Texercise select effectiveness: an examination of physical activity and nutrition outcomes

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Cite this as: *TBM* 2015;5:433–442
doi: 10.1007/s13142-014-0299-3

Abstract

Given the role of physical activity (PA) and good nutrition to delay the onset and progression of most chronic conditions, effective interventions are needed to influence lifestyle behaviors of community-dwelling populations. The purpose of this study is to examine the effectiveness of Texercise Select to improve health indicators, PA, and dietary behaviors, and confidence to engage in healthful behaviors. Texercise Select, a 12-week exercise program, was delivered. Baseline and 12-week follow-up assessments were collected from 220 participants with baseline data who were aged 45 years and older for this non-randomized one-group pre-post design trial. Linear mixed models were fitted for continuous outcome variables and GEE models with logit link function for binary outcome variables. Significant improvements ($P < 0.05$) were seen in physical activity scores ($d = 0.64$ for aerobic activity), weekly fruit/vegetable consumption ($d = 0.31$), daily water consumption ($d = 0.29$), as well as PA- and nutrition-related confidence ($d = 0.38$ and 0.21 , respectively) and social support ($d = 0.45$). Programs rooted in best practices show promise for positively impacting large numbers of participants and becoming sustainably embedded in communities over time.

Keywords

Program evaluation, Physical activity, Nutrition, Older adults

INTRODUCTION

Physical inactivity and poor nutrition are increasingly recognized as major factors in the onset and progression of most chronic diseases, contributing to the burgeoning health care expenditures in America [1–3]. Yet, these lifestyle behaviors are modifiable, even among older adults [4]. Accelerated by the Administration on Community Living's (ACL) state-wide evidence-based disease prevention initiatives that started in 2006 [5], a core of recognized evidence-based programs is now available for promoting chronic disease self-management and healthier lifestyles targeted to adults 60 years of age and older [6]. The most widely disseminated program, Stanford's Chronic Disease Self-Management Program (CDSMP) and its related suite of programs [7], emphasizes the importance of

Implications

Practice: Programs rooted in best practices, but sensitive to community adaptability, show great promise for positively impacting large numbers of participants and becoming sustainably embedded in communities over time.

Policy: While establishing the evidence for existing programs is important, it is equally important to support effective interventions delivered to older adults through the aging services network and consider strategies for reimbursement and sustainability amidst limited financial resources.

Research: Translational researchers can benefit from examining what organizational and programmatic factors facilitate the widespread dissemination and sustainability of effective programs.

building one's confidence or self-efficacy and utilizing behavioral techniques of action planning and problem solving. Although attention is given to lifestyle factors such as exercise and nutrition, limited opportunities exist for in-depth discussion about eating behaviors or instruction in specific stretching and physical exercises within the workshop structure because of the abundance and variety of topics to be covered during the relatively brief program duration (i.e., 6 weeks for CDSMP).

There have been relatively few nutrition-specific lifestyle programs disseminated under the ACL evidence-based initiative. An exception is Healthy Eating for Successful Living among Older Adults, which incorporates components of five existing evidence-based programs [8]. In contrast, as illustrated in ACL's highest tier evidence-based health promotion/disease prevention programs [6], several exercise-specific programs recognized as being evidence-based also focus on helping participants learn goal setting skills (e.g., Active Choices and Active Living Everyday). Particular programs like EnhanceFitness, Geri-Fit Strength Training Workout, and Tai-Chi: Moving for Better Balance provide the opportunity for older populations to promote

strength, balance, flexibility, and endurance with in-class exercises [6]. Other programs are designed for specific older adult populations such as individuals with arthritis (i.e., Walk with Ease, Arthritis Foundation Exercise Program, or Fit&Strong!) or those who are homebound (Healthy Moves for Aging Well). Additionally, few falls prevention programs incorporate exercise training (e.g., A Matter of Balance, Stay Active and Independent for Life, or Stepping On).

In addition to these evidence-based programs, practice-based exercise programs also exist for middle-aged and older adults. While these programs are commonly based on best practices for promoting exercise, most have not undergone systematic evaluation. In Texas, an example of such a program is Texercise, which has been widely disseminated and sustained for over a decade in community settings but has never been externally evaluated in terms of health-related participant outcomes. Relative to the other evidence-based programs described above, Texercise offers a unique programmatic niche by its: (1) broad range of adult participants (i.e., age 45 and older); (2) attention to both physical activity and nutrition; (3) involvement in both small group discussion and hands-on exercise training; (4) online access to a variety of Texercise educational and promotional materials; (5) provision of incentives to participants negotiated through public private partnerships; and (6) availability free-of-charge through volunteer facilitators. Further, Texercise has been endorsed by the Governor's Office, has been widely disseminated in a variety of community settings, and has a delivery infrastructure supported through the Texas Department of Aging and Disability Services. Administrative records have documented the substantial reach of Texercise with over 15,000 Texans having participated in the 12-week program. A limitation of the widespread dissemination of Texercise has been a lack of control in the variability in how the program is delivered, and little to no attention has been given to the assessment of the program's impact on lifestyle factors critical for maintaining health and wellbeing.

To date, no evidence exists to determine if Texercise, a practice-based program generated and facilitated by a state agency, is associated with changes in outcome measures commonly used to evaluate the growing number of evidence-based programs endorsed by ACL and others. An independent evaluation of Texercise, and like programs, has the potential to enrich the body of evidence-based programs that originated from community needs and practices. The objectives of this article are to: (1) describe the characteristics of participants who enrolled in a standardized version of Texercise (known as *Texercise Select*) and (2) examine the effectiveness of *Texercise Select* to improve health indicators, physical activity, and dietary behaviors, and confidence to engage in healthful behaviors among participants from baseline to post-intervention.

METHODS

Program description and procedures

Texercise Select is a health promotion and wellness program envisioned as a state-wide health promotion program designed to encourage middle-aged and older adults and communities to adopt healthy lifestyle habits such as physical activity and good nutrition. Utilizing a volunteer lay leader model, *Texercise Select* explicitly draws on foundational concepts in evidence-based health and wellness programs [9]. To enhance treatment fidelity as this refined program rolls out in different settings and populations, it is led by trained facilitators who have undergone 6 h of standardized training. During the program, facilitators use an official program manual and other complementary materials that identify standardized processes and procedures associated with program activities, timing, and evaluation.

Texercise Select is implemented over a 12-week period that includes 2 weeks for participant recruitment and 10 weeks of activity sessions. Activity sessions are held twice a week, and each session is 1.5 h in duration. A total of 20 activity sessions are delivered. Each session incorporates educational components, interactive discussions, and activities about physical activity and nutrition topics. Additionally, each session dedicates 30 to 45 min of guided exercise. Generally, *Texercise Select* aims to help participants assume an active role in the management of their health status and aging trajectory. An underlying goal of *Texercise Select* is to increase participants' self-efficacy, which will enable them to continue engaging in learned healthy aging activities long after the program has concluded. More specifically, *Texercise Select* elements intend to: (1) improve participants' knowledge about the value of physical activity and nutrition; (2) increase participants' confidence in their ability to make healthier choices related to physical activity, healthy eating, and other healthy behaviors for future years; (3) improve participants' mobility and increase the ease in which they can sit, stand, and walk; and (4) provide participants with effective strategies to prevent falling.

Setting and participants

As part of program delivery, data was collected from 220 participants with baseline data enrolled in *Texercise Select* from delivery sites in eight Texas counties between September 1, 2012 and August 31, 2013. Recruited through a variety of communication channels, participants received the program in various settings such as senior centers ($n=7$), multi-purpose community facilities ($n=5$), faith-based organizations ($n=2$), and senior housing ($n=1$). The program evaluators for this initiative were researchers at the Texas A&M Health Science Center, who obtained Institutional Review Board approval at Texas A&M University to assess de-identified secondary data on program participants and outcomes.

Instrument

Participants were surveyed at each delivery site at baseline and upon completion of the 20-session intervention using instruments measuring the same outcomes at both time points. The self-report questionnaire was six pages, paper-based, and consisted of approximately 50 items. Survey instrument items included Likert-type scales, yes/no, closed-response, and open-ended formats. All measures included in the instrument were collectively selected by the program evaluators, state partners, and public health and aging experts with experience administering multiple evidence-based programs for older adults. Instrument items were selected because of their previous use in grand-scale evaluation and alignment with Texercise Select program objectives and activities intended to change participant beliefs, perceptions, and behavior. Data were collected by the program evaluators who received training about data collection procedures. Baseline and post-intervention instruments took participants approximately 30–45 min to complete each, and program evaluators provided assistance to those needing help filling out the forms.

Measures

This study included two types of variables: personal characteristics (sociodemographics and health indicators) of the participants measured at baseline to describe the sample and variables hypothesized to be influenced by the 12-week intervention (i.e., measured at baseline and post-intervention, then compared to assess change).

Sociodemographics—Personal characteristics of participants utilized in this study included age (i.e., treated as a continuous variable based on the participant's birth date), sex, whether or not the participant was Hispanic (i.e., no, yes), race (i.e., White, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, other/multiple races), and highest educational attainment (i.e., less than high school, some high school, high school graduate or equivalent, some college or vocational school, college graduate or higher). Participants were also asked to report the number of people who live in their household, including themselves (i.e., treated as a continuous variable).

Health indicators—Self-reported health indicators utilized in this study included body mass index (BMI) and the number of chronic condition diagnoses. Body mass index (BMI) was calculated from participants' self-reported height (in feet and inches) and weight (in pounds), which were converted to meters and kilograms, respectively. BMI levels were calculated by dividing weight by height squared, then rounded to the nearest tenth [10]. BMI categories were then created as follows: normal weight, overweight, and obese [11]. Information about participants' chronic conditions was measured using a series of nine items that asked respondents to self-report information about the type of chronic conditions in which they had been

diagnosed (i.e., type 2 diabetes, asthma, chronic bronchitis/emphysema/COPD, other lung disease, high blood pressure/hypertension, heart disease, arthritis/other rheumatic disease, cancer, other chronic condition). Endorsed items were summed to calculate the number of chronic condition diagnoses for each participant. Potential responses ranged from 0 to 9 chronic conditions. These variables are employed to describe the participant population at baseline and were not used as outcome variables in this evaluation.

General health status—Participants' self-assessed health was assessed using one item from the Centers for Disease Control and Prevention's (CDC) Healthy Days measures [12]. Participants were asked to report their general health status. Response choices included "excellent," "very good," "good," and "fair or poor."

Physical activity (RAPA-1 and RAPA-2)—A slight modification of the Rapid Assessment of Physical Activity (RAPA) was used to assess participant physical activity levels [13]. First, respondents were provided with a standard set of definitions and examples for light, moderate, and vigorous activities. Then, participants were asked to complete eight items, each with response options of "no" or "yes." For the purposes of this study, possible RAPA-1 scores could range from 1 to 5 with 5 indicating the highest level of aerobic activity, which reflected meeting the Surgeon General's recommended physical activity for either moderate or vigorous activity [14]. The last two items of the RAPA (RAPA-2) assess participants' engagement in strength training and flexibility activity. For the purposes of this study, these items were examined independently to identify the program's relative influence on strength training and flexibility activities.

Nutrition consumption—A slight modification of items from the Starting The Conversation: Diet instrument [15] were utilized to assess participants' dietary changes from baseline to post-intervention. Participants were asked, "Over the past 7 days, how many times did you eat fast food meals or snacks?" Response categories included "0 days," "1 day," "2 days," "3 days," and "5 or more days." Participants were asked, "Over the past 7 days, how many servings of fruits/vegetables did you eat each day?" Response categories included "0 servings," "1 serving," "2 servings," "3 servings," and "5 or more servings." Participants were also asked, "Over the past 7 days, how many soda or sugar sweetened drinks (regular, not diet) did you drink each day?" Response categories included "0 drinks," "1 drink," "2 drinks," "3 drinks," and "5 or more drinks." Finally, participants were asked, "In the average day, how many cups of water do you drink each day?" Response categories included "0 cups," "1 cup," "2 cups," "3 cups," "4 cups," "5 cups," "6 cups," "7 cups," or "8 or more cups." These items were examined independently to identify the program's relative influence on each dietary behavior.

Confidence—Given the emphasis of programmatic elements to modify physical activity and dietary behaviors, participants' confidence was measured at

baseline and post-intervention. Participants were asked, “On a scale from 1 to 10, how confident are you that you can do moderate or vigorous exercises most days of the week?” Anchors were provided for this 10-point scale with “not at all confident” representing the score of 1 and “totally confident” representing the score of 10. Participants were also asked, “On a scale from 1 to 10, how confident are you that you can eat a healthy diet most days of the week?” Anchors were provided for this 10-point scale with

“not at all confident” representing the score of 1 and “totally confident” representing the score of 10.

Social support—Participants were asked to complete six items intended to measure the extent to which they received social support for activities related to physical activity and nutrition. Participants were asked to rate the level of support received for activities related to physical activities including “planning physical activity goals,” “keeping physical activity goals,” and “reducing barriers to physical activity.” Participants

Table 1 | Baseline characteristics by post-intervention survey completion status

	Number	Total (n=220)	Non- completion (n=93)	Completion (n=127)	χ^2 or <i>t</i>	<i>P</i>
Age	190	74.85 (±8.40)	73.77 (±8.76)	75.58 (±8.10)	−1.47	0.144
Sex	191				0.29	0.591
Female		163 (85.3 %)	67 (87.0 %)	96 (84.2 %)		
Male		28 (14.7 %)	10 (13.0 %)	18 (15.8 %)		
Hispanic	184				0.21	0.651
No		171 (92.9 %)	68 (91.9 %)	103 (93.6 %)		
Yes		13 (7.1 %)	6 (8.1 %)	7 (6.4 %)		
Race	185				6.74	0.241
White		153 (82.7 %)	58 (79.5 %)	95 (84.8 %)		
Black or African American		21 (11.4 %)	11 (15.1 %)	10 (8.9 %)		
American Indian or Alaska native		3 (1.6 %)	0 (0.0 %)	3 (2.7 %)		
Asian		1 (0.5 %)	1 (1.4 %)	0 (0.0 %)		
Native Hawaiian or other Pacific Islander		1 (0.5 %)	1 (1.4 %)	0 (0.0 %)		
Other/multiple races		6 (3.2 %)	2 (2.7 %)	4 (3.6 %)		
Education	190				3.39	0.494
Less than high school		9 (4.7 %)	6 (7.8 %)	3 (2.7 %)		
Some high school		18 (9.5 %)	8 (10.4 %)	10 (8.9 %)		
High school graduate or equivalent		52 (27.4 %)	19 (24.7 %)	33 (29.2 %)		
Some college or vocational school		72 (37.9 %)	30 (39.0 %)	42 (37.2 %)		
College graduate or higher		39 (20.5 %)	14 (18.2 %)	25 (22.1 %)		
Number of individuals in household	189	1.74 (±0.97)	1.74 (±0.92)	1.74 (±1.01)	−0.01	0.996
Body mass index (BMI)	179				1.63	0.442
Normal		45 (25.1 %)	15 (20.6 %)	30 (28.3 %)		
Overweight		68 (38.0 %)	28 (38.4 %)	40 (37.7 %)		
Obese		66 (36.9 %)	30 (41.1 %)	36 (34.0 %)		
Number of chronic conditions	190	2.36 (±1.49)	2.36 (±1.56)	2.37 (±1.45)	−0.02	0.981
Number of sessions attended	220	12.16 (±6.41)	5.58 (±4.21)	16.98 (±1.74)	−24.64	<0.001
Aerobic physical activity (RAPA-1)	150	3.88 (±1.02)	3.89 (±0.90)	3.87 (±1.10)	0.09	0.928
Strength training activities (RAPA-2)	185	0.28 (±0.45)	0.19 (±0.40)	0.48 (±0.05)	−2.22	0.028
Flexibility activities (RAPA-2)	190	0.40 (±0.49)	0.43 (±0.50)	0.38 (±0.49)	−0.72	0.474
Physical activity confidence	189	6.14 (±3.06)	5.95 (±3.22)	6.27 (±2.96)	−0.72	0.473
Fast food consumption (times in past 7 days)	187	2.10 (±1.67)	2.24 (±1.80)	2.00 (±1.58)	0.95	0.342
Fruit/vegetable consumption (servings in past 7 days)	194	3.30 (±1.37)	3.13 (±1.35)	3.42 (±1.38)	−1.48	0.140
Soda/sugar drink consumption (drinks in past 7 days)	194	1.07 (±1.35)	1.14 (±1.46)	1.02 (±1.28)	0.61	0.545
Water consumption (cups daily)	194	5.44 (±2.03)	5.48 (±2.12)	5.42 (±1.98)	0.18	0.856
Dietary behavior confidence	189	7.58 (±2.65)	7.13 (±2.91)	7.88 (±2.43)	−1.91	0.058
Social Support for Lifestyle Behaviors Scale	167	9.02 (±5.39)	9.52 (±5.29)	8.65 (±5.46)	1.04	0.301

were asked to rate the level of support received for the same three activities as they pertained to nutrition and healthy eating. Responses were scored using a 4-point Likert-type scale with categories of “never,” “rarely,” “sometimes,” and “often.” Scores could range from 0 to 18, with higher scores indicating more social support received. All items loaded on one factor, and the items were summed into a single composite score ($\alpha=0.771$).

Statistical analysis

Baseline characteristics were compared between post-test completers to non-completers using χ^2 tests for categorical variables and two sample t tests for continuous variables. An intention-to-treat approach was taken to examine changes from pre-test to post-test assessment for better physical activity, nutrition, and health status outcomes. In this approach different types of longitudinal regression analysis were performed, which used all available data from all participants with non-missing baseline outcome data. Linear mixed models (using SAS Proc Mixed procedure) were fitted for continuous outcome variables. For binary outcome variables (e.g., strength activities), GEE models with logit link function (using SAS Proc GENMOD procedure) were employed. All regression models included an individual level covariance structure to account for the correlation among repeated measures from the same participant. Linear mixed effects models are likelihood-based approaches that provide unbiased estimates of the intervention effects under the assumption of missing at random.

An effect size ($d=[\text{post-test mean}-\text{pre-test mean}]/\text{pre-test standard deviation}$) using estimates of changes from the mixed effects models was computed for each outcome except the binary outcome variables. Effect sizes of $d=0.2$ were considered small, $d=0.5$ medium, and $d=0.8$ large [16].

To investigate the potential impact of missing data on the study results, sensitivity analyses were conducted. First, we used the last observation carry forward (LOCF) method to estimate the outcome changes. Second, because the completers and non-completers of the post-test had significant difference in session attendance, we estimated outcome changes using longitudinal regression models after including the number of sessions attended in the models. Finally, we fit the longitudinal regression models after stratifying the study sample into two subsamples: (1) the participants completed 70 % of the sessions and (2) those who did not complete 70 % of the sessions.

RESULTS

Sample characteristics

In total, 220 participants were recruited and completed the baseline assessment. As shown in Table 1, the average age of these participants was almost 75 years

Table 2 | Outcome changes from baseline to post-intervention survey

	Baseline		Post-intervention		Percent change from pre- to post-survey (%)	Mean change from pre- to post-survey ^a	Odds ratio ^b	P	Effect size
	N	Mean ($\pm$ SD)	N	Mean ($\pm$ SD)					
Aerobic physical activity (RAPA-1)	150	3.9 ($\pm$ 1.0)	105	4.6 ($\pm$ 0.6)	16.9	0.65	–	<0.001	0.64
Strength training activities (RAPA-2)	185	0.3 ($\pm$ 0.5)	121	0.6 ($\pm$ 0.5)	118.4	–	4.04	<0.001	–
Flexibility activities (RAPA-2)	190	0.4 ($\pm$ 0.5)	123	0.8 ($\pm$ 0.4)	96.5	–	5.48	<0.001	–
Physical activity confidence	189	6.1 ($\pm$ 3.1)	122	7.4 ($\pm$ 2.5)	18.9	1.16	–	<0.001	0.38
Fast food consumption (times in past 7 days)	187	2.1 ($\pm$ 1.7)	119	1.9 ($\pm$ 1.6)	–10.1	–0.21	–	0.200	0.13
Fruit/vegetable consumption (servings in past 7 days)	194	3.3 ($\pm$ 1.4)	120	3.8 ($\pm$ 1.2)	12.7	0.42	–	0.002	0.31
Soda/sugar drink consumption (drinks in past 7 days)	194	1.1 ($\pm$ 1.4)	124	1.0 ($\pm$ 1.3)	–12.0	–0.13	–	0.255	0.09
Water consumption (cups daily)	194	5.4 ($\pm$ 2.0)	123	6.1 ($\pm$ 1.8)	10.9	0.59	–	<0.001	0.29
Dietary behavior confidence	189	7.6 ($\pm$ 2.7)	122	8.2 ($\pm$ 2.2)	7.4	0.56	–	0.014	0.21
Social Support for Lifestyle Behaviors Scale	167	9.0 ($\pm$ 5.4)	111	11.4 ($\pm$ 5.1)	26.7	2.41	–	<0.001	0.45

^a Estimated mean changes from linear mixed models

^b Odds ratios for taking strength training/flexibility activities at post-survey vs. pre-survey from GEE models with a logit link

Table 3 | Sensitivity analyses for outcome changes from baseline to post-intervention

	Baseline		Post-intervention		Percent change from pre- to post- survey (%)	Mean change from pre- to post-survey ^a	Odds ratio ^b	P	Effect size
	N	Mean (±SD)	N	Mean (±SD)					
Last observation carried forward method									
Aerobic physical activity (RAPA-1)	150	3.9 (±1.0)	179	4.3 (±0.9)	7.9	0.31	–	<0.001	0.30
Strength training activities (RAPA-2)	185	0.3 (±0.5)	195	0.5 (±0.5)	–	–	2.16	<0.001	–
Flexibility activities (RAPA-2)	190	0.4 (±0.5)	197	0.7 (±0.5)	–	–	2.83	<0.001	–
Physical activity confidence	189	6.1 (±3.1)	195	6.9 (±2.9)	11.1	0.68	–	<0.001	0.22
Fast food consumption (times in past 7 days)	187	2.1 (±1.7)	194	2.0 (±1.7)	–6.7	–0.14	–	0.182	0.08
Fruit/vegetable consumption (servings in past 7 days)	194	3.3 (±1.4)	197	3.5 (±1.3)	6.0	0.2	–	0.023	0.14
Soda/sugar drink consumption (drinks in past 7 days)	194	1.1 (±1.4)	198	1.0 (±1.3)	–9.7	–0.1	–	0.156	0.08
Water consumption (cups daily)	194	5.4 (±2.0)	198	5.8 (±2.0)	5.9	0.32	–	0.003	0.16
Dietary behavior confidence	189	7.6 (±2.7)	196	7.9 (±2.4)	4.3	0.32	–	0.026	0.12
Social Support for Lifestyle Behaviors Scale	167	9.0 (±5.4)	184	10.5 (±5.4)	15.8	1.42	–	<0.001	0.26
Controlling for number of sessions attended									
Aerobic physical activity (RAPA-1)	150	3.9 (±1.0)	105	4.6 (±0.6)	16.8	0.65	–	<0.001	0.64
Strength training activities (RAPA-2)	185	0.3 (±0.5)	121	0.6 (±0.5)	–	–	3.46	<0.001	–
Flexibility activities (RAPA-2)	190	0.4 (±0.5)	123	0.8 (±0.4)	–	–	5.86	<0.001	–
Physical activity confidence	189	6.1 (±3.1)	122	7.4 (±2.5)	18.4	1.13	–	<0.001	0.37
Fast food consumption (times in past 7 days)	187	2.1 (±1.7)	119	1.9 (±1.6)	–7.5	–0.16	–	0.363	0.09
Fruit/vegetable consumption (servings in past 7 days)	194	3.3 (±1.4)	120	3.8 (±1.2)	10.8	0.36	–	0.011	0.26
Soda/sugar drink consumption (drinks in past 7 days)	194	1.1 (±1.4)	124	1.0 (±1.3)	–12.4	–0.13	–	0.254	0.10
Water consumption (cups daily)	194	5.4 (±2.0)	123	6.1 (±1.8)	10.8	0.59	–	0.001	0.29
Dietary behavior confidence	189	7.6 (±2.7)	122	8.2 (±2.2)	6.9	0.52	–	0.026	0.20
Social Support for Lifestyle Behaviors Scale	167	9.0 (±5.4)	111	11.4 (±5.1)	27.7	2.5	–	<0.001	0.46
Among only participants who completed 70 % or more of sessions									
Aerobic physical activity (RAPA-1)	87	3.9 (±1.1)	91	4.6 (±0.6)	16.9	0.65	–	<0.001	0.60
Strength training activities (RAPA-2)	108	0.3 (±0.5)	105	0.6 (±0.5)	–	–	3.38	<0.001	–
Flexibility activities (RAPA-2)	111	0.4 (±0.5)	107	0.8 (±0.4)	–	–	5.79	<0.001	–
Physical activity confidence	113	6.3 (±3.0)	106	7.5 (±2.6)	19.6	1.23	–	<0.001	0.42
Fast food consumption (times in past 7 days)	111	2.0 (±1.6)	104	1.7 (±1.6)	–14.2	–0.28	–	0.124	0.18
Fruit/vegetable consumption (servings in past 7 days)	114	3.4 (±1.4)	104	3.8 (±1.1)	10.9	0.37	–	0.016	0.27
Soda/sugar drink consumption (drinks in past 7 days)	114	1.0 (±1.3)	108	0.9 (±1.2)	–16.5	–0.17	–	0.140	0.13
Water consumption (cups daily)	114	5.4 (±2.0)	107	6.1 (±1.8)	10.8	0.59	–	0.002	0.30
Dietary behavior confidence	113	7.9 (±2.4)	106	8.4 (±2.1)	6.7	0.53	–	0.026	0.22
Social Support for Lifestyle Behaviors Scale	96	8.6 (±5.5)	98	11.3 (±5.2)	30.0	2.59	–	<0.001	0.47
Among only participants who completed less than 70 % of sessions									
Aerobic physical activity (RAPA-1)	63	3.9 (±0.9)	14	4.6 (±0.8)	17.4	0.68	–	0.027	0.75
Strength training activities (RAPA-2)	77	0.2 (±0.4)	16	0.5 (±0.5)	–	–	4.07	0.014	–
Flexibility activities (RAPA-2)	79	0.4 (±0.5)	16	0.8 (±0.4)	–	–	5.56	0.009	–
Physical activity confidence	76	5.9 (±3.2)	16	6.2 (±2.1)	5.8	0.35	–	0.564	0.11

Fast food consumption (times in past 7 days)	76	2.2 (±1.8)	15	3.0 (±1.4)	27.4	0.61	–	0.164	0.34
Fruit/vegetable consumption (servings in past 7 days)	80	3.1 (±1.4)	16	3.3 (±1.5)	15.1	0.47	–	0.138	0.35
Soda/sugar drink consumption (drinks in past 7 days)	80	1.1 (±1.5)	16	1.5 (±1.6)	25.3	0.29	–	0.452	0.20
Water consumption (cups daily)	80	5.5 (±2.1)	16	6.3 (±1.9)	12.8	0.7	–	0.099	0.33
Dietary behavior confidence	76	7.1 (±2.9)	16	6.7 (±2.6)	2.2	–0.16	–	0.826	0.05
Social Support for Lifestyle Behaviors Scale	71	9.5 (±5.3)	13	12.2 (±4.8)	24.7	2.35	–	0.119	0.44

^a Estimated mean changes from linear mixed models

^b Odds ratios for taking strength training/flexibility activities at post-survey vs. pre-survey from GEE models with a logit link

(74.9 years) with an average of 2.4 chronic conditions. The majority of participants were female (85.3 %) and non-Hispanic white (92.9 %). The average number of sessions attended was 12. Table 1 also shows that a total of 127 participants (58 %) completed the post-test. No significant differences were noted between the completers and non-completers except for the number of sessions attended (5.58 vs. 16.98, $P<0.001$) and self-reported baseline strength training activities (0.19 vs. 0.48, $P=0.028$).

Changes in physical activity outcomes

Table 2 shows changes in physical activity outcomes from baseline to post-test. Significant improvements were also observed for all confidence- and physical activity-related outcome variables. The effect sizes for the confidence in physical activity and RAPA-1 were 0.38 and 0.64, respectively, representing medium to large effect sizes. For RAPA-2, the odds of any strength activities at the post-test was 3.04 times higher than that at baseline ($OR=4.04$, $P<0.001$), while the odds for any flexibility activities at the post-test was 4.48 times higher than that at baseline ($OR=5.48$, $P<0.001$).

Changes in nutrition outcomes

Table 2 also shows changes in nutrition outcomes from baseline to post-test. Significant improvements from baseline to post-test were observed for confidence in nutrition, fruits/vegetables consumption, and daily water intake. Specifically, the participants' confidence in nutrition was increased by 0.56 points from baseline to post-test ($P=0.014$), which represents a small effect size ($d=0.21$). The participants ate fruits/vegetables more frequently from baseline to post-test, with an average increase of 0.42 servings ($P=0.002$). They also drank water more often, with an average increase of 0.59 cups per day ($P<0.001$). The effect sizes for these two outcome variables were small to medium (0.31 and 0.29, respectively). While improvements were in the expected direction, no significant differences existed between fast food and soda/sugar drink consumption before and after the intervention.

Sensitivity analysis

The results of the sensitivity analyses are illustrated in Table 3. Table 3 (last observation carried forward method) reveals that using the LOCF method, the magnitudes of outcome changes were all smaller than those estimated from longitudinal regression models. However, all the significant improvements in physical activity and nutritional outcomes reported in Table 2 remained statistically significant. In Table 3 (controlling for number of sessions attended), when we controlled for number of classes attended in the longitudinal regression models, the estimated outcome changes were also very similar to those in Table 2. Table 3 (among only participants who completed 70 % or more of sessions) shows that the estimated

outcome changes among the participants who completed 70 % or more sessions were also similar to the results reported in Table 2. Finally, we analyzed outcome changes among participants who did not complete 70 % of the sessions, which are shown in Table 3 (among only participants who completed less than 70 % of sessions). Although changes in many outcome measures were not significant due to small sample sizes, the magnitude of change did not change much for most of the outcome variables.

DISCUSSION

This evaluation of Texercise Select demonstrates that the standardization of a practice-based program developed for immediate public use can have similar positive effects as those shown in lifestyle-oriented evidence-based programs designed and tested in academic environments (e.g., EnhanceFitness, Fit&Strong!, and Walk with Ease) [17, 18]. Texercise Select also demonstrates the value of the oft-cited public health practice mantra “if we want more evidence-based practice, we need more practice-based evidence” [19].

A major challenge in translational research is the uncertain ability to widely disseminate and sustain programmatic efforts [4]. Texercise Select represents the best of a hybrid community-research approach that can bridge the widely lamented practice to research gap [20, 21]. Conservatively touching more than 15,000 lives over its 10-year existence, the original program has demonstrated its ability to attract large numbers of middle-aged and older adults and to sustain programmatic efforts over time. Its positive outcomes reported for the first time in this study are possible, in part, because Texercise Select was designed with expert input about best exercise practices as well as strategies for engaging adults in behavioral change practices that could be delivered through existing community delivery channels.

In line with the recognition that the growing obesity epidemic in America will impact adults of all ages [22], approximately 75 % of Texercise Select participants were overweight or obese at baseline. Our findings confirm the importance of lifestyle interventions that have both an exercise and nutritional component [23, 24]. Consistent with findings from other studies [25–27], multi-component behavioral and exercise training interventions such as Texercise Select are associated with a range of positive physical outcomes including confidence beliefs, aerobic, strength, and flexibility activities. Further, findings from this study support the role and importance of participants receiving social support to achieve intended program outcomes [28–31].

This study also demonstrates the complexity of programs geared toward changing nutritional behaviors [32]. While there were significant improvements in water consumption and fruit and vegetable consumption, there were only trends in improvement in

reducing fast food consumption and soda/sugary drink consumption. This finding reflects the assumption that it is harder to eliminate a negative behavior than encourage a positive one [33]. For example, while increased water consumption is recommended for older adults to offset dehydration risk [34], these hydration benefits may not be fully realized without simultaneous reductions in sugary beverage intake. Programmatically, it is important to have a comprehensive approach to helping adults reduce or eliminate harmful health behaviors.

Several study limitations and directions for further research must be noted. First, as a pragmatic community-based study, it was not feasible to randomly assign participants to experimental or control groups. There was an initial effort to have a waitlist group design, but it became obvious in the first months of the study that community-based delivery sites did not want to “gather up” participants and have them remain in a “holding pattern” for several months before the intervention started. Additionally, withholding a state-endorsed exercise program designed around evidence-based components and presumed to be effective can cause concern [25]; therefore, it may be challenging to test Texercise Select in a traditional randomized controlled trial or a pragmatic trial where a comparison group is desired [35]. Thus, the benefits of Texercise Select will need to be compared with benefits observed among participants from other similar programs. As populations and measurements differ across studies, it will become increasingly important to work toward the harmonization of outcome measures [36].

Second, as in any community study, recruitment and retention was determined by the individual sites. While the recommended dosage was 14 out of the 20 class sessions (i.e., being exposed to 70 % or more of the intervention), the mean number of classes attended was approximately 12. In retrospect, some classes were observed to have participants “come and go” during the 12-week intervention like a community recreational program rather than diligently attend the intervention as an evidence-based program with a specified number of contact hours. The precise reasons for program attrition are unknown and can only be speculated. It is possible that participant retention may have been influenced by the appropriateness of participants recruited to participate in Texercise Select. For example, participants who enrolled in the program with higher levels of physical functioning or health may have stopped attending the program because of perceptions about the program’s value or anticipated benefits. Moreover, participants who attended portions of the program might have realized the programs benefits and stopped attending because they believed additional benefit could not be achieved or they could replicate the activities on their own outside of the class. Low attendance may also be attributed to other life demands or competing programs and activities offered by the delivery sites at the same time (e.g., bingo, dominos).

However, with about 38 to 82 % of the participants achieving positive benefits across the different study outcomes among the participants with follow-up data (data from sensitivity analyses not shown), it is possible that the number of sessions needed to achieve improvements might be less than initially anticipated. In fact, other evidence-based programs such as Walk with Ease have a shorter duration [6]. An important and much needed area of research in the physical activity field consists of efforts to identify the minimum intervention dosage needed to achieve maximum health benefits [37]. Efforts are needed to assess reasons associated with program attrition and identify low-cost, viable strategies for increasing participant retention (e.g., “buddy systems” or material incentives) [38]. Additionally, efforts are needed to assess the patterns of session attendance to determine if sequence (i.e., attending certain sessions, but missing others) has ramifications on health benefits attributed to the lack of exposure to critical and essential intervention elements related to outcomes of interest.

Third, as a practice-based program, Texercise Select had relatively high rates of missing data and loss-to-follow-up. The substantial proportion of missing data for some variables may be attributed, in part, to the absence of data assessors at all workshop sites to check the data completeness of returned surveys. The LOCF approach to deal with this problem is well known for being conservative and providing a benchmark for the worst-case scenario. Therefore, we decided to use linear mixed models to address this issue because they permit unbiased estimation for model parameters when the missing at random (MAR) assumption is met. Sensitivity analyses were performed because the MAR assumption is difficult to evaluate. For example, Table 1 shows non-completers had significantly lower attendance rates relative to completers. This implies that data might not be missing at random and “survivor bias” could have been introduced. However, when we added the number of classes attended to the regression models during sensitivity analyses, no substantial changes were observed in the results presented in Table 2. Furthermore, when we analyzed outcome changes among participants who did not complete 70 % of the sessions, the magnitude of change did not substantially change for most outcome variables, which indicates the robustness of our results.

Finally, there were limitations associated with measurement. This evaluation relied solely on self-report data; thus, data accuracy was not confirmed and responses may have been over- or under-reported (e.g., physical activity, diet). While measures of physical activity provided participants with standard definitions and examples, such definitions were not provided for concepts such as “healthy diets,” which may have introduced measurement error. Additionally, outcomes for this Texercise Select study were only documented at the 2-month follow-up. Further research is needed to examine the intermediate and long-term effects of this multi-component program, as it is likely there will be a diminishing of effects over time in social and behavioral interventions [4, 32].

CONCLUSION

Texercise Select, a community-based health and wellness program for middle-aged and older adults, demonstrated a variety of positive impacts on physical activity and dietary behaviors, and confidence to engage in healthful behaviors from baseline to post-intervention. Programs rooted in best practices show great promise for positively impacting large numbers of participants and becoming sustainably embedded in communities over time. Translational researchers can benefit from examining what organizational and programmatic factors facilitate the widespread dissemination and sustainability of effective programs.

Acknowledgments: This research was supported in part through the Community Research Center for Senior Health, a joint partnership between Scott & White Healthcare, Texas A&M Health Science Center, and the Central Texas Aging & Disability Resource Center. The Center is funded through a grant from the National Institute on Aging (Award Number RC4AG038183-01).

Conflict of interest and adherence to ethical principles: Authors Smith, Ory, Jiang, Howell, Chen, Pulczynski, Swierc, and Stevens have no conflict of interest to disclose, financial, or otherwise. Coauthors received a grant from the Texas Department of Aging and Disability Services to conduct research on the efficacy and effectiveness of Texercise Select. However, the funding organization did not have a role in: (1) designing or conducting the study; (2) collecting, managing, analyzing, or interpreting the data; or (3) preparing, reviewing, or approving the manuscript. The authors certify that the work described in this study has not been published previously and is not under consideration for publication elsewhere. All authors, external and internal, had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

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