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Original Research Article

Cognitive health of ageing population in Delhi

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Abstract

Background: As the global population ages, understanding cognitive health in older adults is increasingly crucial. Aging often leads to declines in memory and attention, influenced by genetics, lifestyle, and health. These impairments can hinder daily activities and increase emergency vulnerability. This study examines cognitive impairments in Delhi's elderly and highlights the necessity of incorporating cognitive health assessments into disaster preparedness plans to ensure the safety and well-being of older adults.
Materials and Methods: The secondary source data, originally collected by LASI and available in SPSS format, was analysed using IBM SPSS Software. The analysis included descriptive statistics to summarize the data and inferential statistics to identify patterns and relationships. The findings are presented through various charts and diagrams.
Findings: Key findings include that in the 45-59 years age group, mild impairment is most common (57.22%), followed by moderate impairment (33.10%), with very few individuals severely impaired. However, in the ≥60 years group, moderate impairment (42.63%) is most prevalent, and there is a significant increase in severe impairment (14.14%).
Conclusion: The data indicates that cognitive impairment worsens with age, progressing from mild to more severe levels. The study underscores the need for a multidisciplinary approach, combining public health, gerontology, and disaster management, to support the ageing population in Delhi and enhance their quality of life and safety in times of crisis.

Keywords: Ageing population, Cognitive health, Cognitive impairment, Cmergencies preparedness.

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1. Introduction

The global elderly population is growing at an unprecedented rate. Currently, there are 617 million people aged 65 and above (8.5% of the population) expected to reach 1.6 billion (17%) by 2050.[1] In Europe, those over 65 will increase from 16.1% in 2000 to 27.5% by 2050, and those over 80 from 3.6% to 10%.[2] In Asia, the elderly population is also increasing rapidly, with projections indicating that one in four people will be over 60 by 2050. Japan currently has the highest proportion of elderly (28% aged 65 and above), and India is expected to have over 300 million elderly by 2050.[3]

In India, the elderly population (60 and above) is projected to rise from 8% in 2015 to 19% by 2050, presenting social, economic, and healthcare challenges. The 2011 census recorded 8.6% of the population as elderly (104 million), with UN projections in 2019 indicating this will increase to 19.5% (319 million) by 2050. This demographic shift raises concerns about neurocognitive disabilities and age-related cognitive decline, with significant declines in cognitive performance occurring after age 60.[4,5] These shifts highlight challenges like higher old-age dependency and greater support needs for elderly parents. There is limited understanding of the disease burden, public health needs, and economic and social implications of India's growing elderly population.[6]

Aging, a complex biological process, involves a decline in physiological functions leading to physical and cognitive impairment.[7] This includes reduced muscle mass, flexibility, lung capacity, cardiovascular issues, and skin changes, contributing to increased medical complications and cognitive decline in memory, attention, and judgment.

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Factors like diet, lifestyle, genetics, and co-morbidities influence aging rates.[8]

Around 80% of older adults have chronic conditions like arthritis, hypertension, diabetes, heart disease, and sensory impairments. Despite this, most manage daily activities independently, with only 25% needing specialized care. Common psychological issues include anxiety, depression, severe cognitive impairment, and mood disorders. Social challenges often involve loneliness, reduced social participation, isolation, and sometimes abuse.[9]

The cognitive health of the aging population is crucial for public health, affecting individuals, families, communities, and healthcare systems. Cognitive decline, from mild impairment to severe conditions like dementia and Alzheimer's, impacts independence and well-being, increasing healthcare costs and caregiving burdens.[10] Aging increases the risk of neurodegenerative diseases like Alzheimer's, Parkinson's, and Huntington's. Dementia, particularly Alzheimer's, becomes more prevalent with age, affecting less than 1% of those under 59, nearly 4% of those aged 60-79, and over 11% of those aged 80-89, with cases expected to triple by 2050.[15]15 Structural brain changes, such as reduced grey and white matter and decreased synaptic density, contribute to cognitive decline, exacerbated by vascular and neurotransmitter dysfunction.[8]

As the older population grows, focusing on cognitive health—memory, attention, language, motor skills, planning, and judgment—is crucial to leverage their experience.[11] Higher cognitive ability guards against future impairment and dementia. In India, elderly dementia cases are projected to rise from 5.29 million in 2020 to 14.3 million by 2050.[9] Over 20% of those aged 60+ suffer from mental or neurological disorders, with dementia and depression affecting around 5% and 7% of the global elderly population, respectively.[12] Depression, a leading cause of disability, dementia, and mortality, has become a top cause of Years Lived with Disability (YLDs) globally between 1990 and 2017.[13] Understanding cognitive aging is essential for enhancing resilience, supporting mental health, and improving life quality for older adults. This study examines the cognitive health of Delhi's elderly, aiming to improve cognitive function and resilience for better health outcomes.

Rationale: Studying the on the cognitive health of Delhi's aging population is crucial to identify prevalence and risk factors of cognitive impairments, guiding tailored interventions and policies. It aids in disaster management by addressing how impairments affect elderly responses to emergencies, informing community support systems, disaster preparedness, and age-friendly infrastructure. This research aims to improve elderly quality of life and safety, offering insights for policymakers, healthcare providers, and disaster management professionals.

2. Objectives

1. To assess the cognitive decline patterns in Delhi's ageing population.
2. To identify which cognitive domains are most impacted by aging.
3. To develop public health recommendations to promote cognitive health.
4. And to integrate cognitive health into routine care and disaster protocols.

3. Material and Methods

This study uses a quantitative approach to assess the cognitive health of Delhi's aging population. The theoretical framework is based on an extensive literature review, and data is sourced from the Longitudinal Ageing Study in India (LASI). LASI is a comprehensive, nationally representative survey of over 73,000 older adults aged 45 and above across India, focusing on health, economic, and social factors related to aging. By concentrating on these sections of LASI, the study aims to contribute to the development of effective interventions and policies to support the cognitive and mental well-being of Delhi's ageing population.

Data from LASI, available in SPSS format, was analysed using IBM SPSS Software. The analysis included descriptive statistics to summarize data and inferential statistics to identify patterns and relationships. Various charts and diagrams, such as histograms, bar graphs, line graphs, and pie charts, were used to present the findings. Cognitive measurements were assessed using a range of tools and criteria detailed in **Table 1**.

4. Results

The study revealed significant findings on the cognitive health of the aging population through a combination of quantitative and qualitative analyses. The study includes information on measured cognition across various domains, including memory, orientation, arithmetic, executive functioning, and object naming. These cognitive measures are derived from the cognition module of the Health and Retirement Study (HRS), allowing for a comprehensive assessment and comparison of cognitive health among the older population.

Table 1: Description of domain wise cognition measure (Source: https://www.iipsindia.ac.in/lasi)

Domain	Measure	Measurement	Range
Memory	Immediate Word Recall	The interviewer recited a list of 10 words, and the respondents were then asked to repeat the words.	0-10
	Delayed Word Recall	Respondents were requested to recall the same words that had been read to them earlier for immediate recall after a short period.	0-10
	Total Word Recall	Sum of immediate and delayed word recall	0-20
Orientation	Time	Respondents were asked to provide the current date, month, year, and day of the week. Each correct response earned 1 point, while incorrect responses received 0 points. The total score for this time-related section ranged from 0 to 4.	0-4
	Place	Orientation towards place was assessed by asking respondents to identify the location of the interview, the name of the village, street number/colony name/landmark/neighbourhood, and the name of the district. Each correct answer received 1 point, with the total possible score ranging from 0 to 4.	0-4
Arithmetic function	Backward Counting	Respondents were instructed to count backward as quickly as possible from the number 20. They were asked to stop after correctly counting backward from 20 to 11 or from 19 to 10. Correct counting earned 2 points, counting with a mistake earned 1 point, and those who could not count received 0 points.	0-2
	Serial 7	Participants were instructed to start by subtracting seven from 100 and then continue subtracting seven from each previous number in a sequence of five steps. One point was awarded for each correct response.	0-5
	Computation	This test required participants to perform a division operation. They were tasked with calculating the net sale price of a product after applying a discount equivalent to half of the original price.	0-2
Executive function	Paper Folding	This task involved giving respondents a three-step command. They were instructed to take a piece of paper from the interviewer, turn it over, fold it in half, and return it. Three points were awarded for successfully completing each task.	0-3
	Pentagon Drawing	Visio construction involves the ability to coordinate fine motor skills with visuospatial abilities, often by reproducing geometric shapes. Respondents were tasked with copying two overlapping pentagons, earning 1 point for accurately drawing them.	0-1
Object naming		The interviewer indicated specific objects and respondents had to name them. Each correct response earned 1 point.	0-2
Cognition	Composite Cognition	The combined score included memory, orientation, arithmetic function, executive function, and object naming.	0-43

4.1. Memory: Word recall

Memory loss is a common issue and often a primary symptom in the elderly, with short-term memory being one of the most clinically significant and crucial indicators of cognitive function. Short-term memory retention involves storing and processing information so that individuals can move on to a subsequent task and then recall the initial information after completing the secondary task. Immediate word recall tests showed a decline in performance with age. The youngest group (under 45) recalled an average of 5.74 words out of 10, which decreased to 5.54 in the 45-59 age group and further to 4.74 in those aged 60 and above. Among the 60 and above age category out of the 494 collected samples, only 3 scored 10 out of 10 and 13 people scored 0 out of 10. Delayed word recall followed a similar pattern, with the youngest group recalling an average of 4.16 words, while the oldest group recalled 3.63 words.

4.2. Orientation

Orientation is a crucial aspect of cognitive health, reflecting an individual's awareness of time, place, and person. Orientation to time and place remains a critical aspect of cognitive health. The study assessed participants' ability to correctly identify the current date, their location, and personal details. The orientation to time showed high mean scores across all age groups, although a slight decline was observed

with age. Participants under 45 had a mean score of 3.85 out of 4, while those aged 60 and above scored 3.56. Orientation to place revealed similar trends, the data for all three age categories showed a negative skew, with mean scores highest in the 45-59 age group (3.79) and lowest in the 60+ group (3.65), which marks a fall of 3.69%.

4.3. Arithmetic function

Arithmetic function within cognitive assessments evaluates an individual's capacity to perform mathematical calculations mentally or with minimal assistance. These tasks are integral to assessing various cognitive domains, including attention, working memory, processing speed, and executive function.

4.3.1. Backward counting

The backward counting task revealed that most participants across all age groups could count backwards without errors. In the 45-59 age group, 69.9% successfully counted backwards, scoring 2 out of 2. This percentage drops to 54.4% for those 60 and older. Despite a smaller sample size, the under-45 group has a similar percentage to the 45-59 group.(**Figure 1**)

However, there was a notable increase in the proportion of participants aged 60 and above who scored 0, indicating a decline in cognitive abilities.

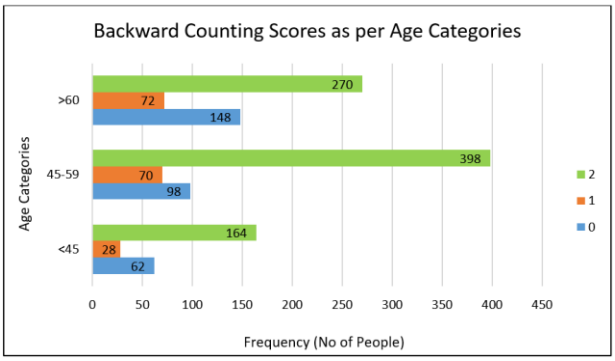

Figure 1: Multiple bar graph showing distribution of scores of backward counting as per age categories

4.3.2. Serial 7

In the 45-59 age group, 50% scored 5 out of 5 on the serial 7s task, with fewer scoring 3, 4, 2, and 1 out of 5. In the 60+ age group, only 45% scored 5 out of 5, with more scoring 2 and 3 out of 5 compared to the 45-59 group.(**Figure 2**)

4.3.3. Computation

Participants scoring 0 are fewest in the under-45 age group, and most in the 60+years age group, indicating declining computational abilities with age. Scoring 1 follows a similar trend. However, for scoring 2 out of 2, the 45-59 age group scores highest (83.7%), followed by under-45 (73.2%) and 60+ (69.6%). This unexpected trend may be due to sample size differences, introducing uncertainty and limiting the study's interpretation.(**Figure 3**)

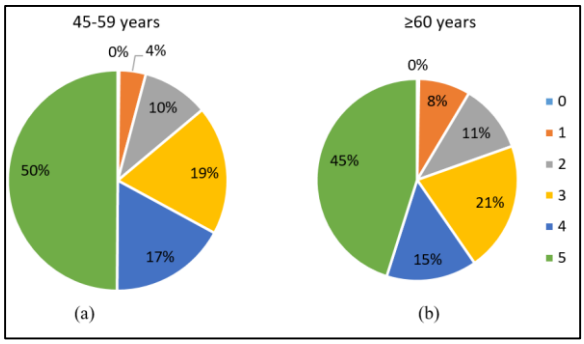

Figure 2: Pie chart showing distribution of Serial 7 as cognitive assessment in (**a**) 45 to 59 years age category (**b**) 60 years and more age category

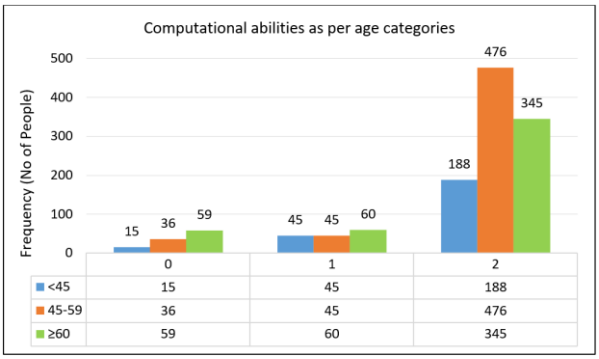

Figure 3: Multiple bar graph showing distribution of computational scores as per age categories

4.4. Executive function

Executive function refers to a collection of cognitive skills that enable individuals to plan, organize, problem-solve, regulate behaviour effectively and motor coordination.

4.4.1. Paper folding

Figure 6 shows a significant increase in the percentage of individuals scoring 0 is significantly higher (about thrice) for those over 60, with a 165.21% increase from the 45-59 age group (4.7% scoring 0) to the 60+ age group (12.3% scoring 0). The mean scores decline in the 60+ group, highlights the challenges faced by older adults in tasks requiring manual dexterity.(**Figure 4**)

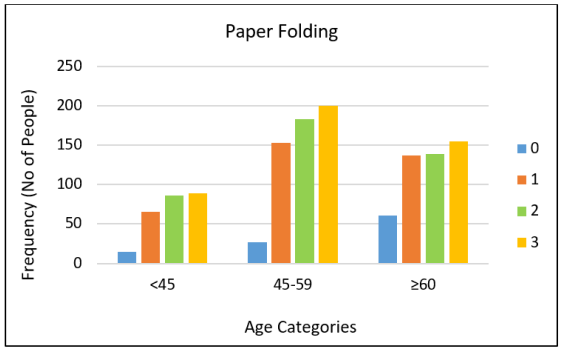

Figure 4: Multiple bar graph showing distribution of paper folding scores as per age categories

4.4.2. Pentagon drawing

In the under-45 age group, about 20% scored 0 and 1 on the pentagon drawing task. In the 45-59 group, more people scored 1 than 0. Conversely, in the 60+ years group, more individuals scored 0 than 1, indicating a decline in task performance with increasing age.(**Figure 5**)

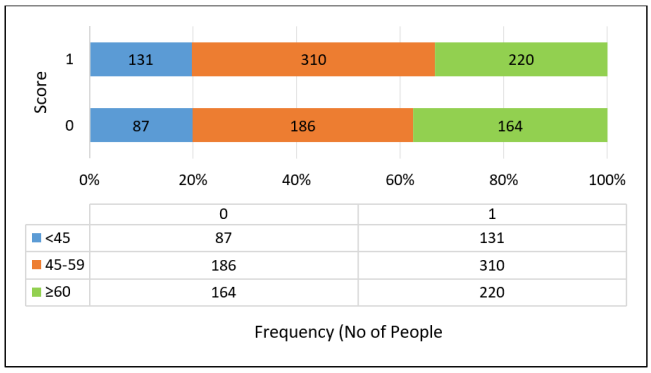

Figure 5: Composite percentage distribution of pentagon drawing scores as per age categories

4.5. Object naming

Object naming in cognitive assessment involves presenting individuals with pictures or actual objects and asking them to identify or name them. This task assesses semantic memory, language abilities, and retrieval processes.

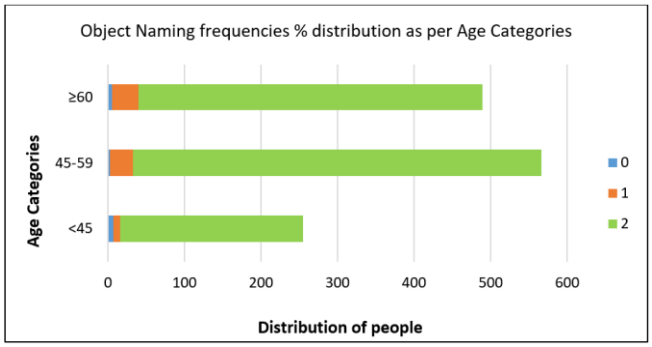

Figure 6: Composite bar graph showing distribution of object naming scores as per age categories

Figure 6 illustrates that 93.7% of the 45-59 age group and 93.0% of the under-45 group scored 2 out of 2 in the object naming activity, while 90.0% of those over 60 did. The 60+ age group shows a slight 3.94% decline compared to the 45-59 group, indicating a minor decrease in object naming ability with age, though overall performance remains high.

4.6. Cognition

Cognitive abilities were assessed across five domains, with a composite score ranging from 0 to 43, with higher scores representing better cognitive functioning. The mean score for individuals aged 60 and above (24.6) is 12.67% lower than that for the 45-59 age group (28.17). Interestingly, the highest score of 42 out of 43 was achieved by a 62-year-old participant, who missed only 1 point in the delayed recall task. While three participants aged 45, 49, and 50 scored 40 out of 43. In the under-45 and 45-59 age groups, only one participant in each scored below 8 out of 43. In contrast, 15 participants aged 60 and above scored below 8. This indicates a decline in cognitive performance with age, despite some high scores among older individuals.[14]

Table 2: Mean composite cognition scores as per age categories

Age category	Mean composite cognition
less than 40	26.89
41-45	27.87
46-50	28.11
51-55	28.29
56-60	26.57
61-65	26.80
66-70	24.23
70 and more	22.4

The mean composite cognition scores reveal several key trends:

1. Early adulthood (<40 to 45 years): Scores are high but slightly below peak levels, with 26.89 for those under 40 and 27.87 for those aged 41 to 45.
2. Peak performance (46-55 years): The highest scores are in the 46-50 years (28.11) and 51-55 years (28.29) age groups, indicating peak cognitive abilities in middle age.
3. Slight decline (56-60 years): Scores drop to 26.57, marking the start of cognitive decline in the late 50s.
4. Significant decline (61+ years): A sharp decline occurs with scores at 26.80 for 61-65 years, 24.23 for 66-70 years, and 22.4 for 70+ years.

Overall, cognitive performance improves through early and middle adulthood, peaks in mid-50s, and declines significantly after age 60. This pattern underscores the importance of addressing cognitive health and implementing interventions to manage age-related cognitive decline.

4.7. Cognitive impairment

Composite cognition scores, with a maximum of 43, categorize levels of cognitive impairment. The **Table 3** shows the distribution of individuals across age groups and impairment levels, offering a detailed view of the population's cognitive health.

1. Scores between 36 and 43 – No cognitive deficit
2. Scores between 28 and 35 - Mild impairment
3. Scores between 16 and 27- Moderate impairment
4. Scores between 0 and 15 - Severe impairment

Table 3: Cognitive impairment levels across different age groups based on composite cognition scores and their percentage distribution

	≤45 years	%	45-59 years	%	≥60 years	%
No impairment (36-43 score)	37	13.21	35	6.16	14	2.83
Mild impairment (28-35 score)	137	48.93	325	57.22	200	40.40
Moderate impairment (16-27 score)	99	35.36	188	33.10	211	42.63
Severe impairment (0-15 score)	7	2.50	20	3.52	70	14.14
Total	280		568		495	

Among those aged 45 years or younger, most have mild to moderate cognitive issues, with a small percentage severely impaired. In the 45-59 age group, 6.16% have no impairment, 57.22% are mildly impaired, 33.10% are moderately impaired, and 3.52% are severely impaired, indicating increased mild and moderate impairments compared to the younger group. For individuals 60 years and older, 2.83% have no impairment, 40.40% are mildly impaired, 42.63% are moderately impaired, and 14.14% are severely impaired, showing a notable rise in moderate and severe impairments with age. The data shows that cognitive impairment increases with age, shifting from mild to more severe levels in older groups. The study assessed 280 individuals aged 45 or younger, 568 individuals aged 45-59, and 495 individuals aged 60 or older, providing a thorough analysis of cognitive health across these age groups.

5. Discussion

Memory, particularly short-term and long-term recall, is a key indicator of cognitive health. When combining the immediate and delayed word recall counts, the total word recall performance for both Delhi and India (as reported in LASI 2020) demonstrates high scores in the ≤45 and 45-59 age groups, with mean scores around 9.68 to 9.8 respectively. However, in the ≥60 years category, scores decline to an average of 8.06 in Delhi and 8.1 in India, highlighting age-related memory retention challenges.[16]

Orientation scores (out of 8) indicate that younger individuals in Delhi have a better grasp of their environment, with a mean score of 7.55 compared to India's 6.8 in the ≤45 age group. This trend continues in the 45-59 age group, with Delhi scoring 7.54 and India 7. In the ≥60 years group, Delhi's mean is 7.12, while India's is 6.5, showing that Delhi's elderly perform better in orientation. Arithmetic function scores (out of 9) also favour Delhi, with the 45-59 age group scoring 6.5 compared to India's 5.1, and the ≥60 years group scoring 5.3 versus India's 4.2. This suggests better cognitive performance in Delhi.

Executive function tasks like pentagon drawing show a decline with age, indicating challenges in visuospatial abilities and motor coordination. Object naming tasks, which assess semantic memory and language abilities, also decline slightly with age, though language remains relatively intact. Mean Composite scores confirm better overall cognitive function in Delhi across all age groups, with Delhi scoring 28.17 for ≤45 years and 24.6 for ≥60 years, compared to India's 26.9 and 23.25, respectively.

Urban environments like Delhi offer structured living conditions, better healthcare, education, and cognitive stimulation, which enhance cognitive health. Resources and technologies for navigation and time management also support better orientation skills. This likely explains Delhi's superior cognitive health compared to the national average, based on LASI 2020 data.

Cognitive impairment classifications in this study are no impairment (36-43), mild (28-35), moderate (16-27), and severe (0-15). In the ≤45 group, most individuals have mild (48.93%) to moderate (35.36%) impairment. In the 45-59 group, mild impairment (57.22%) is most common, followed by moderate (33.10%). In the ≥60 group, moderate impairment (42.63%) is prevalent, with severe impairment (14.14%) increasing significantly. The data shows cognitive impairment worsens with age, shifting from mild to severe.

This study highlights the cognitive decline in Delhi's aging population, especially those 60 and above, despite many maintaining high orientation and language skills. It underscores the need for early intervention and continuous cognitive engagement to mitigate aging effects. Future research should focus on factors contributing to cognitive decline and develop strategies to support older adults.

6. Conclusion

The study reveals significant cognitive impairment trends across different age groups, showing a clear progression with age. In the 45-59 age group, mild impairment is most common, with moderate impairment also notable but severe

cases rare. For those aged 60 and above, moderate impairment is more prevalent, and severe cases increase substantially. Older adults with moderate to severe cognitive impairments are particularly vulnerable during emergencies.

Effective strategies must be developed to ensure clear, simple, and repeated communication through accessible channels. Emergency responders should receive specialized training to support individuals with cognitive impairments, using effective communication techniques and tailored assistance. Building resilient community support networks is vital, involving neighbours and local organizations in checking on and assisting vulnerable individuals. Emergency shelters and facilities need accessibility features like clear signage and supportive staff to accommodate those with cognitive impairments. Public awareness campaigns can foster understanding and empathy, reducing stigma and promoting inclusive disaster response efforts. Integrating these considerations into disaster planning will enhance Delhi's preparedness and responsiveness, ensuring a more inclusive and effective approach to safeguarding all residents, especially those most at risk due to cognitive vulnerabilities.

7. Source of Funding

None.

8. Conflict of Interest

None.

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