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What Types of Physical Function Predict Program Adherence in Older Adults?

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Abstract

Purpose: The aims of this study were to describe participants' demographic characteristics by adherence levels and to examine the association between participants' baseline physical function and their adherence to an evidence-based group exercise program.
Design: A prospective exploratory study (N = 36,373).
Methods: Participants' physical function was assessed using 30-second chair-stand, arm-curl, and 8-foot up-and-go tests. Adherence was calculated as the proportion of attended sessions over offered sessions.
Findings: Participants' mean adherence was 52%. Older male, Asian/Pacific Islander race, and Washington State residents with fewer chronic conditions showed higher adherence. Multinomial logistic regression showed the baseline 30-second chair-stand, arm-curl, and 8-foot up-and-go tests significantly predict adherence levels after controlling for demographics.
Conclusions: Stronger upper- and lower-extremity strength and better walking balance and mobility are associated with higher adherence to exercise programs in older adults.
Clinical Relevance: The results underscored the importance of offering classes at various physical function levels while considering participants' individual needs.

Keywords: Adherence; aged; exercise; health; physical activity.

Introduction

Regardless of age, the importance of physical activity on health is well documented (Garber et al., 2011; Sparling, Howard, Dunstan, & Owen, 2015). Health benefits of physical activity are especially important for older adults because they tend to have a sedentary lifestyle compared with younger counterparts (Schiller, Ward, & Freeman, 2014). People with a sedentary lifestyle are more likely to develop chronic diseases (de Rezende, Rey-López, Matsudo, & do Carmo Luiz, 2014; Proper, Singh, van Mechelen, & Chinapaw, 2011; Thorp, Owen, Neuhaus, & Dunstan, 2011). Thus, being physically active in their daily life is critical as increasing the level of physical activity may reduce the risk of developing these chronic conditions (Booth, Roberts, & Laye, 2012).

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Another element that requires attention is adherence to physical activity. Long-term adherence to physical activity is essential in order to experience the benefits of exercise (Resnick & D'Adamo, 2011). For older adults in particular, maintaining a physically active lifestyle is challenging because they have more chronic diseases and disabilities and tend to have a smaller social support network due to retirement and death of peers (Stokes & Moorman, 2017). These conditions may have negatively influenced adherence to exercise over time (Essery, Geraghty, Kirby, & Yardley, 2017; Sattar, Josephson, & Moore, 2017).

Previous researchers have studied adherence to exercise programs in many ways in order to find the best interventions for various physical and mental conditions of older adults (Duncan, Pozehl, Hertzog, & Norman, 2014; Kloek, Bossen, de Bakker, Veenhof, & Dekker, 2017). However, these studies tended to focus on one part of body function such as heart or knee with small sample sizes. The results widely varied due to various adherence measurements or definitions, participants' baseline health and mental conditions, and the types of programs (i.e., individual or group). In order to better understand the common predictors of exercise adherence as well as to make recommendations for health professionals interested in offering community-based, group exercise programs, a program with a large sample size that has data on multiple parts

of body functions, has been successfully disseminated, and implemented throughout the United States was sought. Thus, a nationwide, large data set (N = 36,373) was used to examine national norms using three different parts of body functions: upper- and lower-extremity strengths, and balance and mobility. The purpose of the study was two-fold. Aim 1 was to describe participants' demographic characteristics, with various adherence levels in older adults who participated in the EnhanceFitness (EF) program. Aim 2 was to examine the association between participants' three different baseline physical functions and their adherence to EF.

Methods

EnhanceFitness is an evidence-based group exercise program for older adults (Wallace et al., 1998). Kaiser Permanente of Washington (formerly known as Group Health Cooperative), Sound Generations (formerly known as Senior Services), and the University of Washington Health Promotion Research Center developed EF. Sound Generations, a nonprofit organization in King County, Washington, has licensed the use of EF to community-based agencies such as YMCA and has trained EF instructors across the United States since 1993. As of December 2017, EF offers classes in 1,319 sites in 46 states and the District of Columbia and has served a total of over 79,936 unduplicated participants (EnhanceFitness Online Data Entry System, 2017).

EF offers 60-minute classes three times per week. Exercises focus on cardiovascular endurance, strength, balance, and stretching. Exercise protocol consists of (1) warm up (5–8 minutes), (2) cardiovascular endurance (20 minutes), (3) cool down (3–5 minutes), (4) strength training (20 minutes), and (5) stretching (9–10 minutes). EF is adjustable for participants' physical function levels. For example, those participants who are unable to do the exercise standing can participate by sitting down on a chair. EF also offers functional fitness checks (Rikli & Jones, 1999) at the first session of the EF program (baseline assessment) and every 4 months afterward. After having completed 16-week EF sessions, participants showed significant physical function improvements in their upper- and lower-extremity strength, ability to climb stairs, bend, and kneel, compared with their baseline levels (Belza et al., 2006). With regard to medical costs, the Centers for Medicare & Medicaid Services (2013) reported that EF participants spent $945 less per year compared with Medicare beneficiaries who were non-EF participants.

Upon joining the EF program and with participants' agreement, each participant's physical function level is assessed with three performance-based tests: 30-second chair-stand, arm-curl, and 8-foot up-and-go tests. The chair-stand test is a 30-second test to measure lower-extremity strength, in which participants were asked to stand up and sit down without using their arms from a chair as many times as they can within 30 seconds. Similarly, the arm-curl test is to measure participants' upper-extremity strength and count the number of arm-curl reps completed in 30 seconds. The 8-foot up-and-go test is to time the number of seconds to complete one circuit of 8-feet and to measure participants' walking balance and mobility. Participants are instructed to sit down on a chair. Once instructed, they stand up, not run, but walk in an 8-foot circuit, and sit down on the chair again. These three tests are scored based on the age- and gender-matched norms (Rikli & Jones, 1999). A score of 1 indicates *below norms*, 2 indicates *within norms*, and 3 indicates *above norms*. A score of 0 (zero) means that the test is underdetermined either due to insufficient data (e.g., missing information) or results are outside the parameters (e.g., participant is too young or too old). In addition to a fitness check, participants' demographic information and attendance details (e.g., total attended sessions and total offered sessions by site) are collected.

This is a community-based prospective exploratory study. Adherence was defined as the proportion of attended sessions divided by offered sessions (Aartolahti, Tolppanen, Lönnroos, Hartikainen, & Häkkinen, 2015). To obtain the adherence for each participant, the total sessions each participant attended and the total sessions offered by the corresponding site were calculated. The adherence was classified into three levels based on the attendance: high adherence (>67% attendance), moderate adherence (33%–66% attendance), and low adherence (<33% attendance). This study was approved by the institutional review board as exempt.

For data analysis, descriptive statistics were used to describe the demographic characteristics of EF participants (≥60 years old) with various adherence levels who had data on their demographic information, baseline physical function, and attendance details between 2002 and 2016 (N = 40,469; Aim 1). To determine the association between participants' baseline physical functions and their adherence to EF (Aim 2), a multinomial regression model was used, controlling for participants' demographics. p Values of less than .05 were considered statistically significant.

Participants with missing data on all three physical function tests were excluded, resulting in a final sample size of 36,373. The remaining missing data were variables on 30-second chair-stand (3%), arm-curl (1%), 8-foot up-and-go tests (3%), marital status (24%), education (19%), and number of diseases (22%). To accommodate these missing data, the patterns of missing data were first analyzed by examining the associations between the variables with missing data and those with complete data using logistic regression models. The results supported the assumption

that those missing data were missing at random. In addition, multiple-imputation technique was used with 21 imputations to accommodate missing data for these variables. Multiple-imputation technique is a flexible way to handle missing data and known to be superior to other single-imputation methods because the variance estimates reflect an appropriate amount of uncertainty surrounding parameter estimates (White, Royston, & Wood, 2011). For Aim 1, to reflect a more objective view of participants' characteristics, the original data set was used, and for Aim 2, the imputed data set was used to investigate which types of baseline physical function predict the adherence levels. All the analyses were conducted using Stata Version 14.0 (StataCorp, 2015).

Results

The EF participants were between ages 60 and 94 years (M = 73.1 years, SD = 7.6 years), and 87% of them were 65 years and older. The majority were female participants (84%), and about 61% participants were non-Hispanic White and 12% were African American. More than half of the participants were college educated (69%), married/partnered (77%), and present one or more chronic diseases (66%).

Table 1 presents participants' adherence and baseline physical function levels. Although 34% were fairly new participants, having attended less than 2 months, about 20% of them were long-time EF participants, having attended more than 1 year. The adherence rates varied and increased with the length of attendance, with the highest mean adherence rate being 64% in participants who attended for more than 1 year. The mean adherence was 52% (SD = 21%), and 80% had moderate to high adherence. About 76% and 85% participants achieved the average level on chair-stand and arm-curl tests, respectively; however, only 50% were in the within-the-norms range on the 8-foot up-and-go test at baseline.

Table 1 Participants' length of attendance, adherence, and physical function level

Variables	*n* (%)	Mean Adherence, % (*SD*)
Adherence rate by length of attendance	36,373	52 (0.21)
Less than 2 months	12,448 (34.2)	39 (0.18)
3–12 months (1 year)	16,530 (45.5)	56 (0.18)
More than 1 year	7,395 (20.3)	64 (0.15)
Adherence levels	36,373	
Low adherence (less than 33%)	7,472 (20.5)	
Moderate adherence (33%–67%)	19,878 (54.7)	
High adherence (more than 67%)	9,023 (24.8)	
Chair-stand test	35,359	
Below the norms	8,494 (24.0)	
Within the norms	20,712 (58.6)	
Above the norms	6,153 (17.4)	
Arm-curl test	36,158	
Below the norms	5,397 (14.9)	
Within the norms	17,831 (49.3)	
Above the norms	12,930 (35.8)	
8-Foot up-and-go test	35,455	
Below the norms	17,832 (50.3)	
Within the norms	15,037 (42.4)	
Above the norms	2,586 (7.3)	

Note. *SD* = standard deviation.

Table 2 describes the participants' demographic characteristics by adherence levels. Older participants (≥85 years) were more likely to achieve moderate to high adherence (81%) compared with younger participants (60–64 years, 76%, $p < .001$). Male participants (83%) were more likely to be in the moderate to high adherence level compared with female counterparts (79%, $p < .001$). In terms of racial/ethnic group, Asian/Pacific Islander participants had the highest adherence level among all racial/ethnic groups ($p < .001$), with 87% achieving the moderate to high adherence level. The majority achieved the moderate adherence level regardless of educational attainment; however, participants with less than high school education tended to be in a high adherence level ($p < .001$). Participants in Washington State were more likely to be in moderate to high adherence levels to EF ($p < .001$). Participants with more disease conditions were more likely to be in low adherence levels ($p < .001$).

Table 3 presents association between participants' physical function and their adherence to the program controlling for demographics. The baseline chair-stand test was predictive of the high adherence ($p < .001$), indicating that the better lower-extremity strength was associated with higher likelihood of being highly adherent to the program. Participants with normal performance on chair-stand test, compared with those with below the norms, were 1.2 times more likely to be in a high adherence level versus the low adherence level. Participants with above the norms performance on chair-stand test were 1.25 times more likely to achieve a high adherence level. Similarly, the arm-curl test was predictive of moderate adherence, suggesting that the better upper-extremity strength is associated with higher likelihood of being moderately adherent to the program. Participants with normal and above the norms performance on the arm-curl test, compared with those with below the norms, were 1.12 times ($p = .005$) and 1.13 times ($p = .008$) more likely to be in a moderate adherence level versus the low adherence level, respectively. In addition, the category of "above the norms" for the baseline 8-foot up-and-go test was also a strong predictor of a moderate ($p = .01$) or high adherence level ($p = .03$). For participants

Table 2 Participants' demographic characteristics by adherence levels

Demographics	Low Adherence (%)	Moderate Adherence (%)	High Adherence (%)	*p*
Age (years)				
60–64	24.1	56.2	19.7	<.001
65–75	21.0	55.7	23.3	
76–85	18.9	53.5	27.6	
Over 85	18.8	50.6	30.6	
Gender				
Female	21.3	55.3	23.4	<.001
Male	16.9	51.6	31.5	
Race/ethnicity				
Non-Hispanic White	19.0	55.7	25.3	<.001
African American	25.3	54.2	20.5	
Asian/Pacific Islander	12.5	51.3	36.1	
Hispanic	19.8	54.3	25.9	
Other	25.4	52.6	22.1	
Education				
Less than high school/high school diploma	18.7	52.9	28.4	<.001
Some college	19.9	55.5	24.6	
College degree	18.6	56.1	25.3	
More than college degree	21.4	57.0	21.6	
Marital status				
Single/divorced/ widowed/ separated	20.9	54.6	24.5	.252
Married/ partnered	21.2	55.3	23.5	
States				
Washington	16.1	56.3	27.6	<.001
Other states	21.6	54.3	24.1	
Number of chronic diseases				
None	19.3	55.6	25.1	<.001
At least one disease	21.2	54.2	24.6	

with fairly good walking balance and mobility, compared with those with limited walking balance and mobility, the possibility of being in a moderate and high levels were 1.17 (p = .01) and 1.16 times higher (p = .03), respectively.

Discussion

The purposes of this study were to describe participants' demographic characteristics with various adherence levels in older adults who participated in the EF program and to examine the association between participants' three baseline physical functions and their adherence to EF using the large, nationwide data set (N = 36,373) during a 14-year period. The study participants were non-Hispanic White (61%), college educated (69%), married/partnered (77%), older (M = 73 years old), and female (84%). The mean adherence to EF was 52%, achieving a moderate adherence level. It is difficult to compare adherence to other studies because there is little consensus among studies how adherence is defined (Hawley-Hague, Horne, Skelton, & Todd, 2016); however, this study contributed to exercise literature by providing adherence statistics from a large, long-term sustained exercise program. It appears that participants in this study are fairly active because about 20% of them attended the EF for more than 1 year and 80% had a moderate to high adherence level to the program.

This study showed that older participants tended to be more adherent to EF than the younger counterparts. This is inconsistent with previous studies that advanced age was associated with decreased physical activity and lower adherence (Aartolahti et al., 2015; Jefferis et al., 2014); however, this finding may be because features of EF are attractive to older adults. For example, EF is a group exercise program. Group-based programs have shown to achieve a better adherence rate and compliance in the long-term compared with home-based programs among older adults (Kohn, Belza, Petrescu-Prahova, & Miyawaki, 2016). The group program provides socialization opportunities with their instructors and other participants, and socialization is a motivator for older adults to adhere to the program (Crizzle & Newhouse, 2012; Franco et al., 2015; Kohn, Belza, Petrescu-Prahova, & Miyawaki, 2016). Another unique feature of EF is its adjustability, which may attract older adults with lower physical function levels. For example, participants can exercise standing or sitting down on a chair. Thus, participants have choices on how they want to exercise, and these features may help adherence to the program. Male participants were more likely to have moderate or high adherence than female participants in this study. It is consistent with previous literature that male participants are more physically active than female participants (Keadle, McKinnon, Graubard, & Troiano, 2016).

Asian/Pacific Islander participants were most likely to be highly adherent to EF compared with participants from other racial/ethnic groups. Some EF sites in Hawaii are free for participants, and the vast majority of participants in Hawaii are Asian/Pacific Islanders (Tomioka, Sugihara, & Braun, 2012). A feature of "free" evidence-based exercise program certainly encourages older adults who are retired with a limited income to take advantage of. This study showed participants with less educational attainment have high adherence. This finding is not supported by previous studies (Hawley-Hague et al., 2013; Shah, Ardern, & Tamim, 2015), and thus, further investigation is warranted. For example, qualitative interviews can be conducted with participants who have less educational

Table 3 Association between participants' physical function and adherence to EnhanceFitness

	Adherence Levels	
	Moderate vs. Low	High vs. Low
Variables	RRR [95% CI]	RRR [95% CI]
Age, years (ref: 60–64)		
66–75	1.10 [1.02, 1.19]**	1.25 [1.14, 1.38]***
76–85	1.14 [1.04, 1.24]**	1.54 [1.39, 1.71]***
Over 85	1.07 [0.95, 1.20]	1.64 [1.43, 1.88]***
Gender (ref: female)		
Male	1.16 [1.08, 1.26]***	1.68 [1.54, 1.84]***
Race/ethnicity (ref: Non-Hispanic White)		
African American	0.77 [0.71, 0.84]***	0.67 [0.60, 0.74]***
Asian/Pacific Islander	1.40 [1.20, 1.62]***	1.98 [1.70, 2.32]***
Hispanic	0.97 [0.85, 1.11]	1.00 [0.86, 1.16]
Other	0.69 [0.64, 0.74]***	0.62 [0.57, 0.68]***
Education (ref: less than high school)		
Some college	0.95 [0.88, 1.03]	0.84 [0.77, 0.92]***
College degree	0.99 [0.90, 1.08]	0.84 [0.76, 0.93]***
More than college degree	0.89 [0.81, 0.98]**	0.65 [0.58, 0.73]***
Marital status (ref: single/divorced/widow)		
Married/partnered	1.00 [0.93, 1.08]	0.90 [0.83, 0.98]**
Number of chronic diseases (ref: none)		
At least one	0.89 [0.84, 0.95]***	0.92 [0.85, 0.98]**
States (ref: Washington)		
Other states	0.77 [0.72, 0.84]***	0.76 [0.70, 0.83]***
Chair-stand (ref: below the norms)		
Within the norms	1.07 [1.00, 1.15]	1.20 [1.11, 1.31]***
Above the norms	1.05 [0.95, 1.16]	1.25 [1.11, 1.40]***
Arm-curl (ref: below the norms)		
Within the norms	1.12 [1.04, 1.22]**	1.05 [0.95, 1.15]
Above the norms	1.13 [1.03, 1.24]**	1.09 [0.98, 1.21]
8-Foot up-and-go (ref: below the norms)		
Within the norms	1.05 [0.99, 1.12]	1.05 [0.98, 1.13]
Above the norms	1.17 [1.04, 1.31]**	1.16 [1.01, 1.33]**

Notes. Ref = reference; RRR = relative risk ratio; CI = confidence interval.
*$p < .05$. **$p < .01$. ***$p < .001$.

attainment (e.g., high school education or less) to learn what makes them motivated to continue to attend the EF program. Washington State residents tended to achieve higher adherence compared with those in other states. This is reasonable because EF was originally developed and started in the State of Washington, which has the longest ongoing classes in the United States. In addition, there are insurance coverages for EF in Washington State. This can be an incentive to adhere to the program. Our study confirmed previous findings that chronic diseases are associated with low adherence to exercise programs (Forechi et al., 2018; Picorelli, Pereira, Pereira, Felicio, & Sherrington, 2014). Although the majority of the participants with at least one disease condition showed at least moderate adherence, about 21% of them were not adherent to the EF, indicating they actually started the program but quit at some time point. Further studies are needed to explore the barriers to participating the EF among older adults with chronic diseases.

Previous studies showed physical abilities predicted adherence to an exercise program, but none focused on multiple specific types of physical function. Our study findings showed that all three baseline physical function tests (30-second chair-stand, arm-curl, and 8-foot up-and-go tests) are significantly predictive of adherence to the EF program. These tests are to examine participants' lower- and upper-extremity strength levels and walking balance and mobility at baseline. The results showed the higher the participants' baseline lower- and upper-extremity strength and the better walking balance and mobility, the higher the participants' adherence, which is supported by previous studies (Aartolahti et al., 2015; Lackinger et al., 2017). This study, however, provided new insights on the association between physical function and the adherence to the EF program specific to the adherence levels. Participants with normal to high lower-extremity strength—those with stronger 30-second chair-stand tests at baseline—more likely have a high adherence level.

Participants with normal to high upper-extremity strength at baseline—those with stronger arm-curl tests at baseline—more likely have a moderate adherence level. Participants with high-level walking balance and mobility at baseline—those with stronger 8-foot up-and-go tests at baseline—more likely have a moderate to high adherence level (Figure 1). Overall, in addition to participants' demographic characteristics and health condition, it is advised to pay particular attention to those participants with low physical function to encourage and support their continued participation.

Study limitations should be noted. There was no data on whether participants are attending the EF program voluntarily or are advised to attend by their healthcare providers. Depending on the purpose of the attendance, their motivation for adherence may differ. Although demographics were controlled when examining physical function as predictors of adherence, we were unable to take other factors into consideration, such as program characteristics (Picorelli et al., 2014) and program environments (Miyawaki, Belza, Kohn, & Petrescu-Prahova, 2018) that have been shown to be also predictive of adherence to exercise program. The adherence was determined by the attendance records in our study, but because there is no consensus in how adherence should be defined, results may not be directly comparable with other studies that used different definitions of adherence. However, our study sheds lights on adherence characteristics of a large-sized program that has been successfully disseminated and implemented throughout the United States.

Implications

This study provides a few implications for rehabilitation nurses and researchers to improve older clients' adherence to exercise programs. First, this study highlights a few physical function predictors that may influence participants' adherence to exercise programs, such as upper- and lower-extremity strength and walking balance and mobility. Rehabilitation nurses can use this information to identify clients who may potentially have a risk of low adherence. Second, it is important to assess older clients' baseline physical function levels by conducting comprehensive performance-based tests. Performing these tests can help older clients recognize their abilities and challenges in order to reach their full potential. Rehabilitation nurses should underscore the importance of creating treatment plans based on their test results because improved physical function can potentially help improve their adherence as well. For example, EF offers classes by standing and sitting down. Depending on the fitness and comfort level, participants can select the EF class levels. As mentioned, the mean adherence for the EF program was 52% already achieving a moderate adherence level. This could be partially due to EF's feature of adjustability to participants' physical function. Third, rehabilitation nurses should cheer on participants who already show moderate adherence and encourage those who want to stop or have low adherence. Qualitative studies with focus groups can be conducted in the future to explore potential barriers to continuing exercise programs

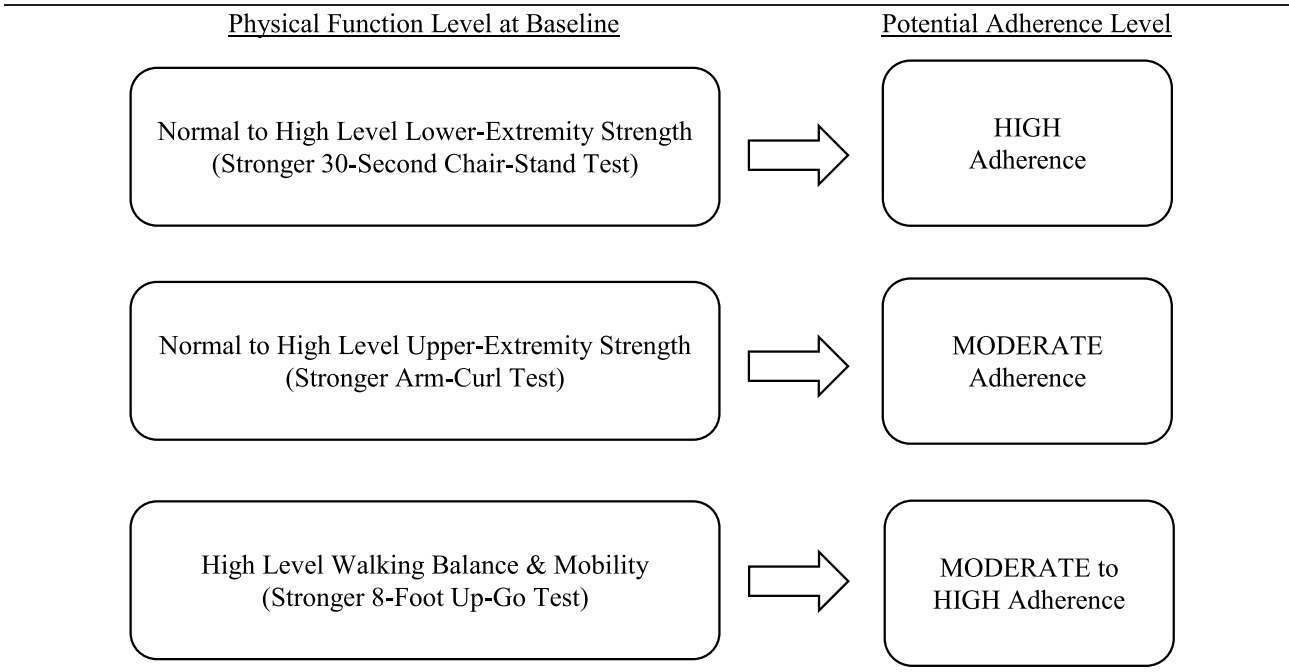

Figure 1. Association between participants' physical function tests at baseline and adherence levels.

Key Practice Points

- Older adults with normal or high lower-extremity strength—those with stronger 30-second chair-stand tests at baseline—more likely have a high adherence level to exercise programs.
- Older adults with normal or high upper-extremity strength—those with stronger arm-curl tests at baseline—more likely have a moderate adherence level to exercise programs.
- Older adults with high-level walking balance and mobility at baseline—those with stronger 8-foot up-and-go tests—more likely have a moderate to high adherence level to exercise programs.
- Rehabilitation nurses should underscore the importance of comprehensive assessment of older adults' baseline physical function and offer exercise classes at various physical function levels.

among participants who have started the program but may quit in a short time period.

Conclusion

This study explored the overall demographic characteristics of EF participants with various levels of EF adherence and investigated the association between their three baseline physical functions and adherence levels to EF. Our findings showed the levels of participants' lower-extremity strength, upper-extremity strength, and walking balance and mobility at baseline are key predictors for adherence to EF. Therefore, based on the baseline fitness check, it is critical to identify those participants with low physical function levels. Rehabilitation nurses can encourage them to continue their participation while attending their individual unique needs and goals for participation so that rehabilitation nurses can successfully promote the health and well-being of older participants.

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Conflict of Interest

The authors declare no conflict of interest.

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