

# Changes in Cognitive Function in Human Aging

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## Abstract

According to 2011 census 7.7 per cent of the population were above the age of 60 years and estimated to be double (15.4%) by the year 2025. As aging brings progressive changes in all parts of the body including changes in the structures and function of brain which leads to cognitive decline, physical and behavioral changes among older adults. Due to in structural and functional brain changes and Neuro cognitive changes in aging which leads to cognitive decline. Studies have reported that several risk factors that affect cognitive decline include demographic, economic, and health-related variables such as gender, age, education, place of residence, marital status, financial status, chronic co morbidities, lifestyle and diet habits are associated with the increased risk of developing cognitive impairment. Several studies reported that socio- emotional factors like Late-life Depression (LLD), social isolation, loneliness which leads to poor cognitive function among elderly.

## Introduction

According to the World Health Organization (WHO), Cognitive function is a broad term that refers to mental processes involved in the acquisition of knowledge, manipulation of information and reasoning. Cognitive function is one aspect of overall brain function and is an essential component for carrying out daily tasks.

## Prevalence of cognitive impairment among elderly

Globally, prevalence of cognitive impairment ranges from (0.3%) to (19.00%) in adults older than 65 years. In India, the prevalence of cognitive impairment ranges between (15.00%) and (33.00%).

## Levels of cognitive impairment

Cognitive impairment is when a person has trouble remembering, learning new things,

concentrating, or making decisions that affect their everyday life.

Cognitive impairment ranges from mild to severe:

**Mild impairment:** People may notice changes in cognitive functions but are still able to do their everyday activities.

**Severe levels of impairment:** Lead to losing the ability to understand the meaning or the ability to talk or write, resulting in the inability to live independently.

## Age-related cognitive decline

Age-associated cognitive decline is an inevitable phenomenon that predisposes individuals to neurological and psychiatric disorders eventually affecting the quality of life.

## Changes in Cognitive functioning with aging

Cognitive change as a normal process of aging which accompany both normal and pathologic which includes:

1. Structural and functional brain changes in aging
2. Neuro cognitive changes in aging

## Structural and functional brain changes in aging

- Neuronal Size and Synaptic Density
- Grey and White matter changes

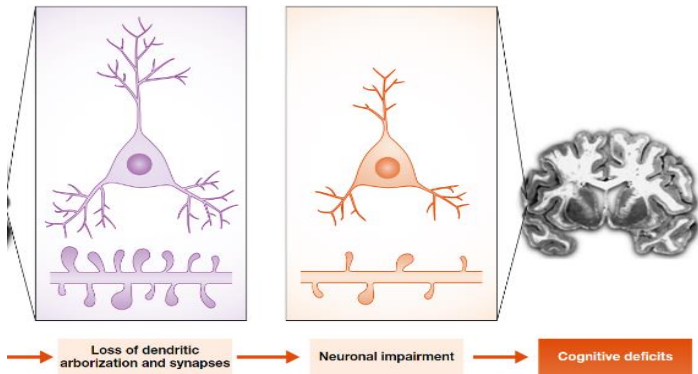
## Neuronal Size and Synaptic Density

Neurons undergo morphologic changes with aging includes decreasing in the complexity of dendrite arborization, dendrite length and neurotic spines. These morphologic changes contribute directly to the reduction of synaptic density which leads to cognitive deficits.

## Grey and White matter changes

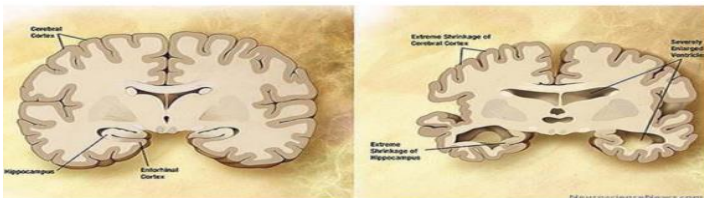
Due to Aging, the death of neurons themselves has been implicated as a possible cause of grey matter volume loss. Grey matter volume begins to decrease after age 20. Age-related changes in the temporal lobes

are more moderate and involve decreases in the volume of the hippocampus.

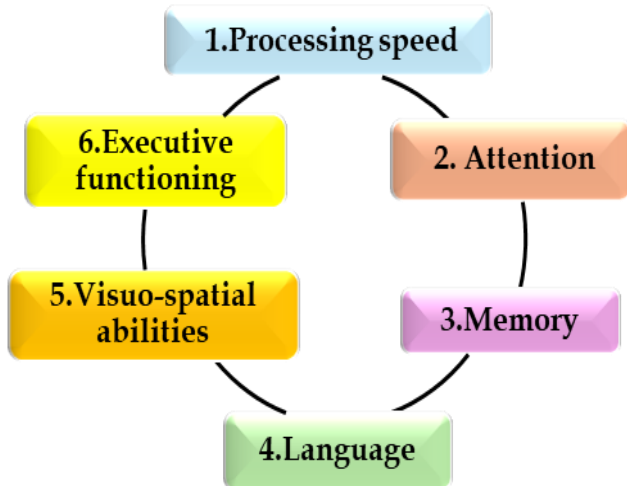


**Fig. 1 Showing Neuronal Size and Synaptic Density**

White matter volume decreases with increasing age. Decreasing white matter leads to decreased communication with hippocampus structures and suggesting a possible mechanism for age-associated memory declines.



**Fig. 2 Grey and White matter changes**



**Fig 3: Neuro-cognitive Changes in cognitive domains**

**Processing speed**

It refers to the speed with which cognitive activities are performed as well as the speed of motor responses. This fluid ability begins to decline in the third decade of life and continues throughout the lifespan.

**Attention**

It refers to the ability to concentrate and focus on specific stimuli. It is also known as immediate memory and shows only a slight decline in late life. A more noticeable age effect is seen on more complex attention tasks.

There are 2 types of attention.

1. Selective attention
2. Divided attention

**Selective attention:** It is the ability to focus on specific information in the environment while ignoring irrelevant information. Example: Engaging in a conversation in a noisy environment.

**Divided attention:** It is the ability to focus on multiple tasks simultaneously. Example: Talking on the phone while preparing a meal.

**Memory**

It is one of the most common cognitive complaints among older adults is change in memory. Age-related memory changes may be related to slowed processing speed, reduced ability to ignore irrelevant information, decreased use of strategies to improve learning and memory.

**Types of memory**

- Declarative
- non-declarative

**Declarative (Explicit) memory**

**Episodic memory:** (also known as autobiographical memory) is memory for personally experienced events that occur at a specific place and time. It can be measured by memory of stories, word lists, or figures.

**Semantic memory:** involves fund of information, language usage, and practical knowledge, for example, knowing the meaning of words.

**Non-declarative (implicit) memory**

It is the other major type of memory. This type of memory is outside of a person's awareness.

An example of implicit memory is remembering how to sing a familiar song, such as "Happy Birthday."

**Procedural memory** is a type of non-declarative memory and involves memory for motor and cognitive skills. Examples: remembering how to tie a shoe and how to ride a bicycle.

**Language:** Overall language ability remains intact with aging. Vocabulary remains stable and even improves over time. Visual confrontation naming, or the ability to see a common object and name it, remains about the same until age 70, and then declines in subsequent years.

### Visuospatial Abilities/Construction

Visual construction skills, which involves the ability to put together individual parts to make a coherent whole (for example, assembling furniture from a box of parts) declines over time.

In contrast, visuo-spatial abilities remain intact. These abilities include object perception, the ability to recognize familiar objects such as household items or faces, and spatial perception.

**Executive functioning:** This includes a wide range of cognitive abilities such as the ability to self-monitor, plan, organize, reason, be mentally flexible, and problem-solve. Research has shown that concept formation, abstraction, and mental flexibility decline with age, especially after age 70, as older adults tend to think more concretely than younger adults.

Concepts of crystallized and fluid intelligence are used to describe patterns of cognitive change over the lifespan.

**Crystallized Intelligence:** It refers to skills, ability, and knowledge that is over learned, well-practiced, and familiar. It can remain stable or gradually improve through the sixth and seventh decades of life. Example: Vocabulary and general knowledge.

**Fluid intelligence:** It refers to abilities involving problem-solving and reasoning about things that are less familiar and are independent of what one has learned. Fluid cognition includes a person's innate ability to process and learn new information, solve problems, and manipulate one's environment. Many fluids cognitive abilities, especially psychomotor ability and processing speed, peak in the third decade of life and then decline in later life.

### Summary of neurocognitive changes in aging

Cognitive domains	Crystallized vs Fluid	Decline with age
Processing speed	Fluid	Yes, simple tasks no
Attention	Fluid	simple tasks- no complex tasks -yes
Memory	Fluid	mixed
Language	Crystallized >fluid	In general -No Visual confronting naming, verbal fluency-Yes
Visuo spatial	Mixed	simple tasks- No complex tasks -Yes
Executive function	Fluid	mixed

(Caroline N. Harada et. al., 2013)

### Factors influence cognitive function

According to WHO, the population aged 60 years and above will increase from 1 billion in 2020 to 1.4 billion. By 2050, the world's population of people aged 60 years and older will double. With increasing population aging due to improvements in life expectancy, there will be a large population of elderly with a high risk for cognitive decline. Studies have reported that several risk factors that affect cognitive decline include demographic, economic, and health-related variables such as gender, age, education, place of residence, marital status, financial status, chronic co morbidities, lifestyle and diet habits are associated with the increased risk of developing cognitive impairment. Several studies reported that socio-emotional factors like Late-life Depression (LLD), social isolation, loneliness which leads to poor cognitive function among elderly. Therefore, interventions like reminiscence therapy, cognitive therapy, yoga practices, playing games, reading books, social engagement were designed to manage risk factors associated with cognitive decline and strategies to prevent this decline in elderly are of great importance.

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