

## Falls-related self-efficacy is independently associated with quality adjusted life years in older women

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### Abstract

**Background**—Falls-related self-efficacy is associated with falls, falls-related injury and subsequent functional decline which may lead to poor health related quality of life (HRQL). To our knowledge, no previous studies have examined the independent contribution of falls-related self-efficacy to HRQL. Our primary objective was to determine whether falls-related self-efficacy is independently associated HRQL, measured by Quality Adjusted Life Years (QALYs), in older women after accounting for known covariates.

**Method**—We conducted a secondary analysis of 135 community-dwelling older women aged 65–75 years who participated in a 12-month randomized controlled trial of resistance training. We assessed falls-related self-efficacy using the Activities Specific Balance Confidence Scale and QALYs calculated from the EuroQol EQ-5D (EQ-5D).

**Results**—Our multivariate linear regression model demonstrated that falls-related self-efficacy as assessed using the Activities Specific Balance Confidence Scale was independently associated with QALYs after accounting for age, group, education, functional comorbidity index, general mobility, global cognition and physiological falls risk. The final model explained 52% of the variation in QALYs. The ABC Scale accounted for an additional 5% of the total variance in the final model.

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#### Conflict of Interest

The authors declare that they have no competing interests.

#### Author's Contributions

JCD was principal investigator for the evaluation of HRQL and was responsible for design, data analysis and interpretation, and writing of manuscript. TLA was principal investigator for the Brain Power study and was responsible for study concept and design, acquisition of data, data analysis and interpretation, writing and reviewing of the manuscript. CAM was responsible for design, interpretation of HRQL data, and critical review of manuscript.

**Conclusions**—Although falls related self efficacy was independently associated with QALYs after controlling for a number of known variables, there may well be other factors not investigated, such as risk taking behaviour and psychological measures, which could account for some of the association.

**Trial Registration**—ClinicalTrials.gov Identifier: NCT00426881.

### Keywords

self-efficacy; quality adjusted life years; older women

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Self-efficacy is defined as an individual's perception or judgment of his/her ability to organize and execute specific tasks or types of performances [1]. According to Bandura's Social Cognitive Theory [1], an individual's perceived capability to perform an activity is a better predictor of activity in a particular domain than an individual's actual physical ability to complete the activity. Previous studies [2], including our own [3, 4], highlight the importance of self-efficacy in healthy aging and maintenance of functional status, mobility and cognitive abilities [5]. For instance, large population-based studies have demonstrated that older men's instrumental efficacy beliefs at baseline were positively associated with change in verbal memory over a 2.5 year follow-up [2]. Older adults ability to carry out a task is influence by their own self-belief, independent of their actual physical ability [6]. Finally, higher baseline self-efficacy had a buffering effect on subsequent functional decline in both high-functioning older adults [7] and those with knee osteoarthritis [8].

Quality adjusted life years (QALYs) are an important construct that describe an individual's overall health status according to the health state vector and the time spent in the health state. Briefly, the QALY is a useful measure of health benefit because it simultaneously captures both quantity and quality gains or losses [9]. QALYs can be assessed indirectly by having individuals complete a short standardized and validated questionnaire that details their health status at a specific time point or across a series of discrete time points. One generic preference based utility instruments that is used to calculate QALYs is the EuroQol-5D (EQ-5D) [10]. The EQ-5D captures 243 health states [10] and assesses an individual's health related quality of life (HRQL) according to the following attributes: mobility, self-care, usual activities, pain, anxiety and depression. Individuals' preferences for the scoring of the EQ-5D were estimated using the time trade off technique on a random sample of adults taken from the population living in the York (UK) region (N=3000) [11]. Thus, the EQ-5D reflects societal norms of individuals' preferences for a distinct set of health states. The EQ-5D is the most widely used generic instrument that uses a utility-based scoring approach, yielding a single summary score on a common scale to facilitate comparison across different health conditions and patient populations [10]. The single summary score, defined as a health state utility value (HSUV) is anchored at zero – a health state equivalent to death and 1.0 – a state of "full health." HSUVs less than zero are defines health states worse than death. The EQ-5D is one example of a tool that is used to attach a metric to measure 'health'. Given that the specific HRQL domains assessed by the EQ-5D are influenced by self-efficacy [5], it stands to reason that self-efficacy may independently contribute to QALYs among older adults. To our knowledge, no study to date has explored the unique contribution of self-efficacy to QALYs among community-dwelling older adults.

Yet, QALYs are a highly relevant and important outcome in both clinical research and clinical practice. Hence, it is important to determine modifiable factors that contribute to and optimize QALYs to better design healthcare interventions. In this study, we examined whether falls-related self-efficacy is independently associated with QALYs in community-dwelling older women, calculated using the EQ-5D at three time points, after accounting for age, group, education, mean number of chronic conditions, general mobility, global cognition and physiological falls risk. We chose to use falls-related self-efficacy as it is associated with two of the five EQ-5D domains – mobility [3] and self-care [5]. Furthermore, since falls-related self-efficacy is associated with falls – in both cross-sectional and prospective studies [5] – and falls are associated with poor QALYs among older adults [11].

## Method

### Participants

The total sample for this analysis consisted of 135 women who consented and completed a randomized controlled trial of exercise (NCT00426881) that aimed to examine the effect of once weekly and twice-weekly resistance training on cognitive performance of executive functions. The design and the primary results of the Brain Power study have been reported elsewhere [12]. Briefly, participants enrolled in Brain Power were: aged 65 to 75 years, community-dwelling, and had a Mini-Mental State Examination (MMSE) score  $\geq 24$ . Participants were enrolled and randomised by the Research Coordinator to one of three groups: once-weekly resistance training (1x RT), twice-weekly resistance training (2x RT), or twice-weekly balance and tone (BAT).

This study was approved by the relevant university and hospital ethics boards. All participants gave written informed consent prior to participants in the study.

### Descriptive Variables

We assessed global cognition using the MMSE and the Montreal Cognitive Assessment (MOCA). The MMSE is a widely used and well-known questionnaire used to screen for cognitive impairment (i.e., MMSE  $< 24$ ) [13]. It is scored on a 30-point scale with a median score of 28 for healthy community dwelling octogenarians with more than 12 years of education [13]. The MMSE may underestimate cognitive impairment for frontal system disorders [14] because it has no items specifically addressing cognitive function [13]. The MOCA is a questionnaire used to screen for mild cognitive impairment [15]. It assessed short term memory, visuospatial ability, executive functions (attention, concentration and working memory), language and orientation. It is scored on a 30-point scale with scores of greater than 26 indicating intact cognitive function.

### Dependent Variable: Measure of Health Related Quality of Life

We assessed HRQL using the EQ-5D. We then calculated QALYs to assess HRQL from the EQ-5D HSUVs at baseline, 6 months and 12 months. Specific to this study only, QALYs are a measure of HRQL because zero participants died and all participants were followed for the same time period, thus any changes in QALYs are due to quality of life from a societal

perspective, rather than quantity of time spent in a given health state. The EQ-5D is a short five item multiple choice questionnaire that measures an individual's HRQL and health status according to the following five domains: mobility, self-care, usual activities, pain and anxiety/depression [11]. Each domain has three possible options that either indicates no problems, some problems or severe problems. The EQ-5D HSUVs at each time point are bounded from -0.54 to 1.00 where a score of less than zero is indicative of a health state worse than death. The HSUVs represent values that individuals within society assign -- values for specific health states such as having rheumatoid arthritis relative to perfect health -- these are UK societal values for given health states.

### Independent Variables

**Falls-Related Self-Efficacy**—The 16-item Activities-Specific Balance Confidence (ABC) Scale [16] assesses falls-related self-efficacy with each item rated from 0% (no confidence) to 100% (complete confidence). The ABC Scale score is correlated with other measures of self-efficacy, distinguishes between individuals of low and high mobility, and corresponds with balance performance measures [16, 17].

**Comorbidity**—Functional comorbidity index (FCI) was calculated to estimate the degree of comorbidity associated with physical functioning [18]. This instrument includes items such as arthritis, osteoporosis, asthma, heart problems, cognitive function, physical impairments and mood. A total of 18 comorbidities are listed in addition to three specific diseases – cancer, hypertension and, thyroid disease.

**Physiological Falls Risk**—We used the Physiological Profile Assessment (PPA) (Prince of Wales Medical Research Institute, Randwick, Sydney, NSW, Australia) to assess each participant's physiological falls risk [19]. The PPA is a valid and reliable tool for assessing fall risk in older people. Based on the performance of five physiological domains (postural sway, hand reaction time, quadriceps strength, proprioception, and edge contrast sensitivity), the PPA computes a fall risk score (standardized score) for each individual; it has 75% predictive accuracy for falls in older people [19]. A PPA z-score of 0 to 1 indicates mild risk, 1 to 2 moderate risk, 2 to 3 high risk, and 3 and above marked risk [20].

**General Mobility**—We used the Timed Up and Go Test (TUG) to assess general mobility [21]. Participants were instructed to rise from a chair with their arms crossed (seat height 45 cm), walk a distance of three meters, turn around, walk back to the chair, and sit down with their arms crossed around their chest. We timed each trial and took the mean of two trials for our statistical analysis.

### Data Analysis

We analysed all data using STATA version 10.0. Our base case analysis included 135 women based on recommendations for multiple imputation of missing cost and HSUV data [22]. For all discrete time points, we used a combination of multiple imputation and bootstrapping to estimate uncertainty caused by missing values and we report the imputed data set analysis. The complete case analysis consisted of 89 participants for the EQ-5D who had all three HSUVs at baseline, 6-months and 12-months.

We report descriptive data for all variables of interest. For data that are normally distributed we report mean and standard deviation and frequencies depending on the measure. For data that were significantly skewed, we report median and interquartile range. We used the Pearson product moment correlation coefficient to determine the level of association between HRQL and age, experimental group, education, FCI, general mobility, global cognition, PPA, and falls-related self-efficacy.

In our multiple linear regression model, age, experimental group, education, FCI, general mobility, global cognition and PPA, were statistically controlled by forcing these six variables into the regression model first. These independent variables were determined based on the results of the Pearson product moment coefficient analyses (i.e., alpha level = 0.05) and assumed biological relevance, such as experimental group and global cognition were entered into the model regardless of the results of the correlation analyses. Falls-related self-efficacy was then entered into the model. We assessed the assumptions of normality of the residuals and heteroscedasticity.

## Results

We report the results of the imputed case analysis given that the results were identical for the complete case analysis.

### Participants

Table 1 reports descriptive statistics for our variables of interest. Participants included in our imputed and case analysis were similar on demographic characteristics. Overall, this cohort of community-dwelling senior women was reasonably high functioning as indicated by their baseline EQ-5D score of 0.82 (SD: 0.19). Further, the mean ABC score was  $88 \pm 13$  (max 100). Eighty one individuals (60%) had a MOCA score below 26 points, the cut-off for probable cognitive impairment.

### Correlation Coefficients

Table 2 reports the correlation coefficients between independent variables of interest and HRQL. Age, education, FCI, general mobility, and PPA were significantly associated with HRQL assessed using QALYs calculated from the EQ-5D ( $p < 0.05$ ). Experimental group and global cognition were not significantly associated with HRQL ( $p > 0.05$ ).

### Multivariate Linear Regression Results for QALYs Calculated From the EQ-5D

The ABC Scale score was a significant and independent predictor for HRQL as assessed by the EQ-5D ( $p < 0.01$ ). The total variance accounted for by the final model was 52% (Table 3). The ABC Scale accounted for an additional 5% of the total variance in the final model.

## Discussion

This study showed that falls-related self-efficacy is independently associated with HRQL among high functioning community-dwelling senior women. To our knowledge, our study is the first to demonstrate the independent contribution of falls-related self-efficacy after accounting for key covariates (i.e., age, group, education, number of chronic conditions,

general mobility, cognition and physiological falls risk) to HRQL measured prospectively over one year using QALYs calculated from HSUVs. We also highlight that our final model explained 52% of the variation in HRQL assessed using QALYs estimated from the EQ-5D; regression models in clinical research often do not account for such a large amount of variance [23].

We highlight that reduced falls-related self-efficacy does not exist only among older adults with a history of falls. Reduced falls-related self-efficacy is reported by 30% or more of older adults who have no history of falling; it is twice that in older adults who have fallen [23]. Furthermore, older women report lower falls-related self-efficacy [24] compared with their male counterparts. Hence, our study findings are relevant to older women with or without a history of falls and have clinical implications for the design of future HRQL promotion strategies among older adults.

Our results concur and extend that of a large community-based study that found that falls-related self-efficacy independently contributed to the physical and the mental component of HRQL assessed using the Short Form-36 after accounting for age, sex, marital status, medical conditions and falling episodes [24]. However, the presence of an association with the total score rather than the eight specific domains that comprise the SF-36 was not assessed. Further global HSUVs were not assessed from the SF-36, thus a global comparison of falls-related self-efficacy and HRQL were not ascertained.

Taking the results of our study with those of previous studies, self-efficacy appears to be an essential psychosocial characteristic of healthy aging. Studies have highlighted the importance of self-efficacy for the maintenance of mobility, balance, functional status, social function and cognitive function among older adults [3, 23, 25]. We also recently demonstrated that improved falls-related self-efficacy is independently and positively associated with increased usual gait speed among community-dwelling older women [25]; improved gait speed is associated with substantial reduction in mortality [26]. Hence, it would appear that healthy aging promotion strategies should target self-efficacy, and specifically falls-related self-efficacy in the context of promoting mobility and falls prevention.

We note that in our final model, age was the only independent variable that did not significantly contribute to HRQL as assessed by EQ-5D. This lends support that age itself does not determine how older adults perceive their overall health status. Rather, key determinants were factors that could be positively influenced by regular physical activity, such as the number of chronic conditions [27], mobility [28], physiological function [29], and cognitive function [12, 30]. Hence, the results of our study also confirm that regular physical activity is important for healthy aging.

We recognize that given that we are only looking at baseline predictors of HRQL, we did not ascertain the temporal relationship between falls-related self-efficacy and HRQL. Further, although falls related self efficacy was independently associated with QALYs after controlling for a number of known variables, there may well be other factors not investigated, such as risk taking behaviour and psychological measures, which could account

for some of the association that were not investigated in this study. We also note that our study sample included only high functioning community dwelling older women. The relationship between falls-related self-efficacy and HRQOL may differ in lower functioning older adults or older men. It is possible that the strength of the association between falls-related self-efficacy and HRQL may be stronger in older adults with a history of falls. Thus, future prospective population based studies are needed to determine whether our present findings apply to more heterogeneous populations.

## Conclusions

Our study, conducted among older community dwelling women, highlights that falls-related self-efficacy independently contributes to HRQL after accounting for age, group, education, number of chronic conditions, general mobility, global cognition and physiological falls risk.

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### Key Points

- Falls-related self-efficacy is associated with functional decline which may lead to poor health related quality of life (HRQL).
- No previous studies have examined the independent contribution of falls-related self-efficacy to HRQL.
- Falls-related self-efficacy was independently associated with QALYs
- Future intervention efforts should target modifiable risk factors such as falls-related self-efficacy improve overall HRQL.

**Table 1**

Characteristics of the Brain Power cohort at baseline\*

Variable at Baseline	Imputed Data Set (N=135)	
	Mean	Standard Deviation
Activities Specific Balance Confidence (%)	87.9	12.9
HRQL – QALY (EQ-5D)	0.83	0.17
Age (years)	69.6	3.0
Baseline EQ-5D HSUV	0.82	0.19
Average waist girth (cm)	86.3	13.0
Function Comorbidity Index	2.1	1.7
MMSE (max 30 pts)	28.6	1.3
Physiological Profile Assessment	0.12	1.28
Timed Up and Go Test (sec)	6.6	1.4
MOCA (max 30 points)	25.0	2.9

\* Variables at baseline were similar to the complete case set on all characteristics

**Table 2**

Correlation coefficient matrix (N=135)

<b>Variable at Baseline</b>	<b>Imputed Data Set HRQL – QALYs (EQ-5D)</b>
Activities Specific Balance Confidence Scale	0.4733 **
Age	-0.2979 **
Group	0.0913
Education	0.3106 **
Physiological Profile Assessment	-0.3456 **
Function Comorbidity Index	-0.4881 **
MOCA	0.0185
MMSE	0.0511
Timed Up and Go (sec)	-0.5977 **

\*  
p < 0.05\*\*  
p < 0.01

**Table 3**Multiple Linear Regression Summary for QALYs in Older Women Calculated from EQ-5D <sup>‡</sup>

Independent Variables	HRQL – QALYs estimated using EQ-5D	
	Unstandardized $\beta$ (Standard P-value Error)	
Model 1	R <sup>2</sup> 0.523	
	R <sup>2</sup> change 0.05	
ABC	0.0019 (0.0006)	0.001 **
Age	0.003 (0.002)	0.177
Group	-0.004 (0.007)	0.572
Education	0.024 (0.004)	0.000 ***
Functional Comorbidity Index	-0.033 (0.004)	0.000 ***
Timed Up and Go	-0.044 (0.005)	0.000 ***
MMSE	-0.013 (0.004)	0.007 ***
MOCA	-0.005 (0.002)	0.021 *
Physiological Profile Assessment	-0.025 (0.006)	0.000 ***

<sup>‡</sup> R<sup>2</sup> and R<sup>2</sup> change were the same for both imputed and complete case analysis

\* p < 0.05

\*\* p < 0.001

ABC = Activities of Balance Confidence Scale

MOCA = Montreal Cognitive Assessment