

Predictors of Health Related Quality of Life in Adults 50 Years and Older

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Abstract

Background: Perceived health related quality of life (HRQoL) and measures of physical function are consistently measured to evaluate the effectiveness of interventions. In older adults there are numerous measures of physical function.

Purpose: To determine which measures of physical function are most closely associated with HRQoL in adults 50 years of age and older.

Methods: 64 participants (54-93 years of age) completed assessments of HRQoL (Short Form Health Survey, Version 2 (SF-12v²) and World Health Organization Quality of Life-BREF (WHOQOL BREF)) and questionnaires related to self-esteem and physical activity. Participants were also assessed for six minute walk distance (6MWD), muscle strength, balance, gait, and lower extremity function (Short Performance Physical Battery; SPPB). Correlation analysis was performed between and within all dependent and independent measures. Forward Stepwise-Linear regression was performed to determine which independent measures predicted dependent measures.

Results: The physical component score (PCS) and the mental component score (MCS) of the SF-12v² were independent of each other unlike the domains of the WHOQOL BREF. The independent measures were best able to predict WHOQOL Physical Health ($r^2=0.60$), WHOQOL Psychological Health ($r^2=0.58$), and PCS ($r^2=0.43$). SPPB score best predicted PCS and WHOQOL Physical Health. The vestibular component of balance best predicted WHOQOL Psychological Health and Social Relationships. Self-esteem helped predict MCS, WHOQOL Psychological Health, and WHOQOL Social Relationships. 6MWD, muscle strength, and specific measurements of gait did not enter into any of the predictive equations for HRQoL.

Conclusion: SPPB, vestibular component of balance, and self-esteem may be important tools in assessing HRQoL in older adults.

Keywords: Short Form 12; Geriatrics; Cardiovascular fitness; Gait; Balance; Physical function

Introduction

By 2030 the population of Americans age 65 and older is projected to double to 71 million [1]. The rapid growth of this demographic group has important public health implications, and will place significant demands on services offered to this group, as well as on the nation's entire health care system. As life expectancy increases, the goal of improving the additional years in spite of the cumulative health effects associated with normal aging, requires consideration of the quality of life experienced with age. As a result, quality of life has become an increasingly important outcome of interventions and research targeting the aging population. Perceived health related quality of life (HRQoL) has become a central measure to determine the effectiveness of various interventions in the elderly population. Measures of physical function are almost always simultaneously completed with evaluations of HRQoL to determine if perceptual changes occur in concert with changes in biological and/or physical function. Changes in several measures of physical function have been correlated with changes in HRQoL within specific disease populations [2-4] and physical function has been found to play an important role in HRQoL among the elderly as well [5].

Interestingly, the magnitude of changes in HRQoL after an intervention are often not as large as changes in physical function [2,6,7] supporting the idea that HRQoL is multidimensional and suggesting that our understanding of what determines HRQoL is limited. Analysis of data collected from older people living independently in Great Britain suggests that the pillars of quality of life include social relationships, satisfaction with one's home and neighborhood, psychological well-being and outlook, activities and hobbies, social roles, and health and

functional ability [8]. There are numerous measurement tools available to assess physical function in the elderly. As a consequence, researchers and clinicians are left to wonder which measures of physical function are most valuable when developing their assessment plan.

The purpose of this investigation was to determine which measures of physical function are most closely associated with HRQoL in an adult population 50 years of age and older. In an effort to examine as many functional domains as possible, measures of cardiovascular fitness, upper and lower extremity strength, balance, and gait were used in this investigation.

Methods

Design

This was a cross-sectional study that investigated the relationships between quality of life and physical function in older adults using subjective, functional and instrumented measures. Prior to

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participation subjects read and signed a consent form approved by the university's Institutional Review Board for Protection of Human Subject Participants.

Participants

Sixty-four freely living participants between the ages of 53 and 94 participated in this investigation. Participants were recruited by advertisement in various newsletters serving older adults in the community. Participants received a \$10 gift card for participating in the study. Participants were excluded if there were unable to ambulate independently without the use of an assistive device. Participants provided demographic information including their past medical history and the number of medications they were currently taking. Demographic information for participants is summarized in Table 1.

Perceived quality of life, self esteem, and physical activity

After providing consent and providing demographic information, participants sat in quiet area and completed several questionnaires. To assess perceived quality of life participants completed the Medical Outcomes Study Short Form 12 general health survey, version 2 (SF-12v2) [9] and the World Health Organization Quality of Life (WHOQOL-BREF) questionnaire [10]. Responses to the SF-12v2 were analyzed using Quality Metrics QM Certified Scoring Software producing scores for eight health domains (Physical Functioning (PF); Role Physical (RP); Bodily Pain (BP); General Health (GH); Vitality (VT); Social Functioning (SF); Role Emotional (RE); Mental Health (MH)) ultimately producing psychometrically-based physical component summary (PCS) and mental component summary (MCS) scores which were used for analysis in this investigation. Responses to the WHOQOL-BREF produced scores for four domains Physical Health; Psychological; Social Relationships; Environment). Self-esteem was evaluated using the Rosenberg Self-Esteem Scale which is a 10-item self-report measure of global self-esteem [11,12].

Measure	Value	Distribution
Age (years)	82 ± 16	≤60 years=6% 61-70 years=39% 71-80 years=41% ≥81 years=16%
Height (m)	1.66 ± 0.13	
Mass (kg)	76.8 ± 14.8	
BMI	27.6 ± 0.6	Underweight=3% Normal weight=26% Overweight=37% Obese=34%
Sex	66% Female, 34% Male	
Marital Status	74% Married	
Prescription Medications Taken	4 ± 3	0-5 Medications=66% 6-10 Medications=28% 10+ Medications=6%
Years Since Retirement	15 ± 19	0 years=9% 1-5 years=28% 6-10 years=19% >10 years=44%
Diagnosed Chronic Diseases	1.5 ± 2.1	
Musculoskeletal Complaints	1.0 ± 1.4	

Table 1: Demographic information for subjects participating in investigation. Average data are presented at Mean ± SD. N=64.

Self-reported physical activity was assessed using the Physical Activity Scale for the Elderly (PASE) [13]. The PASE is a self-administered, 7-day recall questionnaire specifically designed for older adults. The PASE collects information related to leisure-time, household, and work related physical activity. Activity is weighted as being light, moderate, or vigorous and participants indicate the frequency of participation as never, seldom (1-2 days per week), sometimes (3-4 days per week), or often (5-7 days per week). Duration is recorded as 1 hour, 1-2 hours, or more than 4 hours. The total PASE score is computed by multiplying time spent in each activity by the weight or intensity and then a sum for all reported activities is generated.

Measures of physical function

After completing the questionnaires participants completed a series of tests designed to assess different domains of physical function including cardiovascular fitness, muscular strength, balance, and gait. Completion of all questionnaires and measures took each subject approximately 90 minutes.

Cardiovascular fitness

Cardiovascular fitness was assessed using the 6 Minute Walk Test (6MWT). The 6MWT was performed in a tiled hallway using a marked 30-meter walkway according to the procedures described by the merican Thoracic Society [14,15]. Total distance walked or 6 minute walk distance (6MWD) during the test was used as the outcome measure for this test.

Muscular strength and power

Muscular strength of the upper extremities was assessed by measuring grip strength and of the lower extremities by measuring power during bilateral leg extension (leg press). Grip strength was assessed in both hands using an adjustable, hand-held, hydraulic grip strength Jamar dynamometer (Sammons Preston Roylan, Chicago, IL). Each subject stood holding the arm to be tested with the elbow flexed at 90°. The dynamometer was then be fitted to the participants' hand such that the rear part of the dynamometer was snug against the base of the thumb and the front edge of the adjustable part of the grip was exactly in line with the second joint of the middle finger. The participants' forearm was turned out so that the palm was facing up and the wrist was straight [16]. The subject then squeezed the dynamometer as hard as possible and held it for one second. The subject completed three trials of this measure in each hand separated by at least a 30-second recovery period.

The average of the three trials for the dominant hand was used for data analyses. Power during the leg press was assessed using Keiser Air 300 leg Press machine. Prior to assessment of power, participants were positioned on the machine such that their hips, knees, and ankles were all at 90°. Starting at a very low resistance, participants were asked to press both legs out and then provide a rating of difficulty using the 0-10 Borg Rating of Perceived Exertion (RPE) scale. Resistance was then increased during repeated bouts (interspaced by 30 seconds or rest) until RPE reached seven on the scale. Resistance was then increased to 125% of that recorded with an RPE of seven. Participants were then asked to complete six repetitions of leg press as hard and as fast as they could. Power (lower extremity Power) and force (lower extremity Force) during the leg press was then calculated by averaging the maximal power and force recorded during each of the repetitions for the dominant leg.

Short Physical Performance Battery (SPPB)

The SPPB examines three areas of lower extremity function including static balance, gait speed, and getting in and out of a chair [17]. To assess static balance the participant stood in three progressively challenging standing postures (side by side, semi-tandem, and full tandem) for up to 10 seconds. To assess gait speed the participant was asked to walk at his or her comfortable speed across a 4-meter distance. To assess the participants' ability to get in and out of a chair, the subject was asked to stand from a standard chair without upper extremity assistance five times. The time it took for the subject to complete five chair stands was recorded. From this battery of tests a composite score (ranging from 0 to 12) based on performance was calculated and used for the analysis.

Balance assessment

The modified Clinical Test for Sensory Integration of Balance was used for balance assessment. Each subject completed one trial of this test on the Balance System SD (Biodex Medical Systems, Inc., Shirley, NY). Participants were required to perform quiet barefoot standing for 20 seconds in four conditions: 1) with eyes open on a stable surface, 2) with eyes closed (using a mask) on a stable surface, 3) with eyes open on an unstable surface, 4) with eyes closed (using a mask) on an unstable surface. A foam pad supplied by the company was used for creating the unstable surface. Participants stood comfortably using self-selected foot position for the first condition and the same foot position was maintained for all the other conditions. The participants were instructed not to touch the hand rails and the condition was deemed a failure if they touched the handrails during any of the conditions or if the spotter had to catch them from falling. The center of pressure data was collected at 20Hz. The area of the 95% confidence ellipse (ESA) which encloses approximately 95% of the points on the center of pressure trajectory was calculated using customized Matlab (Mathworks, Natick, MA) scripts. Relative contributions of the sensory systems were calculated using the following equations:

Contribution of visual sensory system (Visual ESA) = Ratio of ESA while standing with eyes open on an unstable surface (condition 3) and ESA while standing with eyes open on a stable surface (condition 1).

Contribution of proprioceptive sensory/somatosensory system (Somatosensory ESA) = Ratio of ESA while standing with eyes closed on a stable surface (condition 2) and ESA while standing with eyes open on a stable surface (condition 1).

Contribution of vestibular sensory system (Vestibular ESA) = Ratio of ESA while standing with eyes closed on an unstable surface (condition 4) and ESA while standing with eyes open on a stable surface (condition 1).

Gait

Participants completed five trials at self-selected comfortable walking speed on a 4.9m GAITRite electronic walkway measurement system (CIR systems Inc., Sparta, NJ). Participants started 2m before and walked 2 m past the mat area to achieve steady state walking pattern. All of them walked bare foot. Gait speed, cadence, and functional ambulation profile were then calculated and used as outcome measures. The functional ambulation profile scores were calculated by the GAITRite system using the step length, leg length, step time, normalized velocity and stance width parameters [18]. An average of five trials was used for computations of these outcome measures.

Statistical analyses

The measures that served as independent and dependent variables in this investigation are listed in Table 2. Correlation analysis (Pearson Product-Moment) was performed between all of the dependent measures. Correlation analysis was also performed for each dependent measure and each independent measure. In an effort to predict each dependent measure, all independent measures found to have a significant ($p \leq 0.05$) correlation with the dependent measure were entered into a Forward Stepwise- Linear Regression analysis. Independent variables included in the model were selected using the stepwise regression method with the significance levels for entry and stay fixed at 0.20 and 0.10 respectively. There was a redundancy with some of the measures used like gait speed which was measured both within SPPB as well as from GaitRite. However, this redundancy occurred only with the sub-parts of the independent factors but not the whole factors. Since the overall goal of the project was to assess which of these commonly used instruments and measurements were most useful to predict the quality of life of an older adult, the overall scores of the instruments like SPPB were used for the analyses and not the sub-parts of the instrument.

Results

The results of the correlation analysis between the dependent measures of perceived quality of life are presented in Table 3. The PCS and MCS from the SF-12v2 were not correlated with each other. In comparison all of the domains from the WHOQOL-BREF were found to be significantly correlated with each other. The strength of these correlations between WHOQOL-BREF domains ranged from moderate ($r=0.482$) to good ($r=0.658$). Correlations between dependent and independent measures are presented in Table 4. PCS and WHO- Physical Health were both significantly correlated with Prescription Medications, Number of Diseases, Body Mass Index

Dependent Measures	Independent Measures
MOS SF-12v2	Demographic Information
Physical Component Score (PCS)	Age
Mental Component Score (MCS)	Body mass index (BMI)
	Prescription Medications
WHOQOL-BREF	Number of Chronic Diseases
Physical Health	Marital Status
Psychological Health	Physical Function
Social Relationships	6 Minute Walk Distance (m)
Environment	Hand Grip Strength (kg)
	Lower Extremity Power
	Lower Extremity Force
	SPPB Score
	Balance
	Visual Elliptical Sway Area (ESA)
	Somatosensory ESA
	Vestibular ESA
	Gait
	Gait Speed
	Cadence
	Functional Ambulation Profile
	Self-Esteem
	Physical Activity
	Physical Activity Scale for the Elderly (PASE)

Table 2: Dependent and independent measures used for statistical analysis.

		SF 12 MCS	WHO-Physical	WHO-Psych	WHO-Environ	WHO-Social
SF 12 PCS	r	-.025	.741	.348	.416	.204
	(p)	(.843)	(<.001) *	.005 *	.001 *	.140
SF 12 MCS	r		.441	.667	.477	.535
	(p)		(<.001) *	(<.001) *	(<.001) *	(<.001) *
WHO-Physical	r			.658	.557	.482
	(p)			(<.001) *	(<.001) *	(<.001) *
WHO-Psych	r				.614	.637
	(p)				(<.001) *	(<.001) *
WHO-Environ	r					.618
	(p)					(<.001) *

PCS - Physical Component Score (PCS); MCS - Mental Component Score; * significant correlation ($P < 0.05$)

Table 3: Correlations matrix for dependent measures of perceived quality of life.

		SF 12 PCS	SF 12 MCS	WHO-physical	WHO-Psych	WHO-Environ	WHO-Social
Marital Status	r	.229	-.139	.218	-.097	.047	.156
	(p)	(.069)	(.273)	(.084)	(.446)	(.714)	(.269)
Prescription Medications	r	-.520	-.329	-.676	-.324	-.138	-.079
	(p)	(<.001) *	(.008) *	(<.001) *	(.009) *	(.276)	(.568)
Number of Diseases	r	-.475	-.306	-.655	-.462	-.320	-.094
	(p)	(<.001) *	(.014) *	(<.001) *	(<.001) *	(.010) *	(.499)
Body Mass Index (BMI)	r	-.321	.045	-.262	.031	-.045	-.023
	(p)	(.010) *	(.727)	(.038) *	(.811)	(.726)	(.868)
Age	r	.095	.000	.062	-.052	-.168	-.050
	(p)	(.453)	(.998)	(.629)	(.681)	(.183)	(.717)
6 Minute Walk Distance	r	.429	.223	.489	.282	.303	.188
	(p)	(<.001) *	(.076)	(<.001) *	(.024) *	(.015) *	(.174)
SPPB	r	.528	.343	.504	.501	.350	.233
	(p)	(<.001) *	(.006) *	(<.001) *	(<.001) *	(.005) *	(.093)
Lower Extremity Force	r	.293	-.139	.260	.074	.014	-.142
	(p)	(.021)	(.281)	(.041) *	(.570)	(.912)	(.305)
Lower Extremity Power	r	.311	-.102	.264	.120	.020	-.166
	(p)	(.014) *	(.428)	(.038) *	(.351)	(.875)	(.230)
Hand Grip	r	.048	-.188	-.066	-.159	-.134	-.243
	(p)	(.721)	(.162)	(.624)	(.237)	(.321)	(.092)
Velocity	r	.513	.198	.509	.283	.265	.182
	(p)	(<.001) *	(.121)	(<.001) *	(.024) *	(.036) *	(.191)
Cadence	r	.124	.208	.246	.219	.141	.095
	(p)	(.335)	(.103)	(.052)	(.085)	(.269)	(.497)
Functional Ambulation Profile	r	.273	.124	.241	.145	.276	.114
	(p)	(.031) *	(.332)	(.057)	(.255)	(.028) *	(.416)
Vision ESA	r	.231	.270	.201	.352	.122	.063
	(p)	(.066)	(.031) *	(.112)	(.004) *	(.337)	(.652)
Somatosensory ESA	r	.130	.221	.206	.262	.123	-.018
	(p)	(.304)	(.079)	(.102)	(.036) *	(.332)	(.898)
Vestibular ESA	r	.383	.241	.402	.404	.212	.325
	(p)	(.002) *	(.065)	(<.001) *	(<.001) *	(.093)	(.017) *
Physical Activity Scale for the Elderly (PASE)	r	.361	-.068	.276	.216	.068	.198
	(p)	(.004) *	(.594)	(.028) *	(.080)	(.587)	(.155)
Self-Esteem	r	.180	.487	.317	.657	.317	.415
	(p)	(.157)	(<.001) *	(.011) *	(<.001) *	(.020) *	(<.001) *

PCS - Physical Component Score (PCS); MCS - Mental Component Score; SPPB – Short Physical Performance Battery; ESA – Elliptical Sway Area; * significant correlation ($P < 0.05$)

Table 4: Correlations between dependent measures of perceived quality of life and independent measures.

(BMI), 6 Minute Walk Distance, SPPB Score, Lower Extremity Power, Gait Speed, Vestibular ESA, and PASE. PCS was also correlated with Functional Ambulation Profile, while WHO- Physical Health was also correlated with Lower Extremity Force and Self-Esteem. The WHO- Psychological Health was correlated with 9 independent measures including Prescription Medications, Number of Diseases, 6 Minute Walk Distance, SPPB Score, Gait Velocity, Visual ESA, Somatosensory ESA, Vestibular ESA, and Self-Esteem. In comparison, the MCS (correlated with 5 measures), WHO-Environ (correlated with 6 measures), and WHO-Social (correlated with 2 measures) were correlated with far fewer independent measures. Number of diseases, SPPB score, and Self-Esteem appeared to be the most valuable independent measures since they were correlated with 5 of the 6 dependent measures. The results of stepwise regression analyses for all dependent measures are summarized in Table 5. The strongest predictive equation was produced for WHO-Physical Health where Number of Chronic Diseases, Prescription Medications, and SPPB Score entered into the model producing an $r^2=0.60$ (adjusted $r^2=0.58$). For PCS, Prescription Medications and SPPB Score entered into the model and produced an $r^2=0.43$ (adjusted $r^2=0.41$). In a similar fashion, the model for WHO-Psychological Health included Self Esteem, Number of Chronic Diseases, and Vestibular ESA producing a $r^2=0.58$ (adjusted $R^2=0.56$). The models for MCS, WHO-Environment, and WHO-Social Relationships were much weaker producing r^2 's of 0.30 (adjusted $r^2=0.27$), 0.22 (adjusted $r^2=0.20$), and 0.16 (adjusted $r^2=0.13$), respectively.

Discussion

In this investigation, PCS and MCS of the SF-12v2 were not correlated with each other while all of the domains of the WHOQOL-BREF were found to be at least moderately correlated with each other. The reliability and validity of each of these measures has been well established in numerous disease populations [9,10,19-21]. Original work with the WHOQOL-BREF indicated that all four of the domains

make a significant contribution in explaining overall HRQoL and general health [10]. Both of these questionnaires take a relatively short time to complete. Since both measures address overall HRQoL, the results of this investigation suggest that the SF-12v2 may evaluate a greater spectrum of HRQoL than the WHOQOL- BREF. As a consequence, the practitioner may gravitate to use of the SF-12v2 if they are limited in time and resources.

In general perceptions of HRQoL were negatively correlated with measures describing the presence of disease (Prescription Medications, Number of Diseases) and positively correlated with measures of physical performance (e.g. SPPB score, 6 Minute Walk Distance). This negative relationship between HRQoL and the number of prescription medications taken and number of diseases present has been previously observed by other authors [22,23]. This observation seems obvious; however, this relationship may be much more complex than a simple numerical correlation. For example, Frohlich et al. found that prescribing complexity and the presence of psychotropic drugs was also associated with lower levels of HRQoL [24]. The findings by Frohlich et al. suggest that HRQoL may be influenced by how a disease is managed pharmacologically as well as the need for pharmacological intervention [24].

Of the physical performance measures, SPPB score was most consistently correlated with measures of HRQoL with r-values ranging from 0.343 (MCS) to 0.528 (PCS). SPPB score also entered into the predictive equations for PCS and WHOQOL Physical Health. SPPB score has been previously been associated with HRQoL in older adults by other authors [21,25]. When considering the components of the SPPB test it seems logical that its outcome is predictive of measures of HRQoL that assess the physical domain (PCS and WHOQOL Physical Health). What is curious is that the SPPB test provides an integer score that ranges from 0-12, where measures like Lower Extremity Power and Gait Speed which are more precise (real values) and evaluate similar components are not predictive of these same measures of HRQoL. The

Dependent Measure	Predictors	Estimate	Standard Error	Probability	R-Square	Adjusted R-Square
PCS	Intercept	35.94893	5.10027	<.0001	0.43	0.41
	Prescription Medications	-1.12085	0.28103	0.0002		
	SPPB Score	1.59544	0.44821	0.0007		
MCS	Intercept	38.0082	4.86903	<.0001	0.30	0.27
	Self Esteem	0.76769	0.19133	0.0002		
	Prescription Medications	-0.50436	0.21686	0.0234		
WHOQOL Physical Health	Intercept	70.74816	7.65127	<.0001	0.60	0.58
	Number of Chronic Diseases	-2.86971	0.86133	0.0015		
	Prescription Medications	-1.65214	0.4878	0.0013		
	SPPB Score	1.91111	0.64939	0.0047		
WHOQOL Psychological Health	Intercept	32.90431	7.41842	<.0001	0.58	0.56
	Self Esteem	1.68826	0.27164	<.0001		
	Number of Chronic Diseases	-1.60851	0.56486	0.0061		
	Vestibular ESA	8.44157	2.82193	0.004		
WHOQOL Environment	Intercept	21.56527	16.48402	0.1959	0.22	0.20
	Self Esteem	1.20568	0.36188	0.0015		
	Functional Ambulation Profile	0.35005	0.15955	0.0322		
WHOQOL Social Relationships	Intercept	33.8707	14.39325	0.0226	0.16	0.13
	Self Esteem	1.28743	0.59097	0.0341		
	Vestibular ESA	12.60865	6.5428	0.0597		

PCS - Physical Component Score (PCS); MCS - Mental Component Score; SPPB – Short Physical Performance Battery; ESA – Elliptical Sway Area

PCS - Physical Component Score (PCS); MCS - Mental Component Score; SPPB – Short Physical Performance Battery; ESA – Elliptical Sway Area

Table 5: Stepwise regression for dependent measures.

SPPB test evaluates power (chair rise) and gait speed along with static balance (tandem stance). As a consequence, it is possible that the SPPB score masked the value of the more direct tools used to evaluate power, gait speed, and balance in predicting HRQoL.

Interestingly, Vestibular ESA entered into the predictive equations for WHOQOL Psychological Health and Social Relationships. Dysfunction of the vestibular system and the secondary impact on balance have been previously associated with reductions in measures of overall HRQoL, so the results of this investigation are somewhat consistent with previous findings. In fact, greater sway area while standing has been shown to be positively associated with greater levels of psychosocial variables like apathy in older adults with Parkinson's disease [26]. It remains unclear why Vestibular ESA was valuable at predicting WHOQOL Psychological Health and Social Relationships but was not valuable at predicting measures of HRQoL in the physical domain. It is also not clear why Vestibular ESA is valuable at predicting HRQoL, but the other measures of balance are not. Humans rely primarily on the somatosensory and visual systems to maintain their balance while using the vestibular system mainly to resolve conflicting sensory input from the other two systems. Inability to use the vestibular system effectively to maintain balance could indicate increased reliance on the other two systems. Decreases in visual and proprioceptive acuity are often associated with aging. An alternative possibility that cannot be addressed by the design used in this investigation is the relationship between vestibular function, hearing loss, and HRQoL [27]. As a result, the potentially unique contribution of vestibular function on HRQoL needs to be further examined.

The 6 minute walk test (6MWT) is an extraordinarily common measure used to assess physical function. It has been well established as a valid and reliable measure [14,15]. Six minute walk distance (6MWD), the primary outcome measure produced by the 6MWT, was correlated with four of the measures of HRQoL used in this investigation. Interestingly, 6MWD did not enter into any of the predictive equations. In the two primary measures of quality of life in the physical domain (PCS and WHOQOL Physical Health) SPPB score entered into the equation, but 6MWD did not. Perhaps, the SPPB test possessed enough of the attributes of the 6MWT that the addition of 6MWD was not valuable to the predictive models. These results suggest that SPPB test is more valuable at predicting perceived HRQoL than the 6MWT. 6MWD has been shown to be predictive of HRQoL in many specific disease populations. For example, Verma et al. found 6MWD was predictive of HRQoL in patients with idiopathic pulmonary fibrosis [28].

In contrast, Jacques and associates found that 6MWD distance was not predictive of HRQoL in patients with non-cystic fibrosis bronchiectasis [29]. An explanation for the differences in findings for the value of 6MWD in predicting HRQoL is not clear. It is possible that 6MWD is important at predicting HRQoL in some specific disease populations, but isn't valuable for all specific disease populations or a more general population. The practical experience of these authors, with these two tests, suggests that there is more potential for variability in the outcome of the 6MWT than the SPPB test. Self Esteem was a particularly valuable independent measure, entering in the predictive model for 4 out of the 6 measures of perceived HRQoL (MCS, WHOQOL Psychological Health, WHOQOL Environment, and WHOQOL Social Relationships). Self Esteem has been previously associated with life satisfaction in older adults [30] as well as the general population [31]. As expected, Self Esteem was more valuable at predicting HRQoL in the domains associated with mental and social well-being than for measures representing the physical domain.

Regardless of these differences, the value of Self Esteem in predicting HRQoL seems manifest.

The predictive models produced by this investigation were strongest for WHOQOL Physical Health and psychological Health, explaining nearly 60% of the variability in each of these dependent measures. Similarly, the independent measures were able to explain 43% of the variance in PCS. Much weaker models were created for MCS, WHOQOL Environment, and WHOQOL Social Relationships. The independent measures used in this investigation are clearly more focused on physical ability, so it is no surprise that these models were generally better at predicting HRQoL in the physical domain. What is surprising is that the measures used to evaluate strength of the extremities were not better correlated with measures of HRQoL and none of them entered any of the predictive models. While measures of general muscular strength have previously been associated with HRQoL in older adults [32], it is possible that the specific measures used in this investigation were not adequate for assessing muscle strength in a way that would be useful at predicting quality of life.

The findings of this investigation are likely limited by the sample size and variance of dependent and independent measures. For example, mean 6MWD distance was 437 ± 16 m. With a greater variance in 6MWD and the other measures is possible that our ability to predict perceived quality of life would have been improved and more independent measures would have entered into the model. For correlation analyses, the correlation coefficient is itself considered as a good measure of the effect size. It has been suggested that $n=70$ is approximately required to examine an association of medium strength ($r = 0.3$) and statistical significance of a correlation coefficient (assuming a power of 80% and an alpha value of .05) [33]. Most of the statistically significant correlation coefficient values between the independent factors in the current study (Table 4) satisfied these criteria for effect size.

In summary, the SF-12v2 and WHOQOL BREF produce similar overall results; however, the inter-relatedness of the WHOQOL BREF domains suggest that the two domains of the SF-12v2 evaluate a greater spectrum of HRQoL. Of the measures used to assess physical ability in this investigation, SPPB score and Vestibular ESA were most valuable at predicting HRQoL. Surprisingly 6MWD and measures of muscle strength were not very useful at predicting HRQoL. Within the psychosocial domain, Self Esteem was also very valuable at predicting HRQoL. The results of this investigation may provide insight as to which areas are most important to older adults in terms of HRQoL and suggest where interventions should be focused in an effort to improve HRQoL in the older adult population.

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