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Weight Change for Pediatric Completers in a National Weight Loss Program

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Abstract

Overweight and obese children in low-income households have limited access to weight loss programs. Low-cost programs should be evaluated in this population. The objective of the current study is to determine weight change among 7 to 17-year-old participants in Take Off Pounds Sensibly (TOPS), a national, low-cost weight loss program. This nonconcurrent prospective study analyzes the cumulative change in weight z-score for overweight and obese children and adolescents who joined TOPS from 2008 to 2011 and consecutively renewed their annual membership. The study includes 586 individuals. At 1-year, cumulative mean (SD) weight z-score change was −0.13 (31). In general, mean change in weight z-scores was no different in subsequent years. Mean weight z-score of children and adolescent TOPS participants who renew their program membership decreased significantly in the first year. Randomized controlled trials should prospectively evaluate this program in children and adolescents.

Keywords

pediatrics, obesity, weight management

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Introduction

The epidemic of childhood obesity has many adverse consequences, most importantly the increased risk of adult obesity and increased severity of obesity in adulthood, particularly more severe forms of obesity.[1,2] Further, child and adult obesity are associated with many chronic diseases, including hypertension, dyslipidemia, diabetes, and premature death.[3,4] Though this epidemic has been a major focus of public health efforts, obesity rates remain high, and there are significant disparities in obesity prevalence by race/ethnicity[5,6] and income.[6] Children in households with incomes below the poverty threshold have twice the prevalence of overweight and obesity than children in more affluent households.[6] More needs to be done to address this disparity.

Dissemination and implementation of current research in low-income populations is challenging. First, many programs show modest effect sizes,[7] so their effectiveness may be limited. Second, programs may be efficacious in randomized controlled trials in middle income families,[8] but this may not translate well to low-income populations based on cost or feasibility or acceptability. Third, most programs do not have the infrastructure for wide dissemination. Therefore, there is still a great need for effective, sustainable, and affordable interventions that are accessible for low-income populations, where the epidemic has had a more profound impact.

The Take Off Pounds Sensibly (TOPS) program is a low-cost, effective, community-based intervention in adults. Since 1948, TOPS has operated a nonprofit weight loss program using peer-led weight loss support groups. It is a weekly group meeting that uses the Food Exchange System and My Plate Program to assist in nutrition planning. Educational program topics also include nutrition, physical activity, motivation, and behavior modification. The TOPS program costs each

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participant approximately $100 per year. In previous analyses of adult participants in TOPS, the participants lost 5% to 7% of their initial weight and maintained the weight loss for up to 3 and 7 years.[9,10] Individuals aged 7 years and older are allowed to participate in TOPS, but chapter members can vote on whether a parent or guardian must attend meeting with them. While TOPS chapters include participants aged 7 to 17 years, this population has not been previously studied.

In this study, we analyzed weight data from the national TOPS administrative database to determine the effectiveness of the program for children and adolescents who joined when they were aged 7 to 17 years. The primary objective of this analysis was to determine weight change for this population over a 4-year period. Secondary objectives were to calculate retention rates among U.S. child and adolescent TOPS members and determine if weight change differed between child and adolescent participants.

Methods

Study Design

This is a retrospective longitudinal cohort analysis of annual weight change in children and adolescents in the TOPS national database. The data were provided by the Information Technology manager at TOPS Club, Inc. The protocol was approved by the Colorado Multiple Institutional Review Board.

Study participants. Study participants were individuals aged 7 to 17 years who enrolled in the TOPS program anytime from 2008 to 2011 and who could renew their membership through 2012, when data were collected. Individuals were excluded if the starting and renewal weights were the same because of a concern for entry error. Data for individuals with duplicate records were combined so only one weight used for each renewal year. For example, if an individual had 2 weights in the same year, the first weight was used, and the second was deleted. Additionally, because of our pediatric focus and the lack of availability of standards for weight *z*-scores (main outcome) in individuals ≥20 years old, data was excluded from participants once they became 20 years or older.

Measures

Demographics. Variables used included participant gender and date of birth.

Weight. Both starting weight and weight *z*-score were used in our analyses. In TOPS, weights are measured on a chapter scale weekly. They are documented (in pounds) by the chapter weight recorder and then sent to the national office at the end of each calendar year and at the time of each participant's annual renewal. In this study, starting weight was defined as the weight (in kilograms) measured at the time of initial enrollment in TOPS.

Weight *z*-score was calculated based on the standard United States Centers for Disease Control (CDC) formula for weight-for-age.[11] Weight *z*-scores are categorized as overweight and obese in the same way as BMI *z*-scores. Thus, weight *z*-scores of 1.036 and 1.645 correspond to the 85th and 95th percentiles, which are categorized as overweight and obese, respectively. Since height is not typically measured in TOPS, heights were only available for 12% (n=295) of the initial study population. Therefore, BMI *z*-score could not be calculated for a majority of participants. Hence, weight *z*-score was used. A sensitivity analysis, using Spearman's ranked order correlation, supported the use of the weight *z*-score as an indicator of weight status. This analysis showed that the correlation between starting weight categories (ie, overweight and obese) when determined by weight *z*-score versus BMI *z*-score for children who had a height available was .75. Correlation coefficients of .7 or greater are considered strong, and coefficients of .5 or less are considered weak.

Outcomes

Weight z-score change. The primary outcome was weight *z*-score change among TOPS members with consecutive annual renewals. Starting and renewal weights were converted to weight *z*-scores. Mean (SD) weight *z*-score change was calculated for each renewal year by using the weight *z*-score at each renewal minus the starting weight *z*-score. Therefore, the cumulative weight *z*-score change was calculated for each renewal year.

Retention. Retention was defined as the percentage of eligible participants who renewed their annual membership in consecutive years. Retention was calculated for each year, up to 4 years, by dividing the number of individuals who renewed their membership for a specific year by the number of individuals who were eligible to renew their membership that year.

Statistical Methods

Means (SD) were reported for data with normal distributions and medians (IQR) were reported for data with non-normal distributions. Starting weight (kg), weight *z*-score, and age (years) were reported. Student's *t*-tests were calculated to compare means between males and females. Weight *z*-score change was analyzed across all

Table 1. Participant Characteristics at Time of Enrollment in TOPS, Inclusive of All Years (2008-2011).

Characteristic	All	Female	Male	*P*-value[a]
Number of subjects (% of total)	586 (100)	472 (80.5)	114 (19.5)	—
Age (years) at TOPS start[b]	13.3 (2.8)	13.4 (2.8)	12.9 (2.9)	.09
Weight (kg) at TOPS start[b]	83.3 (27.7)	82.7 (26.6)	85.8 (31.8)	.33
Mean initial weight z-score	2.21 (0.73)	2.15 (0.71)	2.49 (0.75)	<.01

[a]*T*-test used to compare difference between males and females.
[b]Mean (SD) reported.

participants inclusive of all years, stratified by gender and years of consecutive enrollment. The Mann-Whitney *U* test was used to compare starting weight *z*-scores and age for participants who renewed their annual membership and those who did not. Additionally, the Wilcoxon rank sum test was used to compare weight *z*-score change for each renewal year for children <12 years of age and those children ≥12 years of age at study start.

To calculate weight *z*-score change and retention, participants were divided into cohorts based on the year in which they joined TOPS (ie, 2008, 2009, 2010, and 2011). The year the member joined determined how many years they were eligible to renew their annual membership during the study period, and thus the number of years they were eligible for follow up. For example, all participants were eligible to renew their membership for at least 1 year. Hence, because all 4 cohorts were eligible for follow-up at 1 year, all were included in the 1-year retention analysis. However, only those who renewed their membership at 1 year were included in the calculation for weight *z*-score change at 1 year. Participants from cohorts 2008 to 2010 were eligible for at least 2 annual renewals and were included in the 2-year retention analysis; whereas only those who renewed their membership consecutively for 2 years were included in the weight *z*-score change at 2 years. Therefore, for each additional year of follow up, one less cohort was available to be included in the outcomes. Subsequently, only the 2008 cohort was eligible for the retention and weight *z*-score change analyses at 4 years.

Initial age and weight were compared for those who renewed their annual membership at year 1 and those who did not renew their annual membership at year 1. Data were analyzed using SAS, version 9.3 (Cary, NC).

Results

Study Inclusion

The initial dataset included 2557 records, then 79 records were excluded because of concern for data entry error (3% of sample), and 19 were excluded because of duplicate records. Therefore, 2459 individuals were included in the study sample.

Participant Characteristics

Participant characteristics at initial enrollment for those in the weight change analysis are shown in Table 1. The mean age (SD) in years for female and male study participants was 13.4 (2.8) and 12.9 (2.9), respectively. Almost 68% of participants were 12 to 17 years old. Starting weight categories were as follows: 14% overweight and 86% obese. The mean initial weight *z*-score (SD) for all individuals included in the weight change analysis was 2.21 (0.73), but was significantly higher for males at 2.49 (0.75) than females at 2.15 (0.71) ($P < .01$). The mean weight *z*-score was greater than the 99th percentile for males and was greater than the 95th percentile for females.

Weight Change Outcomes

Table 2 shows the mean weight *z*-score change for participants with consecutive annual renewals stratified by gender. For females, mean weight *z*-score was significantly lower than baseline for up to 3 years of renewal. The group of females with 4 years of renewal was small (n = 9) and did not have a significantly lower weight *z*-score as compared to baseline until year 4. For males, the mean weight *z*-score was significantly lower than baseline up to 2 years of renewal. However, the group of males with renewals at 3 and 4 years only contained 16 and 6 individuals respectively, and did not show a significantly lower weight *z*-score at any time point.
While mean weight *z*-score change was significantly different from baseline at year 1 for groups that contained 47 or more individuals, the mean weight *z*-score change in years 2, 3, and 4 was no different than the mean weight *z*-score change at year 1, except for the 9 females in year 4 ($P < .01$). (Data not shown.)

Weight z-Score Change by Age Group

Table 3 shows the comparison of median weight *z* score change in participants <12 years of age and those aged 12 years and older. In general, the weight *z*-score decreased more in older participants compared to younger participants. However, this was only significant at year 1 for females and year 2 for males.

Table 2. Cumulative Weight *z*-Score Change for Participants With Consecutive Annual Renewal.

Renewal period	N	Initial weight *z*-score, mean (SD)	Cumulative mean (SD) weight *z*-score change from baseline			
			1 year	2 years	3 years	4 years
1 year						
All	586	2.21 (0.73)	−0.13 (0.31)[a]			
Females	472	2.15 (0.71)	−0.11 (0.27)[a]			
Males	114	2.49 (0.75)	−0.19 (0.44)[a]			
2 years						
All	213	2.19 (0.79)	−0.14 (0.34)[a]	−0.15 (0.40)[a]		
Females	164	2.07 (0.76)	−0.12 (0.26)[a]	−0.13 (0.35)[a]		
Males	49	2.59 (0.76)	−0.22 (0.53)[b]	−0.22 (0.53)[b]		
3 years						
All	63	2.25 (0.83)	−0.13 (0.37)[b]	−0.18 (0.42)[a]	−0.19 (0.50)[a]	
Females	47	2.13 (0.86)	−0.09 (0.22)[b]	−0.15 (0.32)[b]	−0.17 (0.45)[c]	
Males	16	2.62 (0.63)	−0.23 (0.64)[d]	−0.29 (0.63)[d]	−0.25 (0.64)[d]	
4 years						
All	15	2.31 (0.58)	−0.11 (0.27)[d]	−0.16 (0.26)[c]	−0.10 (0.35)[d]	−0.31(0.43)[c]
Females	9	2.26 (0.60)	−0.20 (0.28)[d]	−0.21 (0.32)[d]	−0.20 (0.41)[d]	−0.44 (0.43)[c]
Males	6	2.37 (0.61)	0.02 (0.20)[d]	−0.09 (0.11)[d]	0.04 (0.16)[d]	−0.11 (0.36)[d]

[a] $P < .001$.
[b] $P < .01$.
[c] $P < .05$.
[d] Not statistically significant.

Table 3. Comparison of Median Weight *z*-Score Change in Children Versus Adolescents, by Follow-Up Year and Gender.

	Female					Male				
	Age < 12		Age ≥ 12			Age < 12		Age ≥ 12		
	N	Median (IQR)	N	Median (IQR)	*P*	N	Median (IQR)	N	Median (IQR)	*P*
Year 1	144	−0.05 (0.3)	328	−0.11 (0.3)	.004	49	−0.02 (0.3)	65	−0.13 (0.5)	.05
Year 2	60	−0.07 (0.5)	104	−0.11 (0.4)	.06	22	0.03 (0.3)	27	−0.16 (0.7)	.03
Year 3	23	−0.10 (0.5)	24	−0.22 (0.6)	.13	8	0.02 (0.3)	8	−0.23 (1.2)	.07
Year 4	3	0.15 (1.0)	6	−0.64 (1.1)	.26	5	−0.10 (0.4)	1	0.03 (0.0)	.67

Retention Rate

The consecutive annual retention rates are shown in Table 4. The 1-year retention rate was 23.8% and the overall 4-year retention rate was 1.9%. The 1-year retention rate was similar between females and males at 24% and 25%, respectively ($P = .46$).

The median starting weight *z*-score for female participants who renewed their annual membership was higher than those who did not renew: 2.22 versus 2.16, respectively ($P = .04$). The median starting weight *z*-score for male participants who renewed their annual membership was 2.55 compared to 2.61 for those who did not renew their membership, but this difference was not statistically significant ($P = .73$).

The median (IQR) starting age for female participants who renewed their annual membership was lower than for those who did not renew their membership 13.6 (4.3) versus 14.1 (4.2) ($P = .002$). The median (IQR) starting age for male participants who renewed their annual membership was not statistically different from those who did not renew their membership 13.0 (4.9) compared to 12.7 (4.4) ($P = .94$).

Discussion

In this study, we sought to determine the effectiveness of the TOPS program among program participants aged 7 to 17 years. The average weight *z*-score for children and adolescents in TOPS who renewed their annual membership

Table 4. Consecutive Annual Retention Rates.

Years of available eligibility	Eligible participants (N)	Participants who renewed membership consecutively (N)	Retention rate (%)
1	2459	586	23.8
2	1948	213	10.9
3	1383	63	4.6
4	779	15	1.9

consecutively decreased by 0.1 or more in year 1. A 0.10 decrease in weight *z*-score is similar to 0.15 decrease in BMI *z*-score, which was associated with clinically significant changes in lipid profiles and insulin levels.[12] In subsequent years, there was no statistically significant weight *z*-score change for those other than for the 9 females who renewed their TOPS membership for 4 consecutive years.

The main strength of this study is that significant weight change was seen after 1 year of participation, and the weight change was maintained for up to 2 and 3 years for males and females, respectively, who remained in the program. This is noteworthy because most weight loss studies in pediatric populations do not have longitudinal data of this duration. Two comprehensive community-based studies, which included school, community, and policy changes, and 3 years of data, noted smaller mean change in unadjusted BMI *z*-score of −0.04 and −0.027.[13,14] Two other studies analyzed longitudinal weight change over a 5 and 10-year period.[15,16] A direct comparison between these longitudinal studies and our current study is difficult because their reported outcome was a decrease in the percentage overweight and BMI *z*-score whereas our outcome was weight *z*-score change. However, despite the difference in outcomes reported, the authors of these longitudinal studies found a trend of a decrease in the percentage overweight and BMI *z*-score change as result of their program. Similarly, our longitudinal study showed a trend of a decrease in weight *z*-score change with each consecutive annual renewal of the TOPS program. Like many other childhood obesity programs, most longitudinal interventions are conducted at 1 site, which limits its large-scale dissemination.[11] In contrast, TOPS has a nationwide infrastructure, and its low cost allows for wide dissemination. Therefore, TOPS has the potential to make a significant impact for overweight and obese children and adolescents in low-income families and in low resource settings. Additionally, annual membership in TOPS allows for weekly ongoing support and education for a year versus the normal 10 to 16-week durations of other programs where typically there is no maintenance phase.[17,18] This lack of continued support can easily lead to difficulty losing weight, as well as difficulty sustaining previous weight loss.

In this study, the retention rates were lower than those seen in other pediatric weight loss interventions at only 24% but this may be due to the study design. In the systematic review of randomized controlled trials, programs that were at least 12 months in duration had ≥50% attrition at 1 year follow up.[7] However, our study analyzes real world data where higher attrition rates are expected. Additionally, prolonged participation in a weekly program may be more difficult if participants do not start to see improvements in weight quickly. This was similarly noted in the systematic Cochrane review that noted it is possible that participants who have a successful outcome may be more likely to return whereas participants who fail to change may not return for follow up.[7] Most of our participants had a starting weight in the severe obese category so if they did not see quick results they may have been more likely to drop out after the first year.

This study has several limitations. First, this was a completers' analysis of a cohort study and not a randomized controlled trial, so we only had follow up data for individuals who renewed their TOPS memberships. Therefore, we do not know what happened to those who did not return—their weight *z* scores may have increased. Second, the retention rates were low but, this is a real-world analysis of a community-based program, so this is not surprising. Third, we used an unconventional measure of weight change. However, we found a strong correlation between weight *z*-scores and BMI *z*-scores, supporting the use of weight *z*-scores. Fourth, we do not have information about the dietary or physical activity changes that led to successful weight change. Fifth, we do not have demographic information about participants. Despite these limitations, we believe this study is important because it demonstrates that TOPS has the potential to assist in weight loss in children and adolescents.

Future studies should include a randomized controlled trial, where comprehensive data can be collected—including demographic information, height, weight, and dietary and physical activity changes. A randomized controlled

trial ensures the fidelity of the program and analysis of what components of the curriculum make the largest impact on weight management. Additionally, how the children and adolescents participate in the program can be examined. It is likely that children aged 12 and under were enrolled with their parents, whereas older adolescents may have participated on their own. These are different levels of program involvement and may indicate the difference between familial versus individual commitment and should be explored further, Finally, if the program is shown to be efficacious, pediatric providers with overweight and obese patients will have a low cost, community-based program to which they can refer their patients.

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Author Contributions

NSM is responsible for the study concept and design, data acquisition through TOPS and had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. RLCW, DAT, and NSM all took part in data interpretation. RLCW, DAT, and NSM all drafted the manuscript. RLCW, DAT, and NSM all revised the manuscript for important intellectual content.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The authors have no conflict of interest to declare. However, in January 2016, Dr. Mitchell was asked to serve on the TOPS Research Advisory Committee. The purpose of the committee is to review any research grants received by TOPS and recommend approval, disapproval, or suggest modification to ensure any proposed study is supportive of TOPS stated mission, acknowledges TOPS contribution, preserves integrity and confidentiality and is not in conflict with other authorized research projects. This is a *pro bono* position, and Dr. Mitchell has reviewed several grants.

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