ARTICLE

Predictors of Completion Status of Older Participants in Short-Term Fall Prevention Program

Qiwei Li Ph.D.[1,3*] Xiaoli Li Ph.D.[2,3] Keith W. Turner Ph.D.[3]

[1] California State University Fresno, Department of Public Health

[2] Southern Illinois University, School of Health Sciences

[3] University of North Texas, Department of Rehabilitation and Health Services

[1]Corresponding Author Qiweili@csufresno.edu

Background: A Matter of Balance (AMOB), as a fall prevention program, has been improving older adults' fall-related efficacy and reducing fear of falls. However, the dropout rates of participants are relatively high. The paper aims to examine the factors associated with the completion status of the participants in this fall prevention program and provide potential suggestions for future improvement of participant retention. **Methods**: The *t*-tests were conducted to determine the cutoff point of adequate sessions. A multinomial logistic regression model was then conducted to predict the factors associated with the completion status of 737 older participants. **Results**: The completion status was defined as "inadequate" which stands for participation of less than six sessions, "adequate" for six and seven sessions, and "completion" for all eight sessions. There are 64% of participants completed the fall prevention program. Education, vision impairment, private insurance, health status, inferences of social activities, and confidence were predictors for completion status.

Keywords: Predictors, A Matter of Balance, Completion Status, older adults, fall prevention

Accidental falls among older adults could be dangerous and costly. Fall prevention programs for older adults have been shown to be beneficial (Bjerk, Brovold, Skelton, & Bergland, 2017; Hauer, Lamb, Jorstad, & Todd, 2006). A Matter of Balance (AMOB), as a volunteer lay leader model that aims to prevent falls among community-dwelling older adults, has been improving older adults' fall-related efficacy and reducing fear of falls (Yoshikawa, Ramirez, Smith, Lee, & Ory, 2020). With reduced falls, older adults could age in place longer and community sustainability could also be improved with healthy aging populations. Therefore, it is critical to scale up the program among older adults nationwide. However, dropout rates of

existing fall prevention programs are relatively high (Kesgin, Suddick, Heesen, Wright, 2021; Nilsagård, von Koch, Nilsson, & Forsberg, 2014). To maximize the benefits of participating in a fall prevention program, Osho, Owoeye, and Armijo-Olivo (2018) suggested that programs with adherence greater than 80% may result in more reduction of fall risks than those with lower adherence. As older adults drop out of the programs, the programs become less beneficial for the overall target population and then become less cost-effective when reported to funders.

Previous studies on attrition frequently focus on longitudinal research, leaving the factors associated with attrition of older adults in short-term programs (e.g., 8 weeks) understudied (Cacioppo and Cacioppo, 2018; Viken et al., 2018). According to their studies, societal factors, life experiences, program procedures, and personal beliefs and perceptions are found to be associated with participants who drop out (Cacioppo and Cacioppo, 2018).

Social supports are strong predictors for participants to complete the program while personal characteristics have moderate effects on treatment outcomes (Lippens and Mackenzie, 2011). Lippens and Mackenzie also recommend the inclusion of contextual characteristics in further studies to explore the association between environmental and personal factors and the impacts thereof on the completion rates.

Physical conditions play crucial roles in retaining older participants in physical exercise programs. Viken et al. (2018) conducted a randomized control trial among older adults who participate in physical activities, a program that lasts about three years. They reported that the participants who dropped out of the program were older adults with low grip strength and low cardiorespiratory fitness. In acute care programs, communication and administrative procedures for recruitment are vital in preventing older adults from dropping out and clinical diagnoses are a good predictor for older adults' willingness to participate. However, to achieve a total participation rate, smooth communication is key (Wu et al., 2013).

Personal characteristics and perceptions are also crucial to retaining older adults in programs. Herman et al. (2002) studied the completion rate among older adults within a therapeutic program and concluded that self-reported anxiety and life satisfaction are good predictors for both completion and treatment outcomes regardless of treatment conditions. Similarly, Gavin and Myers (2003) reported the completion patterns among older adults in Tai-chi and line dancing programs and found that expectations, past experiences, and perceived ease of learning the movements are strongly associated with the completion rate. Viken et al. (2018) also reported that participants with lower levels of education were more likely to quit the three-year program. Smith et al. (2012) conducted two separate binary logistic regression analyses to explore the predictors of completion status and found that females were less likely to complete the program, participants who finished high school tend to have adequate dosage and/or completion. A Matter of Balance is a fall prevention program that has been successfully implemented nationwide. This study focuses on its implementation in location anonymized for Review. We noticed that the post-survey rates among older adults in this short-term fall prevention program

were at 64%, indicating that about 36% of the participants did not finish the program or missed the last session of the program. In this light, retaining participants in fall prevention programs should be considered an important goal. Therefore, this study aims to explore the factors associated with the levels of completion for this short-term fall prevention program in the Dallas-Fort Worth (DFW) area.

To categorize the completion status, we need to first identify the number of sessions with which participants could get a significant improvement in fall-related efficacy and an adequate dosage. Smith, Ory, Belza, and Altpeter (2012) did a study about the attendance of the AMOB program. That study divided the completion status into three categories: inadequate (1 to 4 sessions), adequate (5 to 7 sessions), and complete (8 sessions). Mielenz, Durbin, Hertzberg, and Nobile-Hernandez (2017) also used the five-session cutoff point as an adequate session. The adequate point is somewhere between 5 to 6 sessions.

Upon previous findings, the current study aims to use polynomial analysis to determine the predictors of completion status as it renders more information when comparing between categorized outcome variables (Kleinbaum & Klein, 2010). Furthermore, as mentioned in Mielenz et al.'s (2017) study the sample was predominated by Hispanics, which may bias the generalizability of the research findings. This study tends to verify the cutoff point of the number of adequate sessions as the original suggestions were proposed 11 years ago (*AMOB replication report*, cited in Smith et al., 2012).

In brief, the paper aims to confirm the adequate sessions for participants to get enough improvement in fall prevention; to examine the factors associated with the completion status of the participants in this eight-week fall prevention program; and to provide potential suggestions for future improvement of participant retention.

Methods

Design and Procedures

This study uses quantitative and descriptive methods. Institutional Review Board (IRB) was approved by a public university. The paper-based original data was collected by the Area Agency on Aging (AAA) from the fall prevention program A Matter of Balance. Student assistants manually imputed the data into a digital version and cross-validated each other's work.

Settings and Participants

The AMOB fall prevention program is operated by AAA. Two major goals of AMOB are to increase muscle strength and confidence in self-management of falls (CSMoF; Anonymised for Review #1; Mielenz et al., 2017; Smith et al., 2012). The pre-and post-survey of 737 participants were collected. Of all cases, 46 participants younger than 65 were removed from the study. The sample size included in the final data analysis consisted of 691 participants. The mean age of participants was 76.23, ranging from 65 to 97. The sample was predominated by females (76.1%) and European Americans (95%). Other ethnic groups included 20 Asian Americans (2.9%), 10 African Americans (1.4%), 4 American Indian or Alaska Native (0.6%), and 3 Native Hawaiian or other Pacific Native (0.4%). Four hundred (57.9%) participants were married, followed by widowed (n = 190, 27.5%), divorced (n = 70, 10.1%), and other (n = 31, 4.5%). Regarding living

arrangements, 462 (66.9%) participants reported living alone. The sample exhibits good overall education as 398 (57.6%) participants held a college degree and above and 220 (32%) had some college education. In terms of health conditions, 359 (52%) had

Table 1. *Participant Characteristics (N = 691).*

Characteristics	***n* (%)**	***M* (*SD*)**
Demographic variables		
Age		76.23(6.44)
Living alone		
Yes	229(33.1)	
No	462(66.9)	
Sex		
Male	165(23.9)	
Female	526(76.1)	
Hispanic		
Yes	17(2.5)	
No	674(97.5)	
Ethnicity		
American Indian or Alaska Native	4(0.6)	
Asian American	20(2.9)	
Black or African American	10(1.4)	
Native Hawaiian or other Pacific native	3(0.4)	
European American	654(94.6)	
Education		
Less than high school	2(0.3)	
Some high school	4(0.6)	
High school graduate or GED	67(9.7)	
Some college or vocational school	220(31.8)	
College graduate or higher	398(57.6)	
Marital status		
Married	400(57.9)	
Widowed	190(27.5)	
Divorced	70(10.1)	
Separated	3(0.4)	
Other	28(4.1)	
Chronic conditions		
Arthritis	359 (52)	
Breathing	94 (13.6)	
Depress	80 (11.6)	
Diabetes	113 (16.4)	
Heart disease	163 (23.6)	
Vision limitations	98 (14.2)	
Perception of falls		
Limitation	212 (30.7)	
Fall frequency		0.51 (1.22)
Resulted in injury		0.16 (0.58)
Fear of falls		2.86 (0.87)
Health status		3.34 (0.80)
Poor	1 (0.1)	
Fair	88 (12.8)	
Good	326 (47.2)	
Very good	226 (32.7)	
Excellent	50 (7.2)	

arthritis, 94 (13.6%) had breathing issues, 80 (11.6%) had depressive symptoms, 113 (16.4%) had diabetic conditions, 163 (23.6%) had heart diseases, and 98 (14.2%) had vision impairment. Table 1 concludes the demographic characteristics of participants.

Measurements

Completion Status. The AMOB has eight sessions for 16 weeks. The completion status was coded as 0 (inadequate), 1 (adequate), and 2 (completion). Participants reported their attendance at each session and the total number of sessions they had participated in. The final coding for the completion status would be determined by a series of paired t-tests.

Chronic Conditions. The survey of AMOB asked participants to select yes or no from seven chronic conditions, including arthritis, breathing issues, depressive symptoms, diabetic conditions, heart diseases, and vision impairment.

Health Status. Participants reported their self-perceived health status on a 5-point Likert scale from 1 (Poor) to 5 (Excellent).

Fall History. The perceived limitations of social activities because of concerns about falls were measured, as 1 stands for yes and 0 for no. The incidents of falls and the injuries due to falls during the past three months were measured as continuous variables. A 4-point Likert scale ranges from 1 (Not at all) to 4 (A lot) gauged fear of falls.

The Confidence in Self-Management of Falls (CSMoF). The AMOB program asks participants to rate a set of statements on a 5-item Likert scale. Examples of the statements included "I can get up when I fall" and "I can protect myself while falling". This set of questions was designed to measure CSMoF. The Cronbach's Alpha of the CSMoF scale was .837. A confirmatory factor analysis (CFA) was quickly performed to verify the validity of the measurement. All five items loaded statistically significant toward one dimension, CSMoF, and the fit of the model was satisfactory: $\chi 2(4) = 14.04$, $p = .007$, RMSEA = .06, and CFI = .993 (Acock, 2013).

Demographic Variables. Participants reported their age, gender, ethnicity, marital status, educational attainment, and living arrangements.

Data Management

The number of missing cases ranged from six to 23 across the data set, but no variable had more than 10% of the total cases missing. We completed Little's missing completely at random (MCAR) test and rejected the null hypothesis that the pattern was MCAR. Mean substitution was made for continuous variables (e.g., age, and CSMoF), and mode substitution was applied for categorical variables (e.g., education, marital status, and health status; Acock, 1997; Schumacker & Lomax, 2016)

Data Analyses

To determine the cutoff point of adequate sessions, attendances were recoded to a series of dummy variables. For example, variable Five stands for the participant who attended at least five sessions, and Six for at least six sessions. Variable improvement was calculated by subtracting pre-CSMoF from post-CSMoF. A series of paired *t*-tests were conducted, examining the mean difference by groups such as more than six sessions versus less than six sessions. The *t*-test was statistically significant when grouped by variable Six, with a mean difference of .64, $t = -1.877$, $p = .031$. Levene's test resulted in a statistically

insignificant *p*-value of .850, *df* (1, 439), indicating a homogeneity of variance. Given this outcome, the completion status in this study was defined as "inadequate" which stands for participation of less than six sessions, "adequate" for six and seven sessions, and "completion" for all eight sessions.

Given the ordered and categorical nature of the dependent variable, an ordered logistic model (OLM) is preferable. However, the assumption of proportional odds across response categories was violated, $\chi 2 = 22.03$, df = 7, $p = .003$. A multinomial logistic regression model was then conducted to perform the analysis as it has loose assumptions on the proportional odds (Long & Freese, 2006). This study reported relative risk ratios (RRR) of predictors. The sample size of 691 met the minimal requirement of multinomial logistic regression as suggested by Thompson (1987) that with a significance level set to .05 and a dependent variable of three categories, the sample size should be greater than 510.

We further classified the completion status of the program with predictors in the regression model and a binary outcome (complete and adequate versus inadequate) using a classification and regression tree (CART) model (Khadanga, Savage, Gaalema, & Ades, 2021; Lemon, Roy, Clark, Friedmann, & Rakowski, 2003). The tree model predicts outcomes with more flexible cutoff points within predictors. The CART model was achieved using the *rpart* package (Thernau, Atkinson, & Ripley, 2013) in RRR (v.4.1.1) and R Studio (2021.09.0+351).

Results

Descriptive

Of all participants, 179, 313, and 199 cases were categorized as "inadequate", "adequate", and "completion", respectively. And the completion status was included in the logistic model as the dependent variable. The multinomial logistic regression was statistically significant, $\chi^2 = 73.79$, $df = 42$, $p = .002$. Among the predictors, education, vision impairment, private insurance, health status, inference with social activities, and mean CSMoF were found to be predictive for at least one pair of categories of the outcome. Participants with college and above educational attainment tend to have a significantly lower chance of achieving completion while controlling for other variables. An increase in education is associated with a drop of 66% toward completing the fall prevention program, R = .34, $z = -2.73$, $p < .001$. Higher education is also associated with a lower probability of getting adequate sessions from the program, RRR = 0.49, $z = -1.86$, $p = .03$. The finding indicates that participants with higher education are more likely to have inadequate status.

Participants with vision impairment were more likely to achieve "adequate" rather than "inadequate", with a RRR of 2.47, $z = 2.35$, $p = .009$. This result shows participants with vision impairment are more likely to have adequate sessions and then stop participating, and vision impairment was associated with lower odds of getting "completion".

Private insurance coverage was also negatively associated with "adequate" and "completion" status, as both Rs of private insurance were smaller than 1. Compared to

"inadequate" the RRR of "adequate" was 0.48, z = -2.90, p = .001.
Interference of social activities predicted a lower probability of completing the program, as RRR = .76, z = -2.19, p = .01. Perceived interference of social activities due to falls limits participants from completing the sessions.
Participants who perceived social limitations due to concerns about falls were less likely to complete the fall prevention program with full sessions, RRR = 0.76, z = -2.19, p = 0.28. Similarly, though not significant, such participants also demonstrated lower rates of having an adequate dosage of the program and were more likely to drop out of the program.
Health status was a strong predictor of "completion" and "adequate". The corresponding RRRs of "adequate" was 1.52 (z = 2.97, p < .001) and 1.48 (z = 2.56, p = .005), respectively. This reveals that participants with better health status tend to complete the prevention program more than those who reported worse health status.
A higher level of CSMoF also predicts a lower possibility of completing all the sessions. Compared to "inadequate", participants with higher levels of CSMoF were less likely to fall into "completion" with a RRR of .92, z= -2.16, p = 0.015. Table 2 presents the relative risk ratio, 95% confidence interval, and z scores from the multinomial logistic regression model.

Table 2. *Outcomes of Multinomial Logistic Regression With Completion Status as Dependent Variable.*

	RRR	Std.Err	*Z*	95 CI
Inadequate	**Reference group**			
Adequate				
Age	1.01	0.02	0.40	[0.97:1.04]
Sex	0.81	0.20	-0.84	[0.50:1.31]
Education				
High School	0.56	0.23	-1.43	[0.26:1.23]
College and above	0.49*	0.19	-1.86	[0.23:1.04]
Married	1.2	0.33	0.66	[0.70:2.04]
Live alone	1.06	0.30	0.21	[0.61:1.86]
Depression	1.27	0.38	0.80	[0.71:2.29]
Vision issue	2.15*	0.66	2.47	[1.17:3.93]
Private insurance	0.48***	0.12	-2.90	[0.29:0.79]
Interfered social life	0.86	0.09	-1.41	[0.69:1.06]
Limited life due to falls	0.88	0.20	-0.57	[0.56:1.37]

Fear of falls	1.13	0.16	0.91	[0.87:1.48]
Health Status	1.52***	0.21	2.97	[1.15:2.00]
Confidence in self-management of fall	0.97	0.03	-0.94	[0.90:1.04]
Full complete				
Age	1.02	0.02	0.97	[0.98:1.05]
Sex	0.72	0.20	-1.22	[0.42:1.23]
Education				
High School	0.6	0.25	-1.23	[0.27:1.35]
College and above	0.34***	0.13	-2.73	[0.16:0.74]
Married	1.61	0.50	1.54	[0.88:2.94]
Live alone	1.6	0.51	1.49	[0.86:2.98]
Depression	0.55	0.21	-1.58	[0.26:1.16]
Vision issue	1.46	0.51	1.10	[0.74:2.89]
Private insurance	0.81	0.22	-0.80	[0.48:1.36]
Interfered social life	0.76*	0.09	-2.19	[0.6:0.97]
Limited life due to falls	0.88	0.22	-0.51	[0.53:1.44]
Fear of falls	1.05	0.16	0.33	[0.78:1.41]
Health Status	1.48*	0.23	2.56	[1.1:1.99]
Confidence in self-management of fall	0.92*	0.04	-2.16	[0.85:0.99]

According to the tree classification, the classifying rules were reported in Table 3. Focusing on conditions that predict inadequate status, participants with higher than college degrees, whose health is not in good shape, covered by private insurance, and with arthritis are predicted to have inadequate status. Among participants with less than college degrees, if they were covered by private insurance only and not covered by Medicare were also predicted to not complete the program. Figure 1 presents a tree plot showing the classifying paths under each condition.

Discussion

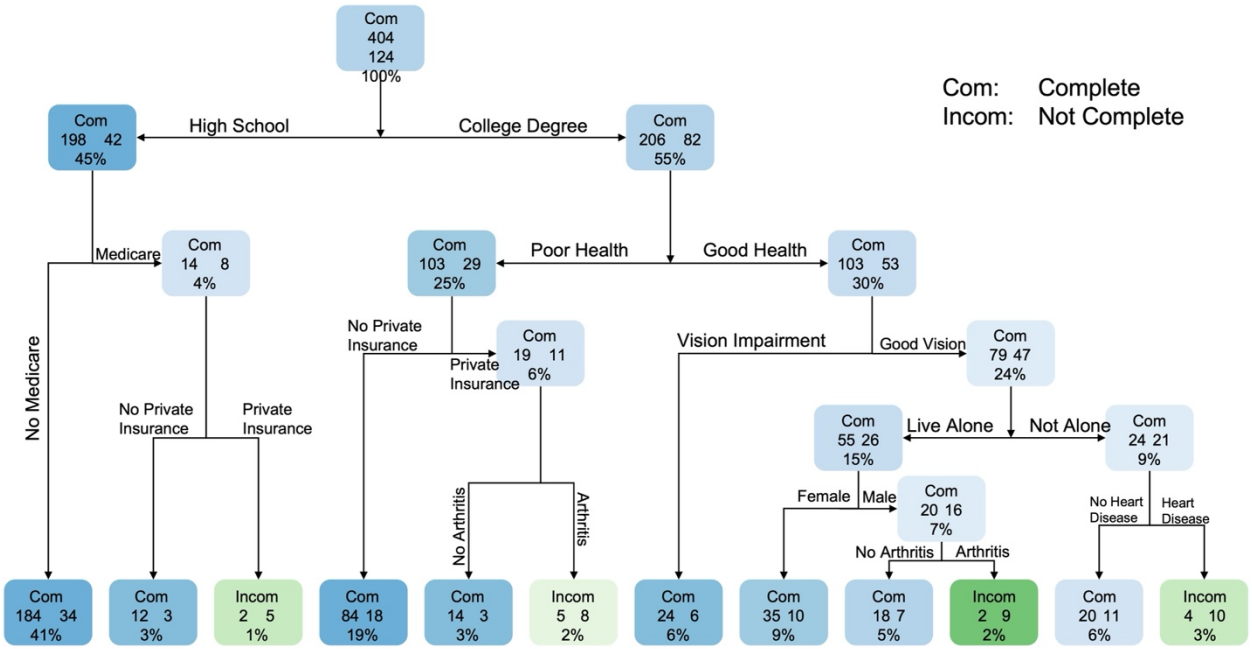
The finding of the study updates the cutoff point of adequate dosage in the AMOB program. The adequate dosage identified in this study is attending at least six sessions, which is right on or a little higher than the cutoff point suggested by

Table 3.
The Classifying Rules Used in The CART Model.

Status	Com	Incom	Conditions	Proportion
complete	[84% : 16%]	when	Education < College & Medicare is Yes	41%
complete	[82% : 18%]	when	Education >= College & health is not good & Private insur. is no	19%
complete	[82% : 18%]	when	Education >= College & health is not good & Private insur. is Yes & Arthritis is No	3%
complete	[80% : 20%]	when	Education < College & Private is No & Medicare is No	3%
complete	[80% : 20%]	when	Education >= College & health is good & Eye issue is Yes	6%
complete	[78% : 22%]	when	Education >= College & health is good & Eye issue is No & Live alone is No & Gender is Female	9%
complete	[72% : 28%]	when	Education >= College & health is good & Eye issue is No & Live alone is No & Arthritis is No & Gender is Male	5%
complete	[65% : 35%]	when	Education >= College & health is good & Eye issue is No & Live alone is Yes & Heart disease is No	6%
Incomplete	[38% : 62%]	when	Education >= College & health is not good & Private insur. is Yes & Arthritis is Yes	2%
Incomplete	[29% : 71%]	when	Education < College & Private is Yes & Medicare is No	1%
Incomplete	[29% : 71%]	when	Education >= College & health is good & Eye issue is No & Live alone is Yes & Heart disease is Yes	3%
Incomplete	[18% : 82%]	when	Education >= College & health is good & Eye issue is No & Live alone is No & Arthritis is Yes & Gender is Male	2%

Note. Com: proportion Complete; Incom: Inadequate.

Figure 1. Tree Classification.



Smith et al. (2012; 5-6 sessions) and Mielenz et al. (2017; 5 sessions).

This exploratory study also found that many of the hypothesized factors were not predictors of completion status for fall prevention programs. For example, fear of falls, fall history, and perceived limitations due to falls were not associated with the participant's completion status of the fall prevention program. To our surprise, participants with higher levels of education were more likely to drop out of the program while those with relatively lower levels of educational attainment tend to stay and achieve completion. This finding is contrary to a previous study that found participants

with lower education are more likely to quit the fall prevention program organized in the northern part of America (Viken et al.,2018). The finding supports a previous study finding that older adults with high school-level education are more likely to complete the program (Smith et al., 2012). One possible explanation for this increased inadequate rate for people with higher educational attainment is that this population may have better health status as well as more sources and information about fall prevention. Therefore, they are less likely to get excited about new information from fall prevention programs.

From our study, we did not see a statistically significant difference between genders regarding the completion status. When compared to older adults who did not achieve adequate sessions, the male gender demonstrated a lower likelihood of completing than females, and the findings are contrary to that from the Smith et al., (2012) study.

Older adults with chronic conditions such as depressive symptoms and/or vision impairment demonstrated more likelihood of attending adequate sessions of the fall prevention program but were less likely to finish all the sessions. It is noteworthy that vision impairment is a risk factor for unintentional falls. Therefore, participants with visual impairing conditions are in fact at risk. In this light, it is no wonder that they intend to finish the adequate dosage of program sessions. However, once they feel that they know enough about how to prevent falls given their conditions, then they might exhibit less interest in staying in the program.

Private insurance coverage predicted lower probabilities of having adequate or complete. This might be due to access to care providers who also provide fall prevention information.

Health status, intuitively, becomes a strong predictor of participants' completion status, as a better health status leads to a higher chance of completing the whole program. This finding was not surprising yet it is so important to note that participants with poor health status or with conditions are then less likely to finish the whole program and to benefit more from all the sessions. Many reasons could contribute to this situation. Poor health conditions prevent participants from attending sessions they want to attend, or the practices are too challenging for them and cause them to drop out of the program. People with poor health conditions may share a high risk of falling, so assisting them with some extra efforts could retain them longer in the program and extend the benefits of participation.

People with a higher level of CSMoF also exhibited a lower probability of completing the program. But is understandable that people with higher pre-survey scores may have known most of the fall prevention information. A better organization of information and a comprehensive overview could help participants quickly locate their information of interest because having a higher level of CSMoF may not mean that the participants are able to prevent falls, it only means that they have confidence in controlling falls, which may or may not be correct.

Implications

The recruitment strategy for short-term fall prevention programs could be more focused on the geographic areas with relatively lower levels of educational attainment. Older adults with lower levels

of education are usually underrepresented because they have limited information regarding the program's availability, and some may need language support for immigrants or residents with less English proficiency. Some of the participants may have a very specific purpose when participating in fall prevention or similar programs. They may have certain health conditions that pose higher risks for them to fall or have other hazardous events, therefore, they have an urgent to learn how to prevent the risks for their specific conditions. Program organizers may need to strengthen the orientation of the program to help participants understand that the information in each session was carefully designed and needs to be delivered in order to have a better prevention outcome. Furthermore, answering questions regarding program expectations could also better serve participants with health conditions as each condition impacts one's behaviors differently.

Another implication for practice is to focus on participants with lower health status because they may need extra help from both peers and instructors. Given the fact that participants are coming in with various levels of CSMoF, program designers and facilitators may pay attention to these participants because they could be good role models. Sharing with their peers about their confidence in fall prevention could assist them in staying longer in the program and learning more evidence-based fall prevention strategies that could help them in practice. For future studies, qualitative research strategies could also be used because the reasons for completion status could be highly individualized. Personal events, responsibilities, interests, expectations, etc., may all impact the completion status of the fall prevention program. Thus, other than quantitative data analyses in the current study, future studies are encouraged to apply qualitative or mixed-design studies to better explore the factors associated with the completion rate of fall prevention programs among older adults.

In addition to conventional regression-based predictive models, this study applied classification tree modeling to demonstrate the paths leading to each completion status based on participants' characteristics. The tree model finds the cutoff points in each variable where the completion status could be distinguished. With more data collection in the future, the accuracy of the model could be improved and then be able to make accurate predictions.

With more successful fall preventive programs that are implemented at community levels, older adults could maintain their mobility levels and increase the quality of life in communities. As a result, the sustainability of both healthy aging and community development may be achieved.

Limitations

The study has some limitations. Given the exploratory nature of the study, many of the measurements and survey items were not designed specifically for this completed research question. For example, health status could potentially include more specified items such as body mass index (BMI), transportation selections, and caregiving responsibilities, which may also be highly correlated with completion status. The second limitation is the composition of the sample. The sample was predominately white, highly educated, and mainly female

participants. This may bias the finding that higher education lowered the probability of "completion". Future studies could use a stratified random sampling strategy to reduce this potential bias. The third limitation is that we should not draw a causal relationship from a cross-sectional study, although the association between the factors and the completion status was significant statistically.

Despite the limitations, the study adds to the existing literature with empirical evidence from a population that is different from the previous studies (i.e., the Hispanic population) and has identified the association between completion status and personal conditions. This is critical information for future program design and recruitment.

Conclusion

Fall prevention programs benefit not only older adults who have a high risk of falling but also the whole U.S. healthcare system by reducing healthcare expenditures. Prevalent fall prevention programs have relatively lower levels of completion rates. This study has explored several potential predictors that explain why participants achieve "completion" status and has found that education, vision impairment, private insurance, health status, perceived inferences of social activities due to falls, and CSMoF were predictive for completion status. Suggestions for retaining current participants and recruitments for future participants were provided.

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