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## The Efficacy of the Web-Based Childhood Obesity Prevention Program in Chinese American Adolescents (Web ABC Study)

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### A B S T R A C T

**Purpose:** To examine the feasibility and efficacy of a theory-driven and family-based program delivered online to promote healthy lifestyles and weights in Chinese American adolescents.

**Methods:** A randomized controlled study of a Web-based intervention was developed and conducted in 54 Chinese American adolescents (ages, 12–15 years) and their families. Data on anthropometry, blood pressure, dietary intake, physical activity, and knowledge and self-efficacy regarding physical activity and nutrition were collected at baseline and 2, 6, and 8 months after the baseline assessment. Data were analyzed using linear mixed modeling.

**Results:** The intervention resulted in significant decreases in waist-to-hip ratio and diastolic blood pressure and increases in vegetable and fruit intake, level of physical activity, and knowledge about physical activity and nutrition.

**Conclusion:** This Web-based behavior program for Chinese American adolescents and their families seems feasible and effective in the short-term. Long-term effects remain to be determined. This type of program can be adapted for other minority ethnic groups who are at high-risk for overweight and obesity and have limited access to programs that promote healthy lifestyles.

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Obesity is a critical public health concern facing children and adolescents of all ethnicities, including Chinese Americans [1]. Approximately 25% of Chinese American children and adolescents are overweight or obese [2]. Several physical and psychosocial health problems are associated with being overweight, including cardiovascular diseases, sleep disorders, type 2 diabetes mellitus, low self-esteem, and social withdrawal [3,4]. At the same body mass index (BMI), Chinese Americans are at a higher risk of developing cardiovascular diseases and type 2 diabetes mellitus than the non-Hispanic whites [5,6]. Obesity in children is associated with annual costs of \$14.1 billion in additional prescription drugs, emergency

room care, and outpatient visits [7]. Prevention of overweight should be started in childhood because 80% of obese children aged 10–15 years will become obese adults [8].

Childhood obesity prevention programs usually include strategies to improve nutritional habits and physical activity [9–11] and can be delivered either in person or online. Wantland et al [12] conducted a meta-analysis of 22 studies and found that an Internet intervention was more successful than a non-Web-based intervention at improving knowledge and behavioral outcomes in an adult population (effect size,  $-.25$  to  $.29$ ). Although an intervention facilitated by or based on the Internet has a moderate and short-term effect in weight loss and eating behaviors in overweight adolescents [13], Williamson et al [14] found that a 2-year Internet-based program did not improve weight loss in African American girls.

Culturally appropriate programs have been reported to promote healthy lifestyles and improve problem-solving in children

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[15]. In addition, a family-based approach to prevent or treat obesity is more successful at helping children maintain a healthy weight than the programs that do not involve families [16,17]. However, to the authors' knowledge, only one Internet-based intervention for childhood obesity prevention that included parents has been conducted in African Americans [18].

Internet-based health promotion and obesity prevention programs have the potential to reach a large number of people by reducing some barriers, such as program availability, transportation concerns, and time constraints at a relatively reasonable cost compared with traditional personal consultation programs [19]. However, no Internet-based obesity prevention program for Chinese American adolescents has been reported. Thus, a Web-based behavioral program (Web-Based Active Balance Childhood [Web ABC] study) that focuses on promoting healthy lifestyles (adequate dietary intake and improved physical activity) and healthy weight in Chinese American adolescents, aged 12–15, and their parents was developed. The aim of this study was to examine the efficacy of the Web ABC program in promoting healthy lifestyles and healthy weight in Chinese American adolescents.

## Methods

The efficacy of the Web ABC study's program was examined by using a randomized control study design. Adolescents in the study completed questionnaires regarding their dietary intake, knowledge of nutrition and physical activity, and self-efficacy related to physical activity and healthy food choices at baseline ( $T_0$ ), and 2 months ( $T_1$ ), 6 months ( $T_2$ ), and 8 months ( $T_3$ ) after the baseline assessment. The mothers completed questionnaires regarding parents' demographic information and levels of acculturation at baseline. Inclusion criteria for this study included: (1) adolescents who were 12–15 years old and were normal weight or overweight based on Centers for Disease Control and Prevention's recommendation; (2) self-identified ethnicity as Chinese or of Chinese origin by both subject and parent, and they must be residing in the same household; (3) adolescents had to be able to speak and read English; (4) adolescents had to be in good health, defined as free of an acute or life-threatening disease; and (5) parents had to be able to speak English, Mandarin, or Cantonese and read English or Chinese. Data were collected between October 2007 and May 2009.

### Study procedure

The Committee on Human Research, University of California, San Francisco, approved the study. Convenience sampling was used to recruit participants from community programs in the San Francisco Bay area. Each site coordinator helped identify potential eligible participants and introduced them to research assistants. Research assistants described the study to adolescents and gave them a letter of introduction to take home to their parents. Parents and adolescents who were interested in participating in the study provided their names and contact information to the research team within 2 weeks of receiving the forms. Research assistants conducted eligibility assessments on the basis of inclusion and exclusion criteria at a meeting with both parents and adolescents. Both parents and adolescents signed the written informed consents. After obtaining informed consent, subjects were randomly assigned to the intervention group or the control group on the basis of a computer-generated random number assignment (Figure 1). A lesson on Internet navigation and log-in

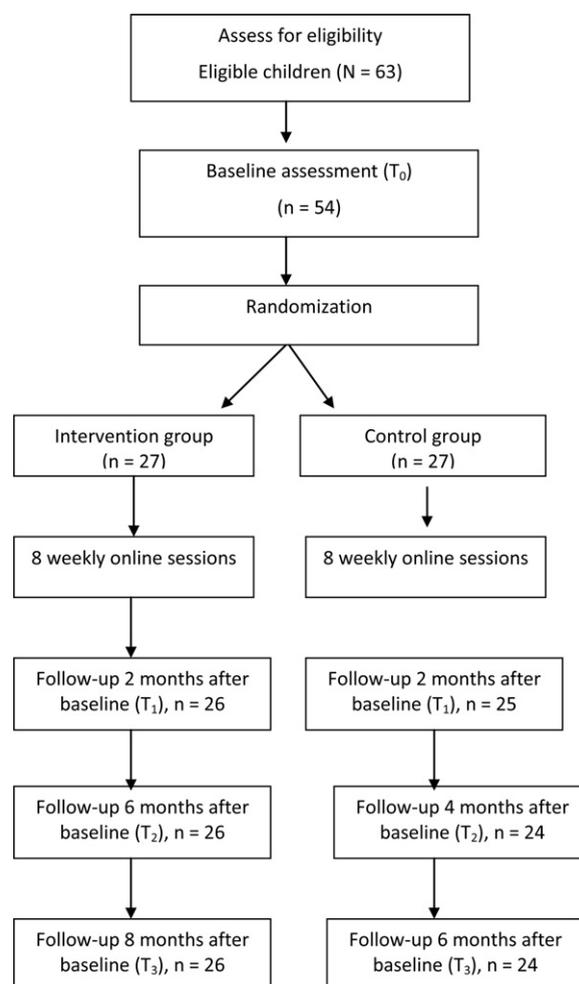


Figure 1. Study procedure.

procedures was demonstrated on a laptop, and a written guide was given to participants. Parents and adolescents used separate usernames and passwords, allowing them access to the study's Web site (intervention or control Web sites). Subjects were able to complete study surveys in parts but were asked to complete the remaining surveys within 1 week. Participants were able to log on to the Web site and complete the online assessment from any place that had Internet access (i.e., home, school, or library). Personal data collection for weight, height, blood pressure, and circumferences were done within the same week of online data collection by a trained research assistant. Because mothers are typically the primary caregiver, they were asked to complete all surveys online at the same as the adolescents. After completing the questionnaires online, subjects had access to lessons assigned to them. In this study, subjects received weekly session activities online for 8 weeks (Table 1), and parents received three online sessions within the same 8 weeks.

### Overview of the Web ABC study intervention

The intervention is based on the Transtheoretical Model–Stages of Change [20] and the social cognitive theory [21]. This intervention was designed to be individually tailored to the be-

**Table 1**  
Program themes for adolescents

Week	Intervention	Control
1	Understand how the body works and how to recognize and cope with feelings	Understand the importance of health in adolescents
2	Apply adequate problem solving techniques and coping skills	Apply appropriate techniques for identifying food and drug allergies
3	Use various relaxation techniques and develop healthy coping skills	Use adequate protection from burns
4	Nutrition 101: understand food and health	Understand basic skin care for adolescents
5	Nutrition 102: make smart food choices	Make smart choices in dental care
6	Understand the importance of an adequate activity level	Understand the consequences of smoking and drinking
7	Being cool and active: various fun activities for youth and families	Being cool: stay away from drugs and alcohol
8	Being yourself and using fun ways to improve your health and maintain a healthy lifestyle	Being yourself and staying healthy

havioral stage of the adolescent. For instance, if the adolescent is in the Preparation stage in physical activity area, he/she will receive information on ways of being active and various types of fun activities he/she can do. Adolescents and their parents were also taught to set realistic and achievable goals in the area that they are ready to make a change and were provided with the necessary skills to achieve mastery and enhance self-efficacy in maintaining a healthy lifestyle.

The Web-based program consisted of activities to enhance self-efficacy of adolescents and facilitated their understanding and use of problem-solving skills related to nutrition, physical activity, and coping. Information related to nutrition (e.g., Food Pyramid, the Big Three, Portion Size, and Meal Planning developed by the American Dietetic Association) and healthy lifestyles (e.g., HeartPower developed by the American Heart Association) was modified and used as the curriculum for the intervention. Adolescents also used an interactive dietary preparation software program (The Wok) tailored to common Chinese food, which was developed by Joslin Diabetes Center. Participants could prepare a dish and check on the nutritional information on The Wok program. In addition, participants learned to set up a realistic goal and plan each week to help improve their behaviors including food intake and physical activity. Information presented over the Internet included text, graphics, comics, and voice-over. Participants could log on to the program from home, library, or community center.

Physical activity was also included in the program, with the goal being to increase the energy expenditure of adolescents. Subjects were encouraged to engage in different types of non-competitive activities (e.g., dancing, brisk walking), learn types of activities that they could perform during recess and at home, and learn alternatives to watching television. Each subject also received a pedometer and completed an online activity diary to monitor their activity levels. Adolescents could enter the average number of steps they took and the average number of servings of fruits and vegetables they had consumed on a daily basis on the Web site. These numbers were converted to two graphics that indicated the subject's progress. All information presented to the adolescents was in English. Each lesson lasted for about 15 minutes.

*Internet sessions for parents.* To increase a healthy environment in the family, three sessions were designed which aimed to coach parents in the skills needed to help their adolescents improve their progress toward healthy lifestyles and healthy weights. Because most parents were busy and had limited time, three short sessions (15 minutes each) were feasible and acceptable for

parents. A family component (three Internet sessions) that is adolescent-specific provides reinforcement and social support at home for the education received during the study. The Internet sessions included sets of exercises to increase parents' knowledge and skills regarding healthy food preparation, discussion of issues related to dealing with adolescents' eating habits and problems, and tips about fun family and/or adolescent activities to improve dietary intake and physical activity. Parents were encouraged to involve their adolescents in shopping and meal preparation. Each lesson lasted for about 15 minutes.

*Control group.* Participants in the control group also logged on to the Web site using a preassigned username and password. Every week for 8 weeks, adolescents received general health information that was not tailored, adapted from the American Academy of Pediatrics, the CDC, and the American Heart Association, related to nutrition, dental care, safety, common dermatology care, and risk-taking behaviors using similar format as the intervention group (text, graphics, comics, and voice-over) (Table 1). Parents also received three Internet sessions related to general information on the topics taught in the control group. Information was presented in English to the adolescents and in English and Chinese to the parents. Each lessons lasted for about 15 minutes.

After completion of each of the in-person data collection, parents and subjects received a \$10 gift certificate. On completion of the study, they received a \$20 gift certificate. Each Adolescent each wore an actigraph monitor to measure physical activity and had their blood pressure, waist, and hip circumferences measured at all the assessments. All adolescents had their weight and height measured at T<sub>0</sub> and T<sub>3</sub> because weight change was not expected to occur in 8 months.

#### *Parental measures*

*Family information.* Parents completed a 12-item questionnaire that asks information about parent(s) and children's ages, parents' weights and heights, parents' occupation(s), family income, and parents' levels of education. The questionnaire was written at a third-grade reading level and took approximately 5 minutes to complete.

*Acculturation: Suinn-Lew Asian Self-Identity Acculturation Scale.* This scale is a 21-item multiple-choice questionnaire that contains items related to language, identity, friendships, behaviors, general and geographic background, and attitudes. The Suinn-Lew Asian Self-Identity Acculturation Scale has moderate to good

validity and reliability for Chinese Americans (Cronbach alpha .79–.91) [22].

#### Children's measures

**Body Mass Index.** BMI was calculated by dividing body mass in kilograms by height in meters squared ( $\text{kg}/\text{m}^2$ ). BMI has acceptable ranges of sensitivities and specificity. Sensitivity ranged from 29% to 88% and specificity ranged from 94% to 100% in children [23].

**Waist-to-hip ratio.** The waist-to-hip ratio was derived from the waist and hip circumferences. Waist circumference was measured midway between the lowest rib and the superior border of the iliac crest. Hip circumference was measured at the maximal protrusion of the buttocks. The circumferences were measured to the nearest .1 cm.

**Blood pressure.** Systolic blood pressure and diastolic blood pressure (DBP) were measured to the nearest 2 mm Hg using a mercury sphygmomanometer with a cuff size appropriate for children (Baumanometer, W.A. Baum Co, Copiague, NY), twice in the adolescent's right arm, with the adolescent seated after 10 minutes of rest.

**Actigraph.** The dual-mode actigraph (MTI/CSA 7164 accelerometer, Health Services, Fort Walton Beach, FL) was used to provide valid assessments of physical activity in adolescents [24,25]. It has high correlations with oxygen consumption ( $r = .78$ ) [24] and direct observations ( $r = .66$ – $.87$ ) in children [24,26]. In this study, a 30-second sampling epoch was used. Each monitor was positioned above the iliac crest of the right hip. Adolescents were instructed to wear the actigraph for 7 days. The outcome variables were average counts in moderate and vigorous physical activity. The cutoff point for moderate is 3,581 cpm and vigorous activity is the count  $\geq 6,130$  cpm.

**Three-day food diary.** Adolescents recorded all foods and beverages and serving sizes consumed for 3 days in a row. A 3-day food diary contains an instruction sheet, a sample-completed day's food-record sheet, and eight blank white dietary record forms. Adolescents were instructed to record food and drink grouped into the following categories: breakfast, snack, lunch, snack, dinner, and snack. Kappa coefficients and percentage agreement for interobserver reliability ranged from .43 to .91 [27,28].

**Physical activity knowledge.** We developed a 5-item questionnaire to assess subject's knowledge about physical activity. Items were adapted from recommendations from the US Department of Agriculture [29] and the American Heart Association [30] regarding MyPyramid and children's health. Sample questions included the following: How much aerobic activity is required for a healthy heart? How many hours a day should an adolescent watch television or play video games? The internal consistency in this study was .78.

**Dietary knowledge.** A 14-item survey on dietary knowledge also was part of the Health Behavior Questionnaire developed for the Child and Health Trial for Cardiovascular Health study [31]. Adolescents were asked to identify which food was "better for your health." Samples of choices included "whole wheat or white

bread" and "frozen corn or canned corn." This survey had a reported internal consistency ranging from .76 to .78 [31].

**Child dietary self-efficacy.** A 15-item self-report questionnaire was used to measure subjects' self-confidence in their ability to choose foods that were low in fat and sugar [31]. The questionnaire began with "How sure are you...?" Items were scored on a Likert scale, with options of "not sure," "a little sure," or "very sure." The internal consistency ranged from .82 to .87 [31,32].

**Physical activity self-efficacy.** This subscale of the Health Behavior Questionnaire was used to measure adolescents' self-confidence in their ability to participate in various age-appropriate physical activities [31,32]. The subscale included five items in which subjects were asked whether they were "not sure," "a little sure," or "very sure" that they could do such things as "keep up a steady pace without stopping for 15–20 minutes." Internal consistency ranged from .67 to .69 [31,32].

#### Data analysis

Descriptive statistics were calculated for demographic characteristics and study variables. We used *t* tests to examine any differences in variables between intervention and control groups at the baseline. Average log-in rate was computed as percentage of sessions the subject logged on and completion of activities over the total eight sessions. Linear mixed-effects models that included functions of time and group effects in the repeated data were used to examine change across the four data collection times between groups. The mixed model approach is a method of modeling population parameters as fixed effects while simultaneously modeling individual subject parameters as random effects. To examine the efficacy of the intervention on three follow-up times ( $T_0$ – $T_1$ ,  $T_0$ – $T_2$ ,  $T_0$ – $T_3$ ), *t* tests were used. All analyses were performed in SPSS (version 17.0, SPSS Inc, Chicago, IL).

#### Power analysis

A minimum of 27 participants per group provides power of .80 at an alpha of .05 to detect a moderate difference in BMI between the two groups between baseline and 8-month follow-up (mean BMI difference .8 between the groups).

## Results

#### Descriptive data

Initially, 63 adolescents and their families agreed to participate in the study; however, nine children and their families never logged on to the Web site, leaving a total of 54 families. Of these, 27 subjects were assigned to either the intervention or control group. The mean age of the adolescents was 12.52 (standard deviation [SD], 3.15) years. The intervention group had 16 boys (59%) and the control group had 13 boys (48%) ( $\chi^2 = .67$ ,  $p = .59$ ). Ten subjects (37%) in the intervention group and nine (33.3%) in the control group were overweight or obese ( $\chi^2 = .08$ ,  $p = .99$ ). The mean maternal age was 41.65 (SD, 3.49) years, and the mean number of years of education was 13.3 (SD, 5.00) years. The mean acculturation score was 2.13 (SD, .51), suggesting a low acculturation. Approximately 47% of families had an annual household income  $>$ \$60,000 and 40% of the families had an annual household income  $<$ \$40,000. The average weekly log on

**Table 2**  
Means and standard deviations (in parenthesis) for all outcome variables

Variable	Intervention				Control			
	T0	T <sub>1</sub> <sup>a</sup>	T <sub>2</sub> <sup>a</sup>	T <sub>3</sub> <sup>a</sup>	T <sub>0</sub>	T <sub>1</sub> <sup>a</sup>	T <sub>2</sub> <sup>a</sup>	T <sub>3</sub> <sup>a</sup>
Body mass index	20.79 (3.12)			20.76 (3.08)	20.25 (3.21)			20.21 (3.13)
Waist-to-hip ratio	.91 (.04)	.90 (.04)	.89 (.04)	.88 (.04)	.89 (.04)	.89 (.04)	.89 (.04)	.89 (.04)
Systolic blood pressure, mmHg	102.02 (5.9)	101.92 (6.05)	101.76 (4.52)	101.12 (5.72)	101.13 (4.55)	100.59 (5.86)	100.26 (5.40)	100.0 (6.12)
Diastolic blood pressure, mmHg	63.26 (8.19)	61.31 (8.39)	61.04 (8.41)	61.20 (8.08)	60.43 (9.98)	61.14 (11.44)	61.35 (9.94)	61.50 (9.84)
Actigraphy results, count per minute	634.85 (107.07)	674.72 (76.51)	671.54 (79.25)	674.37 (76.52)	624.89 (110.72)	617.1 (96.12)	610.75 (105.47)	615.67 (106.77)
Fat, %	29.34 (2.42)	28.37 (2.44)	28.09 (2.27)	27.99 (2.04)	28.34 (2.91)	27.95 (2.88)	27.72 (3.29)	27.78 (2.57)
Vegetables and fruit, servings per day	2.19 (.48)	2.36 (.64)	2.41 (.64)	2.63 (.71)	2.28 (.61)	2.14 (.66)	2.11 (.55)	2.34 (.66)
Physical activity knowledge, point	2.70 (.78)	3.19 (.68)	3.37 (.69)	3.29 (.82)	2.85 (.82)	2.88 (.83)	2.91 (.67)	2.61 (.71)
Nutrition knowledge, point	2.74 (.81)	2.92 (.74)	2.77 (.71)	3.04 (.71)	2.59 (.89)	2.65 (.94)	2.82 (.80)	2.76 (.78)
Physical activity self-efficacy, point	2.55 (.46)	2.81 (.24)	2.72 (.23)	2.72 (.27)	2.49 (.45)	2.51 (.34)	2.39 (.25)	2.44 (.24)
Nutrition self-efficacy, point	2.59 (.29)	2.63 (.28)	2.63 (.26)	2.59 (.27)	2.54 (.32)	2.54 (.30)	2.36 (.27)	2.52 (.29)

<sup>a</sup> T<sub>1</sub> was 2 months, T<sub>2</sub> was 6 months, and T<sub>3</sub> was 8 months after the baseline assessment.

rate was 71.8% (5.74 sessions) for the intervention group and 71.3% (5.7 sessions) for the control group. There was no difference in baseline variables and log on rate between the groups.

#### Outcomes analyses

A total of 50 children and their families (93%) completed baseline and all follow-up measures. No significant differences were found in baseline variables between adolescents who provided follow-up data and adolescents who were lost to follow-up. Table 2 presents follow-up data on outcome variables for the intervention and control groups. Results from the mixed-model analysis indicated that significantly more adolescents in the intervention group than in the control group had decreased their waist-to-hip ratio (Effect size =  $-.01$ ,  $p = .02$ ) and DBP (Effect size =  $-1.12$ ,  $p = .02$ ) while they had increased physical activity as measured by the actigraph (Effect size =  $12.46$ ,  $p = .01$ ), increased vegetable and fruit intake (Effect size =  $.14$ ,  $p = .001$ ), and increased knowledge related to physical activity (Effect size =  $.16$ ,  $p = .008$ ) and nutrition (Effect size =  $.18$ ,  $p = .001$ ) (see Table 3 and Figure 2 for a summary of the mixed-model analysis).

Follow-up  $t$  tests on significant outcome variables revealed that DBP, physical activity, vegetable and fruit intake, and knowledge related to physical activity and nutrition differed significantly between T<sub>0</sub> and T<sub>1</sub>, T<sub>0</sub> and T<sub>2</sub>, and T<sub>0</sub> and T<sub>3</sub> in the intervention group ( $p < .05$ ). Waist-to-hip ratio also differed significantly ( $p < .05$ ) between T<sub>0</sub> and T<sub>2</sub> and between T<sub>0</sub> and T<sub>3</sub> in the intervention group. No outcome variables differed significantly in the control group.

#### Discussion

The results suggest that an Internet-facilitated, family-based, and theory-driven program for prevention of childhood obesity can decrease waist-to-hip ratio and DBP while improving physical activity, vegetable and fruit intake, and knowledge about food intake and physical activity over a course of 8 months in Chinese American adolescents.

The involvement of parents is critical to the overweight management in children. The Web-based program in this study included information for parents related to their adolescent's weight-related health behaviors (eating, physical activity, and coping) and way to improve these behaviors and healthy lifestyles and healthy weight. Other studies had suggested that parental involvement can improve healthy weight in children and adolescents [33–35]. As Chinese parents are typically heavily involved in every aspect of their children's lives, the involvement of parents in a healthy lifestyle and healthy weight program is imperative [36].

Although we did not find a reduction in BMI, the waist-to-hip ratio and DBP were decreased significantly in the intervention group. The possible explanation that no difference was found in BMI could be because of short follow-up time (only 6 months). Future study needs to examine the effect of healthy lifestyles intervention with longer follow-up. Nonetheless, our intervention suggests that improvements in DBP last 6 months after the intervention. Maintaining healthy weight and healthy lifestyle in adolescents is critical in improving their cardiovascular health.

Adolescents in the intervention group also increased vegetable and fruit intake and physical activity level in all follow-up assessments in the study. Moreover, it was found that children in the intervention group also improved their knowledge about physical activity and nutrition. Results of this study are consistent with those of other studies that indicated that Web-based interventions can improve food intake and physical activity in children and adolescents [11,18,37]. The success of the program in improving adolescents' weight-related health behaviors and knowledge may be attributable to the interactive nature and individualization of the Web-based program. The Web-based program includes several components that involve setting realistic and achievable goals, and monitoring eating and physical activity in the form of documenting number of steps reported per day through our secure Web site. Thus, intervention for healthy weight management in Chinese American adolescents should

**Table 3**  
Summary of mixed model analyses

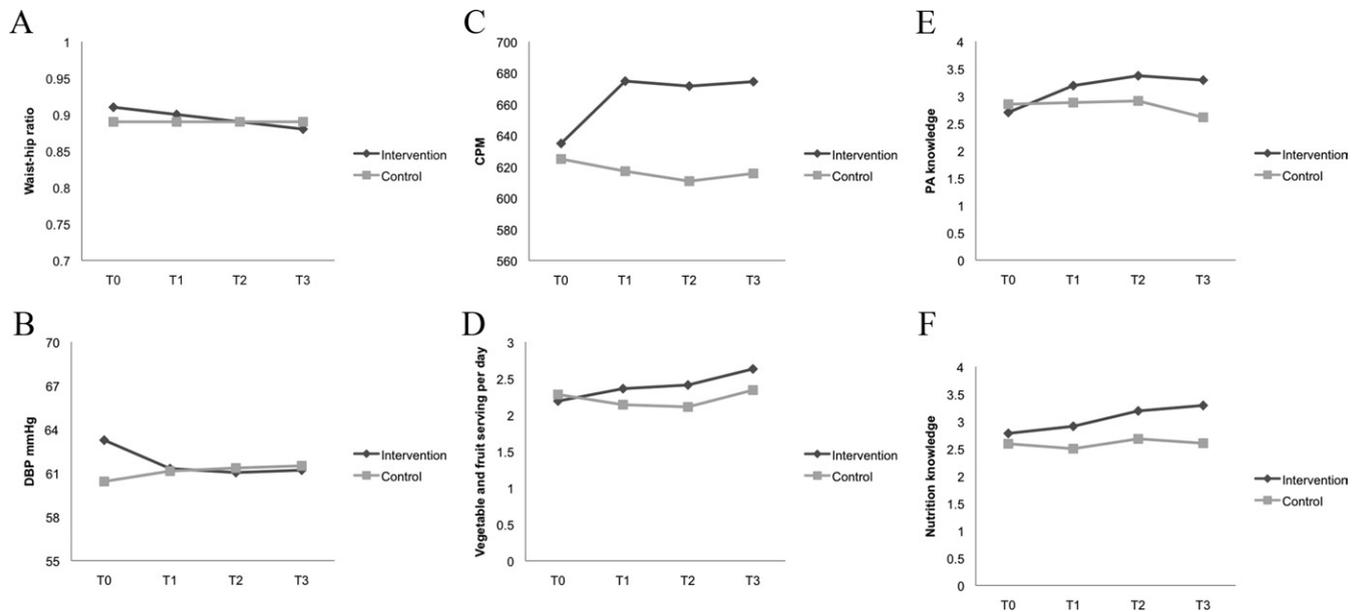
Outcome	Parameter	Effect estimate	95% Confidence interval	p
Body mass index	Time	-.01	-.04 to .01	.28
	Group	-5.15	-5.45 to -4.85	.001 <sup>a</sup>
	Time × group	.01	-.03 to .04	.84
Waist-to-hip ratio	Time	-.001	-.01 to .001	.93
	Group	.01	-.01 to .03	.34
	Time × group	-.01	-.01 to -.001	.02 <sup>a</sup>
Systolic blood pressure	Time	-.52	-1.12 to .10	.10
	Group	1.19	-1.65 to 1.02	.41
	Time × group	.17	-.66 to 1.01	.69
Diastolic blood pressure	Time	.21	-.46 to .88	.54
	Group	2.55	-2.32 to 7.73	.30
	Time × group	-1.12	-2.02 to .21	.02 <sup>a</sup>
Actigraphy results, count per minute	Time	-2.35	-6.61 to 1.91	.27
	Group	-59.56	-89.66 to -29.45	.001 <sup>a</sup>
	Time × group	12.46	6.62 to 18.41	.001 <sup>a</sup>
Fat, %	Time	-.16	-.34 to .02	.07
	Group	1.02	-.03 to 2.07	.06
	Time × group	-.24	-.49 to .01	.06
Vegetables and fruit, servings per day	Time	.01	-.05 to .06	.84
	Group	-.06	-.35 to .22	.67
	Time × group	.14	.06 to .22	.001 <sup>a</sup>
Physical activity knowledge	Time <sup>b</sup>	.05	-.04 to .13	.29
	Group	.01	-.33 to .36	.94
	Time × group	.16	.04 to .29	.008 <sup>a</sup>
Nutrition knowledge	Time	.04	-.02 to .11	.20
	Group	.15	-.27 to .57	.47
	Time × group	.18	.08 to .29	.001 <sup>a</sup>
Physical activity self-efficacy	Time	-.02	-.06 to .01	.16
	Group	.10	-.05 to .25	.17
	Time × group	.032	-.06 to .12	.49
Nutrition self-efficacy	Time	-.006	-.01 to .006	.62
	Group	.08	-.08 to .23	.34
	Time × group	.004	-.009 to .017	.55

<sup>a</sup> Significant p values.

incorporate information related to adequate diet and active lifestyles and should be tailored to the individual's needs.

Although this study is one of the first to examine the feasibility and efficacy of a Web-based behavioral intervention program

for Chinese American adolescents and their families, we acknowledge several limitations. These limitations include convenience sampling, parents with high education, use of self-report measures, involving only Chinese American adolescents, and



**Figure 2.** Significant changes in (A) waist-to-hip ratio, (B) diastolic blood pressure, (C) actigraphy results, (D) vegetable and fruit intake, (E) physical activity knowledge, and (F) nutrition knowledge.

follow-up for only 6 months after the intervention. In addition, the use of food diary for recording dietary intake in adolescents needs to be examined for its reliability and validity. Future research should examine the long-term effects of this program on weight-related health behaviors and other related cardiovascular functions as well.

In conclusion, the results of this study indicate significant improvements in waist-to-hip ratio, DBP, fruit and vegetable intake, and physical activity in Chinese American adolescents, all of which are proxies for improved general health. Given the significant effect of being overweight on Chinese American adolescents' health and the high financial cost of running an individual or group consulting program for behavioral change and weight management, a Web-based behavioral program can involve more families who may not otherwise be able to participate—and at substantially lower total cost.

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