Prevalence and Correlates of Vision Impairment and Its Association With Cognitive Impairment Among Older Adults in India: An Epidemiological Study

Muhammad T

International Institute for Population Sciences

Drishti Drishti

International Institute for Population Sciences

Shobhit Srivastava (✉ shobhitsrivastava889@gmail.com)

International Institute for Population Sciences

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Abstract

Background

Like other major chronic diseases, vision impairment is an independently associated risk factor of cognitive decline among older individuals. We in this study, aim to investigate what are the predictors of vision impairment in old age and how impaired vision is associated with cognitive impairment among the aging population.

Methods

The present research used data from Building a Knowledge Base on Population Aging in India. The effective sample size for the present study was 9541 older adults. Descriptive statistics and bivariate analysis was used to find the preliminary results. Further, binary logistic regression analysis was been done to fulfil the objective of the study.

Results

About 6 in every 10 older adults had a problem of vision impairment. Further, nearly 60% of older adults had cognitive impairment in India. Diabetes [OR: 1.55, CI: 1.32-1.81], hypertension [OR: 1.60, CI: 1.42-1.80], heart disease [OR: 1.43, CI: 1.16-1.76] and cataract [OR: 5.97, CI: 4.83-7.38] were the risk factors for vision impairment among older adults. It was revealed that the older adults who had vision impairment were 11% significantly more likely to have cognitive impairment when compared with the older adults who do not suffer from vision impairment [OR: 1.11, CI: 1.01-1.23]. Low psychological health [OR: 1.55; CI: 1.36, 1.77], low ADL [OR: 1.80; CI: 1.43, 2.27], low IADL [OR: 1.26; CI: 1.14, 1.40], poor self-rated health [OR: 1.28; CI: 1.15-1.41] and chronic morbidity [OR: 1.27; CI: 1.14, 1.41] were the significant factors for cognitive impairment among older adults in India

Conclusions

Additional efforts in terms of advocacy, availability, affordability, and accessibility especially in a country with a greater illiteracy rate are mandatory to increase the reach of eye-care services and reduce the prevalence of avoidable visual impairment and vision losses that lead to cognitive deficits among the older population.

Background

Cognitive deficit in an aging population is becoming a global concern for health and social policy (H. L. Park, O'Connell, & Thomson, 2003). With advancing age, the incidence of sensory and intellectual loss increases affecting the cognitive functioning among older individuals (Fischer et al., 2016). Globally, the prevalence of moderate to severe vision impairment in older adults has been reported as highest in South Asia (Stevens et al., 2013).

It is shown that the public health burden due to vision impairment is substantial and comparable to that of other major diseases in assessing the health-related quality of life (S. J. Park, Ahn, & Park, 2016). A recent study found that there has been no significant reduction in the amount of preventable visual impairment cases over the last decade (Adelson et al., 2020). A review of clinical and epidemiological studies on causes of vision loss found a strong independent association of hypertension with several eye conditions that ultimately result in visual impairment (Bhargava, Ikram, & Wong, 2012). Further, evidence from population-based studies suggests that a large proportion of vision impairments are attributable to diabetic retinopathy during the first 2 decades of developing diabetes (Chou et al., 2010; Fong et al., 2004). A study based on Global Burden of Disease and available population-based studies worldwide indicate that in 2010, more than 40 percent of blindness and 20 percent of visual impairments in South Asia are caused by cataracts (Khairallah et al., 2015). Other chronic health conditions such as heart disease, stroke, and depression were more likely to be reported by people with vision impairment than those without and were associated with self-rating of poor health status (Crews, Chou, Sekar, & Saaddine, 2017).

A growing body of literature based on cross-sectional and longitudinal datasets have shown that vision impairment is associated with cognitive decline among the older population (Anstey, Luszcz, & Sanchez, 2001; Davidson & Guthrie, 2019; Spierer, Fischer, Barak, & Belkin, 2016; Woo et al., 2012). Changes in multiple measures of vision such as visual acuity, sensitivity, and visual processing speed have been observed among the aging population, and these changes have been associated with cognitive impairments (Munoz, Stawski, Sliwinski, Smyth, & Macdonald, 2018; Whitson et al., 2018). On the other hand, some studies found no significant association between vision loss and cognitive impairment among older adults (Duron & Hanon, 2008). Thus, whether a visual impairment is accompanied by a decline in cognitive ability remains uncertain. However, a significant association has been found and well-documented between visual impairment and dementia (Davies-Kershaw et al., 2018; Dawes, Wolski, Himmelsbach, Regan, & Leroi, 2019; Lawrence, Murray, Ffytche, & Banerjee, 2009; Luo et al., 2018). Additionally, a wealth of epidemiological studies have indicated that people with age-related eye diseases have a reduced cognitive score compared to those with healthy eyes (Baker et al., 2009; Harrabi et al., 2015; Ong et al., 2012; Woo et al., 2012).

Due to its increased prevalence and greater effect on physical and mental health, cognitive impairment deserves special attention among all chronic conditions. However, unlike other major chronic diseases, vision impairment as an independently associated risk factor of cognitive decline among older individuals is often overlooked by investigators and policymakers. Thus, we aim to investigate what are the predictors of vision impairment in old age and how impaired vision is associated with cognitive impairment among Indian older adults.

Data And Methods

Data

The present study used data from Building a Knowledge Base on Population Aging in India (BKPAI) which was a national-level survey and was conducted in 2011, across seven states of India (UNFPA, 2012). The survey was sponsored by Tata Institute for social sciences (TISS), Mumbai, Institute for social and economic change (ISEC), Bangalore, United Nations Population Fund (UNFPA), New Delhi and Institute for economic growth (IEG), Delhi. The survey gathered information on various socio-economic and health aspects of aging among households of those aged 60 years and above. Seven regionally representative states were selected for the survey with the highest 60 + year's population than the national average. This survey was carried out on a representative sample in the northern, western, eastern, and southern parts of India following a random sampling process. The urban and rural samples within each state were drawn separately. The primary sampling units (PSUs) in the rural areas were villages, whereas the urban wards were the PSUs in the urban areas. First, villages were classified into different strata based on population size, and the number of PSUs to be selected was determined in proportion to the population size of each stratum. Using probability proportional to population size (PPS) technique, the PSUs were selected and within each selected PSU, elderly households were selected using systematic sampling. A similar procedure was applied for drawing samples from urban areas. Being a survey of the older, the sample size was equally split between urban and rural areas, irrespective of the proportion of the urban and rural population. The respondents to the Household Schedule included any usual resident member above the age of 15 years, while in the case of the Individual Schedule all those aged 60 and above in the sampled households were the respondents and were interviewed. However, a total of 8,329 households were interviewed and among them, 9,852 older adults' interviews were conducted. Further details on the sampling procedure, the sample size is available in national and state reports of BKPAI, 2011 (UNFPA, 2012). For the current study, the effective sample size was 9541 older adults residing in seven states aged 60 + years were selected.

Variable description

Outcome variable

There were two outcome variables in the study. The first outcome variable was visual impairment which was derived from the question of whether older adults were having any difficulty in vision which was recoded as 0 "no" and 1 "yes".

The second outcome variable was cognitive impairment. Cognitive impairment was measured by the number of words recalled. To measure cognitive impairment a scale of 0 to 10 was prepared representing higher the score lower the cognitive impairment. The words used were Bus, House, Chair, Banana, Sun, Bird, Cat, Saree, Rice, and Monkey. Five or more words were recoded as 0 "low" representing lower cognitive impairment and a score of four or less was recoded as 1 "high" representing higher cognitive impairment (Joe, Perkins, & Subramanian, 2019; Skirbekk, Loichinger, & Weber, 2012; Srivastava & Muhammad, 2020). High cognitive impairment represents cognitive disability among older adults in the present study. Place of Residence was categorized as rural and urban. The study was stratified into rural

and urban. However, during multivariate analysis place of residence was used as a control variable to see the adjusted effects.

Explanatory variables

The explanatory variables were derived from the literature. Diabetes, Hypertension Stroke, Heart disease, and Cataract was recoded as no and yes.

The 12-item version of the General Health Questionnaire (GHQ-12) was used as a measure of low psychological health. Psychological health was having a scale of 0 to 12 based on experiencing stressful symptoms and was recoded as 0 “high” (representing 6 + scores) and 1 “low” (representing score 5 and less) (Jacob, Bhugra, & Mann, 1997; Shidhaye & Patel, 2010; Srivastava & Muhammad, 2020). The low psychological health represents lower levels of psychological health or psychological distress among older adults (Cronbach alpha: 0.90). Ability to do activities of daily living was having a scale of 0 to 6 wherein it represents higher the score higher the independence. A score of 6 was categorized as 0 “high” which represents full independence and 5 and less was categorized as 1 “low” which represents not fully independent to do activities of daily living (Cronbach Alpha: 0.93). The ability to do instrumental activities of daily living was having a scale of 0 to 8 representing higher the score higher the independence. A score of 6 + was categorized as 0 “high” representing high IADL and a score of 5 and less was recoded as 1 “low” representing low IADL (Arokiasamy, Uttamacharya, Kowal, & Chatterji, 2016; Joe et al., 2019; Muhammad & Srivastava, 2020). The International Classification of Functioning, Disability, and Health (ICF) proposed the framework on which ADL and IADL were calculated. The Activities of Daily Living (ADL) is an umbrella term relating to self-care, comprising those activities that people undertake routinely in their everyday life. The activities can be subdivided into personal care or ADL and domestic and community activities or Instrumental ADL (IADL). The ADL and IADL have emerged as the most common approaches in empirical assessments of functionality among the elderly and are considered to be befitting to the ICF framework (Saleeby, 2016). Self-rated health was having a scale of 1 to 5 “poor to excellent” and was categorized as 0 “good” (representing good, very good, and excellent) and 1 “poor” (representing poor or fair) (Srivastava, Chauhan, & Patel, 2020). Chronic morbidity was categorized as 0 “no” and 1 “yes” (Srivastava & Gill, 2020).

Age was recoded as 60–69 years, 70–79 years and 80 + years, gender was recoded as men and women, marital status was recoded as not in a marital union and currently in the union, educational status was recoded as no education, below five years, 6–10 years and 11 + years, working status (last one year) was recoded as no, yes and retired. Living arrangement was recoded as living alone and co-residing (with spouse or children or others). Community involvement was generated using the following questions: a. attended a public meeting in the last 11 months with a discussion on the local, community, or political affairs; b. Have attended any group, club, society, union, or organizational meetings in the last 11 months; c. Have worked with other people in the neighbourhood to fix or improve something in the last 11 months; d. Have attended or participated in any religious programs/services etc. (not including weddings and funerals) in last 11 months; and e. Have gone out of the house for visiting friends or relatives in the last 11 months. The responses were never, rarely, occasionally, and frequently. They were coded as 0 “never”

and 1 “rarely/occasionally/frequently” A scale of 0–5 was generated and was coded as 0 “no community involvement” and 1–4 were coded as 1 “community involvement”. Trust over someone was assessed using the question “do you have someone you can trust and confide in?” was recoded as 0 “yes” and 1 “no”.

Wealth status was based on three quintiles i.e. poor, middle, and rich. The wealth index drawn based on the BKPAI survey is based on the following 30 assets and housing characteristics: household electrification; drinking water source; type of toilet facility; type of house; cooking fuel; house ownership; ownership of a bank or post-office account; and ownership of a mattress, a pressure cooker, a chair, a cot/bed, a table, an electric fan, a radio/transistor, a black and white television, a colour television, a sewing machine, a mobile telephone, any landline phone, a computer, internet facility; a refrigerator, a watch or clock, a bicycle, a motorcycle or scooter, an animal-drawn cart, a car, a water pump, a thresher and a tractor (UNFPA, 2012). The range of index was from poorest to the richest i.e. ranging from lowest to the highest. Religion was recoded as Hindu, Muslim, Sikhs, and others, caste was recoded as Scheduled Caste/Scheduled Tribe (SC/ST) and non-SC/ST which includes OBC and others. The Scheduled Caste include “untouchables”; a group of the population that is socially segregated and financially/economically by their low status as per Hindu caste hierarchy. The Scheduled Castes (SCs) and Scheduled Tribes (STs) are among the most disadvantaged socio-economic groups in India. The OBC is the group of people who were identified as “educationally, economically and socially backward”. The OBC’s are considered low in the traditional caste hierarchy but are not considered untouchables. The “other” caste category is identified as having a higher social status (Subramanian, Nandy, Irving, Gordon, & Smith, 2005). The residence was recoded as rural and urban. Data was collected in seven states of India to make it representable i.e., Himachal Pradesh, Punjab, West Bengal, Odisha, Maharashtra, Kerala, and Tamil Nadu.

Statistical analysis

Descriptive statistics and bivariate analysis was used to find the preliminary results. Further, binary logistic regression analysis (Osborne & King, 2011) was been done to fulfil the objective of the study. The outcome variables were vision impairment (no and yes) and cognitive impairment (low and high). The results were presented in the form of odds ratio (OR) with a 95% confidence interval (CI).

The model is usually put into a more compact form as follows:

$$\ln\left(\frac{P_i}{1 - P_i}\right) = \beta_0 + \beta_1 x_1 + \cdots + \beta_M x_{m-1},$$

Where $\beta_0, \dots, \beta_M$ are regression coefficients indicating the relative effect of a particular explanatory variable on the outcome variable. These coefficients change as per the context in the analysis in the study. STATA 14 was used for the analysis purpose (StataCorp, 2015).

Results

Table 1 represents the socio-demographic profile of older adults. It was revealed that about 10% of older adults suffered from diabetes while the older adults who suffered from hypertension were about 21%. Almost 1% of older adults suffered from a stroke while only 6% of older adults suffered from heart diseases. About 13% of the older adults had cataracts. Nearly 23% of older adults had low psychological health. Older adults with low Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) were nearly 7% and 57% respectively. Nearly 55% of older adults had poor self-rated health (SRH). About 65% of older adults suffered from one or more chronic diseases. Nearly 39% of older adults were not in a union as per marital status. About 51% of older adults had no education while 67% of older adults were currently not working. Almost 6% of older adults were living alone and about 21% of older adults had no community involvement. Nearly 17% of older adults had no trust over someone.

Table 2 gives an insight into the distribution and logistic regression estimates of older adults having vision disability by their background characteristics. It was found that the odds of vision impairment were significantly high among older adults with diabetes in comparison to older adults who do not have diabetes [OR: 1.55, CI: 1.32–1.81]. Older adults with hypertension were 60% significantly more like to have vision impairment in comparison to the older adults who do not suffer from hypertension [OR: 1.60, CI: 1.42–1.80]. Older adults who suffered from stroke were 6% less likely to have visual impairments in comparison to the older adults who have not suffered from stroke [OR: 0.94, CI: 0.57–1.57]. The odds of vision impairment were significantly high among older adults with heart disease in comparison to older adults who do not have heart disease [OR: 1.43, CI: 1.16–1.76]. Older adults with cataracts were almost six times significantly more like to have vision impairment in comparison to those who do not have cataract [OR: 5.97, CI: 4.83–7.38]. Older adults in the age group 80 + were almost 2.4 times significantly more likely to have vision impairment [OR: 2.41, CI: 2.02–2.88] while older adults among the age group 70–79 were 66% significantly more likely to have vision impairment compared to the 60–69 years age group [OR: 1.66, CI: 1.49–1.85]. The odds of vision impairment was significantly low among the older adults who were currently in the marital union as per marital status [OR: 0.88, CI: 0.79–0.99]. Older adults who had living arrangements as co resided were 13% significantly less likely to suffer from vision impairment compared to those who lived alone [OR: 0.77, CI: 0.63–0.95]. The odds of vision impairment was significantly high among older adults from the rich wealth quintile as compared to older adults from the poor wealth quintile [OR: 1.18, CI: 1.03–1.36].

Table 3 is a representation of the distribution and logistic regression of older adults having cognitive impairment. It revealed that the older adults who had vision impairment were 11% significantly more likely to have cognitive impairment when compared with the older adults who do not suffer from vision impairment [OR: 1.11, CI: 1.01–1.23]. The odds of cognitive impairment were significantly high among older adults with low psychological health issues [OR: 1.55, CI: 1.36–1.77]. The older adults with low ADL and IADL were 80% and 26% significantly more likely to have cognitive impairment respectively in comparison to older adults with high ADL and IADL [OR: 1.80, CI: 1.43–2.27], [OR: 1.26, CI: 1.14–1.40]. The odds of cognitive impairment among older adults with poor self-rated health (SRH) was significantly high [OR: 1.28, CI: 1.15–1.41]. The older adults with chronic morbidity were 27% significantly more likely to have cognitive impairment compared to older adults who do not have chronic morbidity [OR: 1.27, CI:

1.14–1.41]. The older adults who were currently in a union as per marital status were 9% less likely to have cognitive impairment. The odds of cognitive impairment among older adults who had living arrangements as co resided was high [OR: 1.01, CI: 0.81–1.25] while among older adults who had community involvement was significantly low [OR: 0.79, CI: 0.69–0.9]. The older adults who had trust over someone were 22% significantly less likely to have cognitive impairment in comparison to the older adults who do not have trust over someone [OR: 0.78, CI: 0.68–0.89].

Discussion

A higher prevalence of chronic conditions such as diabetes, hypertension, and heart disease consistent with past studies, is strongly associated with vision impairment among older people (Crews et al., 2017). Consistently, the present study found that vision impairment is significant associated with reporting diabetes among older individuals. Again, studies have found patients with diabetes militias to be at an increased risk of developing vascular dementia and Alzheimer's disease (Arvanitakis, Wilson, Bienias, Evans, & Bennett, 2004; Exalto, Whitmer, Kappelle, & Biessels, 2012; Peila, Rodriguez, & Launer, 2002). Hence, establishing a link that relates diabetes and vision impairment with cognitive functioning is required that may allow more effective screening for and prevention of vision impairment and/or cognitive decline to be developed in the future.

Vision impairment as a post-stroke disability has been well-acknowledged in the literature (Sand et al., 2013, 2016). Concordant with past studies that have shown that people who experienced a stroke were at higher risk of visual defects than people without experiencing stroke (Suchoff et al., 2008), results of the present study showed that stroke is significantly associated with visual impairment among older adults. Further, clinical studies found that high blood pressure increases the risk of developing diabetic retinopathy and other retinal vascular diseases (Duke-Elder, 2007; Wong et al., 2001). In line with this, we found a significant association of hypertension with vision impairment among the study participants. Moreover, multiple studies have found that compared with older adults who have normal vision, visually impaired persons had higher chances to have heart diseases and cardiovascular mortality (Dianed Zheng et al., 2012; Evans et al., 2002; Hsueh et al., 2019; Liew, Wong, Mitchell, Cheung, & Wang, 2009). Similarly, the present study found a significant positive association of heart disease with reporting visual impairment in the older participants.

Cataracts are found to be the leading cause of blindness and visual impairment worldwide, especially in developing countries (Bourne et al., 2013). A meta-analysis of all available population-based studies found that the highest percentages of visual impairment caused by cataracts were recorded in the South Asian region (Khairallah et al., 2015). The present analysis also shows that after controlling for socio-demographic variables, the chances of reporting vision impairment among older adults who had cataracts were almost six times higher than their counterparts. Although cataracts and resultant impairment cases can be avoided with early detection and timely intervention, the delivery of surgical interventions continues to be a challenge in developing countries (Khanna, Pujari, & Sangwan, 2011).

On the other hand, vision impairment among aging populations is closely associated with their cognitive and behavioral manifestations (Clemons, Rankin, & McBee, 2006). Consistently, our results suggested a significant relationship between visual and cognitive impairment, an association not previously demonstrated in any population-based studies in India. Findings from several cross-sectional and longitudinal studies in other countries, however, support such an association (Anstey et al., 2001; Davies-Kershaw et al., 2018; Luo et al., 2018; Mandas et al., 2014). Another Japanese study found that older adults with both impaired vision and hearing had higher odds of cognitive impairment (Mitoku, Masaki, Ogata, & Okamoto, 2016). Further, such studies suggested that better visual acuity by means of cataract surgery or refractive correction and wearing glasses seem to correlate with better cognitive functioning (Albers et al., 2015; Rogers & Langa, 2010; Spierer et al., 2016; Tamura et al., 2004). Contrarily, some of them found that vision-enhancing interventions did not lead to short-term improvements in functioning or cognitive status (Elliott, McGwin, & Owsley, 2009).

While the strength of this study is that it uses data from a large, nationally representative, population-based survey to examine a comprehensive list of chronic conditions in conjunction with vision impairment and its association with a cognitive deficit, it is subject to several limitations. First, the data is cross-sectional in nature; we, therefore, cannot confirm whether a cognitive decline preceded vision impairment or vision impairment preceded a cognitive deficit, and we cannot infer causality between chronic illnesses and vision impairment. Second, the data excludes people living in nursing homes and other institutional settings, who may report higher rates of vision impairment. Third, the vision question in BKPAI is a self-reported measure of function and does not capture the severity of vision problems or different eye diseases.

Conclusion

The results underscore the risk of vision impairment in older ages as a public health burden compared with other major chronic diseases and the importance of normal vision for healthy brain aging. Additional efforts in terms of advocacy, availability, affordability, and accessibility especially in a country with a greater illiteracy rate are mandatory to increase the reach of eye-care services and reduce the prevalence of avoidable visual impairment and vision losses that lead to cognitive deficits among the older population.

Research and programs must consider the strategies to include people with both vision and cognitive impairment along with chronic illnesses in efforts to reduce the burden of aging and chronic conditions. Further, other causes of visual impairments should be explored using longitudinal studies and the clinical investigation is warranted to understand the underlying pathophysiology linking visual impairment and cognitive decline in aging populations.

Abbreviations

OR

Odds Ratio

CI

Confidence Interval

SC

Scheduled Caste

ST

Scheduled Tribe

ADL

Activities of daily living

IADL

Instrumental activities of daily living

GHQ

General Health Questionnaire

BKPAI

Building a Knowledge Base on Population Aging in India

PSU

Primary Sampling Units

PPS

Probability Proportional to Size

Declarations

Ethics approval and consent to participate: The data is freely available in the public domain and survey agencies that conducted the field survey for the data collection have collected prior consent from the respondent. No ethical approval was required as the data was freely available through a request from <http://www.isec.ac.in/>.

Consent for publication: Not applicable

Availability of data and materials: The study utilizes a secondary source of data that is freely available in public domain through request from <http://www.isec.ac.in/>.

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Author's Information:

Muhammad T completed his M.Phil. in Population Studies and currently pursuing his Ph.D. in Population Studies at International Institute for Population Sciences, Mumbai, India.

Drishti Drishti completed her MPS in Population Studies from International Institute for Population Sciences, Mumbai, India.

Shobhit Srivastava completed his M.Phil. in Population Studies and currently pursuing his Ph.D. in Population Studies at International Institute for Population Sciences, Mumbai. His area of interest is ageing and Mental Health issues among older adults, India.

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Tables

Table-1 Socio-demographic profile of older adults in India

Background characteristics	Sample	Percentage
Diabetes		
No	8,570	89.8
Yes	971	10.2
Hypertension		
No	7,520	78.8
Yes	2,021	21.2
Stroke		
No	9,448	99.0
Yes	93	1.0
Heart disease		
No	8,991	94.2
Yes	550	5.8
Cataract		
No	8,305	87.1
Yes	1,236	13.0
Psychological health		
High	7,218	76.6
Low	2,209	23.4
ADL		
High	8,732	92.6
Low	695	7.4
IADL		
High	4,092	43.4
Low	5,335	56.6
Self-rated health		
Good	4,212	44.7

SC/ST: Scheduled Caste/Scheduled Tribe; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living

Poor	5,215	55.3
Chronic morbidity		
No	3,320	35.2
Yes	6,107	64.8
Age (years)		
60–69	5,891	61.8
70–79	2,613	27.4
80+	1,036	10.9
Gender		
Men	4,526	47.4
Women	5,015	52.6
Marital Status		
Not in Union	3,758	39.4
Currently in Union	5,783	60.6
Education		
None	4,870	51.1
Below 5 years	1,955	20.5
6–10 years	2,137	22.4
11 + years	578	6.1
Working status (last one year)		
No	6,421	67.3
Yes	2,310	24.2
Retired	810	8.5
Living arrangement		
Alone	561	5.9
Co-reside	8871	94.1
Community involvement		

SC/ST: Scheduled Caste/Scheduled Tribe; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living

No	1,965	20.9
Yes	7,462	79.2
Trust over someone		
No	1,617	17.2
Yes	7,810	82.9
Wealth Status		
Poor	4,367	45.8
Middle	1,969	20.6
Rich	3,204	33.6
Religion		
Hindu	7,572	79.4
Muslim	671	7.0
Sikh	898	9.4
Others	400	4.2
Caste		
SC/ST	2,510	26.3
Non-SC/ST	7,031	73.7
Residence		
Rural	7,044	73.8
Urban	2,497	26.2
State		
Himachal Pradesh	1,470	15.4
Punjab	1,354	14.2
West Bengal	1,127	11.8
Orissa	1,453	15.2
Maharashtra	1,379	14.5
Kerala	1,356	14.2

SC/ST: Scheduled Caste/Scheduled Tribe; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living

Tamil Nadu	1,403	14.7
Total	9,541	100.0
SC/ST: Scheduled Caste/Scheduled Tribe; ADL: Activities of Daily Living; IADL: Instrumental Activities of Daily Living		

Table-2 Percentage distribution of older adults having vision disability by their background characteristics among older adults

Background characteristics	Vision impairment (%)	p < 0.05	OR (95% CI)
Diabetes		*	
No	57.5		Ref.
Yes	72.8		1.55*(1.32,1.81)
Hypertension		*	
No	55.1		Ref.
Yes	73.8		1.60*(1.42,1.80)
Stroke		*	
No	58.9		Ref.
Yes	73.6		0.94(0.57,1.57)
Heart disease		*	
No	58.1		Ref.
Yes	73.8		1.43*(1.16,1.76)
Cataract		*	
No	54.4		Ref.
Yes	90.6		5.97*(4.83,7.38)
Age (years)		*	
60–69	52.7		Ref.
70–79	67.0		1.66*(1.49,1.85)
80+	75.3		2.41*(2.02,2.88)
Gender			
Men	57.3		Ref.
Women	60.6		0.98(0.87,1.10)
Marital Status		*	
Not in Union	63.8		Ref.
Currently in Union	56.0		0.88*(0.79,0.99)
Education		*	

SC/ST: Scheduled Caste/Scheduled Tribe; *if p < 0.05; OR: Odds Ratio; CI: Confidence Interval; Ref: Reference

None	59.1	Ref.
Below 5 years	63.5	1.10(0.97,1.25)
6–10 years	53.0	0.90(0.78,1.03)
11 + years	66.0	1.31*(1.07,1.62)
Working status		*
No	62.1	Ref.
Yes	53.8	0.89(0.79,1.01)
Retired	50.0	0.81*(0.68,0.96)
Living arrangement		
Alone	56.5	Ref.
Co-reside	59.2	0.77*(0.63,0.95)
Wealth Status		*
Poor	58.1	Ref.
Middle	55.9	0.91(0.80,1.04)
Rich	62.3	1.18*(1.03,1.36)
Religion		*
Hindu	57.7	Ref.
Muslim	68.6	0.98(0.81,1.2)
Sikh	56.2	0.74*(0.59,0.93)
Others	73.9	1.12(0.87,1.44)
Caste		
SC/ST	59.0	Ref.
Non-SC/ST	59.1	1.02(0.91,1.14)
Residence		
Rural	59.1	Ref.
Urban	58.8	1.04(0.94,1.15)
State		*

SC/ST: Scheduled Caste/Scheduled Tribe; *if $p < 0.05$; OR: Odds Ratio; CI: Confidence Interval; Ref: Reference

Himachal Pradesh	48.5	Ref.
Punjab	58.8	1.30*(1.06,1.59)
West Bengal	79.7	3.48*(2.87,4.22)
Orissa	59.8	1.55*(1.32,1.83)
Maharashtra	65.0	1.74*(1.47,2.06)
Kerala	72.4	1.69*(1.41,2.04)
Tamil Nadu	34.1	0.58*(0.49,0.69)
Total	59.1	
SC/ST: Scheduled Caste/Scheduled Tribe; *if $p < 0.05$; OR: Odds Ratio; CI: Confidence Interval; Ref: Reference		

Table-3 Percentage distribution of older adults having cognitive impairment by their background characteristics among older adults

Background characteristics	Cognitive impairment	p < 0.05	OR (95% CI)
Vision impairment		*	
No	51.6		Ref.
Yes	65.8		1.11*(1.01,1.23)
Psychological health		*	
High	55.0		Ref.
Low	76.2		1.55*(1.36,1.77)
ADL		*	
High	58.0		Ref.
Low	84.6		1.80*(1.43,2.27)
IADL		*	
High	49.7		Ref.
Low	67.9		1.26*(1.14,1.40)
Self-rated health		*	
Good	49.0		Ref.
Poor	68.9		1.28*(1.15,1.41)
Chronic morbidity		*	
No	51.6		Ref.
Yes	64.5		1.27*(1.14,1.41)
Age (years)		*	
60–69	53.1		Ref.
70–79	68.2		1.42*(1.27,1.59)
80+	78.6		1.83*(1.52,2.20)
Gender		*	
Men	52.9		Ref.
Women	66.4		1.1(0.98,1.24)
Marital Status		*	
Not in Union	69.1		Ref.
Currently in Union	54.1		0.91(0.81,1.02)

Education		*
None	70.7	Ref.
Below 5 years	63.3	0.68*(0.6,0.77)
6–10 years	40.5	0.43*(0.38,0.50)
11 + years	31.3	0.26*(0.21,0.32)
Working status		*
No	66.0	Ref.
Yes	53.0	0.88*(0.77,1.00)
Retired	32.6	0.71*(0.59,0.85)
Living arrangement		*
Alone	63.0	Ref.
Co-reside	59.8	1.01(0.81,1.25)
Community involvement		*
No	69.8	Ref.
Yes	57.4	0.79*(0.69,0.9)
Trust over someone		*
No	68.4	Ref.
Yes	58.3	0.78*(0.68,0.89)
Wealth Status		*
Poor	68.1	Ref.
Middle	60.0	0.89(0.78,1.02)
Rich	48.8	0.66*(0.57,0.76)
Religion		*
Hindu	59.7	Ref.
Muslim	66.3	0.89(0.73,1.09)
Sikh	56.1	0.93(0.74,1.16)
Others	63.4	1.24(0.98,1.56)
Caste		*
SC/ST	67.4	Ref.

Non-SC/ST	57.3	0.94(0.84,1.06)
Residence		*
Rural	62.8	Ref.
Urban	52.0	0.94(0.85,1.04)
State		*
Himachal Pradesh	54.2	Ref.
Punjab	55.2	1.14(0.93,1.41)
West Bengal	81.9	4.75*(3.84,5.86)
Orissa	69.3	1.60*(1.34,1.92)
Maharashtra	55.3	1.14(0.96,1.36)
Kerala	66.3	2.44*(2.02,2.94)
Tamil Nadu	41.6	0.64*(0.53,0.77)
Total	60.0	

*SC/ST: Scheduled Caste/Scheduled Tribe; *if $p < 0.05$; OR: Odds Ratio; CI: Confidence Interval; Ref: Reference*