

# Relationship between Vision Impairment and Loneliness in Older Chinese: The Mediating Role of Depression

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**Abstract:** While vision impairment is a known risk factor for adverse psychosocial outcomes, its specific links to social isolation and loneliness, along with the underlying mediating mechanisms, remain under explored in aging Chinese. This study aimed to investigate these associations and examine potential mediators. We utilized data from the China Health and Retirement Longitudinal Study (CHARLS), following a cohort of adults aged 45 years or older from 2011 (wave 1) to 2015 (wave 3). Participants with incomplete data on demographics, vision, social relationships, or depression, or with baseline loneliness or social isolation, were excluded. Associations were assessed using Cox regression, and mediation analysis was employed to quantify the mediating effect. The analytic sample consisted of 3,379 Chinese adults (mean age, 59.26±8.29 years; 50.3% male). Longitudinally, distance vision impairment was associated with a significantly increased risk of incident loneliness (HR = 1.218, 95% CI: 1.028–1.442) rather than social isolation. Mediation analysis confirmed that depression accounted for 17.7% of this association (P = 0.006). Distance vision impairment was independently linked to increased loneliness, which was mediated by depression. The findings implied that implementing actively targeted interventions in preventing loneliness among aging Chinese people should focus on distance vision impairment and depression.

**Keywords:** Distance Vision Impairment; Loneliness; Social Isolation; Depression; Aging People

## 1. Introduction

Vision impairment is a primary global public health concern, affecting approximately 2.2 billion individuals worldwide[1]. Characterized

by restricted social interaction, social isolation has been reported to affect 25% of the older adult population in Western nations [2,3]. Conversely, loneliness is a subjective perception of social disconnection, which can arise regardless of actual social interaction. Research has estimated the incidence of loneliness among older persons in Eastern European nations to be between 18.7% and 24.2%[4]. Therefore, incorporating social isolation and loneliness into medical or nursing curricula is a pressing need.

Given the increasing concerns surrounding population aging, exploring the association between vision impairment, social isolation, and loneliness may deepen our understanding of the psychosocial implications of vision impairment. Nevertheless, empirical evidence on the link between vision impairment, social isolation, and loneliness remains limited. Existing evidence on the psychosocial impacts of vision impairment largely stems from populations of European descent, which may limit its generalizability to Asian contexts. Moreover, the underlying mechanisms of the correlation between vision impairments, social isolation, and loneliness remain largely unclear, necessitating further exploration of potential mediators. The current study aimed to explore the associations of vision impairment with both social isolation and loneliness in an Asian context, and to investigate possible mediators that may account for these relationships.

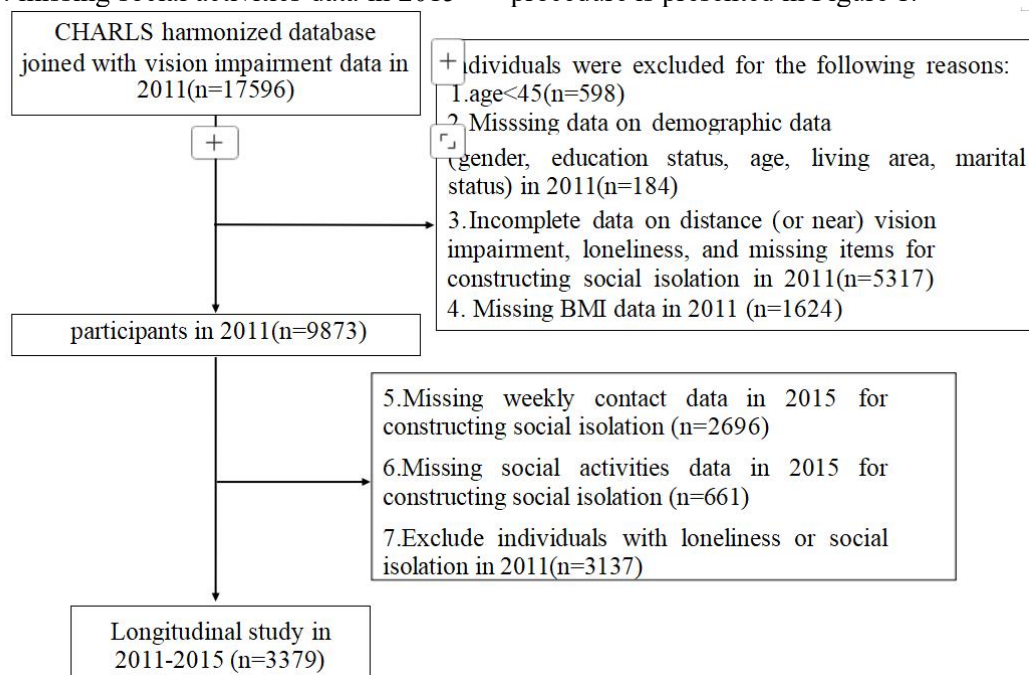
## 2. Methods

### 2.1 Participants

This study utilized data from 2011 (wave 1 as the baseline) and 2015 (wave 3 as the follow-up) of CHARLS study. The 2011 wave, derived from a harmonized database, was analyzed alongside distance and near vision impairment data from raw data, serving as the baseline. The exclusion criteria were: 1. age < 45 years old; 2. missing

data on demographic variables (gender, education status, age, living area, marital status) in 2011; 3. incomplete data on distance (or near) vision impairment, loneliness, and missing items for constructing social isolation in 2011; 4. missing BMI data in 2011; 5. missing weekly contact data in 2015 for constructing social isolation; 6. missing social activities data in 2015

for constructing social isolation; 7. individuals with loneliness or social isolation (score  $\geq 2$ ) in 2011. The final analytic included 3,379 participants. These individuals reported neither loneliness nor social isolation in CHARLS 2011, had no missing data, and were fully followed up in 2015. An overview of the recruitment procedure is presented in Figure 1.



**Figure 1. Participant Selection Process for the Analytical Sample. (BMI: Body Mass Index).**

## 2.2 Assessment of Exposure

### Vision impairment assessment

The CHARLS database classifies vision impairment into distance, near vision impairment. Participants were evaluated based on their self-reports of vision, categorized as excellent, very good, good, fair, or poor for both distance and near vision. Reporting poor or fair eyesight was recognized as a vision impairment in either of the two questions, following previous CHARLS-based studies[5].

## 2.3 Assessment of Outcome

### Social isolation assessment

Social isolation was quantified using a cumulative scoring approach, with one point assigned for each of the following conditions: being unmarried; living alone; having fewer than weekly contacts with children via phone, in-person visits, or email; and reporting no participation in social activities over the past month. The social isolation scores ranged from 0 to 4, constructed according to the criteria in the previous study[6], with scores of 2 or higher

indicating social isolation.

### Loneliness assessment.

Respondents who indicated feelings of loneliness rarely or not at all were categorized as not experiencing loneliness, while those who reported feeling lonely sometimes, occasionally, or most of the time were classified as lonely[7].

## 2.4 Assessment of Covariates

Demographic characteristics included age, sex, educational level, marital status, and residential area based on hukou status.

Health-related covariates comprised smoking status, alcohol consumption, and body mass index (BMI), which was classified into three categories: underweight, normal weight and overweight. Self-reported, physician-diagnosed medical conditions were also included.

Depressive symptoms were assessed using the 10-item Center for Epidemiological Studies Depression Scale (CESD-10). To derive a depression score independent of social isolation, the item related to loneliness was removed, and the sum of the remaining nine items was calculated, resulting in a modified CESD-9 score

ranging from 0 to 27[8]. Depression was recognized as a CESD-9 score of  $\geq 9$ , indicating depression, and  $< 9$ , indicating no depression.

## 2.5 Statistical Analysis

**Table 1. Characteristics of Study Participants Characteristics**

	Overall	no distance vision impairment	distance impairment	P value	no near vision impairment	near vision impairment	P value
n	3379	1324	2055		1132	2247	
Gender (%)							
Male	1700 (50.3)	724 (54.7)	976 (47.5)	<b>&lt;0.001</b>	609 (53.8)	1091 (48.6)	<b>0.004</b>
Female	1679 (49.7)	600 (45.3)	1079 (52.5)		523 (46.2)	1156 (51.4)	
Education status (%)							
Less than lower secondary education	3032 (89.7)	1153 (87.1)	1879 (91.4)	<b>&lt;0.001</b>	992 (87.6)	2040 (90.8)	<b>0.017</b>
Upper secondary/vocational training	313 (9.3)	154 (11.6)	159 (7.7)		127 (11.2)	186 (8.3)	
Tertiary education	34 (1.0)	17 (1.3)	17 (0.8)		13 (1.1)	21 (0.9)	
Age (mean (SD))	59.26 (8.29)	58.29 (8.34)	59.89 (8.20)	<b>&lt;0.001</b>	59.39 (8.75)	59.20 (8.05)	0.515
Living area (%)							
urban	512 (15.2)	216 (16.3)	296 (14.4)	0.144	186 (16.4)	326 (14.5)	0.155
rural	2867 (84.8)	1108 (83.7)	1759 (85.6)		946 (83.6)	1921 (85.5)	
Marital status (%)							
others	324 (9.6)	128 (9.7)	196 (9.5)	0.948	112 (9.9)	212 (9.4)	0.714
married	3055 (90.4)	1196 (90.3)	1859 (90.5)		1020 (90.1)	2035 (90.6)	
Drinking (%)							
No	2003 (59.3)	766 (57.9)	1237 (60.2)	0.188	674 (59.5)	1329 (59.1)	0.854
Yes	1376 (40.7)	558 (42.1)	818 (39.8)		458 (40.5)	918 (40.9)	
Smoking (%)							
No	1957 (57.9)	744 (56.2)	1213 (59.0)	0.111	648 (57.2)	1309 (58.3)	0.599
Yes	1422 (42.1)	580 (43.8)	842 (41.0)		484 (42.8)	938 (41.7)	
Cancer (%)							
No	3349 (99.1)	1308 (98.8)	2041 (99.3)	0.159	1115 (98.5)	2234 (99.4)	<b>0.012</b>
Yes	30 (0.9)	16 (1.2)	14 (0.7)		17 (1.5)	13 (0.6)	
Lunge disease (%)							
No	3076 (91.0)	1227 (92.7)	1849 (90.0)	<b>0.009</b>	1037 (91.6)	2039 (90.7)	0.443
Yes	303 (9.0)	97 (7.3)	206 (10.0)		95 (8.4)	208 (9.3)	
Liver disease (%)							
No	3280 (97.1)	1296 (97.9)	1984 (96.5)	<b>0.032</b>	1104 (97.5)	2176 (96.8)	0.313
Yes	99 (2.9)	28 (2.1)	71 (3.5)		28 (2.5)	71 (3.2)	
Kidney disease (%)							
No	3199 (94.7)	1267 (95.7)	1932 (94.0)	<b>0.041</b>	1080 (95.4)	2119 (94.3)	0.205
Yes	180 (5.3)	57 (4.3)	123 (6.0)		52 (4.6)	128 (5.7)	
Digestive disease (%)							
No	2678 (79.3)	1083 (81.8)	1595 (77.6)	<b>0.004</b>	923 (81.5)	1755 (78.1)	<b>0.023</b>
Yes	701 (20.7)	241 (18.2)	460 (22.4)		209 (18.5)	492 (21.9)	
Asthma (%)							
No	3233 (95.7)	1276 (96.4)	1957 (95.2)	0.131	1088 (96.1)	21 (95.5)	0.429
Yes	146 (4.3)	48 (3.6)	98 (4.8)		44 (3.9)	102 (4.5)	
Dyslipidemia (%)							
No	3054 (90.4)	1204 (90.9)	1850 (90.0)	0.413	1020 (90.1)	2034 (90.5)	0.746
Yes	325 (9.6)	120 (9.1)	205 (10.0)		112 (9.9)	213 (9.5)	
Heart problem(%)							
No	2996 (88.7)	1205 (91.0)	1791 (87.2)	<b>0.001</b>	1012 (89.4)	1984 (88.3)	0.369
Yes	383 (11.3)	119 (9.0)	264 (12.8)		120 (10.6)	263 (11.7)	
Stroke (%)							
No	3302 (97.7)	1293 (97.7)	2009 (97.8)	0.938	1099 (97.1)	2203 (98.0)	0.102
Yes	77 (2.3)	31 (2.3)	46 (2.2)		33 (2.9)	44 (2.0)	
Psychology problem (%)							
No	3357 (99.3)	1316 (99.4)	2041 (99.3)	0.958	1129 (99.7)	2228 (99.2)	0.079
Yes	22 (0.7)	8 (0.6)	14 (0.7)		3 (0.3)	19 (0.8)	
Memory problem (%)							
No	3348 (99.1)	1313 (99.2)	2035 (99.0)	0.811	1118 (98.8)	2230 (99.2)	0.234
Yes	31 (0.9)	11 (0.8)	20 (1.0)		14 (1.2)	17 (0.8)	
Arthritis (%)							
No	2268 (67.1)	946 (71.5)	1322 (64.3)	<b>&lt;0.001</b>	803 (70.9)	1465 (65.2)	<b>0.001</b>

Yes	1111 (32.9)	378 (28.5)	733 (35.7)		329 (29.1)	782 (34.8)	
High blood pressure (%)							
No	2533 (75.0)	1010 (76.3)	1523 (74.1)	0.167	843 (74.5)	1690 (75.2)	0.669
Yes	846 (25.0)	314 (23.7)	532 (25.9)		289 (25.5)	557 (24.8)	
Diabetes (%)							
No	3179 (94.1)	1246 (94.1)	1933 (94.1)	1	1071 (94.6)	2108 (93.8)	0.395
Yes	200 (5.9)	78 (5.9)	122 (5.9)		61 (5.4)	139 (6.2)	
BMI (%)							
BMI<18.5	186 (5.5)	69 (5.2)	117 (5.7)	0.387	69 (6.1)	117 (5.2)	0.551
18.5≤BMI<25	2087 (61.8)	804 (60.7)	1283 (62.4)		692 (61.1)	1395 (62.1)	
BMI≥25	1106 (32.7)	451 (34.1)	655 (31.9)		371 (32.8)	735 (32.7)	
Depression (CESD-9)	8.53(3.93)	7.77(3.58)	9.02(4.06)	<0.001	7.99(3.74)	8.80(3.99)	<0.001
Loneliness (%)							
No	2720 (80.5)	1117 (84.4)	1603 (78.0)	<0.001	919 (81.2)	1801 (80.2)	0.504
Yes	659 (19.5)	207 (15.6)	452 (22.0)		213 (18.8)	446 (19.8)	
Social isolation (%)							
No	2681 (79.3)	1058 (79.9)	1623 (79.0)	0.542	896 (79.2)	1785 (79.4)	0.881
Yes	698 (20.7)	266 (20.1)	432 (21.0)		236 (20.8)	462 (20.6)	

Abbreviations: BMI, body mass index; CI, confidence intervals; CESD-9,10-item Center for Epidemiological Studies Depression Scale without the loneliness question.

Statistical analysis was performed using R software version 4.4.2. Mean and SD were used to describe age, number, and percentage, and to assess the categorical variables. Subsequently, we employed the survival and survminer packages to conduct Cox regression analysis. Three models were estimated in the Cox regression analyses examining the relationship between loneliness and distance vision impairment. To identify potential mechanisms underlying the association between distance vision impairment and loneliness, a mediation analysis was conducted. The mediating effects were explored using R, the CMAverse, sjPlot, lmtest, and mediation packages to regress distance vision impairment and the mediator on the outcome of loneliness. In the mediation analysis investigating the impact of distance vision impairment on loneliness, variables with statistical significance in Table 1 as potential mediating factors were assessed, and a Cox model utilizing the bootstrap methods with 5000 iterations was employed[9].

### 3. Results

#### 3.1 Participants' Characteristics

A flowchart detailing the selection process is presented in Figure 1.

Following the exclusion of individuals outlined in the aforementioned methods, our study sample consisted of 3,379 participants aged between 45.0 and 101.0 years, with 50.3% being male, in China. Table 1 showed that the distance vision impairment group comprised 2,055 individuals (60.8%), while the near vision impairment group included 2,247 participants

(66.5%). Distance vision impairment showed strong associations with gender, education status, age, systemic conditions (lung, liver, kidney, digestive, and heart problems, arthritis), depression (CESD-9), and loneliness. A significantly higher proportion of loneliness corresponded to the presence of distance vision impairment (22.0% vs. 15.6%,  $P < 0.001$ ). By contrast, there was no evidence of a connection between distance vision impairment and social isolation. There was no statistical difference between near vision impairment and loneliness ( $P=0.504$ ), or social isolation( $P=0.881$ ).

#### 3.2 The Relationship between Distance Vision Impairment and Loneliness

**Table 2. Association of Distance Vision Impairment and social Isolation, Loneliness with Cox Regression Analysis**

	distance vision impairment	
	HR (95%CI)	P value
<b>Social isolation</b>		
Model1	0.925(0.793 to 1.079)	0.325
Model2	0.919(0.788 to 1.073)	0.288
Model3	0.913(0.780 to 1.069)	0.258
<b>Loneliness</b>		
Model1	1.319(1.118 to 1.557)	<b>0.001</b>
Model2	1.319(1.118 to 1.557)	<b>0.001</b>
Model3	1.218(1.028 to 1.442)	<b>0.023</b>

Model1 was adjusted for gender, education, age, living area, marital status

Model 2 was adjusted for gender, education, age, living area, marital status, drinking, smoking, BMI

Model 3 was adjusted for gender, education, age, living area, marital status, drinking, smoking,

BMI, cancer, lung disease, liver disease, kidney disease, digestive disease, asthma, dyslipidemia, heart problem, stroke, psychological problem, memory problem, arthritis, high blood pressure, diabetes, CESD-9

Abbreviations: HR, Hazard Ratio; CI, confidence intervals; CESD-9, 10-item Center for Epidemiological Studies Depression Scale without the loneliness question

A significant association between distance vision impairment and loneliness was observed across all three models (Model 3: HR = 1.218, 95% CI: 1.028–1.442). Conversely, distance vision impairment showed no significant association with social isolation, with non-significant P-values in Table 2 corroborating the results presented in Table 1.

### 3.3 Mediation Analysis

Table 3 indicates that depression (CESD-9) exhibited statistically significant mediation effects in the analysis. Education status exerted a significant mediating effect, with an indirect effect size of 0.177 (P = 0.006), indicating that depression significantly mediated the relationship between distance vision impairment and incident loneliness.

**Table 3. The Mediation Analysis between Variables with Statistical Significance and Loneliness**

	Cox model utilizing the bootstrap methods	
	Percentage mediated (95% CI)	P value
Gender	-0.002(-0.106-0.080)	0.976
Age	0.068(-0.025-0.291)	0.138
Education status	0.064 (-0.001-0.288)	0.054
Lung disease	0.002(-0.044-0.042)	0.886
Liver disease	-0.002(-0.073-0.042)	0.851
Kidney disease	-0.0005(-0.034-0.032)	0.968
Digestive disease	0.007(-0.023-0.061)	0.599
Heart problem	-0.016(-0.112-0.027)	0.407
Arthritis	0.045(-0.005-0.202)	0.076
<b>Depression (CESD-9)</b>	<b>0.177(0.066-0.559)</b>	<b>0.006</b>

Abbreviations: BMI, body mass index; CI, confidence intervals; CESD-9, 10-item Center for Epidemiological Studies Depression Scale without the loneliness question

As presented in Table 4, the indirect effect, direct effect, and total effect of depression were all statistically significant (Figure 2). These results suggested that depression partially

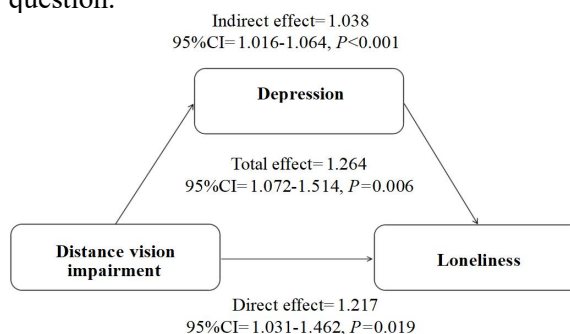
mediates the relationship between distance vision impairment and loneliness.

**Table 4. Bootstrap Test for Mediation Models**

Paths	Bootstrap test		
	Standard error	Lower 95% CI-upper 95% CI	P value
Depression (CESD-9) <sup>a</sup>			
Indirect effect	1.038	1.016-1.064	<0.001
Direct effect	1.217	1.031-1.462	0.019
Total effect	1.264	1.072-1.514	0.006

<sup>a</sup> mediation model was adjusted for gender, age, living area, marital status, education status, drinking, smoking, BMI, cancer, lung disease, liver disease, kidney disease, digestive disease, asthma, dyslipidemia, heart problem, stroke, psychological problem, memory problem, arthritis, high blood pressure, diabetes

Abbreviations: CI, confidence intervals; CESD-9, 10-item Center for Epidemiological Studies Depression Scale without the loneliness question.



**Figure 2. Flow Diagram for Association between Distance Vision Impairment, Depression, and Loneliness. (CI: Confidence Intervals)**

### 4. Discussion

This longitudinal study among aging Chinese adults demonstrated that distance vision impairment is an independent predictor of loneliness, mediated by depression, but is not significantly associated with social isolation. These findings suggested that interventions targeting depression among older adults with distance vision impairment may alleviate the overall burden of loneliness.

While vision impairment is known to be correlated with depression [10,11], and depression has been linked to loneliness in older adults in Western populations like the United States and Spain [12,13], it remains unknown whether depression mediates the relationship between vision impairment and loneliness in the aging Chinese population. Our analysis revealed a

significant indirect effect of vision impairment on loneliness through depression (estimate = 1.038, 95% CI: 1.016 to 1.064,  $p < 0.001$ ), supporting the mediator role of depression between vision impairment and loneliness. This mediation effect can be interpreted through the pathway of a loss of independence; the loss of independence due to poor vision likely contributes to depressive symptoms. Subsequently, the anhedonia and lack of motivation characteristics of depression lead to feelings of loneliness. Our results suggested that policies aimed at early screening or intervening in depression could, over the long term, reduce the burden of loneliness in aging populations with vision impairment.

Several limitations of this study should be acknowledged. First, vision impairment was based on self-report, which may have led to overestimation or underestimation of actual visual function. Second, loneliness was measured using a single item, potentially introducing subjective bias. Third, the analysis could not account for all possible confounders associated with vision impairment or loneliness, leaving the possibility of residual confounding. Future research should therefore replicate these findings using an independent sample of older Chinese adults, incorporating objective clinical assessments and validated loneliness scales.

## 5. Conclusion

This study showed that distance vision impairment was associated with an increased risk of loneliness, but not social isolation in aging Chinese. Moreover, depression appeared to mediate the relationship between distance vision impairment and loneliness. These findings highlight the importance of integrated, multidimensional strategies to mitigate loneliness among aging Chinese with visual impairment.

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