TBM

Programmatic influences on outcomes of an evidence-based fall prevention program for older adults: a translational assessment

Matthew Lee Smith, PhD, MPH, CHES, CPP,[1,2] Angela K Hochhalter, PhD,[3] Yichen Cheng, BS,[4] Suojin Wang, PhD,[4] Marcia G Ory, PhD, MPH[2]

[1]Department of Health Promotion and Behavior, College of Public Health, The University of Georgia, 330 River Road 315 Ramsey Center, Athens, GA 30602-6522, USA

[2]Department of Social and Behavioral Health, School of Rural Public Health, Texas A&M Health Science Center, 1266 TAMU, College Station, TX 77843, USA

[3]Scott & White Healthcare and Texas A&M Health Science Center, Temple, TX, USA

[4]Department of Statistics, Texas A&M University, College Station, TX, USA

Correspondence to: M L Smith
health@uga.edu
matlsmit@tamu.edu

Cite this as: *TBM* 2011;1:384–393
doi: 10.1007/s13142-011-0058-7

ABSTRACT

Investigating the implementation and dissemination of evidence-based health-promotion programs to reach large numbers of diverse older adults is needed. The purpose of this study is to examine relationships between class size and session attendance and assess differences in intervention outcomes based on these community-based fall prevention program characteristics. Pre-post data were analyzed from 2,056 falls prevention program participants. PROC MIXED for repeated measures and ordinary least squares regressions were employed. Approximately 32% of participants enrolled in recommended class sizes (eight to 12 participants) and 76.4% of enrolled seniors attended more than five of eight sessions. Enrolling in smaller class sizes was associated with higher class attendance (X^2=43.43, p<0.001). Recommended class sizes and those with 13–20 participants reported significant improvements in falls efficacy and physical activity. Perfect attendance was associated with improvements in falls efficacy (t=2.52, p<0.05) and activity limitation (t=−2.66, p<0.01). Findings can inform fall prevention program developers and lay leader deliverers about ideal class sizes relative to maximum intervention benefits and cost efficiency.

KEYWORDS

Dissemination, Falls prevention, Translational research, Intervention intensity

The findings of this study are useful for grand-scale deliverers, implementers, and evaluators of evidence-based disease-prevention programs for older adults. Examining the interactions between program variables such as class size and attendance with health-related outcomes has vast implications for maximizing intervention effects, fostering positive group dynamics and participant–lay leader interactions, and informing cost-related decisions (i.e., administrative and program specific).

Implications

Practice: Perfect class attendance was associated with greater health outcomes, which suggests the importance of implementing evidence-based retention strategies (e.g., participant reminders, "buddy" systems) to reduce attrition.

Policy: Exceeding the theoretical recommendations for class size (i.e., 8 to 12 participants) when delivering evidence-based fall prevention programs may reduce operational cost without compromising health outcomes.

Research: Research is need to identify ideal programmatic factors necessary to achieve maximum intervention benefits and cost efficiency for evidence-based programs delivered to persons of all ages.

INTRODUCTION

With the identification of modifiable risk factors for successful aging [1, 2], there has been dramatic growth in the number of evidence-based behavioral and social interventions for promoting health and well-being among middle-aged and older adults [3, 4]. The US Administration on Aging (AoA) has supported the development and dissemination of disease-prevention programs to address behavioral pathways to major chronic illnesses (e.g., physical inactivity and poor dietary behaviors) and address common chronic problems faced by older adults, such as multiple co-morbidities, depression, and falls [5, 6].

Falls are recognized as a major public health problem with serious personal, health, and economic costs for older adults, their caregivers, and society at large [7–10]. In 2000, the national costs of falls was estimated to exceed 19 billion annually and projected to surpass $50 billion annually with the aging of the baby boomers [11]. A major development toward addressing the public health challenge of falls has been increased awareness that behavioral approaches delivered with fidelity to intervention protocols by trained lay persons can be as effective as those delivered by healthcare professionals (e.g., by physical therapists) [12]. An infrastructure training lay leaders, ensuring program

fidelity, and disseminating programs broadly has in turn developed across the country [13].

Attention to fidelity is a major concern as health programs get disseminated into community settings through lay leader delivery [14, 15]. The AoA has placed particular emphasis on intervention fidelity as part of its evidence-based disease-prevention initiative [16]. Program developers identify and recommend essential program elements that must be adhered to in order to help guide community-based implementation [17]. Examples of essential elements include the number and duration of class sessions, class size, and emphasis on class completion [18]. These recommendations are often based more on theory than on empirical evidence. For example, class size recommendations are based on assumptions about the ideal size for permitting small group cohesion and allowing full participation for each class member [19, 20]. Recommended class duration is often based on the assumption of how long it takes to initiate and maintain recommended behavior changes [21]. Program developers and researchers recognize that program attendance and other dose–response variables are important but also acknowledge that participants may not attend all sessions of a multi-session program. It is assumed that greater benefits accrue with receipt of more class sessions and program components [22, 23]; however, it is important to empirically determine the minimal intervention needed for change [24] in order to appropriately advise lay leaders, participants, and other stakeholders.

A matter of balance falls prevention program in Texas

Based on social cognitive learning principles with exercises designed by a physical therapist, A Matter of Balance is a group-based program to reduce the fear of falling and improve health indicators associated with the risks of falling. Positive program outcomes were first documented in a randomized trial with the intervention delivered by healthcare professionals [25]. A Matter of Balance/Volunteer Lay Leader model (AMOB/VLL) is an adaptation of the randomized trial where the program content is delivered by lay leaders instead of professionals [12]. Rather than focusing on clinical outcomes such as falls, AMOB/VLL targets falls-related risk factors by addressing both attitudes and behaviors that predispose older adults to falls. The program includes eight 2-h classes held over 4 or 8 weeks. The program goal is to reduce fall-related disability by instilling greater confidence in one's abilities to prevent or manage falls while simultaneously increasing physical activity to counter balance and gait deficits.

At the time of this study, The Texas Falls Prevention Coalition had introduced AMOB/VLL as a community-based falls prevention program throughout the state with dissemination by the Texas Association of Area Agencies on Aging (AAA). Twenty-six of the 28 AAA regions in Texas agreed to offer AMOB/VLL with the potential of reaching 236 of the 254 counties in the state. Details about the Texas implementation of AMOB/VLL have been reported elsewhere [26–28].

This study examined several translational research questions about the Texas-wide roll out of AMOB/VLL, including characteristics of the population reached with state-wide dissemination and questions related to the program developers' recommendations for class size and attendance [13]. Program developers have defined the recommended or "ideal" class size as between eight and 12 participants. "Successful completion" of the program is defined as attending five or more of the eight class sessions (i.e., attending fewer than five class sessions is defined as "non-successful completion"). These recommendations are based on the translation of theoretical principles to practitioner guidelines about the ideal situation for fostering desired group dynamics and participant–lay leader interactions. Yet, there is little empirical evidence investigating associations between program characteristics and effects among older adults [29, 30] and the impact of these specific AMOB/VLL class size and attendance recommendations on health-related outcomes has never been empirically tested.

The study addressed three purposes. The first purpose was to identify characteristics of AMOB/VLL participants across Texas, as related to class completion. The second purpose was to examine the relationship between AMOB/VLL class size and participant attendance to examine whether larger classes would result in more dropouts or if smaller classes could sustain over time. The third purpose was to assess differences in intervention outcome-based class size and number of classes participants completed. Because of the traditionally high level of successful completion associated with AMOB/VLL, we were interested in specifically examining differences in intervention outcomes among "successful completers" who attended the recommended minimum of five classes or more but did not attend all classes to those with "perfect attendance" (i.e., attended all eight class sessions).

METHODS

Participants and procedures

A total of 3,092 participants enrolled in AMOB/VLL falls prevention intervention between September 2007 and October 2009 in Texas. Participants were recruited to the program through local AAA and other community-based organizations. Institutional Review Board approval was obtained at Texas A&M University for this secondary data analysis. The analytic sample consisted of 2,056 older participants who completed both the baseline and post-intervention survey instruments. Participants in the sample attended one of 227

classes offered in various AAA regions in Texas. Lay leaders distributed then collected the instruments from which health-related outcome data are drawn during class time. Completed surveys were submitted by lay leaders to local AAA representatives who then mailed surveys to the Evaluation Center at Texas A&M Health Science Center. Specific AMOB/VLL protocols and guidelines can be found on the Texas Healthy Lifestyles website at http://www.srph.tamhsc.edu/research/texashealthylifestyles/tfpc/index.html.

Survey instruments

Participants responded to similar survey items at baseline (i.e., at the beginning of the first class) and upon completion of the intervention (i.e., at the conclusion of class 8). Baseline and post-intervention survey instruments differed; baseline instruments included six demographic measures (i.e., age, sex, race/ethnicity, education, living situation, and ZIP codes) required by the National Council on Aging for uniform inter-state reporting purposes, which were not included in the post-intervention instrument. The self-report paper-based survey instruments were nine pages and consisted of 28 items. Survey instrument items included Likert-type scales, yes/no, closed-response, and open-ended formats. Each measure was selected by public health and aging experts affiliated with the program coordinating center, which held a common database for evaluating program effectiveness in a national consortium of studies [6]. Baseline and post-intervention instruments took participants approximately 15 min each to complete. Additionally, class size and participant attendance were obtained from standardized class attendance rosters (i.e., administrative forms utilized by the program deliverers) and linked to each participant's survey data.

Measures

We included three types of variables in this study: self-reported personal characteristics of the participants measured at baseline; program implementation variables (i.e., class size and participant attendance) and self-reported health status indicators hypothesized to be influenced by the intervention (i.e., variables measured at baseline and post-intervention).

Personal characteristics–Participant sociodemographics measured on the survey included: age, sex, race/ethnicity (i.e., non-Hispanic White and racial/ethnic minority), the highest level of education received by the participant (i.e., less than high school and graduated high school or more than a high school education), number of chronic conditions selected from a list of six options or specified on the survey as "others," living situation (i.e., live alone and live with others), and self-rated health (i.e., 5-point Likert-type item scored 0 for excellent, 4 for poor) [31].

Program implementation variables–Characteristics of the program used in this study included: class size at baseline (i.e., enrollment between one and seven participants, between eight and 12 participants, between 13 and 20 participants, and between 21 and 42 participants) and class attendance among successful completers (i.e., attended between five and seven class sessions and attended all eight sessions). Attending all eight sessions was considered to be perfect attendance. Attrition for this study was defined as those participants who attended fewer than five class sessions, thus, considered to be non-successful completers.

Health indicators–Based on principal components analysis of several possible health indicators (data not shown), a reduced set of items were selected for this study. Self-reported health indicators included two well-used Centers for Disease Control and Prevention measures of quality of life: number of days physical health not good (i.e., continuous score based on the number of reported unhealthy physical days in the previous 30 days) and number of days limited from usual activities (i.e., continuous score based on the number of reported days limited from their usual activities in the previous 30 days)[31]. Additional measures included the number of days physically active (i.e., continuous scored based on the number of reported days physically active in the previous 7 days for at least 30 min; participants were informed that physical activity included "things like brisk walking, bicycling, vacuuming, gardening, or anything else that causes you to breathe faster") [29] and the Falls Efficacy Scale score (i.e., composite score of five 4-point Likert-type scale items, ranging from 5 to 20, scored 1 for "not sure at all," and 4 if "absolutely sure" that the respondent could prevent or manage falls) [32, 33].

Data analysis

Data were analyzed to determine score changes associated with the AMOB/VLL health indicators as explained by program variables and personal characteristics. Frequencies were calculated for participant characteristics and class variables of interest. Pearson's chi-square tests were performed to assess the goodness of fit for frequency distributions and the independence between categorical participant personal characteristics [34]. Independence was also examined based on participant class attendance. To analyze changes in survey responses about health indicators from baseline to post-intervention, a mixed model was used that accounted for cluster effects with repeated measures. The covariates in the model were: age, sex, race/ethnicity, number of chronic conditions, living situation, and baseline self-rated health. These variables were controlled for in these models because of their potential influences on changes in health indicator scores from baseline to post-intervention.

The analysis was performed in SAS using PROC MIXED. Restricted maximum likelihood was used as the estimating algorithm. Cluster effects were

estimated using the classes as clusters, assuming a compound symmetry covariance structure within each class. The repeated measure component was based on each individual's baseline and post-intervention scores, allowing for them to be correlated with an autoregressive structure. The score differences were analyzed with a post hoc procedure based on the least squares means of the baseline and post-intervention scores with all the covariates set at their respective averages. Self-rated health was added as a covariate in these analyses as an indicator of the participants' health status upon enrollment of the intervention. Bonferroni corrections were applied to yield more conservative estimates of statistical significance and reduce Type I error. Estimates for this set of analyses were deemed statistically significant at $p<0.0025$ (i.e., $p<0.05/20$ independent analyses).

To assess the influence of class size on changes in health indicator scores from baseline to post-intervention (i.e., "ideal" class size of eight to 12 participants compared with all other class size groups), four independent ordinary least squares regressions were performed (i.e., one for each health indicator). To assess the influence of perfect attendance on changes in health indicator scores from baseline to post-intervention, four independent ordinary least squares regressions were performed (i.e., one for each health indicator). The covariates in these models were: age, sex, race/ethnicity, number of chronic conditions, and living situation. These variables were controlled for in these models because of their potential influences on changes in health indicator scores from baseline to post-intervention. Baseline health indicator scores were included in each respective model to account for potential biases associated with score differences upon entering the intervention. Unlike the PROC MIXED procedures described above where baseline health indicator scores were treated as response variables, baseline health indicator scores were included in these models rather than self-rated health, as indicators of the participants' health status upon enrollment of the intervention. Bonferroni corrections were applied to yield more conservative estimates of statistical significance and reduce Type I error. Estimates for these sets of analyses were deemed statistically significant at $p<0.0125$ (i.e., $p<0.05$/four independent analyses).

RESULTS

Baseline characteristics of program participants and classes

Characteristics of class participants for this study sample are presented in Table 1. The majority of study participants were age 75 years and older (n=1,317, 63.8%), female (n=1,720, 81.4%), non-Hispanic White (n=1,588, 74.0%), had completed high school or more education (n=2,006, 91.2%),

Table 1 | Sample characteristics and health status indicators at baseline

	Non-successful completion	Successful completion	Total	X^2 or t	p
Age				4.208	0.122
50–59 years	11 (3.0%)	36 (2.1%)	47 (2.3%)		
60–74 years	109 (29.7%)	591 (34.8%)	700 (33.9%)		
75+years	247 (67.3%)	1,070 (63.1%)	1,317 (63.8%)		
Sex				‹0.001	0.987
Female	305 (81.3%)	1,415 (81.4%)	1,720 (81.4%)		
Male	70 (18.7%)	324 (18.6%)	394 (18.6%)		
Race/ethnicity				7.988	0.005
Non-Hispanic White	304 (79.8%)	1,284 (72.8%)	1,588 (74.0%)		
Non-White	77 (20.2%)	480 (27.2%)	557 (26.0%)		
Education				4.778	0.444
Less than high school	34 (8.6%)	160 (8.9%)	194 (8.8%)		
High school graduate or more	360 (91.4%)	1,646 (91.1%)	2,006 (91.2%)		
Number chronic conditions				8.255	0.311
One	176 (44.9%)	807 (45.7%)	989 (45.5%)		
2 or more	216 (55.1%)	959 (54.3%)	1,175 (54.5%)		
Living situation				6.428	0.011
Alone	234 (61.4%)	965 (54.3%)	1,199 (55.6%)		
With others	147 (38.6%)	812 (45.7%)	959 (44.4%)		
General health status	3.02 (±0.88)	2.89 (±0.86)	2.92 (±0.87)	2.603	0.009
Unhealthy physical days	6.46 (±9.33)	4.79 (±8.46)	5.08 (±8.64)	3.061	0.002
Days physically active	3.51 (±2.46)	3.58 (±2.35)	3.57 (±2.37)	−0.543	0.587
Falls efficacy scale	14.29(±3.61)	14.28 (±3.72)	14.28 (±3.70)	0.041	0.967
Days limited usual activity	3.35 (±6.95)	2.73 (±10.24)	2.84 (±9.74)	1.096	0.273

Means and standard deviations are reported for continuous variables

Non-successful completion attending four or fewer class sessions, *successful completion* attending five or more class sessions

reported having two or more chronic conditions (n=1,175, 54.5%), and lived alone (n=1,199, 55.6%). Overall, 76.4% (n=2,056) met the definition of "successful completer," having attended at least five of eight classes. Compared with non-successful completers, a significantly larger proportion of successful completers were non-white (X^2=7.99, p<0.01), lived with others (X^2=6.43, p<0.05), reported better self-rated health at baseline (t=2.60, p<0.01), and reported fewer unhealthy physical days at baseline (t=3.06, p<0.01).

Among the 227 classes, the mean class size at baseline was 15.36 participants (±6.02) with 29.7% (affecting n=800 participants) categorized as the recommended or ideal size of eight to 12 participants. Approximately 4% (n=99 participants) were smaller than recommended and 66.6% (n=1,792 participants) were larger than recommended.

Relationship of class size to attendance

Table 2 compares participants' attendance rates by the size of the class (at baseline) in which they were enrolled to examine the association between class size and programmatic attrition rates. Seventy-six percent (76.4%; n=2,056) of participants successfully completed the program, and 30.4% (n=818) had perfect attendance. Approximately 30% (n=800) of participants who enrolled in the program were in classes of the ideal size and 57.0% (n=1,535) were in classes of between 13 and 20 participants. The proportion of participants with the highest attrition rates (i.e., attended one to four sessions) was largest for class sizes of eight to 12 participants and 13 to 20 participants. When comparing class attendance by class size, a significantly larger proportion of participants who enrolled in the smallest classes (one to seven participants) attended more classes, whereas those enrolled in the largest classes (21 to 42 participants) attended fewer classes (X^2=43.43, p<0.01).

Changes in health indicators by class size

Adjusted for key covariates (i.e., age, sex, race/ethnicity, and self-rated health), Table 3 shows the changes in health indicators from baseline to post-intervention by class size. Significant improvements in days physically active were observed among those enrolled in class sizes of eight to 12 participants (t=3.06, p<0.0025, Cohen's d=0.170) and 13 to 20 participants (t=3.72, p<0.0025, Cohen's d=0.152). Significant improvements in Falls Efficacy Scale scores were observed for all class sizes. Significant improvements in unhealthy physical days or days limited from usual activity were not observed for any class size.

Changes in health indicators by class size and participant characteristics

Table 4 shows the results of the random effects ordinary least squares regressions that included measures of class size (i.e., ideal class size of eight to 12 participants served as the referent group to other class size groups). This set of regression analyses was performed to explain differences in health indicator scores at post-intervention while accounting for key covariates. Baseline health indicator scores, age, sex, race/ethnicity, number of chronic conditions, and living situation were added to each model as covariates. When compared with participants enrolled in the ideal class size, those within other class sizes reported no significant differences in post-intervention health indicator scores. At post-intervention (i.e., after eight sessions held over 4 or 8 weeks), participants with more chronic conditions reported significantly more unhealthy physical days (β=0.07, p<0.0125), more days limited from usual activity (β=0.07, p<0.0125), and fewer days physically active (β=−0.07, p<0.0125), when compared with their counterparts with fewer chronic conditions. At post-intervention, older participants reported significantly lower Falls Efficacy Scale scores (β=−0.17, p<0.0125), when compared with their younger counterparts.

Changes in health indicators by class attendance and participant characteristics

Table 5 shows the results of the random effects ordinary least squares regressions that included measures of attendance (i.e., attending between five and seven classes served as the referent group to

Table 2 | Number of sessions attended by class size

Class size	Number of sessions attended		
	1 to 4[a]	5 to 7[b]	8[c]
1 to 7 participants	9 (1.4%)	45 (3.6%)	45 (5.5%)
8 to 12 participants	164 (25.8%)	393 (31.7%)	243 (29.7%)
13 to 20 participants	372 (58.6%)	688 (55.6%)	475 (58.1%)
21 to 42 participants	90 (14.2%)	112 (9.1%)	55 (6.7%)
Total	635 (23.6%)	1238 (46.0%)	818 (30.4%)

X^2 =43.43; p<0.001

[a] Non-successful completion

[b] Successful completion

[c] Perfect attendance

Table 3 | Changes in intervention outcomes by class size

	Pre-mean	Post-mean	t	p	Cohen's d
Unhealthy physical days					
1 to 7 participants	5.25	3.72	1.17	0.2475	0.246
8 to 12 participants	4.42	4.01	0.77	0.4420	0.054
13 to 20 participants	4.87	4.14	1.99	0.0474	0.099
21 to 42 participants	4.47	4.66	−0.18	0.8572	−0.027
All class sizes	4.80	4.19	2.12	0.0338	0.081
Days physically active					
1 to 7 participants	3.67	3.85	0.52	0.6038	0.085
8 to 12 participants	3.49	3.86	3.06	0.0024	0.170
13 to 20 participants	3.54	3.88	3.72	0.0002	0.152
21 to 42 participants	3.52	4.03	2.04	0.0446	0.246
All class sizes	3.55	3.91	5.15	<0.0001	0.158
Falls efficacy scale					
1 to 7 participants	14.19	15.81	3.35	0.0015	0.764
8 to 12 participants	14.21	16.22	10.84	<0.0001	0.690
13 to 20 participants	14.24	16.24	13.20	<0.0001	0.621
21 to 42 participants	14.42	16.58	5.64	<0.0001	0.727
All class sizes	14.28	16.28	18.27	<0.0001	0.640
Days limited usual activity					
1 to 7 participants	3.28	2.00	1.27	0.2113	0.265
8 to 12 participants	2.48	2.07	1.19	0.2348	0.076
13 to 20 participants	2.57	2.38	0.70	0.4815	0.033
21 to 42 participants	2.51	1.83	1.08	0.2851	0.154
All class sizes	2.52	2.16	1.80	0.0726	0.063

Statistical significance at p=0.0025 with the Bonferroni correction for 20 independent analyses

perfect attendance). This set of regression analyses was performed to explain differences in health indicator scores at post-intervention while accounting for key covariates. Baseline health indicator scores, age, sex, race/ethnicity, number of chronic conditions, and living situation were added to each model as covariates. When compared with successful completers who attended between five and seven sessions, those with perfect attendance reported significantly fewer days limited from usual activity (β=−0.06, p<0.0125) and more falls efficacy (β=0.05, p<0.0125). At post-intervention (i.e., after eight sessions held over four or eight weeks), participants with more chronic conditions reported significantly more unhealthy physical days (β=0.08, p<0.0125), more days limited from usual activity (β=0.07, p<0.0125), and fewer days physically active (β=−0.07, p<0.0125), when compared with their counterparts with fewer chronic conditions. At post-intervention, older participants reported significantly lower Falls Efficacy Scale scores (β=−0.17, p<0.0125), when compared with their younger counterparts.

DISCUSSION

Successes in the Texas implementation and evaluation of AMOB/VLL can be documented. During this time period, AMOB/VLL reached over 3,000 older adults and gathered surveys at two time points from nearly two thirds of those who participated. Over 75% of participants evaluated completed five or more of the eight class sessions, which is considered successful completion according to intervention protocols and is indicative of older adults' sustained interest in attending the classes. Thirty percent of the classes were within the class size range recommended by program developers as ideal; most were larger than recommended, indicating substantial demand from older adults for this program and willingness among program leaders to expand class sizes to accommodate this demand.

This study represented a unique opportunity to examine the influence of class size on health outcomes. Unlike the current roll out through ARRA funding where there are tight reporting requirements (i.e., where class size deviations would get noted and immediately corrected), in the current study analyses were not conducted in a real-time basis. Thus, we did observe substantial variability in class sizes representing a deviation from AMOB/VLL developer recommendations and were able to relate these to health-relevant impacts. In general, smaller class sizes tended to have larger effect sizes, yet few statistical differences emerged by class size. Consistent with the primary intervention focus, participants experienced a significant increase from baseline to post-intervention in self-efficacy for avoiding falls and number of days they were physically active for class sizes of between eight to 12 participants, 13 to 20 participants, and when all class sizes were combined (see Table 3).

This state-wide evaluation is an example of the opportunity for continued intervention refinement once programs are widely disseminated. In Texas,

Table 4 | Changes in intervention outcomes by class size and participant characteristics

	β	t	p	Adj. R^2
Unhealthy physical days				0.458
Baseline score	−0.69	−30.98	‹0.001	
8 to 12 participants	1.00	–	–	
1 to 7 participants	−0.01	−0.54	0.587	
13 to 20 participants	−0.01	−0.44	0.659	
21 to 42 participants	0.02	0.70	0.487	
Age	0.03	1.25	0.212	
Sex	−0.01	−0.46	0.644	
Race/ethnicity	−0.02	−0.95	0.341	
Number of chronic conditions	0.07	3.08	0.002	
Living situation	0.02	0.75	0.452	
Days physically active				0.296
Baseline score	−0.55	−21.95	‹0.001	
8 to 12 participants	1.00	–	–	
1 to 7 participants	−0.01	−0.31	0.757	
13 to 20 participants	0.00	0.09	0.925	
21 to 42 participants	0.00	0.12	0.902	
Age	0.00	−0.16	0.877	
Sex	0.00	−0.14	0.889	
Race/ethnicity	0.05	1.86	0.064	
Number of chronic conditions	−0.07	−2.74	0.006	
Living situation	−0.01	−0.46	0.646	
Falls efficacy scale				0.496
Baseline score	−0.72	−33.17	‹0.001	
8 to 12 participants	1.00	–	–	
1 to 7 participants	−0.03	−1.14	0.256	
13 to 20 participants	0.00	0.04	0.970	
21 to 42 participants	0.03	1.15	0.249	
Age	−0.17	−7.67	‹0.001	
Sex	0.01	0.60	0.547	
Race/ethnicity	0.02	1.11	0.266	
Number of chronic conditions	−0.02	−1.15	0.252	
Living situation	0.03	1.17	0.244	
Days limited usual activity				0.468
Baseline score	−0.69	−32.19	‹0.001	
8 to 12 participants	1.00	–	–	
1 to 7 participants	−0.01	−0.34	0.735	
13 to 20 participants	0.03	1.07	0.283	
21 to 42 participants	−0.01	−0.45	0.650	
Age	0.00	−0.19	0.847	
Sex	−0.03	−1.26	0.207	
Race/ethnicity	0.03	1.18	0.239	
Number of chronic conditions	0.07	3.09	0.002	
Living situation	0.00	0.09	0.931	

Statistical significance p=0.0125 applying the Bonferroni correction for four independent analyses. Among successful completers, class sizes are compared with the referent group of sessions with eight to 12 participants

we found the most positive pre-post-changes were observed for class sizes of eight to 12 participants and 13 to 20 participants. This is an important finding, given that the recommended class size for the program is eight to 12 participants and that only approximately 30% of classes offered were actually within the recommended size range, and 57.0% of classes offered enrolled between 13 and 20 participants. Texas program leaders seem to manage high demands for classes by increasing class size rather than strictly limiting size and offering additional classes, which is a more cost-efficient way to deliver the program because more participants can be served while minimizing additional cost or leader time. While small classes were as effective as classes of larger sizes, there is a higher per treated individual cost than in larger classes (e.g., training master trainers, volunteer time, facility expenses) [35]. The evaluation confirmed this tendency did not limit effects of the program, at least up to classes with 20 participants for participants who successfully completed the program.

However, the impact of class size on attrition must be considered. The proportion of participants who

Table 5 | Changes in intervention outcomes by attendance and participant characteristics

	β	t	p	Adj. R^2
Unhealthy physical days				0.481
Baseline score	−0.71	−31.92	‹0.001	
Perfect attendance	−0.05	−2.43	0.015	
Age	0.03	1.20	0.231	
Sex	−0.01	−0.49	0.627	
Race/ethnicity	−0.03	−1.17	0.243	
Number chronic conditions	0.08	3.39	0.001	
Living situation	0.02	0.83	0.408	
Days physically active				0.299
Baseline score	−0.55	−21.71	‹0.001	
Perfect attendance	0.06	2.18	0.030	
Age	−0.02	−0.58	0.565	
Sex	−0.01	−0.21	0.836	
Race/ethnicity	0.06	2.12	0.034	
Number chronic conditions	−0.07	−2.80	0.005	
Living situation	−0.02	−0.57	0.570	
Falls efficacy scale				0.499
Baseline score	−0.72	−32.70	‹0.001	
Perfect attendance	0.05	2.52	0.012	
Age	−0.17	−7.71	‹0.001	
Sex	0.01	0.34	0.733	
Race/ethnicity	0.04	1.61	0.109	
Number chronic conditions	−0.03	−1.34	0.182	
Living situation	0.02	0.92	0.356	
Days limited usual activity				0.479
Baseline score	−0.70	−32.31	‹0.001	
Perfect attendance	−0.06	−2.66	0.008	
Age	−0.02	−0.73	0.464	
Sex	−0.04	−1.69	0.092	
Race/ethnicity	0.02	1.02	0.310	
Number chronic conditions	0.07	3.01	0.003	
Living situation	0.00	0.03	0.973	

Statistical significance p=0.0125 applying the Bonferroni correction for four independent analyses. Among successful completers, perfect attendance is compared with the referent group attending five to seven sessions

did not successfully complete the program (e.g., attended <5 classes) increase dramatically across categories of class size–approximately 10% did not complete the program in class sizes of one to seven participants, and approximately 35% did not complete the program in class sizes of 21 to 42. While larger class sizes may be as effective for those who complete the program and require relatively fewer resources per participant, larger class sizes also result in relatively fewer participants completing the program. In short, it appears that program demand can be accommodated by adding more than 13 participants per class, without sacrificing expected outcomes for those completing the program, but those larger class sizes may mean that lower proportions of participants complete the program. Because it is not clear whether the lower proportion of successful completion with larger class size is due to the dynamics of large group sizes or due to large numbers attending initial classes to try them out but then deciding the classes were not a good match for their interests or needs. Community lay leaders may benefit from guidance about the point at which size appears to limit benefits for individual participants (i.e., class sizes over 20 participants, which diminish the individualized attention offered to participants and may dilute the program effects). Lay leaders may also benefit from guidance on managing larger classes to encourage continued participation (e.g., encouraging participation by all or managing various participation styles).

Limitations

The findings of this study are for a large state with an effective infrastructure for implementing the program. It is reasonable to expect that implementation would differ across states depending on characteristics of residents in the community and of the aging services network in the state. In fact, implementation may differ across regions of Texas; a question beyond the scope of this particular study. However, the Texas experience demonstrates that it is possible to reach a large number of geographically disparate older adults with the AMOB/VLL and that the program can have a positive impact on participants.

As with any community-based program, we acknowledge the participant attrition from baseline to post-intervention assessment both in terms of missing data as well as programmatic involvement (i.e., attendance). Because participants who attended only a few sessions were unlikely to have completed baseline and post-intervention assessments, we were unable to examine the relationship between class participation and outcomes across the full range. For this reason, the purpose of our study was to examine participants' attendance by outcomes among the most successful completers. We must additionally acknowledge this study may have demonstrated a "healthy participant effect," whereas those healthier participants at baseline (and/or those who reported more program effects) were more likely to be successful completers than their less healthy counterparts [36]. Further, we acknowledge our inability to detect other potential biases associated with the lack of a control group for this community-based initiative (i.e., individuals completing assessments without enrolling in the program).

We can comment, however, on the general representativeness of our study participants. Most AMOB/VLL participants were female, non-Hispanic white, and well-educated (most had at least a high school diploma). The proportion of females in the sample is very close to the proportion of females age 50 and older in Texas in 2008 (53%) [37]; however, non-Hispanic white Texans (74%) were overrepresented in the sample compared with state demographics. In 2008, only 63% of Texans age 50 and older were characterized as "Anglo" [30]. However, a higher percentage of non-white participants (86.2%) than non-Hispanic white participants (80.8%) successfully completed the AMOB/VLL program, suggesting that minority participants once reached also valued the program, and were able to attend multiple classes required for successful completion. Additional efforts to reach minority participants may therefore be needed to ensure all groups of Texans have the opportunity to participate in the program.

Implications for research translation and public health practice

This study supports the assertion that large-scale dissemination of evidence-based programs is possible and can improve the health of older adults, as found in the original study [25] and the initial examination of the adapted program [12]. In the case of AMOB/VLL, thousands of Texans across the state were reached with an intervention that reduced falls. Given the poor outcomes and high costs associated with falls in older populations [10], the ability to broadly impact falls with community-level programs is important for healthcare and public health practitioners. The study identified the value of classes of all sizes, opening the possibility of regularly enrolling fewer or more than the 12 participant limit that was previously recommended as ideal. Enrolling more persons per class to as many as 20 participants could reduce the cost per person of the program, perhaps making it feasible for additional groups to offer the program although the impact on attrition should be carefully monitored by lay leaders. Ensuring that participants are retained across class size may require implementation of new strategies to encourage continued participation in larger class sizes. Examples of applicable evidence-based retention strategies include participant reminders, "buddy" systems for calling participants before class, or identifying and addressing barriers that might go unnoticed in larger classes, such as transportation issues [38].

Our study shows the complex interactions between class size, program attendance, and reported outcomes while highlighting the importance of program evaluation after widespread implementation of evidence-based interventions. While completion rates were generally high (76.4%), perfect attendance was a factor influencing participants' health-related outcomes. However, the overall reported improvements among AMOB/VLL participants (i.e., not just those attending eight of eight sessions) imply that perfect attendance is not necessary for substantial optimal outcomes. This finding is encouraging because it reflects the realities of "real life," especially among older participants, where individuals may miss one or more class sessions due to illness, physicians visits, and/or other obligations. Considering the additional program benefits reported by those with perfect attendance, participant retention strategies should be employed to reduce attrition.

Although our study focused on factors related to successful program dissemination, it is noteworthy that many of the organizational and programmatic factors that facilitate program dissemination are also keys in program sustainability [39]. In recognition of the multifaceted nature of falls risk, the Coalition is now promoting a wider range of intervention strategies, and providing informational briefings to the Texas legislature for raising community attention and support of strategies for promoting physical activity, home safety, medication management, family awareness, and evidence-based falls prevention programs [5, 6].

Acknowledgments: A Matter of Balance/Voluntary Lay Leader (AMOB/VLL) is a major program activity in the Aging Texas Well's Texas Healthy Lifestyles Initiative. State-wide implementation is supported by the Department of Aging and Disability Services and administered through the Texas Association of Area Agencies on Aging. The evaluation is conducted by the Texas A&M Health Science Center School of Rural Public Health. We recognize faculty support from The Center for Community Health Development which is a member of the Prevention Research Centers Program, supported by the Centers for Disease Control and Prevention cooperative agreement number 5U48 DP000045. The findings and conclusions in this article are those of the author(s) and do not necessarily represent the official position of Department of Aging and Disability Services or the Centers for Disease Control and Prevention.

1. Rowe, J. W., & Kahn, R. L. (1997). Successful aging. *The Gerontologist, 37*, 433–440.
2. Rowe, J. W., & Kahn, R. L. (1998). *Successful aging: The MacArthur Foundation Study*. New York: Random House.
3. Ory, M. G., Smith, M. L., Mier, N., & Wernicke, M. M. (2010). The science of sustaining health behavior change: the Health Maintenance Consortium. *American Journal of Health Behavior, 34*, 647–659.
4. Ory, M. G., Jordan, P. J., & Bazzarre, T. (2002). The Behavior Change Consortium: setting the stage for a new century of health behavior-change research. *Health Education Research, 17*, 500–511.
5. National Council on the Aging: Issue Brief: Evidence-based Health Promotion Series. (Vol. November 2006), 2006.
6. National Council on the Aging: *Evidence-based programs: 2006 & 2007 AoA Evidence-based disease prevention grantees and their programs.* Available from: http://healthyagingprograms.org/content.asp?sectionid=32&ElementID=589. Accessed 29 June 2009
7. Centers for Disease Control and Prevention, National Center for Injury Prevention and Control (2009). *Falls Among Older Adults: An Overview.* Available from: http://www.cdc.gov/HomeandRecreationalSafety/Falls/adultfalls.html. Accessed 19 June 2009
8. Orces, C. H. (2008). Trends in fall-related mortality among older adults in Texas. *Texas Medicine, 104*, 55–59.
9. Rubenstein, L. Z. (2006). Falls and their prevention in elderly people: what does the evidence show? *Medical Clinics of North America, 90*, 807–824.
10. Smith, M. L., Ory, M. G., Beasley, C., et al. (2010). Falls among older adults in Texas: profile from 2007 hospital discharge data. *Texas Public Health Association Journal, 62*, 7–13.
11. National Center for Injury Prevention and Control, Centers for Disease Control and Prevention: *WISQARS Nonfatal Injury Reports.* Available from: http://webappa.cdc.gov/cgi-bin/broker.exe. Accessed 19 June 2009
12. Healy, T. C. (2008). The feasibility and effectiveness of translating a matter of balance into a volunteer lay leader model. *Journal of Applied Gerontology, 27*, 34–51.
13. Partnership for Healthy Aging: *A Matter of Balance replication report.* Available from: http://www.healthyagingprograms.org. Accessed 22 April 2009
14. Bellg, A. J., Borrelli, B., Resnick, B., et al. (2004). Enhancing treatment fidelity in health behavior change studies: best practices and recommendations from the Behavior Change Consortium. *Health Psychology, 23*, 443–451.
15. Griffin, S. F., Wilcox, S., Ory, M. G., et al. (2010). Results from the active for life process evaluation: program delivery fidelity and adaptations. *Health Education Research, 25*, 325–342.
16. Frank, J. C., Coviak, C. P., Healy, T., Belza, B., & Casado, B. L. (2008). Addressing fidelity in evidence-based health promotion programs for older adults. *Journal of Applied Gerontology, 27*, 4–33.
17. Stanford School of Medicine: *Program Fidelity Manual: Stanford Self-Management Programs 2010.* Availble from: http://patienteducation.stanford.edu/licensing/Fidelity_Manual2010.pdf
18. Texas A&M Health Science Center. (2009). *Texas Falls Prevention Coalition: Evaluation protocols manual*. College Station: Texas A&M Health Science Center School of Rural Public Health.
19. Carron, A. V., & Spink, K. S. (1995). The group size-cohesion relationship in minimal groups. *Small Group Research, 26*, 86–105.
20. Burke, S. M., Carron, A. V., Patterson, M. M., et al. (2005). Cohesion as a shared beliefs in exercise classes. *Small Group Research., 36*, 276–288.
21. Centers for Disease Control and Prevention: *Guide to community preventive services. Behavioral and social approaches to increase physical activity: Individually-adapted health behavior change programs.* Available from: http://www.thecommunityguide.org/pa/behavioral-social/individuallyadapted.html. Accessed 1 November 2010
22. Seymour, R. B., Hughes, S. L., Ory, M. G., et al. (2010). A lexicon for measuring maintenance of behavior change. *American Journal of Health Behavior, 34*, 660–668.
23. Schulz, R., Czaja, S. J., McKay, J. R., Ory, M. G., & Belle, S. H. (2010). Intervention taxonomy (ITAX): describing essential features of interventions. *American Journal of Health Behavior, 34*, 811–821.
24. Glanz K, Rimer BK, Viswanath K (eds) 2008. *Health behavior and health education: Theory, research, and practice* (4th Ed.). San Francisco: Jossey-Bass.
25. Tennstedt, S. A. (1998). randomized, controlled trial of a group intervention to reduce fear of falling and associated activity restriction in older adults. *Journals of Gerontology Series B: Psychological Sciences & Social Sciences., 54*, 384–392.
26. Smith ML, Ahn S, Sharkey JR, et al. Successful falls prevention programming for older adults in Texas: Rural-urban variations. *Journal of Applied Gerontology.* 2011. in press.
27. Smith, M. L., Ory, M. G., & Larsen, R. A. A. (2010). Older women in a statewide evidence-based falls prevention program: who enrolls and what benefits are obtained? *Women's Health Issues, 20*, 427–434.
28. Ory MG, Smith ML, Wade A, et al. (2010). Implementing and disseminating an evidence-based program to prevent falls in older adults, Texas, 2007–2009. *Preventing Chronic Disease. 7.* Available from: http://www.cdc.gov/pcd/issues/2010/nov/2009_0224.htm
29. Funnell, M. M., Arnold, M. S., Fogler, J., Merritt, J. H., & Anderson, L. A. (1998). Participation in a diabetes education and care program: experience from the diabetes care for older adults project. *Diabetes Education, 24*, 163–167.
30. Topp, R., & Stevenson, J. S. (1994). The effects of attendance and effort on outcomes among older adults in a long-term exercise program. *Research in Nursing and Health, 17*, 15–24.
31. Centers for Disease Control and Prevention. (2000). *Measuring healthy days: population assessment of health-related quality of life*. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Adult and Community Health.
32. Powell, L. E., & Myers, A. M. (1995). The activities-specific balance confidence (ABC) scale. *Journal of Gerontology: Medical Sciences, 50A*, M28–M34.
33. Tinetti, M. E., Richman, D., & Powell, L. (1990). Falls efficacy as a measure of fear of falling. *Journal of Gerontology: Psychological Sciences, 45*, 239–243.
34. Chernoff, H., & Lehmann, E. L. (1954). The use of maximum likelihood estimates in χ^2 tests for goodness-of-fit. *Annals of Mathematical Statistics, 25*, 579–586.
35. Miller TR, Dickerson JB, Smith ML, Ory MG. Assessing costs and potential returns of evidence-based programs for seniors. *Evaluation and the Health Professions.* 2011. in press.
36. Klesges, R. C., Williamson, J. E., Somes, G. W., et al. (1999). A population comparison of participants and nonparticipants in a health survey. *American Journal of Public Health, 89*, 1228–1231.
37. U.S. Census Bureau (2009). *2009 State & County QuickFacts.* Available from: http://quickfacts.census.gov/qfd/index.html. Accessed 1 November
38. Goins, R. T., & Krout, J. A. (Eds.). (2006). *Service delivery to rural older adults*. New York: Springer.
39. Evashwick, C., & Ory, M. G. (2003). Factors essential to sustaining public health and aging programs over time. *Generations, 29*, 76–81.