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Characteristics of achieving clinically important weight loss in two pediatric weight management interventions

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Abstract

Objective: To examine characteristics and lifestyle behaviors associated with achieving clinically important weight loss (CIWL) in two PWMI's.

Methods: We examined 1010 children enrolled in the STAR and Connect for Health trials. We defined achieving CIWL as any participant who had decreased their BMI z-score by ≥ 0.2 units over 1 year. Using log-binomial regression we examined associations of child and household characteristics and lifestyle behaviors with achieving CIWL.

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Results: In multivariable analyses, children with severe obesity had a lower likelihood of achieving CIWL compared to children without severe obesity (RR: 0.68 [95% CI: 0.49, 0.95]). Children who were ≥10 years were less likely to achieve CIWL (RR: 0.56 [95% CI: 0.42, 0.74]) vs. those 2–6 years of age. Children who consumed <1 sugary beverage per day were more likely to achieve CIWL vs. those who did not meet the goal (RR: 1.36 [95% CI 1.09–1.70]).

Conclusion: In this analysis of children enrolled in PWMIs, achieving CIWL was associated with younger age, not having severe obesity, and consuming less sugary beverages. Focusing on intervening earlier in life, when a child is at a lower BMI and reducing sugary beverages could allow for more effective PWMI's.

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Keywords

Clinically important weight loss; Childhood obesity

Introduction

In the United States, approximately 18% of children ages 2 – 19 years have obesity (1). Childhood obesity is associated with both short- and long-term adverse outcomes including hyperlipidemia, diabetes, and hypertension; and with higher morbidity and mortality in adulthood (2). The annual direct medical costs of childhood obesity are estimated at $14.3 billion, and estimates of future economic burden when these children transition into adulthood include $45 billion annually in direct medical costs and $208 billion because of lost productivity from earlier death or morbidity (3). While childhood obesity rates may have plateaued in some US population subgroups, overall rates remain high and racial/ethnic and socioeconomic disparities appear to be widening (1).

Effective weight management interventions in childhood could reduce morbidity, mortality and health care spending. However, most clinically-based randomized controlled trials (RCT) to improve a child's body mass index (BMI) have had modest success (4). Furthermore, they utilize multiple concurrent components which make it difficult to know which components were effective.

The United States Preventive Services Task Force (USPSTF) defines clinically important weight loss (CIWL) associated with cardio- metabolic improvements as a change in BMI z-score by ≥0.2 units (4). Characterizing children enrolled in clinical obesity interventions who achieve the USPSTF's criteria for improvement in weight may inform the design of future interventions for children struggling to get to a healthier BMI. The aim of this study was to examine what individual and parent/household characteristics and healthful lifestyle changes were associated with achieving CIWL in two childhood obesity RCTs. We hypothesized that children who were drinking < 1 sugary beverage per day would be the most likely to achieve this status given previous research has shown this to be an effective healthy lifestyle behavior change.

Methods:

Study Participants

Data were from 1010 children who previously participated in the intervention arms of one of two pediatric weight management interventions (PWMIs): the Study of Technology to Accelerate Research (STAR) trial and the Connect for Health Study. STAR was a cluster-randomized PWMI that occurred from October 2011- July 2013, for children 6–12 years of age with a BMI ≥ 95th percentile. We obtained Institutional Review Board approval from Harvard Pilgrim Health Care and written or verbal consent from all participants. Recruitment and study procedures of STAR have been previously published (5).

In this secondary analysis we included 340 participants randomized to 1) computerized clinic decision support plus a family self-guided behavior change intervention (CDS) (5 practices) or 2) computerized clinician decision support plus a health coach intervention (CDS + Coaching) (5 practices). Children in the CDS intervention had a similar change in BMI z-score over one year (−0.06 units; 95% CI: −0.11, −0.02); compared to the CDS + Coaching intervention (−0.05; 95% CI: −0.09,0.00) (p=0.52) (5).

The Connect for Health trial was an individually RCT which occurred from June 2014 – March 2016. Recruitment and study procedures of Connect for Health have been previously published (6). In this trial children were randomized to: 1) enhanced primary care (e.g. flagging of children with BMI≥ 85th percentile, clinical decision support tools for pediatric weight management, parent educational materials, a Neighborhood Resource Guide and monthly text messages) or 2) enhanced primary care plus contextually tailored, individual health coaching (twice-weekly text messages and telephone or video contacts every other month) to support behavior change and linkage of families to neighborhood resources. There were no significant differences between the intervention arms in BMI z-score (enhanced primary care BMI z-score change −0.06 (95% CI: −0.10, −0.02) and enhanced primary care plus coaching group BMI z-score change −0.09 (95% CI:−0.13, −0.05).

Outcomes:

The primary outcome was those who achieved CIWL ≥ 0.2 BMI z-score change over the 1-year intervention period(4). Children's age and sex-specific BMI z-scores were derived from the height and weight measurements recording in the electronic health record (EHR) at enrollment at their 1 year well -child visit. BMI was calculated as kg/m^2 and the CDC growth charts (7) were used to define the participants BMI z-score.

Exposures:

Exposure data were measured at baseline. Child's age, sex, height, and weight were obtained from the EHR. Severe obesity was defined as ≥120th percent of the 95th percentile of weight and height measurements (8). Child race and ethnicity, parental education, age, household annual income, and BMI were based on parent report. We examined parental report of the following healthy lifestyle behaviors assessed after the intervention ended:

1. Sugary beverage intake: < 1 serving per day (9,10)

2. Fruit and Vegetable intake: ≥ 5 servings per day (9,10)
3. Screen Time Duration per day: ≤ 2 hours per day (11)
4. Meeting Age Appropriate Sleep Goals (12)
5. Fast Food Intake: ≤ once per week (13)

Statistical Analysis

We examined overall baseline descriptive characteristics and evaluated bivariate associations of CIWL with the various exposures. We then used log binomial regression to examine the adjusted associations of exposures with our outcome of interest. We included covariates with a $p<0.10$ in bivariate analyses or based on a priori hypotheses in the final model to ensure a parsimonious model. We ran two models: first adjusted for child and household demographics including child age, gender, race/ethnicity, severe obesity, parental education, and parental BMI, intervention and arm. The second, fully adjusted models added individual healthy lifestyle behaviors including sugary beverage intake, fruit and vegetable intake, screen time duration, meeting appropriate sleep goals and fast food intake. Statistical analyses were performed in SAS 9.3.

Results

Sample characteristics of the two clinical trials are shown in Table I. Over a quarter (26%; N=261) of participants achieved CIWL. In bivariate analyses children were more likely to achieve CIWL if they were 2-< 6 years vs. older than 6 years ($p<0.01$). Children were less likely to achieve CIWL if they had severe obesity ($p<0.01$), if their parents did not have a college degree ($p=0.09$), and if their parents had a lean BMI ($p<0.01$) (Table I). These covariates were included in the multivariate analyses.

In fully adjusted models children 6-<10 years of age were less likely to achieve CIWL than children 2-<6 years old (RR: 0.55 (95%CI: 0.42, 0.71)). Older children (RR 0.56;95% CI: 0.42, 0.74 for 10+ years versus 2-<6 years) and children with severe obesity (RR 0.68;95% CI:0.49, 0.95) were also less likely to achieve CIWL than their counterparts, while those who drank < 1 sugary beverage per day were more likely to achieve CIWL (RR 1.36;95% CI: 1.09, 1.70) than those who were drinking 1 or more sugary beverages per day (Table II).

Discussion

In this study of 1010 children participating in two childhood obesity randomized controlled trials 26% were able to achieve CIWL or a BMI z-score decrease of by ≥ 0.2 units. In adjusted analyses, these children were characterized by younger age, lower baseline BMI status, and lower consumption of sugary beverages.

There are studies that examine characteristics of success in PWMIs but none to our knowledge have examined those who have been able to meet the threshold of CIWL. A positive deviance or positive outlier approach, which examines those that are the most successful, has been used in childhood obesity research; however, these studies have been mostly limited to qualitative analyses (14,15). Wiegand et al examined 3,135 children over 2

years and found that boys were more likely to have long-term reductions in BMI z-score and those that were younger, 5–11 years, vs 12–15 years were more likely to be successful (16). This is similar to our findings that younger children were more likely to achieve CIWL.

To investigate the behaviors and practices of a population in a community at high-risk for obesity, Foster at al used a mixed methods, cross-sectional approach to interview and survey 40 families with children with a lean BMI, overweight and obesity in Texas (17). They found that children of a lean BMI were more likely to limit juice, consistent with our results that those consuming < 1 sugary beverage per day were more likely to achieve CIWL. Similar to our study, they did not find evidence that screen time or physical activity were different among the three groups studied.

Our findings that those with severe obesity are less likely to achieve CIWL is also consistent with previous literature. Baxter et al. examined predictors of weight loss among 80 children enrolled in a 12-week dietary weight management study, and found that lower BMI z-score predicted weight loss (18). Previous studies have suggested that for children with severe obesity, the magnitude of decreases in net daily energy intake necessary to achieve a healthy weight is considerably greater (19). Previous literature has also suggested that BMI z-score may not be the best measure for change in children with severe obesity, which is a limitation of this study and the current USPSTF definition of CIWL (20). We hope to explore emerging definitions of CIWL in future work.

This study has numerous strengths including its longitudinal design, EHR BMI measurements, and relatively large number of participants. This study also has limitations including self-reported measures for diet and physical activity and sleep.

In conclusion, our results support that limiting sugary beverages is a healthy lifestyle behavior that was associated with CIWL. Future research should examine more effective strategies for children with severe obesity and also ensure that children are referred to PWMIs at younger ages. Solutions learned from children who achieve CIWL could be generalized and promoted to optimize interventions for other children who are struggling to get to a healthier BMI.

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References

1. Ogden CL, Fryar CD, Hales CM, Carroll MD, Aoki Y, Freedman DS. Differences in Obesity Prevalence by Demographics and Urbanization in US Children and Adolescents, 2013–2016. JAMA. 20186;319(23):2410–8. [PubMed: 29922826]

2. Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. Pediatrics. 19983;101(3 Pt 2):518–25. [PubMed: 12224658]

3. Lightwood J, Bibbins-Domingo K, Coxson P, Wang YC, Williams L, Goldman L. Forecasting the future economic burden of current adolescent overweight: an estimate of the coronary heart disease policy model. Am J Public Health. 200912;99(12):2230–7. [PubMed: 19833999]

4. 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. 20176;317(23):2417–26. [PubMed: 28632874]

5. 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. 20156;169(6):535–42. [PubMed: 25895016]

6. Taveras EM, Marshall R, Sharifi M, Avalon E, Fiechtner L, Horan C, et al.Comparative effectiveness of clinical-community childhood obesity interventions a randomized clinical trial. JAMA Pediatr. 2017;171(8):1–8.

7. 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 11. 2002 May; (246):1–190.

8. Skinner AC, Skelton JA. Prevalence and trends in obesity and severe obesity among children in the United States, 1999–2012. JAMA Pediatr. 20146;168(6):561–6. [PubMed: 24710576]

9. Hoelscher DM, Day RS, Kelder SH, Ward JL. Reproducibility and validity of the secondary level School-Based Nutrition Monitoring student questionnaire. J Am Diet Assoc. 2003 Feb;103(2):186–94. [PubMed: 12589324]

10. Thiagarajah K, Fly AD, Hoelscher DM, Bai Y, Lo K, Leone A, et al.Validating the food behavior questions from the elementary school SPAN questionnaire. J Nutr Educ Behav. 2008;40(5):305–10. [PubMed: 18725149]

11. Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. JAMA. 199910;282(16):1561–7. [PubMed: 10546696]

12. Chervin Hedger, Dillon Pituch. Pediatric sleep questionnaire (PSQ): validity and reliability of scales for sleep-disordered breathing, snoring, sleepiness, and behavioral problems. Sleep Med. 2000 Feb;1(1):21–32. [PubMed: 10733617]

13. Taveras EM, Berkey CS, Rifas-Shiman SL, Ludwig DS, Rockett HRH, Field AE, et al.Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. Pediatrics. 200510;116(4):e518–24. [PubMed: 16199680]

14. Sharifi M, Sequist TD, Rifas-Shiman SL, Melly SJ, Duncan DT, Horan CM, et al.The role of neighborhood characteristics and the built environment in understanding racial/ethnic disparities in childhood obesity. Prev Med (Baltim). 2016 Oct;91:103–9.

15. Sharifi M, Marshall G, Goldman RE, Cunningham C, Marshall R, Taveras EM. Engaging children in the development of obesity interventions: Exploring outcomes that matter most among obesity positive outliers. Patient Educ Couns. 201511;98(11):1393–401. [PubMed: 26166630]

16. Wiegand S, Keller K-M, 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(6):380–7. [PubMed: 25531074]

17. Foster BA, Farragher J, Parker P, Hale DE. A positive deviance approach to early childhood obesity: cross-sectional characterization of positive outliers. Child Obes. 2015 Jun;11(3):281–8. [PubMed: 25885174]

18. 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(2):e147–54. [PubMed: 24331776]

19. Hall KD, Butte NF, Swinburn BA, Chow CC. Dynamics of childhood growth and obesity: development and validation of a quantitative mathematical model. lancet Diabetes Endocrinol. 201310;1(2):97–105. [PubMed: 24349967]

20. Freedman DS, Butte NF, Taveras EM, Goodman AB, Blanck HM. Longitudinal changes in BMI z-scores among 45 414 2–4-year olds with severe obesity. Ann Hum Biol. 2017 Dec;44(8):687–92. [PubMed: 29082754]

Table I.

Sample Characteristics of 1010 Children in the STAR and Connect for Health Interventions by Achieving Clinically Important Weight Loss

	Overall	Achieved Clinically Important Weight Loss BMI z-score change ≥ 0.2		p-value
	N=1010	Yes N=261	No N=749	
Child Characteristics	N (%)			
Gender				
Female	505 (50)	126 (48)	379 (51)	0.52
Male	505 (50)	135 (52)	370 (49)	
Race/Ethnicity				
White	430 (43)	121 (46)	309 (41)	0.34
Black	283 (28)	64 (25)	219 (29)	
Hispanic	182 (18)	44 (17)	138 (19)	
Asian/Other	113 (11)	32 (12)	81 (11)	
Age (years at baseline)				
2-<6 years	178 (18)	74 (28)	104 (14)	<0.01
6-<10	430 (43)	94 (36)	336 (45)	
10+	402 (40)	93 (36)	309 (41)	
Severe Obesity (≥120th percent of the 95th percentile)	233 (23)	38 (15)	195 (26)	<0.01
Parental Characteristics	N (%) or Mean (SD)			p-value
Parental Education				
Some College or Less	463 (46)	108 (41)	355 (48)	
College Graduate	545 (54)	153 (59)	392 (53)	0.09
Household Income				
≤$50,000	375 (38)	96 (37)	279 (38)	0.81
>$50,000	612 (62)	161 (63)	451 (62)	
Parental BMI				
Lean BMI	231 (24)	77 (30)	154 (21)	<0.01
≥ 25 kg/m2	751 (76)	177 (70)	574 (79)	
Parent Age in years	40 (7)	39 (7)	40 (7)	0.14
Intervention Arm				
Star, CDS	183 (18)	51 (20)	132 (18)	0.49
Star, CDS + Coaching	163 (16)	36 (14)	127 (17)	
Connect for Health Control	328 (33)	91 (35)	237 (32)	
Connect for Health, Health	336 (33)	83 (32)	253 (34)	

	Overall	Achieved Clinically Important Weight Loss BMI z-score change ≥ 0.2		p-value
	N=1010	Yes N=261	No N=749	
Coach				
Child Healthy Lifestyle Behaviors at Follow-up:	N (%) or Mean (SD)			p-value
Met age-specific sleep goal	266 (28)	78 (31)	188 (27)	0.16
Screen Time ≤ 2 hours per day	284 (30)	85 (34)	199 (28)	0.08
Fruit and Vegetable 5 servings per day or more	127 (13)	34 (14)	93 (13)	0.85
Sugary Beverage servings < 1 serving per day	469 (49)	140 (56)	329 (47)	0.01
Fast food goal:1 time per week or less	841 (88)	224 (90)	617 (88)	0.38

Table II.

Associations of Child, Parent/Household and Child Healthy Lifestyle Behaviors with Achieving Clinically Important Weight Loss

Child Characteristics	RR (95% CI)
Gender *	
Female	0.95 (0.77, 1.17)
Male	0.0 (ref)
Race/Ethnicity *	
White	0.0 (ref)
Black	0.87 (0.66, 1.15)
Hispanic	0.97 (0.72, 1.31)
Asian/Other	0.90 (0.65, 1.25)
Age (years at baseline) *	
2-<6year	0.0 (ref)
6-<10 years	**0.55 (0.42,0.71)**
≥10 years	**0.56 (0.42, 0.74)**
Severe Obesity (≥120th percent of the 95th percentile) *	**0.68 (0.49, 0.95)**
No Severe Obesity	0.0 (ref)
Parental Characteristics *	
Parental Education *	
Some College or Less	0.90 (0.73, 1.12)
College Graduate	0.0 (ref)
Child Healthy Behaviors at Follow-up **:	
Met age-specific sleep goal	1.12 (0.89, 1.41)
Screen Time ≤ 2 hours per day	1.11 (0.89, 1.39)
Fruit and Vegetable 5 servings per day or more	1.01 (0.74, 1.37)
Sugary Beverage servings < 1 serving per day	**1.36 (1.09, 1.70)**
Fast food goal:1 time per week or less	1.16 (0.80, 1.67)

* adjusted for child age, gender, race/ethnicity, severe obesity, parental education, and parental BMI, intervention and arm

** adjusted for child age, gender, race/ethnicity, severe obesity, parental education, and parental BMI, intervention and arm

*** bold denotes statistically significant results with p<0.05