

Cognitive Training: Strategy for Improving Mental Health of Elderly Inmates Living in Old Age Homes across Delhi, India

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ABSTRACT

Interindividual variability in cognitive function is attributed to biological, psychological, health-related, environmental, and lifestyle factors. The present study is to examine the beneficial effects of lifestyle and environmental factors on the cognitive ability after social and cognitive intervention residing in old age homes across Delhi, India. The elderly aged 60 years and above were randomly selected and a 21-day workshop of 90 min was conducted at each facility. Of the 89 inmates, 64 of them participated regularly in the workshop. Mini-Mental State Examination test and Mini-Cog test were conducted before and after the workshop. A Poisson regression model was fitted to assess the key determinants on the improvement of cognitive function. According to the fitted model, higher level of improvement was observed among the female (95% confidential interval [CI] 0.26–1.19; SE = 0.24) participants. Participants which had the lower level of cognitive impairment showed highly significant improvement in cognitive performance (95% CI 0.14–0.44; SE = 0.08) whereas physically active participants showed a negative association with improvement in cognitive performance (95% CI 1.58–0.26; SE = 0.34). Cognitive training helped in improving the mental health of elderly population. The notable distinction between the institutions is that in the institution in which the residents interacted the most with each other showed higher levels of improvement. The most significant factor found to be associated with cognitive improvement of the participants was their present level of cognitive impairment; it was observed that those with the least cognitive impairment benefitted the most from the intervention program. Hence, an early detection and intervention could be beneficial.

Keywords: Cognitive intervention, Lifestyle factors, Mini-Mental State Examination, Negative binomial regression model, Old age homes
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INTRODUCTION

The current aging society is an occurrence related to the rising median age of the population as an outcome of declining fertility and increasing life expectancy across the world. It is also a result of a better standard of living, improved quality of life, and tremendous advancements in medical technology, diagnostics, and treatment.^[1] Today, nearly 800 million individuals are aged over 60 years accounting for about 12% of the world population and this number is projected to increase rapidly to over 2 billion by 2050.^[2] In India, the percentage of the population aged 65 years and above is estimated to increase from the present 6.4% to 8.6% of the total population by 2030.^[3]

Cognitive decline and dementia are pathological conditions that affect an individual's social functioning and their ability to live independently. Studies have shown that the annual conversion rate of mild cognitive impairment to Alzheimer's ranges from 5% to 20%, with higher susceptibility observed in subjects with subjective memory complaints.^[4,5] It is estimated that nearly 10–20% of people in the age group of 60–80 years suffer from one of the three neurological diseases (stroke, Alzheimer's disease, or Parkinson's disease).^[2] Recent findings show that annually over 9.9 million new cases of dementia are identified worldwide implying that by 2050, the cases of dementia will have increased to an alarming 131.5 million. The financial impact of such a tremendous increase could be potentially overwhelming. While the present economic worldwide cost of dementia is approximately 818 billion US dollars, in only a few years, it is expected to climb to a trillion dollar challenge.^[6] To prevent such an overwhelming increase in progression of dementia among the elderly, it is imperative to find a treatment that can potentially prevent or delay cognitive decline among elderly population. Recent pharmacological interventions have not proved to be effective in preventing dementia, however,

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the use of cognitive training to regain specific functions such as attention and memory processes has shown positive results on the subjective well-being, mood status, and quality of life of the geriatric population.^[4]

The Indian family structure has been traditionally described to provide natural social security to the ill, dependent, and older members of the family, but recent times have seen this structure becoming more and more elusive due to the shift to a more nuclear family structure. The increased involvement of women in the workforce and migration of the younger labor force away from home towns^[7,8] also contributed to the shift. This change in family structure has raised the need for community care of the elderly and has led to the emergence of old age homes in India.^[9] Old age homes are sheltered accommodation for older people without any nursing or health-care infrastructure.^[10] The rapid emergence of nuclear families and the increase in elderly population has compelled them to live in old age homes.^[9]

Recent studies highlight several major problems in these institutions, including the lack of support for mental and physical

ailments, dependency due to a decreasing physical capacity, total or near-total separation from their family and social milieu along with apprehensions with a new environment, including social anxiety and fear due to ailments in the institutions^(8,9) leading to close encounters with death, and the lack of financial resources to meet the needs of their inhabitants. In India, the changing family structure and heightened vulnerability of the elderly population to mental illnesses, especially people residing in old age homes, call for effective interventions to prevent or delay the onset of cognitive impairment and elevate the general well-being of the inmates.

The aim of the present study is to examine the impact of the living conditions under which elderly people are residing in institutional care and to analyze the effect of physical, mental, and social factors on improvement in cognitive performance after intervention of elderly population residing in old age homes across Delhi.

METHODOLOGY

Conducting the Workshop

Intervention Program

The intervention program of 21 days was conducted at each old age home. On the 1st day, the purpose of the workshop was explained to the participants. A consent form and a questionnaire for background information got filled. Mini-Mental State Examination (MMSE) test and the Mini-Cog test were also conducted to assess the initial cognitive status of the participants. From the 2nd day onward, the workshop, divided into two parts, was conducted – social intervention, consisted of entertainment activities to increase the interaction between the investigators and the participants and also among the participants to increase their comfort level and motivate them to attend sessions regularly. Cognitive intervention broadly addressed three cognitive functions, namely, memory, visual, and logical functioning of the brain. During the course of the program, the worksheets were explained to each individual properly and solved under the guidance of the investigators. The difficulty level of worksheets was slowly increased. Questions included in the worksheet involved memory tests such as call-recall, basic arithmetic, logic, and general awareness. The workshop details are shown in Table 1.

The sample consisted of 89 participants aged 60 years and above from four old age homes in Delhi, India. People aged below 60 years or who had been diagnosed with dementia were excluded from the study. The participants were explained the purpose of the study and recruited in the study after obtaining verbal consent from each one of them. Among the 89 participants, only 64 participants who had attended the workshops regularly were included in the final analyses. While the study program included both men and women, the majority (70%) of the participants in the study were women.

Data Collection

At the beginning of the intervention program, basic information about the participant’s characteristics of age, gender, morbidities, physical, mental, and social activities were collected. The questionnaire was approved by the Institutional Research Committee for ethical clearance. Furthermore, a formal permission

Table 1: Workshop details

Schedule	Social intervention	Component
Day 1	Introduction and explaining the purpose of the workshop	MMSE 1
Day 2	Puzzles	Mini-Cog test
Day 3	Cup stacking	Visual
Day 4	Dumb charades	Memory
Day 5	Antakshari	Memory
Day 6	Tambola	Logical
Day 7	Cards	Visual
Day 8	UNO	Memory
Day 9	Bingo	Logic
Day 10	Carrom board	Visual
Day 11	Meditation	Memory
Day 12	Pictionary	Logic
Day 13	Singing competition	Visual
Day 14	Sharing experiences with each other	Memory
Day 15	Interaction with neurologist	Memory
Day 16	Guess the movie	Visual
Day 17	Puzzles (Maps)	Memory
Day 18	Tambola	Memory
Day 19	Comedy show	Logic
Day 20	Meditation	Memory
Day 21	Closing ceremony and workshop feedback	Logic
		Visual
		MMSE 2

MMSE: Mini-Mental State Examination

was taken from the management of each old age home. Information was also collected on the facilities available to the inmates at each of the old age homes. During the intervention program in each old age home, the worksheets for each day of the workshop were scored and a Microsoft Excel worksheet was maintained to keep track of the participants’ performance.

Measurements

This study used the MMSE test and Mini-Cog test to examine the differences in cognitive functions before and after the workshop. The MMSE test is a widely used test of cognitive function among the elderly; it includes tests of orientation, attention, memory, language, and visual-spatial skills. The Mini-Cog test is a simple screening tool that is well accepted and can be used to detect cognitive impairment.

After the completion of the workshop, the weighted average of the scores obtained in all the sessions of the workshop was estimated as an indicator of the performance of the participants in the study. The Mini-Cog test provided an estimate of the initial

cognitive level of the participants without any intervention, and the difference in scores of MMSE 1 and MMSE 2 was considered to evaluate the effect of social and cognitive intervention on memory skills of the participants.

Statistical Analysis

The study utilized descriptive statistics to examine the characteristics of the study participants. The frequency of involvement in physical, cognitive, and social activities was converted into a 4-point Likert scale.

Mann-Whitney U-test also known as the Wilcoxon rank-sum test for the difference between two groups on a single ordinal scale with no specific distribution^[11] was applied to see the effects of actively and not actively engaged subjects in three groups (physical active, socially active, and cognitive active) on improvement in cognitive score after intervention.

Imputations are done to estimate the missing values in MMSE scores. To estimate the missing scores of MMSE 1, the scores of the first 5 days of the workshop were used whereas for imputing the scores of MMSE 2, the scores obtained on all days of the workshop were utilized. One of the most commonly recommended diagnostics for plausibility of the imputed data is the graphical method where the observed and imputed values are compared graphically, these checks are also referred to as internal checks.^[12] The graphical comparison of density curves of the observed and imputed values showed similar distribution of the MMSE scores for both MMSE 1 and MMSE 2, indicating that the above-mentioned variables can be used for imputing the missing values of MMSE 1 and MMSE 2 [Figure 1a and b].

The missing values of the initial cognitive scores of study participants were also imputed using the cognitive scores at the end of the study and the weighted average of the scores obtained by the participants on all days of the workshop; these too showed similar density curves for the observed and imputed values [Figure 1c]. Entire analysis in the study was done using software STATA 14.0.

The previous studies have shown that while linear regression is one of the most commonly used distributions in medical and biological sciences data, cognitive datasets do not always meet the assumptions required for the dependent variable in the regression model. In such cases, Poisson and negative binomial regression models are the options that can be considered.^[13] A Poisson regression model is one of the most commonly used models for analyzing count data. This regression model is based on the assumption that the mean is equal to its variance. However, in cases of overdispersion of data where the variance is greater than the mean

of the dataset, it is not recommended to fit a Poisson regression as it may underestimate the standard errors of the regression parameters and result in drawing misleading conclusions. For overdispersed data, a negative binomial regression model has been recommended as a suitable alternative.^[14] For the present dataset, the dependent variable had a variance notably higher than the mean indicating overdispersion of the dependent variable.

A negative binomial regression model is based on the Poisson-gamma mixture distribution and can be used to model non-negative count-based dependent variables, in case of presence of overdispersion of the dependent variable in the dataset.^[15] Thus, a negative binomial regression model was fitted to the dataset to fulfill the study objective. Model was fitted to analyze the association of physical, mental, and social factors with improvement in cognitive performance.

RESULTS

Living Condition at the Old Age Homes

The study collected information on the facilities available to the inmates of each of the old age homes included in the study.

Table 2 shows the details of the facilities available for the inmates at each of the old age homes. Among the institutions included in the study, two of them were government institutions, one was a private institution and one being run as a charity.

OAH 1

A government runs institution where the residents had to bear the expenses of their stay as well as other amenities such as food and medical care. It housed both men and women, and was open to retired government officials. A mess was included for the residents where timely meals were provided, also creating a setting for the residents to interact with each other. The premises were kept clean and required hygiene practices were met. In addition to this, there was also a garden inside the facility with an open gym for the residents, which was widely used by many inmates. A recreational center along with a common reading room was also made available to the residents. The residents mainly consisted of retired government officials.

OAH 2

The OAH2 was a privately run facility by a religious committee adjoining the old age home. The stay and other amenities for the

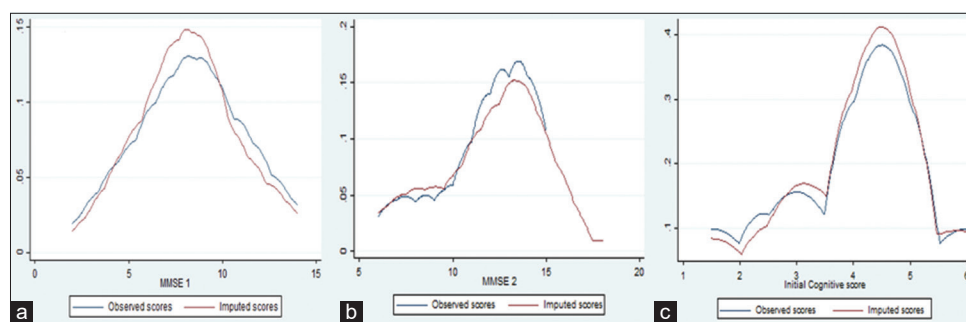


Figure 1: (a) k-density plot of the observed and imputed values for Mini-Mental State Examination (MMSE). (b) k-density plot of the observed and imputed values for MMSE 2. (c) k-density plot of the observed and imputed values for initial cognitive score

Table 2: Facilities available at each of the old age homes

Activity	OAH 1	OAH 2	OAH 3	OAH 4
Daily activities				
Park	√a	x	√	x
Gymnasium	√y	x	x	x
Prayer meeting	x	x	√	x
Dining hall	√i	x	√	√
Communication with inmates	Daily	Frequent	Daily	Occasional
Relation with caretakers	Good	Bad	Good	Bad
Social activities				
Dining hall	√i	x	√	√
Reading room	√e	x	x	x
Recreational center	√e	x	√	x
Prayer hall	√r	x	√	x
Entertainment modes	Common room with television	No facility	Some of the residents had their own television sets	No facility
Freedom to visit places	√l	√l	√l	√l
Freedom to visitors	√r	√r	Only with prior permission	√n
Access to Medicare	Dispensary in the facility	No facility	Dispensary in the facility	Dispensary in the facility
Involvement in management	x	x	√	x
Location of old age home	Isolated area	No nearby market	No nearby market, however, a built-in grocery store was present	Market within 1 km area

residents were arranged for by donations. The living conditions were not very comfortable; one of the reasons for that could be the dependence on donations for meeting the living expenses. The building was under construction and basic electrical facilities such as fans were also not functional in some rooms. However, other basic amenities such as meals and medical care were looked after by the management. The residents mainly consisted of individuals who moved to India post-partition. It was open to both men and women.

OAH 3

The OAH3 was a privately run institution with the expenses of stay and amenities borne by the residents. The area was lush green and had a recreational center as well as a library for the residents. The routine for all the residents was the same; it started with prayer in the morning followed by other duties allotted to the residents for the maintenance of the facility which changed periodically. There was also staff for cleaning and other purposes. The residents could either cook their meals in their respective houses or avail the mess facility provided economical meals. Due to the absence of stores nearby, a dedicated grocery store was available for the residents and fresh produce (fruits and vegetables) vendors were allowed to come inside the facility. Only female residents, mainly former working women, were housed. The old age home had a very lively ambience giving the residents ample opportunities to interact with one another.

OAH 4

A government runs institution for women only. The residents bore the cost of their board as well as other amenities such as meals and medical care. A mess was available for the residents with timely meals provided, however, not much interaction took place among the residents. The place was kept clean and the required hygiene practices were followed. There was also a garden inside the facility. There existed a high level of dissatisfaction among the residents over the quality of food and other services. A recreational center along with a common reading room was also present but not much utilization of these facilities was observed. The residents mainly consisted of retired government officials.

Characteristics of Study Participants

The background characteristics of the study participants are summarized in Table 3.

The majority of the participants were female and over half the study participants were aged between 70 and 80 years. Most of the participants had completed their secondary school education.

The results in Table 4 give the descriptive statistics of the study variables. The mean improvement seen among the participants was 3.84 with a standard error of 2.79. The mean initial cognitive score observed was 4.04 with a standard deviation of 1.23. The table indicates that the mean and mode of the distribution of initial cognitive score are approximately the same for all. The average involvement of the participants in social and cognitive activities was fairly low, in contrast, the majority of the participants were involved in physical activities with varying frequency.

Comparison of Improvement in Cognitive Performance by involvement in Physical, Cognitive, and Social Activities

The Mann-Whitney U-test applied to compare the level of improvement in cognitive performance after the workshop by level of involvement in physical, cognitive, and social activities.

The results of the analysis are shown in Table 5. The test indicates a significant difference in level of improvement in cognitive performance between those who were physically more active and those who exercised only occasionally or not at all with z-score -2.36 ($P < 0.05$). Further, analysis showed that those who were physically more active had higher improvement after the workshop compared to those who were physically less active. No significant difference in improvement was observed for cognitive and social involvement by the participants.

Association of Select Background Characteristics and Cognitive Intervention with Improvement in Cognition Performance Observed Among the Study Participants

A negative binomial regression model was used to analyze the association of background characteristics such as age, gender,

Table 3: Background characteristics of participants

Variable	Level	Sample size	Percentage
Center	OAH 1	20	31.25
	OAH 2	10	15.63
	OAH 3	25	39.06
	OAH 4	09	14.06
Sex	Male	19	29.69
	Female	45	70.31
Age	60–69	14	21.88
	70–79	34	53.13
	80–89	16	25.00
Education	No education	01	1.56
	Primary	07	10.94
	SSC	15	23.44
	HSC	09	14.06
	Graduate	19	29.69
	Postgraduate	11	17.19
Total	PhD	02	3.13
		64	100.0

Table 4: Frequency of various activities

Frequency of activities	Physical activity		Social activity		Mental activity	
	n	Percentage	n	Percentage	n	Percentage
Never	26	29.2	57	30.3	47	52.8
Sometimes	15	16.9	44	49.4	19	21.3
Often	10	11.2	15	16.9	10	11.2
Daily	38	42.7	3	3.4	13	14.6

Table 5: Results of Mann–Whitney U-test to determine the difference in cognitive improvement by level of involvement in physical, mental, and social activities

Variable	Z-score	p-value
Physical active	-2.36	0.018
Cognitively active	-1.60	0.109
Social active	-1.41	0.158

education, place of residence, their present cognitive state, their frequency of involvement in physical mental and social activities, and performance in the workshop with the improvement in cognitive performance observed after the workshop. The results of the negative binomial regression model are summarized in Table 6.

The likelihood ratio test indicates the overall model to be highly significant with value -127.18 ($P < 0.001$). According to the fitted model, a higher level of improvement was observed among the female participants compared to their male counterparts. On the basis of residence, participants residing in OAH 3 ($P = 0.049$) and OAH 4 ($P = 0.019$) showed significantly lower levels of improvement compared to OAH 1. The performance of the participants in the workshop showed significant positive association with improvement in cognitive functioning among the participants with coefficient 0.063 ($P = 0.085$). The most significant factor associated with the observed improvement among the participants is their cognitive state, that is, those participants which had the lower level of cognitive impairment (based on Mini-Cog scores) showed highly significant improvement in cognitive performance ($P < 0.001$). Incidentally, participants who were physically active showed negative association with improvement in cognitive performance ($P = 0.006$).

DISCUSSION

The results from a previous analysis of the study data show significant improvement in the scores of the participants post

Table 6: Results of negative binomial regression model for association of select background characteristics and cognitive intervention with improvement in mental cognition among study participants

Variables	Coefficient (SE)	95% CI
Age	0.011 (0.012)	-0.013–0.034
Gender		
Male*		
Female	0.727** (0.237)	0.263–1.191
Level of education		
No education*		
Primary	0.105 (0.809)	-1.481–1.691
Secondary and higher secondary	0.842 (0.779)	-0.685–2.370
Graduation and above	0.889 (0.772)	-0.624–2.403
Old age home		
Old age home 1*		
Old age home 2	-0.137 (0.317)	-0.758–0.484
Old age home 3	-0.604** (0.307)	-1.206–-0.002
Old age home 4	-0.946** (0.404)	-1.737–-0.154
Physical activity		
Never*		
Sometimes	-0.917** (0.337)	-1.577–-0.257
Often	-0.244 (0.306)	-0.844–0.356
Daily	-0.250 (0.290)	-0.818–0.318
Mental activity		
Never*		
Sometimes	0.198 (0.223)	-0.240–0.635
Often	0.020 (0.337)	-0.641–0.680
Daily	0.342 (0.308)	-0.261–0.945
Social activity		
Never*		
Sometimes	-0.401* (0.213)	-0.818–0.017
Often	-0.060 (0.217)	-0.486–0.365
Daily	0.187 (0.377)	-0.553–0.926
Initial cognitive score	0.288*** (0.075)	0.141–0.435
Performance in workshop	0.063* (0.036)	-0.009–0.134

*Reference category: * $P < 0.10$; ** $P < 0.05$; *** $P < 0.001$

cognitive and social intervention in the workshops, indicating that such interventions may be instrumental in preventing/delaying cognitive decline among elderly population to some extent.^[16] Similar studies have also shown that even a low-intensity training program is able to promote some of the protective factors that promote successful cognitive aging.^[17] The present study examined the factors which have a possible association with the improvement in cognitive performance among elderly participants along with the intervention program. Of the factors studied, gender and place of residence were found to have a role in the level of improvement observed among the participants. The most notable distinction between the institutions that showed higher levels of improvement was that the inmates in the old age home were on interactive terms with each other. A substantial factor found to be associated with cognitive improvement of the participants was their present level of cognitive impairment; it was observed that those with the least cognitive impairment benefitted the most from the intervention program, hence, an early detection and intervention proves of greater benefit. During the course of the workshop, the participants' state-of-mind was also observed to affect the performance in that session of the workshop, a stressful day due medical concerns, family matters, etc., negatively affected the results, however, this could not be quantified and cannot be included in the analysis.

Participants involved in physical activities unexpectedly showed lower levels of improvement compared to those not involved in any physical activities, although it was observed that

the mean score obtained in both the MMSE was higher for those involved in physical activities, a similar trend was observed in the association of improvement in cognitive performance with involvement in social activities. While involvement in stimulating mental activities showed a positive association with improvement in cognitive performance among the participants, it was not reported significant in the present study. For the present study, age of the participants was not observed to be a factor significantly associated with higher levels of improvement in cognitive performance among the participants. However, other recent studies have shown the existence of variation in performance of elderly population by age, emphasizing the necessity of considering various age groups when designing the workshop, as the effects of the program will differ by age group (under 80 years and above 80 years).^[5] One of the reasons for the results from the present study could be that there is not much variation present in the age of the study participants. Studies also state the importance of observing the impact of the workshop after a span of time,^[18] hence, it is necessary to conduct a follow-up training on a regular basis for elderly people who take part in the workshops.

CONCLUSION

The study highlights the effectiveness of cognitive training in improving the mental health of elderly population, thus indicating that it can be used as a potential preventive measure for cognitive decline in elderly population. It highlights the importance of living conditions as a factor which can potentially affect the mental health of elderly individual. The study also points to the necessity of early introduction of mental and social intervention programs to prevent or delay cognitive decline among elderly population so as to help improve the overall mental well-being of elders in our society, especially those living without the security of family support.

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