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Comorbid Visual and Cognitive Impairment: Relationship With Disability Status and Self-Rated Health Among Older Singaporeans

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Abstract

The objective of this study was to examine the prevalence and consequences of coexisting vision and cognitive impairments in an Asian population. Data were collected from 4508 community-dwelling Singaporeans aged 60 years and older. Cognition was assessed by the Short Portable Mental Status Questionnaire whereas vision, disability, and self-rated health (SRH) were determined by self-report. Vision impairment was present in 902 (18.5%) participants and cognitive impairment in 835 (13.6%), with 232 (3.5%) participants experiencing both impairments. Persons with the comorbidity experienced higher odds of disability than persons with either single impairment. The association of vision impairment with SRH was stronger among women (odds ratio [OR] = 6.79, 95% confidence interval [CI] = 4.64-9.92) than among men (OR = 1.71, 95% CI = 1.21-2.41). Concurrent cognitive and vision impairment is prevalent in older Singaporeans and is associated with high rates of disability. Gender differences in vision-dependent roles may affect the patient-perceived impact of this comorbidity.

Keywords

older people, visual impairment, comorbidity, cognitive impairment, ADL/IADL disability, mobility disability, self-rated health

Introduction

In older adults, vision impairment is a risk factor for cognitive decline and incident dementia,[1-4] and vision and cognitive deficits frequently co-occur.[5] Many etiologies of cognitive impairment and vision impairment in older adults, such as Alzheimer's disease and age-related macular

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degeneration, are progressive and incurable.[6,7] Often, people with this comorbidity can expect to experience both impairments for the rest of their lives. Qualitative research has revealed unmet needs among patients with this comorbidity and uncertainty among providers about appropriate management.[8] Efforts to promote quality of life for these patients depend, in part, on understanding the impact of this comorbidity on independence and patient-perceived health.

The presence of either vision impairment or cognitive impairment increases an older adult's risk of disability,[9,10] but relatively less is known about the impact of both impairments on functional status. A previous study involving 3878 community-dwelling American seniors found that the 4% who experienced comorbid vision and cognitive impairments had the highest risk of prevalent and incident disability, although the contributions of each impairment to disability risk were additive rather than synergistic.[5] The study did not model the association of the comorbidity with patient-perceived health. People with vision impairment are more likely to report their health as poor.[11,12] Although not as well-documented as the association between vision and self-rated health (SRH), worsening cognition also appears to be associated with lower SRH in older adults.[13]

Many factors may influence task performance and SRH, including socioeconomic resources and societal support, medical conditions, psychological well-being, and culture.[14] The associations between impairments, disability, and SRH may be partially culturally mediated, and etiologies of vision impairment and cognitive impairment may vary by population; thus, the relationship between these variables may vary across societies.

Many Asian nations have witnessed substantial increases in life expectancy in recent decades, resulting in higher prevalence of age-related diseases of the brain and eye.[15,16] Yet little is known about the prevalence or the consequences of comorbid vision and cognitive deficits among older Asians. The objective of the current analysis is to examine the relationship between comorbid cognitive and vision impairment with disability status and SRH in a representative sample of community-dwelling, older Singaporeans. Because previous work has reported gender differences in SRH and function in Asian countries,[17] we further explored whether the association between the impairments and the patient-reported outcomes differed between men and women.

Methods

Study Population

Singapore is a multiethnic, multilingual city state with a population of 5.08 million as of 2010.[18] The Singapore Social Isolation, Health, and Lifestyles Survey is an ongoing cohort study that includes a nationally representative sample of Singaporeans aged 60 years or older at the time of enrollment in 2009. The analyses presented here are restricted to baseline data, as the second interview wave is currently underway. The survey, which assesses social and medical risks as well as protective and mediating factors for health and quality of life among older Singaporeans, is a collaborative effort between the National University of Singapore and the Ministry of Community Development, Youth, and Sports, designed to aid in policy planning for Singapore's aging population.

A random sample of 8400 older adults, stratified by gender, ethnicity, and 5-year age-group, was drawn from the national database of dwellings. The ethnic distribution of the residents (citizens and permanent residents) of Singapore is as follows: 74.1% Chinese, 13.4% Malay, 9.2% Indian, and 3.3% other.[19] In this study, purposeful oversampling of Malays, Indians, and those aged 75 years or older ensured that these groups were sufficiently represented. In total, 1195 (14.2%) of the sampled addresses were invalid; of the remaining 7205 potential participants, 5000 (69.4%) participated in the baseline survey. Nonresponders were more often ≤70 years old

and of "other" ethnicity, but gender distribution was similar to responders. The current analysis excluded participants with 1) proxy respondents (n = 450) or severe cognitive impairment (n = 28) because of possible inaccuracy of self-reported outcomes or 2) no vision in both eyes (n = 14) because most lacked cognitive data. These analyses used de-identified survey data and were exempted from full review by the Institutional Review Boards of the National University of Singapore and Duke University.

Vision Status

Participants rated their vision (with glasses or contact lenses, if worn) as excellent, very good, good, fair, or poor. We defined vision impairment as self-reported "fair" or "poor" vision.

Cognitive Status

Cognitive status was assessed with the 10-item Short Portable Mental Status Questionnaire (SPMSQ) and adjusted for education (one point added for <primary school, one point subtracted for >secondary level).[20] Cognitive impairment was defined as ≥3 errors.

Disability Status

Participants answered whether they find it difficult to independently perform 7 instrumental activities of daily living (IADLs): prepare meals, shop, use the phone, light housework, use public transport, take medication as prescribed, and manage financial matters. Participants were similarly asked about difficulty performing 7 basic activities of daily living (BADLs; dress, take a bath/shower, sit down and stand up, walk around the house, go outside, use the toilet, and eat) and 10 mobility tasks (walk 200 to 300 m, stand without sitting for 2 hours, climb 10 steps without rest, sit continuously for 2 hours, stoop, extend arm in front, raise hand over head, grasp with fingers, lift 10 kg, lift 5 kg). We defined disability in the 3 domains—BADL, IADL, or mobility—as self-reported difficulty with one or more task in that domain.

Self-Rated Health

Participants rated themselves as very healthy, healthier than average, of average health, somewhat unhealthy, or very unhealthy. We defined low SRH as somewhat or very unhealthy.

Covariates

Analyses included several covariates likely to correlate with vision or cognition and with disability status or SRH. Age was analyzed as a categorical variable (60-69, 70-79, and ≥80 years). Ethnicity was reported as Chinese, Malay, Indian, or other; education as less than primary (including those with no education), primary, secondary, or beyond secondary. Marital status was dichotomized as married versus widowed, divorced/separated, or never married. Housing type reflects socioeconomic status and was categorized as public housing (further categorized as 1-2 rooms, 3 rooms, ≥4 rooms), private condominiums, or bungalow/terrace/other. Participants were asked about adequacy of income to meet monthly expenses ("more than enough," "just enough," "some difficulty," or "much difficulty") and about whether they had ever been diagnosed with the following chronic conditions: heart attack/angina/myocardial infarction, cancer (excluding skin cancer), cerebrovascular disease, high blood pressure, diabetes, chronic back pain. Depressive symptoms were assessed with a modified, 11-item version of the Center for

Epidemiologic Studies–Depression Scale (CES-D) with a possible score range of 0 to 22.[21] Depression scores were analyzed as a continuous variable.

Statistical Analysis

The sample was divided into 4 mutually exclusive vision/cognitive impairment groups: (*a*) neither cognitive nor vision impairment, (*b*) cognitive impairment only, (*c*) vision impairment only, and (*d*) both vision and cognitive impairments. χ^2 tests and analysis of variance were used to compare these groups with respect to covariates.

Logistic regression models were constructed to determine the odds of disability or low SRH among participants with one or both impairments compared with the odds among participants with neither vision nor cognitive impairment. Separate unadjusted and adjusted (for the covariates described above) models were constructed for each dependent variable (IADL disability, BADL disability, mobility disability, low SRH). The SRH model was further adjusted for disability status. Because of concerns regarding possible overcorrection, we ran the SRH model both with and without the depressive symptoms covariate.

To assess whether vision impairment and cognitive impairment were associated with disability or SRH in a synergistic manner, we reran each model to include a multiplicative interaction term (vision impairment × cognitive impairment). A significant difference ($P < .05$) in the −2 log likelihood (−2LL) value of the model after inclusion of the interaction term was taken to indicate synergism, meaning that the risk of disability/low SRH associated with cognitive or vision impairment was stronger (or weaker) in the presence of the other impairment.

Next, we explored whether the association between vision impairment and cognitive impairment with SRH or disability differed by gender, age-group, or gender/age group. Logistic regression models were run with and without 2-way and 3-way multiplicative interaction terms (eg, vision/cognitive status × age-group × gender) to assess for a significant difference ($P < .05$) in the −2LL values of the models with and without the interaction terms.

Results

The average age of the 4508 study participants was 69.2 ± 7.2 years and 53.4% were female. Vision impairment was present in 902 (18.5%) and cognitive impairment in 835 (13.6%), with 232 (3.5%) experiencing both vision and cognitive impairment. The weighted prevalence of cognitive impairment among visually impaired persons was 19.1%, whereas that of vision impairment among cognitively impaired persons was 25.8%. Participants with the comorbidity were older, less educated, more likely to have financial difficulty, and reported more depressive symptoms and higher rates of coronary disease, diabetes, and high blood pressure (Table 1). Consistent with previous reports, women and Malays were overrepresented in the groups with cognitive impairment.[22]

Association of Vision, Cognitive Impairment, or Both With Disability

Of 4508 participants, 380 (6.1%) reported BADL disability, 527 (8.6%) reported IADL disability, and 1977 (38.8%) reported mobility disability. Vision impairment and cognitive impairment were significantly associated with disability (Table 2). The point estimate for the odds ratio was consistently highest among participants with coexisting cognitive and vision impairment. Even after adjustment for potential confounders (Table 2), participants with the comorbidity remained at 2.5 to 3.5 greater odds of each type of disability.

Table 1. Characteristics of Study Participants, Stratified by 4 Mutually Exclusive Categories of Vision and Cognitive Impairment Status.[a]

Characteristic	Overall Participants (N = 4508)	Neither Impairment (n = 3003)	Visually Impaired Only (n = 670)	Cognitively Impaired Only (n = 603)	Both Impairments (n = 232)	P^b
Age-group in years (%)						
60-69	60.4	65.4	59.5	38.1	27.4	<.0001
70-79	29.8	27.8	29.7	40.7	40.5	
≥75	9.8	6.9	10.9	21.2	32.1	
Gender (%)						
Female	53.4	48.9	45.3	87.5	80.9	<.0001
Ethnicity (%)						
Chinese	83.3	85.1	88.5	68.2	68.8	<.0001
Malay	9.1	7.3	6.0	22.4	21.0	
Indian	6.2	6.0	4.6	8.7	9.0	
Other	1.4	1.6	0.9	0.7	1.2	
Education (%)						
<Primary	28.6	23.3	23.8	59.7	67.1	<.0001
Primary	37.4	39.4	40.0	25.1	19.6	
Secondary	24.7	27.1	26.7	10.9	9.1	
>Secondary	9.3	10.2	9.5	4.3	4.2	
Marital status (%)						
Married	65.1	69.9	67.2	38.9	35.8	<.0001
Housing type (%)						
1-2 rooms public	7.1	6.6	7.0	9.3	11.9	.1067
3 rooms public	26.6	26.0	26.4	29.2	30.6	
4+ rooms public	53.4	54.1	53.2	51.0	47.4	
Condo	5.1	5.4	4.8	4.3	4.5	
Other[c]	7.8	7.9	8.6	6.3	5.6	
Income adequacy (%)						
Much difficulty	2.5	1.7	4.9	3.0	7.7	<.0001
Some difficulty	14.5	13.0	19.2	14.8	24.7	
Just enough	62.1	62.5	61.8	62.6	54.6	
More than enough	20.8	22.8	14.2	20.0	13.0	
Depressive symptoms (mean ± SD)[d]	3.3 ± 3.1	3.0 ± 2.8	3.7 ± 3.6	4.4 ± 3.2	5.7 ± 3.5	<.0001
Diseases (%)						
MI/angina	6.2	5.6	9.0	4.5	11.3	.0001
Cancer	3.0	2.8	3.6	3.1	2.4	.7087
CV disease	2.9	2.2	5.6	2.9	5.3	<.0001
High blood pressure	51.7	49.6	54.4	57.4	67.6	<.0001
Diabetes	21.3	19.1	27.7	22.9	34.5	<.0001
Back pain	10.3	9.0	13.0	14.6	15.2	<.0001

Abbreviations: MI, myocardial infarction; CV disease, cerebrovascular disease.
[a]Weighted values are reported for all variables.
[b]*P* values based on χ^2 test (for categorical variables) or analysis of variance (for continuous variables) comparing the proportions or means across the 4 vision/cognitive impairment groups.
[c]Bungalow/terrace/shophouse/other
[d]Scores (mean estimate ± standard deviation) on the 11-item version of the Center for Epidemiologic Studies–Depression Scale (CES-D).

Table 2. Occurrence of Disability Among People With Vision Impairment, Cognitive Impairment, or Both.

Unadjusted Analyses	BADL Disability; OR (95% CI) [Prevalence of BADL Disability[a]]	IADL Disability; OR (95% CI) [Prevalence of IADL Disability[a]]	Mobility Disability; OR (95% CI) [Prevalence of Mobility Disability[a]]
Impairment category			
People with vision impairment only	3.35 (2.44-4.61) [9.7%]	2.49 (1.88-3.30) [11.5%]	1.90 (1.61-2.24) [47.2%]
People with cognitive impairment only	5.67 (4.12-7.79) [15.4%]	5.44 (4.16-7.12) [22.2%]	3.36 (2.76-4.11) [61.3%]
People with comorbid vision and cognitive impairment	10.61 (7.09-15.87) [25.4%]	9.02 (6.25-13.03) [32.1%]	6.66 (4.63-9.59) [75.9%]
People with neither impairment	1.0 [3.1%]	1.0 [5.0%]	1.0 [32.0%]
Adjusted Analyses[b]	**BADL Disability; OR (95% CI)**	**IADL Disability OR (95% CI)**	**Mobility Disability; OR (95% CI)**
Impairment			
People with vision impairment only	2.40 (1.68-3.44)	1.93 (1.39-2.66)	1.85 (1.53-2.25)
People with cognitive impairment only	2.73 (1.87-3.99)	2.26 (1.63-3.13)	1.50 (1.18-1.90)
People with comorbid vision and cognitive impairment	3.26 (1.99-5.33)	2.50 (1.59-3.93)	2.59 (1.69-3.96)
People with neither impairment	1.0	1.0	1.0

Abbreviations: BADL, basic activities of daily living; IADL, instrumental activities of daily living; OR, odds ratio (compares the odds of disability among people in each impairment category with the odds of disability among people with neither impairment); CI, confidence interval.

[a]Weighted prevalence of disability

[b]Adjusted for age, gender, ethnicity, education, marital status, housing type, perceived income adequacy, self-reported chronic diseases (angina/myocardial infarction, cancer, cerebrovascular disease, hypertension, diabetes, chronic back pain) and depressive symptoms score.

Models that included an interaction term (vision impairment × cognitive impairment) revealed no significant interaction between vision and cognitive status with respect to IADL or mobility disability. However, when the dependent variable was BADL disability, comparison of the −2LL values of models with and without the interaction term confirmed significant effect modification ($P = .03$). The effect modification was negative, meaning that although participants with concurrent vision and cognitive impairment had higher risk of BADL disability, that risk was not as high as would be expected given the independent contributions from single impairments. Analyses did not suggest any effect modification by age or gender, indicating that the association between vision or cognitive impairment and BADL, IADL, and mobility disability did not vary by gender, age-group, or gender/age groups.

Table 3. Occurrence of Low Self-Rated Health in Men (N = 2094) and Women (N = 2413) With Vision impairment, Cognitive Impairment, or Both.

Unadjusted Analyses	Men; OR (95% CI) [Prevalence of Low SRH[a]]	Women; OR (95% CI) [Prevalence of Low SRH[a]]
Impairment category		
People with vision impairment only	2.59 (1.96-3.43) [24.4%]	9.21 (6.60-12.85) [30.8%]
People with cognitive impairment only	1.76 (0.89-3.48) [18.0%]	1.72 (1.12-2.64) [7.7%]
People with comorbid vision and cognitive impairment	7.00 (3.41-14.35) [46.6%]	11.05 (7.22-16.91) [34.8%]
People with neither impairment	1.0 [11.1%]	1.0 [4.6%]
Adjusted Analyses[b]	**Men; OR (95% CI)**	**Women; OR (95% CI)**
Impairment category		
People with vision impairment only	1.71 (1.21-2.41)	6.79 (4.64-9.92)
People with cognitive impairment only	1.50 (0.64-3.53)	1.02 (0.62-1.69)
People with comorbid vision and cognitive impairments	4.27 (1.53-11.92)	5.35 (3.12-9.18)
People with neither impairment	1.0	1.0

Abbreviations: SRH, self-rated health; OR, odds ratio (compares the odds of low SRH among people in each impairment category with the odds of low SRH among people with neither impairment); CI, confidence interval.
[a]Weighted prevalence of low SRH.
[b]Adjusted for age, gender, ethnicity, education, marital status, housing type, perceived income adequacy, self-reported chronic diseases (angina/myocardial infarction, cancer, cerebrovascular disease, hypertension, diabetes, chronic back pain), disability in basic activities of daily living (BADLs), disability in instrumental activities of daily living (IADLs), and mobility disability. Models that further adjusted for depression score did not change results significantly and are not shown.

Association of Vision, Cognitive Impairment, or Both With Self-Rated Health

Gender-stratified results are presented because the inclusion of interaction terms revealed significant effect modification by gender (but not age-group). The weighted prevalence of low SRH was 14.1% among men and 10.0% among women. The relationship between vision and cognitive impairment and SRH differed in men and women because of a stronger association between vision impairment and low SRH among women (Table 3).

In adjusted models, men with either single impairment experienced modest odds of low SRH, whereas men with the comorbidity were at 4 times greater odds of low SRH. In women, low SRH was similarly and strongly associated with either vision impairment alone or coexisting vision and cognitive impairment. In the adjusted models, cognitive impairment alone was not significantly associated with low SRH for either men or women.

Discussion

To our knowledge, this is the first study to document the prevalence and consequences of comorbid vision and cognitive impairment among non-Americans and the first to explore the association of this comorbidity with SRH. The prevalence of concurrent vision and cognitive impairment among older Singaporeans reported here (3.5%) was similar to the prevalence of 4.0% found among older Americans.[5] The rate of cognitive impairment was higher among

participants with vision impairment than among those with intact vision, and the rate of vision impairment was higher among cognitively impaired than cognitively intact participants. Similar to Americans, Singaporeans with coexisting vision and cognitive impairment had higher odds of disability than their peers with lone vision or cognitive impairment, but there was no evidence that the excess disability reflected a synergistic interaction between these impairments. Whereas the relationship between concurrent vision and cognitive impairment and disability appears consistent across cultures, age-groups, and gender, the relationship between the impairments and SRH differed by gender, with a stronger association between vision impairment and low SRH among women. Nevertheless, both men and women with comorbid vision and cognitive impairment, compared with those with normal vision and cognition, had 4- to 5-fold higher odds of low SRH.

In this population, cognitive impairment alone was not associated with low SRH, but older adults with both vision and cognitive impairment very frequently experienced low SRH. The results highlight the importance of efforts to develop and evaluate community-based programs or clinical interventions that prevent the development of this prevalent comorbidity or mitigate its effects on quality of life.[23] For example, future research might investigate whether correcting reversible vision loss in cognitively impaired seniors is associated with improved independence or quality of life.

We are aware of only a few other studies that have addressed the consequences of this particular pair of impairments (vision and cognition).[5,8] However, our results add to mounting evidence that comorbidity is a common pathway to functional decline and adverse outcomes in an aging society.[24,25] Comorbidity research frequently considers the overall burden of illness, but the current study demonstrates the utility of examining the health-related consequences of particular pairs of conditions that frequently co-occur.

One unexpected finding was the striking gender-based difference in the pattern of association between vision impairment and SRH. Although it is well-known that vision impairment is associated with depression and low SRH.[11,12,26] previous studies did not report a modifying effect of gender. Our finding is consistent with a large body of work that suggests that men and women differ in their self-assessments of health.[17,27] Women's health assessments tend to be sensitive to a wider range of health problems and life circumstances; this so-called "sponge" hypothesis has been offered as an explanation for the lower correlation of SRH to mortality among women compared with men.[28] That is, women may be more likely to lower their SRH based on a troubling—but not life-threatening—condition, such as vision impairment. The finding may also reflect culturally mediated differences in role expectations for older men and women in Asia.[29] If older Singaporean women are typically engaged in more vision-dependent tasks (such as cooking, cleaning, caregiving) than men, they may perceive their health to be more significantly affected by vision loss.

Some limitations may affect the interpretation of results. First, most variables were assessed by self-report, which is subject to bias, particularly for variables reflecting adequacy of income or health status. Cognitive impairment could introduce further bias to the reporting of all outcomes, including vision and disability. However, those with severe cognitive impairment (n = 28) were excluded, and evidence suggests that people with mild to moderate cognitive impairment provide reliable information about symptoms and basic health parameters.[30] Second, causation cannot be inferred from the associations observed in this cross-sectional data, though it seems less plausible that disability or low SRH would lead to sensory or cognitive impairment.

Conclusion/Recommendation

This study provides new information about the relationship of a common comorbidity (vision impairment and cognitive impairment) to older adults' functional status and self-perceived health.

With increasing recognition of the importance of patient-reported outcomes, the results suggest a promising point of emphasis for efforts aimed at improving independence and quality of life for older adults. In Singapore, approximately 3% to 4% of community-dwelling elderly had coexisting vision and cognitive impairment. Individuals with this pair of conditions are at high risk of disability and poorly perceived health, and culturally appropriate interventions that accommodate both conditions and strive to lessen their mutual impact are needed.

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