Evaluation of a web-based program promoting healthy eating and physical activity for adolescents: Teen Choice: Food and Fitness

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Abstract

This randomized clinical trial tested the impact of a website promoting nutrition and physical activity for adolescents (Teen Choice: Food and Fitness). Participants, (408) 12- to 17-year-old adolescents in the Houston area, completed online surveys measuring diet, physical activity, sedentary behavior and diet/physical activity mediators at baseline. After randomization, they were asked to log onto either the intervention or the control condition website weekly for 8 weeks to review web content and set goals to improve dietary and physical activity behaviors. Post-test occurred after 8 weeks. Logistic regression analyses and one-way analyses of covariance were used in the analyses. At post, more intervention group adolescents reported eating three or more daily vegetable servings in the past week compared with the control group (P < 0.05); both groups reported significant increases in physical activity (P < 0.001) and significant decreases in TV watching (P < 0.01). Average log on rate was 75% over the 8 weeks; there was no difference by condition. The website enabled adolescents to improve vegetable intake and daily physical activity, reduce sedentary behavior and had a high log on rate. Future research should identify effective methods for disseminating this website to wider audiences.

Introduction

Most Americans do not meet recommended guidelines for physical activity (PA) [1] or diet [2]. Because these behaviors contribute to energy balance and successful weight management, improving diet and PA behaviors are national priorities [3]. Targeting both behaviors during adolescence may help prevent obesity development during these years and enable adolescents to maintain acceptable body weight as adults [4]. Web-based intervention programs would be convenient and readily available; they also meet the expectations of today’s adolescents who widely use technology [5, 6]. Interactive web applications allow the user to take an active part in activities that promote healthy choices [7]. Multi-media and web-based intervention programs for adolescents have been successful at improving diet and physical activity behaviors [8–20] and promoting weight loss [21]. Successful online programs engaged adolescents in the development of the programs [7, 22], used theory to guide program development, and included behavior change techniques [23, 24].

Internet access is widespread. In 2009, 84% of 8- to 18-year olds reported Internet access with an ethnic composition of 74% Hispanic, 78% African-American and 88% non-Hispanic white [25]. About 63% of adolescent Internet users reported going...
online daily, with few differences in use based on demographic indicators [6]. About 55% reported searching for health information on the Internet [25]. Furthermore, smartphone use was reported by about 29% of adolescent cellphone users in 2011, with increases to 50% forecast by the end of 2012 [26]. Therefore, web-based behavior change programs have the potential to reach large numbers of adolescents in a familiar, convenient and readily available manner. This article presents the results of a study testing the outcomes of a website on PA and healthy eating for 12- to 17-year-old adolescents [27]. The major hypotheses were that adolescents with access to the intervention website would report greater consumption of fruit, vegetables, milk and less sweetened beverages and engage in more PA and less sedentary behavior compared with adolescents in the control condition. We also hypothesized greater improvements in the mediating variables (home availability of fruit, vegetables, low fat and milk products, self-efficacy for eating fruit and vegetables and PA enjoyment, environment and self-efficacy) for the adolescents with access to the intervention website.

Methods

Study design

This study was approved by the Institutional Review Board at Baylor College of Medicine, Houston, TX, USA. Participants provided signed parental consent and assent. Recruitment began in January 2010 and concluded in October 2011. Participants received a small gratuity for baseline and post-data collection ($20 each).

Intervention

The online program, ‘Teen Choice: Food & Fitness’, was designed by adolescents and has been described elsewhere [27]. Briefly, adolescents enter their unique username and password to log on to the program website, which is hosted on a secure server. At their first log in, adolescents are asked to view the materials about nutrition and PA, use the healthy eating calculator to identify food group and PA recommendations and then set goals to improve one nutrition and/or PA-related behavior each week. The website has 12 short role model video stories addressing barriers; six on healthy eating and six on PA led by four adolescent characters (i.e. role models). Recipes for adolescents and parents are available in the Teen Kitchen. Nutrition and PA information sections are also available (‘Did you know?’). Participants can also access a refereed blog, make plans to help them attain their goal, track progress online, report goal attainment, participate in problem solving and print a goal sheet. The role model stories, goal setting, problem solving and self-monitoring are the critical behavior change components that promote self-regulation and observational learning, two key components of Social Cognitive Theory [27, 28]. All the content is available at each login; however, a new goal can only be set once a week.

A control condition website was constructed from the basic Teen Choice intervention website. The role model stories, online self-monitoring, goal review and problem-solving components were removed. Control condition participants were asked to set a goal and could print a goal sheet.

Recruitment and sample size

Twelve- to seventeen-year-old adolescents were recruited via health fairs, flyers at schools, churches, community organizations and newspaper and radio advertisements. Interested adolescents were given a consent packet. Inclusionary criteria were ages 12–17 years and Internet access. When the signed parental consent form was returned, adolescents were enrolled and emailed the link and a secure password to access the online questionnaires, (i.e. baseline assessment). After questionnaire completion, participants were randomized to the intervention or control group in a 4:1 ratio and emailed the link, user name and password for their appropriate website. Power calculations were based on sweetened beverage, fruit and vegetable intake of seventh- and eighth-grade students in Houston, TX, USA [29, 30]. To obtain a significant difference of 0.30 SD in each variable and allow for 20% attrition, 400 adolescents were recruited.
Measurement

Subject characteristics

Standard demographic information was collected with the consent forms: birth date, gender, ethnic affiliation, parental educational level, household membership and eligibility for free or reduced price meals at school. Participant height and weight were self-reported; body mass index was calculated by the statistician.

Diet

Fruit and vegetable intake data were collected with the seven questions from the Youth Risk Behavior Survey (YRBS) [31]. Reliability and validity information for this survey has previously been reported [31]. Students were asked about consumption of the following items in the past week: fruit (not including juice), green salad, carrots, other vegetables (not including potatoes), potatoes (not including French fries, fried potatoes or potato chips), French fries or fried potatoes (not including potato chips) and 100% fruit juice like orange (not including punch, sports drinks or fruit-flavored drinks). Responses ranged from 0 to 4 or more times per day.

Physical activity

PA-related data were collected with questions from the YRBS [31]. Questions asked whether adolescents were physically active at least 60 min per day on 5 or more days or all 7 days in the past week, attended physical education (PE) classes at least once per week or played on at least one sports team. They were also asked whether they used computers or watched TV 3 or more hours per day.

Mediating variables

Availability and accessibility of foods in the home environment were measured with a questionnaire that was found reliable and valid in previous studies with children [29]. Participants identified whether 17 fruits, three 100% fruit juices, 15 vegetables, 13 beverages, and 13 low fat food products were present in the home in the past week (1 = yes, 0 = no). Higher scores represent greater availability.

Dietary self-efficacy was measured with a 15-item instrument previously developed and tested [32, 33]. Responses were not sure, a little sure and very sure. Internal consistency was 0.86 in this study. Higher scores represent greater self-efficacy.

PA self-efficacy was measured by an 8-item scale [34]. Responses ranged from 1 = disagree a lot to 5 = agree a lot. Baseline internal consistency was 0.81 in this study. Higher scores represent greater self-efficacy.

PA enjoyment was measured with a 16-item questionnaire [35]. Responses ranged from 1 = disagree a lot to 5 = agree a lot. Baseline α was 0.91 in this study. Higher scores represent greater enjoyment.

PA environment was measured with four items that form two scales: equipment and neighborhood safety [34, 36]. Responses ranged from 1 = disagree a lot to 5 = agree a lot. At baseline, internal consistency was 0.53 for the equipment scale and 0.71 for neighborhood safety.

Social desirability reflects the desire to give answers that are socially desirable or expected and has been observed in both adults [37, 38] and children [39]. Because this may distort responses, thereby affecting study validity, it was assessed using the 9-item ‘Lie Scale’ from the Revised Children’s Manifest Anxiety Scale [40]. The scale has a yes/no response format and good reliability and validity in children across a variety of ethnic groups [39]. Baseline internal consistency was 0.82 in this study.

Process evaluation was conducted via a database embedded within the Internet program. Log on data were collected for each participant for each log on event. A website evaluation was conducted with a 22-item survey. Both intervention and control group participants were asked to select answers under each question that reflected their opinions about the Teen Choice website. There were an additional three questions that asked for comments about the program.

Statistical analysis

Chi-square tests of independence assessed whether there were demographic differences between the
intervention and control groups at baseline and those who did and did not complete post questionnaires. Internal reliability was measured by Cronbach’s $\alpha$. Logistic regression analyses examined differences in the probability of students who reported answering the YRBS diet, PA, and sedentary behavior questions by study group (intervention, control), controlling for gender, age, race/ethnicity, SES (free/reduced price school meal eligibility), parent education level, numbers of children and adults at home, TV availability in child’s bedroom and social desirability. Results were reported as the percentage of students answering the questions for purposes of interpretation and comparison to other studies; missing data were not imputed.

A test for proportions was computed comparing gender and race/ethnicity of study data with national and Texas YRBS data [31]. One-way analyses of covariance were conducted on the mediating variables listed above with the study group as the between-group factor. Covariates included gender, age, SES (free/reduced price school meal eligibility), parent education level, race/ethnicity, number of children and adults at home, TV availability in child’s bedroom, social desirability and the corresponding baseline measures. Separate models were conducted for each dependent variable (e.g. fruit availability). Adjusted means for intervention and control groups were reported as well. Alpha was set at 0.05. All the analyses were performed using SAS (version 9.2, 2009, SAS Institute Inc., Cary, NC, USA).

**Results**

A total of 1065 consent packages were distributed during recruitment (Fig. 1). Four hundred eight adolescents returned signed consent and assent forms, were enrolled in the study and were emailed the link to complete the online baseline questionnaires. Those who completed the questionnaires ($n = 390$) were randomized and sent the links to the corresponding intervention ($n = 288$) or control ($n = 102$) websites. At post, 211 intervention and 80 control participants completed the post questionnaire (25% attrition). Those not completing the post questionnaires ($n = 99$) were more likely to be black ($P < 0.01$), obese ($P < 0.05$), live in a single-parent family ($P < 0.05$) with three or more children ($P < 0.01$) and have lower parent ($P < 0.01$) education than those who completed both questionnaires.

Overall, participants were females (54%), middle income based on eligibility for free or reduced price school meals (69%), lived in two-parent families (69%) and had parents with higher education (62% for the parent completing the consent) (Table I). About 70% reported being normal weight. Compared with adolescents in the intervention group, more adolescents in the control group reported receiving free/reduced school meals ($P < 0.05$) and lower levels of parental spouse education ($P < 0.05$).

The race/ethnicity of Teen Choice study participants was different than national and Texas YRBS participants. Compared with national YRBS data, the proportions of white and Hispanic participants in the Teen Choice study were significantly lower ($P < 0.001$, and $P < 0.01$, respectively), but there was a significantly higher proportion of black participants ($P < 0.001$). Compared with Texas YRBS data, the Teen Choice study had significantly higher
proportions of black ($P < 0.001$) and other ($P < 0.001$) participants, but a significantly lower proportion of Hispanic participants ($P < 0.001$). There were no differences in the proportion of participants by gender across the three study groups. There was a significant group-by-time effect such that the percentage of intervention group adolescents who reported eating three or more servings of vegetables per day in the past week was significantly higher in the treatment group at post compared with the control group ($P < 0.05$) (Table II). At post regardless of group, significantly more adolescents reported being physically active at least 60 min per day on all 7 days in the past week.

### Table I. Characteristics of the Teen Choice: Food and Fitness participants who completed baseline and post questionnaires

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Total ($n = 291$)</th>
<th></th>
<th>Control ($n = 80$)</th>
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<th>Intervention ($n = 211$)</th>
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<td></td>
<td>$n$</td>
<td>%</td>
<td>$n$</td>
<td>%</td>
<td>$n$</td>
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<td>59.1</td>
<td>41</td>
<td>51.3</td>
<td>131</td>
<td>62.1</td>
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<td>17.5</td>
<td>26</td>
<td>12.3</td>
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(P < 0.001) and significantly fewer reported watching 3 or more hours of TV per day in the past week (P < 0.01).

Significant group-by-time effects were found for PA enjoyment (P < 0.001) and both fruit/juice (P < 0.05) and whole milk (P < 0.01) home availability (Table III). Adolescents in the control group reported higher PA enjoyment and fruit/juice home availability at post compared with adolescents in the intervention group. Adolescents in the intervention group reported lower whole milk home availability in the past 7 days compared with the control condition adolescents.

Although 390 adolescents completed the baseline questionnaires, only 366 logged in during week 1 and began the study. Of these 366, approximately 75% of the participants logged in at least once a week for the 8-week intervention period regardless of condition. There was no difference in log on rate by condition (data not presented).

After the 8-week intervention, 284 participants (98% of those who completed both baseline and post test; 80 control and 204 intervention participants) completed the evaluation questionnaire. Overall, most adolescents reported that the Teen Choice website was helpful in helping them become more physically active (84%) and make healthy food selections (90%). Eighty-nine percent liked the energy calculator. Although goals were set by 91%, more intervention group participants reported setting five or more goals (77%), compared with 23% of control group participants. Only 33% of the intervention group participants reported using the diary three or more times. About 62% reported preparing at least one of the recipes from the website; 39% reported a parent preparing at least one recipe. The ‘Did You Know’ information sections were visited at least once by 88% of the participants; 42% used these sections six or more times. When asked to grade the Teen Choice website, 91% gave it an A or B; this score did not vary by group.

**Discussion**

Teen Choice: Food and Fitness, an online program targeting healthy eating and PA that was developed by and for 12-17-year-old adolescents, was successful. After the 8-week intervention, about 18% of intervention group participants reported eating three or more servings of vegetables per day over the past week, compared with about 5% of control condition
participants (Table II). Baseline data for vegetable consumption (~7% control and 9% intervention) were slightly lower than 2011 data from the Youth Risk Behavior Survey (2011 YRBS), whereby about 11% of Texas adolescents and 15% of US adolescents reported eating vegetables three or more times per day in the past week [41]. The impact of the intervention on vegetable consumption is an important finding. It is doubtful that the significant race/ethnicity difference in the Teen Choice participants was related to this finding as there were few differences in the percentage of white (14.4%), black (15.8%), and Hispanic (16.0%) students who reported eating three servings of vegetables per day over the past week [41]. The impact of the intervention on vegetable consumption is an important finding. It is doubtful that the significant race/ethnicity difference in the Teen Choice participants was related to this finding as there were few differences in the percentage of white (14.4%), black (15.8%), and Hispanic (16.0%) students who reported eating three servings of vegetables per day over the past week [41]. Preference for and consumption of fruit is higher than for vegetables, and vegetable intake seems to be more difficult to improve [42]. Mississippi 8th- and 10th-grade students participating in a free school-based fruit and vegetable program reported significant increases in fruit consumption at lunch and for the entire day, but no improvement in vegetable intake [43]. Vegetable intake did not change among Texas high school students participating in a free school-based fruit and vegetable program [44]. Perhaps the role model stories, based on feedback from the target population, and the goal setting and problem-solving components were responsible for this increase.

Both intervention and control groups in this study reported significant increases in the frequency of daily PA and reductions in daily television viewing. At post, about 15% of control and 11% of intervention group participants reported being physically active at least 60 min per day for all 7 days in the past week (Table II). These rates are much lower than 2011 YRBS data of 28.7% and 27.1% of US and Texas adolescents, respectively, and there were few differences in the percentage of white (30.4%), black (26%) and Hispanic (26.4%) students in the national YRBS data [41]. The data on PA for this group are surprising, given that ~87% of control and 90% of intervention group participants reported attending school PE classes at least once per week.
School PE requirements have been positively associated with child PA [45, 46]. However, schools allow exemptions from PE classes and this could contribute to lower rates of PA [45]. In addition, about 76% of this group of adolescents reported playing on at least one sports team in the past year. These rates are almost 50% higher than national (58%) and Texas (58%) data from 2011 [41]. Given these results, it is difficult to explain the low percentage of this group who reported being physically active for 60 min per day on all 7 days, particularly since the analysis controlled for social desirability of response. Perhaps sports participation does not mean actually being active; there are some sports that are relatively sedentary, e.g. golf, and some are seasonal for only a few months in a year. More research is needed to explore the associations between type of sport and overall physical activity.

At post, about 8% of control and 12% of intervention group participants reported watching television 3 or more hours a day in the past 7 days (Table II). These were reductions of 33% and 48% for control and intervention groups, respectively. However, baseline television watching rates for these participants were lower than the national (32%) and Texas (37%) rates reported in 2011 which might partially explain this finding [41]. But nationally, black teens (54%) reported higher rates of TV watching than white (25.6%), and Hispanic (37.8%) teens [41]. Therefore these findings are important given the greater proportion of black teens in this study.

The significant improvements found for the control group in this study may be explained by the control condition website. It was the same website that the intervention students used, but with a limited self-regulation component (goal setting, problem solving and self-monitoring) believed to be key components of SCT-promoting behavior change [28], and no role model stories. Results from a study with fourth-grade children showed that among those with low baseline vegetable consumption, attaining one vegetable goal was related to higher post vegetable consumption [47]. The control condition participants in this study were asked to select a goal, but were not able to report goal attainment or complete problem-solving activities to improve goal attainment. However, perhaps these minimal goal setting activities were enough to enable the control group participants to improve physical activity and reduce sedentary behavior. Future research on the ideal level and type of goal setting activities that enable goal attainment is needed.

The control group website did not have the observational learning component of Social Cognitive Theory (SCT) provided by the role model video stories. These videos incorporated the real and perceived barriers and solutions that adolescents reported they encountered when trying to make healthy food choices and engage in physical activity [27]. Attracting and maintaining attention is an important first step in observational learning because it initiates learning and behavior change processes [28]. Although the control group participants could not view these stories, they were able to access the knowledge components, use the Healthy Eating Calculator to assess their diet and PA and identify personal goals for improvement. The website, designed by teens, was engaging; the evaluation data support the website appeal. There were no differences in the ‘grade’ given to the website by each group. More research is needed to identify the appropriate design and use of role model stories and other behavioral mediators to promote behavior change in web-based interventions [48].

The adolescents signing up for the Teen Choice study might have been more motivated to participate in an online program compared with those who did not participate. This motivation might be responsible for the changes in the control group participants.

The Teen Choice program did have a significant impact on three of the mediating variables. The intervention group reported significantly lower availability of whole milk in the home in the past week compared with the control group, which is a positive finding, but was not related to frequency of consumption. Both groups reported low frequency of milk consumption in the past week at both
time points. PA enjoyment and fruit/juice home availability were improved for the control group. These results are difficult to explain; there was improvement in daily PA for both groups, and frequency of fruit/juice consumption did not change. Perhaps other mediating variables, not assessed in this study, were influenced by the intervention and resulted in the observed behavior change.

Most of the previously published studies on multimedia programs promoting improved diet and PA or reductions in sedentary behavior for children and adolescents reported some positive outcomes but were delivered in the school setting. These interventions were led by teachers or accessed during computer labs [15–19, 49, 50]. The number of sessions varied from 2 to 10. However, four diet and/or physical activity Internet-based programs [11, 21] and two CD-ROM [12, 20] programs were found that were designed for out-of-school use. Many included a short graphic novel-type story, goal setting, problem solving and self-monitoring and reported success at improving the targeted behaviors. In contrast, the Teen Choice: Food and Fitness program did not have an ongoing storyline. It was available every day and participants were asked to log on at least once per week for 8 weeks. Intervention group participants could return to the website at any time to view the role model stories, use the diary or read other sections of the website, increasing dose of the intervention. Control group participants could also return to the website for more information. The website features were based on extensive formative assessment with 12- to 17-year-old adolescents [27]. Including the ‘users’ input into program design helps to ensure that these programs meet their needs and are acceptable [51, 52].

As identified from the results from this study, and in the published literature, multimedia and web-based health promotion programs provide a new channel for achieving behavior change. An advantage to the Teen Choice: Food and Fitness program is that it is easily accessible outside of school. There are potential logistical issues that can arise with implementing Internet-based programs in schools [16, 19]. In addition, an Internet-based program is also easier to access compared with a CD-ROM product. Future research should follow participants for longer periods and objectively assess impact on weight.

There are several limitations to this study that should be considered. All of the data are from self-report, which is subject to memory error and reliability concerns. Alternatively, the measures have been tested and used in previously published studies. Although participation or self-selection bias is a potential problem, the final sample of 408 adolescents was diverse. However, there was differential attrition at post 1. Future research should investigate family systems and interactions that support enrollment in and continued support of participation in web-based programs. However, the intervention was conducted in only one area in Texas, which limits its external validity. Finally, the control group website might have been too similar to the intervention website and provided control group participants with useful information that enabled them to improve some of the targeted behaviors.

This study shows that the Teen Choice: Food and Fitness website was successful at enabling adolescents to improve vegetable intake and daily PA and reduce sedentary behavior. The 75% log on rate suggests that the website materials were engaging and used by the participants. Future research should identify effective methods for disseminating this website to wider audiences and assess continued participation, behavior change and maintenance.

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**Conflict of interest statement**

None declared.
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