, and severity of obesity in adolescents: is emotional eating the link? Clin Pediatr (Phila) 2016;55:1120-5.
32. Baxter KA, Ware RS, Batch JA, Truby H. Predicting success: factors associated with weight change in obese youth undertaking a weight management program. Obes Res Clin Pract 2013;7:e147-54.
33. Best JR, Goldschmidt AB, Mockus-Valenzuela DS, Stein RI, Epstein LH, Wilfley DE. Shared weight and dietary changes in parent-child dyads following family-based obesity treatment. Health Psychol 2016;35:92-5.
34. Reinehr T, Brylak K, Alexy U, Kersting M, Andler W. Predictors to success in outpatient training in obese children and adolescents. Int J Obes Relat Metab Disord 2003;27:1087-92.
35. Goldschmidt AB, Best JR, Stein RI, Saelens BE, Epstein LH, Wilfley DE. Predictors of child weight loss and maintenance among family-based treatment completers. J Consult Clin Psychol 2014;82:1140-50.
36. Jansen E, Mulkens S, Jansen A. Tackling childhood overweight: treating parents exclusively is effective. Int J Obes (Lond) 2011;35:501-9.
37. Danielsson P, Kowalski J, Ekblom O, Marcus C. Response of severely obese children and adolescents to behavioral treatment. Arch Pediatr Adolesc Med 2012;166:1103-8.
38. Beets MW, Brazendale K, Weaver RG. The need for synergy between biological and behavioral approaches to address accelerated weight gain during the summer in children. Int J Behav Nutr Phys Act 2019;16:39.
39. Shrewsbury V, Wardle J. Socioeconomic status and adiposity in childhood: a systematic review of cross-sectional studies 1990-2005. Obesity (Silver Spring) 2008;16:275-84.

40. Boutelle KN, Cafri G, Crow SJ. Parent predictors of child weight change in family based behavioral obesity treatment. Obesity (Silver Spring) 2012;20:1539-43.
41. Wiegand S, Keller KM, Lob-Corzilius T, Pott W, Reinehr T, Robl M, et al. Predicting weight loss and maintenance in overweight/obese pediatric patients. Horm Res Paediatr 2014;82:380-7.
42. Millen BE, Abrams S, Adams-Campbell L, Anderson CA, Brenna JT, Campbell WW, et al. The 2015 Dietary Guidelines Advisory Committee scientific report: development and major conclusions. Adv Nutr 2016;7:438-44.
43. Dumuid D, Wake M, Clifford S, Burgner D, Carlin JB, Mensah FK, et al. The association of the body composition of children with 24-hour activity composition. J Pediatr 2019;208:43-9.
44. Hampl S, Paves H, Laubscher K, Eneli I. Patient engagement and attrition in pediatric obesity clinics and programs: results and recommendations. Pediatrics 2011;128(suppl 2):S59-64.

50 Years Ago in *The Journal of Pediatrics*

The Effect of Pentobarbital Anesthesia on Resuscitation and Brain Damage in Fetal Rhesus Monkeys Asphyxiated on Delivery

Cockburn F, Daniel SS, Dawes GS, James LS, Myers RE, Nienann W, et al. J Pediatr 1969;75:281-91.

There has been a long, ongoing search for neuroprotective agents for administration following birth asphyxia. Cockburn and a group of eminent scientists in the field at that time reported 50 years ago in *The Journal* their study examining the effect of maternal pentobarbital anesthesia on fetal monkeys subjected to perinatal asphyxia. Pentobarbital reduced metabolic acidosis, increased the duration of primary apnea, increased the duration of gasping, and led to faster onset of rhythmic breathing after ventilation. They also showed a decrease in incidence and severity of brain damage. These findings of potential neuroprotection of pentobarbital after perinatal asphyxia were supported by other primate studies in the 1970s and also in some studies in human newborns.[1] However, in the mid-1980s, clinical studies using thiopental instead of pentobarbital showed that barbiturates were not beneficial and potentially harmful because of significant cardiovascular adverse effects.[2] Since then, barbiturates are only used as an antiseizure medication, using phenobarbital, in neonates subjected to perinatal asphyxia.[3] Cockburn's study highlights the difference between animal models and the clinical setting, and gives valuable insight into basic research on the primate model and neuroprotective strategies. This is a field that still is undergoing extensive research; we still have not found the ideal combination of treatments to optimize long-term neurocognitive outcome.[4]

Jannicke H. Andresen, MD, PhD
Department of Neonatology
Oslo University Hospital
Oslo, Norway

Ola Didrik Saugstad, MD, PhD
Department of Pediatric Research
University of Oslo
Oslo, Norway

Ann and Robert H. Lurie Children's Hospital of Chicago
Northwestern University Feinberg School of Medicine
Chicago, Illinois

References

1. Cuestas RA Jr. Creatine kinase isoenzymes in high-risk infants. Pediatr Res 1980;14:935.
2. Goldberg RN, Moscoso P, Bauer CR, Bloom FL, Curless RG, Burke B, et al. Use of barbiturate therapy in severe perinatal asphyxia: a randomized controlled trial. J Pediatr 1986;109:851-6.
3. Šíma M, Pokorná P, Hartinger J, Slanař O. Estimation of initial phenobarbital dosing in term neonates with moderate-to-severe hypoxic ischaemic encephalopathy following perinatal asphyxia. J Clin Pharm Therapeut 2018;43:196-201.
4. Nair J, Kumar VHS. Current and emerging therapies in the management of hypoxic ischemic encephalopathy in neonates. Children 2018;5:99.