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Investigating the Link between Cognitive Reserve and Early Signs of Cognitive Decline

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Abstract: As the world's population ages, the prevalence of cognitive impairment and dementia increases. The objective of the current study was to examine cognitive reserve (CR) in older adults with mild cognitive impairment (MCI), those with risk factors (RF), and healthy controls. Sixty participants (20 each group) performed evaluations such as the Mini Mental State Examination (MMSE) and Cognitive Reserve Index questionnaire (CRIq). Analysis of variance (ANOVA) found significant differences in CR scores between groups (F (2, 57) = 12.366, p <.001). Post-hoc analysing demonstrated that those with MCI had considerably lower CR ratings compared to HC (mean difference = -53.15, p <.001), while RF did not differ significantly from HC (mean difference = 20.75, p =.141). These results indicate that higher CR may mitigate cognitive decline in aging adults and underscore the importance of preventive interventions targeting CR. Further research is needed to explore longitudinal effects and mechanisms underlying CR in cognitive aging and dementia prevention.

Keywords*: Cognitive Reserve, Mild Cognitive Impairments, Risk Factors, Cognitive Decline, Aging.*

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I. INTRODUCTION

The world's population is aging rapidly. There are currently older adults than ever before, and this number is expected to keep growing. By 2050, the number of people over 60 will double, making up a significant portion of the global population. This trend is having a major impact on societies around the world. India is also experiencing a rapid rise in its older adult population. This trend started some time ago and shows no signs of slowing down. From 2001 to 2011 alone, India's elderly population jumped from 77 million to 104 million. If current projections hold true, this number could triple by 2050, reaching a staggering 300 million and making up one-fifth of the entire country's population (based on India's 2011 census).

With the rapid rise in older adults worldwide, it's crucial to address the challenges they face and promote healthy aging practices. Statistics paint a concerning picture: a vast majority (92%) of seniors have at least one chronic illness, and a significant portion (77%) struggle with two or more. Heart disease, stroke, cancer, and diabetes top the list of common chronic conditions. These, along with high blood pressure, diabetes, and HIV, further elevate the risk of neurological and mental illnesses like dementia and depression. Dementia, or the loss of cognitive ability, affects roughly 47.5 million individuals worldwide, with forecasts showing a nearly threefold increase by 2050. Additionally, the World Health Organization (2021) reports that over 15% of adults over 60 experience some form of mental disorder, with depression being a prevalent issue.

Dementia warning signs can appear long before full-blown symptoms. These early signs often show up as a condition called Mild Cognitive Impairment (MCI). Individuals with MCI experience more forgetfulness and thinking problems than you'd expect with normal aging, but it's not severe enough to be considered dementia yet. Unlike dementia, they can still manage their daily lives independently.

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MCI is like a crossroads. It might be a stepping stone on the path towards dementia. Because of this, it's a very important condition for doctors and researchers to study. By focusing on MCI, they might be able to develop ways to slow down or even prevent people with MCI from progressing to full-blown dementia.

In this context, it is theorized that cognitive reserve (CR) serves as a protective factor in cognitive impairment and other age related decline. In its latest definition, cognitive reserve (CR) is characterized as a brain characteristic that allows for higher cognitive abilities even in the presence of substantial brain changes, injury, or disease associated with age related changes. Although the protective function of cognitive reserve (CR) in clinical dementia conditions is well acknowledged, its role in preclinical conditions like Mild Cognitive Impairment (MCI) remains a topic of debate.

However, certain studies have suggested that higher levels of cognitive reserve (CR) are linked to a decreased likelihood of developing Mild Cognitive Impairment (MCI) (Nelson et al., 2021). Conversely, other studies have indicated that CR may act as a risk factor for the progression from MCI to dementia (Allegri et al., 2010; Xu et al., 2019). Based on this evidence, several researchers have suggested that cognitive reserve could be a focal point for interventions aimed at preventing MCI.

Therefore, the primary objective of this study was to detect and examine differences in cognitive reserve (CR) proxy scores between healthy adults and individuals with Mild Cognitive Impairment (MCI), and persons with risk factors (history of Hypertension, Diabetes Mellitus, Hypothyroidism, Vitamin B12 deficiency). The hypothesis posited that healthy older adults would exhibit higher CR compared to older adults diagnosed with MCI, and adults with risk factors.

II. METHODS

A. Participants

Sixty adults were selected by using purposive and convenient sampling techniques from residential area of IHBAS and East Delhi and persons come with the patients. Participants were selected using the inclusion and exclusion criteria stated here. *Inclusion Criteria for risk factor participants as follows:* persons in the age range of 55 years and above, history of risk factor on the basis of personal data sheet. *Exclusion Criteria for the risk factor participants as follows:* any other co-morbid medical illness (including Cardiovascular and Cerebrovascular disease), any other co-morbid psychiatric illness, history of any head injury or any other developmental or degenerative disease. *Inclusion Criteria for the Mild Cognitive Impairments participants:* persons in the age range of 55 years and above, mild Cognitive Impairments on the basis of MMSE. *Exclusion Criteria for the Mild Cognitive Impairments participant:* any other co-morbid medical illness (including Cardiovascular and Cerebrovascular disease), any other co-morbid psychiatric illness, past history of any head injury or any other developmental or degenerative disease. *Inclusion Criteria for healthy participants: p*ersons in the age range of 55 years and above, no history of risk factor on the basis of personal data sheet, no Mild Cognitive Impairments on the basis of MMSE. *Exclusion Criteria for healthy participants:* Any other co-morbid medical illness (including Cardiovascular and Cerebrovascular disease), any other co morbid psychiatric illness, history of any head injury or any other developmental or degenerative disease.

B. Instruments

- *Personal Data Sheet:*

A self-created questionnaire was utilised to collect sociodemographic and risk factor data. The researcher specifically obtained demographic data (e.g., age, education, occupation, marital status, etc.), medical conditions (e.g., history of psychiatric disorders, psychopathological diagnosis), and physical health (e.g., brain injury, hypertension, diabetes, neurological diagnoses, and vitamin B12 deficiency).

- *Mini Mental Status Examination (MMSE):*

The Mini Mental State Examination (MMSE) was used to evaluate cognitive deficits. This scale consists of 11 items that test five aspects of cognitive functioning: orientation, registration, attention and computation, recall, and language. The maximum score on this scale is 30, with a score of 23 or lower indicating cognitive impairment.

- *Cognitive Reserve Index Questionnaire (CRIq):*

Cognitive reserve was assessed using the Cognitive Reserve Index Questionnaire (CRIq) developed by Nucci et al. (2011). It is a three-point Likert scale with 20 items that were divided into three sections: education, work activity, and leisure time. Each participant receives scores in the three domains, and these are summed to determine the overall level of cognitive reserve. According to Nucci et al. (2011), the total score on the CRIq can be classified into five levels: very low (score < 70), low-medium (70-84), medium (85-114), high-medium (115-130), and high (> 130).

- *Premorbid Intelligence:*

Premorbid Intelligence was assessed using several subtests, including information and digit span tests from the verbal adult intelligence scale (VAIS), the Abstraction and Ideation Fluency test from the Mukundan Neuropsychological battery, and the Vocabulary test from the WAIS (Wechsler Adult Intelligence Scale).

C. Procedure

The personal data sheet was administered following the establishment of rapport with participants, serving as a screening tool to determine eligibility based on inclusion and exclusion criteria for the study. Information regarding Risk factors, as taken in the study, was also gathered through the personal data sheet. Participants who met the inclusion criteria proceeded to further assessment scales, contingent upon providing informed consent. All assessment tools were administered individually across all participant

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groups. Scoring was conducted manually following the administration of each tool.

➢ *Analysis of Data*

The researchers used SPSS software to analyse the raw data from participant questionnaire responses. Descriptive statistics, such as means and standard deviations, were calculated to summarize the cognitive reserve scores.

III. RESULTS

Table 1. Socio-Demographic Characteristics

		N	%	Mean	SD
Age		60		57.900	3.634
Gender	Male	45	73.8		
	Female	15	24.6		
Religion	Hindu	57	93.4		
	Muslim	3	4.9		
Education	Illiterate	2	3.3		
	Below 10^{th}	20	32.8		
	10^{th}	11	18.0		
	12^{th}	10	16.4		
	Graduation	16	26.2		
	Post –graduation	1	1.6		
Occupation	Unemployed	12	19.7		
	Employed	48	78.7		
Family Type	Nuclear	23	37.7		
	Joint	37	60.7		

Total N=60, (20 for each group)

Table-1 shows socio-demographic characteristics of the participants involved in the present study. The demographic variables reported are gender, age, religion, occupation, family type and education level of the participants. The data in the table shows the frequency and percentage for each of the variable mentioned. As can be seen in the table the total sample comprised of 60 participants; 20 with Risk factor, 20 with Mild Cognitive impairment and 20 Healthy Control. Participants in the study were mostly male and consisted of Hindus followed by Muslims. The participants in the study were well educated and employed; most of the participants at least completed their higher secondary education.

Table.2 Mean & S.D. of scores on Cognitive Reserve in Individuals with Risk Factors, Mild Cognitive Impairment and Healthy Controls

Groups	N	Mean	Standard Deviation
Risk Factor	20	84.4000	39.42401
Mild Cognitive Impairment	20	31.2500	15.38925
Healthy Control	20	63.6500	41.11508
Total	60	59.7667	40.09538

(RF>HC>MCI)

Table 2 shows the mean and SD score of each group on CR. The average score of the MCI group **is** elevated as compared to that of the HC group. However, the average score of the RF group **is** almost close to the HC group.

Table. 3 Comparison of Cognitive Reserve in Individuals with Risk Factors, Mild Cognitive Impairment, and Healthy Controls

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	28701.633	2	14350.817	12.366	.000
Within Groups	66149.100	57	1160.511		
Total	94850.733	59			

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Table.4 Post Hoc Analyses of Cognitive Reserve Differences in Older Adults with Risk Factors, Mild Cognitive Impairment, and Healthy Controls

Group (I)	Group (J)	Mean difference (I-J)	Sig.
Risk factor	MCI	53.15*	.000
	Healthy Control	20.75	.141
MCI	Risk Factor	-53.15*	.000
	Healthy Control	-32.40*	.011

*. The mean difference is significant at the 0.05 level.

**p < 0.05, **p< 0.01*

In order to compare cognitive reserve in person with Risk Factor, Mild Cognitive Impairment and Healthy Controls groups in older adults one way analysis of variance (ANOVA) followed by post hoc analysis was applied. The results are presented in tables 3 and 4.Post hoc analysis shows that persons with Mild Cognitive Impairment in older adults significantly differed from healthy controls on the cognitive reserve scale, but persons with risk factors did not significantly differ from healthy controls. The healthy control group scored higher on the cognitive reserve scale compared to the Mild Cognitive Impairment group, but the average scores on the cognitive reserve scale of the healthy control and risk factor groups were almost similar to each other.

IV. DISCUSSION

The study aimed to investigate and evaluate differences in cognitive reserve between healthy adults and patients with mild cognitive impairment (MCI) and adults with risk factors. Our findings validate that enhancing certain lifestyle factors could serve as a personal defence against dementia. The clinical findings in this study indicate that reduced cognitive reserve could be regarded as a feature of pathological aging, such as mild cognitive impairment (MCI). From this standpoint, decreased cognitive reserve heightens the likelihood of pathological aging. Since, high cognitive reserve enables flexible adaptation to age-related cognitive decline or neurodegeneration, our findings support the theory that a higher cognitive reserve, shaped by lifelong experiences, enhances cognitive flexibility. This characteristic could potentially delay the onset of dementia. Furthermore, we additionally affirm that cognitive reserve (CR) can be regarded as a protective factor for overall cognitive function during the initial phase of cognitive decline. Our findings indicate that cognitive reserve (CR) might have been employed as a compensatory mechanism to counteract cognitive decline.

Furthermore, we reaffirm that cognitive reserve (CR) can also be regarded as a protective factor for overall cognition during the initial stages of cognitive decline. Our results suggest that cognitive reserve (CR) may have functioned as a compensatory mechanism to mitigate cognitive decline. These findings align with previous evidence indicating that higher cognitive reserve (CR) correlates with better overall cognitive performance in older adults (Liu et al., 2013) and individuals diagnosed with mild cognitive impairment (Berezuk et al., 2021).

Premorbid intelligence appears to be a stronger predictor of incidence dementia than amount of education. This finding lends support to the brain reserve theory, which holds that intelligence more directly reflects brain reserve capacity than education (Satz 1993). Educational attainment is a critical component of effective cognitive ageing and a major protective factor against dementia (Stern, 2009). Similar results were obtained in another study by Meng and D'Arcy (2012), which reported that higher education has a protective effect on the development of dementia and that cognition and function decline and brain pathology become more significant with the onset of clinical disease.

Interestingly it was noted that in the findings of the present study Persons with Risk Factors scored high on the cognitive reserve scale followed by Healthy Control and Mild Cognitive Impairment, which shows that Risk factors taken into the present study do not directly affect the cognitive reserve. The lack of Indian norms regarding Cognitive Reserve further makes it difficult to say whether the score is high or is in line with the average score. Another explanation of the present findings could be the sample bias, as the persons in risk factor group had high education levels and most of the participants were employed, which might have some contribution in their obtained higher levels of Cognitive Reserve.

V. CONCLUSION

The present study attempted to study the Cognitive Reserve in older adult persons with risk factor, and mild cognitive impairment. A non-clinical group was also included to act a standard comparative measure. Findings indicate that the persons with mild cognitive impairment significantly differ with healthy control group on the measure of cognitive reserve scale. The healthy control scored high on cognitive reserve scale in comparison of mild cognitive impairment group. The persons with risk factor do not significantly differ with healthy controls. The score of both groups on the measure of cognitive reserve are very close to each other.

VI. LIMITATIONS

Based on the study's findings, various strengths and limitations should be noted. A key strength is the inclusion of subjects in the early stages of cognitive decline, as well as the extensive measurement of cognitive reserve (CR). However, due to our small sample size and subjects' young ages, the generalisability of our findings may be limited.

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Additionally, the cross-sectional and observational design of the study prevented us from examining age-related changes in cognitive performance and the role of CR as a mediator of these changes, which could have been shown by longitudinal research. Another limitation is that, according to the latest definition of CR (Stern et al., 2023), the Cognitive Reserve Index questionnaire (CRIq) used in our study assesses "proxies for cognitive reserve" rather than directly measuring "the level of CR."

REFERENCES

[1]. Bellou, V., Belbasis, L., Tzoulaki, I., Middleton, L. T., Ioannidis, J. P., & Evangelou, E. (2016). Systematic evaluation of the associations between environmental risk factors and dementia: An umbrella review of systematic reviews and meta-analyses. Alzheimer's & Dementia, 13(4), 406–418.

[2]. Das, S. K., Bose, P., Biswas, A., Dutt, A., Banerjee, T. K., Hazra, A., Raut, D. K., Chaudhuri, A., & Roy, T. (2007). An epidemiologic study of mild cognitive impairment in Kolkata, India. Neurology, 68(23), 2019–2026.

[3]. Das, S., Ghosal, M., & Pal, S. (2012). Dementia: Indian scenario. Neurology India, 60(6), 618.

[4]. Farron, M. R., Kabeto, M. U., Dey, A. B., Banerjee, J., Levine, D. A., & Langa, K. M. (2020). Hypertension and Cognitive Health among Older Adults in India. Journal of the American Geriatrics Society, 68(S3).

[5]. Farron, M. R., Kabeto, M. U., Levine, D. A., Wixom, C. R., & Langa, K. M. (2022). Blood pressure and cognitive function among older adults in India. Journal of International Medical Research, 50(1), 030006052110687.

[6]. Government of India. (2011). *Census of India 2011: Population enumeration data*. Office of the Registrar General & Census Commissioner, India. Retrieved from http://censusindia.gov.in

[7]. Hosseinpoor, A. R., Bergen, N., Kostanjsek, N., Kowal, P., Officer, A., & Chatterji, S. (2015). Socio-demographic patterns of disability among older adult populations of low-income and middle-income countries: results from World Health Survey. International Journal of Public Health, 61(3), 337–345.

[8]. Kaur, A., Sonal, A., Ghosh, T., & Ahamed, F. (2023). Cognitive reserve and other determinants of cognitive function in older adults: Insights from a community-based cross-sectional study. Journal of Family Medicine and Primary Care, 12(9), 1957–1964.

[9]. Khullar, S., Kaur, G., Dhillon, H., Sharma, R., Mehta, K., Singh, M., & Singh, P. (2017). The prevalence and predictors of cognitive impairment in type 2 diabetic population of Punjab, India. Journal of Social Health and Diabetes, 05(01), 047–053.

[10]. Konda, P. R., Sharma, P. K., Gandhi, A. R., & Ganguly, E. (2018). Correlates of Cognitive Impairment among Indian Urban Elders. Journal of Gerontology & Geriatric Research.

[11]. Lalithambika, C. V., Arun, C. S., Saraswathy, L. A., & Bhaskaran, R. (2019). Cognitive impairment and its association with glycemic control in type 2 diabetes mellitus patients. Indian Journal of Endocrinology and Metabolism, 23(3), 353.

[12]. Meng, X., & D'arcy, C. (2012). Education and dementia in the context of the cognitive reserve hypothesis: a systematic review with meta-analyses and qualitative analyses. *PloS one*, *7*(6), e38268.

[13]. Mukku, S. S. R., Dahale, A. B., Muniswamy, N. R., Muliyala, K. P., Sivakumar, P. T., & Varghese, M. (2021). Geriatric Depression and Cognitive Impairment—An Update. Indian Journal of Psychological Medicine, 43(4), 286–293.

[14]. Munshi, M., Grande, L., Hayes, M., Ayres, D., Suhl, E., Capelson, R., Lin, S., Milberg, W., & Weinger, K. (2006). Cognitive Dysfunction Is Associated With Poor Diabetes Control in Older Adults. Diabetes Care, 29(8), 1794–1799.

[15]. Prabhakaran, D., Jeemon, P., Sharma, M., Roth, G. A., Johnson, C., Harikrishnan, S., Gupta, R., Pandian, J. D., Naik, N., Roy, A., Dhaliwal, R. S., Xavier, D., Kumar, R. K., Tandon, N., Mathur, P., Shukla, D. K., Mehrotra, R., Venugopal, K., Kumar, G. A., . . . Dandona, L. (2018). The changing patterns of cardiovascular diseases and their risk factors in the states of India: the Global Burden of Disease Study 1990–2016. ˜the œLancet. Global Health/˜the œLancet. Global Health, 6(12), e1339–e1351.

[16]. Ragubathy, P. K., & Adikane, H. (2020). Prevalence of Risk Factors for Dementia in Elderly Population in a Tribal Area of Central India – A Community-Based Cross-Sectional Study. Journal of Medical Sciences and Health, 05(03), 19–30.

[17]. Sengupta, P., Benjamin, A., Singh, Y., & Grover, A. (2014). Prevalence and correlates of cognitive impairment in a north Indian elderly population. WHO South-East Asia Journal of Public Health, 3(2), 135.

[18]. Solanki, R. K., Dubey, V., & Munshi, D. (2009). Neurocognitive impairment and comorbid depression in patients of diabetes mellitus. International Journal of Diabetes in Developing Countries, 29(3), 133.

[19]. Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. Journal of the International Neuropsychological Society, 8(3), 448–460.

[20]. Stern, Y., Habeck, C., Moeller, J., Scarmeas, N., Anderson, K. E., Hilton, H. J., Flynn, J., Sackeim, H., & Van Heertum, R. (2005). Brain Networks Associated with Cognitive Reserve in Healthy Young and Old Adults. Cerebral Cortex, 15(4), 394–402.

[21]. Subaiya, L., & Bansod, D. W. (2014). Demographics of Population Ageing in India. In Cambridge University Press eBooks (pp. 1–41).

[22]. Tripathi, M., Vibha, D., Gupta, P., Bhatia, R., Srivastava, M. V. P., Vivekanandhan, S., Singh, M. B., Prasad, K., Dergalust, S., & Mendez, M. F. (2012). Risk factors of dementia in North India: a case–control study. Aging and Mental Health/Aging & Mental Health, 16(2), 228–235.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25mar1958

[23]. Vance, D. E., & Crowe, M. (2006). A Proposed Model of Neuroplasticity and Cognitive Reserve in Older Adults. Activities, Adaptation & Aging, 30(3), 61–79.
[24]. World Health Organization. (2021). *Ageing and health*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/ageing-and-health
[25]. Zahodne, L. B., Manly, J. J., Brickman, A. M., Siedlecki, K. L., Decarli, C., & Stern, Y. (2013). Quantifying Cognitive Reserve in Older Adults by Decomposing Episodic Memory Variance: Replication and Extension. Journal of the International Neuropsychological Society, 19(8), 854–862.