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COGNITIVE DECLINE AND LIFESTYLE FACTORS

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ABSTRACT

The development of cognitive decline that comes with old age including mild cognitive impairment (MCI) and Alzheimer's disease (AD) is subject to many different psychological and lifestyle incidences. The purpose of this review is to emphasize the role of personality traits, mood states, and lifestyle habits in brain health and behavior. Key brain regions impacted by Alzheimer's disease such as the hippocampus central to memory are particularly sensitive to these influences. Studies show traits such as extraversion, openness to experience, and conscientiousness can boost cognitive function. They do so through more social interactions and physical activities, lifestyle, and cognitive engagement. On the contrary, feelings of sadness, stress, loneliness and so on, which are negative in nature are linked with less activity and withdrawal from social life. Also, these cause cognitive decline faster and the risk for mild cognitive impairment (MCI) and Alzheimer's disease (AD) is on the rise. The review highlights how mood and personality alter behavior as well as cognitive aging in interconnected ways. This narrative review synthesizes findings from observational, longitudinal, and clinical studies to evaluate how lifestyle, mood, and personality traits influence cognitive aging. Older models of cognitive decline focused on things like age and health. But now studies show social factors and certain behaviors matter too. Attributing importance to early identification of mood and personality related factors for intervention. Learning how these variables contribute to brain aging can help develop therapy aids to slow or prevent age-related disorders and improve cognitive reserves in older life.

KEYWORDS: Cognitive Decline, Alzheimer's Disease, Personality Traits, Lifestyle, Mood Disorders.

1. INTRODUCTION

Cognitive decline in old age can arise as part of a range of neurological disorders termed dementia, a term describing gradual and progressive deterioration in cognition (1). Alzheimer's disease (AD) is the most common form of dementia, accounting for 60–80% of all dementia cases (2). There are many predisposing factors underlying the onset and progression of cognitive decline in old age, MCI, and AD (3). These factors include age, being female, genetics (APOE4 allele), brain pathology (e.g. plaques and tangles), metabolic disorders (e.g. diabetes), and vascular risk factors (e.g. hypertension). Changes in cognition accompany aging, and such changes in normal aging can be reflective of, or co-occur with, disease mechanisms leading to dementia (1). It is important to consider cognitive decline in old age in terms of neurodegenerative and neuroplasticity models already discussed (3).

Despite widely held beliefs that cognitive decline in old age results from cognitive reserve being exhausted, resistive memory training efforts in old age have not demonstrated significant effectiveness (4). Researchers have therefore turned their attention to understanding the factors that affect why some older adults desegregate early or late into dementia during which cognitive decline in old age is initially or predominantly revealed in memory (4). A number of factors strongly influencing the individual aetiology, development, and progression are now considered (5). These factors include personality traits, mood states (both positively and negatively valence), and lifestyle factors (6). The factors discussed herein affect the behaviour of older adults and also have physiological consequences on the brain, including changes in brain structure, function, and connectivity that have the potential naively, or otherwise, to influence cognition and the trajectory of aged cognition (6).

Herein, a review of research addressing personality, mood, and lifestyle factors underlying cognitive decline in old age is provided, with the effects of the factors discussed and mechanisms by which the factors are thought to be involved in influencing brain and behavior detailed (7). Also considered will be whether or not greater investigation into such factors is warranted, including questions as to the degree to which these factors vary across individuals, if they are modifiable, and whether or not such factors drive cognitive decline in older adults, particularly late-onset AD, neurodegenerative disease models involving the onset of cognition-related, primarily hippocampal, atrophy and loss of memory function in old age (8). Finally, it is hoped that this review will spark an initial interest amongst other researchers in behavioural and brain changes in old age, and a call to arms amongst concerned parties (therapists, family, and older adults themselves collectively) in addressing such factors at a younger age, thus ameliorating risk factors for neurodegenerative disease (9). This review differs from previous literature by combining biomedical, psychological, and lifestyle-based dimensions into a unified narrative framework of cognitive health in older adults.

2. UNDERSTANDING COGNITIVE DECLINE

Cognitive decline encompasses challenges in concentration, memory retention, decision-making abilities, spatial perception, language skills, and self-care functions (10). The memory of recent events and tasks is affected more frequently (10). Short-term memory difficulties are usually the first sign of dire cognitive decline (11). In addition, attention problems, misplaced objects, and word-finding issues are early signs of this decline (10). In the subsequent stages, such decline will more likely manifest itself as an inability to comprehend newly-formed memories, extra-ordinary mood swings, mental wandering, difficulty in interpreting visual input, and loss of initiative (12). At the terminal stages of this decline, apathy over the surrounding world, inability to recognize family and friends, total loss of communicative capability, bodily functions loss, and total dependence on others will appear and intensify (12). Pathologies such as a vascular incident resulting in infarction or hemorrhage to parts of the brain generate cognitive profile changes (13). However, such changes are not gradual; rather, they are sudden and severe events followed by periods of near-normal functions (13). This discovery provoked considerable research efforts to understand the mechanisms underlying the typical gradual decline (1).

Like other bodily functions, cognition could be expected to decline with aging. The pattern of this decline describes a smooth curve extending from an early adult period of rapid increase, peaking in middle age, and declining from then on (14). The average ages of dementia onset are 72.9, 83.8, and 91.9 for mild, moderate, and severe degrees of dementia (15). Individuals, who tend to be highly educated, use sophisticated vocabulary, present good language expression of thoughts and ideas, and

have complex sentence structure tend to develop dementia at an age 17 later than usual (16). The rapid cognitive decline is correlated with the basal forebrain depletion of cholinergic projections (15). However, in normal aging, the metabolic adaptations in this pathway seem to yield a lithium-like strategic-only deficit mode of operation (16). These deep, persistent changes may form a homeostatic mechanism rendering activity not dependent on damage but rather on the time elapsed (17). Other factors such as lifestyle, nutrition, hormone replacement, exercise, genetic polymorphism, and body composition could contribute to the rate of this decline and to the degree of cognitive reserve (17).

2.1. The Role of Genetics in Cognitive Health

With the recent aging of human populations, research interest in cognitive decline in old age and Alzheimer's disease (AD) has been increasing (18). Particularly, the contribution of the hippocampal system to memory cognitive decline in normal and abnormal aging is a focus of research (19). An early and prevalent cognitive symptom in AD is episodic memory impairment; interference with hippocampally-dependent memory processes leads to this anterograde amnesia (18). The hippocampus is the major area affected by AD pathophysiological conditions and is thought to be the key area mediating cognitive impairment (20). The early and protracted decline of episodic memory among other cognitive domains was also corroborated and linked to the hippocampus by vascular dementia and subcortical damage research (1).

Episodic memory is a long-term memory mode of particular events related to a specific spatio-temporal context and is the ability to recall a specific event that occurred in the past (21). It depends on network connections between the temporal lobe, association region, and the hippocampus, where event traces are constructed, processed into long-term memory, stored, and integrated with existing memories for subsequent retrieval (22). Memory recall generates neurophysiological reactivation of the original event and replay it in temporal proximity (21). Patients with hippocampal lesions could explicitly retain some memories, however could not create new ones, indicating that eco-support suppresses some neurodegenerative conditions (23). Age effect on cognitive decline in episodic memory dominates other cognitive domains, and event cognition and recall difficulties are the earliest complaints of pathology in normal and abnormal aging (24).

Cognitive abilities are essential for successfully navigating aging and have been shown to be highly heritable (25). Thus, genetics can provide insight into individual differences in cognitive decline trajectories (26). However, genetic influences are often small; thus, gene format in polygenic scores (GPS) has become widely used (27). GPS aggregating across thousands of variants explain a substantial portion of the population variance in intelligence and with far larger effect sizes than single SNPs (26). Due to the availability of large biobanks and advances in computing power, GPS-based PheWAS is available to leverage diverse health outcomes against genetic risk factors (28). To understand the biological basis and clinical significance of cognitive capacity GPS risk factors, this study assessed the genetic influence of cognitive abilities on cognitive decline phenotypes relevant to aging 70 (29). In this study, estimates of polygenic scores for general cognitive abilities, known to be associated with later-life cognitive decline, were computed (29). Seven widely used longitudinal cognitive tests and well-known phenotypes were analyzed to assess the association of cognitive capacity GPS with initial level and change in cognitive health (28).

2.2. Impact of Nutrition on Cognitive Function

The aging of world populations leads to an increase in cognitive decline, and dementia represents a serious public health challenge in both developed and developing countries (12). Harmonized estimates indicate that 47 million people had dementia in 2015, with estimates of 75 million in 2030 and 131 million in 2050 (13). However, considerable variations exist between countries (13). Consequently, the investigation of factors that can prevent or delay the onset of dementia is urgently needed (30). Compelling evidence shows that adequate nutrition plays a critical role in maintaining cognitive health and preventing cognitive decline (30). Among other contributors, diet composition could merit specific attention, as diet is one of the lifestyle factors that can be modified through education, campaigns, and communication strategies (31). Over the last decade, research on nutrition and cognition has shifted focus from single components to dietary pattern analyses (32). As no single food or nutrient can prevent dementia, combinations of foods and/or nutrients may exert a synergistic effect and, thus, be more effective (32).

Research studies focusing on food groups and dietary patterns that promote optimal brain health should be encouraged (33). Dietary patterns that have been found beneficial include the Mediterranean diet, the DASH diet, and the MIND diet (33). The MedDiet has high intakes of fruit,

vegetables, fish, legumes, nuts, and cereals, with low quantities of dairy products, meat, and saturated fats (34). It has neuroprotective nutrients, including omega-3 fatty acids, folate, polyphenols, and antioxidants (35). Further research in other countries is warranted, particularly in Australia, New Zealand, and Oceania (34). Population studies in Oceania suggest that these patterns may assist cognitive health and ameliorate age-related cognitive decline (33). On top of diet, essential lifestyle factors include physical activity, sleep quality, keeping cognitively and socially active (35). Aspects of lifestyle are modifiable, and numerous positive lifestyle factors are strongly predictive of dementia and cognitive decline (35). Education, mental and physical exercise, and absence of history of diabetes and hypertension are the strongest (36). Public health campaigns using different strategies, from general education to interactive approaches, could promote positive lifestyles (36).

2.3. Physical Activity and Brain Health

Physical activity is an influential lifestyle factor in predicting rates of cognitive decline and the subsequent development of age-related neurodegenerative diseases such as Alzheimer's disease (37). In a study of an older adult cohort who were free from cognitive impairment at baseline, women who reported being physically active at any point over the life course were significantly less likely to be cognitively impaired in late life than those who were never active (37). A prospective study measured cognitive function of an older adult population at baseline and subsequently (38). Over 8 years, 30% of the participants maintained cognitive function, 53% showed minor decline and 16% had major cognitive decline (38). The maintainers were more likely to engage in moderate to vigorous exercise compared to cognitive decliners (38). Neuroprotective effects of physical activity were also found (39). Regular exercise is associated with a delay in the onset of dementia and Alzheimer's disease (39). In particular, a reduced incidence rate of dementia was reported for persons who exercised three or more times a week compared with those who exercised fewer than three times per week (21). Subsequently, actigraphy was employed to obtain an objective measure of total daily physical activity (40). Participants in the lowest physical activity percentiles had more than twofold higher risk of developing Alzheimer's disease compared to participants in the highest physical activity percentiles (40). Several neuroimaging studies also suggested a protective role of physical activity in preventing age-related decline related to brain atrophy (40).

2.4. Social Engagement and Cognitive Resilience

Growing evidence suggests that social engagement has the potential to foster cognitive resilience (41). Whereas the commonly used terms "social engagement" or "social involvement" can refer to a broad array of interconnected constructs, including social networks, social support, and social participation, the current background concentrates on the latter two aptly termed "social participation" (42). Taken together, the social relationships that make up one's social network might be viewed as the structure of one's social engagement, whereas social support and social participation constitute the function of one's social engagement (41).

Different aspects of social engagement, including living alone, having contacts with friends and relatives, participation in organizations, and participation in leisure activities, are negatively associated with the development of dementia and cognitive decline (43). A multi-domain social engagement score encompassing social participation, support, and activity frequency was predictive of both lower current cognitive ability and cognitive decline over a period of 10 years in older age (44). This association remained significant after controlling for a host of potential confounders (44).

Decreased cognition may lead to lower levels of social engagement, but cross-lagged data showed that decreased social club attendance predicted higher losses in generalized cognitive ability over 5 years (45). To provide a framework to assess the relationship between social engagement and cognitive ability, a two-dimensional model is proposed characterizing the degree of social engagement on a spectrum ranging between isolated (that is, no social interactions) and wholly immersed (that is, highly socially engaged) (16). The degree of social engagement might be construed as the direct effect on cognition through social facilitation or might indirectly modulate the rate of cognitive ability decline through lifestyle changes (46).

2.5. Mental Stimulation and Cognitive Preservation

Research has long supported the idea that people who regularly engage in mental stimulation, such as reading, playing crossword puzzles, doing arithmetic problems, and playing games like chess or bridge, are less likely to develop AD (38). A large portion of the literature on this subject has involved observing relationships between retrospective

assessments of lifetime intellectual engagement activities and comparisons of DM and nondemented individuals (38). Though these studies show adequately that DM participants engage in fewer cognitively stimulating activities, the relatively small number of participants, the difficulty in gathering required information about lifetime engagement activities, and the study designs do not clearly specify the nature of the experiences that may lead someone to develop better cognitive skills or resilience to age-related cognitive decline (47).

2.6. Sleep Quality and Cognitive Performance

Considerable evidence indicates sufficient and high-quality sleep benefits cognition. Sleep remains critical for well-being across all ages, and age-related changes in sleep have been documented (48). In particular, older adults show a reduction in total sleep time and an increase in awakenings after sleep onset, and the quality of sleep tends to decline. Older adults report worse sleep quality compared to young people (48). Aging is also associated with cognitive changes, including the decline of memory and information processing speed (49). The quantity and quality of sleep may act as moderators for cognitive aging (49). Longitudinal data show that adequate and high-quality sleep promote cognitive health, whereas increased sleep fragmentation is associated with a higher rate of cognitive decline (50). However, some studies have not shown associations between subjective sleep quality and global cognition, whereas others have indicated an association between low-quality sleep and decline in processing speed and decreased executive function (50). The lack of a uniform set of cognitive measures across studies may make it challenging to compare findings (51). Subjective memory complaints are found to predict future cognitive impairment and dementia, and a few studies have examined the possible connection between poor sleep and memory dysfunction (51). Given the inconsistent findings in the literature regarding sleep quality and cognitive performance, the association between subjective sleep measures and the specific aspects of neurocognitive performance and self-reported memory in a sample of non-demented middle-aged and older adults with subjective memory complaints is examined (52).

The quality of sleep is self-reported via the Pittsburgh Sleep Quality Index (PSQI), a 19-item questionnaire assessing sleep quality over the past month (53). It consists of seven discrete components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction (a score ≥ 5 across seven components indicates poor sleep) (53). Given the lack of a uniform definition of sleep quality in the literature, two PSQI items assessing the subjective feeling of sleep quality and use of sleep medications are also examined (54). Neurocognitive performance is assessed using a neurocognitive battery including measures of attention and processing speed, executive function, immediate and delayed memory, and visual memory. This neurocognitive battery is semi-structured and consists of the following tests: The Color Trails Test, the Stroop Test, the immediate and delayed Recall Trial of the Rey Auditory Verbal Learning Test, a modified version of the Bangalore Test and the Complex Figure test (55). Self-reported memory is measured using the Memory Functioning Questionnaire (55).

3. STRESS MANAGEMENT AND COGNITIVE FUNCTION

Despite the inherent limitations of patient education, cognitive decline is generally gradual in its emergence (41). Those in the early stages of a neurodegenerative condition may have good insight into their impairments, despite not being functionally impaired (56). They may benefit from resources addressing potential changes in their own mood or capabilities, as well as in those of their loved ones (57). Providing families with resources to lessen the distress of living with a neurodegenerative disease is an obvious practical use (157). Providing services such as home health care, educational materials on the course of various disorders, and caregiver support groups may lessen the stress on families of MCI or AD patients (56). This may be an important issue, as having the capacity to manage or cope with a negative event can determine whether that event is seen as threatening or stressful and encourages proactivity in one's life in return (58). Potential stressors, the impact of those stressors, and coping mechanisms vary by cultural background (58). Males are generally more prone to engage in a fight-or-flight response, while females are thought to be more prone to utilize social support and are at greater risk for stress-induced disorders (59).

3.1. Substance Use: Alcohol and Tobacco

The relationship between alcohol, tobacco use, and cognitive decline in aging adults is a current area of research (60). Alcohol use is challenging to study in aging populations because of factors like age, cohort, time, and the difficulty of measuring an appropriate temporal window (61). Alcohol use is a

major global cause of preventable disease and is linked with substantial levels of cognitive impairment in global studies (61). Since alcohol declines sharply in older adults, the amount of alcohol required to fill the typical U-shaped relationship likely correlates with lower perceived impairment (62). Therefore, alcohol may have a significant role in predicting longitudinal cognitive impairment (62). This was examined through longitudinal modeling of growth trajectories to investigate how alcohol use relates to subsequent cognitive decline in older adults, taking into account socio-demographic factors, smoking behavior, and physical health at baseline (63). Results indicate that drinking levels are related to subsequent cognitive decline, with lower rates more predictive of persistent cognitive impairment (64). Cognitive impairment is associated with a substantial healthcare burden, leading to studies on modifiable risk factors, including tobacco and alcohol use (63). Cigarette smoking is known to have profound effects on cardiovascular, respiratory, and cancer outcomes. Since adverse health effects tend to follow later in life, multiple studies are attempting to determine when illness onset occurs (64). Cognitive decline in aging is a precursor to broad neurodegeneration, leading to paradoxical research questions (65). How does cigarette smoking, negative impacts on vasculature, and systemic inflammation correlate with cognitive outcomes in older adults? It increasingly appears that links do exist (65). Several variables are involved in the relationship between smoking and cognitive decline (66). Previous literature has used these restrictions extensively, leading to bifurcated literature without allowing explicit modeling of the lifetime impacts of smoking on cognition (66). This is remedied using an approach, whereby they are able to more flexibly estimate the necessity of smoking to a fitted model of cognitive decline (60).

3.2. Chronic Diseases and Their Cognitive Effects

Many chronic diseases, including systemic diseases, and chronic neurological disorders are early and current models for the study of cognitive impairment to untangle the effects of age and disease on cognition (67). The cognitive effects of important chronic diseases, such as systemic inflammation, cerebral inflammation, and chronic stress, are discussed (67). Several notable chronic conditions potentially culminating in an inflammatory state compatible with cognitive deterioration have emerged from the ongoing effort (68). A big project has been launched to set up a cohort of 10,000 cognitively normal individuals aged between 60 and 75 who will be followed every year for 15 years (68). This cohort is designed to test data on serum, CSF, genes, neuroimaging, and cognition (69). Hope is that the combination of known and new factors with advanced imaging and chemical techniques will provide some idea of how the neural system works in health and early disease, just as certain work has provided pathogenic insight in the blood vascular system, leading to new therapies (69). This project, along with many others, is welcomed and should be supported by the scientific community (70). The description of prospects for revealing more and better cognitive biomarkers for early pre-clinical trials and clinical trials is a strong point of the presentation, and many will agree that the greatest needs are in that area (70).

Nonetheless, one major omission is the chronic effects of chronic illnesses on cognition from a macro perspective linking aging to disease and eventual ensuing cognitive impairment (71). This is unfortunate since understanding chronicity and its effects are more essential to society in general, as countless lives may be lost before significant neurosystems, brain parenchyma, and cognition are affected (72). The advancement of understanding with cognitive neuroscience and neuroimaging must be supplemented with expanding enlightenment on how these diseased processes produce cognitive decline (10). Herein is a simple overview of how major chronic diseases lead to cognitive impairment (72). While conventional considerations of cognitive impairment mainly look at heavy and overt acute insults, cognitive degeneration is pervasive and is hoped to be less impossible to highlight the importance of cognitive impairment (73). While very few of these chronic diseases initially considered cognitive impairment, by the time cognitive decline is severe, these chronic diseases will inevitably be found to be the cause (74). Over the years, the chronic conditions would be seen progressively accumulating evidence of cognitive involvement, in breadth as comprising memory, attention, executive function, language, and other non-specific features as affectation and disinterests (74).

3.3. The Aging Process and Cognitive Decline

Cognitive decline is closely linked to the aging process, which involves a multitude of changes in social, emotional, biochemical, physiological, and cognitive processes (75). Each person's aging trajectory is marked by individual variability, due to the wide range and interactive effects of these changes (76). Some risk factors can negatively

influence cognitive performance (75). Changes in cognitive functions also shape the aging process. Having a moderate-based cognitive performance upon retirement is desirable (76). Better cognitive performance is linked with continued involvement in cognitively demanding work and leisure activities, involvement in physically demanding leisure activity, and post-retirement engagement in new leisure activities. At the same time, some established leisure activity patterns can be vulnerable to cognitive decline (77).

As women, minority groups, and individuals with low education levels have less access to cognitively complex work and leisure activities, the life course issue refers to the fact that the individuals who contributed the most to their cognitive reserve may also be the ones most at risk for cognitive decline (78). On the other hand, those individuals with low educational levels may have fewer cognitive activities engaging in activities (78). A close examination of between- and within-group differences in social, emotional, and cognitive characteristics, along with work and leisure activity engagement patterns, might shed light on the question of vulnerability (79). Changes in cognitive reserve, mood, motivation, and health can influence the aging process (79). These cognitive, emotional, health, and functional self-evaluative changes are captured in multiple domains and levels (80). Different trajectories need to be examined with respect to their associations with changes in work and leisure activity participation (80).

3.4. Cultural Factors Influencing Cognitive Health

As an alternative approach, necessary life-style changes include nutrition (diet), fitness (exercise and sleep), and the care and company of family, friends, and caregivers (81). Nutrition for non-Alzheimer's individuals includes healthy eating plans such as the Mediterranean Diet rich in fish, fruit, vegetables, and whole grains, and/or DASH Diet as well as the ability to cook the meals (81). Main foods to limit are refined carbohydrates, sugar, red meat, saturated fat, and cholesterol (82). Fitness includes exercise (walking, swimming, cycling and golf) and sleep (medication, tea, therapies, sleep hygiene, habit, and/or exercise) (82). Last but not least, the care and company of family, friends, and caregivers as close and regular Social Contact Protective Social Network are vital (1).

The effect of culture on cognitive decline is a very broad field of research that is yet to be fully investigated (63). Therefore, only some specific directions in socio-cultural embodiments that may be good candidates for future investigation regarding Alzheimer's Disease and Cognitive Decline are presented (77). Many factors may come from cultural environments. These could be classified into two classes: positive and negative (83). Positive factors affect gradually towards improving or maintaining cognitive functions while negative factors may accelerate decline (83). It is also important to consider individuals' passive behavior (84). Trying to quantify healthy lifestyles by giving the amount of exercise, sleep, and social activity would be the most straightforward approach (84). Each item could be scored by a valid instrument, adding up, and conduct statistical analyses by employing this summary score as a covariate (85). However, this accounts for passive behavior regarding cognitive decline and fails to measure cognitive-promoting lifestyle in active ways (85).

3.5. Interventions for Reducing Cognitive Decline

More than 99% of the randomized controlled trials (RCTs) published to date on lifestyle interventions are single domain interventions which focus on selected lifestyle factors (86). This article briefly describes the lifestyle factors against which the selected multi-domain non-pharmacological lifestyle interventions were compared in the lifestyle intervention studies (87). To examine the effectiveness of diverse types of multi-domain non-pharmacological lifestyle interventions, sound reasoning and hypotheses have been developed (86). The biomarkers, measurement tools, and statistics that were employed to assess the feasibility and adherence of the interventions and the potential prevention of cognitive decline have been indicated (87). Cognitive decline is a multidimensional construct that represents a general slowing down of cognitive activity (88). Although the cognitive factors that comprise it are almost always not correlated, they nevertheless need to be measured and mimicked by different tasks (88). Current biomarkers of early warm memory impairment include some neuropsychological assessments, neuroimaging, and blood biomarkers (89).

A questionnaire measuring mean living place satisfaction, changeable and unchangeable leisure and community activity, mobility and travel, social contacts and conversations, and worry and anxiety was designed to measure prospectively the effects of pre-existing environmental, social, and lifestyle factors on cognitive decline (90). Physical activity explains both the development of Alzheimer's

disease pathology and the preventive effect of lifestyle factors against dementia (91). Both pre-existing and newly learned cognitive activities predict a reduced risk of dementia and improved global cognition over time (92). Leisure and community activities and taking part in educational and discussion groups predict a reduced risk of incident dementia (91). In a cross-sectional cohort study, food consumption frequency tests were co-related both insertionally (physical characteristics) and semantically including spoken and written communication styles, and access to news programs, views, and printed sources of information being all significant in global cognition (91).

4. THE ROLE OF TECHNOLOGY IN COGNITIVE HEALTH

Cognitive decline, a gradual deterioration of cognitive performance, is a highly prevalent health issue among the aging population posing significant concerns for individuals and society (93). Cognitive decline is also a major risk factor of disability and death, and may serve as a precursor of dementia (93). Understanding the risk factors of cognitive decline is crucial for the design of preventive interventions (94). Evidence from past years suggests that lifestyle factors are related to cognitive decline (94). However, these findings were mainly based on single process-level factors (95). This is the first study to investigate the association of lifestyle factors with the trajectory of cognitive decline in the largest population-based cohort study (95). In particular, it quantified the relative contributions of multiple lifestyle factors to cognitive decline, and further investigated the differential effects of lifestyle factors by cognitive function levels and across different population subgroups, which provided greater insights for future preventative strategies (96).

Digital devices can provide a platform of cognitively stimulating activities which might help to slow cognitive decline during the process of normal aging (97). Increased use of the setting of personal activity website reminders can enhance large size cognitive reserve by buffering cognitive decline in the very elderly, and thus decrease risk of dementia (98). In addition, greater use of websites for socially connected activities could enhance participation in upward social comparison activity, reduce depression and loneliness, and thus increase cognitive resilience from the neuropathology burden related to cognitive decline in the very elderly (97). Thus it's imperative to identify the characteristics of those who are less likely to own digital devices, for preventive measures and public health campaigns (99). Given the rapid pace and heavy societal cost of cognitive decline across the globe, this growing health problem is an urgent need to be addressed (98).

4.1. Community Support and Cognitive Well-Being

The increase in life expectancy of the world's population is predicted to accelerate the increase in the number of elderly, and thus the number of patients with dementia (100). Dementia is an irreversible impairment of cognitive function such as memory (101). Behavioral and psychological symptoms of dementia are associated with cognitive decline, which leads to a heavy burden not only on the patient, but also on his or her family, nurse, supporter, and society (100). For those who reach 85 years of age or older, the likelihood of suffering from dementia increases to approximately 30% (101). In 2005, the number of people with dementia worldwide was estimated to be 35.5 million, and it is projected to exceed 82 million by 2030 (102). Behavioral symptoms of dementia and decline of cognitive function greatly contribute to disability, health problems, and social care needs among older people (102). Because there is no current cure for dementia, there is increasing interest in the identification of modifiable factors that may contribute to the delay or prevention of the onset of dementia and cognitive decline among older people (103).

Dementia, which is a disorder, is widely regarded as undesirable (104). It is assumed that, given a choice, many people would prefer to die rather than become demented (104). The World Health Organization's policy framework on active aging states that good health, social participation, and security are key factors that contribute to active aging (11). In relation to cognitive decline or the onset of dementia, which is the opposite of good health, social relationships are another key factor of active aging (104). A wealth of knowledge from longitudinal epidemiological studies has suggested that a rich social relationship is protective of cognitive decline or the onset of dementia (33). In older people whose social relationships are rich, the chances of cognitive activity increase, and low mood, which is also linked to the onset of disorder, is prevented (103). Social support can be defined as an exchange between persons and is embedded in people's social networks (105). Previous studies have suggested that social support has protective effects against cognitive decline and dementia onset (105). As a health supportive factor, friends and acquaintances (other

than members of the family) are important in addition to family (especially spouses and adult children) (100). The effect of family support on health and psychology may be beneficial in general, but there is heterogeneity in families with respect to social support (106).

4.2. Prevention Strategies for Cognitive Decline

Scientists and health professionals have long been looking for ways to reduce cognitive decline as people age (107). A major cause of cognitive decline is Alzheimer disease (107). Although there are drugs that can slow the progression of the disease, they are only effective at the mild cognitive impairment stage (108). There is, therefore, a great need for non-pharmacological, lifestyle changes that can delay the onset of Alzheimer's disease even further (108). For those who are later in life with healthy cognitive function, the ideal situation is to adopt certain lifestyle habits that can make a difference (109). At present, the medical community largely recommends changes in diet, physical activity, cognitive stimulation, and social engagement to promote brain health and prevent the onset of dementia in older adults (110). Recommendations include engaging in cognitively stimulating activities, maintaining a healthy diet, and preserving good social engagement (110). Public attention is often focused on the risk factors for developing cognitive decline. Unfortunately, many studies usually examine only one lifestyle factor in relation to cognition or use only one measure of cognition, limiting interpretation (111). This has led to a focus on the right choices individuals must make for dementia prevention, whereas factors affecting one's ability to make the right choices have received little attention thus far (111). For their part, the big□data risk factors probed by machine learning put emphasis on public health interventions to reduce the incidence of dementia (112). However, legal interventions in extreme cases, promoting individuals to make good choices in collective health, and addressing the social structure of health inequality have also received little exploration (112). To gain deeper insight into positive influencing factors for lifestyle changes, other academic fields and their methodologies should be examined (113). The intuitive content analyses of motivational interviewing have already been applied to the dementia field with promising results (113). Content analyses serve to uncover the underlying structure of a certain phenomenon and guide future development (114). It has also been suggested that consequential ethical questions regarding the acceptance and usage of machine learning remain vastly under□explored (114).

4.3. Case Studies: Successful Lifestyle Changes

While long-term studies will be difficult to find for many of the lifestyle changes recommended above, a few case studies highlight how these changes have positively affected those suffering from conditions producing cognitive decline (115). It should be noted that the ideas may not apply to all cognitive decline situations, but these examples show that these lifestyle changes can make a huge difference in some cases (115).

For example, in (116), a 45-year-old high-income woman from London reported memory loss. She was a senior manager at a telecommunications firm when she first observed forgetting special codes at work, misplacing personal items, and struggling to remember names of new acquaintances (116). Reversal by medication was not an option for her type of cognitive decline (116). Instead, she addressed several lifestyle recommendations: dietary change, improved sleep management, and learning relaxing breathing techniques (116). Using cooking blogs and clearing her diet of all processed foods made cooking a fun hobby and lessened irritability (116). Moreover, sleep became prioritized, with a gas night exposure strategy to ensure all screens were off before sleeping (116). Finally, taking regularly scheduled time to read a relaxing book, away from screens, and practicing breathing techniques significantly improved her mental health and memory. At age 55 these symptoms still recurred periodically, but they were tremendously diminished in severity and frequency with these interventions (116).

In the same study, another case was highlighted concerning a 49-year-old woman who, after complaining that she was stressed and forgetfulness, showed increased fatigue and anger (116). Conventional medication for this decline was ruled out again. Several recommendations were pursued: a commitment to mindfully take 10 minutes of happiness-inspiring time every morning, introduce physical activity to, among other things, spend some time with her family, and an investigation into nutrition for some supplements affecting stress. The person was relieved to find after a while that there were indeed possible methods to address this. At age 55, these lifestyle changes made a grand difference: less forgetfulness and irritability, happier family relationships, and an additional measure of personal wellness with a more active life (116).

Both of these cases demonstrate the overall effectiveness of many recommended lifestyle

changes, including diet, sleep, physical activity, and other habits. While every instance of cognitive decline is different, simple lifestyle changes can offer significant help when medications are not an option (116).

4.4. Public Awareness and Education

Concern over memory impairment is one of the main reasons for older people to consult their physicians; however, low awareness of dementia risk factors among the general population has previously been reported (15). Public campaigns to raise awareness of both the positive and negative factors for dementia risk are needed (33). Alzheimer's disease is a progressive neurodegenerative disease and the most common cause of dementia worldwide with a massive impact on the person, families, communities, and health care systems (66). Depending on the diagnostic criteria applied, the prevalence in developed countries is approximately 3-5% among people aged 65 years and older, increasing to up to 25-30% among those aged 85 years and older (117). Alarming reports predict an increase in prevalence to 270 million by 2050 owing to global population aging, highlighting the urgent need for effective prevention and intervention strategies (117). Recently, the concept that lifestyle factors might affect the risk of dementia has gained increasing recognition (118). A growing number of epidemiological studies on vascular and nonvascular risk and protective factors covering midlife and late life came to consensus (118). Twelve modifiable risk factors including low education, hypertension, smoking, obesity, a sedentary lifestyle, diabetes, and depression might account for 40% of the worldwide dementia cases (119). Populations in Low and Middle-Income Countries will bear the heavy burden of age-related insults including dementia in the coming decades yet lack awareness (120). A limited number of recent studies examined the associations of dementia risk factors with public awareness and perceptions of dementia and concluded that most of the general populations have low awareness of dementia risk factors (121). Lack of awareness is associated with the risk factors and few networks and contact with a healthcare professional (120). National and subnational campaigns to raise awareness of risk factors for dementia are urgently needed. Most dementia risk factors have not yet been less well-known compared to risk factors (122). Public awareness and education programs incorporating both riskless and risk factors were warranted considering cultural differences (121). Differential effects by education levels and contact with physicians should be emphasized for effective public campaigns targeting the general population (122).

4.5. Recommendations for Individuals

The relationship between lifestyle factors and cognitive decline, dementia risk, and behavior has gained wide acceptance with growing epidemiological evidence (12). This has led to several public health initiatives to promote healthy activities or behaviors in middle-aged and older individuals to reduce the risk of cognitive decline or dementia (46). However, there are crucial gaps in knowledge regarding the precise relationships between specific lifestyle and risk factors, as well as in addressing clinical and research implications (27). The epidemiological literature has focused on several social and behavioral factors with associations to risk of cognitive decline or dementia: physical exercise or activity, mental stimulation, social engagement, sleep, diet, moderate alcohol consumption, and others (123). This research has provided strong evidence to support a potential role of these modifiable factors in the risk of cognitive decline or dementia (123). However, there are important limitations. Most literature has focused on identifying binary or continuous risk factors, without discussing how or under what conditions the factors may exert their influence (123). This has implications for public health promotion efforts (124). There would be little benefit, for example, in having an individual who very rarely engages in physical activity suddenly begin a very vigorous exercise program designed for elite athletes (125). Such knowledge gaps limit the applicability of the literature to efforts in intervention or prevention of cognitive decline or dementia (125).

See Table 1 below.

Table: Summary of Lifestyle Factors and Their Association with Cognitive Decline

Implications for Practice:

- Promote early lifestyle interventions in middle age.
- Encourage cognitive and social engagement in routine elder care.
- Integrate behavioral assessments into cognitive screening.
- Develop public campaigns targeting modifiable lifestyle risks

5. CONCLUSION

A better understanding of cognitive decline and its risk and protective factors could lead to more effective preventive interventions, and possibly also targets for future therapeutically interventions (126).

Findings highlight that there is no one-size-fits-all lifestyle approach with respect to cognitive outcomes (126). Future research could examine which combination of lifestyle factors is effective for whom, including a more in-depth exploration of the reasons behind lifestyle changes (127). It was very recently shown that knowledge on lifestyle and cognition has increased, although there is still a need to inform and tailor content to a more general audience, even amongst self-selected participants in studies (127). The content of the interventions is expected to fill the current gap between knowledge and behavior (128). Moreover, a greater emphasis on community interventions could be useful, to further raise awareness about lifestyle choices in a more informal setting (128). In describing factors determining development or prevention of cognitive decline, future studies may include more nuance and cognate health and lifestyle outcomes (129). It was consistently found that in order to encourage participants to make changes to their diet, physical activity or alcohol consumption, interventions need to be targeted more directly to one behavior (129). Group-level studies found some indication that there is some knowledge on lifestyle behaviour effects on cognition, and that it varies by domain (130). Interventions must be preceded by research examining what works and what does not (130). Further research may consider a broader result measure, such as change in motivation, intention, or other (131). Participants value early-stage preventive interventions that provide screening opportunities, possibly in combination with health inspiring preventive information (131). The results suggest that these preventive interventions could be optimally tailored, involving individuals who are at greater risk of cognitive decline, are middle-aged, or have less education (132). State-of-the-art persuasive techniques could also be integrated to boost engagement or interaction. Cognitive health screening and motivational counselling on improving cognitive, emotional or lifestyle domains in a prevention-oriented manner is novel, and could aid knowledge transfer to professionals in related fields (132).

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REFERENCES

A. Kline S, S. Mega M. Stress-Induced Neurodegeneration: The Potential for Coping as Neuroprotective Therapy. 2020. Ncbi.nlm.nih.gov

Abbott S, Smith E, Tighe B, Lycett D. Group versus one□to□one multi□component lifestyle interventions for weight management: a systematic review and meta□analysis of randomised controlled trials. Journal of Human Nutrition and Dietetics. 2021 Jun; 34(3):485-93. coventry.ac.uk

Abubakar MB, Sanusi KO, Ugusman A, Mohamed W, Kamal H, Ibrahim NH, Khoo CS, Kumar J. Alzheimer's disease: an update and insights into pathophysiology. Frontiers in aging neuroscience. 2022 Mar 30; 14:742408. frontiersin.org

Alfeo F, Lanciano T, Abbatantuono C, Gintili G, De Caro MF, Curci A, Taurisano P. Cognitive, emotional, and Daily Functioning domains involved in decision-making among patients with mild cognitive impairment: a systematic review. Brain sciences. 2024 Mar 14; 14(3):278. mdpi.com

Alvares Pereira G, Silva Nunes MV, Alzola P, Contador I. Cognitive reserve and brain maintenance in aging and dementia: An integrative review. Applied Neuropsychology: Adult. 2022 Nov 2; 29(6):1615-25. [HTML]

Aonuma R, Mayers T, Mizukami K, Aonuma K, Matsuda H. Factors Associated with Volunteer activities and Sleep Efficiency in older adults with Hypertension: a sequential model study. Geriatrics. 2021 Sep 11;6(3):89. mdpi.com

Arora S, Santiago JA, Bernstein M, Potashkin JA. Diet and lifestyle impact the development and progression of Alzheimer's dementia. Frontiers in nutrition. 2023 Jun 29; 10:1213223. frontiersin.org

Bachmann D, Buchmann A, Studer S, Saake A, Rauen K, Zuber I, Gruber E, Nitsch RM, Hock C, Gietl A, Treyer V. Age-, sex-, and pathology-related variability in brain structure and cognition. Translational psychiatry. 2023 Aug 14; 13(1):278. nature.com

Barakat S, McLean SA, Bryant E, Le A, Marks P, Touyz S, Maguire S. Risk factors for eating disorders: findings from a rapid review. Journal of eating disorders. 2023 Jan 17; 11(1):8. springer.com

Behl T, Kaur I, Sehgal A, Singh S, Albarrati A, Albratty M, Najmi A, Meraya AM, Bungau S. The road to precision medicine: Eliminating the "One Size Fits All" approach in Alzheimer's disease. Biomedicine

& Pharmacotherapy. 2022 Sep 1; 153:113337. sciencedirect.com
Benatar M, Wuu J, McHutchison C, Postuma RB, Boeve BF, Petersen R, Ross CA, Rosen H, Arias JJ, Fradette S, McDermott MP. Preventing amyotrophic lateral sclerosis: insights from pre-symptomatic neurodegenerative diseases. Brain. 2022 Jan 1; 145(1):27-44. oup.com
Bir SC, Khan MW, Javalkar V, Toledo EG, Kelley RE. Emerging concepts in vascular dementia: a review. Journal of Stroke and Cerebrovascular Diseases. 2021 Aug 1; 30(8):105864. sciencedirect.com
Blazer D. The Importance of Social Risk Factors for Cognitive Decline. The American Journal of Geriatric Psychiatry. 2024. [HTML]
Bogucka A, Kotkowiak A, Knychalska K, Łabuda M, Sowińska T, Szema A, Mentel O, Słojewska A, Sikora J, Królikowska K. The Role of Diet, Physical Activity, and Lifestyle in Alzheimer's Disease Prevention: A Literature Review. Journal of Education, Health and Sport. 2025 May 9; 80:60011-. umk.pl
Brito DV, Esteves F, Rajado AT, Silva N, Araújo I, Bragança J, Castelo-Branco P, Nóbrega C. Assessing cognitive decline in the aging brain: lessons from rodent and human studies. npj Aging. 2023 Oct 19; 9(1):23. nature.com
Buçinca Z, Malaya MB, Gajos KZ. To trust or to think: cognitive forcing functions can reduce overreliance on AI in AI-assisted decision-making. Proceedings of the ACM on Human-computer Interaction. 2021 Apr 22; 5(CSCW1):1-21. [PDF]
Buckinx F, Aubertin-Leheudre M. Nutrition to prevent or treat cognitive impairment in older adults: a GRADE recommendation. The journal of prevention of Alzheimer's disease. 2021 Jan 1; 8(1):110-6. sciencedirect.com
Cadar D, Pikhart H, Mishra G, Stephen A et al. The Role of Lifestyle Behaviors on 20-Year Cognitive Decline. 2012. Ncbi.nlm.nih.gov
Castro R, Ribeiro-Alves M, Oliveira C, Romero CP, Perazzo H, Simjanoski M, Kapciznki F, Balanzá-Martínez V, De Boni RB. What are we measuring when we evaluate digital interventions for improving lifestyle? A scoping meta-review. Frontiers in public health. 2022 Jan 3; 9:735624. frontiersin.org
CHIEFFI S, MESSINA A, MONDA M, Messina G et al. Neuroprotective Effects of Physical Activity: Evidence from Human and Animal Studies. 2017. [PDF]
Coon DW, Gómez-Morales A. Modifiable risk factors for brain health and dementia and opportunities for intervention: a brief review. Clinical Gerontologist. 2023. [HTML]
Czaja SJ, Moxley JH, Rogers WA. Social support, isolation, loneliness, and health among older adults in the PRISM randomized controlled trial. Frontiers in psychology. 2021. Frontiersin.org
Dalile B, Kim C, Challinor A, Geurts L, Gibney ER, Galdos MV, La Fata G, Layé S, Mathers JC, Vauzour D, Verkuyl JM. The EAT–Lancet reference diet and cognitive function across the life course. The Lancet Planetary Health. 2022 Sep 1;6(9):e749-59. thelancet.com
de Frutos Lucas J, Sewell KR, García-Colomo A, Markovic S, Erickson KI, Brown BM. How does apolipoprotein E genotype influence the relationship between physical activity and Alzheimer's disease risk? A novel integrative model. Alzheimer's research & therapy. 2023 Jan 27; 15(1):22. springer.com
Dingle SE, Milte CM, Daly RM, Torres SJ. Attitudes and considerations for multidomain lifestyle approaches to dementia prevention: a qualitative study. Journal of Alzheimer's Disease. 2024 Jan 16; 97(2):939-49. [HTML]
Dominguez LJ, Veronese N, Vernuccio L, Catanese G, Inzerillo F, Salemi G, Barbagallo M. Nutrition, physical activity, and other lifestyle factors in the prevention of cognitive decline and dementia. Nutrients. 2021 Nov 15; 13(11):4080. mdpi.com
Duffy JF, Wang W, Ronda JM, Czeisler CA. High dose melatonin increases sleep duration during nighttime and daytime sleep episodes in older adults. Journal of pineal research. 2022 Aug; 73(1):e12801. nih.gov
E. Marioni R, Proust-Lima C, Amieva H, Brayne C et al. Cognitive lifestyle jointly predicts longitudinal cognitive decline and mortality risk. 2014. Ncbi.nlm.nih.gov
Edinoff AN, Nix CA, Hollier J, Sagrera CE, Delacroix BM, Abubakar T, Cornett EM, Kaye AM, Kaye AD. Benzodiazepines: uses, dangers, and clinical considerations. Neurology international. 2021 Nov 10; 13(4):594-607. mdpi.com
Ellis RJ, Marquine MJ, Kaul M, Fields JA, Schlachetzki JC. Mechanisms underlying HIV-associated cognitive impairment and emerging therapies for its management. Nature Reviews Neurology. 2023 Nov; 19(11):668-87. nih.gov
Erickson KI, Donofry SD, Sewell KR, Brown BM, Stillman CM. Cognitive aging and the promise of physical

activity. Annual Review of Clinical Psychology. 2022 May 9; 18(1):417-42. annualreviews.org
F Hughes T. The Role of Lifestyle Factors in Cognitive Aging and Dementia. 2008. [PDF]
Fekete M, Szarvas Z, Fazekas-Pongor V, Feher A, Csipo T, Forrai J, Dosa N, Peterfi A, Lehoczki A, Tarantini S, Varga JT. Nutrition strategies promoting healthy aging: from improvement of cardiovascular and brain health to prevention of age-associated diseases. Nutrients. 2022 Dec 22; 15(1):47. mdpi.com
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García-Morales V, González-Acedo A, Melguizo-Rodríguez L, Pardo-Moreno T, Costela-Ruiz VJ, Montiel-Troya M, Ramos-Rodríguez JJ. Current understanding of the physiopathology, diagnosis and therapeutic approach to Alzheimer's disease. Biomedicines. 2021 Dec 14; 9(12):1910. mdpi.com
Ghodeshwar GK, Dube A, Khobragade D, Dube AH. Impact of lifestyle modifications on cardiovascular health: a narrative review. Cureus. 2023. Cureus.com
Gonzalez-Latapi P, Bayram E, Litvan I, Marras C. Cognitive impairment in Parkinson's disease: epidemiology, clinical profile, protective and risk factors. Behavioral Sciences. 2021. Mdpi.com
Gottesman RF, Seshadri S. Risk factors, lifestyle behaviors, and vascular brain health. Stroke. 2022. Ahajournals.org
Govindugari VL, Golla S, Reddy SD, Chunduri A, Nunna LS, Madasu J, Shamshabad V, Bandela M, Suryadevara V. Thwarting Alzheimer's disease through healthy lifestyle habits: hope for the future. Neurology International. 2023 Jan 28; 15(1):162-87. mdpi.com
Guo S, Zheng XY. New evidence of trends in cognitive function among middle-aged and older adults in China, 2011-2018: an age-period-cohort analysis. BMC geriatrics. 2023. Springer.com
Hansdottir H, Jonsdottir MK, Fisher DE, Eiriksdottir G, Jonsson PV, Gudnason V. Creativity, leisure activities, social engagement and cognitive impairment: the AGES-Reykjavík study. Aging Clinical and Experimental Research. 2022 May; 34(5):1027-35. [HTML]
Harriden B, D'Cunha NM, Kellett J, Isbel S, Panagiotakos DB, Naumovski N. Are dietary patterns becoming more processed? The effects of different dietary patterns on cognition: A review. Nutrition and Health. 2022 Sep; 28(3):341-56. [HTML]
Hill NL, Bhargava S, Brown MJ, Kim H, Bhang I, Mullin K, Phillips K, Mogle J. Cognitive complaints in age-related chronic conditions: A systematic review. PLoS One. 2021 Jul 7; 16(7):e0253795. plos.org
Hou J, Jiang H, Han Y, Huang R, Gao X, Feng W, Guo Z. Lifestyle influence on mild cognitive impairment progression: a decision tree prediction model study. Neuropsychiatric disease and treatment. 2024 Dec 31:271-80. tandfonline.com
Huang YY, Chen SD, Leng XY, Kuo K, Wang ZT, Cui M, Tan L, Wang K, Dong Q, Yu JT. Post-stroke cognitive impairment: epidemiology, risk factors, and management. Journal of Alzheimer's Disease. 2022 Apr 5; 86(3):983-99. [HTML]
Iraniparast M, Shi Y, Wu Y, Zeng L, Maxwell CJ, Kryscio RJ, St John PD, SantaCruz KS, Tyas SL. Cognitive reserve and mild cognitive impairment: predictors and rates of reversion to intact cognition vs progression to dementia. Neurology. 2022 Mar 15; 98(11):e1114-23. neurology.org
Ismail Z, McGirr A, Gill S, Hu S, Forkert ND, Smith EE. Mild behavioral impairment and subjective cognitive decline predict cognitive and functional decline. Journal of Alzheimer's disease. 2021 Mar 9;80(1):459-69. sagepub.com
Jiang Q, Liu J, Huang S, Wang XY, Chen X, Liu GH, Ye K, Song W, Masters CL, Wang J, Wang YJ. Antiageing strategy for neurodegenerative diseases: from mechanisms to clinical advances. Signal Transduction and Targeted Therapy. 2025 Mar 10; 10(1):76. nature.com
Jin Y, Jing M, Ma X. Effects of Digital Device Ownership on Cognitive Decline in a Middle-Aged and Elderly Population: Longitudinal Observational Study. 2019. Ncbi.nlm.nih.gov
John A, Ali K, Marsh H, Reddy PH. Can healthy lifestyle reduce disease progression of Alzheimer's during a global pandemic of COVID-19? Ageing Research Reviews. 2021. Nih.gov
Kieckhaefer C, Schilbach L, Bzdok D. Social belonging: brain structure and function is linked to membership in sports teams, religious groups, and social clubs. Cerebral cortex. 2023. Nih.gov
Kong J, Zhou L, Li X, Ren Q. Sleep disorders affect cognitive function in adults: an overview of systematic reviews and meta-analyses. Sleep and biological rhythms. 2023. Nih.gov
Krivanek TJ, Gale SA, McFeeley BM, Nicastri CM, Daffner KR. Promoting successful cognitive aging: a ten-year update. Journal of Alzheimer's Disease. 2021 Jun 1; 81(3):871-920. sagepub.com

Kulmala J, Rosenberg A, Ngandu T, Hemiö K, Tenkula T, Hyytiä A, Vienola M, Huhtamäki-Kuoppala M, Saarinen A, Korkki S, Laatikainen T. Facilitators and barriers to implementing lifestyle intervention programme to prevent cognitive decline. European journal of public health. 2021 Aug 1; 31(4):816-22. oup.com

Lack L, Wright H. Pittsburgh sleep quality index. InEncyclopedia of Quality of Life and Well-Being Research 2024 Feb 11 (pp. 5188-5190). Cham: Springer International Publishing. [HTML]

Lao Y, Hou L, Li J, Hui X, Yan P, Yang K. Association between alcohol intake, mild cognitive impairment and progression to dementia: a dose–response meta-analysis. Aging Clinical and Experimental Research. 2021 May; 33:1175-85. [HTML]

Latino F, Tafuri F. Physical activity and cognitive functioning. Medicina. 2024. Mdpi.com

Lee M, Whitsel E, Avery C, Hughes TM, Griswold ME, Sedaghat S, Gottesman RF, Mosley TH, Heiss G, Lutsey PL. Variation in population attributable fraction of dementia associated with potentially modifiable risk factors by race and ethnicity in the US. JAMA network open. 2022 Jul 1; 5(7):e2219672-. jamanetwork.com

Lehtisalo J, Palmer K, Mangialasche F, Solomon A, Kivipelto M, Ngandu T. Changes in lifestyle, behaviors, and risk factors for cognitive impairment in older persons during the first wave of the coronavirus disease 2019 pandemic in Finland: results from the FINGER study. Frontiers in Psychiatry. 2021 Feb 12; 12:624125. frontiersin.org

Lehtisalo J, Rusanen M, Solomon A, Antikainen R, Laatikainen T, Peltonen M, Strandberg T, Tuomilehto J, Soininen H, Kivipelto M, Ngandu T. Effect of a multi-domain lifestyle intervention on cardiovascular risk in older people: the FINGER trial. European Heart Journal. 2022 Jun 1; 43(21):2054-61. oup.com

Leso V, Fontana L, Caturano A, Vetrani I, Fedele M, Iavicoli I. Impact of shift work and long working hours on worker cognitive functions: current evidence and future research needs. International journal of environmental research and public health. 2021 Jun 17; 18(12):6540. mdpi.com

Li F, Qin W, Zhu M, Jia J. Model-based projection of dementia prevalence in China and worldwide: 2020–2050. Journal of Alzheimer's Disease. 2021. [HTML]

Li X, Feng H, Chen Q. Social participation patterns and associations with subsequent cognitive function in older adults with cognitive impairment: a latent class analysis. Frontiers in Medicine. 2025. Frontiersin.org

Libby P, Smith R, Rubin EJ, Glassberg MK, Farkouh ME, Rosenson RS. Inflammation unites diverse acute and chronic diseases. European Journal of Clinical Investigation. 2024 Nov; 54(11):e14280. [HTML]

Lin FR, Pike JR, Albert MS, Arnold M, Burgard S, Chisolm T, Couper D, Deal JA, Goman AM, Glynn NW, Gmelin T. Hearing intervention versus health education control to reduce cognitive decline in older adults with hearing loss in the USA (ACHIEVE): a multicentre, randomised controlled trial. The Lancet. 2023 Sep 2; 402(10404):786-97. thelancet.com

Lisko I, Kulmala J, Annetorp M, Ngandu T, Mangialasche F, Kivipelto M. How can dementia and disability be prevented in older adults: where are we today and where are we going? Journal of internal medicine. 2021 Jun; 289(6):807-30. wiley.com

Liss JL, Seleri Assunção S, Cummings J, Atri A, Geldmacher DS, Candela SF, Devanand DP, Fillit HM, Susman J, Mintzer J, Bittner T. Practical recommendations for timely, accurate diagnosis of symptomatic Alzheimer's disease (MCI and dementia) in primary care: a review and synthesis. Journal of internal medicine. 2021 Aug; 290(2):310-34. wiley.com

Liu CR, Liou YM, Jou JH. Ambient bright lighting in the morning improves sleep disturbances of older adults with dementia. Sleep Medicine. 2022. [HTML]

López-Ortiz S, Pinto-Fraga J, Valenzuela PL, Martín-Hernández J, Seisdedos MM, García-López O, Toschi N, Di Giuliano F, Garaci F, Mercuri NB, Nisticò R. Physical exercise and Alzheimer's disease: effects on pathophysiological molecular pathways of the disease. International Journal of Molecular Sciences. 2021 Mar 12; 22(6):2897. mdpi.com

M. Hakim A. A Proposed Hypothesis on Dementia: Inflammation, Small Vessel Disease, and Hypoperfusion Is the Sequence That Links All Harmful Lifestyles to Cognitive Impairment. 2021. Ncbi.nlm.nih.gov

Machado L. Understanding cognition and how it changes with aging, brain disease, and lifestyle choices. Journal of the Royal Society of New Zealand. 2021. Tandfonline.com

MacKillop J, Agabio R, Feldstein Ewing SW, Heilig M, Kelly JF, Leggio L, Lingford-Hughes A, Palmer AA, Parry CD, Ray L, Rehm J. Hazardous drinking and alcohol use disorders. Nature Reviews Disease Primers. 2022 Dec 22; 8(1):80. nih.gov

Margoni M, Preziosa P, Rocca MA, Filippi M. Depressive symptoms, anxiety and cognitive impairment: emerging evidence in multiple sclerosis. Translational psychiatry. 2023. Nature.com

Ma'u E, Cullum S, Cheung G, Livingston G, Mukadam N. Differences in the potential for dementia prevention between major ethnic groups within one country: a cross sectional analysis of population attributable fraction of potentially modifiable risk factors in New Zealand. The Lancet Regional Health–Western Pacific. 2021 Aug 1; 13. thelancet.com

Mazza M, Lisci FM, Brisi C, Traversi G, Gaetani E, Pola R, Marano G. Beyond One-Size-Fits-All: Personalized Medicine and Future Directions in Sex-Based Psychopharmacological Treatment. Future Pharmacology. 2024 Sep 1; 4(3). [HTML]

Medoro A, Davinelli S, Milella L, Willcox BJ, Allsopp RC, Scapagnini G, Willcox DC. Dietary astaxanthin: a promising antioxidant and anti-inflammatory agent for brain aging and adult neurogenesis. Marine Drugs. 2023 Dec 16; 21(12):643. mdpi.com

Meng X, Fang S, Zhang S, Li H, Ma D, Ye Y, Su J, Sun J. Multidomain lifestyle interventions for cognition and the risk of dementia: A systematic review and meta-analysis. International journal of nursing studies. 2022 Jun 1; 130:104236. [HTML]

Mobin A, Obeid A, El□Kebbi I, Everett D, Ibrahim S, Farhat J, Al□Omari B. Beyond one size fits all: Probing patient choices in gestational diabetes management, from screening to postpartum. Chronic Diseases and Translational Medicine. 2025 Mar; 11(1):33-45. wiley.com

Muhammad T, Govindu M, Srivastava S. Relationship between chewing tobacco, smoking, consuming alcohol and cognitive impairment among older adults in India: a cross□sectional study. BMC geriatrics. 2021. Springer.com

Mukherjee U, Sehar U, Brownell M, Reddy PH. Mechanisms, consequences and role of interventions for sleep deprivation: Focus on mild cognitive impairment and Alzheimer's disease in elderly. Ageing Research Reviews. 2024. [HTML]

Mumme KD, Conlon CA, von Hurst PR, Jones B, Haskell-Ramsay CF, de Seymour JV, Stonehouse W, Heath AL, Coad J, Mugridge O, Slade C. Dietary patterns and cognitive function in older New Zealand adults: the REACH study. European journal of nutrition. 2022 Jun; 61(4):1943-56. [HTML]

Nagel AK, Loetscher T, Smith AE, Keage HAD. What do the public really know about dementia and its risk factors? Dementia. 2021. [HTML]

Neumann DL, Piatkowski TM, Moffitt RL, Minahan CL. The mental health of elite athletes in developing nations of the greater Oceania region. Australian Psychologist. 2023 Mar 4; 58(2):94-104. [HTML]

Nijs J, Malfliet A, Roose E, Lahousse A, Van Bogaert W, Johansson E, Runge N, Goossens Z, Labie C, Bilterys T, Van Campenhout J. Personalized multimodal lifestyle intervention as the best-evidenced treatment for chronic pain: state-of-the-art clinical perspective. Journal of clinical medicine. 2024 Jan 23; 13(3):644. mdpi.com

Noguchi T, Nojima I, Inoue-Hirakawa T, Sugiura H. The Association between Social Support Sources and Cognitive Function among Community-Dwelling Older Adults: A One-Year Prospective Study. 2019. Ncbi.nlm.nih.gov

Nogueira J, Gerardo B, Santana I, Simoes MR, Freitas S. The assessment of cognitive reserve: a systematic review of the most used quantitative measurement methods of cognitive reserve for aging. Frontiers in psychology. 2022 Mar 31; 13:847186. frontiersin.org

O'Toole SM, Walker RJ, Garacci E, Dawson AZ, Campbell JA, Egede LE. Explanatory role of sociodemographic, clinical, behavioral, and social factors on cognitive decline in older adults with diabetes. BMC geriatrics. 2022 Dec; 22:1-0. springer.com

Oliveira J, Gamito P, Souto T, Conde R, Ferreira M, Corotnean T, Fernandes A, and Silva H, Neto T. Virtual reality-based cognitive stimulation on people with mild to moderate dementia due to Alzheimer 's disease: a pilot randomized controlled trial. International journal of environmental research and public health. 2021 May 16; 18(10):5290. mdpi.com

Oosterhuis EJ, Slade K, May PJ, Nuttall HE. Toward an understanding of healthy cognitive aging: The importance of lifestyle in cognitive reserve and the scaffolding theory of aging and cognition. The Journals of Gerontology: Series B. 2023 May 1; 78(5):777-88. oup.com

Pahlen S, Stallings M, Corley R, Wadsworth S et al. Consequential Impacts of Tobacco Use on Cognitive Performance. 2021. Ncbi.nlm.nih.gov

Parial LL, Lam SC, Ho JY, Suen LK, Leung AY. Public knowledge of the influence of modifiable cardiovascular

risk factors on dementia: a systematic literature review and meta-analysis. Aging & Mental Health. 2021 Aug 3; 25(8):1395-409. [HTML]

Perry BL, McConnell WR, Coleman ME, Roth AR, Peng S, Apostolova LG. Why the cognitive "fountain of youth" may be upstream: Pathways to dementia risk and resilience through social connectedness. Alzheimer's & Dementia. 2022 May; 18(5):934-41. nih.gov

Proctor AS, Barth A, Holt□Lunstad J. A healthy lifestyle is a social lifestyle: The vital link between social connection and health outcomes. Lifestyle Medicine. 2023. Wiley.com

Purgato M, Singh R, Acarturk C, Cuijpers P. Moving beyond a 'one-size-fits-all'rationale in global mental health: prospects of a precision psychology paradigm. Epidemiology and Psychiatric Sciences. 2021 Jan; 30:e63. cambridge.org

Puri S, Shaheen M, Grover B. Nutrition and cognitive health: A life course approach. Frontiers in public health. 2023. Frontiersin.org

Ran LS, Liu WH, Fang YY, Xu SB, Li J, Luo X, Pan DJ, Wang MH, Wang W. Alcohol, coffee and tea intake and the risk of cognitive deficits: a dose–response meta-analysis. Epidemiology and psychiatric sciences. 2021 Jan; 30:e13. cambridge.org

Rao RV, Subramaniam KG, Gregory J, Bredesen AL, Coward C, Okada S, Kelly L, Bredesen DE. Rationale for a multi-factorial approach for the reversal of cognitive decline in Alzheimer's disease and MCI: a review. International Journal of Molecular Sciences. 2023 Jan 14; 24(2):1659. mdpi.com

Rao YL, Ganaraja B, Murlimanju BV, Joy T, Krishnamurthy A, Agrawal A. Hippocampus and its involvement in Alzheimer's disease: a review. 3 Biotech. 2022 Feb; 12(2):55. springer.com

Rayathala J, Kumar K. Review on Alzheimer's disease: Past, present and future. Journal of Innovations in Applied Pharmaceutical Science (JIAPS). 2022 Jan 27:28-31. saapjournals.org

Rodriguez FS, Hofbauer LM, Reppermund S, Samtani S, Röhr S. Updating risk and protective factors for dementia in older adults. Nature Reviews Psychology. 2025 Mar 28:1-4. [HTML]

Sancho-Domingo C, Carballo JL, Coloma-Carmona A, Buysse DJ. Brief version of the Pittsburgh Sleep Quality Index (B-PSQI) and measurement invariance across gender and age in a population-based sample. Psychological assessment. 2021 Feb; 33(2):111. pitt.edu

Scher C, Amano T, Reynolds A, Jia Y. Influences of Having Cognitive Impairment or Dementia on Social Engagement among Older Adults: A Systematic Review. Innovation in Aging. 2023. [HTML]

Shang X, Zhu Z, Wang W, Ha J et al. The association between vision impairment and incidence of dementia and cognitive impairment: a systematic review and meta-analysis. Ophthalmology. 2021. Aaojournal.org

Shanmugasundaram M, Tamilarasu A. The impact of digital technology, social media, and artificial intelligence on cognitive functions: a review. Frontiers in Cognition. 2023. Frontiersin.org

Sharma C, Kim S, Nam Y, Jung UJ, Kim SR. Mitochondrial dysfunction as a driver of cognitive impairment in Alzheimer's disease. International journal of molecular sciences. 2021 May 3; 22(9):4850. mdpi.com

Sherzai D, Sherzai A, Sherzai A. Lifestyle intervention and Alzheimer disease. J Fam Pract. 2022. Lifestylemedicine.org

Siddarth P, Thana-udom K, Ojha R, Merrill D et al. Sleep quality, neurocognitive performance, and memory self-appraisal in middle-aged and older adults with memory complaints. 2020. Ncbi.nlm.nih.gov

Sliwinska S, Jeziorek M. The role of nutrition in Alzheimer's disease. Roczniki Państwowego Zakładu Higieny. 2021. Icm.edu.pl

Smid J, Studart-Neto A, César-Freitas KG, Dourado MC, Kochhann R, Barbosa BJ, Schilling LP, Balthazar ML, Frota NA, Souza LC, Caramelli P. Subjective cognitive decline, mild cognitive impairment, and dementia-syndromic approach: recommendations of the Scientific Department of Cognitive Neurology and Aging of the Brazilian Academy of Neurology. Dementia & Neuropsychologia. 2022 Nov 28;16:1-24. scielo.br

Sommerlad A, Kivimäki M, Larson EB, Röhr S, Shirai K, Singh-Manoux A, Livingston G. Social participation and risk of developing dementia. Nature aging. 2023 May; 3(5):532-45. ucl.ac.uk

Sophia Borgeest G, N. Henson R, Shafto M, Samu D et al. Greater lifestyle engagement is associated with better age-adjusted cognitive abilities. 2020. Ncbi.nlm.nih.gov

Stefaniak O, Dobrzyńska M, Drzymała-Czyż S, and Przysławski J. Diet in the prevention of Alzheimer 's disease: current knowledge and future research requirements. Nutrients. 2022 Oct 30; 14(21):4564. mdpi.com.

Stern Y. How can cognitive reserve promote cognitive and neurobehavioral health? Archives of Clinical Neuropsychology. 2021. Nih.gov

Tappen R, Koszalinski R, Newman D. RELATIONSHIP OF SOCIAL SUPPORT AND SOCIAL ENGAGEMENT WITH COGNITION IN AN ETHNICALLY DIVERSE OLDER POPULATION. 2023. Ncbi.nlm.nih.gov

Toman J, Klímová B, Vališ M. Multidomain Lifestyle Intervention Strategies for the Delay of Cognitive Impairment in Healthy Aging. 2018. Ncbi.nlm.nih.gov

Tomaszewski Farias S, Fox J, Dulaney H, Chan M, Namboodiri S, Harvey DJ, Weakley A, Rahman S, Luna C, Beech BF, Campbell L. Memory support training and lifestyle modifications to promote healthy aging in persons at risk for Alzheimer's disease: a digital application supported intervention (Brain Boosters). BMC geriatrics. 2023 Dec 21; 23(1):881. springer.com

ul Hassan M, Ahmed A, Abbas A, Qazi T, Hadid F, Malik Z, Jaffery F, Rahim A, Khan FS. Deconstructing the One-Size-Fits-All Model: A Systematic Review of Personalized Acute Care Strategies. Review Journal of Neurological & Medical Sciences Review. 2025 May 15;3(2):1-5. rjnmsreview.com

Van Asbroeck S, van Boxtel MP, Steyaert J, Köhler S, Heger I, de Vugt M, Verhey F, Deckers K. Increasing knowledge on dementia risk reduction in the general population: Results of a public awareness campaign. Preventive Medicine. 2021 Jun 1; 147:106522. sciencedirect.com

van der Flier WM, de Vugt ME, Smets EM, Blom M, Teunissen CE. Towards a future where Alzheimer's disease pathology is stopped before the onset of dementia. Nature aging. 2023 May; 3(5):494-505. maastrichtuniversity.nl

Vauzour D, Camprubi-Robles M, Miquel-Kergoat S, Andres-Lacueva C et al. Nutrition for the ageing brain: towards evidence for an optimal diet. 2017. [PDF]

Vikner T, Eklund A, Karalija N, Malm J, Riklund K, Lindenberger U, Bäckman L, Nyberg L, Wåhlin A. Cerebral arterial pulsatility is linked to hippocampal microvascular function and episodic memory in healthy older adults. Journal of Cerebral Blood Flow & Metabolism. 2021 Jul; 41(7):1778-90. sagepub.com

Wafa J, Julia G, Sandra G, Michael H et al. Factors underlying cognitive decline in old age and Alzheimer's disease: the role of the hippocampus.. 2017. [PDF]

Walker KA, Koralesky KE. Student and instructor perceptions of engagement after the rapid online transition of teaching due to COVID□19. Natural Sciences Education. 2021. Wiley.com

Wang G, Li DY, Vance DE, Li W. Alcohol use disorder as a risk factor for cognitive impairment. Journal of Alzheimer's Disease. 2023 Aug 1;94(3):899-907. [HTML]

Wang Y, Fan D, Zhang Y, Wang J, Dong L, Hu Y, Wang S. Long-term exposure to advanced lipid peroxidation end products impairs cognitive function through microbiota-gut-brain axis. Food Chemistry. 2024 Dec 15; 461:140864. [HTML]

Weisberg SM, Ebner NC, Seidler RD. Getting LOST: A conceptual framework for supporting and enhancing spatial navigation in aging. Wiley Interdisciplinary Reviews: Cognitive Science. 2024 Mar; 15(2):e1669. osf.io

Willroth EC, Pfund GN, McGhee C, Rule P. Well-being as a protective factor against cognitive decline and dementia: A review of the literature and directions for future research. The Journals of Gerontology: Series B. 2023 May 1; 78(5):765-76. nih.gov

Yang Y, Wang D, Hou W, Li H. Cognitive decline associated with aging. Cognitive aging and brain health. 2023. [HTML]

Yoonie Joo Y, Cha J, Freese J, Geoffrey Hayes M. Cognitive Capacity Genome-Wide Polygenic Scores Identify Individuals with Slower Cognitive Decline in Aging. 2022. Ncbi.nlm.nih.gov

Zak RS, Zitser J, Jones HJ, Gilliss CL, Lee KA. Sleep self-report and actigraphy measures in healthy midlife women: validity of the Pittsburgh Sleep Quality Index. Journal of women's health. 2022 Jul 1; 31(7):965-73. nih.gov

Zhou R, Belge T, Wolbers T. Reaching the goal: Superior navigators in late adulthood provide a novel perspective into successful cognitive aging. Topics in cognitive science. 2023. Wiley.com

Zijlmans JL, Lamballais S, Vernooij MW, Ikram MA, Luik AI. Sociodemographic, lifestyle, physical, and psychosocial determinants of cognitive reserve. Journal of Alzheimer's Disease. 2022 Jan 18; 85 (2):701-13. sagepub.com

Zitser J, Allen IE, Falgàs N, Le MM, Neylan TC, Kramer JH, Walsh CM. Pittsburgh Sleep Quality Index (PSQI) responses are modulated by total sleep time and wake after sleep onset in healthy older adults. PloS one. 2022 Jun 24; 17 (6):e0270095. plos.org