

## Utility and Validity of the Self-administered SF-36: Findings From an Older Population

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### Abstract

**Introduction:** The objectives of this study were to assess the utility and validity of the self-administered SF-36 and the effect of visual or cognitive impairment on these measures in an older population. **Materials and Methods:** Attempt rates, completion rates and internal consistency (Cronbach  $\alpha$ ) were compared within the second cross-sectional, population-based Blue Mountains Eye Study (n = 3509, mean age 66.7 years, 57% women). **Results:** The SF-36 was attempted by 3162 (90.1%) participants, of which 2470 (78.1%) completed all items and 2873 (90.9%) completed sufficient items for calculation of all dimensions. In a multivariate model adjusting for age, sex, and presenting visual and cognitive impairments, women ( $P = 0.011$ ) and participants with visual or cognitive impairments ( $P < 0.0001$ ) were less likely to attempt the questionnaire. Completion rates were significantly lower with increasing age ( $P < 0.0001$ ), in men ( $P \leq 0.0005$ ) and in those with cognitive impairment ( $P < 0.0001$ ). A high level of internal consistency (Cronbach  $\alpha > 0.85$  for all dimensions) and construct validity was demonstrated, the latter distinguishing between those with and without medical conditions, disabilities or recent hospital admissions ( $P < 0.01$ ). As the prevalence of visual or cognitive impairment was relatively low in this population, we found no apparent effect of these impairments on the validity of SF-36. **Conclusions:** Attempt and completion rates, but not internal consistency and construct validity, of the SF-36 were influenced by age, gender, and presenting visual and cognitive impairments. The overall high attempt and completion rates, internal consistency and construct validity suggest that the self-administered SF-36 is a suitable health-related quality of life (HRQOL) measure in similar older community-living populations.

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**Key words:** Ageing, Cognitive impairment, Quality of life, SF-36, Validity, Visual impairment

### Introduction

The shift towards broader health perspectives and the emphasis on patient preferences have led to the development of many health questionnaires<sup>1</sup> and their inclusion as primary and secondary outcome measures in clinical trials. Measurements of health-related quality of life (HRQOL), a multidimensional concept encompassing physical, emotional and social aspects associated with a disease or its treatment,<sup>2,3</sup> are increasingly used to organise, finance and deliver health care services for the growing older population.<sup>4</sup> The generic, multidimensional 36-item Short-

Form health survey (SF-36)<sup>5</sup> has been used across a range of populations, disease and treatment groups.<sup>6-13</sup> The advantages of the SF-36 over other similar instruments, particularly its balance between being concise but comprehensive, and its versatility, suitable for self-, interview- and telephone-administration, have led to its widespread use in many studies.<sup>4,5,14-18</sup>

Validation studies of the SF-36 in older populations have reported conflicting evidence for its suitability in this age group, particularly the more commonly used self-administered version. Studies supporting its use include

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those by Singleton and Turner,<sup>19</sup> Lyons et al,<sup>20</sup> Hayes et al<sup>18</sup> and Walters et al<sup>21</sup> However, studies reporting concerns have suggested its usefulness may be compromised by low response rates, high levels of missing data and the inability of many older persons to independently complete self-administered questionnaires,<sup>14,15,18,22,23</sup> particularly those with visual and cognitive impairments.<sup>18,22</sup> The age-related increase in the prevalence of visual and cognitive impairments has been well documented.<sup>24-29</sup> Hence there is a need to determine the extent to which these impairments interfere with the utility and validity of this common health outcome measure in older populations.

This report aims to assess the utility and validity of the self-administered SF-36 as a health outcome measure in an older, community-living population sample and to determine whether the SF-36 utility and validity is compromised by the presence of visual or cognitive impairments.

## Materials and Methods

### *Study Population*

The Blue Mountains Eye Study (BMES) is a population-based cohort study of an older urban population, living in the Blue Mountains region, west of Sydney, Australia.<sup>27</sup> Study procedures were approved by the University of Sydney Human Research Ethics Committee and in accordance with the tenets of the Declaration of Helsinki.

In 1991, BMES I identified 4433 eligible non-institutionalised permanent residents from a defined area, in a door-to-door census. Of this target population, 3654 (82.4%) participated in detailed examinations during 1992 to 1994. During 1997 to 1999, all BMES I participants were invited to attend 5-year follow-up examinations (BMES IIA). By the time these commenced, 543 persons had died (14.9%) and 2335 (75.1% of surviving participants) were re-examined. In 1999, a repeat door-to-door census conducted in the same area identified 1378 additional eligible permanent residents who had moved into the targeted area or study age group. We examined 1174 (85.2%) of this group during 1999 to 2000 (BMES IIB). Cross-section 2 thus comprised 3509 participants from BMES IIA and IIB.<sup>30</sup>

### *Instrument Used*

The SF-36 contains 36 items measuring 8 dimensions of health and well-being, namely “physical functioning”, “role limitations due to physical problems”, “bodily pain”, “general health perceptions”, “vitality”, “social functioning”, “role limitations due to emotional problems” and “mental health”.<sup>31</sup> The Australian-adapted version<sup>32</sup> was used in this study.

Each dimension was scored from 0 (worst possible health state) to 100 (best possible health state) by coding,

summing and transforming its relevant item scores according to the SF-36 manual.<sup>33</sup> Missing values were substituted by averaging other items if the number of missing items was less than half the total number of items in that dimension. No substitution was used for dimensions with only 2 items. Physical and mental component scores were summary measures calculated only when scores were available from all dimensions using factor analysis and Australian normalised scores.<sup>34,35</sup>

### *Data Collection*

Prior to their examination, all participants were sent a 6-page questionnaire that included the SF-36. Additional information on lifestyle, long-standing medical conditions, disability and hospital admissions during the last 12 months, together with visual acuity and Mini Mental State Examination (MMSE),<sup>36</sup> was obtained by trained interviewers during clinic attendance 1 to 2 weeks later. Participants were asked to bring the questionnaire booklets to their examination or to return it by reply-paid mail.

### *Definitions*

Questionnaires were considered attempted if any of the 36 items were answered and considered complete when either all items were scored or when sufficient questions had been completed for a score to be calculated in each dimension.

Mild visual impairment was defined as presenting visual acuity (using current glasses, if worn) in the better eye of worse than 6/12, but better than or equal to 6/24; moderate visual impairment as visual acuity worse than 6/24 but better than or equal to 6/60 and severe visual impairment (blindness) as visual acuity worse than 6/60. Cognitive impairment was defined as MMSE score <24/30.

### *Statistical Analysis*

The utility of the SF-36 in this population was assessed by an examination of the attempt and completion rates. Univariate analyses and multivariate logistic regression model analyses were conducted by age, sex and by the presence of visual and cognitive impairment.

Internal consistency or the extent to which items within the same dimension correlated with each other was measured using the Cronbach  $\alpha$  statistic.<sup>37</sup> Ranging between 0 and 1, higher values indicate higher correlation; values of  $\geq 0.7$  were considered acceptable.<sup>38</sup> The internal consistency as well as the correlations between dimensions were also compared, as outlined by McHorney,<sup>4</sup> among the subgroups of patients with and without visual and cognitive impairments.

Construct validity was assessed by comparing mean scores of participants with and without medical conditions

Table 1. SF-36 Dimensions: Comparison of Completion Rates and Mean Scores for Two Different Definitions of Completion Rate and Internal Consistency (Cronbach  $\alpha$ ).

	Completion rates				Cronbach $\alpha$
	All items		Dimensions		
	n (%)	Mean score (95% CI)	n (%)	Mean score (95% CI)	
Physical functioning (10 items)	2872 (90.8)	73.2 (72.3-74.1)	3123 (98.8)	72.1 (71.2-73.0)	0.867
Role limitation: physical (4 items)	3003 (95.0)	67.5 (66.1-69.0)	3076 (97.3)	67.0 (65.5-68.4)	0.869
Bodily pain (2 items)	3092 (97.8)	70.7 (69.8-71.6)	3143 (99.4)	70.6 (69.7-71.5)	0.868
General health (5 items)	2911 (92.1)	68.0 (67.2-68.8)	3006 (95.1)	67.9 (67.1-68.6)	0.868
Vitality (4 items)	3003 (95.0)	61.9 (61.2-62.7)	3109 (98.3)	61.9 (61.2-62.7)	0.862
Social function (2 items)	3077 (97.3)	83.9 (83.1-84.8)	3135 (99.2)	83.7 (82.9-84.6)	0.863
Role limitation: emotional (3 items)	3001 (94.9)	80.9 (79.7-82.2)	3034 (96.0)	80.6 (79.3-81.8)	0.878
Mental health (5 items)	3007 (95.1)	78.4 (77.8-79.0)	3095 (97.9)	78.3 (77.7-78.9)	0.874

Table 2a. Participants Attempting and Completing the SF-36 Questionnaire by Age and Sex

Age group (y)	50-64	65-74	75-84	85+	Total
<b>Attempted SF-36</b>					
Men (%)	574 (87.0)	502 (90.9)	227 (91.2)	39 (79.6)	1342 (88.9)
Women (%)	796 (91.5)	618 (93.8)	336 (87.5)	70 (82.4)	1820 (91.1)
Persons (%)	1370 (89.5)	1120 (92.5)	563 (88.9)	109 (81.3)	3162 (90.1)
<b>Completed SF-36 (all items)</b>					
Men (%)	501 (87.3)	404 (80.5)	158 (69.6)	29 (74.4)	1092 (81.4)
Women (%)	664 (83.4)	468 (75.7)	210 (62.5)	36 (51.4)	1378 (75.7)
Persons (%)	1165 (85.0)	872 (77.9)	368 (65.4)	65 (59.6)	2470 (78.1)
<b>Completed SF-36 (all dimensions)</b>					
Men (%)	547 (95.3)	470 (93.6)	206 (90.8)	36 (92.3)	1259 (93.8)
Women (%)	739 (92.8)	559 (90.5)	268 (79.8)	48 (68.6)	1614 (88.7)
Persons (%)	1286 (93.9)	1029 (91.9)	474 (84.2)	84 (77.1)	2873 (90.9)

(defined as a self-reported history of angina, acute myocardial infarct, stroke, cancer excluding skin cancer, arthritis, diabetes mellitus or asthma), disability (defined as any visual or cognitive impairment, mobility impairment or walking difficulty, use of a cane/crutches, walker or wheelchair as determined by trained examiners, and hearing impairment or average pure-tone air conduction hearing threshold >25 dB over 4 frequencies in the range of 500 to 4000 Hz in the better ear), and hospital admissions as those within the previous 12 months. After adjusting for age and sex, the differences between mean scores of each dimension and summary component scores were compared using analysis of covariance.

## Results

### Response and Completion Rates

BMES participants had a mean age of 66.7 years (range, 49 to 98) and 57% were women. The self-administered SF-36 was attempted by 90.1% of the participants (3162/

3509), of which 78.1% ( $n = 2470$ ) completed all 36 items and 90.9% ( $n = 2873$ ) answered sufficient items for scores to be calculated in each dimension.

Item completion ranged from 94.9% (item 11d) to 99.4% (items 11a and 11c) (data not shown). Completion of all items within a dimension or calculation without interpolation ranged from 90.8% ("physical functioning") to 97.8% ("bodily pain"). Dimension completion with interpolation ranged from 95.1% ("general health") to 99.4% ("bodily pain", Table 1). More than one-third of the participants who did not complete all items only missed 1 item (38.3%,  $n = 265$ ), with the majority of participants missing 3 or fewer items (65.5%,  $n = 453$ ).

As outlined in Table 2a, the rate at which the SF-36 was attempted and completed (with interpolation) was greater than 80% for all age groups except for the completion rate in the 85+ year age group (77.1%). There was a significant decline in both attempt and completion rates with increasing age ( $P < 0.001$ ) after adjusting for sex. After age- and sex-

adjustment, participants with presenting visual impairment were significantly less likely to attempt ( $P < 0.0001$ ) the SF-36 but their completion rates were not significantly lower ( $P \leq 0.65$ ). However, after age- and sex-adjustment, participants with cognitive impairment were less likely to attempt ( $P < 0.0001$ ) and complete ( $P \leq 0.045$ ) the SF-36 (Table 2b).

Multivariate models simultaneously adjusting for all the co-variables showed that the SF-36 was less likely to be attempted by women ( $P = 0.011$ ) and by participants with visual or cognitive impairments ( $P < 0.0001$ ). Completion rates were also significantly lower with increasing age ( $P < 0.0001$ ), in men ( $P \leq 0.0005$ ) and in those with cognitive impairment ( $P < 0.0001$ , Table 3). Using our first definition, i.e., completion of all items, both presenting visual and cognitive impairments were associated with lower completion rates, though this was not statistically significant ( $P = 0.092$  and  $0.085$ , respectively).

#### Internal Consistency and Construct Validity

A high degree of internal consistency was demonstrated as indicated by the Cronbach  $\alpha$  statistic exceeding 0.85 for

Table 2b. Participants' Attempt and Completion Rates of the SF-36 Questionnaire by Presenting Visual and Cognitive Impairments

SF-36 questionnaire	Attempted	Completed (all items)	Completed (all dimensions)
<b>Visual impairment (VI)</b>			
No VI (%)	2916 (91.0)	2309 (79.2)	2666 (91.4)
Mild VI (%)	210 (83.7)	141 (67.1)	178 (84.8)
Moderate – severe VI (%)	27 (69.2)	15 (55.6)	21 (77.8)
<b>Cognitive impairment (CI)</b>			
No CI (%)	2979 (91.1)	2309 (79.2)	2723 (91.4)
CI (%)	85 (75.9)	141 (67.1)	60 (70.6)

Table 3. Multivariate Model\* of Participants Attempting and Completing the SF-36, Expressed as Odds Ratios (OR), with 95% Confidence Intervals (CI)

	Attempted SF-36		Completed SF-36			
	OR (95% CI)	P value	All items		All dimensions	
			OR (95% CI)	P value	OR (95% CI)	P value
Age	1.07 (0.92-1.22)	0.33	0.62 (0.56-0.69)	<0.0001	0.64 (0.56-0.75)	<0.0001
Women	0.74 (0.59-0.94)	0.011	1.38 (1.15-1.65)	0.0005	1.94 (1.47-2.55)	<0.0001
Visual impairment	0.49 (0.26-0.55)	<0.0001	0.79 (0.60-1.03)	0.085	0.84 (0.60-1.18)	0.31
Cognitive impairment	0.36 (0.22-0.58)	<0.0001	0.67 (0.42-1.07)	0.092	0.32 (0.19-0.54)	<0.0001

\* Adjusted variables including age, sex, presenting visual and cognitive impairments.

each dimension (Table 1). This was also demonstrated among the subgroups of patients with and without visual or cognitive impairments (Table 4). A high degree of correlation among the SF-36 dimensions in participants with and without presenting visual impairment was also demonstrated. Although some differences in correlation coefficients between participants with and without cognitive impairments were found, no consistent pattern of difference was evident.

Construct validity is shown in Table 5. Participants with medical conditions ( $n = 1778$ , 43.8%), disabilities ( $n = 1016$ , 32.1%) or hospital admissions within the last 12 months ( $n = 743$ , 30.7%) consistently reported less favourable outcomes ( $P < 0.01$ ) than participants without these conditions.

#### Discussion

Our study demonstrated that the self-administered SF-36 was attempted and completed by more than 90% of community-living older participants, with a high level of internal consistency and construct validity. Women and participants with visual or cognitive impairments were less likely to attempt the questionnaire but completion rates were significantly lower with increasing age, in men and in those with cognitive impairment.

Previous validation studies of the SF-36 have reported conflicting evidence for its utility in older populations. Studies cautioning its use in the older population have tended to have smaller sample sizes<sup>23</sup> or been based on hospital patients.<sup>22</sup> Parker et al<sup>22</sup> reported a response rate of 46% for the self-administered SF-36 among participants aged  $\geq 65$  years. Hayes et al<sup>18</sup> reported that 43% of participants aged  $\geq 65$  years were unable to self-complete the SF-36 due to visual problems, writing difficulties or a general unfamiliarity with completing questionnaires. On the other hand, studies supporting the use of the

Table 4. SF-36 Profiles to Demonstrate Construct Validity: Age- and Sex-adjusted Mean Scores (standard error) for 8 Dimensions and Physical and Mental Component Scores (PCS and MCS, respectively).

	Physical function	Role limit physical	Bodily pain	General health	Vitality	Social function	Role limit emotional	Mental health	PCS	MCS
<b>Medical condition</b>										
None (n = 1384)	78.8 (0.6)	76.3 (1.1)	78.9 (0.7)	74.1 (0.6)	66.8 (0.6)	87.3 (0.6)	83.9 (1.0)	79.8 (0.5)	48.7 (0.3)	52.4 (0.3)
≥1 (n = 1778)	66.8 (0.6)	59.7 (1.0)	64.0 (0.6)	62.9 (0.5)	58.1 (0.5)	80.9 (0.6)	78.0 (0.8)	77.2 (0.4)	42.1 (0.3)	51.4 (0.3)
P value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0083
<b>Disability</b>										
None (n = 2143)	75.6 (0.5)	70.5 (0.9)	73.3 (0.6)	70.0 (0.5)	63.9 (0.5)	86.2 (0.5)	82.6 (0.8)	79.4 (0.4)	46.3 (0.2)	52.4 (0.2)
≥1 (n = 1016)	64.6 (0.8)	59.3 (1.3)	64.8 (0.8)	63.4 (0.7)	57.6 (0.7)	78.3 (0.8)	76.0 (1.2)	75.9 (0.6)	42.2 (0.4)	50.6 (0.3)
P value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
<b>Hospital admission</b>										
None (n = 2419)	74.2 (0.5)	70.4 (0.8)	72.9 (0.5)	70.0 (0.4)	63.5 (0.4)	85.7 (0.5)	81.9 (0.7)	79.1 (0.3)	46.1 (0.2)	52.2 (0.2)
≥1 (n = 743)	65.0 (0.9)	55.5 (1.5)	62.7 (0.9)	61.5 (0.8)	56.7 (0.8)	77.3 (0.9)	76.3 (1.3)	75.7 (0.6)	41.5 (0.4)	50.5 (0.4)
P value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002

Table 5. Comparing Correlation Coefficients and Cronbach α of SF-36 Dimensions for Participants With (Without) Presenting Visual or Cognitive Impairments

	PF	RP	BP	GH	VT	SF	RE	MH	Cronbach α
<b>Presenting visual impairment (n = 199)</b>									
Physical function (PF)		0.61 (0.59)	0.61 (0.53)	0.54 (0.55)	0.64 (0.55)	0.56 (0.47)	0.42 (0.34)	0.37 (0.28)	0.872 (0.851)
Role limit physical (RP)			0.62 (0.57)	0.58 (0.52)	0.60 (0.57)	0.66 (0.57)	0.60 (0.49)	0.39 (0.35)	0.869 (0.851)
Bodily pain (BP)				0.53 (0.49)	0.52 (0.54)	0.52 (0.50)	0.48 (0.32)	0.35 (0.34)	0.874 (0.851)
General health (GH)					0.64 (0.63)	0.54 (0.46)	0.44 (0.36)	0.46 (0.45)	0.876 (0.851)
Vitality (VT)						0.59 (0.60)	0.42 (0.44)	0.57 (0.61)	0.873 (0.843)
Social function (SF)							0.62 (0.52)	0.56 (0.56)	0.866 (0.845)
Role limit emotional (RE)								0.54 (0.54)	0.882 (0.864)
Mental health (MH)									0.885 (0.861)
<b>Cognitive impairment (n = 60)</b>									
PF		0.69 (0.59)	0.48 (0.54)	0.54 (0.55)	0.54 (0.56)	0.58 (0.48)	0.46 (0.34)	0.45 (0.28)	0.862 (0.852)
RP			0.56 (0.57)	0.53 (0.53)	0.52 (0.58)	0.65 (0.58)	0.65 (0.50)	0.32 (0.35)	0.856 (0.852)
BP				0.62 (0.49)	0.42 (0.54)	0.49 (0.50)	0.45 (0.33)	0.39 (0.34)	0.869 (0.853)
GH					0.55 (0.64)	0.60 (0.46)	0.51 (0.36)	0.59 (0.44)	0.864 (0.853)
VT						0.54 (0.60)	0.35 (0.44)	0.56 (0.60)	0.873 (0.845)
SF							0.49 (0.53)	0.44 (0.56)	0.862 (0.846)
RE								0.48 (0.54)	0.876 (0.865)
MH									0.877 (0.862)

interviewer-<sup>18,20</sup> and self-administered<sup>19,21</sup> SF-36 in the older population have tended to have larger sample sizes and based on community-living participants. The high attempt rates found in our study population (mean age, 66.7 years; range, 59 to 98 years) were comparable to community-based studies of both older adults aged ≥65 years (Singleton and Turner<sup>19</sup> 85%, Lyons et al<sup>20</sup> 82% and Walters et al<sup>21</sup> 82%) and those that included a younger age group (Brazier et al<sup>14</sup> 83%, participants aged 16 to 74 years; Jenkinson

et al<sup>15</sup> 72%, aged 18 to 64 years; the Australian National Health Survey<sup>35</sup> 95.2%, aged 18 to 75+ years; and McCallum<sup>17</sup> 56.5%, aged 23 to 72 years).

Most previous studies have defined completion of the SF-36 as completion of all 36 items. Using this definition, the completion rate in our study was 78.1% (n = 2470) but increased to 90.9% (n = 2873) when the scoring algorithm defined by the authors of this questionnaire was used, i.e., completing sufficient questions for all dimensions to be

calculated. As noted by McHorney,<sup>4</sup> the SF-36 scoring algorithm has the advantage of assigning a scale score for patients missing a minority of items but involves potential biases related to item difficulty, particularly when data are non-randomly missing. Hayes et al<sup>18</sup> reported that non-randomly missing items concentrated among role functioning and health outlook items. Most concerns have focused on questions relating to “work” and “vigorous activity”.<sup>4,14,18,21,39</sup> This, however, was not noted in our study, with the exception of item 11d (“My health is excellent”), which had the lowest completion rate (94.9%).

Previous studies of the older populations have reported factors most strongly associated with poor response and completion rates were increasing age<sup>18,21,22</sup> and the mode of administration.<sup>18,22</sup> Completion of the self-administered SF-36 was significantly poorer than the interviewer-administered version.<sup>18,22</sup> In community-based older adults, Walters et al<sup>21</sup> reported completion rates of 86% to 98% for self-administered SF-36 dimensions, while Lyons et al<sup>20</sup> reported an overall completion rate of 98% using the interviewer-administered version. Mixed-mode survey design has been reported to increase response rates but could compromise validity.<sup>4</sup>

Women in our study were less likely than men to attempt but more likely to complete the SF-36 after adjusting for age, presenting visual and cognitive impairments. Walters et al<sup>21</sup> found that men were more likely to complete all dimensions ( $P < 0.001$ ) except “bodily pain” although no response rate differences were evident. It has been argued that the lower response and completion rates associated with either visual or cognitive impairment could interfere with the interpretation of the SF-36 scores and limit its potential clinical utility.<sup>22</sup> In our study, participants with presenting visual or cognitive impairments had substantially higher rates of missing data, but this did not significantly affect either the internal or construct validity. McHorney<sup>4</sup> also found that the subgroup of participants with cognitive impairment had higher rates of missing data but the psychometric test results of those with and without cognitive impairments were comparable.

The inter-correlations among dimensions were usually lower in all subjects than the Cronbach  $\alpha$  of each dimension, indicating that they measured 8 related but distinct constructs<sup>9</sup>. In our study, internal validity as demonstrated by the Cronbach  $\alpha$  statistic  $> 0.85$  is comparable with studies of similar age groups<sup>19-21</sup> and also those that included younger populations.<sup>14-17,40</sup>

It is also important to note that the high co-morbidity and chronicity of diseases associated with ageing may mask<sup>39</sup> or underestimate changes<sup>41</sup> in SF-36 scores, and thus an improvement in patient satisfaction associated with increasing age or with a longer duration of disease at any

level of disability. Our findings confirm earlier concerns that presenting visual and cognitive impairments significantly affect attempt and completion rates of the self-administered SF-36. However, presenting visual or cognitive impairments did not affect the internal consistency and construct validity of this instrument. The relatively low prevalence of these conditions also did not significantly affect the overall high attempt and completion rates in our study. Our results, in keeping with those from previous studies, demonstrate that the self-administered SF-36 is an effective and valid health care measure in older community-based populations. Its utility in the oldest old sub-sample with relatively high prevalence of co-morbidities and disabilities remains undetermined.

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