



## PHYSICAL HEALTH STATUS IN MIDDLE AGE ON COGNITIVE FUNCTION: LITERATURE REVIEW

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### Abstract

This study aimed to systematically examine the relationship between physical health status in middle age and cognitive function. This systematic literature review was conducted following the PRISMA guidelines, with searches such as PubMed/MEDLINE, Scopus, Web of Science, PsycINFO, and CINAHL for articles published between 2020 and 2024. The inclusion criteria focused on original studies involving individuals aged 40-65 years, measuring physical health indicators, and evaluating cognitive function. 7 relevant articles were analyzed and narratively synthesized. The findings showed that various aspects of physical health status in middle adulthood were significantly associated with cognitive function. Body composition (BMI, muscle mass, visceral obesity) and metabolic health (fasting blood glucose levels) were consistently associated with cognitive performance and the risk of cognitive impairment. Cardiovascular health, represented by diastolic blood pressure, also affected brain structure and cognitive function. The relationship between physical activity and balance with cognition is variable, but some evidence suggests benefits of moderate-intensity physical activity and mind-body exercises such as Tai Chi. Other contextual factors such as education and early life conditions also play a role in cognitive resilience. In conclusion, interventions targeting weight management, metabolic health, cardiovascular health, and physical activity promotion in middle age have great potential to maintain optimal cognitive function. Further longitudinal studies are needed to confirm causal relationships and explore underlying mechanisms in more depth.

**Keywords:** Cognitive function, Middle age health, Physical status

### Abstrak

Penelitian ini bertujuan untuk mengkaji secara sistematis hubungan antara status kesehatan fisik pada *middle age* terhadap fungsi kognitif. Tinjauan literatur sistematis ini dilakukan mengikuti pedoman PRISMA, dengan pencarian seperti PubMed/MEDLINE, Scopus, Web of Science, PsycINFO, dan CINAHL untuk artikel yang diterbitkan antara tahun 2020 hingga 2024. Kriteria inklusi berfokus pada studi asli yang melibatkan individu berusia 40-65 tahun, mengukur indikator kesehatan fisik, dan mengevaluasi fungsi kognitif. 7 artikel relevan dianalisis dan disintesis secara naratif. Temuan menunjukkan bahwa berbagai aspek status kesehatan fisik pada masa dewasa pertengahan memiliki hubungan signifikan dengan fungsi kognitif. Komposisi tubuh (Indeks Massa Tubuh, massa otot, obesitas visceral) dan kesehatan metabolik (kadar glukosa darah puasa) secara konsisten terkait dengan performa kognitif dan risiko gangguan kognitif. Kesehatan kardiovaskular, yang direpresentasikan oleh tekanan darah diastolik, juga memengaruhi struktur otak dan fungsi kognitif. Hubungan antara aktivitas fisik dan keseimbangan dengan kognisi bervariasi, namun beberapa bukti menunjukkan manfaat aktivitas fisik intensitas sedang dan latihan mind-body seperti Tai Chi. Faktor-faktor kontekstual lain seperti pendidikan dan kondisi awal kehidupan juga berperan dalam resiliensi kognitif. Kesimpulan, intervensi yang menargetkan pengelolaan berat badan, kesehatan metabolik, kesehatan kardiovaskular, dan promosi aktivitas fisik pada usia pertengahan berpotensi besar untuk memelihara fungsi kognitif yang optimal. Studi longitudinal lebih lanjut sangat diperlukan untuk mengkonfirmasi hubungan sebab-akibat dan mengeksplorasi mekanisme yang mendasari secara lebih mendalam.

**Kata Kunci:** Fungsi kognitif, Kesehatan *middle age*, Status fisik

## INTRODUCTION

Optimal cognitive function is a fundamental element for human quality of life. It includes essential abilities such as thinking, learning, remembering, solving problems, and adapting to environmental dynamics (Gauci et al., 2022). As time passes and people get older, changes in cognitive function often become a focus of attention, especially as individuals enter middle adulthood (Betthausen et al., 2020). Middle adulthood, generally conceptualized as the age range between 40 and 65 years, represents a significant transitional phase in one's life



course. During this period, many individuals are at the peak of their professional productivity, experiencing a series of physical and psychological changes that can comprehensively affect their well-being and quality of life (Uludağlı & Pekçetin, 2021).

Common physical changes that occur in middle adulthood include modifications to body metabolism, a gradual decrease in muscle mass, and a decrease in muscle mass (Micklesfield et al., 2022). Then there is an increase in the prevalence and risk of developing chronic diseases such as hypertension, type 2 diabetes mellitus, and various forms of cardiovascular disease, even sleep disorders (Khowaja et al., 2022). Physical health status during this crucial decade not only has a direct impact on daily activities and quality of life, but is also believed to have significant long-term implications for the integrity and performance of cognitive health. Many scientific findings indicate a complex reciprocal relationship between physical health conditions and cognitive function capabilities (Nooyens et al., 2021), (Shimoda et al., 2023). For example, less than optimal physical condition, such as obesity, the presence of metabolic syndrome, or low levels of physical activity (Nooyens et al., 2015), (Chung & Kim, 2020), (Zegarra-Valdivia et al., 2023). These findings have been consistently identified as potential risk factors contributing to accelerated cognitive decline later in life.

However, the specific underlying mechanisms and the extent to which physical health status in middle adulthood causally influences cognitive function remain an area of ongoing and evolving research. Numerous studies have been conducted to investigate correlations and interventions in this relationship, but the results often show variability and in some cases, contradictions (Chung & Kim, 2020). These variations are often caused by differences in research design, characteristics of the populations being studied, and diversity of methods used to measure physical health parameters and cognitive function (Okely et al., 2021), (Liu et al., 2022).

Therefore, the need for a systematic and comprehensive literature review is crucial to identify consistent patterns, uncover remaining knowledge gaps, and formulate relevant clinical and policy implications. This study aims to systematically identify, synthesize, and analyze existing empirical evidence on the association between various aspects of physical health status and cognitive function in individuals in middle adulthood, with a view to identifying patterns, risk factors, and protective factors, as well as uncovering knowledge gaps and inconsistencies in the existing literature, in order to formulate relevant clinical implications and policy recommendations for cognitive health promotion.

## **METHOD**

This study adopts a comprehensive systematic literature review design, with the primary objective to identify, critically evaluate, and synthesize current empirical evidence on the relationship between physical health status in middle adulthood and its impact on cognitive function. The review process will strictly adhere to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines as the primary framework (Rethlefsen et al., 2021).

The literature search strategy will be conducted extensively through major electronic databases that are credible and relevant to the health and cognitive fields. The databases used will include PubMed, Scopus, Web of Science, PsycINFO, and CINAHL. Keyword combinations will utilize Boolean operators (AND, OR) to optimize search results, including relevant synonyms and MeSH terms. An example of a search string used in PubMed is as follows (adapted for other database syntax): (("physical health"[MeSH] OR "metabolic syndrome"[MeSH] OR "cardiovascular diseases"[MeSH] OR "obesity"[MeSH] OR "diabetes mellitus"[MeSH] OR "hypertension"[MeSH] OR "exercise"[MeSH] OR "physical activity"[MeSH]) AND ("cognitive function"[MeSH] OR "cognition"[MeSH] OR



"memory"[MeSH] OR "executive function"[MeSH] OR "attention"[MeSH] OR "processing speed"[MeSH]) AND ("middle age"[MeSH] OR "midlife"[Title/Abstract] OR "middle-aged adults"[Title/Abstract] OR "adults 40-65 years"[Title/Abstract])). The search will be limited to English-language articles published between 2020 and 2024.

Studies will be assessed based on precisely defined inclusion and exclusion criteria to ensure relevance and quality. Inclusion criteria include studies in which the majority of the population or primary analysis is in the middle adult age range (40-65 years), or studies that provide extractable data specific to that age group, even if they include older adults. Studies must measure at least one relevant indicator of physical health status, such as anthropometry (e.g., BMI, body composition), metabolic status (e.g., blood glucose), blood pressure, physical activity level, or the presence/severity of chronic disease. In addition, studies must measure cognitive function (e.g., memory, executive function, global cognition) and have an original research design, such as a cohort study, cross-sectional study, or randomized controlled trial, that reports on the relationship or impact of physical health on cognition.

Meanwhile, exclusion criteria will eliminate studies that focus exclusively on children, adolescents, or the elderly (>65 years) without specific data relevant to the 40-65 age group. Review articles, meta-analyses, editorials, opinion pieces, letters to the editor, and book chapters will also be excluded. Studies that do not explicitly measure the relationship between physical health and cognitive function, as well as research that has not undergone peer review or pre-print publications that are not yet final, will also be excluded. The study selection process will be conducted independently by two researchers, starting with title and abstract screening, followed by full-text screening.

## RESULTS DAN DISCUSSION

### Results

Figure 1 below is the result of work using the PRISMA-ScR framework, the findings of articles based on the entire database are 3.261 articles. Selection based on title and abstract produced 1.047 articles, then selection of article content based on exclusion criteria produced 283 articles, the last selection is based on exclusion criteria produced 7 relevant articles.

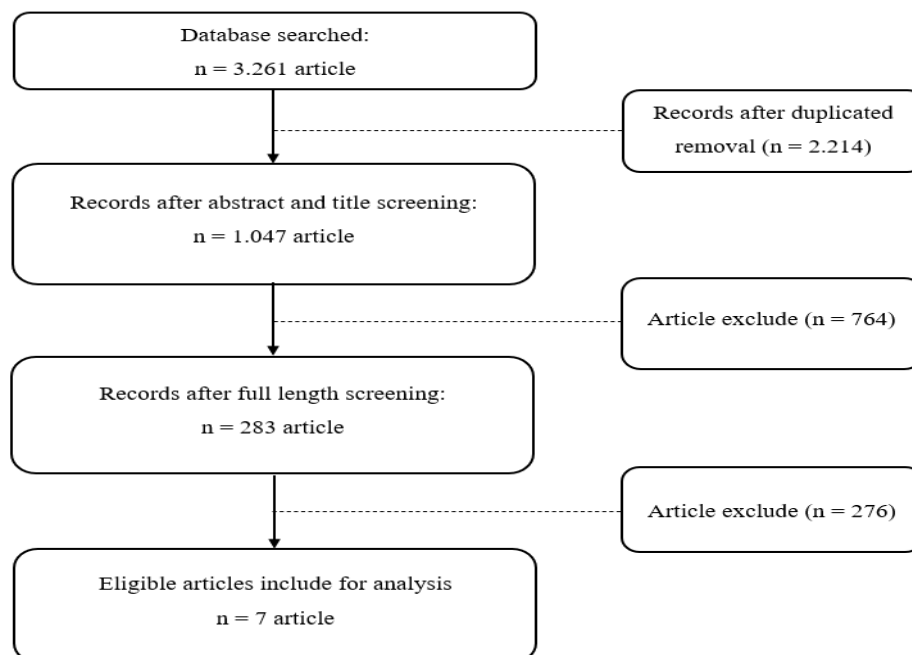


Figure 1. Research framework



Then, after the article is worthy of analysis, the next stage is analysis based on each article. Below is table 1 of article analysis

Table 1. Results of review of eligible articles

Title (Author and Year)	Health Status	Cognitive Function	Research Findings	Research Gap
Correlation Between Cognition and Balance Among Middle-Aged and Older Adults Observed Through a Tai Chi Intervention Program (Xiao et al., 2020)	Balance (static and dynamic), Tai Chi intervention, lower limb strength	Global cognitive function (Montreal Cognitive Assessment score / MoCA Chinese version)	Cognitive function and balance are interrelated in middle and older adults. Lower limb strength moderates this relationship. Changes in cognitive function and balance scores caused by Tai Chi training were positively correlated	Further research is needed to confirm the causal relationship and the factors influencing it in middle and older adults, especially intervention studies with larger sample sizes
Effects of Diastolic Blood Pressure on Brain Structures and Cognitive Functions in Middle and Old Ages: Longitudinal Analyses (Takeuchi et al., 2022)	Diastolic Blood Pressure (DBP)	Cognitive functions (fluid intelligence, reaction time, prospective memory, pair matching, numerical memory) and brain structure	Higher baseline DBP was associated with slightly smaller relative increases in reaction time and decreases in depression scores. Higher baseline DBP was also associated with greater retention of total gray matter volume. White matter microstructural changes consistent with aging were associated with higher DBP. The relationship between BP and the aging brain is complex	The complex relationship between high blood pressure and the aging brain requires further research



<p>Body mass index and trajectories of the cognition among Chinese middle and old-aged adults (Zhang et al., 2022)</p>	<p>Body Mass Index (BMI)</p>	<p>Cognitive function measured by the Chinese version of the Mini-mental state examination (MMSE), focusing on the trajectory of cognitive change (slow decline, rapid decline, stable function)</p>	<p>Underweight (BMI &lt; 18.5) is associated with both fast and slow cognitive decline trajectories. Obesity (BMI &gt; 28) is associated with slow cognitive decline trajectories. BMI can be used to screen people at risk for cognitive decline</p>	<p>Implications for BMI-based screening and intervention for at-risk populations</p>
<p>Relationships Between Body Composition and Cognitive Impairment in Hospitalised Middle-Aged Type 2 Diabetic Patients (Li et al., 2023)</p>	<p>Body composition (BMI, lean mass, muscle mass, visceral/abdominal obesity) in middle-aged type 2 diabetes patients.</p>	<p>Cognitive Impairment (CI) and Montreal Cognitive Assessment (MoCA) scores</p>	<p>BMI, lean mass, and muscle mass predict MoCA scores in men; BMI and lean mass are protective factors against CI in men. Visceral and abdominal obesity are risk factors for CI in women</p>	<p>Large prospective studies are needed to support the association and understand changes in body composition on cognition over time</p>
<p>Relationship Between Fasting Blood Glucose Levels in Middle Age and Cognitive Function in Later Life: The Aichi Workers' Cohort Study (Shimoda et al., 2023)</p>	<p>Fasting Blood Glucose (FBG) levels in middle age (normal, IFG, DM)</p>	<p>Cognitive function assessed with the Montreal Cognitive Assessment (MoCA)</p>	<p>Midlife FBG levels were negatively correlated with MoCA-J scores assessed later in life, suggesting midlife DM is associated with lower cognitive function in later life</p>	<p>Evidence regarding the association of DM in middle age with mild cognitive impairment after follow-up is still limited</p>
<p>Physical activity and cognitive</p>	<p>Physical activity (objectively measured and self-</p>	<p>Cognitive performance (Symbol</p>	<p>There were no significant associations</p>	<p>Longitudinal studies with objective measures of physical</p>



function in middle-aged adults: a cross-sectional analysis of the PATH through life study (Quinlan et al., 2023)	reported) at various intensities	Digit Modalities Test, Digit Span Backwards, Immediate and Delayed Recall)	between physical activity (either objective or self-reported) and cognitive function in this group of healthy, well-educated middle adults	activity are important to determine the impact of midlife behavior on trajectories of cognitive change into old age
Association between obesity, physical activity, and cognitive decline in Chinese middle and old-aged adults: a mediation analysis (Xu et al., 2024)	Obesity (BMI) and physical activity (intense physical activity)	Cognitive decline (episodic memory and mental status) and cognitive trajectories	Obesity is associated with lower cognitive decline clusters. Intense physical activity mediated less than 10% of the association between obesity and cognitive decline	Further studies are needed to explore potential factors related to the “obesity paradox” in cognitive domains (where higher BMI is sometimes associated with better outcomes in certain conditions)

Source: data proceed

## Discussion

Based on the synthesis of seven primary studies analyzed, it was found that various aspects of physical health have diverse and multifaceted relationships with cognitive domains in individuals aged 40 to 65 years.

The first analysis, the study showed that body composition and metabolic status play a crucial role in cognitive function during middle adulthood. Li et al. (2023) found that in middle-aged type 2 diabetes patients, Body Mass Index (BMI), lean mass, and muscle mass were predictors of MoCA scores in men, with BMI and lean mass acting as protective factors against cognitive impairment. Interestingly, visceral and abdominal obesity were risk factors for cognitive impairment in women, suggesting differences in mechanisms based on sex. This finding is supported by Zhang et al. (2022) who observed that extreme BMI, both underweight and obesity, were associated with cognitive decline trajectories in middle-aged and elderly adults in China, indicating that BMI could be an early indicator for screening for cognitive decline risk. Furthermore, Xu et al. (2024) examined the association between obesity and cognitive decline, finding that obesity was associated with lower cognitive decline clusters, although vigorous physical activity only mediated a small part of this association, underscoring the complexity of the role of obesity.

Metabolic health, specifically blood glucose levels, has also been shown to have long-term impacts. Shimoda et al. (2023) showed that high fasting blood glucose (FBG) levels in midlife were negatively correlated with cognitive function assessed later in life, highlighting the importance of blood sugar control from midlife on maintaining cognition in old age. This confirms that health factors occurring in midlife can influence cognitive trajectories later in life.



The second analysis, cardiovascular health as represented by blood pressure, is also an important determinant of cognitive health. Takeuchi et al. (2022) in a large-scale longitudinal analysis, identified that higher diastolic blood pressure (DBP) in midlife and older age was associated with changes in brain structure and cognitive function, such as shorter reaction times and greater gray matter volume retention. White matter microstructural changes consistent with aging were also associated with higher DBP. These findings underscore the complex relationship between vascular health and brain health with aging.

The third analysis, the relationship between physical activity and cognitive function showed variation across studies. Quinlan et al. (2023) found no significant association between physical activity (either objective or self-reported) and cognitive function in a healthy, highly educated middle-aged group. However, this finding may reflect sample homogeneity or measurement tools used. On the other hand, Alsubaie et al. (2020) who studied an adult population with a mean age of 50 years, reported significant positive associations between different types of physical activity, especially moderate intensity, and cognitive ability. This suggests that the type and intensity of physical activity, as well as population characteristics, may moderate these associations.

Furthermore, Xiao et al. (2020) found that cognitive function and balance were related in middle-aged and older adults, with lower limb strength moderating this relationship, and Tai Chi training positively correlated with changes in both domains. These findings are supported by Bhattacharyya et al. (2021) who showed that movement-based mind-body (MBP) practices were independently associated with smaller declines in episodic memory over a 10-year period in middle and older adults. This evidence collectively supports the idea that movement-based interventions and specific physical activity may be non-pharmacological strategies to maintain and possibly improve cognitive function. This concept is consistent with the view of active aging reviewed by Dogra et al. (2022), who highlighted the multiple benefits of physical activity for physical function, cognition, and overall quality of life. Fourth, although the primary focus of this review was physical health status, several comparative studies highlighted other factors that are also important to consider. Beller et al. (2022) found that improvements in cognitive speed over time in middle adulthood could be explained in part by changes in health, along with education and other routine activities, underscoring the broader significance of health. Interestingly, they found that changes in health were more important in explaining cognitive gains in middle adulthood compared to older adults, reinforcing the relevance of the review's focus.

## **CONCLUSION**

This systematic literature review concludes that there are significant and complex relationships between various aspects of physical health status in middle age and cognitive function. The synthesized evidence consistently shows that factors such as body composition (BMI, muscle mass), metabolic health (fasting blood glucose), cardiovascular health (diastolic blood pressure), and physical activity levels and balance play important roles in influencing individuals' cognitive performance and trajectories between the ages of 40 and 65, with long-term effects extending into old age. Therefore, middle adulthood is a crucial period where interventions focused on optimizing physical health have great potential to maintain optimal cognitive function and reduce the risk of cognitive decline in later life; however, future research is needed to more definitively confirm causal relationships through large-scale longitudinal studies, explore underlying mechanisms, and identify holistic interventions that take into account the complex interactions between physical and non-physical factors.



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### Conflict of Interest

The authors of this study declare that they have no conflicts with other authors.

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