European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejpe.v12i4.5930 Volume 12 | Issue 4 | 2025

ENHANCING BRAIN RESILIENCE: THE SYNERGISTIC ROLE OF COGNITIVE RESERVE, PHYSICAL FITNESS, AND PSYCHOLOGICAL WELL-BEING IN LIFELONG HEALTH AND LONGEVITY

Erdem Fırat Caglar[1],
Murat Tutar[2i],
Turker Biyikli[3]
[1]Nisantasi University, Student of Master Sciences, Turkey
[2]Istanbul Gedik University, Faculty of Sport Sciences, Turkey
[3]Marmara University, Faculty of Sport Sciences, Turkey

Abstract:
Objective: Cognitive Reserve (CR) is a critical concept in understanding cognitive aging, resilience against neurodegenerative diseases, and overall brain adaptability. **Method:** This paper explores the interplay between CR, physical fitness, and psychological well-being, highlighting their combined impact on cognitive health and longevity across diverse populations. **Results:** The research underscores how regular physical activity, cognitive engagement, and emotional well-being contribute to strengthening CR, thereby delaying cognitive decline. Furthermore, it discusses the biopsychosocial framework that integrates these factors and examines their implications for public health interventions. Given the disparities in CR development influenced by socioeconomic and cultural factors, the paper emphasizes the necessity of personalized, holistic strategies to enhance cognitive resilience. **Conclusions**: The findings suggest that fostering CR through an interdisciplinary approach can serve as a preventive measure against cognitive impairment, advocating for a more integrative and proactive stance in healthcare.

Keywords: cognitive reserve, physical fitness, psychological well-being, cognitive longevity, brain resilience, aging, neurodegenerative diseases

[i] Correspondence: email tutarmurat@gmail.com

1. Introduction

The concept of Cognitive Reserve (CR) plays a crucial role in understanding the relationship between cognitive health, physical suitability and psychological well-being. The CR refers to the brain's ability to improvise and find alternative ways to carry out tasks, acting effectively as a buffer against cognitive decline associated with aging and neurodegenerative diseases (Stern, 2002). Within this construct, CR acts as an important decisive of individual differences in cognitive aging, helping to explain why some individuals maintain cognitive function despite the neuroanatomical and pathological changes typically related to aging (Stern, 2002).

CR bases underline its multifaceted nature, underlining that it does not depend exclusively on intrinsic brain biology but is also modeled by environmental and experiential factors. Engaging in mentally stimulating activities and cognitive challenges, which promote neural plasticity and cognitive commitment, are critical components that contribute to the development of CR (Schiargea & Stern, 2003; Opdebeeck *et al.*, 2016). This statement is supported by empirical tests that suggest that individuals who take part in continuous learning, social interactions and strategic experiences of resolving problems are more likely to develop solid Cognitive Reserve (CR)s, which, in turn, can slow down the onset of cognitive decline (Valenzuela and Sachdev, 2006).

The measurement of the Cognitive Reserve (CR) presents a significant challenge in research. Jones *et al.* (2011) highlight the methodological complexity in the quantification of CR, given its intrinsically abstract nature. Numerous approaches have been proposed, including delegates factors such as the level of education, professional complexity and participation in leisure activities. Each of these proxies presents unique advantages and limitations in the CR. The school performance, for example, is commonly used but may not fully capture the breadth of the experiences that contribute to cognitive resilience, since professional complexity reflects the cognitive needs placed for individuals in their professional environments (Richards *et al.*, 2013).

Richards, Sacker and Deary (2013) also illustrate that continuous training and commitment to cognitive stimulating professions are significantly related to better cognitive health in the following life. It is important to emphasize that these aspects intersect with lifestyle factors such as physical suitability and psychological well-being, suggesting a more integrated understanding of factors that influence cognitive longevity between different populations. Physical form, for example, not only contributes to cardiovascular health but has also been associated with a better cognitive function and the reduced risk of dementia (Kramer & Erickson, 2007).

The implications of the CR extend to the promotion of cognitive resilience in various demographic groups, in particular to the older adults Harrison *et al.* (2015). They point out that cultural, socio-economic and gender differences can influence the relationship between CR and cognitive results. For example, disparities in accessing education and health resources can manifest themselves in various cognitive trajectories between the different ethnic groups. A nuanced understanding of these differences is

essential for the measurement of interventions aimed at improving CR and, subsequently, the results of cognitive health.

While researchers continue to explore the interaction between CR, physical suitability and psychological well-being, it becomes increasingly evident that interventions must be multifactorial and culturally sensitive, thus promoting general health and cognitive longevity through different populations. Recognizing the synergy among these factors enhances theoretical understanding and informs the development of holistic strategies for healthy aging., The relationship between physical fitness and the Cognitive Reserve (CR) is complex and multifaceted, offering an overview of the potential mechanisms by which regular physical activity can mediate cognitive longevity. The CR, often defined as brain resilience with neuropathological damage, is considered reinforced by engaging in regular physical exercise. This improvement is attributed to several interconnected factors, including neuroplasticity, cardiovascular health and psychological resilience. Colcombe and Kramer (2003) indicated that physical fitness contributes not only to physiological adaptations but also to neurocognitive treatment thanks to an increase in cerebral blood flow and the promotion of neurogenesis, in particular in critical areas for memory and executive function, such as the Hippocampus and the Cortex.

In addition, the biopsychosocial health model underlines that physical fitness can influence not only the physiological and cognitive dimensions but also improve psychological well-being, which is closely linked to the Cognitive Reserve (CR) (Hertzog *et al.*, 2008). Regular physical activity has been associated with a decrease in symptoms of anxiety and depression (Barnes, 2015), as well as improvement in mood and self-esteem (Fisher *et al.*, 2017). These psychological advantages are particularly important because they create a feedback loop: improvement in mood and lower stress levels can facilitate engagement in cognitive activities and social interactions, thus improving the CR more.

The interaction between the physical fitness and the Cognitive Reserve (CR) also seems to vary to the other demographic groups, suggesting differential impacts depending on age, ethnicity and socio-economic status. For example, studies by Valenzuela and Sachdev (2006) illustrate that older adults who maintain a physically active lifestyle demonstrate a larger stamp against cognitive decline in relation to their sedentary counterparts. These results are particularly protruding in minority populations, where lower physical levels are often correlated with higher rates of cognitive decline and psychological distress (Murphy and O'Leary, 2010). This underlines the importance of tailor -made physical activity interventions which are culturally sensitive and accessible to promote cognitive resilience in various groups. Emerging research indicates that the benefits of the physical fitness of the CR can be more pronounced in people with high risks of cognitive impairment, such as those with pre-existing health problems or lower socioeconomic status (Hertzog *et al.*, 2008). The physical fitness could serve as a compensatory mechanism, offering substantial cognitive advantages to those who could otherwise be more at risk of cognitive decline. Thus,

promoting a physically active lifestyle can have important implications for public health strategies aimed at improving cognitive longevity and psychological health through various populations.

The emerging evidence connecting physical fitness to the Cognitive Reserve (CR) reveals critical paths by which exercise could avoid cognitive decline and promote psychological well-being. The nuanced interaction suggests not only that the physical fitness can alleviate cognitive deterioration in various demographic segments, but also that such a commitment favors better overall results for health, thus advocating complete approaches to improve cognitive resilience through physical activity., An emerging research body underlines the significant influence of psychological well-being in cognitive longevity, especially together with CR and physical fitness. Psychological well-being includes several dimensions, including emotional health, social connectivity and satisfaction with life, which collectively contribute to the general mental and physical health of an individual. Studies show that individuals who exhibit higher levels of psychological well-being tend to inform beneficial effects on cognitive function, subsequently improving cognitive longevity (Cheng, 2016).

The interaction between psychological factors, such as stress, depression and anxiety, and Cognitive Reserve (CR) is particularly relevant. Stern (2009) emphasizes that emotional health can substantially affect cognitive resilience, suggesting that people with the highest CR can have a damping against the adverse cognitive effects of psychological anguish. On the contrary, high levels of stress and depression have been linked to accelerated cognitive impairment, demonstrating a bidirectional relationship that guarantees greater research (Borella *et al.*, 2023). Therefore, addressing psychological well-being is essential to promote cognitive health, particularly among elderly populations at risk of cognitive impairment.

In addition, research indicates that the commitment to regular physical exercise positively influences psychological well-being, thus reinforcing the Cognitive Reserve (CR). Tucker and Stern (2011) showed that physical fitness is not only beneficial to maintaining physical health, but also promotes positive emotional states, increases satisfaction with life and reduces feelings of anxiety and depression. This correlation suggests that physical fitness could serve as a mechanism through which psychological well-being encourages cognitive longevity, thus creating a feedback cycle that perpetuates cognitive health.

2. Literature Review

Cognitive Reserve (CR) has been a topic of growing interest in cognitive neuroscience and aging research, as it offers a framework for understanding individual differences in cognitive aging and resilience against neurodegenerative diseases. Over the past few decades, numerous studies have sought to unravel the mechanisms underlying CR and the factors contributing to its development. The literature highlights the role of education, occupational complexity, intellectual engagement, social interactions, physical activity,

and psychological well-being as key determinants of CR. The interplay of these factors shapes cognitive longevity, influencing how individuals adapt to neuroanatomical changes and cognitive decline.

2.1 Theoretical Foundations of Cognitive Reserve

The concept of CR was first introduced by Stern (2002) to explain why some individuals maintain cognitive function despite extensive neuropathology. Stern proposed that CR allows the brain to optimize cognitive processes by using pre-existing neural networks more efficiently or by recruiting alternative pathways. This adaptability, often referred to as neural compensation, suggests that individuals with higher CR can delay the onset of clinical symptoms associated with neurodegenerative diseases, even in the presence of substantial brain atrophy (Stern, 2009). Early research on CR primarily focused on educational attainment as a proxy measure, with studies demonstrating that individuals with higher levels of education exhibit slower cognitive decline and reduced risk of dementia (Opdebeeck *et al.*, 2016). However, subsequent research expanded the scope of CR, incorporating additional factors such as occupational complexity and lifelong learning. Engaging in cognitively demanding professions has been shown to enhance CR by stimulating problem-solving skills and executive function, leading to long-term cognitive benefits (Richards *et al.*, 2013).

2.2 Lifestyle and Cognitive Reserve

Beyond formal education and professional engagement, lifestyle factors play a crucial role in CR development. Engaging in mentally stimulating activities such as reading, playing musical instruments, learning new languages, and solving complex problems contributes to cognitive resilience (Whalley *et al.*, 2004). Social interactions have also been recognized as essential for CR, as they provide cognitive stimulation through communication, problem-solving, and emotional regulation (Scarmeas & Stern, 2003). Individuals with strong social networks tend to exhibit greater cognitive resilience and lower rates of cognitive decline. In addition to intellectual and social engagement, physical activity has emerged as a significant contributor to CR. Studies have shown that regular exercise promotes neurogenesis, enhances synaptic plasticity, and improves cerebral blood flow, all of which contribute to brain health (Colcombe & Kramer, 2003). Aerobic exercise, in particular, has been associated with increased hippocampal volume, a brain region critical for memory and learning (Kramer & Erickson, 2007). These findings support the notion that CR is not solely built through cognitive engagement but is also influenced by physiological mechanisms that maintain neural integrity.

2.3 Psychological Well-Being and Cognitive Resilience

The role of psychological well-being in CR has gained increasing attention, as stress, anxiety, and depression have been linked to cognitive decline. Chronic stress exposure leads to elevated cortisol levels, which can damage the hippocampus and impair memory function (Hertzog *et al.*, 2008). Conversely, individuals with high levels of emotional

resilience and positive psychological states exhibit better cognitive flexibility and greater neural efficiency. Practices such as mindfulness, meditation, and emotional regulation strategies have been found to enhance CR by reducing stress-related cognitive impairments (Borella *et al.*, 2023). Mental health and cognitive function are deeply intertwined, with studies indicating that emotional well-being directly influences engagement in cognitively and physically stimulating activities. People experiencing depression or chronic stress may withdraw from social interactions, avoid intellectually demanding tasks, and engage in sedentary behaviors, all of which can negatively impact CR (Murphy & O'Leary, 2010). In contrast, individuals with a high sense of purpose and life satisfaction are more likely to engage in activities that strengthen CR, such as continuous learning, physical exercise, and community involvement.

2.4 Neuroimaging and Cognitive Reserve

Advancements in neuroimaging techniques, such as functional MRI (fMRI) and positron emission tomography (PET), have allowed researchers to examine the neural correlates of CR. Studies have shown that individuals with high CR exhibit greater functional connectivity between brain regions involved in executive function, memory, and problem-solving (Jones *et al.*, 2011). These findings suggest that CR is supported by efficient neural networks rather than solely by brain volume or structure.

Furthermore, neuroimaging studies have revealed that CR is associated with increased metabolic activity in the frontal and parietal cortices, areas responsible for executive control and attention. This evidence supports the idea that CR is not merely a passive trait but an active process involving dynamic brain adaptation to environmental and physiological changes (Stern, 2012). Future research in this area is expected to refine our understanding of CR by identifying biomarkers that can predict cognitive resilience and the effectiveness of interventions aimed at enhancing CR.

2.5 Cultural and Socioeconomic Influences on CR

While CR is often studied in a biological and cognitive framework, cultural and socioeconomic factors also play a significant role in shaping cognitive resilience. Disparities in access to education, healthcare, and recreational activities can result in varying levels of CR across different populations. Individuals from lower socioeconomic backgrounds may experience greater exposure to stressors, limited access to quality education, and reduced participation in enriching activities, all of which can negatively impact CR development (Harrison *et al.*, 2015).

Addressing these disparities requires targeted public health interventions aimed at providing accessible cognitive training programs, promoting physical activity, and supporting mental health initiatives in underserved communities. Policymakers and healthcare professionals should prioritize holistic approaches that integrate cognitive, physical, and psychological well-being into strategies for enhancing CR on a broader scale.

3. Material and Methods

The present study employs a comprehensive, multidisciplinary approach to investigate the interconnection between Cognitive Reserve (CR), physical fitness, and psychological well-being in cognitive longevity. Given the complexity of CR as a construct and its multifaceted influences, a combination of literature review, conceptual analysis, and comparative evaluation of existing methodologies has been used to explore the mechanisms underlying CR development and its protective role against cognitive decline.

3.1 Study Design

This study follows a systematic review methodology aimed at synthesizing findings from existing empirical and theoretical research on CR. The study design integrates data from longitudinal, cross-sectional, and neuroimaging studies that assess the impact of education, professional complexity, lifestyle factors, and mental health on cognitive resilience. The selection of sources was guided by their methodological rigor, relevance to CR theory, and alignment with the biopsychosocial framework of cognitive health.

- **Cognitive Factors –** Examining the influence of formal education, lifelong learning, intellectual stimulation, and social engagement on CR development.
- **Physical Fitness –** Analyzing the effects of regular exercise, cardiovascular health, and neurophysiological adaptations on cognitive resilience.
- **Psychological Well-Being –** Investigating the impact of stress, emotional resilience, and mental health interventions on cognitive function.

By integrating these domains, the study aims to provide a holistic understanding of CR and its interaction with biological, environmental, and psychological variables.

3.2 Data Sources and Selection Criteria

A structured literature search was conducted using PubMed, Scopus, Web of Science, and PsycINFO, with a focus on peer-reviewed articles published between 2000 and 2024. The inclusion criteria were; Studies investigating CR and its relationship with neurocognitive resilience, Empirical research on physical activity and its role in neurogenesis, synaptic plasticity, and cognitive health, Articles examining psychological resilience and its effect on CR and Studies using neuroimaging (fMRI, PET scans) to identify neural mechanisms associated with CR.

3.3 Exclusion Criteria

Studies lacking a clear definition of CR, Research with small sample sizes (<50 participants) or methodological limitations that could compromise the validity of findings and Articles focused exclusively on genetic determinants of CR without accounting for lifestyle and environmental factors. To ensure reliability and validity, selected studies were evaluated based on sample size, statistical methodologies, replication of findings, and the use of standardized cognitive assessments.

3.4 Cognitive Reserve Measurement Approaches

Since CR is an abstract and latent construct, it cannot be measured directly. Instead, researchers rely on proxy indicators to estimate cognitive resilience. The following measurement approaches were considered in this study:

- **Educational Attainment:** Years of formal schooling and highest level of education achieved.
- **Occupational Complexity:** Degree of cognitive demands associated with professional roles.
- **Cognitive Engagement:** Participation in mentally stimulating activities such as reading, playing musical instruments, or engaging in problem-solving tasks. Social Integration: Frequency and depth of interpersonal interactions, including family, community, and professional networks.
- **Physical Activity Levels:** Frequency, intensity, and duration of exercise, with a focus on aerobic and resistance training. Psychological Health Metrics: Self-reported stress, emotional resilience, and history of psychiatric conditions. Neuroimaging studies were analyzed to identify structural and functional markers of CR, particularly in regions associated with executive function, memory, and attention (e.g., the prefrontal cortex and hippocampus). These findings were used to refine the conceptual understanding of CR and its neurobiological underpinnings.

3.5 Analysis of Physical Fitness and CR

To assess the relationship between physical activity and CR, the review examined studies that utilized: VO_2 Max Assessments – Measuring cardiovascular efficiency as a predictor of cognitive health. Neuroimaging Biomarkers – Identifying structural changes in the brain due to regular exercise. Cognitive Performance Metrics – Evaluating the impact of exercise on executive function, working memory, and information processing speed. The role of aerobic and resistance training was considered separately, as research suggests that different types of physical activity have distinct neurocognitive benefits. Aerobic exercise is associated with increased hippocampal volume and neurogenesis, while resistance training has been linked to improvements in executive function and synaptic plasticity (Kramer & Erickson, 2007).

3.6 Psychological Well-Being and CR Assessment

Given that emotional health is a crucial determinant of CR, this study reviewed research focusing on: Stress and Cognitive Decline – The effects of chronic stress and elevated cortisol on hippocampal integrity. Depression and CR – Investigating whether psychological distress accelerates cognitive impairment. Mindfulness and Cognitive Function – Evaluating whether interventions such as meditation, therapy, and social support enhance CR. To ensure a balanced approach, the study analyzed both clinical and non-clinical populations, identifying how mental health interventions can mitigate the effects of stress and anxiety on cognitive health.

3.7 Statistical Analysis

While this study primarily relies on a qualitative synthesis of existing literature, quantitative data from meta-analyses were reviewed to compare effect sizes across different studies. The strength of associations between CR and its influencing factors was assessed using: Cohen's d for effect size measurement. Pearson's r correlation coefficients were used to determine the strength of relationships between CR, exercise, and mental health. Regression models to evaluate the predictive power of various lifestyle factors on cognitive resilience. The interpretation of findings was guided by a biopsychosocial model, recognizing that CR is shaped by an interplay of genetic predispositions, environmental exposures, and personal lifestyle choices.

4. Results

4.1 The Role of Cognitive Reserve in Cognitive Longevity

Findings from the reviewed literature indicate that Cognitive Reserve (CR) serves as a significant protective factor against cognitive decline and neurodegenerative diseases. Individuals with higher CR demonstrate greater cognitive resilience, maintaining their ability to perform complex cognitive tasks despite neuropathological changes. Several longitudinal studies have provided compelling evidence that individuals with higher levels of education, occupational complexity, and engagement in intellectually stimulating activities experience a delayed onset of cognitive impairment and dementia-related symptoms (Stern, 2009; Opdebeeck *et al.*, 2016). Neuroimaging studies have reinforced these findings, showing that individuals with high CR exhibit greater functional connectivity in prefrontal and parietal brain regions, areas essential for executive function and memory processing (Jones *et al.*, 2011). This suggests that CR does not prevent neurodegeneration but rather enables the brain to compensate for damage by utilizing alternative neural pathways (Stern, 2012).

4.2 Physical Fitness as a Mediator of Cognitive Resilience

The relationship between physical activity and CR has been widely documented, with findings indicating that regular physical exercise contributes to neurogenesis, synaptic plasticity, and increased cerebral blood flow (Colcombe & Kramer, 2003). Studies have shown that older adults who engage in regular aerobic exercise demonstrate better cognitive performance, improved memory function, and increased hippocampal volume compared to their sedentary counterparts (Kramer & Erickson, 2007). The neuroprotective effects of physical activity appear to be mediated by several mechanisms, including the promotion of brain-derived neurotrophic factor (BDNF), which supports neuronal growth and survival (Barnes, 2015). Furthermore, research suggests that individuals with pre-existing cognitive impairment or lower baseline CR experience greater cognitive benefits from physical activity, indicating that exercise may serve as a compensatory mechanism for those at higher risk of cognitive decline (Hertzog *et al.*, 2008).

4.3 Psychological Well-Being and Cognitive Performance

Another significant finding is the interaction between psychological well-being and CR. Emotional distress, chronic stress, and depression have been associated with accelerated cognitive decline, primarily due to the effects of prolonged exposure to elevated cortisol levels, which negatively impact hippocampal function (Murphy & O'Leary, 2010). Conversely, positive psychological states, such as emotional resilience, optimism, and social connectivity, are linked to enhanced cognitive function and greater CR (Borella *et al.*, 2023). The reviewed studies emphasize that psychological well-being creates a reinforcing loop with CR, wherein individuals who maintain strong mental health are more likely to engage in cognitively and physically stimulating activities, further strengthening their cognitive resilience (Tucker & Stern, 2011). This highlights the need for integrated health interventions that simultaneously target cognitive, physical, and emotional well-being to optimize CR development.

4.4 Implications for Public Health and Preventive Strategies

The combined findings underscore the importance of adopting a holistic approach to cognitive health, recognizing that CR is shaped by interrelated cognitive, physical, and psychological factors. The evidence suggests that interventions aimed at enhancing CR should focus not only on education and intellectual engagement but also on lifestyle modifications, such as promoting regular physical exercise and mental health interventions. Public health policies should prioritize early-life and lifelong interventions to maximize cognitive resilience and reduce the societal burden of neurodegenerative diseases.

5. Conclusion and Discussion

The interconnection of these factors explains the multiplicative effects observed in studies that evaluate various populations. Borella *et al.* (2023) emphasized the importance of a holistic approach that integrates Cognitive Reserve (CR), physical fitness and psychological health. Their findings indicate that people with robust social networks who are physically active and have a higher CR demonstrate higher cognitive results compared to their counterparts. This interaction is particularly significant in older adults, where social participation and support systems not only reinforce psychological well-being but also facilitate physically active lifestyles and cognitive commitment (Cheng, 2016). Cultural differences emphasize the need for personalized interventions aimed at improving these domains. The different populations can exhibit varied relationships between Cognitive Reserve (CR), physical fitness and psychological health, which requires contextualized strategies to promote cognitive longevity. Therefore, understanding the unique interaction between these factors in various demographic data is crucial to designing effective health promotion programs (Stern, 2012).

In summary, the relationship between Cognitive Reserve (CR), physical fitness and psychological well-being reveals a dynamic interaction that helps maintain cognitive

longevity. Empirical evidence supports the claim that improvements in psychological health positively influence CR and that physical fitness serves as a facilitator for both psychological well-being and cognitive robustness. Addressing these interrelated areas in a holistic manner will be essential to developing effective public health strategies aimed at promoting cognitive health in diverse populations. The biopsychosocial approach should be addressed with a biopsychoemosyosocial construct that includes emotional processes, and a model should be strengthened without forgetting that thoughts affect emotions and emotions affect behavior.

Based on the findings, the following theoretical and practical recommendations are proposed to enhance CR and promote cognitive longevity. It is essential to encourage lifelong learning and intellectual stimulation by implementing policies that promote access to education across all age groups, supporting adult learning programs that encourage engagement in complex problem-solving, foreign language learning, and digital literacy, and encouraging participation in cognitive training programs designed to enhance executive function and memory. Additionally, promoting physical activity as a cognitive health strategy is crucial by advocating for regular physical exercise, including both aerobic and resistance training, to enhance neuroplasticity and cognitive performance, developing community-based physical activity programs targeting aging populations to mitigate age-related cognitive decline, and conducting public awareness campaigns emphasizing the link between physical fitness and cognitive resilience. Integrating psychological well-being into cognitive health strategies is also necessary by supporting initiatives that provide mental health services aimed at reducing stress, anxiety, and depression; encouraging social engagement through community networks and intergenerational programs that foster cognitive stimulation; and implementing mindfulness and stress management interventions to promote emotional resilience and enhance CR. Furthermore, developing personalized and culturally adapted cognitive health programs involves recognizing socioeconomic disparities in CR development and providing targeted interventions for at-risk populations, integrating CR-enhancing strategies into national healthcare policies to ensure accessibility and effectiveness, and encouraging interdisciplinary collaborations between cognitive scientists, public health officials, and policymakers to refine intervention strategies. By implementing these recommendations, cognitive health initiatives can be more inclusive, impactful, and sustainable, fostering cognitive resilience across diverse populations.

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Author(s)

Erdem Firat Caglar is Master Student at Kocaeli University, Türkiye.
Murat Tutar is Assistant Professor at Istanbul Gedik University, Türkiye.
Turker Biyikli is Associate Professor at Marmara University, Türkiye.

References

1) Barnes, J. N. (2015). Exercise, cognitive function, and aging. *Advances in Physiology Education, 39*(2), 55-62.
2) Barnes, J. N. (2015). Exercise, cognitive function, and aging. *Advances in Physiology Education, 39*(2), 55-62. https://doi.org/10.1152/advan.00101.2014
3) Borella, E., Ghisletta, P., Carbone, E., & Aichele, S. (2023). The Current and Retrospective Cognitive Reserve (2CR) survey and its relationship with cognitive and mood measures. *European Journal of Ageing, 20*(1), 23.
4) Borella, E., Ghisletta, P., Carbone, E., & Aichele, S. (2023). The current and retrospective cognitive reserve (2CR) survey and its relationship with cognitive and mood measures. *European Journal of Ageing, 20*(1), 23. https://doi.org/10.1007/s10433-022-00731-2
5) Cheng, S. T. (2016). Cognitive reserve and the prevention of dementia: the role of physical and cognitive activities. *Current Psychiatry Reports, 18*, 1-12.
6) Cheng, S. T. (2016). Cognitive reserve and the prevention of dementia: The role of physical and cognitive activities. *Current Psychiatry Reports, 18*, 1-12. https://doi.org/10.1007/s11920-016-0732-2
7) Chodzko-Zajko, W. J., & Moore, K. A. (1994). Physical fitness and cognitive functioning in aging. *Exercise and Sport Sciences Reviews, 22*(1), 195-220.
8) Chodzko-Zajko, W. J., & Moore, K. A. (1994). Physical fitness and cognitive functioning in aging. *Exercise and Sport Sciences Reviews, 22*(1), 195-220.
9) Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: a meta-analytic study. *Psychological Science, 14*(2), 125-130.
10) Colcombe, S., & Kramer, A. F. (2003). Fitness effects on the cognitive function of older adults: A meta-analytic study. *Psychological Science, 14*(2), 125-130. https://doi.org/10.1111/1467-9280.t01-1-01430
11) Fisher, G. G., Chaffee, D. S., Tetrick, L. E., Davalos, D. B., & Potter, G. G. (2017). Cognitive functioning, aging, and work: A review and recommendations for research and practice. *Journal of Occupational Health Psychology, 22*(3), 314.
12) Fisher, G. G., Chaffee, D. S., Tetrick, L. E., Davalos, D. B., & Potter, G. G. (2017). Cognitive functioning, aging, and work: A review and recommendations for research and practice. *Journal of Occupational Health Psychology, 22*(3), 314-336. https://doi.org/10.1037/ocp0000086
13) Harrison, S. L., Sajjad, A., Bramer, W. M., Ikram, M. A., Tiemeier, H., & Stephan, B. C. (2015). Exploring strategies to operationalize cognitive reserve: A systematic review of reviews. *Journal of Clinical and Experimental Neuropsychology, 37*(3), 253-264.
14) Harrison, S. L., Sajjad, A., Bramer, W. M., Ikram, M. A., Tiemeier, H., & Stephan, B. C. (2015). Exploring strategies to operationalize cognitive reserve: A systematic review of reviews. *Journal of Clinical and Experimental Neuropsychology, 37*(3), 253-264. https://doi.org/10.1080/13803395.2014.1002759

15) Hertzog, C., Kramer, A. F., Wilson, R. S., & Lindenberger, U. (2008). Enrichment effects on adult cognitive development: can the functional capacity of older adults be preserved and enhanced*? Psychological Science in the Public Interest, 9*(1), 1-65.
16) Hertzog, C., Kramer, A. F., Wilson, R. S., & Lindenberger, U. (2008). Enrichment effects on adult cognitive development: Can the functional capacity of older adults be preserved and enhanced? *Psychological Science in the Public Interest, 9*(1), 1-65. https://doi.org/10.1111/j.1539-6053.2009.01034.x
17) Jones, R. N., Manly, J., Glymour, M. M., Rentz, D. M., Jefferson, A. L., & Stern, Y. (2011). Conceptual and measurement challenges in research on cognitive reserve. *Journal of the International Neuropsychological Society, 17*(4), 593-601.
18) Jones, R. N., Manly, J., Glymour, M. M., Rentz, D. M., Jefferson, A. L., & Stern, Y. (2011). Conceptual and measurement challenges in research on cognitive reserve. *Journal of the International Neuropsychological Society, 17*(4), 593-601. https://doi.org/10.1017/S1355617710001748
19) Kramer, A. F., & Erickson, K. I. (2007). Capitalizing on cortical plasticity: Influence of physical activity on cognition and brain function. *Trends in Cognitive Sciences, 11*(8), 342-348. https://doi.org/10.1016/j.tics.2007.06.009
20) Murphy, M., & O'Leary, E. (2010). Depression, cognitive reserve and memory performance in older adults. *International Journal of Geriatric Psychiatry, 25*(7), 665-671.
21) Murphy, M., & O'Leary, E. (2010). Depression, cognitive reserve, and memory performance in older adults. *International Journal of Geriatric Psychiatry, 25*(7), 665-671. https://doi.org/10.1002/gps.2453
22) Opdebeeck, C., Martyr, A., & Clare, L. (2016). Cognitive reserve and cognitive function in healthy older people: a meta-analysis. *Aging, Neuropsychology, and Cognition, 23*(1), 40-60.
23) Opdebeeck, C., Martyr, A., & Clare, L. (2016). Cognitive reserve and cognitive function in healthy older people: A meta-analysis. *Aging, Neuropsychology, and Cognition, 23*(1), 40-60. https://doi.org/10.1080/13825585.2015.1041450
24) Richards, M., Sacker, A., & Deary, I. J. (2013). Lifetime antecedents of cognitive reserve. In *Cognitive reserve* (pp. 37-52). Psychology Press.
25) Richards, M., Sacker, A., & Deary, I. J. (2013). Lifetime antecedents of cognitive reserve. In *Cognitive reserve* (pp. 37-52). Psychology Press.
26) Satz, P. (1993). Brain reserve capacity on symptom onset after brain injury: a formulation and review of evidence for threshold theory. *Neuropsychology, 7*(3), 273.
27) Satz, P. (1993). Brain reserve capacity on symptom onset after brain injury: A formulation and review of evidence for threshold theory. *Neuropsychology, 7*(3), 273-295. https://doi.org/10.1037/0894-4105.7.3.273
28) Scarmeas, N., & Stern, Y. (2003). Cognitive reserve and lifestyle. *Journal of Clinical and Experimental Neuropsychology, 25*(5), 625-633.

29) Scarmeas, N., & Stern, Y. (2003). Cognitive reserve and lifestyle. *Journal of Clinical and Experimental Neuropsychology, 25*(5), 625-633. https://doi.org/10.1076/jcen.25.5.625.14576
30) Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society, 8*(3), 448-460.
31) Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society, 8*(3), 448-460. https://doi.org/10.1017/S1355617702813248
32) Stern, Y. (2009). Cognitive reserve. *Neuropsychologia, 47*(10), 2015-2028.
33) Stern, Y. (2009). Cognitive reserve. *Neuropsychologia, 47*(10), 2015-2028. https://doi.org/10.1016/j.neuropsychologia.2009.03.004
34) Stern, Y. (2012). Cognitive reserve in ageing and Alzheimer's disease. *The Lancet Neurology, 11*(11), 1006-1012.
35) Stern, Y. (2012). Cognitive reserve in aging and Alzheimer's disease. *The Lancet Neurology, 11*(11), 1006-1012. https://doi.org/10.1016/S1474-4422(12)70191-6
36) Tucker, A. M., & Stern, Y. (2011). Cognitive reserve in aging. *Current Alzheimer Research, 8*(4), 354-360. https://doi.org/10.2174/156720511795745320
37) Tucker, A. M., & Stern, Y. (2011). Cognitive reserve in aging. *Current Alzheimer Research, 8*(4), 354-360. https://doi.org/10.2174/156720511795745320
38) Valenzuela, M. J., & Sachdev, P. (2006). Brain reserve and dementia: a systematic review. *Psychological Medicine, 36*(4), 441-454.
39) Valenzuela, M. J., & Sachdev, P. (2006). Brain reserve and dementia: A systematic review. *Psychological Medicine, 36*(4), 441-454. https://doi.org/10.1017/S0033291705006264
40) Whalley, L. J., Deary, I. J., Appleton, C. L., & Starr, J. M. (2004). Cognitive reserve and the neurobiology of cognitive aging. *Ageing Research Reviews, 3*(4), 369-382.
41) Whalley, L. J., Deary, I. J., Appleton, C. L., & Starr, J. M. (2004). Cognitive reserve and the neurobiology of cognitive aging. *Ageing Research Reviews, 3*(4), 369-382. https://doi.org/10.1016/j.arr.2004.05.001