



Self-reported Balance Confidence Relates to Perceived Mobility Limitations in Older Cancer Survivors

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Background: Mobility difficulty in cancer survivors is the leading functional problem that impacts independence, participation, and quality of life. **Purpose:** This study examined the relationships of demographics, health-related variables, Timed Up and Go (TUG), and short version of Activities-specific Balance Confidence scale (ABC-6) with respect to mobility limitations in older cancer survivors. **Methods:** This was a cross-sectional study at a university-based laboratory. Forty cancer survivors (aged = 67.8 ± 8.90 years) living in the community participated. Comorbidity was measured using Functional Comorbidity Index (FCI). The TUG and the ABC-6 were administered. Mobility limitations were measured using the Physical Functioning subscale of the Medical Outcomes Study Short Form-36v2 (PFS). Descriptive statistics were calculated for all variables. Independent-samples *t* test was used to compare between-group differences in scores of the PFS for dichotomous variables, and the Pearson correlation was used to examine the association of continuous variables with the PFS. A stepwise regression model evaluated the relationships between demographics, health-related variables, TUG, and ABC-6 with the PFS. **Results:** Body mass index, FCI, TUG, and ABC-6, but not age or years since cancer diagnoses, significantly correlated with the PFS ($P < .05$). In the final regression model, a history of falls, comorbidity, and ABC-6 were significant predictors of mobility limitations as measured by the PFS ($P < .001$). **Conclusion and Discussion:** Together with a history of falls and comorbidity, the ABC-6, a self-report measure of balance confidence, predicted mobility limitations. Clinicians should consider using the ABC-6 to detect deficits underlying mobility problems when treating older cancer survivors. (**Rehab Oncol 2016;34:64–71**) **Key words:** *balance, mobility limitations, neoplasms, outcome assessment*

Mobility refers to the ability of a person to move around and walk safely and independently at home and in the community.^{1,2} The most frequently assessed mobility activities in rehabilitation practice include chang-

ing and maintaining body position, carrying, lifting, walking, climbing stairs, and moving around.^{1,3,4} Mobility is central to independence in activities of daily living, participation in societal roles, and health-related quality of life (QOL).^{1,5-8} Mobility as measured by gait speed has been linked to survival in older adults⁹ and older cancer survivors.¹⁰ Difficulty lifting and walking were identified as the most frequent functional problems among cancer survivors at outpatient settings.⁶ In older cancer survivors, impaired mobility increases risks of falling,¹¹ reduces well-being and QOL,¹² and causes distress in managing household activities, coping with grief, and caring for others.¹² Taken together, mobility is an indicator of major health outcomes in cancer survivors.

Complications associated with cancer and its treatment impact multiple body systems and functions,

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increasing the risks of mobility disability.^{11,13-16} The prevalence of functional impairment and activity limitations is found to be more frequent and increases more rapidly in cancer survivors than in the noncancer cohort, suggesting an accelerated aging process in health outcome following a cancer diagnosis.¹⁷ Fatigue,¹⁸⁻²⁰ limitations in muscle strength and endurance,²¹ and upper extremity function and range of motion²²⁻²⁵ are common in breast cancer survivors. Chemotherapy-induced peripheral neuropathy and lower limb lymphedema can interfere with walking and using transportation.^{11,13} Androgen-deprivation therapy has been linked to reduced muscle strength and functional mobility in older men with prostate cancer.^{26,27} In light of diverse sequelae following the cancer diagnosis, the assessment of mobility limitations is vital in the survivorship care plan.^{16,28}

Clinical assessment tools for mobility include performance-based and self-report measures.²⁹ Performance-based tests rely on clinicians' professional judgment. In contrast, self-reported measurements are patient centered and reflect the values, preferences, needs, and outcomes that are most important to patients and/or caregivers.²⁹⁻³¹ Incorporating patient-centered outcome measures can facilitate the communication between patients, caregivers, and clinicians to make informed health care decisions and improve patients' satisfaction and quality of care.^{30,31} The Timed Up and Go (TUG), a performance-based tool, has been recommended for assessing mobility in cancer survivors.^{16,28} The Physical Function subscale of the Medical Outcomes Study Short Form-36v2 (PFS) is considered a self-reported measurement of mobility in older adults.²⁹ While the construct of mobility comprises a wide variety of activities,^{3,32} balance confidence is found to significantly contribute to functional mobility in older adults.³³ Higher balance confidence relates to better mobility performance in older adults with hip fracture as a result of falls.³⁴ The purpose of this study was to examine the relationships of performance-based measures of mobility, self-reported measures of balance confidence, and comorbidities with respect to self-reported physical function and perceived mobility in community-dwelling older cancer survivors.

METHODS

Setting

This study was a cross-sectional design and conducted at a university-based research laboratory.

Participants

Forty-four cancer survivors 55 years and older and living independently in the community were recruited from cancer centers, oncology clinics, and support groups through flyers, face-to-face meetings, and word of mouth. Inclusion criteria were a medically confirmed new can-

cer diagnosis, completion of primary cancer treatment (eg, chemotherapy, surgery, and radiation) for more than 3 months, and ability to walk 50 ft or more with or without an assistive device or another person's help. Exclusion criteria were 1 or more cancer diagnoses, a diagnosis of skin cancer, recurrent or metastatic cancer, a history of neurologic conditions, and unstable medical conditions. Individuals with impaired cognition and 10% low-contrast vision³⁵⁻³⁷ were also excluded. After arriving at the research laboratory, 2 individuals with skin cancer were excluded. Another 2 declined to finish the study. A total of 40 participants were included in the study. The study was approved by the University of Michigan–Flint Institutional Review Board.

Procedure

After consenting to the study, participants received cognitive assessment using Mini-Cog.³⁸ A person who is able to recall 1 or 2 words after 1 minute and draw the clock correctly is negative for cognitive impairment.³⁸ For community-dwelling older adults, Mini-Cog has sensitivity of 76% and specificity of 89% in detecting individuals with dementia.^{38,39} Low-contrast vision at 10% contrast was examined at a viewing distance of 40 cm (10% SLOAN Low Contrast Vision Chart; Precision Vision, La Salle, Illinois). Impaired lower-contrast vision has been identified as a risk factor of falls in older adults.³⁶ In breast cancer survivors, those with a history of falls took longer to read the low-contrast eye chart.³⁵ Compared with the controls without a cancer diagnosis, breast cancer survivors had significantly worse low-contrast visual acuity.³⁷ The information on demographics (age and gender), health history (cancer diagnosis, chronic medical condition, past medical diagnosis and surgery, and completion of chemotherapy), Functional Comorbidity Index (FCI),³⁴ and a history of falls was gathered through interviewing and review of medical documents provided by the participants. The FCI is a measure that assesses the effect of 18 conditions reported by patients on their physical function.⁴⁰ A score of 18 corresponds to the highest number of comorbid conditions. A score of "0" is no comorbid condition.⁴⁰ A fall is defined as "unintentionally coming to rest on the ground or at some other lower level, not as a result of a major intrinsic event (e.g., a stroke or syncope) or overwhelming hazard."⁴¹(p1702) Participants were asked whether they had fallen in the previous 12 months, and if yes, how often. People who reported having 1 or more falls were categorized as "fallers."⁴² Because sensory impairment has been linked to increased risks of mobility limitations,⁴³ plantar tactile sensation over the first, third, and fifth metatarsal heads of each foot was examined using a 5.07/10-g Semmes-Weinstein monofilament.⁴⁴ Impaired sensation was defined as 2 incorrect responses out of 3 attempts at each site.⁴⁴ After the aforementioned assessment concluded, the investigators administered outcome measures as described in the next section.

Outcome Measures

Timed Up and Go. The TUG was developed as a tool to assess mobility in older adults.⁴⁵ It has been recommended for use in cancer survivors to assess mobility.^{16,28} It is a simple, quick, and widely used performance-based clinical tool. Participants rose from a chair upon a verbal “go” command, walked 3 m at a comfortable pace, turned, walked back to the chair, and sat down. Timing began from the “go” command and ended when the patient was seated.^{45,46} The reliability and validity of the TUG have been well established in community-dwelling older adults⁴⁷⁻⁴⁹ and breast cancer survivors.^{37,50}

Short Version of Activities-Specific Balance Confidence Scale. The ABC-6 contains 6 items from the original 16-item Activities-specific Balance Confidence scale.⁵¹ The ABC-6 was developed to evaluate balance confidence and detect individuals with a history of falls in community-dwelling older adults.⁴² Participants rated their level of balance confidence while carrying out 6 daily activities on a scale from 0% (no confidence) to 100% (complete confidence). The average of scores from all items was the score of the ABC-6.⁴² The ABC-6 has been validated in patients with Parkinson disease⁵² and older adults.^{51,53}

Physical Functioning Subscale of the Medical Outcomes Study Short Form-36v2. The Short Form-36v2 is a generic, self-report measure for multiple domains of QOL.⁵⁴ A recent systematic review has recommended its use in breast cancer survivors.⁵⁵ The PFS is a subscale of the Short Form-36v2. It has 10 questions about functional mobility. Participants were asked, “The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?” Participants rated their response to each question on a Likert scale: 1 = “Yes, limited a lot”; 2 = “Yes, limited a little”; and 3 = “No, not limited at all.” Scores from all 10 items were summed and then transformed into population norm-based scoring in standardized units (average = 50; SD = 10). A score of 100 indicates the best QOL in the physical functioning domain. A score of “0” is the worst. Mobility activities in the PFS include the following: (1) vigorous activities; (2) moderate activities; (3) lifting or carrying groceries; (4) climbing several flights of stairs; (5) climbing 1 flight of stairs; (6) bending, kneeling, or stooping; (7) walking more than a mile; (8) walking several hundred yards; (9) walking 100 yards; and (10) bathing or dressing.⁵⁴ Vigorous activities refer to running, lifting heavy objects, and participating in strenuous sports. Examples of moderate activities include moving a table, pushing a vacuum cleaner, bowling, or playing golf.

The PFS was found to be significantly correlated with the TUG ($r = -0.70$) and gait speed ($r = 0.75$) in older adults⁵⁶ and with the Functional Independence Measure Mobility subscale ($r = 0.73$) in stage IV breast cancer survivors.⁵⁷ These results confirmed the concurrent validity of the PFS with outcome measures of mobility.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics version 22 (IBM Corporation, Armonk, New York). Descriptive statistics were calculated for all variables. The independent-samples *t* test was used to compare the group differences in scores of the PFS for dichotomous variables, including gender, participants with a history of falls versus nonfallers, participants with impaired sensation versus persons without impaired sensation, and participants with versus without chemotherapy. Pearson correlations were used to examine the association of continuous variables, including age, body mass index (BMI), the number of year since cancer diagnosis, scores of the FCI, TUG, and ABC-6, with scores of the PFS. The strength of correlation was determined using the guideline: little-none ($r < 0.25$), poor ($r = 0.25-0.50$), moderate-good ($r = 0.50-0.75$), and good-excellent ($r > 0.75$).⁵⁸ Subsequently, a stepwise backward linear regression model was constructed. The PFS was the dependent variable. The TUG and the ABC-6 were the independent variables. Covariates in the regression model included demographics and health-related variables that significantly differed between groups or significantly correlated with the PFS on the basis of the results of the *t* test and Pearson correlation, respectively. Multicollinearity of variables in the regression model was evaluated using variance inflation factors (VIF), with a value of VIF of more than 5 as the exclusion criteria.⁵⁹ Statistical significance level was set at $P < .05$.

RESULTS

Characteristics of Participants

Table 1 presents the descriptive statistics for demographics and health-related variables. Table 2 presents the scores of the TUG, ABC-6, and PFS for all participants.

TABLE 1
Characteristics of Participants (N = 40)

	Mean ± SD or n
Continuous variables	
Age, y	67.8 ± 8.90
Time since cancer diagnosis, y	4.8 ± 2.94
Body mass index, kg/m ²	29.6 ± 5.89
Functional Comorbidity Index	2.7 ± 1.70
Dichotomous variables	
Women	29
Person with impaired plantar tactile sensation	11
Person completed chemotherapy	20
Person with a history of falls in the past 12 mo	22
Cancer diagnosis	
Breast	23
Prostate	8
Colorectal	1
Thyroid	3
Non-Hodgkin's lymphoma	1
Other	4

TABLE 2

Outcome Measures of Participants (N = 40)

Outcome Measures	Mean ± SD
Timed Up and Go, s	9.7 ± 0.36
Short version of Activities-specific Balance Confidence scale, %	75 ± 18.8
Physical Functioning subscale of Medical Outcomes Study Short Form-36v2	44.4 ± 8.97

Twenty-two of 40 participants reported having at least 1 fall in the previous 12 months before enrolling in the study. The mean score of the PFS was below the norm-based mean of 50, the average level of perceived functional mobility in the US population.⁵⁴ Breast cancer was the most prevalent diagnosis affecting 23 participants. The frequency of self-reported limitations for each mobility activity in the PFS among the participants is shown in Figure 1. Limitations in (1) vigorous activities, such as running, lifting heavy objects; participating in strenuous sports; (2) bending, kneeling, or stooping; and (3) climbing several flights of stairs were the most frequently reported items by participants.

Differences in Scores of the PFS Between Groups

Participants with a history of falls in the past 12 months had significantly lower scores on the PFS (40.3 ± 8.05) than those without falls (49.4 ± 7.54) ($P < .01$). Differences in scores of the PFS between women (43.3 ± 9.33) and men (47.2 ± 7.74), between participants with (43.9 ± 9.86) and without (45.0 ± 8.28) chemotherapy, and between participants with (47.4 ± 7.89) and without (43.3 ± 9.22) impaired plantar sensation did not reach statistical significance.

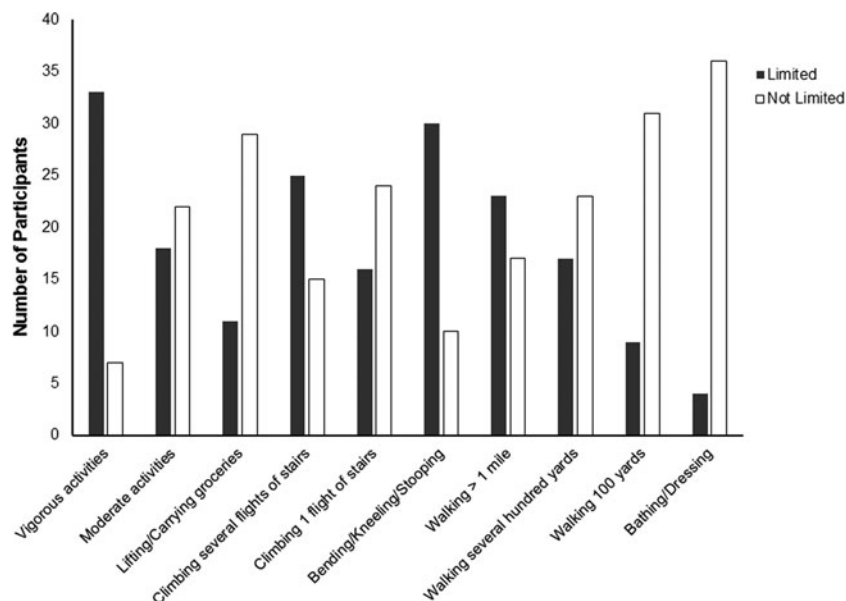


Fig. 1. Frequency of mobility limitations measured by Physical Functioning subscale of the Medical Outcomes Study Short Form-36v2. On the basis of their responses to each activity, participants answered “Yes, limited a lot” or “Yes, limited a little” were assigned to the “limited” group and those who answered “No, not limited at all” were in the “not limited” group.

Association of Variables With the PFS

Table 3 presents association of Pearson correlation coefficients for age, BMI, year since cancer diagnosis, FCI, and scores of the TUG and ABC-6, with scores of the PFS. Age had significant but poor correlations with the TUG ($P < 0.01$) and the ABC-6 ($P < 0.01$). Increasing age was associated with longer time to complete the TUG and reduced level of balance confidence. The BMI had significant but poor correlation with the PFS ($P < .05$). A higher BMI was associated with lower functional mobility. The year since cancer diagnosis was not significantly correlated with any variables. Chronicity of the cancer in current participants was not associated with scores of the TUG, ABC-6, and PFS. The FCI had significant but poor correlation with the ABC-6 ($P < .05$), as well as significant and moderate correlation with the PFS ($P < .01$). An increased number of comorbid conditions were associated with reduced balance confidence and increased mobility limitations. The FCI was not correlated significantly with the TUG. Self-reported comorbidity was not associated with the performance-based mobility test. The TUG had significant and moderate correlation with the ABC-6 ($P < 0.001$) and significant but poor correlation with the PFS ($P < .05$). Better performance on the TUG was associated with higher balance confidence and reduced perceived limitations in mobility. Finally, the ABC-6 had significant and moderate correlation with the PFS, suggesting that higher balance confidence was associated with better perceived mobility.

Relationships of Demographic, Health-Related Variables, TUG, and ABC-6 With the PFS

On the basis of the results of the *t* test and Pearson correlations, a history of falls, BMI, and FCI were entered into the regression model as covariates. The TUG and the

TABLE 3

Pearson Correlation Coefficients for Variables

		BMI	Year	FCI	TUG	ABC-6	PFS
Age	Coefficient	-0.31	0.21	0.13	0.44 ^a	-0.41 ^a	-0.27
BMI	Coefficient	...	0.15	0.29	0.25	-0.20	-0.36 ^b
Year	Coefficient	...	...	0.15	0.10	-0.35	-0.25
FCI	Coefficient	...	...	...	0.22	-0.38 ^b	-0.52 ^a
TUG	Coefficient	...	...	...	...	-0.54 ^c	-0.37 ^b
ABC-6	Coefficient	...	...	...	...	...	0.62 ^c

Abbreviations: ABC-6, short version of Activities-specific Balance Confidence scale; BMI, body mass index; FCI, Functional Comorbidity Index; PFS: Physical Functioning subscale of the Medical Outcomes Study Short Form-36v2; TUG, Timed Up and Go.

^aP < .01.

^bP < .05.

^cP < .001.

ABC-6 were independent variables and the PFS was the dependent variable in the regression analysis. In the final model, a history of falls and the FCI remained as significant covariates whereas the ABC-6 significantly predicted mobility as measured by the PFS ($F_{3,39} = 15.93, P < .001$). These variables together explained 59.2% of the variance in mobility limitations in the model. On the basis of the regression model (Table 4), participants' predicted mobility was estimated by the equation: $PFS = (-4.45 \times \text{a history of falls}) + (-2.36 \times \text{FCI}) + (0.18 \times \text{ABC-6})$, where a history of falls was coded as 1 = fallers and 0 = nonfallers. Participants' PFS increased 4.45 points with a negative history of fall, 2.36 points for a 1-unit reduction of the FCI, and 1.8 points for a 10% increase in the ABC-6 score.

DISCUSSION

This study demonstrated that self-reported balance confidence together with a history of falls and comorbidity significantly contributed to perceived mobility during daily activities in community-dwelling older cancer survivors. Although the BMI and the TUG were associated with mobility limitations, neither age, years since cancer diagnosis, BMI, or TUG could predict outcomes in mobility. Evaluation of balance confidence and the effect of comorbidity on physical function through self-report measures including the ABC-6 and the FCI may provide insight into limitations in mobility activities from the survivors' perspectives.

TABLE 4

Final Linear Regression Model^a

Predictor of PFS	Model Coefficient	SE of Coefficient	P
A history of falls ^b	-4.45	2.002	.03
FCI ^c	-2.36	0.672	.001
ABC-6 ^c	0.18	0.057	.003

Abbreviations: ABC-6, short version of Activities-specific Balance Confidence scale; FCI, Functional Comorbidity Index; PFS, Physical Functioning subscale of the Medical Outcomes Study Short Form-36v2; SE, standard error; TUG, Timed Up and Go.

^aUnstandardized coefficients are shown.

^bP < .05.

^cP < .01.

Current findings are consistent with previous reports that in older adults, a history of falls,³⁴ low BMI or obesity,⁶⁰ comorbidity, and low balance confidence³³ were linked to poor performance in mobility. In this study, BMI was correlated with the PFS but was not a significant predictor of mobility limitations in the linear regression model. Research had found that the relationship between the BMI and mobility limitations was likely nonlinear.⁶⁰ Older adults with BMI of less than 25 kg/m² and higher than 30 kg/m² had significantly higher risks of mobility disability.⁶⁰ The average BMI of current participants was 29.6 kg/m², which was within the range of lower risks of mobility disability according to the previous study.⁶⁰ In cancer survivors, the effect of the level of comorbidity⁶¹ and a history of falls⁶² on QOL has been well established. Survivors with higher comorbid conditions had poor QOL in the physical and emotional domains, whereas fallers had lower scores on the physical component of SF36-v2 than nonfallers.⁶¹ The control of balance ensures that a person remains stable while carrying out mobility activities, such as maintaining a posture, changing positions, and walking.⁶³ Our findings suggested that the assessment of balance is critical to understanding mobility problems in older cancer survivors. In comparison with the TUG, the ABC-6 accounted for significant variance in survivors' perceived ability to engage in mobility activities. While the TUG has been recommended to assess functional mobility in cancer survivors,^{16,28,37} clinicians should consider using the ABC-6 to detect the deficits underlying mobility limitations when treating these patients. The inquiry into the history of falls and comorbidity would also assist with the evaluation of mobility problems in the survivors.

The PFS is a self-report measure assessing the effect of a person's health on limitations in carrying out a variety of mobility activities on a typical day.²⁹ Current findings of significant correlations between scores of the PFS and TUG supported the validity of the PFS in evaluating mobility limitations in older cancer survivors. The utilization of patient-centered outcome measures, such as self-report questionnaires, has increasingly been recognized as a pivotal step to patient-centered care.^{30,64} Few clinical assessment tools for functional mobility based on patients' self-report have been validated in the oncology population.

In a recent systematic review of outcome measures for functional mobility in breast cancer survivors, only 1 of 11 measures being recommended was a questionnaire.¹⁶ Moreover, there is a lack of consensus with regard to what mobility activities should be measured among rehabilitation professionals.^{3,4} Future research needs to identify and develop self-report measures to assess functional mobility in cancer survivors with respect to their ability to carry out daily activities and meet societal roles.

There are limitations in this study. Frailty is an important indicator of health outcomes in cancer survivors.^{65,66} While frailty of current participants was not assessed, future research is necessary to delineate the interplay between frailty and mobility among older cancer survivors. Current findings were based on a small sample of survivors with diverse diagnoses, aged 55 years and older, and living independently in the community. The effect of different cancer diagnoses and treatments on mobility limitations was not analyzed in this study. Clinicians should not generalize the findings to other subgroups of survivors. Research evidence has suggested that among long-term (≥ 5 years) cancer survivors, the odds ratios (ORs) of lower-body functional limitations vary by cancer type.⁶⁷ Cancer survivors were found to have a higher prevalence in difficulty or inability to perform at least 1 of 5 activities including walking a quarter of a mile; walking up and down 10 steps without rest; standing for 2 hours; stooping, crouching, or kneeling; and lifting 10-lb weight compared with noncancer controls.⁶⁷ The OR for lower-body functional limitations was higher in survivors of lung (OR = 7.91) and uterine (OR = 2.41) cancer than those with breast cancer (OR = 1.35).⁶⁷ Survivors in this study would be considered as in the chronic stage of survivorship based on the average time since the cancer diagnoses. Women who were cancer survivors for less than 2 years reported the most functional limitations.⁶⁸ However, compared with noncancer cohorts, long-term (≥ 5 years) cancer survivors remained at higher risks of functional limitations, including unable to walk half a mile (OR = 1.31, 95% CI = 1.1-1.54) and unable to walk up and down stairs (OR = 1.34, 95% CI = 1.05-1.72).⁶⁸ This study only analyzed a limited number of factors related to mobility. Other factors, such as muscle weakness,⁶⁰ were not examined. Population-based longitudinal studies with a large sample size are necessary to delineate various factors linked to mobility limitations across different cancer diagnoses and spectrum of survivorship. Findings should also be compared with prediagnostic data and those from noncancer cohorts to directly evaluate the effect of cancer.

CONCLUSION

Self-reported balance confidence is an important predictor of perceived mobility limitations during daily activities in community-dwelling older cancer survivors. In addition, the history of falls and comorbidity should be evaluated with respect to the mobility problems in this population.

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