

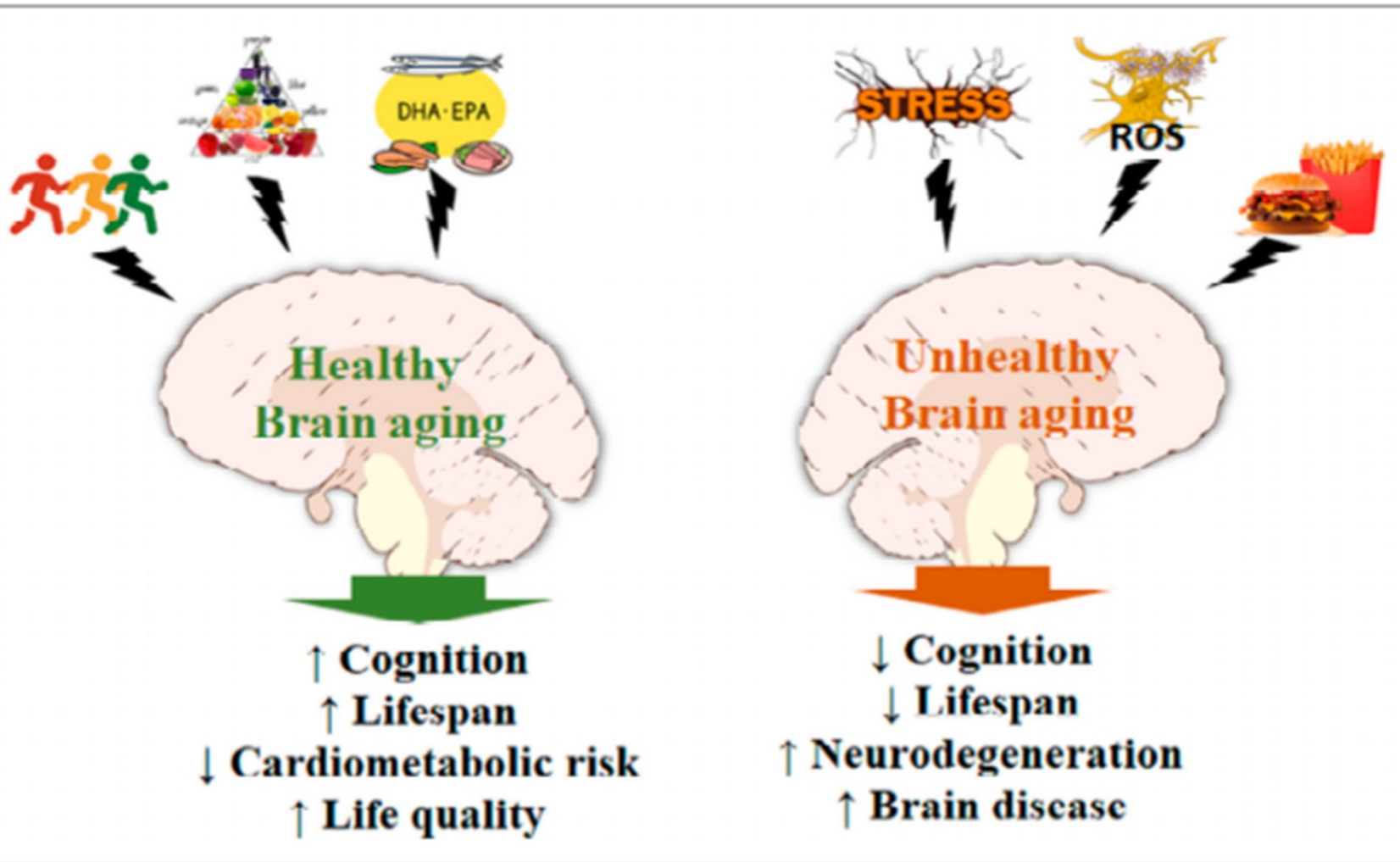
LIFESTYLE AND BRAIN HEALTH

DR SEEMA PURI
ASSOCIATE PROFESSOR
INSTITUTE OF HOME ECONOMICS
UNIVERSITY OF DELHI

BRAIN HEALTH

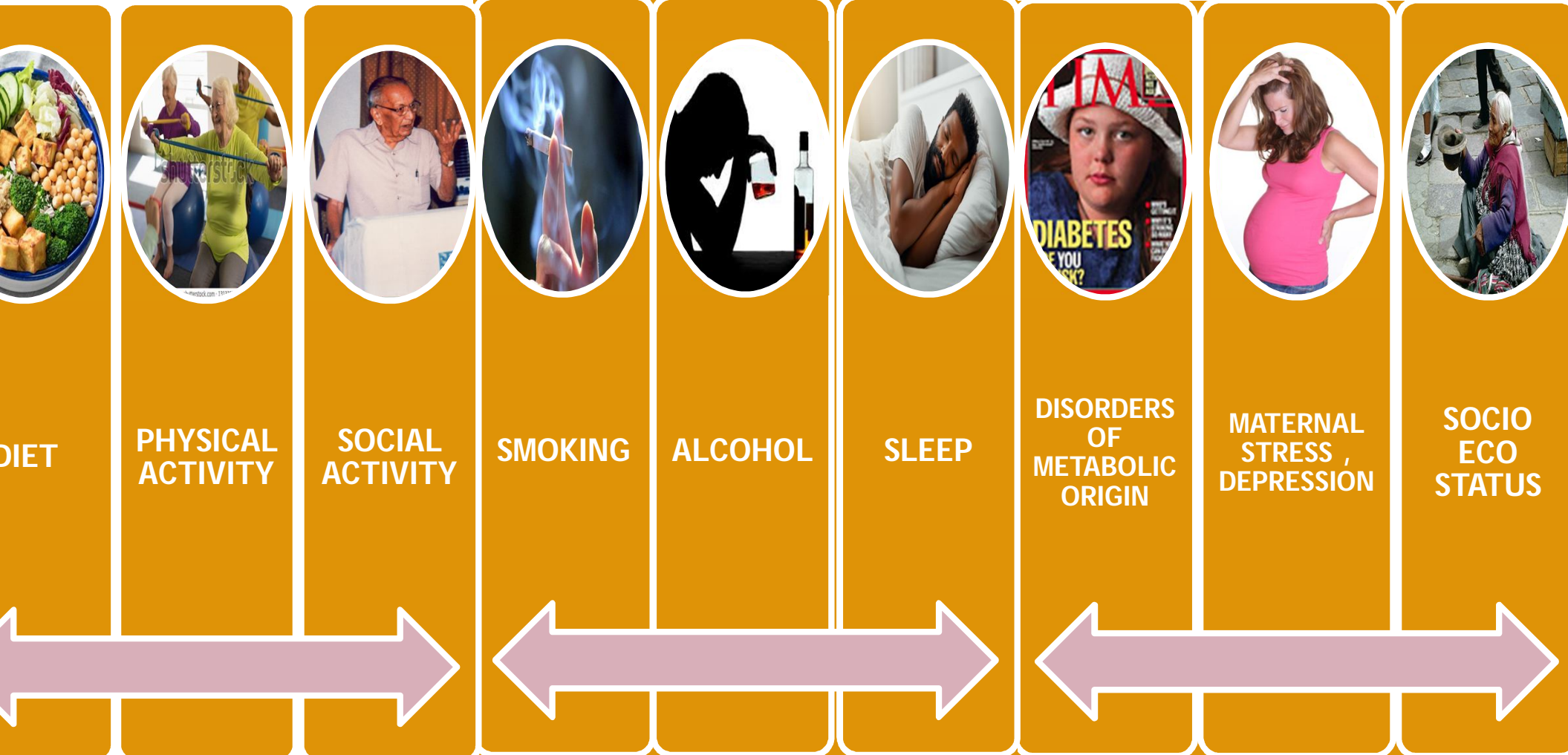
- ◉ Brain health refers to how well a person's brain functions in the domains of cognitive health involving motor, emotional and tactile functions
- ◉ According to Hendrie et al (2006), "cognitive health is the development and preservation of the multidimensional cognitive structure that allows older people to maintain social connectedness, an ongoing sense of purpose and the abilities to function independently, to permit functional recovery from illness or injury, and to cope with residual functional deficits"

BRAIN DYNAMICS IN HEALTHY AND UNHEALTHY AGING



Source: Freitas et al, 2017

LIFESTYLE RISK FACTORS



DIET & DIETARY PATTERNS

Mediterranean diet

- ◉ Key features of the diet: Crusty breads, rice, legumes & beans, seeds, fishes & seafood, goats cheese & yoghurt, vegetables & fruits, herbs, olive oil, red wine (diluted with water) Chicken, fish and eggs are consumed few times a week; red meats are not consumed more than few times in a month
- ◉ Low in saturated fat & animal protein, high in MUFAs, carbohydrates & fibre, antioxidants & phytochemicals
- ◉ Studies have also showed that this diet is linked with better cognitive function, a low risk of cognitive decline and reduced risk of dementia including Alzheimer's



Solfrizzi and Panza, 2014; Woodside et al, 2014, Lourida et al, 2013

DIET & DIETARY PATTERNS

Mediterranean-DASH (Dietary Approaches to Stop Hypertension) Intervention for Neurodegenerative Delay (MIND diet)

At least 3 serving of whole grains, salad, GLVs, a glass of wine, and nuts everyday; beans every other day, poultry and berries twice a week and fish once a week

Significant associations between MIND diet and slower cognitive decline

Strict compliance - approx 53% lower risk of Alzheimer's
Moderate compliance - 35% lower risk

Another study reported improved verbal memory score over six years, but no associations were obtained on the cognitive decline

Berendsen et al, 2018; Morris et al, 2015



GUT AND BRAIN HEALTH

- The GIT communicates with the CNS through the gut-brain axis to support neuronal development and maintenance
- Probiotics may not only support a healthier gut, but a healthier brain too
- Probiotics may help boost mood and cognitive function and lower stress and anxiety
- Probiotics prevent many harmful effects of aging such as decreased neurotransmitter levels, chronic inflammation, oxidative stress and apoptosis—all factors that are proven aggravators of neurodegenerative disease

Westfall et al, 2017



UTRIENTS

Protein

- **Pre-clinical models of early life malnutrition indicate that protein or protein-energy restriction results in smaller brains with reduced RNA and DNA contents, fewer neurons, simpler dendritic and synaptic head architecture, and reduced concentrations of neurotransmitters and growth factors**

Winick, 1985; Wiggins et al, 1984

PUFAs

- **A high intake of omega-6 fatty acids adversely impacts cognition by depleting DHA**
- **In contrast, a low omega- 6/3 ratio predicts better cognitive function in healthy older people**
- **A dose-response meta-analysis showed that an increment of 100 g per week of fish intake was associated with an 11% lower risk of AD**

Andruchow et al, 2017; Wu et al, 2015; Sheppard and Cheatham, 2013

NUTRIENTS

Vitamin D

- Serum 25-hydroxyvitamin D (25(OH)D) levels are lower in those with impaired cognitive function and AD than healthy controls (Goodwill and Szoeki, 2017)

Iron

- Iron is necessary for normal anatomic development of the fetal brain, myelination, and the development and function of the dopamine, serotonin, and norepinephrine systems
- Iron also modifies the epigenetic landscape of the brain (Tran et al, 2015; Greminger et al, 2014; Lozoff et al, 2006)

Zinc

- Preclinical models indicate that zinc is necessary for normal neurogenesis and migration, myelination, synaptogenesis, regulation of neurotransmitter release in GABA-ergic neuron and ERK1/2 signaling (Adamo and Oteiza, 2010)

Iodine

- Behavioral abnormalities range from global abnormalities in severe deficiency to poorer learning and memory, sensory gating, and increased anxiety in milder deficiency (Navarro et al, 2015)

PHYSICAL ACTIVITY/ EXERCISE

- Physical exercise could provide a widely available and cost-effective approach to reduce age related cognitive decline at a large scale
- Prospective studies show that low fitness in early adulthood is associated with increased risk for early onset dementia later in life
- In individuals at the age of 75 years, a higher level of physical activity was associated with better memory performance and with greater volumes of both total brain and white matter

Nyberg et al, 2014; Wendell et al, 2014; Benedict et al, 2013; Baker et al, 2010; Erickson et al, 2009

THE BRAIN BENEFITS OF EXERCISE



INCREASES PRODUCTION OF NEUROCHEMICALS THAT PROMOTE BRAIN CELL REPAIR



IMPROVES MEMORY



LENGTHENS ATTENTION SPAN



BOOSTS DECISION-MAKING SKILLS



PROMPTS GROWTH OF NEW NERVE CELLS AND BLOOD VESSELS



IMPROVES MULTI-TASKING AND PLANNING



PHYSICAL ACTIVITY/ EXERCISE

- Physical activity increases brain volume of individuals from all ages
- Higher aerobic fitness level was related to higher hippocampal volume and better memory performance in older non-demented individuals, older individuals in the earliest stages of AD, and in preadolescent children
- RCTs have shown that even acute bouts of exercise can provide small benefits to cognition
- Recent meta-analyses have indicated that longer duration exercise interventions can enhance cognition in healthy people >50 years of age as well as individuals at risk of or diagnosed with AD

Northey et al, 2018; Panza et al, 2018; Morris et al, 2017; Chang et al, 2012; Chaddock et al, 2010; Erickson et al, 2009

MODE OF EXERCISE

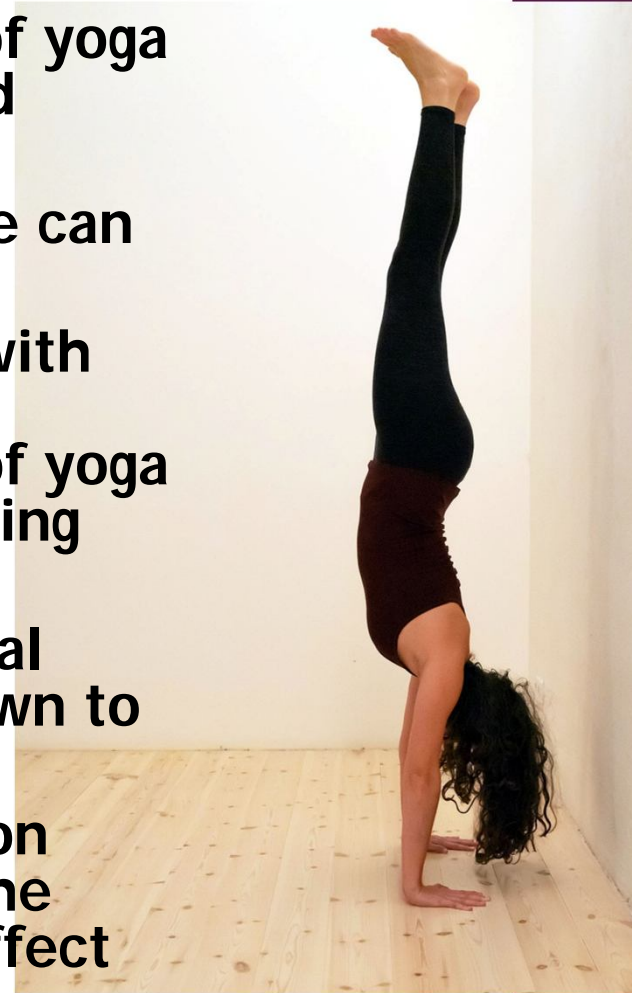
- ◉ Aerobic exercise is beneficial to cognitive functioning
- ◉ Resistance training improves cognition
- ◉ Multicomponent training (both aerobic and resistance) improves cognitive functions
- ◉ Tai-chi (non-traditional modes of exercise) improved cognitive function in older adults



Northey et al, 2018; Maass et al, 2015

YOGA

- ◉ Considerable evidence exists for the beneficial effects of yoga on mental health including anxiety, stress depression and overall mental health
- ◉ Behavioral mind-body interventions such as yoga practice can affect the anatomy of the brain
- ◉ Yoga practice showed a consistent positive relationship with measures of brain structure (i.e. GM volume, GM density, cortical thickness), such that regions showing an effect of yoga practice were greater in experts or had more gain following intervention
- ◉ A majority of the studies highlight changes in hippocampal volume following yoga practice. The hippocampus is known to be critically involved in learning and memory processes
- ◉ While the nature of yoga's relationship with brain function seems less straightforward than it does with structure, the evidence still points toward yoga exerting a beneficial effect on brain function



Gothe et al, 2019

MEDITATION

- ◉ In a 2012 study, researchers compared brain images from 50 adults who meditate and 50 adults who don't meditate. Results suggested that people who practiced meditation for many years have more folds in the outer layer of the brain. This process (gyrification) may increase the brain's ability to process information
- ◉ A 2013 review of three studies suggests that meditation may slow, stall, or even reverse changes that take place in the brain due to normal aging
- ◉ Research about meditation's ability to reduce pain has produced mixed results. However, in some studies scientists suggest that meditation activates certain areas of the brain in response to pain

<https://www.nccih.nih.gov/health/meditation-in-depth>

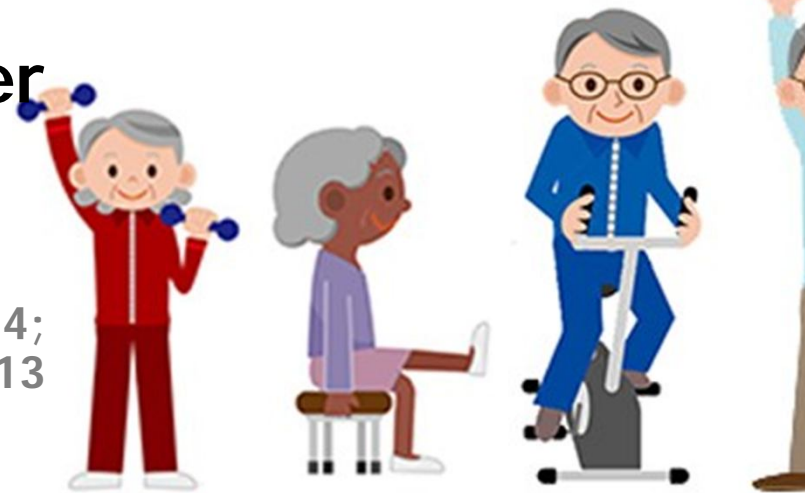


EXERCISE PRESCRIPTION

Duration: Exercise of between 45 and 60 min in duration, of moderate or vigorous intensity and of any frequency or length is beneficial to cognitive function

Frequency: Exercise interventions of 4-6 months' duration that have used resistance or multimodal programmes, incorporating resistance training, have indicated that, in older people, a frequency of two sessions per week can benefit cognition

Northey et al, 2018; Fiatarone et al, 2014; Vaughan et al, 2014; Nagamatsu et al, 2013



MENTAL ACTIVITY

- **Bronx 20-year longitudinal Aging Study - self-reported crossword puzzle use was associated with a 2.54 year delay in dementia onset, which suggests that mentally stimulating activities may help delay the onset of symptoms, but on their own cannot prevent dementia**
- **Those who did word or number puzzles at least once a month showed significantly better performance across all cognitive domains including attention compared to those who never used them**
- **Participants who did word puzzles had higher scores on measures of grammatical reasoning, while those who did number puzzles had higher scores on measures of executive functions, which includes activities such as organizing and planning**
- **Since the magnitude of overall cognitive improvement was similar for either type of puzzle, participating in a brain engaging activity on a regular basis may be more important than the specific type of activity**
- **Although there is a large body of evidence suggesting that cognitive training can improve reasoning, memory, and speed of processing, the validity of these connections has yet to be documented in large randomized control trials.**

Mintzer et al, 2019; Pillai et al, 2011

KEEPING MENTALLY ACTIVE

- ◉ **Cognitively stimulating activities are defined as mentally engaging activities or exercises that challenge a person's ability to think and process information.**
- ◉ **These include mindteaser games, educational activities, intellectual inquiries, and mental challenges**
- ◉ **Playing board games, solving puzzles may help middle aged and elderly people keep their memories sharp**
- ◉ **Those who regularly play games such as chess and bingo are more likely to have maintained their thinking skills**
- ◉ **It is important to note that no specific "brain game" or "brain exercise" has shown to be effective on brain health**



Deary, 2019

SOCIAL ACTIVITY

- ◉ **Social isolation and subjective loneliness** are risk factors for cognitive impairment and dementia among older people
- ◉ **Active social engagement**, including contact with family and friends and **positive social support and engagement in leisure activities** have beneficial effects for preventing cognitive impairment and dementia
- ◉ **Conversation time** was an important predictive factor for MMSE score and longer durations of conversation time (more than 321.1min) exerted a negative effect on cognitive function among older people

Kimura et al, 2019; Kuiper et al, 2015; Marioni et al, 2015; Fratiglioni et al, 2004



SMOKING

- ◉ **Smoking increased the rate of cognitive decline in middle-aged males in comparison to non-smokers or female smokers**
- ◉ **Smokers were found to have 30% increased likelihood to develop dementia in a meta-analysis of prospective cohort studies**
- ◉ **Chronic smoking in adults is associated with accelerated age-related brain volume loss**

Durazzo et al 2017; Zhong et al, 2015; Sabia et al, 2012

POLLUTION

In elderly, exposure to higher levels of fine air pollutants may cause decline in memory which leads to Alzheimer's-disease like brain damage

Researchers found that fine particles i.e. PM_{2.5} which come from traffic exhaust, smoke and dust remain airborne for long periods, get inside buildings, be inhaled easily, and reach and accumulate in the brain

With an increase of 2.81 ug/m³ of PM_{2.5}, the annual memory decline rate was accelerated by 19.3 %



Fine particle pollution is associated with asthma, cardiovascular disease, lung disease and premature death (Petkus,2019)

ALCOHOL CONSUMPTION

- ◉ Prolonged alcohol exposure can result in a wide range of adaptive responses of neurons, changes in brain function, and significant brain damage
- ◉ Reduced cortical connectivity contribute to decline in cognitive abilities associated with heavy alcohol consumption
- ◉ A cohort study revealed participants who did not drink alcohol and those who drank alcohol frequently at midlife were twice as likely to have MCI more than those who drank alcohol infrequently
- ◉ However, no significant association was found between alcohol intake and the incidence of MCI in another 2 cohort studies

Hui et al, 2019; Shokri-Kojori et al 2017; Sutherland et al, 2014

SLEEP

- ◉ Sleep is important for brain plasticity and memory consolidation
- ◉ Sleep disturbance is a common problem for older people as well as patients with MCI and dementia
- ◉ Longer sleep duration may increase the risk of dementia, function as an early symptom of dementia, or be associated with sleep disorder-related breathing and smoking habits

Spira et al, 2017; da Silva, 2015; Benito-León et al, 2014; Abel et al, 2013



"If you have trouble falling asleep, lick your feet for a few minutes. It works for my cat!"

DISORDERS OF METABOLIC ORIGIN

- ◉ **Insulin resistance and type 2 diabetes** shown to predict the development of aging-related diseases and a preserved insulin action is strongly associated with longevity
- ◉ AD development and symptoms are closely related to an insulin-resistant brain state, and type 2 diabetes mellitus is a risk factor for dementia and AD
- ◉ Intranasal insulin therapy in patients with AD or mild cognitive impairment has been associated with improvement in cognitive function

Craft et al, 2017; Bertram et al, 2016; Claxton et al, 2015; Akintola and van Heemst, 2015

MATERNAL STRESS

- Maternal stress can adversely affect the brain even during the prenatal stage
- Maternal stress found enmeshed in the poverty environment collectively affects brain development in terms of type and extent of cognitive deficits that are determined by
 - the timing (sensitive periods: when environmental influences have maximum effect on brain and behavioural development during specific ages),
 - co-occurring and cumulative influences (duration and extent of cumulative risks), and
 - differential reactivity (moderated by infant characteristics)
- In poverty situations, risks often co-exist and also persist, exposing children to multiple and cumulative hardships during their growing years

Walker et al, 2011; Talge et al, 2007

MATERNAL DEPRESSION

- ◉ **Maternal depression can increase the risk of low birth weight, stunting and result in insecure emotional attachment**
- ◉ **Maternal depressive symptoms are negatively associated with early child development, stunting and poor quality of parent- child interaction across different cultures and socio economic groups**
- ◉ **It can occur due to several risk factors that include poverty, low education, high stress, lack of empowerment, and poor social support**

Black et al, 2009;Cooper et al, 2009;Wachs et al, 2009

SOCIO-ECONOMIC STATUS (SES)

- ◉ **SES is composed of education ,occupation, social status and wealth of families that affect their ability to purchase and consume the goods and services that are essential for health, wellbeing and identification with the community**
- ◉ **Poverty, food insecurity and malnutrition are linked directly to nutritional deficiencies, which adversely affect learning and result in developmental deficits among vulnerable infants and toddlers**
- ◉ **Education and learning enhance cognitive reserves, making an individual less susceptible to the effects of age or disease-related brain changes**
- ◉ **Several studies on healthy aging have reported that individuals with a low educational level have an accentuated decline in memory, verbal skills and functional level**
- ◉ **Continuous cognitive stimulation throughout life, including formal education, engagement in cognitively stimulating activities and occupation can result in protection against age-related cognitive decline and reduce the risk of developing Alzheimer's disease**

Baldivia et al, 2008;Cook et al, 2008, Weinreb et al, 2002

SOCIO-ECONOMIC STATUS (SES)

- ◉ **Occupation - complexity of work and amount of time spent working under pressure were related to reduced risk of developing cognitive impairment three years later and that this relationship was independent of age**
- ◉ **A classical study by Stern et al (1999) indicated that higher lifetime educational level and occupation (e.g. manager, professional, technician) were associated with a reduced risk for incident dementia, in contrast to lower educational level and occupation (e.g. unskilled, semiskilled skilled trade, clerical/office worker)**
- ◉ **Occupation could be a better long-term predictor of cognitive decline than education. Despite the fact that occupation and education level have synergistic effects, occupation represents an indicator of social class and socioeconomic inequalities**

OPTIMIZING THE COGNITIVE HEALTH OF INDIVIDUALS AND SOCIETIES

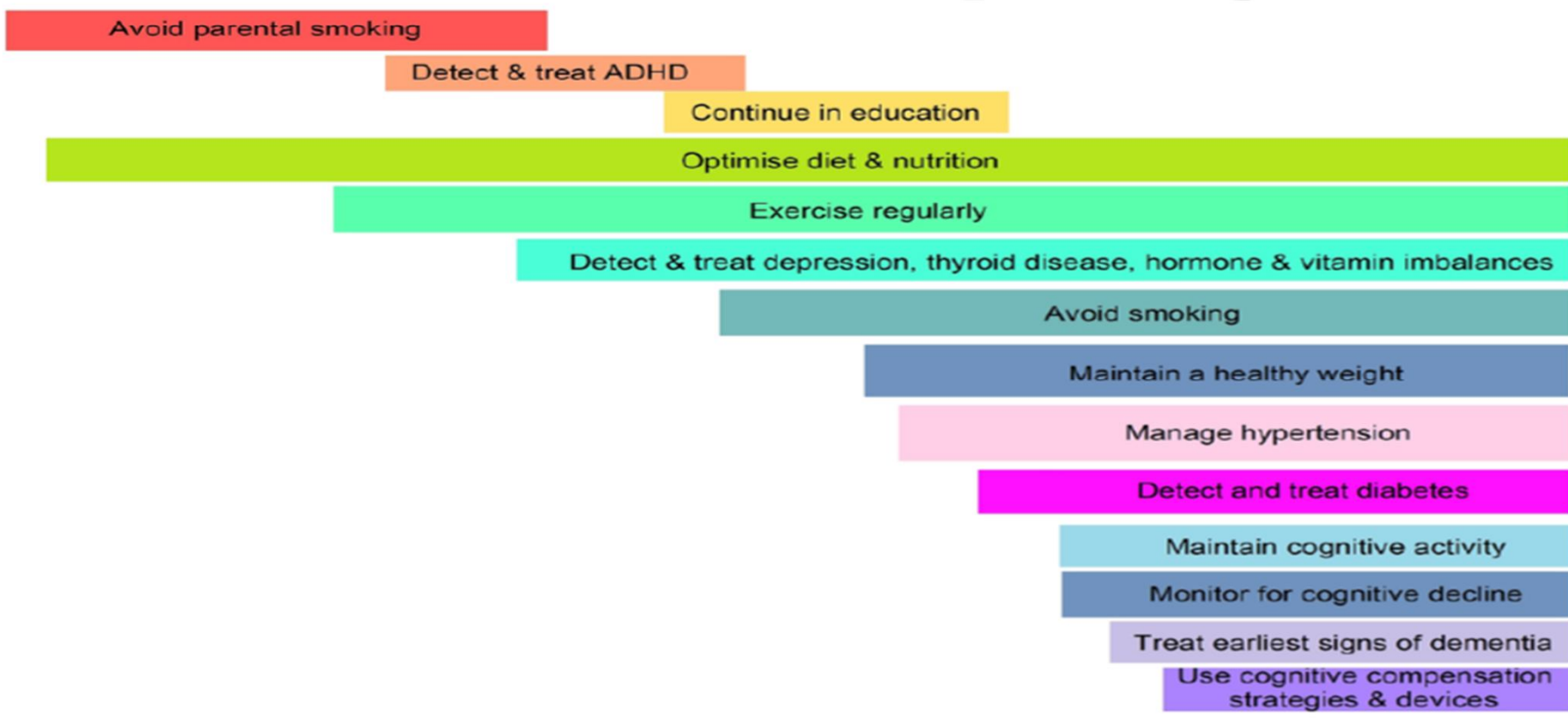
- Throughout life, many potentially treatable or reversible causes of cognitive impairment can occur. If not detected, these conditions may have long term consequences for cognitive health.
 - Among children, disorders such as attention deficit hyperactivity disorder (ADHD) and dyslexia impair specific cognitive functions that can considerably impact a child's educational attainment
 - Among adults, reversible causes of cognitive impairment can include stress, sleep deprivation, drug and alcohol use, depression, thyroid disease, and vitamin deficiencies
- To maximize the cognitive health of the population it is therefore important that cognitive function is monitored throughout life, so that any changes can be detected and, where appropriate, treated

Barnett et al, 2013

PREVENTION

- ◉ **Strategies might include the optimizing of diet through neonatal periods as well as later in life, further reducing behaviors such as smoking, which may be directly or indirectly harmful to cognitive health, and the early detection and treatment of reversible causes of cognitive impairment throughout life.**
- ◉ **Given the potential burden of dementia on society, it should be a public health priority to educate both clinicians and the population to understand that risk for dementia is driven by lifestyle choices as well as genetic predisposition.**
- ◉ **The modifiable factors that most predict risk for dementia are conditions (obesity, hypertension, diabetes), or lifestyle factors (diet, cognitive and physical activity, smoking cessation)**

Barnett et al, 2013



Preventing dementia throughout life

Source: Barnett et al, 2013

ACKNOWLEDGEMENTS

ILSI India for supporting the Review on Lifestyle and Brain Health

**Ms Majida Shaheen, Senior Research Fellow,
Institute of Home Economics for contributing to
the presentation**