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Original Research Article

A cross-sectional study on prevalence of cognitive impairment and its associated factors among the elderly in an urban area of Chennai, India

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ABSTRACT

Background: Elderly people often experience cognitive decline with aging. Existing longitudinal studies report that older adults with mild cognitive impairment (MCI) have a 10-15% annual risk of converting to probable Alzheimer's disease (AD). Objectives were to determine the prevalence of cognitive impairment among the elderly in an urban area of Chennai and to assess the factors associated with cognitive impairment among the elderly.
Methods: This Community based Cross sectional study was conducted between July and October 2019 among 77 individuals aged 60 years and above from an urban area in Chennai, Pudupet. After the institutional ethics committee approval, subjects were interviewed with a pre-designed semi-structured questionnaire followed by administration of standardized mini mental state examination (SMMSE) tool and scoring. Data was analysed using relevant descriptive and inferential statistics with trial version of SPSS.v.25. and OpenEpi software.
Results: The overall prevalence (95% CI) of cognitive impairment was 35.06 % (25.35%, 46.20%). Its prevalence among males and females were 26.08 % (12.55%, 46.47%) and 38.88 (27.04%, 52.21%) respectively. The mean age (95% CI) of study subjects with cognitive impairment was 66.37 years (64.58, 68.16). Those subjects who led a solitary life, had less than 10 years of schooling, used kerosene as cooking fuel and consumed bore well water had significant association with cognitive impairment.
Conclusions: Usage of cooking fuel like LPG and consumption of filtered and purified water could minimize cognitive impairment. Early detection of cognitive impairment would improve the health care and quality of life of the elderly.

INTRODUCTION

Cognition is the process by which the brain receives and processes information from the outside in order to recognize the world actively. Cognitive functions involve memory, attention, language, execution, reasoning, computation, and orientation.[1] Cognitive impairment is when a person has trouble remembering, learning new things, concentrating, or making decisions that affect their everyday life.[2] Cognitive functioning is typically characterized into 1 of 5 domains: learning and memory, language, visuospatial, executive and psychomotor. These domains have a rough correspondence with their cerebral localization.[3] Cognitive impairment ranges from mild to severe.[2] Mild Cognitive Impairment (MCI) is the term used to describe the condition of individuals whose cognition lies between the cognitive changes of aging and early dementia.[4] For a diagnosis of MCI, only one of these five areas must be impaired, whereas a diagnosis of dementia requires that more than one domain must be impaired. Evidence for involvement of individual domains can be obtained from the history, a brief mental status examination, or neuropsychological testing.[3]

Cognitive impairment can affect a patient's social functioning and quality of life to varying degrees, and even lead to death in severe cases.[1] MCI is typically associated with either memory impairments or deficits in cognitive and/or motor performance.[5-7] MCI is about four-times as prevalent as dementia.[8] Elderly people often experience cognitive decline with aging. The reasons for cognitive dysfunctions can range from physiological mild forgetfulness described by many older individuals to mild cognitive impairment until the severe effects of Alzheimer's Disease (AD).[9] Existing longitudinal studies report that older adults with MCI have a 10%-15% annual risk of converting to probable AD.[10,11] However, a significant number tends to remain stable over-time and some may even return to a "healthy" state.[12,13]

Considering the characteristics of MCI and dementia and its prevalence worldwide, it is one of the major public health problems which need attention.[14] Many patients with mild cognitive impairment (MCI) and AD do not recognize cognitive, functional or behavioral impairment.[15] But this anosognosia can have serious effects on health, because patients eventually deny adequate treatment due to their unawareness of deficits. Daily functioning may be compromised, because they lack adequate judgement of situations.[16-18]

Studies show cognitive impairment is a main contributor to institutionalization in the elderly, independently of their socio-demographic status, social network, or functional status.[19] More than half of MCI patients will progress to dementia within 5 years.[5] Therefore, timely intervention of MCI is very important to delay the occurrence and development of dementia.[20] Hence this study was done to determine its burden in the community and to emphasize the need for screening. This would help in early detection of cognitive impairment thereby improving the health care of the elderly and eventually reduces the need for institutionalization in elderly care facilities.

With this background the present study was conducted with the objectives to determine the prevalence of cognitive impairment among the elderly in an urban area of Chennai and to assess the factors associated with cognitive impairment among the elderly.

METHODS

This community based cross sectional study was conducted for a period of four months between July and October 2019 in the urban field practice area of Pudupet, under the urban health training center of our medical college hospital in Chennai. Elderly people aged 60 years of age and above who consent to participate were included as study subjects. Data was collected from the eldest member of the household. Those who were terminally ill; those with visual, hearing or speech impairment and those with mental retardation from childhood were excluded from the study. As per the dementia India 2010 report, the reported prevalence of dementia from urban areas was 0.9 to 4.8%.[21] So assuming a prevalence of 4.8% at 5% level of significance and 95% Confidence interval (CI), Sample size was calculated as follows:

$$n = Z^2pq \div d^2$$
$$= (1.96 \times 1.96 \times 4.8 \times 95.2) \div (5 \times 5)$$
$$= 70.21$$

By considering 10% as non-responders, a sample size of 77 was obtained**.** Sample households were selected by simple random sampling technique using random number tables, from the line listing of family folders maintained at the urban primary health center. Data was collected by interview of study subjects using a pre-designed semi-structured questionnaire for socio-demographic details like age, sex, educational status, occupation, marital status, life style, food habits, physical exercise, family history, co-morbidities, etc., and a Standardized Mini Mental State Examination (SMMSE) Questionnaire to identify the cognitive impairment**.** Based on the SMMSE score, cognitive impairment of the study subjects was classified as normal (25-30), mild/early (21-24), moderate (10-20), Severe (0-9).[22] Those with a SMMSE score of lesser than 25 were considered to have cognitive impairment. Data was coded and entered in trial version of SPSS v.25.0 and OpenEpi software. Data was analysed using descriptive statistics like mean, median, standard deviation, inter-quartile range and proportion as well as inferential statistics like Pearson Chi-square test, Mann Whitney U test and Kruskall Wallis H test. P value <0.05 was considered to be statistically significant.

RESULTS

Among the 77 study subjects, 50 (64.93%) had normal cognitive function, 15 (19.48%) had mild cognitive impairment and 12 (15.58%) had moderate cognitive impairment. Occurrence of cognitive impairment in the total study participants was reported in only 27(35.06%) individuals. The cognition status of the study participants were distributed based on their SMMSE score (Table 1).

The overall prevalence (95% CI) of cognitive impairment was 35.06% (25.35%, 46.20%). The prevalence of cognitive impairment among males and females were 26.08% (12.55%, 46.47%) and 38.88 (27.04%, 52.21%) respectively. Of the 77 study subjects, majority 56 (72.7%) were in the age group of 60-69 years. The mean age (95% CI) of the study subjects who had normal cognitive function, mild and moderate cognitive impairment were 65.48 years (63.84, 67.12), 66.07 years (63.58, 68.56) and 66.75 years (63.73, 69.77) respectively. There were 54 (70.1%) females and 23 (29.9%) males. Of the study participants majority 41 (53.2%) were Hindu. Of the 27 study subjects with cognitive impairment, majority 19 (70.3%) were living without spouse and this association was found to be statistically significant (p=0.04, OR=2.788, 95%

CI=1.030-7.547). Majority 72 (93.5%) of the study subjects belonged to families with more than 5 members. There were 67 (87%) subjects who had an education of 10 years or less of which 27 (40.3%) showed cognitive impairment and this association between duration of education and cognitive impairment was found to be statistically significant (p=0.012, OR=1.675, 95% CI=1.376-2.039) (Table 2).

Table 1: Distribution of cognitive status of study subjects based on SMMSE score.

Cognitive status	Frequency (%)	Mean SMMSE score (95% CI)	SD	Median SMMSE score	IQR
Normal	50 (64.93)	27.06 (26.61, 27.51)	1.58	27.00	2
Mild cognitive impairment	15 (19.48)	22.73 (22.09, 23.38)	1.16	23.00	2
Moderate cognitive impairment	12 (15.58)	18.17 (16.79, 19.54)	2.16	18.50	4

Table 2: Socio-demographic factors associated with cognitive impairment.

Factors	Cognition		Total	P Value
	Normal	Impaired		
Age category (Year)				
60-64	26 (74.3)	9 (25.7)	35	0.146
65-69	11 (52.4)	10 (47.6)	21	
70-74	7 (50.0)	7 (50.0)	14	
75-80	6 (85.7)	1 (14.3)	7	
>80	0	0	0	
Sex				
Male	17 (73.9)	6 (26.1)	23	0.281
Female	33 (61.1)	21 (38.9)	54	
Religion				
Hindu	25 (61.0)	16 (39.0)	41	0.761
Muslim	23 (69.7)	10 (30.3)	33	
Christian	2 (66.7)	1 (33.3)	3	
Family members				
Up to 5 members	5 (100.0)	0	5	0.107
More than 5 members	45 (62.5)	27 (37.5)	72	
Marital Status				
With spouse	27 (77.1)	8 (22.9)	35	0.04*
Without spouse	23 (54.8)	19 (45.2)	42	
Education status				
Up to 10 years of schooling	40 (59.7)	27 (40.3)	67	0.012*
More than 10 years of schooling	10 (100.0)	0	10	
Occupation status				
Unemployed	29 (61.7)	18 (38.3)	47	0.756
Employed	9 (69.2)	4 (30.8)	13	
Retired	12 (70.6)	5 (29.4)	17	
Family type				
Nuclear	19 (67.9)	9 (32.1)	28	0.469
Joint	5 (83.3)	1 (16.7)	6	
Three Generation	26 (60.5)	17 (39.5)	43	

(Note: Figures in parenthesis denotes percentages, * Pearson Chi-square test; P value <0.05 is considered as statistically significant)

Of the total study participants majority of them 72 (93.5%) used liquid petroleum gas (LPG) as daily cooking fuel. The median SMMSE score of study participants using kerosene as cooking fuel (21.00) was lesser than those who used LPG as fuel (26.00) and this association between type of cooking fuel daily used and cognitive impairment was found to be statistically significant by Mann Whitney U test (p value=0.019). On studying the association between source of drinking water and cognitive impairment, among bore well water consumers majority 11 (55.0%) had cognitive impairment and this association was statistically significant. Many other factors like presence of any other illnesses, diabetes mellitus, hypertension, intake of medication for other

illnesses, past history of surgery, past history of head injury and history of vital events in the past did not have any statistically significant association with cognitive status of the study subjects (Table 3).

Table 3: Distribution of certain factors associated with cognitive impairment.

Factors	Cognition		Total	P value
	Normal	Impaired		
Cooking fuel				
LPG	49 (68.1)	23 (31.9)	72	0.048*
Kerosene	1 (20.0)	4 (80.0)	5	
Diet category				
Vegetarian	1 (50.0)	1 (50.0)	2	1.0
Mixed diet	49 (65.3)	26 (34.7)	75	
Drinking water				
Metro	25 (89.3)	3 (10.7)	28	0.001*
Bore well	9 (45.0)	11 (55.0)	20	
Packaged water	12 (48.0)	13 (52.0)	25	
RO	4 (100.0)	0	4	
H/o any illness				
Present	43 (64.2)	24 (35.8)	67	0.746
Absent	7 (70.0)	3 (30.0)	10	
H/o Diabetes mellitus				
Present	23 (59.0)	16 (41.0)	39	0.267
Absent	27 (71.0)	11 (28.9)	28	
H/o hypertension				
Present	31 (67.4)	15 (32.6)	46	0.582
Absent	19 (61.3)	12 (38.7)	31	
H/o both diabetes and hypertension				
Present	16 (64.0)	9 (36.0)	25	0.905
Absent	34 (65.4)	18 (34.6)	52	
H/o any medication				
Present	45 (66.2)	23 (33.8)	68	0.712
Absent	5 (55.6)	4 (44.4)	9	
H/o surgery				
Present	32 (64.0)	18 (36.0)	50	0.815
Absent	28 (66.7)	9 (33.3)	27	
H/o head injury				
Present	6 (46.2)	7 (53.8)	13	0.20
Absent	44 (68.8)	20 (31.3)	64	
H/o vital events				
Present	26 (66.7)	13 (33.3)	39	0.747
Absent	24 (63.2)	14 (36.8)	38	

(Note: Figures in parenthesis denotes percentages, *- Pearson Chi-square test; p value<0.05 is considered as statistically significant)

Table 4: Distribution of certain factors associated with cognitive impairment.

Factors	Cognition		Total	P value
	Normal	Impaired		
No. of siblings				
Up to 5 siblings	36 (62.1)	22 (37.9)	58	0.357
More than 5 siblings	14 (73.7)	5 (26.3)	19	
Birth order				
Up to 3rd	29 (59.2)	20 (40.8)	49	0.162
Above 3rd	21 (75.0)	7 (35.1)	28	

Continued.

No. of children				
Up to 2	15 (71.4)	6 (28.6)	21	0.465
More than 2	35 (62.5)	21 (37.5)	56	
BMI category				
Underweight	4 (80.0)	1 (20.0)	5	0.546
Normal	11 (64.7)	6 (35.3)	17	
Over weight	10 (55.6)	8 (44.4)	18	
Obese class 1	15 (60.0)	10 (40.0)	25	
Obese class 2	10 (83.3)	2 (16.7)	12	
Smoking status				
Smoker	1 (100.0)	0	1	1.00
Non-smoker	49 (64.9)	27 (35.5)	76	
H/o alcoholism				
Present	4 (80.0)	1 (20.0)	5	0.652
Absent	46 (63.9)	26 (35.1)	72	

(Note: Figures in parenthesis denotes percentages, *Pearson chi-square test; p value<0.05 is considered as statistically significant)

It is also evident that certain other factors like birth order, number of siblings the study subjects had, number of children the study subjects had, body mass index (BMI), personal habits like smoking and alcoholism did not have a statistically significant association with cognitive impairment (Table 4).

DISCUSSION

Studies done around the world have found significant association of factors like age, gender, educational status, marital status, BMI, co-morbidities, environmental factors like cooking fuel, drinking water with cognitive impairment. Elderly people often experience cognitive decline with aging. The cognitive dysfunctions can range from physiological mild forgetfulness to mild cognitive impairment until the severe effects of Alzheimer's disease.[9] In our study though the proportion of cognitive impaired was higher among the 70-74 years age group, it was not statistically significant. In our study we found that the proportion of women with cognitive impairment was higher compared to men but the association was not statistically significant. In contrast a study done by Ren et al showed that women were significantly associated with increased risk of cognitive impairment than men.[23]

Ren et al study reported that people who led a solitary life (AOR: 3.15, 1.89-5.26), were significantly associated with increased risk of cognitive impairment, compared with those who lead a non-solitary life.[23] Also the Liu H et al study suggested that being divorced or widowed at older ages may be a risk factor for cognitive impairment and progression to dementia for both men and women.[24] Similarly in our study we observed that among study subjects with cognitive impairment, majority 19 (70.3%) were leading a solitary life without spouse and this association was found to be statistically significant (p=0.04, OR=2.788, 95% CI=1.030-7.547).

In our study, subjects who have had an education of 10 years or less showed a significant association with cognitive impairment (p=0.012, OR=1.675, 95% CI=1.376, 2.039). This was similar to many other studies which showed that lower education levels were associated with high risk for dementia and MCI compared with higher levels of education.[20,25,26] In our study we found the median SMMSE score of study subjects using kerosene as cooking fuel (21.00) was significantly lesser than those who used LPG. as fuel (26.00) (p=0.019) and this association between cooking fuel used and cognitive impairment was statistically significant. Similarly, Krishnamoorthy et al reported that about one-fourth of their participants were exposed to indoor air pollution by using kerosene as cooking fuel, out of which more than one fourth had cognitive impairment which is twice that of the general population.[27]

The chemical composition of drinking water has been associated with cognitive impairment. Rondeau et al found that the risk of developing AD was twice as high in subjects exposed to an aluminum concentration of 0.1 mg/L in their drinking water.[28] Certain other studies have reported that high silica concentrations and long-term increased exposure to lithium in drinking water may protect against impairment of cognitive function and dementia.[29,30] In our study we found that proportion of cognitive impairment was higher among bore well water consumers followed by packaged drinking water consumers and the association between source of drinking water and cognitive impairment was statistically significant.

Several studies done earlier have reported that personal habits like tobacco smoking and alcoholism were significant risk factors associated with MCI and dementia.[31-33] In contrast in our study we observed that smoking and alcoholism did not have a statistically significant association with cognitive impairment. We also did not observe a statistically significant association between obesity and cognitive impairment while Hou et al study had reported that overweight was associated with a decreased risk of cognitive impairment in the elderly, while abdominal obesity was associated with an increased risk of cognitive impairment.[34]

Xue et al had reported that diabetes conferred a 1.25- to 1.91-fold excess risk for cognitive disorders. Compared with non-diabetes, diabetes was associated with 49% increased risk of MCI (RR=1.49, 95% CI=1.26-1.77). Diabetes nearly the doubled risk of progression from MCI to dementia (RR=1.91, 95% CI=1.54-2.36).[35] Ebady et al had observed that diabetes was also associated with increased odds of cognitive decline as determined by MMSE scores (odds ratio=1.9; CI=95%, 1.01-3.6). A significant correlation between duration of disease, quality of diabetes control and cognitive dysfunction was observed (p=0.001).[36] Also Zhou et al study showed that for MCI patients, those with T2DM showed poor performance in cognitive functions, including attention, information processing speed and memory.[37] In our study such a statistically significant association between Diabetes Mellitus and cognitive impairment was not found probably due to a smaller sample size.

Hypertension is also considered as a significant risk factor for cognitive impairment. Study of Obisesan indicated that in age groups 60 to 64, 65 to 69, and 70 to 74, optimal blood pressure (<120/80 mmHg) was associated with best cognitive performance and severe hypertension was associated with the poorest performance in all age groups.[38] In recent years, hypertension has become increasingly recognized as an important risk factor for the development of MCI and dementia.[39,40] But in our study such a statistically significant association was not found between hypertension and cognitive impairment.

Limitations of our study include smaller sample size, cross-sectional study design and univariate analysis. Probably a larger sample size, a cohort study design and multivariate analysis of data could elicit significant association of various risk factors with cognitive impairment.

CONCLUSION

Assessment of cognitive impairment is an important entity in health care of the elderly, as it is an early indicator for development of dementia. As per the dementia India report 2010 the numbers of persons with dementia double every 5 years of age and so India will have one of the largest numbers of elders with this problem. It mainly affects older people; only 2% of cases start before the age of 65 years. After this, the prevalence doubles with every five year increment in age. The prevalence of dementia increases steadily with age and higher prevalence is seen among older women than men. It is estimated that the prevalence of dementia would increase of twofold by 2030 and threefold by 2050.

Factors like marital status, education status, cooking fuel, drinking water source are having a statistically significant association with cognitive impairment in the elderly. Environmental friendly cooking fuel like LPG could reduce the emission of smoke and thereby could reduce the indoor air pollution compared to kerosene or charcoal. Consumption of water that is purified by any of the treatment methods is also an important factor to be considered. SMMSE questionnaire is a useful tool for assessing the cognitive function and could be used routinely at the level of primary health care services. Early assessment and detection of cognitive impairment could help in improving the health care of the elderly and thereby could improve their quality of life.

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