Long-Term Outcomes of Group-Based Treatment for Obese Children and Adolescents

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ABSTRACT

Objective: A 1-year, group-based, treatment program with parental involvement was conducted on 115 obese youths during 2006-2011. The intervention decreased obesity severity. The current study assessed the participants' long-term weight loss and obesity-related complications.

Methods: Participants were invited for a single visit. Their weights, heights, and waist circumferences were measured and compared with corresponding figures at group-based treatment program completion. Factors associated with changed percentage weight-for-height (%W/H) were assessed.

Results: There were 43 subjects, including 6 participating telephonically. The median follow-up duration was 5.8 years. %W/H, BMI, and waist circumference increased significantly (p = 0.012, 0.002, and 0.003, respectively). %W/H rose for 26 participants (60.5%; failed group) but declined or stabilized for 17 (39.5%; successful group). The successful-group exercise duration and frequency were significantly higher (p = 0.006 and 0.018, respectively). Three participants had type 2 diabetes, including 1 known case, all in the failed group. Newly-found obesity-related disorders were elevated transaminases (6 participants, with 5 from the failed group), elevated blood pressure (1 failed-group participant), and dyslipidemia (one from each group).

Conclusion: Only 40% of the participants maintained long-term weight reduction. Regular exercise was associated with successful weight maintenance. Obesity-related complications were common in the failed group.

Keywords: Obese; child; adolescent; group-based treatment; outcome (Siriraj Med J 2020; 72: 132-139)

INTRODUCTION

Obesity among children and adolescents is increasing globally, leading to numerous health problems.[1,2] Complications such as type 2 diabetes (T2DM), metabolic syndrome, hypertension, and dyslipidemia are as common among obese children as among obese adults.[1,2] Adolescent obesity is associated with increased adulthood mortality from ischemic heart disease, metabolic diseases, respiratory diseases, etc.[3] It is therefore imperative to address obesity early to obviate detrimental health effects in adulthood.

Childhood obesity treatment involves dietary control, increased physical activity, and lifestyle changes. Phamarcotherapy should only be considered for adolescents unable to reduce weight via intensive lifestyle modifications, and bariatric surgery is only recommended for severely obese adolescents of final or near-final height with extreme complications.[4] The treatment goals are weight maintenance or gradual weight loss, depending on age and obesity degree.[5]

At our institute, a 1-year, group-based treatment program with parental involvement was conducted during 2006-2011.[6] Participants underwent behavioral modification as inpatients at the start of the program and via 5, group-based, outpatient sessions in months 1, 2,

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3, 6, and 9. The detail of the intervention was previously described.[6] Of the 126 participants (mean age 12.3 years), 115 completed the program. By program-end, the percentage weight-for-height (%W/H) and percentage body fat had decreased significantly (181.8 ± 39.1% vs. 169.3 ± 36.3%, $p < 0.001$; and 48.2 ± 5.1% vs. 45.0 ± 6.8%, $p < 0.001$, respectively). Moreover, glucose metabolism, lipid profiles, and liver functions had improved.[6]

Although our program produced successful weight management at the end of the 1-year intervention, long-term weight-maintenance data was lacking. Previous studies[7-9] that demonstrated long-term successful weight loss, had more intensive intervention with more frequent sessions than our program. This study aimed to examine the long-term impact of our 1-year, group-based treatment program, consisting of an initial hospitalization and 5 outpatient sessions, on weight maintenance and obesity-related complications, and factors associated with weight-control success.

MATERIALS AND METHODS

A cross-sectional study of the participants of the 1-year, group-based program was conducted at the Department of Pediatrics, Faculty of Medicine Siriraj Hospital, during 2014-2016. Participants were invited by telephone or mail to a single visit to obtain anthropometric measurements; if unable to attend, a phone interview was conducted. The number of daily meals, frequency and duration of exercise (all intensity of aerobic exercise, anaerobic exercise and any physical activity were included), interim obesity treatment (including follow-up at our Pediatric Endocrine clinic and/or at other Hospital), and healthy lifestyle habits (healthy eating and regular exercise) were collected. Participants with %W/H > 120% were defined as obese[10] and were advised to test for fasting blood sugar (FBS), lipid profile, and liver enzymes.

Blood tests were performed after overnight fasting. Glucose was measured using an automated analyzer (Integra 800/Cobas 8000; Roche Diagnostics, Manheim, Germany). Total cholesterol, HDL-cholesterol, LDL-cholesterol, triglycerides, ALT, and AST were measured using a biochemical autoanalyzer (Cobas 8000; Roche Diagnostics). HbA1c was determined using turbidimetric inhibition immunoassay (Integra 800 CTS, Roche Diagnostics).

Participants whose %W/H had risen since program-end were categorized as "failed"; those with reduced or maintained %W/H were deemed "successful".

Siriraj Ethics Committee, Mahidol University, approved this study. All participants gave informed consent (Si 626/2013).

Statistical analysis

To make comparisons between the participants and the unreachable/non-participating individuals, and between the failed and successful weight-control groups, independent t-tests were used for the normally distributed data, and Mann–Whitney U tests for the non-normally distributed data. Comparisons of the clinical and biochemical data at program-end and long-term follow-up were performed by paired t-test for the normally distributed data and Wilcoxon signed-rank test for the non-normally distributed data. Logistic regression analysis identified the weight-management strategies associated with successful weight maintenance after program-end: 1) no treatment nor continued healthy lifestyle; 2) continued follow-up at our clinic; and 3) continued healthy lifestyle (diet control and regular exercise) for at least 12 months preceding this study. A chi-square test was performed to assess the difference in the numbers of participants for each treatment strategy in the failed and successful groups. The normally distributed data were presented as mean ± standard deviation, and the non-normally distributed data as median (min, max). Statistical significance was $p < 0.05$. Data were analyzed using SPSS (version 18.0).

RESULTS

Out of 115 participants who completed the 1-year group-based program, 37 participants enrolled, and another 6 were interviewed telephonically (22 males and 21 females). Fourteen declined, and 58 were unreachable (Fig 1).

Demographic data at the end of the group-based obesity treatment program of the participants and non-participants were similar, except the non-participants had longer durations after completing their weight-treatment programs (Table 1).

Overall, obesity severity had worsened since program-end (Table 2). Twenty-six participants (60.5%), consisting of 14 males and 12 females, had increased %W/H (failed group); the remaining 17 participants (39.5%), consisting of 8 males and 9 females, had a maintained or decreased %W/H (successful group). The successful group exercised more frequently than the failed group (4.7 ± 2.0 vs. 2.9 ± 2.7 days/week, $p = 0.018$), and for longer (240 [80,1890] vs. 110 [0,900] min/week, $p = 0.006$; Table 3).

As to treatment following program-end, 25 participants (58.1%) did not continue healthy lifestyles nor receive weight-reduction treatment during the preceding year. Twenty of those (80%) were in the failed group. Of the 14 participants (32.6%) continuing healthy lifestyles

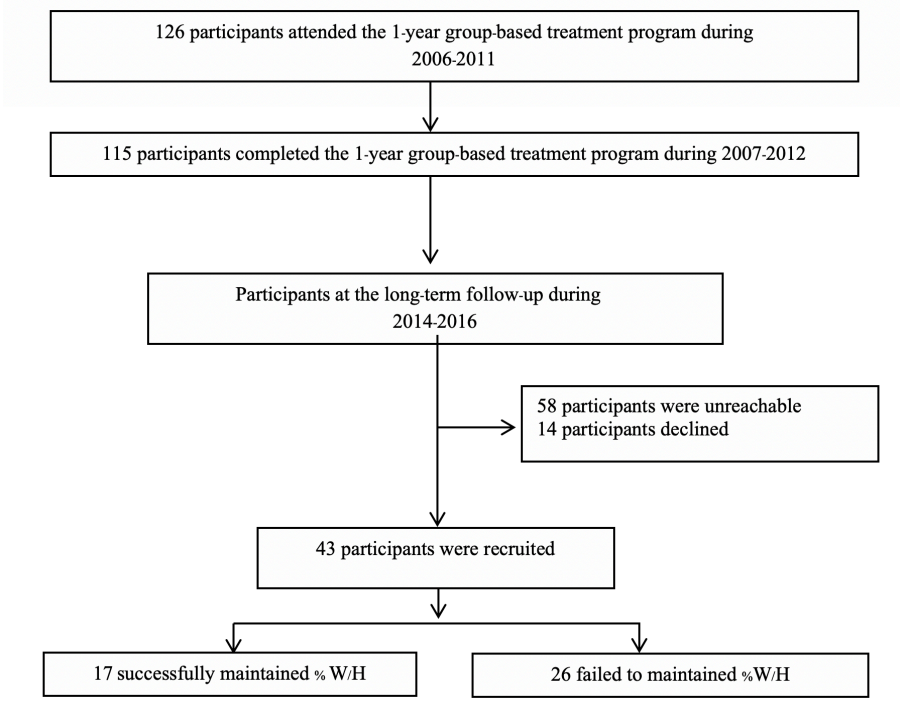

Fig 1. Numbers of participants at the beginning of the 1-year intervention, at the end of the intervention, and at the long-term follow-up.

TABLE 1. Comparison of demographic characteristics at the end of the group-based program of participating and unreachable/non-participating volunteers.

Data	Participating volunteers (n = 43)	Unreachable/ non-participating group (n = 72)	*P*-value
Male[a], person	22 (51.2)	37 (51.4)	0.981
Age (years)	13.2 ± 2.2	13.4 ± 2.0	0.548
%W/H (%)	167.2 ± 32.8	170.1 ± 37.6	0.670
BMI (kg/m^2)	31.9 ± 6.5	32.6 ± 7.1	0.570
Waist (cm)	94.0 ± 14.1	95.6 ± 13.8	0.548
Waist-height ratio	0.59 ± 0.1	0.59 ± 0.1	0.892
Years after program-end[b] (years)	5.8 (3.8–8.6)	7.2 (5–8.6)	< 0.001

Data presented as mean ± SD, [a]Data presented as number (percentage), [b]Data presented as median (min, max)
Abbreviations: BMI = body mass index; %W/H = percentage weight-for-height

(dietary control and regular exercise) during the year preceding the long-term follow-up study, 11 (78.6%) were in the successful group. Four participants (9.3%) received continuing health follow-ups at our institute; 3 (75%) of those were in the failed group. In the case of the successful group, more participants continued with healthy lifestyles than those who did not continue healthy lifestyles nor receive treatment, or who continued to receive follow-up at our institute (p = 0.001). A logistic regression analysis showed that continuing healthy lifestyles was associated with weight-control success (OR 14.67, p < 0.001).

Nineteen participants with increased %W/H had blood tests to evaluate metabolic complications (19 had HbA1c; 18 had BS, 17 had lipid profiles, and 15 had ALT and AST). Ten successful-group participants also

TABLE 2. Comparison of clinical characteristics of participants at the end of the group-based program and at long-term follow-up.

	At program-end	At long-term follow-up	*P*-value
Age (years)	13.2 ± 2.2	19.2 ± 2.2	< 0.001
Percentage weight-for-height (%)	167.2 ± 32.8	180.9 ± 52.9	0.012
BMI (kg/m^2)	31.9 ± 6.5	35.2 ± 10.1	0.002
Waist[a] (cm)	95.0 ± 13.8	102.4 ± 21.8	0.003
Waist-height ratio[a]	0.59 ± 0.1	0.61 ± 0.1	0.164
Systolic blood pressure[a] (mmHg)	118 ± 12	127 ± 13	< 0.001
Diastolic blood pressure[a] (mmHg)	67 ± 9	78 ± 12	< 0.001

Data presented as mean ± SD, [a]n = 37
Abbreviation: BMI = body mass index

TABLE 3. Comparison of characteristics and factors affecting obesity control of the "failed" and "successful" groups.

	Failed group n = 26	Successful group n = 17	*P*-value
Male, person[a]	14 (53.8)	8 (47.1)	0.663
Age (years)	19.6 ± 2.2	18.5 ± 2.1	0.127
Weight (kg)	112.5 ± 29.8	76.1 ± 13.2	< 0.001
Height (cm)	166.7 ± 9.4	166.7 ± 7.0	0.978
BMI (kg/m^2)	40.2 ± 9.4	27.4 ± 4.9	< 0.001
%W/H (%)	207.5 ± 48.9	140.1 ± 26.6	< 0.001
Difference in %W/H between program-end and the long-term follow-up	36.3 ± 22.9	-20.8 ± 13.2	< 0.001
Exercise frequency (days/week)	2.9 ± 2.7	4.7 ± 2.0	0.018
Exercise duration[b] (min/week)	110 (0, 900)	240 (80, 1890)	0.006
Sleeping duration (hours/day)	7.7 ± 1.3	7.6 ± 1.1	0.780
Time spent on TV and internet (hours/day)	5.6 ± 3.1	4.2 ± 2.9	0.149
Number of meals daily	2.9 ± 0.4	2.8 ± 0.4	0.849

Data presented as mean ± SD, [a]Data presented as number (percentage), [b]Data presented as median (min, max)
Abbreviations: BMI = body mass index; %W/H = percentage weight-for-height

sought blood testing (10 had BS and lipid profile; and 9 had HbA1c, AST, and ALT). The results, detailed in Table 4, revealed increased FBS, ALT, total cholesterol, LDL-cholesterol, and HDL-cholesterol levels (p = 0.002, 0.031, 0.001, 0.041, and 0.003, respectively). The comparison of biochemical data between the failed-group participants and successful-group participants was shown in Table 5. Failed-group participants had higher levels of FBS and ALT and lower level of HDL-cholesterol (p = 0.005, p = 0.012, p = 0.002, respectively).

TABLE 4. Comparison of biochemical data at the end of the group-based program and at long-term follow-up.

	At program-end	At long-term follow-up	*P*-value
FBS (mg/dl; n = 28)	85 (71–96)	91 (76–209)	0.002
HbA1c (%; n = 28)	5.6 (4.8–6.2)	5.5 (4.5–8.9)	0.120
Triglyceride (mg/dl; n = 27)	84 (33–315)	93 (37–314)	0.869
Total cholesterol[a] (mg/dl; n = 27)	163.4 ± 28.3	180.3 ± 29.4	0.001
HDL-cholesterol[a] (mg/dl; n = 27)	45.6 ± 7.9	53.8 ± 14.0	0.003
LDL-cholesterol[a] (mg/dl; n = 27)	97.7 ± 24.2	106.2 ± 29.4	0.041
AST (U/L; n = 24)	19 (12–60)	20 (14–58)	0.884
ALT (U/L; n = 24)	17 (8–69)	23 (12–108)	0.031

Data presented as median (min-max), [a]Data presented as mean ± SD

Abbreviations: FBS = fasting blood sugar; AST = aspartate transaminase; ALT = alanine transaminase; HbA1c = hemoglobin A1c; HDL-cholesterol = high-density lipoprotein cholesterol; LDL-cholesterol = low-density lipoprotein cholesterol

TABLE 5. Comparison of biochemical data between the "failed-group participants" and "successful-group participants" at the long-term follow-up study.

	Failed-group participants	Successful-group participants	*P*-value
FBS (mg/dl)	93 (83–209) [n=18]	83 (76–94) [n=10]	0.005
HbA1c (%)	5.5 (4.7–8.9) [n=19]	5.2 (4.5–5.9) [n=9]	0.236
Triglyceride (mg/dl)	95 (48–314) [n=17]	74 (37–122) [n=10]	0.075
Total cholesterol[a] (mg/dl)	182.3 ± 30.6 [n=17]	182.1 ± 31.0 [n=10]	0.881
HDL-cholesterol[a] (mg/dl)	46.6 ± 11.0 [n=17]	64.4 ± 13.2 [n=10]	0.002
LDL-cholesterol[a] (mg/dl)	111.9 ± 23.2 [n=17]	102.0 ± 39.6 [n=10]	0.415
AST (U/L)	20 (14–58) [n=15]	18 (14–29) [n=9]	0.324
ALT (U/L)	33 (15–108) [n=15]	16 (12–50) [n=9]	0.012

Data presented as median (min-max), [a]Data presented as mean ± SD

Abbreviations: FBS = fasting blood sugar; AST = aspartate transaminase; ALT = alanine transaminase; HbA1c = hemoglobin A1c; HDL-cholesterol = high-density lipoprotein cholesterol; LDL-cholesterol = low-density lipoprotein cholesterol

At program-end, the 43 participants had these obesity complications: impaired glucose tolerance, 6 (14.0%); T2DM, 1 (2.3%); dyslipidemia, 17 (39.5%), comprised of hypertriglyceridemia, 6 (14%), low HDL-cholesterol, 11 (25.6%), and high LDL-cholesterol, 5 (11.63%); elevated transaminases, 1 (2.3%); and hypertension, 4 (9.3%).

In this long-term follow-up study, 28 had FBS performed; 3 (10.7%) had T2DM, comprising 2 new cases plus 1 case diagnosed during the group-based treatment program. The three were: 1) a 20-year-old female, with %W/H of 225.5% and a 48.9-kg weight gain over 7 years 4 months; 2) a 21-year-old female, who had had impaired

glucose tolerance during the group-based treatment program, with %W/H of 221.3% and a 21.5-kg weight gain over 5 years; and 3) a 22-year-old male, diagnosed with T2DM during the group-based treatment program, with %W/H of 254.1% and a 38.7-kg weight gain over 5 years 9 months. All three belonged to the failed group, had family histories of diabetes, and did not consistently control their diets or exercise before this study.

Four out of the 37 participants (10.8%) had elevated blood pressure; 3 were from the failed group. One failed-group participant had newly-found elevated blood pressure. All four had a family history of hypertension. Out of 27 participants tested for lipid profiles, 9 (33.3%) had dyslipidemia (hypertriglyceridemia, 3; low HDL-cholesterol, 4; and high LDL-cholesterol, 5), with 7 from the failed group, including 1 new case. Only 1 successful-group participant had newly-found high LDL-cholesterol. Out of 24 participants tested for liver function, 7 (29.2%) had elevated transaminases; 6 from the failed group included 5 new cases. Only 1 successful-group participant had newly-found elevated transaminases.

DISCUSSION

During 2006-2011, 115 obese children and adolescents participated in a 1-year, group-based treatment program focusing on healthy lifestyles and parental involvement.[6] Forty-three (37.4% of the initial subjects) enrolled in this subsequent, cross-sectional, follow-up study. Overall, they demonstrated an increased degree of obesity, with a median of 5.8 years after the program ended. However, 40% maintained their weight loss.

Weight-reduction programs involving more intensive therapy were reported to be successful at long-term weight maintenance.[7-9] An intensive program involving parents by Reinehr et al. resulted in sustained weight reduction for most participants 3 years after program-end.[7] This "Obeldicks" program comprised a 3-month intensive phase, with patients attending 6 group sessions and parents 6 evening sessions; a 6-month establishing phase, with individual, monthly, psychological family therapy given; and a late phase, with individual care if necessary. Moreover, weekly exercise therapy was provided for 12 months.[11,12] Participants were monitored annually up to 3 years following intervention-end; a BMI-SDS (BMI-standard deviation score) change during the first 3 intervention months was related to a BMI-SDS change 3 years after intervention-end.[7]

Following patients for 8 years, another study by Moens et al. found successful weight-reduction maintenance for most participants.[8] Focusing on healthy eating habits, moderate exercise, and cognitive-behavioral techniques, the intervention comprised 12-16 sessions during 3 phases: screening and motivation (2 sessions, 3 weeks); intensive treatment (6 biweekly sessions, 12 weeks); and follow-up (4-8 monthly meetings). At 8-year follow-up, participants had an 8% adjusted-BMI reduction, and 66% of children maintained weight control. The authors found long-term weight loss was positively associated with age, baseline BMI, and child's self-worth, but negatively associated with mother's poor mental health.[8]

The Combined DAK Therapy, an intensive, 1-year, weight-reduction intervention utilizing inpatient and outpatient treatment sessions, demonstrated weight reductions at 3- and 5-year follow-ups.[9] During the first 6 weeks, a multidisciplinary team provided inpatient, obese children and adolescents with structured, behavioral therapy. Over the subsequent 10.5 months, the participants had 11, one-hour, outpatient sessions for nutritional and physical-activity education, and behavioral therapy.[13] Five-year follow-up found a significant decrease in BMI-SDS from baseline (-0.15 ± 0.51, $p < 0.001$). Altogether, 26% saw BMI-SDS reductions (21.3% with successful weight reduction [a BMI-SDS decrease of ≥ 0.2], and 4.7% with a BMI-SDS reduction < 0.2).[9]

The aforementioned programs differ from ours in several ways. Firstly, our group-session frequency was much lower. This may partly explain the unsuccessful, long-term weight reduction displayed by 60% of our participants. Limited resources meant we could only provide 5 group-based sessions. However, we admitted patients for several days at program-commencement for lifestyle-modification education. The infrequent sessions may have impeded lifestyle changes in all patients, resulting in failure to develop long-term weight-control behaviors. Secondly, while psychological or cognitive behavioral therapy was provided by 3 other programs,[7-9] our program lacked such sessions. Psychotherapy could coach patients in positive-behavior development, weight-loss goal setting, weight-loss maintenance, and problem coping.[14]

In our study, 17 (39.5%) participants decreased or maintained %W/H (successful group) while 26 (60.5%) increased %W/H (failed group). The exercise frequency and duration were higher for the successful than the failed group. Participants who maintained reduced weight exercised 4.7 days/week (median: 4 hours/week) versus the failed group's 2.9 days/week (duration: 1.8 hours/week). Furthermore, consistent exercise and food control were associated with weight-control success: 11 (64.7%) of successful-group participants maintained healthy lifestyles through regular exercise and diet control during the year preceding the long-term follow-up study.

Other studies have found dietary control and physical activity benefit weight-loss maintenance.[15,16] Mirza et al. reported that intensive dietary control in the form of both low glycemic loads and low-fat diets resulted in weight reduction in obese children at 2-year follow-up.[15] In a cluster-randomized controlled trial, Donnelly et al. studied the effects of physical activity on weight control over 3 years in elementary school-children.[16] Ten schools (713 participants) were the control, while 14 schools (814 participants) were assigned to Physical Activity Across the Curriculum (PAAC). PAAC promoted 90 minutes/week of moderate-to-vigorous, physically active academic lessons, plus 60 minutes/week of physical education. PAAC exposure affected BMI: schools with ≥ 75 minutes of PAAC/week showed significantly lower BMI increases at 3 years than schools with < 75 minutes/week.[16] The results of those studies[15,16] and ours confirm that exercise and dietary control significantly impact long-term weight control.

By completion of our 1-year group-based treatment program, obesity complications had fallen.[6] At program-commencement, 23 participants were prediabetic, 2 had T2DM, and 65 had dyslipidemia. At program-end, there were 13 prediabetic participants (reduction: 43.5%); no new T2DM cases; and 48 dyslipidemia cases (reduction: 26.2%).[6] However, at long-term follow-up, 2 patients with massive weight gain had T2DM (one already had impaired glucose tolerance at program-end). For patients at risk (positive family history of T2DM and/or inability to achieve weight loss), psychotherapy might induce the motivation and long-term behavioral changes were needed to establish healthy lifestyles. Evaluation of underlying psychological disorders or stress should also be performed for individuals with pronounced weight gain.

Other obesity-related complications were common in the failed group. Newly-found disorders were high blood pressure and dyslipidemia (1 participant each), and elevated liver enzymes suggesting non-alcoholic steatohepatitis (5 participants). Our findings highlight the importance of effective childhood obesity-management because youth obesity is associated with increased adult mortality from obesity-related complications.[3,17]

The small number of participants in the long-term follow-up study is a limitation. Although the non-participants and 43 participants had similar profiles (age at first presentation and obesity degree), the long-term weight-control findings might not represent the whole group. Moreover, patients unable to attend hospital were interviewed telephonically.

Overall, this study revealed that the 1-year group-based treatment program did not achieve long-term weight reductions for most patients and was less intensive than more successful interventions. Resource limitations precluded the provision of psychotherapy, booster education, and annual follow-ups. However, 40% of participants maintained weight around 5 years after program-end. Continued healthy lifestyles, and frequent and longer-duration exercise were associated with successful weight maintenance. To achieve long-term weight maintenance, a more intensive weight-loss program with frequent sessions, psychotherapy, and annual follow-ups or continuous contact and support (e.g., by telephoning or messaging) might ensure sustained weight loss.

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