Measuring the impact of increased exercise on quality of life in older adults: the UQQoL, a new instrument

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Abstract The University of Queensland Quality of Life instrument (UQQoL) was developed to provide a quantitative measure sensitive to the impact of increased exercise on the quality of life (QoL) of older individuals. This paper describes the development and testing of the UQQoL including an exploratory study of focus group interviews with 18 participants aged 65 and over, item development and selection, and instrument piloting with groups of older adults undergoing high-intensity training. The SF-36, another established QoL tool, was also administered at the same time points for comparative purposes. The UQQoL displayed good convergent validity with selected SF-36 domains. A significant change in QoL following training was found, complementing functional improvements. This change was not detected by the SF-36. While broader testing is required, the UQQoL appears to be a reliable instrument sensitive to the change in QoL experienced by healthy community-dwelling older adults following resistance exercise.

Keywords Exercise · Functional ability · Older adults · Quality of life · Resistance training

Introduction

Quality of life (QoL) is a subjective measure perceived differently at an individual level and varies across the lifespan. Establishing an accepted definition of the concept has therefore posed challenges for researchers (Spiriduso and Cronin 2001; Halvorsrud and Kalfoss 2007). However, while some suggest that through the development of population specific measures, the need for a concise QoL definition has been somewhat reduced (Ashley 2001), others propose the improvement of a common QoL assessment model (Halvorsrud and Kalfoss 2007). By 1997 Bowling (Bowling 1997) documented 73 measures of QoL, which may have been a somewhat conservative estimate given Huges and Hwang (as cited in [Halvorsrud and Kalfoss 2007]) suggestion that over a 1,000 items existed to measure the various aspects of QoL. Further impediments to an accepted definition are created by the recent addition of specialised QoL measures such as The Minnesota Living with Heart Disease Questionnaire (Oldridge et al. 2002), The National Eye Institute Refractive Error Quality of Life Instrument (Nichols et al. 2003) and The Appetite and Dietary Assessment Tool (Buckner and Dwyer 2003). However, even following the introduction of measures targeting an older population, no instruments are currently available with specific reference to community-dwelling older adults and that measure the change in QoL experienced following increased physical activity and exercise.

Exercise commenced in later life will increase cardio-respiratory parameters and muscle function, it will raise energy levels, is associated with improved functional ability and will prolong independence (McCartney et al. 1996; Buchner 1997; Taaffe et al. 1999; Bauman and Smith 2000). Moreover, positive personal testimonials

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indicate that following training individuals “feel, sleep and move better” (Myers et al. 1999). Nevertheless, with the exception of investigations targeting functionally challenged seniors, studies questioning the benefits of increased exercise on QoL among older adults report little or no effect (Spiriduso and Cronin 2001; de Vreede et al. 2006). Of concern, however, is the use of non-specific instruments to assess change.

Although most regularly used, the Medical Outcome Survey Short Form (MOS SF-36) has proven problematic in its administration due to older individuals returning questions unanswered or answering at the “ceiling” of the scale (Bowling 1997; Walters et al. 2001). In addition, its domain of *Bodily Pain* is reported to achieve low convergent validity with severity of illness and independent pain measures (Bowling 1997; Walters et al. 2001). In contrast, questionnaires such as the Nottingham Health Profile and the World Health Organization Quality of Life instruments (WHOQOL: OLD, BREF & 100) focus on social, psychological and environmental factors, and report little change in QoL despite the significant physical impact of training (Bowling 1997; Ashley et al. 2001). Therefore, the aim of the study reported in this paper was to design and validate an easy to complete self-report QoL instrument specific to older adults that is capable of measuring the change in QoL following increased exercise. It is hypothesised that with a validated instrument, the improved physical function following training will result in an improved QoL.

Methods

Focus group interviews

To inform the instrument development an exploratory phase was undertaken. This involved three focus groups of randomly selected older community-dwelling adults, recruited from three exercise perspectives: presently involved (G1), past intervention participants (G2) and those contemplating participation (G3). Specifically, G1 participants (four males, two females; 67–77 years) were involved in an ongoing study investigating varied types of resistance training in older adults. Potential G1 volunteers were contacted in person during training and offered the opportunity to participate. G2 participants (three males, three females; 69–81 years) were recruited by telephone from a subject database compiled during a previous intervention and consisting of individuals who had either continued or ceased to train since the program’s completion. Participants for G3 (three males, three females; 65–79 years) were recruited from the Australasian Centre on Ageing 50 + Registry (a pool of research volunteers) at the

University of Queensland (UQ) (Brisbane, Australia) via a mailed information pack that invited their participation. Focus group research approval was granted by the UQ Medical Research Ethics Committee and participants provided informed consent.

All focus group sessions were recorded, lasted approximately 2 h, and were run by two interviewers, one to guide the session and one to take notes. A range of guided questions, informed by the literature and experts in the field, were posed to the participants. These questions, aimed at encouraging open conversation about the benefits of exercise participation in older people:

- What do you think attracts people to being involved in an exercise study?
- What are/were your experiences in preparation for exercise?
- What would motivate you or has motivated you to continue attending?
- What do you believe are the benefits of training?
- What do you perceive is the importance of physical activity?

While these questions prompted participants to consider specific beliefs and experiences about their exercise behaviour, the interviews were conducted in a manner that facilitated open conversation. The topics covered a range of quality of life issues such as daily living, social withdrawal and social interaction, family and financial well-being, and impact of general health on maintaining independence. Consequently, the focus groups generated an in-depth insight into participants’ perceptions of the relationship between physical activity and quality of life.

The focus group transcripts, along with the written notes, were imported into the qualitative data software package NVivo (QSR NVivo, Version 2.0.161, QSR International Pty. Ltd., Melbourne, VIC, Australia) for analysis (Kolewaski et al. 2005). The analytical process was undertaken by the authors and involved generating an organising framework guided by focus group data. The fields that emerged reflected the extent to which items were raised and were regrouped into larger domains. Further informed by a comprehensive review of existing QoL instruments, the selected domains aimed to capture the multidimensional concept of QoL, including physical, psychological and social well-being (Bowling 1997; Brown et al. 2000; Hawthorne 2003b; Streiner and Norman 2003; Halvorsrud and Kalfoss 2007). To ensure that categories were mutually exclusive within the nominated domains, a field commonality elimination process was undertaken. Specifically, where fields emerged in multiple domains, those receiving the greatest number of references during focus group interviews were retained within that domain. The results of focus group analysis by field, domain

classification, and within domain categories are presented in Table 1.

Instrument development

A comprehensive review of instruments frequently used in exercise studies among adults was undertaken. The questionnaires of interest were the SF-36 (Walters et al. 2001), WHOQOL-100, WHOQOL-BREF and WHOQOL-OLD (Hawthorne 2003a, b), the Vitality Plus Scale (Myers et al. 1999) and the Assessment of Quality of Life Instrument

(AQoL) (Osborne 2003). Key areas examined were: items (questions), domains; number of and specificity per instrument, total questionnaire length, means of achieving reliability and validity, scoring mechanisms, and sensitivity to change in health and well-being.

The item design for the UQQoL instrument occurred in several stages. Firstly, items used in existing questionnaires that related to the domains emerging from the focus group data were investigated for their appropriateness to older people. Secondly, the item wording was constructed using actual textual data from the focus groups and consultation

Table 1 The UQQoL development: domains and categories

Fields ^a	Domain	Categories ^b
Physiology (105)	General Health	Physiology
Function (103)		Prevention of disease
Prevention of disease (65)		Increased health
Rehabilitation from disease/disability (55)		QoL and well-being
Increased health (54)		
QoL and well-being (39)	Physical Well-Being	
Muscle function (98)		Muscle function
Balance (47)		Self Image
Flexibility and range of movement (30)		
Mental function (27)		
Maintained QoL (25)	Physical Ageing	
Self Image (11)		General health
General health (75)		Function
Function (52)		
Physiology (48)		
Flexibility and range of movement (38)	Fatigue/sleep	Improved sleep
Mental function (34)		Sleep latency
Balance (29)		
Improved sleep (43)	Mental Well-Being	Confidence
Sleep latency (16)		
Confidence (42)		
Mental function (25)	Role Physical	
Vitality (15)		Increased family interaction
QoL and well-being (15)		
Increased family interaction (47)	Bodily Pain	
Social contact (27)		
Function (22)		
Maintained QoL (14)	Social Interaction	
Rehabilitation from disease/disability (56)		Rehabilitation from disease/disability
Flexibility and range of movement (16)		
Increased health (12)	Body Image	
QoL and well-being (9)		
Social well-being/contact (34)		Improved Body
Interaction with younger adults (7)	Body Image	
Confidence (32)		
Self Image (17)		
Improved Body (11)		

^a Field data were generated from focus group conversation and, in brackets, the number of references recorded

^b Categories emerged following field within domain commonality elimination

with academic experts in ageing. Thirdly, individual items were then trialled with a group of older volunteers for appropriateness and comprehensiveness, and reliability and validity testing undertaken. Following these processes the trial 20 item UQQoL instrument was truncated to 16 items. This process is described in greater detail below.

Subsequent to item design and domain identification, a content validation approach similar to that used by Hawthorne (Hawthorne et al. 2000) was undertaken. Specifically, domains were compared and items concept matched with the selected instruments as mentioned above and listed in Table 2. It was concluded that the proposed UQQoL provided good coverage of the concepts related to physical well-being, in particular the benefits experienced with training, while also broadly addressing the social and psychological dimensions of QoL.

A five-point rating scale of “True” to “Never True” was used to score each question with a descriptor of each attribute located along a continuum. To avoid confusion, the scale was worded in the same direction and repeated under each of the questions (Myers et al. 1999). Each question was scored individually, the summation of which allowed the generation of an overall UQQoL summary score.

Content validity

As the items were refined, the content validity of an earlier 20-item version was explored with a group of older volunteers ($n = 20$) randomly selected from the Australasian Centre on Ageing “Friends of the Centre” at the University of Queensland. The questionnaire was administered as a package by mail with instructions for completion and with a request for individuals to thoroughly review the relevance of the content and the domain appropriateness for older persons, in addition to ease of completion. Peer reviewed observations and interviews resulted in the elimination of four questions deemed inappropriate or unnecessary by the group. In addition, suggestions as to the general layout of the instrument and ordering of items were given. The final 16-item instrument was produced, complete with an introduction and instruction page, questions grouped according to domain and with the five-point single direction assessment scale. The resulting instrument was then administered to a group of community-dwelling adults aged 65 years and over entering an exercise study to assess for change over the course of the intervention.

Instrument testing

The exercise intervention and associated data analysis have been described in greater detail elsewhere (Henwood et al. 2007). Briefly, 61 participants were randomised into one of

Table 2 Relationship between suggested aspects of quality of life, pre-existing quality of life instruments and the UQQoL

	SF-36	AQoL	VPS	WHOQoL		UQQoL	
				100	BREF	OLD	
Physical well-being							
Anxiety/depression	***	*	*	#	*	***	*
Bodily care	*	*					
Cognitive ability				#	*		*
General health	**		*	#			*
Mobility	***	*	*	#	*	*	*
Pain	**	*	*	#	*		*
Physical ability/vitality	##		*		*	*	**
Rest and fatigue	**	*	***	##	**		**
Sensory function		**				#	
Social well-being							
Activities of daily Living		*		#		*	**
Communication		*				*	
Emotional fulfilment	**		*	##	**	#	
Family role		*					
Intimacy/isolation		*		#	*	#	
Independence						#	*
Looking to the future						#	*
Medical aids use		*					
Medical treatment	**			#	*		
Sexual relationships				#	*		
Social function	**	*		#	*	***	*
Self satisfaction				#			*
Spirituality				#	*		
Work function	**			#	*		*

Based on Hawthorne et al. (2000)

* Represents individual items related to this facet

Represents 4 items. Both the WHOQoL-100 and -BREF have domains representative of the environment that have not been included in this analysis

two exercise-training groups (*Muscle Strength* or *Muscle Power*) or to a non-training control group. Prior to training participants provided personal consent and also obtained approval for participation from their general practitioners. In addition, prior to training participants undertook familiarisation sessions to ensure a high level of technique adherence and to promote safety. Exercise participants trained twice-weekly for 24 weeks at a small specialised gymnasium at the University of Queensland (Brisbane, Australia). All participants used six exercise machines (Chest press, Supported row, Biceps curl, Leg press, Leg

curl and Leg extension) and followed a protocol of 3 sets of 8 repetitions. Resistance was maintained at a high-intensity (75% of their 1 repetition maximum) throughout the study and weights were altered weekly to promote progressive gains. Muscle strength and functional performance (battery of five tasks; functional reach, chair rise, 6 m and 400 m walk, and stair climbing) were assessed at baseline and post-intervention. Given the comparable physical improvements experienced by the exercise groups, and to increase the sample for the UQQoL assessment, exercise groups were pooled. Consequently, the combined exercise group was compared to the non-training control group to assess whether training could increase QoL among older adults. Following training, exercise participants had a significant increase in all muscle strength exercises ($p < 0.001$) when compared to controls, and significant improvement in the functional reach ($p = 0.012$), fast 6 m walk ($p = 0.001$), chair rise ($p < 0.001$) and 400 m walk ($p < 0.001$) task.

To examine the test–retest reliability of the instrument, the UQQoL was completed at baseline by a sample selected using simple randomisation (Schulz and Grimes 2002) of intervention participants ($n = 30$) (Myers et al. 1999). These participants were mailed the questionnaire and requested to complete and return it at the first baseline testing session. At this session, participants were issued with the retest instrument and guidelines to complete and return it at their final baseline testing session and to leave at least 1 week between the completion of the first and second instrument. During baseline testing all data related to the exercise intervention were collected in addition to the test–retest reliability of the instrument being measured. Baseline testing lasted a minimum of 1 week and a maximum of 10 days. To ensure similar test conditions, all participants who completed the UQQoL twice were asked whether there had been a change in their normal activity or lifestyle over this period. In addition, personal testimonials were collected from participants in relation to the time to completion of the UQQoL and of the SF-36.

To assess the appropriateness of the UQQoL among the older participants, the occurrence of floor (the lowest possible response) and ceiling (the highest possible response) effects were examined following baseline administration, and compared to those occurring with a well-validated instrument (SF-36).

To measure the *concurrent validity* of the UQQoL instrument, the SF-36 was administered to study participants at the same time points as the UQQoL (baseline and post-intervention), with the exception of the test–retest reliability administration. As a highly validated measure of health-related QoL (Bowling 1997), the SF-36 domains of physical function, bodily pain, general health, vitality, social function and mental health were used as an external

standard for correlation analysis with the UQQoL. A high correlation between similar domains at baseline would support the *concurrent validity* of the UQQoL. Conversely, a weak relationship between conceptually unrelated domains would be used to demonstrate discriminant validity. We expected discriminant validity to be demonstrated between previously unrepresented domains such as Body Image and the SF-36 measures of Role Physical and Social Function. We also expected the UQQoL domains measuring social and functional health to be conceptually unrelated to the SF-36 domains of generalised health and emotion. In contrast, it was predicted that the UQQoL summary scale would correlate strongly with all SF-36 domains representing physical health and well-being.

The responsiveness of the UQQoL instrument was assessed as its ability to detect change in participants over time (Husted et al. 2000).

A brief overview of the instrument development and validation are presented in Table 3.

Data analysis

Descriptive statistics were calculated using the SPSS (SPSS 11, Inc., Chicago, IL, USA) statistical software package. Intraclass correlation coefficients (ICC) on test–retest reliability data involved using an *alpha* model and 95% confidence intervals (Streiner and Norman 2003). Pearson's correlations were used to examine the concurrent validity between the UQQoL instrument and the SF-36, and strong associations defined as moderate to large correlations, >0.3 to >0.5 , respectively (Cohen 1988). In addition, Cronbach's alphas were calculated for the analysis of domain and instrument internal consistency. The item floor and ceiling magnitudes were calculated as a percentage of the total respondent population and an effect size of $>30\%$ was considered unacceptable (Streiner and Norman 2003). Independent sample *t* tests were used to compare groups at baseline, paired *t* tests to investigate within group change and two-way repeated measures analysis of variance (ANOVA) was used to examine group differences over the training period and investigate the instruments sensitivity and predictive validity. In addition, standard response mean effect sizes (ES) were calculated to assess responsiveness. An alpha level of 0.050 was adopted for significance.

Results

Sixty-one participants commenced (exercise: 17 male, 26 female, control: 6 male, 12 female) and 51 participants completed the training intervention (exercise: 14 male, 22 female, control: 5 male, 10 female). Baseline

Table 3 Development and validation of the University of Queensland Quality of Life Instrument (UQQoL)

Development phase
Focus groups: 3 perspectives of older adults ($n = 18$; aged 65–81 years; 10 M)
Focus group data analysis and field generation using the NVivo qualitative data software package
Review of pre-existing instruments
Initial item generation based on emerging categories
Blinded random pre-pilot testing ($n = 20$) (<i>content validity</i>)
Items consolidation and refinement of questionnaire
Reliability phase
Administration to 30 adults (aged 65–84 years; 12 M) on 2 occasions, 1 week apart
Validation and pilot phase
Administration to 61 adults (aged 65–84 years; 23 M) entering a training intervention
Administration of SF-36 to intervention cohort for purpose of analysing <i>concurrent validity</i>
Pre- and post-comparisons on 53 participants completing the training intervention
Data consolidation and analysis
Document preparation related to the pilot trial of the instrument containing limitation and benefits

N number, *M* males, *NVivo* QRS NVivo, Melbourne, Aust

characteristics for the total, exercise and control groups are presented in Table 4. At baseline there was no difference between exercisers and controls for any measure and those who withdrew from the study were not distinguished from those who remained ($p > 0.050$). No change in normal activity was reported during the test–retest reliability period. In addition, participants' testimonials suggested the UQQoL questionnaire required around 5 min (maximum of 10) for completion, approximately a quarter of the time required for the SF-36.

Psychometric properties

The ICC for the UQQoL summary scale was 0.85 [95% confidence intervals (CI) = 0.51, 0.96] indicating good temporal stability over a 1 week period among older adults preparing to enter a training intervention. For the specific domains ICCs were as follows: General Health: 0.68 (CI = 0.34, 0.86), Mental Well-Being: 0.64 (CI = 0.05, 0.91), Physical Well-Being: 0.86 (CI = 0.52, 0.96), Role Physical: 0.67 (CI = 0.10, 0.92), Bodily Pain: 0.75 (CI = 0.26, 0.94), Social Interaction: 1.0 (CI = 1.0, 1.0), Sleep: 0.87 (CI = 0.56, 0.97), Physical Ageing: 0.84 (CI = 0.46, 0.96) and Bodily Image: 0.53 (CI = 0.21, 0.84). In addition, Cronbach's alphas for the summary scale and domains were as follows: UQQoL summary scale: 0.97, General Health: 0.63, Mental Well-Being: 0.77, Physical

Well-Being: 0.91, Role Physical: 0.78, Bodily Pain: 0.85, Social Interaction: 1.0, Sleep: 0.92, Physical Ageing: 0.91 and Bodily Image: 0.91. Strong Cronbach's alpha scores represented good domain consistency over a 1 week period.

The UQQoL summary scale can range from 16 to 80, with high scores indicating a greater QoL. When examining baseline data a mean value of 60.0 ± 8.9 was found, which sat slightly above the desired central range (Streiner and Norman 2003). However, these above average scores were also reflected by the SF-36 scores.

Assessment of the UQQoL's Internal Consistency produced moderate Cronbach's alpha (0.72) (Streiner and Norman 2003). In addition, each individual domain was moderately correlated with the summary scale indicating homogeneity (range 0.39–0.81) (Myers et al. 1999; Streiner and Norman 2003) (Table 5 bottom row).

Concurrent validity

When a bivariate analysis was undertaken, the UQQoL achieved strong correlations between conceptually related SF-36 domains, more so than unrelated domains, supporting the concurrent and divergent validity of the instrument (Table 5). The UQQoL summary scale was significantly correlated with all the domains of the SF-36 and the Physical and Mental Component Summary scales (PCS and MCS, respectively). However, the UQQoL summary scale displayed the largest correlation with those domains reflecting the physical health of the individual. A strong correlation between the SF-36 PCS and UQQoL summary scale further reflected the instrument's relationship with physical well-being.

While the UQQoL summary scale was well within an acceptable floor and ceiling range, other specific domains returned items at an unacceptable ceiling. Unacceptable ceiling effects were found with both the SF-36 domains of Social Function (72.10%) and UQQoL domain of Social Interaction (70.53%), and similarly the SF-36 domain Role Physical (65.63%) and UQQoL Role Physical domain (57.43%). In contrast, no unacceptable floor effects were found in either questionnaire.

Sensitivity and predictive validity

For the UQQoL summary score, following training there was no effect for time ($F = 3.63$, $p = 0.073$), but a group by time interaction emerged ($F = 7.27$, $p = 0.010$). In addition to increases in muscle strength and functional performance, training had a significant effect on QoL when compared to controls ($F = 0.34$, $p = 0.009$). While the exercise group experienced a significant increase in QoL (59.77 ± 8.30 – 63.17 ± 7.61 , $F = 21.35$, $p < 0.001$, $ES = 0.77$), no change was observed in the control group

Table 4 Total and group characteristics at baseline

	Total group (<i>N</i> = 61)	Range (total group)	Exercise (<i>N</i> = 43)	Control (<i>N</i> = 18)	<i>p</i> value ^a
Age (years)	70.30 ± 5.05	65.01–84.90	70.30 ± 5.05	69.22 ± 3.86	0.420
Height (cm)	166.87 ± 7.84	149.00–183.20	165.55 ± 7.85	167.88 ± 7.61	0.291
Weight (kg)	74.01 ± 11.48	46.32–101.00	74.82 ± 12.03	70.89 ± 11.32	0.241
BMI (kg/m ²)	26.58 ± 3.84	17.83–36.25	27.29 ± 3.91	25.15 ± 3.78	0.054
UQoL summary score	60.61 ± 9.14	37.00–75.00	59.93 ± 8.57	62.22 ± 10.45	0.376
SF-36: PCS	49.63 ± 0.96	47.42–52.37	49.52 ± 1.00	49.89 ± 0.86	0.178
MCS	50.35 ± 0.93	46.60–51.75	50.35 ± 1.00	50.33 ± 0.78	0.929

BMI Body mass index, *UQoL* University of Queensland Quality of Life instrument, *PCS* physical component summary, *MCS* mental component summary, values are mean and SD

^a Of test of difference between exercise and control groups

Table 5 Pearson's correlation coefficients between the SF-36 and UQoL instruments

	General Health	Physical Well-Being	Physical Ageing	Sleep	Mental Well-Being	Role Physical	Bodily Pain	Social Interaction	Body Image	UQoL Sum. Sc.
SF-36										
Physical Health	0.41	0.39	0.28	0.23	0.13	0.22	0.41	0.02	0.17	0.47
Role Physical	0.57	0.43	0.26	0.22	0.35	0.21	0.49	0.21	0.08	0.55
Bodily Pain	0.47	0.35	0.23	0.19	0.23	0.29	0.53	0.16	0.18	0.50
General Health	0.47	0.35	0.39	0.05	0.36	0.19	0.37	0.06	0.13	0.48
Vitality	0.44	0.39	0.32	0.19	0.44	0.14	0.49	0.26	0.19	0.52
Social Function	0.51	0.40	0.34	0.16	0.33	0.13	0.53	0.15	0.12	0.52
Role Emotional	0.25	0.26	0.26	0.13	0.25	−0.08	0.31	0.08	0.18	0.34
Mental Health	0.37	0.16	0.16	0.24	0.44	0.10	0.21	0.05	0.15	0.39
PCS	0.55	0.31	0.31	0.23	0.19	0.29	0.56	0.13	0.14	0.57
MCS	0.37	0.32	0.25	0.19	0.44	0.05	0.32	0.11	0.18	0.40
UQoL Sum. Sc.	0.78	0.81	0.63	0.51	0.55	0.44	0.58	0.40	0.39	

Using Cohen's convention (Cohen 1988) the magnitude of the correlation can be viewed as follows; >0.5 large, 0.5–0.3 moderate, <0.3 small. All strong correlations (>0.30) are highlighted

UQoL University of Queensland Quality of Life instrument, *PCS* physical component summary, *MCS* mental component summary. *N* = 61

(60.93 ± 10.49–60.27 ± 9.99, $F = 0.18$, $p = 0.677$, $ES = -0.11$). The increase in QoL was not reflected by either of the SF-36 summary scales (PCS and MCS), ($p = 0.554$ and 0.337 , respectively). In addition, the exercise group displayed a significant increase in the UQoL dimensions Mental Well-Being, Physical Well-Being, Physical Ageing and Bodily Pain ($p < 0.050$).

Discussion

The aim of the present study was to design and validate a quality of life questionnaire specific to the impact of

physical well-being among older adult. Prior to the design of the questionnaire, substantial research revealed that to successfully investigate the subjective concept of quality of life an instrument must embrace the physical, psychological and social domains (Bowling 1997; Halvorsrud and Kalfoss 2007; Osborne et al. 2003; Spirduso and Cronin 2001). The study further aimed to assess these concepts in a brief questionnaire that could be easily completed by the target population of older adults.

As a measure of QoL, the UQoL displayed good reliability among a target population of older adults undertaking resistance exercise. In addition, the UQoL summary score showed strong correlations with all

domains of the SF-36 that reflected physical and functional health. The UQQoL is a straightforward instrument that requires less time to complete than alternative questionnaires, which is suggested to be an advantage when investigating older populations (McHorney 1996). In addition, following 24 weeks of resistance training, increased muscle strength and functional ability were accompanied by an increase in QoL as measured by the UQQoL.

The UQQoL was designed following focus group discussions aimed at identifying physical health factors important to the older adult and related to physical health. Specifically, the individual's perception of functional well-being was highlighted by group discussion and the effect appropriate exercise could have on parameters such as functional and physical confidence identified. In contrast, instruments such as the AQoL (Osborne 2003) and WHOQoL (Hawthorne 2003a, b) are weighted significantly towards the more psychological domains of QoL. In relation to the older adult this is of particular concern due to the significant decrease in the physical and functional health experience with increasing age (Walters et al. 2001). As mental health is reported to remain relatively unchanged throughout the lifespan (Walters et al. 2001) it is not surprising that the WHOQoL and similar instruments detect no change in QoL following exercise, even though significant positive functional benefits occur.

If effective in measuring overall physical well-being, the UQQoL would have significant correlation with selected SF-36 domains (i.e., concurrent validity). As a recognised gold standard, the SF-36 has been regularly used to investigate concurrent validity in emerging QoL instruments (Bowling 1997; Myers et al. 1999; Oldridge et al. 2002; Hawthorne 2003b; Nichols et al. 2003). Strong associations were noted between the UQQoL summary scale and the four conceptually related SF-36 domains (Role Physical, Bodily Pain, Vitality and Social Function), however, the highest correlation was found with the Physical Component Scale (PCS). This association reflects the ability of the instrument to effectively measure the physical components of QoL. It is also worth noting the strong correlation between the UQQoL summary scale and General Health domain, and the SF-36 domain of Social Function. Given recent evidence that the loss of social networks is significantly associated with later life depression (Greaves and Farbus 2006), this correlation points to an interaction of social and physical well-being in later life. Moreover, as these participants felt they had a high level of social capability, as reflected by the ceiling effect returned for the domain of Social Function, this increased social well-being may have resulted in a perceived high level of health and quality of life.

Interestingly, the Physical Ageing domain, concerned with the impact of ageing on the individual, displayed moderate correlation with a number of the SF-36 domains, most noticeably Vitality and General Health, designed to evaluate the pep and energy, and rise and fall in the health of the individual, respectively. These moderate correlations support the idea that successful ageing, and its subjective impact on the individual, is a multifactorial event that is influenced by many of the concepts that encompass QoL. The UQQoL dimensions of Role Physical, Social Interaction, Sleep and Body Image displayed low correlation with the SF-36. However, of these, all returned good divergent validity with non-related domains or domain related only in part. Most notably was the negative correlation between the UQQoL domain of Role Physical and the SF-36 domain of Role Emotional that represented the unrelated nature of these items. In contrast, the low correlation between the UQQoL domain of Role Physical and the SF-36 domain of Bodily Pain, assessing magnitude and interference of pain, may be representative of the in part association related to movement limitations.

All items within the UQQoL were intended to target independent older adults and were carefully worded to reflect situations to which they could relate. For example, the domain of Role Physical was based on the confidence the individual would have in picking up a grandchild. As these questions were specifically designed for this age group, it may explain why strong correlations were not found between what appeared to be conceptually related domains. Where the UQQoL Role Physical domain assessed specific functional interaction, the SF-36 domain of Role Physical is a broader concept assessing limitations and accomplishments in functional well-being. Likewise, the UQQoL domain of Social Interaction, assessing an older individual's confidence interacting across age groups, did not correlate strongly with the SF-36 domain of Social Function that examines social extent and time. The UQQoL included new domains that have until recently not been well represented in QoL instruments, but are shown to be related to raised levels of activity among an older population. In addition to improved quality of sleep (Buchner 1997; King et al. 2000), the item body image was included because focus group discussions gave prominence to this issue and suggested that satisfaction with body image might relate to QoL (Hulens et al. 2002; Webster and Tiggemann 2003).

Approximately half of the participants tested in this study indicated that their Mental Health and Physical Function were uncompromised. While this is a consideration for future versions of the UQQoL, the high functioning nature of intervention participants and the occurrence of ceiling effects often compromise the measurement of significant change (Bowling 1997; Streiner and

Norman 2003). Specifically, when large numbers of subjects return the highest score available, no room for improvement is possible. Fortunately, the problem caused by participants scoring at ceiling levels is somewhat alleviated by the UQQoL summary score, which remained below the instrument's ceiling prior to and following training. Moreover, it would be expected that if this tool was administered to the general population, the ceiling effects observed in the current study would be reduced.

The UQQoL displayed good test–retest reliability over a 1 week period for individuals maintaining normal activity pattern. In contrast, following long-term exercise the instrument was sensitive to the change in QoL that accompanied increased functional ability. While a relationship between increased physical and functional ability, and QoL has not been demonstrated in a healthy older cohort (Damush and Damush 1999; King et al. 2000), studies using individuals with chronic disease or disability regularly report this association (Rejeski et al. 1996; Singh et al. 2001; Willenheimer et al. 2001). Studies among institutionalised populations reinforce the impact of exercise upon well-being and further establish the need for a QoL measure sensitive to the benefits experienced by disease or disability free older adults. Moreover, the UQQoL was sensitive enough to show change in individuals who already displayed a higher than average QoL. In the present study participants aged 65–74 years scored themselves 17, 22 and 19% higher, and those 75 years and older scored themselves 57, 38 and 24% higher for the SF-36 domains of Physical Health, Role Physical and General Health, respectively, when compared to Australian norms (Australian Bureau of Statistics 1995) for the same age groups. However, in comparison to the UQQoL the SF-36 was not sensitive to change in QoL following training for exercise participants.

There are some limitations to this study. The older population is highly diverse, but this instrument was developed and tested with healthy community-dwelling older adults only. While the present data suggest a positive association between increased physical function and QoL, unmeasured factors such as social environment and exercise empowerment may also have had an influence (Katula et al. 2006). As a new instrument, the UQQoL requires more extensive testing within the older population, including frail older people and those with disability. In addition, given the association of the many modes of exercise with improved physical well-being among older adults (Evans 1995; Evans 1999), the application of this tool to aerobic and/or specific functional interventions is needed to broaden its spectrum of use. Finally, we acknowledge the limitations of the study's sample size. As the investigation was part of a larger

study (Henwood and Taaffe 2007), this restricted the sample available for the present study. For the larger study, the sample was calculated using an alpha of 0.050 for a two-tailed test and a statistical power of 80% (0.80). Using previous data from our laboratory it was observed that a SD for change in muscle strength and functional performance was approximately 25 and 15%, respectively. Therefore, when considering a SD of 1 (25%) and allowing for study dropouts, we aimed to recruit 20 participants per group. Following recruitment, baseline testing was undertaken with 61 participants, of whom 36 exercise and 15 control subjects completed the study, thereby allowing sufficient analytical power.

Following 24 weeks of high-intensity resistance exercise, participants had significantly increased their muscle strength and functional ability, reflected by an increase in QoL as measured by the UQQoL. Following training, participants rated their Physical Well-Being better, were more optimistic about the ageing process, experienced fewer aches and pains, and said they had a more positive outlook.

Conclusion

As a quality of life instrument, the UQQoL demonstrated that it was able to go beyond the domains of physical and cognitive health typical of health-related QoL instruments. While the scope of the UQQoL may not be as broad as instruments such as the WHOQoL that include items specific to environmental or spiritual satisfaction, it does investigate an individuals' ability to interact in their home and external environment. Consequently, the UQQoL has shown itself to be a promising tool, appropriate to its target population and easy to complete. Importantly, the UQQoL is capable of assessing the interaction between the benefits of physical activity for older adults and the associated increase in QoL. The ability of exercise studies to report an improved QoL in older individuals will further establish the efficacy of these interventions beyond the physical and functional benefits presently reported. Given the outcomes of this study, the UQQoL appears an appropriate tool for measuring the QoL changes that result from the physical and functional improvements associated with exercise-training among older adults.

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Appendix

With the exception of the title page, which has had the University of Queensland logo removed, the version of the UQQoL presented here has been significantly decreased in front size for the convenience of the reader.

University of Queensland Quality of Life Instrument

Instructions.

This questionnaire aims to assess your current quality of life, physical health and social well-being. The questions are concerned with both the mental and physical aspects of your day-to-day life. Please answer each question by placing a circle around one answer which best describes you.

Examples:

A. I have no problem with household tasks.

You would circle “TRUE” if you experience no restrictions within your own home.

B. I have no problem with household tasks.

But if required assistance for the bulk of the household tasks (e.g. laundry, cleaning, bed making) then you would circle “ALMOST NEVER TRUE”.

Name: _____

Please answer all questions.

1. My physical ability concerns me.

2. I feel my quality of life could be better.

3. Lifting a child (3 years and under) is something I would not hesitate to do.

4. In day-to-day life aches and pains always affect me.

5. I feel confident among people of all ages.

6. If I was stronger I would be more confident with every day activities.

7. I have a positive outlook.

8. Ageing has had an impact on my physical well-being.

9. Changes in my physical well-being as I age concern me.

10. I am satisfied with my present level of health.

11. I have no problem with household tasks.

12. Tasks away from the house (e.g. Shopping) require the assistance of others.

13. In my garden my activity is not limited.

14. I have trouble getting to sleep.

15. My sleep is never broken or restless.

16. When I look at my body in the mirror I am satisfied with what I see.

Thank you for completing this questionnaire.

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