Research article

Influence of social support on cognitive function in the elderly
Shu-Chuan Jennifer Yeh*1,2 and Yea-Ying Liu1,3

Address: 1Institute of Human Resource Management, National Sun Yat-sen University, Kaohsiung, Taiwan, 2Institute of Health Care Management, National Sun Yat-sen University, Kaohsiung, Taiwan and 3College of Nursing, Kaohsiung Medical University, Kaohsiung, Taiwan

Email: Shu-Chuan Jennifer Yeh* - syeh@cm.nsysu.edu.tw; Yea-Ying Liu - yeyili@cc.kmu.edu.tw

* Corresponding author

Abstract

Background: Social support is important in daily activities of the elderly. This study tests the hypothesis that there is an association between social support and cognitive function among the elderly in a community setting.

Methods: Face-to-face interviews were conducted in a cross-sectional stratified random sample of 4,993 elderly (≥65 years) city residents. Using multiple regression analysis, we investigated the influence of social support on cognitive function.

Results: 12% were over 80 years old. 53.28% were men. 67.14% were married. Higher Short Portable Mental Status Questionnaire (SPMSQ) scores (higher score means better cognitive function) were associated with strong social support, as measured by marital status and perceived positive support from friends. Lower cognitive function was associated with older and with female respondents. Only instrumental activities of daily living (IADL) were statistically and negatively related to SPMSQ. Lower functional status was associated with lower cognitive function. Elders with grade school educations had lower SPMSQ scores than did elders with high school educations.

Conclusions: In Taiwan, higher cognitive function in community-living elderly was associated with increased social support. Life-style management should provide social activities for the elderly to promote a better quality of life.

Background

Social support is important in daily activities for the elderly living in community settings, and several studies have provided evidence of an association between social support and cognitive function. A socially engaging lifestyle is correlated with higher cognition scores in both community and nursing home settings [1,2]. Because social activities provide the challenge of effective communication and participation in complex interpersonal exchanges, social support has been thought to inhibit cognitive decline in the elderly [3].

A longitudinal study from Bassuk & colleagues (1999) found that elderly persons who had no social ties were at increased risk for cognitive decline, compared with those who had five or six social ties [4]. Using frequency of contact with friends and colleagues as an indicator for social support, Boult & colleagues found that social support was associated with a reduced risk of developing disability up to 4 years later [5]. Research has also shown that social role involvement and personal control were factors not only in slowing age-related decline in physical health, but also in reducing levels of ADL disability [6]. In a prospective cohort study that followed 1,203 non-demented aged
Committee of the Health Department of Kaohsiung City.

The study was approved by the Research Ethics

contain the names, addresses, sex and ages of all city resi-

years old were obtained from Resident Registries, which

respondents from each district. Lists of residents

collect data from all 11 districts in Kaohsiung City, south-

In October 2000, we used stratified random sampling to

Study sample

Methods

Loneliness has also been used to predict mental status, in-

cluding depression [12]. However, loneliness is subjective

and not synonymous with objective social isolation. A

person may live alone with few social contacts and not

feel lonely. In contrast, an individual surrounded by oth-

ers may report a long-standing sense of loneliness. With

respect to the elderly, a discrepancy between the social

network and the need for social contact may cause loneli-

ness [13–16]. Social contacts and perceived social support

from family members, friends and acquaintances are im-

portant for fulfillment of different social needs. Although

one study indicated that ADL functions were associated

with emotional and social loneliness [17], it did not ex-

amine the relationship between loneliness and cognitive

function.

We examine the effect of social support on cognitive func-

tion in a large sample selected to represent a cross-section of

the elderly population in Taiwan. By controlling for in-

dividual characteristics such as age, gender and health sta-

tus, we investigated the association between social support and cognitive function in the elderly.

Methods

Study sample

In October 2000, we used stratified random sampling to

collect data from all 11 districts in Kaohsiung City, souther-

n Taiwan. An equal interval method randomly selected respondents from each district. Lists of residents ≥ 65

years old were obtained from Resident Registries, which

contain the names, addresses, sex and ages of all city resi-

dents. The study was approved by the Research Ethics

Committee of the Health Department of Kaohsiung City.

All elderly residents ≥ 65 years old living in the Kaohsiung

area were included unless they were vegetative, stuporous,

semi-comatose, suffering from dementia or other serious

psychiatric diseases or had a serious spinal cord injury. In-

dividuals with an unknown address or proxy respondents

were excluded from final analysis.

Of 106,697 persons listed, a total of 6,367 questionnaires

were sent out and from these 4,993 face-to-face interviews

were completed successfully by trained registered nurses. The

interviewers’ training involved both a general intro-

duction to survey interviewing and fieldwork techniques

and procedures, and a review of the specific aspects of the

study for which interviewers were responsible. Inter-rater

reliability was measured by intraclass correlation coeffi-

cient (ICC) during the training stage. Correlation among

raters was 0.827.

82 subjects were represented by proxy interviews with a

close acquaintance or family member. Proxy respondents

were not asked about self-perceived memory and were re-

moved from the final analysis. Forty-six elders with seri-

ous psychiatric diseases were excluded. Forty-two elders

died prior to the interview, and 742 were never contacted

due to a change in residence or an unknown address. Four

respondents were diagnosed with dementia during the

study period. Seventy-six refused to participate. Over half

of the data was missing for 386 respondents. These sub-

jects were excluded from the final analysis. Final study

sample contained 4,989 respondents with aged ≥ 65

years.

Around 12 percent of the elderly were over 80 years old,

53.28% were men, 67.14% were married, and 18.9% had

at least a high school education. These percentages were

representative of the overall elderly population in Kaohs-

iung [18]. Although distributions of gender (χ² = 3.43, p =

.148) and education (χ² = 5.955, p = .062) in our study

were similar to those of the entire elderly population in

Taiwan, marital status (χ² = 48.432, p < .05) and age (t-

value = 15.26, p < .05) were not.

Measures

Dependent variable

The dependent variable was cognitive status measured by

the 10-item Short Portable Mental Status Questionnaire

(SPMSQ). The SPMSQ was developed by Pfeiffer to assess

mental status of the elderly. We chose SPMSQ to measure

cognitive status because its brevity permitted assessment

without taxing the endurance and capabilities of the least

 cognitively fit. Although public health nurses were pre-

trained for conducting interviews, their formal neurologic

training was not evaluated. However, Welch & West

(1999) found that SPMSQ could be accurately applied by

persons without formal neurologic training [19]. For all of
these reasons, we chose SPMSQ, even though MMSE has better sensitivity and specificity [20]. MMSE scores are also more easily affected by education, intelligence, age, CVA and social class.

The validity of SPMSQ in a Taiwanese population and in patients with organic brain syndrome has been established [21–24]. SPMSQ can assess the total range of performance from intact functioning despite severe impairment. Respondents were asked the questions and not allowed access to information or objects that might stimulate their memories. This test included 10 questions dealing with orientation, personal history, remote memory and calculations. Correct answers received 1 point each. A summary score was constructed by summing the 10 items, yielding a range from 0 to 10. Internal consistency of SPMSQ scale for this study was 0.98.

Missing items from cognitive tests are generally informative in the measurement of cognitive performance [25], and a "don't know" response is generally considered incorrect [11,26]. In this study, missing values in the SPMSQ were always considered incorrect answers.

Independent variables
Four measures of social support that reflected objective and subjective dimensions were examined. Marital status, measured by one dichotomous variable (married vs. non-married) was chosen because a spouse can be an important source of emotional and tangible support [27]. Perceived positive support from friends was measured by asking the respondent whether he had a good friend with whom to talk. Living alone was measured by one categorical variable (yes vs. no). Loneliness was measured by asking respondents to rank this feeling on a 3-point scale: 1 = strong, 2 = some and 3 = little.

Control variables
Social support might be related to SPMSQ because of its association with other factors known to be involved in the aging process. To reduce the possibility of spurious associations, we selected a set of control variables that have been empirically evaluated with respect to social relationships and SPMSQ [28–30].

Socio-economic status
Five socio-demographic variables were used. Age was the difference between date of birth and date of interview. Gender was defined as a dummy variable, with male coded as 0 and female as 1. Religion was categorized into 4 dummy variables: Traditional, Christian, Catholic and other, with Buddhist as the reference group. Occupation was classified into 5 dummy variables: blue collar, farmer, professional-administrator, retired and housewife, with white collar as the reference group. Education was categorized into 5 dummy variables: blue collar, farmer, professional-administrator, retired and housewife, with high school as the reference.

Functional status
Physical health status might affect social networks and social support, particularly if the interviewee considered disease, disability and self-rated health stressful [31]. Functional status was the ability to perform activities of daily living (ADL) and instrumental activities of daily living (IADL). Katz index of ADL was used to assess personal self-maintenance (bathing, dressing, toileting, transferring, continence and feeding) on a four-point scale: 0 = independent, 1 = semi-independent on devices (needs assistance by using devices), 2 = semi-independent on persons (needs assistance from persons) and 3 = totally dependent. Total score was produced by summing the scored items, yielding a range from 0 to 18. Internal consistency was $\alpha = 0.95$.

IADL are complex tasks such as traveling, shopping, preparing meals, doing housework and handling personal finances [32]. Unlike ADL, which is largely concerned with basic bodily maintenance, IADL deals with the execution of more complicated tasks that have a broad impact in linking social competency and independent living [33,34]. Therefore, IADL might be more useful than ADL in detecting disabilities in an elderly population [32]. Lower functional status has been assumed to limit opportunities for social contact by reducing interactions with family and friends outside the home [35] and by limiting social activities [36].

The self-reported functional status measure asked respondents if they were able to perform each IADL on their own: preparing meals, shopping, taking medicine, traveling out of walking distance, managing money or using the telephone. We used a three-point scale to measure the above six items: 0 = independent, 1 = semi-independent on devices (needs assistance by using devices), 2 = semi-independent on persons (needs assistance from persons) and 3 = totally dependent. Total score was produced by summing the scored items, yielding a range of 0 to 18. Internal consistency was $\alpha = 0.91$.

Reported health conditions
An interrelation among health condition variables (Parkinson’s disease, heart disease, hypertension, chronic lung diseases, diabetes and stroke) and psychometric tests, such as SPMSQ, has been suggested. However, research regarding this interrelation has yielded inconclusive results [37–39]. We included several health conditions as dummy variables (1 = yes and 0 = no): hypertension, diabetes, vision, hearing, cancer and depression. We did not include dementia as a health condition because of its strong
association with the dependent variable and because of its exclusion from the final analysis.

**Analytic plan**

Descriptive analyses were conducted to understand the study sample. Differences in SPMSQ were examined with respect to demographic variables. We also investigated the association between SPMSQ scores and all two-level demographic and health-related variables by using chi-square test. For multiple groups of demographic variables, one-way analysis of variances (ANOVA) was used to detect any differences in variance among groups. Once differences were confirmed, post-hoc analysis (Scheffe's test) was applied to evaluate specific group differences.

Multiple regression was used to regress SPMSQ scores on independent variables (social support) and all covariates to find significant indicators (used $\alpha$ level at 0.05 and 0.01). Initial analyses included age, gender, religion, occupation and health-condition variables (e.g., diabetes and hypertension) as covariates to determine the relationship between individual characteristics, functional status, social support and SPMSQ. All analyses used SAS 8e statistical software.

**Results**

Table 1 describes the response rates of the study sample. We sent out 6,367 questionnaires. 4,993 interviews were valid, and 1,378 were invalid. Response rate was 78%.

Summary statistics for the study variables are displayed in Table 2. Mean age of participants was 73 years ± 5.49. Most subjects were married, perceived positive support from friends and felt lonely. 56% were Buddhists (56%), 33.93% were housewives. Around 20% were professional administrators. About 32 percent had hypertension and 0.6% had cancer. Average ADL and IADL scores (range 0–18) were 0.35 and 0.95, respectively. Mean SPMSQ score was 9.36 (± 1.41), range 0–10.

SPMSQ scores were used to measure cognitive function (Table 3). Cognitive function in females was lower than in males. Unmarried elders had lower cognitive function than did married elders. Elderly who perceived positive support from friends had higher SPMSQ scores than those without such a perception. Most covariates showed differences in SPMSQ scores except for the following: living alone, diabetes, Parkinson’s disease, depression, hearing and dental problems. Correlations between SPMSQ scores and 3 continuous variables (ADL, IADL and age) were statistically significant.

Regression results showed that higher SPMSQ scores were clearly associated with two groups: married elders ($\beta = 0.13, p = 0.005$) and those who perceived positive support from friends ($\beta = 0.11, p = 0.005$). Older ($\beta = -0.03, p < .0001$) or female ($\beta = -0.38, p < .0001$) respondents were more likely to have cognition problems as indicated by lower SPMSQ scores. Cognitive function of respondents who had a grade school education was lower in comparison with those who had a high school education ($\beta = -0.22, p < .001$). Compared with white-collar workers, both farmers and blue-collar workers were negatively associated with SPMSQ scores ($\beta = -0.61, p < .0001$; $\beta = -0.19, p = .016$, respectively). IADL ($\beta = -0.14, p < .0001$) was statistically and negatively related to SPMSQ. The association of ADL with cognitive function was not statistically significant. Two reported health conditions, depression ($\beta = -0.79, p = 0.031$) and vision problems ($\beta = -0.19, p = 0.017$), were associated with lower cognitive function (lower SPMSQ score). Other factors were not statistically significant. Overall model fit statistic (adjusted $R^2$) was 0.2019 ($F = 40.33; p < .0001$). Table 4 lists results for the full regression model.

**Discussion**

Our study examined primary data collected on an elderly population in Kaohsiung, Taiwan. The relationship between social support and cognitive function indicated that two out of the four measures of social support, mari-
tal status and perceived positive support from friends, were statistically significant. These findings support our hypothesis that social support is an indicator of cognitive function in community-dwelling older adults. We suggest that interventions or activities that enhance social support would improve cognitive functions in the elderly.

Living alone and loneliness were not significantly associated with the SPMSQ scores. Our result regarding living alone is similar to another study that used ADLs, IADLs, cognition and nursing home utilization as outcome indicators to investigate whether living alone influenced these outcomes [40]. It was determined that patients living alone after hospitalization were less likely to improve in physical function; however, no relationship with cognitive function was found.

Research on the association between loneliness and cognitive function is limited. Our results indicate that loneliness did not have a statistically significant influence on cognitive function. However, post-hoc analyses using Scheffe's method (Table 3) revealed that elders who felt very alone had higher SPMSQ scores than those who felt less lonely. Studies have indicated that there is a negative relationship between loneliness and social support [17,41,42]. Therefore, we believe that although loneliness can be associated with social support, it cannot predict all perspectives of mental status, including cognitive function.

Cognitive function was correlated with functional status in ways consistent with available knowledge. Because physical function may confound the association of social support and cognitive status, we controlled for ADL and IADL in the model. We found that functional status, particularly IADL, may have substantial impact on cognitive function (with partial R-square = 0.14, F-value = 699.48, p-value < .0001).

In summary, this study used data from a representative elderly community sample of substantial size in Taiwan. Respondents were not self-referred, thereby reducing referral bias. Our results confirm the findings of two earlier studies that found a positive association between social support and cognitive function [1,3]. In our study, marriage and perceived positive support from friends were significantly and positively associated with cognitive function. Loneliness and living alone were not significantly associated with cognitive function.

**Limitations**

This and other similar studies are limited because the SPMSQ score (the only cognitive measure available for this analysis) may provide only attenuated information on memory and does not optimally detect mild cognitive deficits [29]. Some respondents who seemed cognitively intact may have been suffering from early-stage dementia [4]. Perhaps a more sophisticated neuropsychological test would be better measure for evaluating the relationship between cognition function and social support.

Although our study has a substantial representative sample, it is not a longitudinal study. Variables measured at a single point in time tend to be related more than those

---

**Table 2: Descriptive analyses for Kaohsiung elderly (n = 4,993)**

| Variable          | Frequency (%) | Mean (Std Dev) |
|-------------------|---------------|----------------|
| Female*           | 2,330 (46.67) |                |
| Education**       |               |                |
| Grade School or below (1) | 4,037 (81.10) |                |
| High School (2)   | 576 (11.57)   |                |
| College or above (3) | 365 (7.33)    |                |
| Married *         | 3,345 (67.14) |                |
| Perceives positive support* |            |                |
| Yes               | 3,350 (71.92) |                |
| No                | 1,308 (28.08) |                |
| Feels lonely**    |               |                |
| Strong            | 2,844 (59.27) |                |
| Some              | 1,708 (35.60) |                |
| Little            | 246 (5.13)    |                |
| Lives alone       |               |                |
| Yes               | 427 (8.79)    |                |
| No                | 4431 (91.21)  |                |
| Religion**        |               |                |
| Buddhist (1)      | 2,796 (56.0)  |                |
| Traditional (2)   | 1,111 (22.25) |                |
| Christian (3)     | 247 (4.95)    |                |
| Catholic (4)      | 73 (1.46)     |                |
| Other (5)         | 651 (13.04)   |                |
| Occupation**      |               |                |
| White collar (1)  | 495 (9.91)    |                |
| Blue collar (2)   | 873 (17.48)   |                |
| Farmer (3)        | 267 (5.35)    |                |
| Prof-Admin (4)    | 998 (19.99)   |                |
| Retired (5)       | 610 (12.22)   |                |
| Housewife (6)     | 1,644 (33.93) |                |
| Comorbidities*    |               |                |
| CVA               | 169 (3.38)    |                |
| Hypertension      | 1,592 (31.88) |                |
| Cancer            | 28 (0.56)     |                |
| DM                | 391 (7.83)    |                |
| CHD               | 283 (5.67)    |                |
| Parkinson's       | 12 (0.24)     |                |
| Vision problem    | 308 (6.0)     |                |
| Hearing problem   | 56 (1.1)      |                |
| Dental problem    | 87 (1.7)      |                |
| ADL               | 0.35 (1.94)   |                |
| IADL              | 0.95 (2.98)   |                |
| Age               | 72.72 (5.49)  |                |
| SPMSQ             | 9.36 (1.41)   |                |

Higher ADL or IADL scores indicate more functional dependency.
Table 3: Descriptive analyses for Kaohsiung elderly (n = 4,993)

| Variable                                      | Mean (Std Dev) | t-value [F-value] | p-value | Scheffe's |
|-----------------------------------------------|----------------|-------------------|---------|-----------|
| Gender* : Female                              |                |                   |         |           |
| Female                                        | 9.07(1.63)     | 13.02             | < .0001 |           |
| Male                                          | 9.60(1.12)     |                   |         |           |
| Education** : Grade School or below (1)       |                |                   |         |           |
| High School (2)                               | 9.26(1.47)     |                   | [60.55] | < .0001   |
| College or above (3)                          | 9.81(0.89)     |                   |         |           |
| Marital Status*: Married                      | 9.52(1.18)     | -10.13            | < .0001 |           |
| Unmarried                                     | 9.04(1.70)     |                   |         |           |
| Perceives positive support*: Yes              |                |                   |         |           |
| Yes                                           | 9.46(1.24)     | -4.60             | < .0001 |           |
| No                                            | 9.23(1.56)     |                   |         |           |
| Lives alone*:                                 |                |                   |         |           |
| Yes                                           | 9.39(1.37)     | -0.45             | 0.66    |           |
| No                                            | 9.36(1.39)     |                   |         |           |
| Feels lonely*                                 |                |                   |         |           |
| Strong (1)                                    | 9.49(1.25)     |                   | [33.16] | < .0001   | 1>2      |
| Some (2)                                      | 9.32(1.36)     |                   |         | 1>3       |
| Little (3)                                    | 8.81(1.95)     |                   |         | 2>3       |
| Religion**                                    |                |                   |         |           |
| Buddhist (1)                                  | 9.32(2.04)     |                   | [7.94]  | < .0001   | 5>1      |
| Traditional (2)                               | 9.27(1.35)     |                   |         | 5>2       |
| Christian (3)                                 | 9.58(0.95)     |                   |         |           |
| Catholic (4)                                  | 9.49(1.45)     |                   |         |           |
| Other (5)                                     | 9.63(1.02)     |                   |         |           |
| Occupation**                                  |                |                   |         |           |
| White collar (1)                              | 9.82(0.66)     |                   | [41.59] | < .0001   | 1>4; 1>2 |
| Blue collar (2)                               | 9.41(1.39)     |                   |         | 1>6; 1>3  |
| Farmer (3)                                    | 8.73(1.92)     |                   |         | 4>6; 4>3  |
| Prof-Admin (4)                                | 9.56(1.14)     |                   |         | 5>6; 5>3  |
| Retired (5)                                   | 9.55(1.17)     |                   |         | 2>6; 2>3  |
| Housewife (6)                                 | 9.10(1.58)     |                   |         | 6>3       |
| Reported Health Conditions*                   |                |                   |         |           |
| Stroke: Yes                                   | 8.66(2.26)     | 4.12              | < .0001 |           |
| No                                            | 9.38(1.36)     |                   |         |           |
| Hypertension: Yes                             | 9.44(1.23)     | -3.03             | < .0001 |           |
| No                                            | 9.32(1.49)     |                   |         |           |
| Cancer: Yes                                   | 9.82(0.39)     | -6.09             | < .0001 |           |
| No                                            | 9.36(1.41)     |                   |         |           |
| Diabetes: Yes                                 | 9.37(1.31)     | -0.14             | 0.89    |           |
| No                                            | 9.36(1.42)     |                   |         |           |
| Heart Disease: Yes                            | 9.52(1.24)     | -2.21             | 0.03    |           |
| No                                            | 9.35(1.42)     |                   |         |           |
| Parkinson’s: Yes                              | 8.00(2.56)     | 1.84              | 0.09    |           |
| No                                            | 9.36(1.40)     |                   |         |           |
| Depression: Yes                               | 8.17(2.04)     | 2.03              | 0.07    |           |
| No                                            | 9.36(1.41)     |                   |         |           |
| Vision problem: Yes                           | 9.10(1.79)     | 2.62              | 0.01    |           |
| No                                            | 9.38(1.38)     |                   |         |           |
| Hearing problem: Yes                          | 9.55(1.41)     | -1.26             | 0.21    |           |
| No                                            | 9.36(1.06)     |                   |         |           |
| Dental problem: Yes                           | 9.35(1.49)     | 0.07              | 0.94    |           |
| No                                            | 9.36(1.41)     |                   |         |           |
| ADL***                                        | -0.27          |                   | < .0001 |           |
| IADL***                                       | -0.38          |                   | < .0001 |           |
| Age***                                        | -0.20          |                   | < .0001 |           |

1. Higher ADL or IADL scores indicate more functional dependence. 2. *t-statistic used to compare mean SPMSQ scores in 2 groups defined by dichotomous covariates. 3. **ANOVA used to test the differences in variance of SPMSQ scores among multiple groups. 4. ***Correlation analysis was used. 5. Statistical significance is being assessed at the 0.05 levels.
measured at different points. Cross-sectional studies cannot establish the direction of an association (cause and effect) [44,45]. Therefore, future research needs to test the causality between social support and cognition function in the elderly by using longitudinal design.

Mean ADL and IADL scores tended to be lower, which meant most of the elders were more independent. Since we lacked the information on ADL and IADL status for the total elderly population in Taiwan, we could not determine whether any difference in functional status existed between our study sample and national data.

We used specifically defined indicators (marital status, living alone, loneliness or perceived positive support from friends) to make inferences about the effects of social support on cognition. Although we did not examine in detail the nature of the social interactions, two of our simple measures showed significant associations with cognitive function. Social interactions require varying levels of cognitive effort. An earlier study found that active behaviors represented more robust associations with cognition than did passive behaviors [43]. Future research may employ different social-activity constructs to examine these issues.

Perceived positive support from friends have been used proxies for social support in USA [46]; however, it has not been validated in Taiwan elderly population. In addition, a 3-point scale for loneliness may not be discriminatory enough to measure loneliness. For future study, the revised UCLA loneliness scale may be a better choice. This scale contains 20 questions, each with a 4-point Likert-

---

**Table 4: Multiple regression of SPMSQ scores, social support and characteristics**

| Variable                          | Coefficients (s.e.) | T value | P-value |
|-----------------------------------|---------------------|---------|---------|
| Intercept                         | 12.30(0.29)         | 42.97   | < .0001 |
| **Social Support**                |                     |         |         |
| Married                           | 0.13(0.04)          | 2.81    | 0.005   |
| Perceives positive support       | 0.11(0.04)          | 2.79    | 0.005   |
| Feels lonely                      | -0.03(0.03)         | -1.09   | 0.276   |
| Lives alone                       | 0.09(0.07)          | 1.25    | 0.210   |
| Age                               | -0.03(0.00)         | -9.40   | < .0001 |
| Female vs. male                   | -0.38(0.06)         | -6.57   | < .0001 |
| **Education**                     |                     |         |         |
| Grade School vs. High School      | -0.22(0.05)         | -4.37   | < .0001 |
| College vs. High School           | -0.05(0.09)         | -0.58   | 0.564   |
| **Religion**                      |                     |         |         |
| Christian vs. Buddhist            | 0.16(0.08)          | 2.01    | 0.078   |
| Catholic vs. Buddhist             | 0.04(0.15)          | 0.26    | 0.793   |
| **Occupation**                    |                     |         |         |
| Farmer vs. white collar           | -0.61(0.10)         | -5.88   | < .0001 |
| Blue collar vs. white collar      | -0.18(0.07)         | -2.40   | 0.016   |
| Prof-Admin vs. white collar       | -0.08(0.07)         | -1.19   | 0.233   |
| Housewife vs. white collar        | -0.09(0.09)         | -1.12   | 0.264   |
| Retirement vs. white collar       | -0.11(0.08)         | -1.37   | 0.172   |
| ADL                               | -0.01(0.01)         | -0.56   | 0.578   |
| IADL                              | -0.14(0.01)         | -15.35  | < .0001 |
| **Reported Health Conditions**    |                     |         |         |
| CVA                               | -0.02(0.11)         | -0.21   | 0.835   |
| Hypertension                      | 0.07(0.04)          | 1.56    | 0.118   |
| DM                                | 0.02(0.07)          | 0.26    | 0.796   |
| CHD                               | 0.11(0.08)          | 1.30    | 0.195   |
| Cancer                            | 0.40(0.26)          | 1.56    | 0.118   |
| Parkinson's                       | -0.52(0.35)         | -1.49   | 0.136   |
| Depression                        | -0.79(0.37)         | -2.14   | 0.031   |
| Vision problem                    | -0.24(0.08)         | -3.16   | 0.017   |
| Hearing problem                   | 0.23(0.19)          | 1.21    | 0.227   |
| Dental problem                    | 0.16(0.15)          | 1.06    | 0.287   |
| Adjusted R-square                 |                     |         |         |
| F-value                           | 0.2019              |         |         |
| Adjusted R-square                 |                     |         |         |
| F-value                           | 40.33               | < .0001 |

s.e. = standard error
type answer ranging from never to often. Although this questionnaire was not specifically designed for use with the elderly, its reliability and validity have been reported to have a Cronbach's alpha of 0.96. Factor analysis has indicated that it measures emotional as well as social loneliness. Thus, validation of the suitability of applying the revised UCLA loneliness scale in Taiwan's elderly population is a subject worthy of future research.

**Authors' Contributions**

SCY participated in the design of the study, carried out the study, performed the statistical analysis and drafted the manuscript. YYL participated in the design of the study and literature review.

**Competing interests**

None declared

**Acknowledgements**

This work was supported by a grant of the National Science Council of Taiwan, R.O.C.

**References**

1. Christensen H, Korten A, Jorm AF, Henderson AS, Scott R and Mackinnon AJ. *Activity levels and cognitive functioning in an elderly community sample*. Age Ageing 1996; 25:72-80
2. Langer EJ, Rodin J, Beck P, Weinman C and Spitzer L. *Environmental determinants of memory improvement in late adulthood*. J Pers Soc Psychol 1997; 37:2003-2013
3. Berkman LF. *Which influences cognitive function: Living alone or being alone?* Lancet 2000; 355:1291-1292
4. Bassuk SS, Glass TA and Berkman LF. *Social engagement and incidental cognitive decline in community dwelling elderly persons*. Ann Intern Med 1999; 131:165-173
5. Boult C, Kane RL, Louis TA, Boult L and McCaffrey D. *Conditions that lead to functional limitation in the elderly*. J Gerontol B Psychol Sci Soc Sci 1999; 49:M28-M36
6. Mendes de Leon CF, Glass TA, Beckett LA, Seeman TE, Evans DA and Berkman LF. *Social networks and disability transitions across eight intervals of yearly data in the New Haven EPESE*. J Gerontol B Psychol Sci Soc Sci 1999; 54B:S162-S171
7. Fratiglioni L, Wang HX, Ericsson K, Maytan M and Winblad B. *Influence of social network on occurrence of dementia: a community-based longitudinal study*. Lancet 2000; 355:1315-1319
8. Beard CM, Kokmen E, Offord KP and Kurland LT. *Lack of association between Alzheimer's disease and education, occupation, marital status, or living arrangement*. Neurology 1992; 42:2063-2068
9. Fabrigoule C, Letenneur L, Dartigues JF, Zarrouk M, Commenges D and Barberger-Gateau P. *Social and leisure activities and risk of dementia: A prospective longitudinal study*. J Am Geriatr Soc 1995; 43:485-490
10. Griebkin K, Schaie KW and Parham IA. *Complexity of life style and maintenance of intellectual abilities*. Journal of Social Issues 1980, 36:47-61
11. Zunzunegui MV, Gutierrez P, Cuadra B, Beland F, Del Ser T and Wolfson C. *Development of simple cognitive function measures in a community dwelling population of elderly in Spain*. Int J Geriatr Psychiatry 2000, 15:130-140
12. Prince MJ, Harwood RH, Blizzard RA, Thomas A and Mann AH. *Social support deficits, loneliness and life events as risk factors for depression in old age*. The Gospel Oak Project VI. Psychol Med 1997, 27:323-332
13. Anderson L. *Loneliness and perceived responsibility and control in elderly community residents*. J Soc Behav Pers 1992, 3:431-443
14. Cutrona CE, Russel DW and Rose J. *Social support and adaptation to stress by the elderly*. J Psychol Aging 1986, 1:47-54
15. Jones WH and Moore TL. *Loneliness and social support*. IN Loneliness: Theory, research, and applications (Edited by: Hoijat M, Crandall R) Newbury Park, CA: Sage 1986; 145-157
16. Weiss RS. *Reflections on the present state of loneliness research*. In Loneliness: Theory, research, and applications (Edited by: Hoijat M, Crandall R) Newbury Park, CA: Sage 1989, 116
17. Bondrevik M and Skogstad A. *The oldest old, ADL, social network, and loneliness*. West J Nurs Res 1998; 20:325-343
18. Ministry of Interiors 2003, [http://www.moi.gov.tw/W3/stat/topic/topic403.htm](http://www.moi.gov.tw/W3/stat/topic/topic403.htm)
19. Welch DC and West RL. *The Short Portable Mental Status Questionnaire: assessing cognitive ability in nursing home residents*. Nursing Research 1999; 48:329-32
20. MacKenzie DM, Copp P, Shaw RJ and Goodwin GM. *A Comparison of the Mini-Mental State Examination (MMSE), Abbreviated Mental Test (AMT) and Mental Status Questionnaire (MSQ)*. Psychological Medicine 1996; 26:427-430
21. Flaherty JT. *A functional performance status questionnaire for the assessment of organic brain deficit in elderly patients*. J Am Geriatr Soc 1975, 23:433-441
22. Litwin H. *Social network type and morale in old age*. The Gerontologist 2001, 41:S16-524
23. Sugisawa H, Liang J and Liu X. *Social networks, social support, and mortality among older people in Japan*. Gerontologist 1994; 49:S3-13
24. Sonn U and Asberg KH. *Assessment of activities of daily living in the elderly*. Scand J Rehabil Med 1991, 23:193-202
25. Fillenbaum GG. *Screening the elderly: A brief instrumental activities of daily living measure*. J Am Geriatr Soc 1985, 33:698-706
26. Hokoishi K, Ikeda M, Maki N, Nomura M, Torikawa S, Fujimoto N, Fukuhara R, Komori K and Tanabe H. *Interrater reliability of the physical self-maintenance scale and the instrumental activities of daily living scale in a variety of health professional representations*. Aging Ment Health 2001, 5:38-40
27. Bergeman CS, Plomin R, Pedersen NL and McClean GE. *Gene-environmental mediation of the relationship between social support and psychological well-being*. Psychol Aging 1991, 6:640-646
28. Thompson MG and Hagger K. *Facets of support related to well-being: Quantitative social isolation and perceived family support in a sample of elderly women*. Psychol Aging 1990, 5:535-544
29. Woo J, Ho SC, Lau S, Lau J and Yuen YK. *Prevalence of cognitive impairment and associated factors among elderly Hong Kong Chinese aged 70 years and over*. Neuroepidemiology 1994, 13:50-58
30. Scherr PA, Hebert LE, Smith LA and Evans DA. *Relation of blood pressure to cognitive function in the elderly*. J Am Epidemiol 1991, 134:303-1315
31. Sook O, Lernfelt B, Landahl S, Palmertz B, Andresson LA, Nilsson L, Persson G, Oden A and Svanborg A. *15-year longitudinal study of blood pressure and dementia*. Lancet 1996, 347:1141-1145
40. Mahoney JE, Eisner J, Havighurst T, Gray S and Palta M *Problems of older adults living alone after hospitalization* J Gen Intern Med 2000, 15:611-619

41. Sarason IG, Sarason BR and Sherion EN *Social support as an individual difference variable: Its stability, origins, and relational aspects* J Pers Soc Psychol 1986, 50:845-855

42. Stokes JP and Levin I *Gender differences in predicting loneliness from social network characteristics* J Pers Soc Psychol 1986, 51:1069-1074

43. Hultsch DF, Hammer M and Small BJ *Age differences in cognitive performance in later life: Relationships to self-reported health and activity life style* J Gerontol 1993, 48:1-11

44. Bowling A *Research methods in health: investigating health and health services* Open University Press, Buckingham, Philadelphia 1997

45. Grady KE and Wallston BS *Research in health care settings. Thousand Oaks, California: Sage Publications* 1988.

46. Potts MK *Social Support and Depression among Older Adults Living Alone: The Importance of Friends Within and Outside of a Retirement Community* Social Work 1997, 42:348-362

**Pre-publication history**
The pre-publication history for this paper can be accessed here:

http://www.biomedcentral.com/1472-6963/3/9/prepub