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FACTOR STRUCTURE AND INVARIANCE OF THE QUALITY OF LIFE IN ALZHEIMER'S DISEASE (QoL-AD) SCALE

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Abstract

The factor structure and factorial invariance of the Quality of Life in Alzheimer's Disease (QoL-AD) Scale was investigated in a sample of 653 nondemented, community-dwelling older adults, ages 57 to 95 years (M = 71.62, SD = 8.86), from the Seattle Longitudinal Study. The total sample was split into two random halves to explore and confirm the structure of the QoL-AD. Confirmatory factor analyses indicated better fit for a three-factor solution than one- or two-factor solutions. Weak factorial invariance was found for the three-factor solution (Physical, Social, and Psychological Well-being) across age group and gender. These findings may help to establish a baseline quality of life before the onset of any noticeable AD symptoms.

Clinical research has established the importance of assessing quality of life in populations with Alzheimer's disease (AD) and those with preclinical AD (Almkvist & Winblad, 1999; Logsdon, Gibbons, McCurry, & Teri, 2002; Wierenga & Bondi, 2007). The loss of function and cognitive abilities for these individuals can lead to reduced frequency of pleasurable activities (Teri & Logsdon, 1991) and may increase agitation and interpersonal conflicts (Reisberg et al., 1997), thereby altering quality of life. Interventions by medical staff may also affect quality of life. The Quality of Life in Alzheimer's Disease (QoL-AD) Scale has been found to be a reliable and valid self-report measure for individuals meeting criteria for probable or possible AD (Logsdon, Gibbons, McCurry, & Teri, 1999) as defined by McKhann et al. (1984) and individuals with dementia (Fuh & Wang, 2006; Selwood,

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Thorgrimsen, & Orrell, 2005; Thorgrimsen et al., 2003). Whitehouse, Patterson, and Sami (2003) stated that, of the quality-of-life measures appropriate for individuals with dementia, the QoL-AD is "the most widely used internationally perhaps due to its ease and rapidity of administration" (p. 199). The QoL-AD has been used in multiple studies demonstrating that caregiver reports of patient QoL are poorly correlated with patient reports and that caregivers rate patients' QoL as lower than the patients themselves do (e.g., Edelman, Fulton, Kuhn, & Chang, 2005; Fuh & Wang, 2006; Hoe, Hancock, Livingston, & Orrell, 2006; Shin, Carter, Masterman, Fairbanks, & Cummings, 2005; Sloane et al., 2005). Such findings have led to the conclusion that proxy ratings are not good substitutes for the patient's own QoL rating and that ratings of nondemented individuals should be considered separately in their own right (Edelman et al., 2005; Hoe et al, 2006). Although the assessment of quality of life has been recommended as a part of routine health assessments for all people, regardless of illness or dementia status (WHOQOL Group, 1995, 1998), studies examining the factor structure of the QoL-AD in nondemented samples are lacking.

Establishing the factor structure of the QoL-AD for nondemented samples, such as caregivers or community-dwelling elderly, is important for several reasons. First, it is reasonable to expect that one's subjective assessment of quality of life domains may change as one progresses from normative cognitive functioning to early cognitive impairment and possibly even to AD. Similar to the dedifferentiation observed in cognitive abilities in late life (e.g., Lövdén, Ghisletta, & Lindenberger, 2004), dedifferentiation may also be present in factor analyses of individuals' perceptions of quality of life. In this case, one might expect a factor analysis of quality of life domains, much like in cognitive ability domains, to find more factors in a nondemented sample and fewer factors in a demented sample. These expected changes were a central reason for including this measure in the neuropsychological assessment component of the Seattle Longitudinal Study (Schaie, 2005), in which the initial sample was composed of nondemented older adults. Second, deficits in the domains assessed by the QoL-AD (e.g., health, social activities, IADLs) are not restricted to individuals with AD but can also be affected in older adults without AD. For example, non-AD individuals may also experience impairment in physical functioning, one of the main components of definitions of quality of life based on the theoretical framework devised by Lawton (1983, 1991). These impairments may be the result of any number of medical conditions, such as arthritis, hip fracture, stroke, thyroid disorders, diseases of the central nervous system, and so forth (Reisberg et al., 1997). Finally, caregiver reports make an increasingly salient contribution to the assessment of the demented individual's quality of life as limitations in cognitive ability increase the difficulty of assessing these individuals (Whitehouse, 1999). Understanding the dimensions used by caregivers when assessing quality of life, and how these might differ from those used by AD patients, would increase the utility of both sets of ratings.

A single study has previously examined the factor structure of the QoL-AD measure designed by Logsdon et al. (1999). Thorgrimsen et al. (2003) used a sample of 201 participants with moderate to severe dementia in residential care facilities and found four uncorrelated principal components with eigenvalues over 1, accounting for a total of 62.7% of the variance in QoL-AD responses. However, because all QoL-AD items loaded on the first component and this component accounted for 32.5% of the total variance, Thorgrimsen and colleagues concluded that the scale was composed of a single factor. It is unclear what the additional components may have represented, whether more than the first factor could have been interpreted meaningfully, and how dimensions beyond the first may have added to the interpretation, particularly if correlated factors had been allowed. Using a revised version of the QoL-AD, Edelman et al. (2005) also performed separate factor analyses of staff and patient data. In the staff data, four factors had eigenvalues greater than 1, but as in Thorgrimsen et al., a one-factor solution was chosen, explaining 41.8% of the total variance.

Given the recommendations that quality of life should be viewed and assessed as a multidimensional construct (e.g., Birren & Dieckmann, 1991; Lawton, 1983, 1991), it seems likely that multiple factors might be represented in the QoL-AD measure. In the current study, we hypothesized that, for our sample of nondemented elders, we would find more than the single factor found in the Thorgrimsen et al. study of demented elders.

In addition to investigating the factor structure of the QoL-AD for nondemented elders, this study examined the factorial invariance of the measure across several subgroups of interest. The purpose of this examination is to establish that observed differences between age and gender groups on the QoL-AD represent true differences in the underlying construct of quality-of-life and do not simply reflect group differences in the relations of the items to the latent construct (Baltes & Nesselroade, 1970; Given et al., 1992; Meredith, 1993). At a minimum, we aim to demonstrate weak factorial invariance, in which the relation of each item to the factors is found to be equal across the groups being compared (Hofer, 1999). More stringent levels of invariance are often difficult to obtain (Horn, McArdle, & Mason, 1983).

The objectives then for this study were to (1) conduct exploratory factor analyses to identify possible factor structures for the QoL-AD measure in a sample of nondemented older adults; (2) identify the model that provides the best fit to the data, using confirmatory factor analysis; and (3) identify whether the best-fitting model is invariant across age group and gender.

METHODS

Participants

The sample for this investigation was comprised of community-dwelling older adults (N=653), aged 57 to 95 years (M= 71.62, SD = 8.86), who participated in at least one wave of the Seattle Longitudinal Study (SLS; Schaie, 2005) and completed the first wave of an additional series of neuropsychological assessments, including the QoL-AD, between 1997 and 2003. The sample included 270 males and 383 females and was well educated (M= 15.14, SD=2.73). All participants identified their ethnicity/race as Caucasian. For the analysis of factorial invariance of the QoL-AD, in addition to comparing males and females, we classified the sample into young-old (n = 392; 57–74 years) and old-old (n=261; 75–95 years), following the age group classifications of Neugarten (1975). Descriptive statistics by gender and by age group are presented in Table 1. Participants with dementia, either probable (n = 26) or definite (n = 15), as determined by case conference consensus ratings (Schaie et al., 2005), were excluded from the analyses to ensure that this study sample would be clinically nondemented.

Measures

Quality of Life in Alzheimer's Disease (QoL-AD) Scale—The Quality of Life in Alzheimer's Disease Scale (QoL-AD; Logsdon et al., 1999, 2005) is a self-report measure of overall quality of life. Each of 13 areas were rated on two scales: (a) the current state of that area (1 = poor, 2 = fair, 3 = good, 4 = excellent), and (b) the importance of that area (0 = not important, 1 = somewhat important, 2 = very important). The areas (denoted by item number) are physical health (1), energy (2), mood (3), living situation (4), memory (5), family (6), marriage (7), friends (8), self (9), ability to do chores around the house (10), ability to do things for fun (11), money (12), and life as a whole (13). This study utilized only the ratings of the current level of functioning for these 13 areas.

The QoL-AD was administered by a trained test examiner. The participants marked their responses in a questionnaire-like manner. Previous research has found that the original 13-item QoL-AD measure is internally consistent (α = .88) for AD participants (Logsdon et al., 1999). In the current sample of nondemented participants, the Cronbach's alpha reliability coefficient was .83. Logsdon et al. (1999) also reported that the QoL-AD was correlated with the Mini-Mental State Examination (MMSE) ($r = .24$, $p < .05$; higher QoL-AD scores were associated with higher MMSE scores), the activity of daily living (ADL) score from the Physical and Instrumental-Self Maintenance Scale (Lawton & Brody, 1969; $r=-.33$, $p<.01$; lower ratings were associated with higher levels of ADL impairment), a variety of depression measures (Hamilton Depression Rating Scale, $r=-.43$, $p< .001$; Geriatric Depression Scale—Patient report of self, $r = -.56$, $p < .001$), and the short form of the Pleasant Events Schedule-AD, which asks AD caregivers to rate the care receiver on enjoyment of various activities (PES-AD; Logsdon & Teri, 1997; Teri & Logsdon, 1991; $r = .30$, $p < .01$). In our nondemented sample, the QoL-AD was correlated significantly with the CES-D ($r= -.46$, $p < .001$), the Mattis Dementia Rating Scale (Mattis, 1988) grand total ($r=.09$, $p< .05$), and the MMSE ($r=.09$, $p<.05$). The statistical significance of the QoL-AD's low correlations with the Mattis and the MMSE are due to the large size of the analysis sample and likely have little practical significance, as the QoL-AD only accounts for less than 1% of the variance in the Mattis ($M= 139.07$, $SD = 4.56$) and the MMSE ($M= 28.59$, $SD = 1.48$).

Life Complexity Inventory (LCI)—Demographic characteristics of the participants were obtained with the LCI (Gribbin, Schaie, & Parham, 1980).

Statistical Analyses

In this study, we split the total sample (N=653) into two random halves to explore and confirm the structure of the QoL-AD measure in a community-dwelling sample of older adults. First, exploratory factor analyses were conducted on the first random half (N= 326) using principal axis factor analysis of the QoL-AD item-level data with a Promax rotation. Confirmatory factor analyses (CFAs) were then conducted with the second random half of the data set (N = 327) to compare the fit of the factor solutions generated in the exploratory factor analyses. Finally, the factorial invariance (FI) of the selected factor solution was then assessed using Amos (version 6; Arbuckle, 1994, 2006) to test whether the factors were comparable with respect to age group and gender.

Factorial Invariance—The evaluation of factorial invariance involves testing a nested sequence of increasingly stringent models (Meredith, 1993), allowing differences in the models' overall fit to be compared statistically. Configural invariance (Horn et al., 1983) simply specifies a consistent pattern of factor loadings for the groups and is used as a baseline model. The next most stringent form of invariance, weak factorial invariance, requires that the factor loadings be equal across the groups; however, factor variances and covariances are unconstrained across groups. Establishing weak factorial invariance is necessary to show evidence for invariant measurement operations between groups (Hofer, 1999). The third and more stringent form of factorial invariance is called strong factorial invariance and requires the added equality constraints between corresponding mean intercepts between the groups. In this analysis, the factor means in the reference group outcome are set to zero, so that mean differences are expressed at the factor level for the unconstrained factor means. Finally, strict factorial invariance adds the constraint of invariance among unique variances, in addition to the constraints added in prior steps of the hierarchy (i.e., equality of intercepts and factor loadings). This additional constraint assesses possible differences in the proportion of residual to true variance by forcing equivalence of random and specific error variances between the groups. Differences in variance are then expressed at the factor level.

Evaluating Goodness of Fit—The confirmatory factor analysis models and each factorial invariance model were first assessed with the chi-square statistic. Differences in the chi-square values for pairs of nested models for the factorial invariance investigation were also computed to obtain a direct comparison of model fit. Because the chi-square statistic will likely be affected by our moderately sized sample (N = 327 for the CFA; N = 653 for the FI analyses), the models and differences between alternative models were better assessed by comparing the models' fit indices (Hu & Bentler, 1995). Several fit indices were calculated for each model. Fit indices, as discussed by Hu and Bentler (1995), quantify variations in the data for a particular model and further reduce some degree of the interpretation difficulty of the chi-square statistic.

For this set of analyses, the fit indices used included the Normed Fit Index (NFI; Bentler & Bonnet, 1980), the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), the Comparative Fit Index (CFI; Bentler, 1990), and the root mean square error of approximation (RMSEA; Steiger, 1990). The NFI and CFI are on a 0 to 1 scale, with values above .90 considered to indicate a good fit, though the higher the better. The TLI, although considered robust to variations in sample size, is not scaled between 0 and 1, making it more difficult to interpret (Maruyama, 1998). An RMSEA value at or below .05 would indicate a good fit of the data to the model, whereas a value between .05 and .08 would be considered acceptable (Browne & Cudeck, 1993). The Browne-Cudeck Criterion (BCC; Browne & Cudeck, 1989, 1993) was also used for comparison of alternative models; smaller BCC values indicate better fit.

Model Evaluation—For each model, regression weights for the parameters or specified relations were also evaluated. Unstandardized parameter estimates, standard errors, and standardized parameter weights were assessed in the model to determine the best-fitting model, though standardized weights, as presented, are most appropriate for equal comparison across groups in the FI analyses. Meredith and Horn (2001) stated that, when factors are correlated, as they often are, and invariance is evaluated among groups, the standardized weights of a factor in one group should be proportional to the standardized weights of that factor in another group.

RESULTS

Three research questions were investigated in this study, aimed at examining the factor structure and invariance properties of the QoL-AD Scale. The first research question explored possible factor structures for the QoL-AD measure in a sample of nondemented older adults. The second research question investigates which factor structure provided the best fit to the data. The third and final research question investigated whether the best-fitting model was invariant across age group and gender.

Exploration of the QoL-AD Factor Structure

Exploratory factor analyses were conducted for a randomly split half (N =326) of the total sample with a principal axis factor analysis of the QoL-AD item-level data, using a Promax rotation. Three factors had eigenvalues greater than 1 (specifically, 4.393, 1.673, 1.004). Together, the three factors accounted for 54.4% of the variance in the QoL items; individually, the three factors accounted for 33.8%, 12.9%, and 7.7% of the variance, respectively. For interpretation of the rotated factors, salient loadings were defined as values greater than or equal to .5; in cases where an item did not have a loading of .5 or greater, its highest loading was selected to define its position in the factor structure in the confirmatory analyses. The factor structures for the one-, two-, and three-factor exploratory factor analysis solutions are shown in Table 2.

Model Selection by Confirmatory Factor Analysis

To determine which of the three exploratory models shown in Table 2 had the best fit to the data, the fit of these models was tested in the second random half of the data set (*N*= 327) using confirmatory factor analysis. As shown in Table 3, the one-factor model did not show good fit to the data. The fit of the two-factor model was marginal, with both the NFI and TLI falling below the desired minimum value of .90. The three-factor model showed good fit, with all fit indices meeting the specified criteria. In addition, the BCC values favored the three-factor model.

Six-factor loadings in the three-factor model were not significant. To further improve the fit of this model, we followed the standard procedure of removing nonsignificant factor loadings (Schumaker & Lomax, 2004) and reassessing the fit of the model. Items with a nonsignificant loading were removed in a sequential manner, eliminating a single loading in each step beginning with the smallest loading from the exploratory results, given that the loading remained nonsignificant in the modified model. Items were removed in this order with a nonsignificant change in model fit after each model modification: Item 9 on Factor 1 ($\Delta\chi^2(1) = 3.06$, $p = .08$); Item 9 on Factor 2 ($\Delta\chi^2(1) = 0.44$, $p = .51$); Item 6 on Factor 3 ($\Delta\chi^2(1) = 2.23$, $p = .14$); and Item 13 on Factor 2 ($\Delta\chi^2(1) = 2.13$, $p = .15$). The fit of the modified three-factor model, also shown in Table 3, was good. This final model was also simpler in that most of the cases where an item had been associated with multiple factors in the exploratory factor solution were eliminated. Therefore, this modified three-factor solution was chosen as the best-fitting model and was retained for the factor invariance analyses.

As a final step, the modified three-factor model was estimated for the total sample (*N*=653). All factor loadings were significant, and the fit of the model was very good: $\chi^2(61) = 169.61$, $p < .001$, NFI = .93, CFI = .95, TLI = .94, RMSEA = .05. The standardized factor loadings for each of the items by factor were significant and are provided in Table 4. Factor 1 was defined by items that were related to the individual's ability to participate in activities (i.e., physical health, energy, ability to do chores, ability to do things for fun); we labeled this factor "Physical Well-being." Factor 2 included items that represented aspects of and influences on the individual's social environment (e.g., living situation, marriage, money); we labeled this factor "Social Well-being." Finally, Factor 3 included items that represented an individual's awareness of self-related influences on quality of life (e.g., mood, memory, self); we labeled this factor "Psychological Well-being."

Factorial Invariance

The factorial invariance of the three-factor model for the ratings of current quality of life was examined across age group (young-old: $n = 392$, 57 to 74 years of age; old-old: $n = 261$, 75 to 95 years of age) and gender (male: $n = 270$; female: $n = 383$). First, the configural invariance model was compared to the weak invariance model. For both age group and gender, this comparison was not significant (age group: $\Delta\chi^2(11, N= 653) = 6.27$, $p = .86$; gender: $\Delta\chi^2$ $(11, N= 653) = 4.88$, $p = .94$), indicating that adding the constraint of equal factor loadings across groups was appropriate. In contrast, the $\Delta\chi^2$ statistic was statistically significant for the comparisons of the weak invariance model with the strong invariance model and the strong invariance model with the strict invariance model, suggesting that the constraints of equal mean intercepts and equal unique variances were too restrictive. The relative fit indices for the weak factorial invariance model also indicated a good fit for this model (e.g., CFI = .95 and RMSEA = .04 for age group; CFI =.96 and RMSEA =.04 for gender). Thus, we concluded that weak factorial invariance was present for the three QoL-AD factors between the young-old and old-old age groups as well as between males and females.

Factor correlations by age group and gender are shown in Table 5. A similar pattern of statistically significant associations between the three factors was observed across age group and gender. Specifically, although all correlations were statistically significant ($p < .001$), the association between Physical Well-being and Social Well-being tended to have lower values, particularly for the young-old ($r = .37$) and for males ($r = .31$). For all subgroups, Social Well-being and Psychological Well-being had the highest factor correlation ($r = .76$–.87).

DISCUSSION

This study examined the factor structure and invariance of the Quality of Life in Alzheimer's Disease (QoL-AD) assessment scale in a large, normal, and well-characterized sample using state-of-the-art statistical procedures. Identification of invariance in this investigation allows researchers to assume that the measurement of these constructs remains invariant when comparing age groups and genders. In addition, establishing the factor structure and invariance of this QoL measure provides a baseline for understanding how ratings of QoL may change as community-dwelling older adults experience changes in functioning leading to cognitive impairment and resulting alterations to their quality of life or for the comparison of impaired individuals and their caregivers.

Prior to establishing factorial invariance, clear factor structures were needed. In the exploratory factor analyses, one-, two-, and three-factor solutions were generated and compared. The three-factor solution had a clearer interpretation and explained more variance in QoL-AD responses than the other factor solutions. Confirmatory factor analyses revealed that the three-factor model had a better fit, based on the absolute and relative fit indices, than the one-factor and two-factor models. For the three-factor solution, the factors were labeled Physical Well-being, Social Well-being, and Psychological Well-being. After model modification, the three-factor confirmatory factor model was then tested for factorial invariance. We were able to accept weak factorial invariance across both age group and gender for the current status ratings. This finding indicated that the pattern of items to these underlying domains as well as the actual level of relation of the items to the factors were constant across these subgroups.

In contrast to our three-factor solution, Thorgrimsen et al. (2003) may have found a one-factor solution in part due to the sample used, specifically involving 201 participants with a mean MMSE of 14.4 (*SD* = 3.8, range = 7–24), of whom 86.4% were in residential homes and day centers. Our sample was comprised of healthy, community-dwelling older adults, with a mean MMSE of 28.6 (*SD*= 1.5, range = 20–30). In addition, Thorgrimsen et al.'s use of principal components analysis (PCA) differed from our use of principal axis factor exploratory factor analysis (EFA) in that PCA explains the total variance in the data whereas EFA explains the common variance shared by the items (Bryant & Yarnold, 1995). Further, the confirmatory analysis results did not show a good fit for a single-factor model, a finding that is supported by the literature. The majority of studies on various QoL measures, including the current study, contain support for a multidimensional model, as Lawton (1983, 1991) had originally proposed. Similar to our multi-factor model, the World Health Organization's Quality of Life Group (WHOQOL Group, 1998) found four dimensions for the 26-item WHOQOL-Bref measure of quality-of-life through confirmatory factor analysis. The actual items of the WHOQOL-Bref, which are in full sentence question format, are different than those of the QoL-AD, yet the content of several items is very similar to the

QoL-AD. Two of our three factors, those tapping psychological and physical aspects of quality of life, were also identified by the WHOQOL four-dimension model, and our third factor (Social Well-being) shares many of the areas tapped by the remaining two factors of the WHOQOL model, labeled Social Relations and Environment. Likewise, Kane et al. (2003) found 10 distinct factors through confirmatory factor analysis for a 42-item short scale, whereas other research (Brod, Steward, Sands, & Walton, 1999; Rabins, Kasper, Kleinman, Black, & Patrick, 1999) determined five dimensions were necessary to evaluate the quality of life for dementia patients.

When compared across males and females and across age groups, the interrelations among the three factors found in the current study were similar both in level of statistical significance and in pattern of correlation strength. In all groups, the correlation between Psychological Well-being and Social Well-being was higher than the correlation of Psychological Well-being with Physical Well-being, and both of these correlations were stronger than the correlation between Social Well-being and Physical Well-being. A pattern was also observed that the correlation between Physical Well-being and Social Well-being was stronger for women than for men and stronger for old-old than for young-old. This finding is supported by research by Almeida, Wethington, and Kessler (2002) indicating the relation between daily health symptoms and both network and interpersonal stressors, measured using the Daily Inventory of Stress Events (Almeida, 1998), was significantly stronger for women than for men.

The relatively lower standardized loadings for the items assessing memory (Item 5), ability to do things for fun (Item 11), and money (Item 12) in both the age and gender invariance models could be due to variations in participants' perceptions of item content. Other studies using this measure have reported that the item on "money" may have been endorsed less for those who saw themselves as self-sufficient and needing privacy (Thorgrimsen et al, 2003), whereas another study suggested that participants may have been unable to interpret the context of this item in relation to their quality of life (Selai, Vaughan, Harvey, & Logsdon, 2001). Similar to our item of "ability to do things for fun," low loadings for the WHOQOL-Bref item of "how much do you enjoy life?" were found in a factor analytic model of the WHOQOL-Bref (Ohaeri, Olusina, & Al-Abassi, 2004). Similar issues may have influenced the frequency to which the items were endorsed and thus how the items loaded on the associated factors in our sample.

As noted in the description of this study's sample, our sample was uniformly Caucasian with a high educational level; thus, our results may not be generalizable to a more diverse population. Given the lack of sufficient numbers of participants with a second time point of data on the QoL-AD in our sample, longitudinal stability of the factors was not assessed in this investigation and will be warranted in future research, particularly if participants in this sample progress to early dementia. Future research directions also include replicating these findings in more diverse populations and in those with chronic health conditions.

In conclusion, the QoL-AD was found to represent three dimensions of quality of life for our sample of nondemented, community-dwelling older adults: Physical, Social, and Psychological Well-being. The findings will enable clinicians and other researchers to use this measure to assess these dimensions in clinically nondemented samples that are similar to the SLS sample assessed in this study of healthy, community-dwelling older adults. The results will also enable research investigators to utilize this scale and the latent constructs to obtain indications of treatment efficacy and patient satisfaction through repeated use of this scale. In the nondemented or preclinical individual, these findings could be useful for establishing a baseline of quality of life before disease onset. This baseline level could then be compared at a later time in diseased states when the individual's living situation or environment may change and thus alter quality of life.

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References

Almeida, DM. Daily Inventory of Stressful Events (DISE) expert coding manual. Tucson: Division of Family Studies and Human Development, University of Arizona; 1998.

Almeida DM, Wethington E, Kessler RC. The Daily Inventory of Stressful Events: An interview-based approach for measuring daily stressors. Assessment 2002;9:41–55. [PubMed: 11911234]

Almkvist O, Winblad B. Early diagnosis of Alzheimer dementia based on clinical and biological factors. European Archives of Psychiatry and Clinical Neuroscience 1999;249(Suppl 3):3–9. [PubMed: 10654093]

Arbuckle JL. AMOS: Analysis of moment structures. Psychometrika 1994;59:135–137.

Arbuckle, JL. Amos 6.0 user's guide. Chicago: SPSS; 2006.

Baltes PB, Nesselroade JR. Multivariate longitudinal and cross-sectional sequences for analyzing ontogentic and generational change: A methodological note. Developmental Psychology 1970;22:163–168.

Bentler PM. Comparative fit indexes in structural models. Psychological Bulletin 1990;107:238–246. [PubMed: 2320703]

Bentler PM, Bonnet DG. Significance tests and goodness of fit in the analysis of covariance structures. Psychological Bulletin 1980;88:588–606.

Birren, JE.; Dieckmann, L. Concepts and content of quality of life in the later years: An overview. In: Birren, JE.; Lubben, JE.; Rowe, JC.; Deutchman, DE., editors. The concept and measurement of quality of life in the frail elderly. New York: Academic Press; 1991. p. 344-360.

Brod M, Steward AL, Sands L, Walton P. Conceptualization and measurement of quality of life in dementia: The Dementia Quality of Life instrument (DQoL). The Gerontologist 1999;39:25–35. [PubMed: 10028768]

Browne MW, Cudeck R. Single sample cross-validation indices for covariance structures. Multivariate Behavioral Research 1989;24:445–455.

Browne, MW.; Cudeck, R. Alternative ways of assessing model fit. In: Bollen, KA.; Long, JS., editors. Testing structural equation models. Newbury Park, CA: Sage; 1993. p. 136-162.

Bryant, FB.; Yarnold, PR. Principal-components analysis and exploratory and confirmatory factor analysis. In: Grimm, LG.; Yarnold, PR., editors. Reading and understanding multivariate statistics. Washington, DC: American Psychological Association; 1995. p. 99-136.

Edelman P, Fulton BR, Kuhn D, Chang C-H. A comparison of three methods of measuring dementia-specific quality of life: Perspectives of residents, staff, and observers. The Gerontologist 2005;45:27–36. [PubMed: 16230747]

Fuh J-L, Wang S-J. Assessing quality of life in Taiwanese patients with Alzheimer's disease. International Journal of Geriatric Psychiatry 2006;21:103–107. [PubMed: 16416471]

Given CW, Given B, Stommel M, Collins C, King S, Franklin S. The Caregiver Reaction Assessment (CRA) for caregivers to persons with chronic physical and mental impairments. Research in Nursing & Health 1992;15:271–283. [PubMed: 1386680]

Gribbin K, Schaie KW, Parham IA. Complexity of life style and maintenance of intellectual abilities. Journal of Social Issues 1980;36:47–61.

Hoe J, Hancock G, Livingston G, Orrell M. Quality of life of people with dementia in residential care homes. British Journal of Psychiatry 2006;188:460–464. [PubMed: 16648533]

Hofer, SM. Assessing personality structure using factorial invariance procedures. In: Mervielde, I.; Deary, I.; DeFruyt, F.; Ostendorf, F., editors. Personality psychology in Europe. Vol. 7. The Netherlands: Tilburg University Press; 1999. p. 35-49.

Horn JL, McArdle JJ, Mason R. When is invariance not invariant: A practical scientist's look at the ethereal concept of factor invariance. The Southern Psychologist 1983;1:179–188.

Hu, LT.; Bentler, PM. Evaluating model fit. In: Hoyle, RH., editor. Structural equation modeling. Thousand Oaks, CA; Sage: 1995. p. 76-99.

Kane RA, Kling KC, Bershadsky B, Kane RL, Giles K, Degenholtz HB, et al. Quality of life measures for nursing home residents. Journal of Gerontology: Medical Sciences 2003;58A:240–248.

Lawton MP. The dimensions of well-being. Experimental Aging Research 1983;9:65–72. [PubMed: 6354725]

Lawton, MP. A multidimensional view of quality of life in frail elders. In: Birren, JE.; Lubben, JE.; Rowe, JC.; Deutchman, DE., editors. The concept and measurement of quality of life in the frail elderly. New York: Academic Press; 1991. p. 3-27.

Lawton MP, Brody EM. Assessment of older people: Self-maintaining and instrumental activities of daily living. The Gerontologist 1969;9:179–186. [PubMed: 5349366]

Logsdon RG, Teri L. The pleasant events schedule-AD: Psychometric properties and relationship to depression and cognition in Alzheimer's disease patients. The Gerontologist 1997;37:40–45. [PubMed: 9046704]

Logsdon RG, Gibbons LE, McCurry SM, Teri L. Quality of life in Alzheimer's disease: Patient and caregiver reports. Journal of Mental Health and Aging 1999;5:21–32.

Logsdon RG, Gibbons LE, McCurry SM, Teri L. Assessing quality of life in older adults with cognitive impairment. Psychosomatic Medicine 2002;64:510–519. [PubMed: 12021425]

Logsdon, RG.; Gibbons, LE.; McCurry, SM.; Teri, L. Unpublished manuscript. 2005. Assessing quality of life of dementia caregivers: The QoL-AD.

Lövdén M, Ghisletta P, Lindenberger U. Cognition in the Berlin Aging Study (BASE): The first 10 years. Aging, Neuropsychology, and Cognition 2004;11:104–133.

Maruyama, GM. Basics of structural equation modeling. Thousand Oaks, CA: Sage; 1998.

Mattis, S. Dementia rating scale. Odessa, FL: Psychological Assessment Resources; 1988.

McKhann B, Drachman D, Folstein MF, Katzman R, Price D, Stadlan EM. Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA work group under the auspices of Department of Health & Human Services Task Force on Alzheimer's disease. Neurology 1984;34:939–944. [PubMed: 6610841]

Meredith W. Measurement invariance, factor analysis and factorial invariance. Psychometrika 1993;58:525–543.

Meredith, W.; Horn, JL. The role of factorial invariance in modeling growth and change. In: Collins, LM.; Sayer, AG., editors. New methods for the analysis of change. Washington, DC: The American Psychological Association; 2001. p. 204-240.

Neugarten BL. The future and the young-old. The Gerontologist 1975;15:4–9. [PubMed: 1110022]

Ohaeri JU, Olusina AK, Al-Abassi A-HM. Factor analytic study of the Short Version of the World Health Organization Quality of Life instrument. Psychopathology 2004;37:242–248. [PubMed: 15353890]

Rabins PV, Kasper JD, Kleinman L, Black BS, Patrick DL. Concepts and methods in the development of the ADRQL, an instrument for assessing health-related quality of life in persons with Alzheimer's disease. Mental Health and Aging 1999;5:33–8.

Reisberg B, Burns A, Brodaty H, Eastwood R, Rossor M, Sartorius N, et al. Diagnosis of Alzheimer disease. Report of an International Psychogeriatric Association Special Meeting Work Group. International Psychogeriatrics 1997;9(Suppl 1):11–38. [PubMed: 9447425]

Schaie, KW. Developmental influences on adult intelligence: The Seattle Longitudinal Study. New York: Oxford University Press; 2005.

Schaie KW, Caskie GIL, Revell AJ, Willis SL, Teri L, Kaszniak A. Extending neuropsychological assessments into Primary Mental Ability space. Aging, Neuropsychology, and Cognition 2005;12:245–277.

Schumaker, RE.; Lomax, RG. A beginner's guide to structural equation modeling. Mahway, NJ: Erlbaum; 2004.

Selai C, Vaughan A, Harvey RJ, Logsdon R. Using the QOL-AD in the UK [Letter to the editor]. International Journal of Geriatric Psychiatry 2001;16:537–538. [PubMed: 11376471]

Selwood A, Thorgrimsen L, Orrell M. Quality of life in dementia—a one-year follow-up study. International Journal of Geriatric Psychiatry 2005;20:232–237. [PubMed: 15717339]

Shin I-S, Carter M, Masterman D, Fairbanks L, Cummings JL. Neuropsychiatric symptoms and quality of life in Alzheimer's disease. American Journal of Geriatric Psychiatry 2005;13:469–474. [PubMed: 15956266]

Sloane PD, Zimmerman S, Williams CS, Reed PS, Gill KS, Preisser JS. Evaluating the quality of life of long-term residents with dementia. The Gerontologist 2005;45:37–49. [PubMed: 16230748]

Steiger JH. Structural model evaluation and modification: An interval estimation approach. Multivariate Behavioral Research 1990;25:173–180.

Teri L, Logsdon RG. Identifying pleasant activities for Alzheimer's disease patients: The Pleasant Events Schedule–AD. The Gerontologist 1991;31:124–127. [PubMed: 2007468]

Thorgrimsen L, Selwood A, Spector A, Royan L, de Madariaga Lopez M, Woods RT, Orrell M. Whose quality of life is it anyway? The validity and reliability of the Quality of Life–Alzheimer Disease (QoL-AD) Scale. Alzheimer Disease and Associated Disorders 2003;17:201–208. [PubMed: 14657783]

Tucker LR, Lewis C. The reliability coefficient for maximum likelihood factor analysis. Psychometrika 1973;38:1–10.

Whitehouse P. Quality of life in Alzheimer's disease: Future directions. Journal of Mental Health and Aging 1999;5:107–110.

Whitehouse PJ, Patterson MB, Sami SA. Quality of life in dementia: Ten years later. Alzheimer Disease and Associated Disorders 2003;17:199–200. [PubMed: 14657782]

WHOQOL Group. The World Health Organization quality of life assessment (WHOQOL): Position paper from the World Health Organization. Social Science Medicine 1995;41:1403–1409. [PubMed: 8560308]

WHOQOL Group. The World Health Organization quality of life assessment (WHOQOL): Development and general psychometric properties. Social Science Medicine 1998;46:1569–1585. [PubMed: 9672396]

Wierenga CE, Bondi MW. Use of functional magnetic resonance imaging in the early identification of Alzheimer's disease. Neuropsychology Review 2007;17:127–143. [PubMed: 17476598]

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Table 1

Descriptive statistics for the total sample and by age group and gender

Variable	Total (*N*=653)	Males (*n* = 270)	Females (*n* = 383)	Young-old (*n* = 392)	Old-old (*n* = 261)
Age	71.62	71.55	71.67	65.64	80.61
Education	15.14	15.71	14.73	15.49	14.61
% female	59%			59%	58%
% young-old	60%	59%	61%		

Note. Young-old = 57–74 years; Old-old = 75–95 years.

Table 2

Salient factor loadings for the one-, two-, and three-factor exploratory factor analysis solutions

	1-factor	2-factor		3-factor		
Item	**1**	**1**	**2**	**1**	**2**	**3**
1. Physical Health	.52		.68	.68		
2. Energy	.46		.68	.69		
3. Mood	.54	.59				.67
4. Living situation	.54	.60			.69	
5. Memory	.32		.31			.32
6. Family	.50	.62			.56	.55
7. Marriage	.47	.57			.54	
8. Friends	.43	.49			.45	
9. Self	.69	.63	.55	.50	.52	.68
10. Ability to do chores	.53		.71	.72		
11. Ability to do things for fun	.66	.52	.66	.63		.51
12. Money	.47	.44			.52	
13. Life as a whole	.70	.69	.50		.66	.59
Factor 1		—	.53	—	.43	.44
Factor 2		—	—	—	—	.65

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Table 3

Fit of the one-, two-, and three-factor confirmatory factor analysis models

Model	Chi-square	*df*	NFI	CFI	TLI	RMSEA	BCC
One-factor	269.72***	65	.79	.83	.80	.10	324.05
Two-factor	183.43***	61	.86	.90	.87	.08	246.13
Three-factor	129.88***	57	.90	.94	.92	.06	200.93
Three-factor modified	137.74***	61	.89	.94	.92	.06	200.43

*** $p < .001$.

Table 4

Confirmatory factor analysis solution for the three-factor model of the QoL-AD ($N = 653$)

Item	Physical well-being	Social well-being	Psychological well-being
1. Physical Health	.73		
2. Energy	.74		
3. Mood			.64
4. Living situation		.63	
5. Memory			.35
6. Family		.58	
7. Marriage		.57	
8. Friends		.50	
9. Self			.71
10. Ability to do chores	.66		
11. Ability to do things for fun	.35		.38
12. Money		.42	
13. Life as a whole			.71
Factor intercorrelations			
Physical Well-being	—	.42	.71
Social Well-being	—	—	.83

Note. Factor loadings are standardized regression coefficients. All values are significant at $p<.001$.

Table 5

Factor correlations in the weak factorial invariance models by age group and gender

		Factor		
Group	**Factor**	**Physical Well-being**	**Social Well-being**	**Psychological Well-being**
Young-old (*n* = 392)	Physical Well-being	—	.37***	.69***
	Social Well-being	—	—	.83***
Old-old (*n* = 261)	Physical Well-being	—	.51***	.72***
	Social Well-being	—	—	.85***
Males (*n* = 270)	Physical Well-being	—	.31***	.74***
	Social Well-being	.—	—	.76***
Females (*n* = 383)	Physical Well-being	—	.48***	.70***
	Social Well-being	—	—	.87***

Note. Young-old = 57–74 years; Old-old = 75–95 years.

*** p<.001.