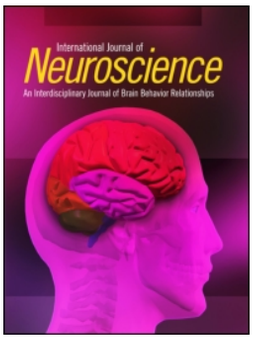

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Memory impairment and its associated risk and protective factors among older adults in Indonesia

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Abstract

Aims: This study aimed to evaluate the association between memory impairment and its risk and protective factors, focusing on demographic and health-related variables among older adults in Indonesia.

Method: The data analyzed were the Indonesian Family Life Survey-5 (IFLS-5) using cross-sectional variables of 4236 older adults aged 60 years and over included in the 2015 round. Memory impairment was assessed by immediate word list recall from the Telephone Interview for Cognitive Status (TICS). Sociodemographic factors and multiple health variables were included as predictors. Data were analyzed using frequency analyses bivariate and stepwise logistic regression tests.

Result: Among 4236 older adults, 49.7% were male and 50.3% were female. Stepwise backward analyses showed that memory impairment was independently associated with older age, being female, or not in a union (unmarried, separated, divorced, or widowed), having obtained low levels of education, living in a rural area, reporting low life satisfaction, low social capital, higher dependency, and having clinical depression. Only moderate (but not high or low) physical activity levels were associated with a lower risk. Being underweight increased the risk, but being overweight/obese (as assessed by BMI) protective factors for a lower immediate recall score.

Conclusion: Increasing education and continued engagement of older adults in psychosocial activities, including moderate physical activity, improving mental health, preventing weight loss, and maintaining functional ability to decrease dependency, are associated with increased episodic memory, especially in non-married and older women in rural areas of Indonesia.

Keywords: Memory impairment, immediate episodic recall, risk factors, older adults

Introduction

Around 36% of older adults in South East Asia live in Indonesia, which has an older population of over 16 million people. This number increases each year as public health, medicine, and socioeconomic development advance. At a global level, life expectancy at birth has reached 72.3 years.[1] In 2015, the prevalence of dementia was estimated to be 5.2% among older Indonesian adults, affecting almost 800 thousand people (of 16 million older people).[2] Aging often harms health, but aging is not necessarily causing age-associated declines in health and function.[3,4] Episodic memory is typically the first cognitive domain that can change subclinically and is sensitive to the effects of aging.[5] The episodic memory function can be assessed using a free recall test consisting of immediate and delayed recall.[6]

The utilization of cognitive assessment tools involving immediate recall, such as Freee and Cued Selective Reminding Test (FCSRT-FR) and Logical Memory I immediate recall (LM-IR), which is a subtest of the Wechsler Memory Scale-Revised, was shown to have the predictive ability towards dementia.[7] Derby et al. showed that FCSRT-FR and LM-IR showed significant diagnostic accuracy in screening for predementia Alzheimer's Disease (AD). FCSRT-FR diagnostic accuracy was shown to be comparable with APOE Ɛ4 status. The study by Younan et al. showed that external pollution, primarily particulate matter 2.5, increased the risk of AD and caused a greater decline in immediate recall and new learning, but did not associate with delayed recall decline.[8] Luke et al. found that the increased oxidative stress marker (F2-Isoprostanes) was associated with impaired verbal episodic memory (immediate and delayed recall).[9] The increase of viscoelasticity of hippocampus measured using Magnetic Resonance Imaging (MRI), which indicates the reduction of tissue integrity, was significantly correlated with lower Verbal Paired Associates immediate recall subtest (VPA-IM) score in a study by Hiscox et al.[10]

In multiple studies, cognitive impairment in the early stage of AD often begins with impairment in episodic memory.[8,11] There is no definitive tool in diagnosing AD in living patients until now. Still, multiple diagnostic tools have been established, such as measurement of amyloid-beta with PET imaging, volume measurement of hippocampal dan frontal cortex using MRI, or amyloid-beta oligomerization and fragments measurement in cerebrospinal fluid. Utilization of these tools was challenging because these tests are invasive, expensive, dan time-consuming in the context of screening. Therefore, cognitive assessment tools, particularly involving episodic memory or immediate recall, might help screen for dementia or predementia stage.

Healthy aging can be reflected in good cognitive function in older adults. Cognitive functions are associated with multiple factors, such as demographic factors, comorbidities, disability, social capital, and psychosocial profiles.[2,4] Study by Olaya et al. investigating multiple trajectories of verbal episodic memory in English older adults showed that many factors, including sociodemographic, depression, and chronic conditions, modulated the decline of episodic memory in low and high episodic score groups at baseline after ten years of follow up.[12] It is essential to know factors affecting immediate recall since it predicts the progression of older adults to AD. Until now, there was no study involving Indonesian older adults identifying the potentially modifiable factors of episodic memory, particularly immediate recall. Therefore, we aim to evaluate the associations between memory impairment (measured by immediate recall) and associated risk factors (e.g., demographic and health variables) among older adults in Indonesia.

Methods

Study Designs and Participant

Data were taken from the Indonesia Family Life Survey-5 (IFLS-5) collected in 2014-2015. The IFLS-5 is a cross-sectional study with a multistage stratified sampling design covering several major regions in Indonesia.[13] A total of 4236 individuals aged 60 and over with cognitive function measurements were included. We followed the methods of Pengpid et al., 2019.[14]

Measures

Memory impairment was measured by reading participants the lists of ten Indonesian nouns which they had to recall without prompting or cues. Respondents were randomly assigned to one of the four recall tasks drawn from four categorized word lists. The immediate recall score was classified into (1) high (score 6-10), (2) medium (score 3-5), and (3) low (score 0-2). Low scores were considered as memory impairment.[13]

The functional capability was measured using six items from the Katz Activity of Daily Living (ADL) index (bathing, dressing, toileting, transference, continence, and feeding) and six items of the Lawton Instrumental Activity of Daily Living (IADL) index (shopping, food preparation, housekeeping, laundry, taking medications, and handling finance).[15,16] ADL and IADL were then classified into 'independent' and 'dependent,' with having difficulty in at least one of the items indicating dependency.

Sociodemographic factors included age, sex, marital status, education, residential status, region (rural or urban and location, see below), and subjective economic status. Age was classified into

three groups (60-69 years, 70-79 years, and ≥80 years). Marital status was grouped into married or co-habiting vs. never married, separated, widowed, or divorced. Educational level was grouped into high (≥9 years of schooling) and low (< 9 years of education). Regions were grouped into Sumatra, Java, and 'other' (comprising Kalimantan, Sulawesi, Bali, and West Nusa Tenggara). Subjective economic status was assessed using the question "Please imagine a six-step ladder where on the bottom stand the poorest people and on the highest step stand the richest people. On which economic step are you today?" with answers ranging from (1) poorest to (6) richest, which was grouped into 'poor' (if at step 1 and 2), 'medium' (step 3 and 4), and 'rich' (step 5 and 6).

Using standardized instruments, the body mass index (BMI) was calculated using measured height and body weight. The Asia Pacific Classification was used to classify BMI into Underweight, Normal, and Overweight/Obese.[17]

Self-perceived health status was assessed using the question "Please think about your health. How healthy do you feel?", with four options ranging from 'very healthy' (option 1) to 'unhealthy' (option 4), which were regrouped into 'healthy' (option 1 and 2) and 'unhealthy' (option 3 and 4).

Chronic health conditions were assessed using the self-reported questions whether the participants had been diagnosed by a doctor, paramedic, nurse, or midwife with hypertension, diabetes, tuberculosis, chronic pulmonary disease, brain injury, psychological problems, memory problems, cardiac disease, stroke, kidney disease, arthritis, cancer, hearing or visual problems, or high cholesterol. This variable was later classified into 'none' vs. 'one or more chronic morbidities.' The treatment status of the participants was not considered in the study design.

Life satisfaction was measured using the question “Please think about your life as a whole. How satisfied are you with it?” with five answers ranging from ‘completely satisfied’ (option 1) to ‘not at all satisfied’ (option 5). This variable was later regrouped into high life satisfaction (option 1 to 3) vs. low life satisfaction (option 4 to 5).

Social capital was measured with questions regarding activities in the past 12 months, such as participation in community meetings, volunteering, being involved in neighborhood activities, and engaging in religious activities. High social capital was defined as participants who had participated at least in one of the mentioned activities.

The International Physical Activity Questionnaire short version (IPAQ-S7S) was used to assess the intensity of physical activity. The classification was based on IPAQ protocol into ‘low,’ ‘moderate,’ and ‘high.’[18]

Falls were measured using the question “In the last two years, have you ever fallen?” with the classification of (1) ‘no’ and (2) ‘yes.’

The question from the Center for Epidemiologic Studies Depression Scale (CES-D 10), which was “How often did you feel lonely in the past week?” was used to assess loneliness, with four options ranging from ‘rarely or not at all’ (option 1) to ‘most of the time’ (option 4).[19] Loneliness was reclassified into ‘not lonely’ (option 1 to 2) and ‘lonely’ (option 3 to 4).

Depression was also measured using items from CES-D 10. Clinical depression was defined as having a score higher than 10.[19] The treatment status of the participants was not considered in the study design.

Five items were included from the Patient-Reported Outcomes Measurement Information System (PROMIS) on sleep disturbance, and sleep impairment measures were used to measure insomnia, with a score ranging to 40.[20,21] Insomnia was defined as having a score higher or equal to 21.

Tobacco usage was measured using questions "Have you ever chewed tobacco, smoked a pipe, smoked self-enrolled cigarettes, or smoked cigarettes/cigar?" with two options of no and yes, and "Do you still have the habit or have you quit?", with options of 'have quit' and 'current use' if the participants had a history of tobacco use. Later, tobacco usage was classified into 'never/former' and 'current smoker.'

Statistical Analysis

Descriptive analyses were calculated using frequencies. Comparison of characteristics between those with memory impairment and those without was analyzed using bivariate logistic regression. The association between dependent and independent variables was then evaluated using multivariate logistic regression analysis using the stepwise backward method. The analyzed data presented a p-value ($p<0.05$ was considered significant) and a 95% confidence interval. Analyses were conducted using IBM SPSS software version 22 (IBM, New York, USA).

Results

The total sample included 4236 older adults aged 60 years and older (Table 1). The ratio between male and female was almost equal (49.7% were male and 50.3% were female) The majority of respondents (68.8%) had a medium to high score in immediate recall, and 31.2% had

low scores in immediate recall. About half of the sample (50.3%) was female. Two-thirds (66.6%) of the older adults were 'married or co-habiting.' Eighty-five percent of the participants had low educational status (< 9 years), 49.2% resided in a rural area, 12.6% participants lived in Sumatra, and 78.2% on Java. The self-perceived socioeconomic status of most participants (39.9%) was medium, but 33.7% regarded themselves as poor. Low life satisfaction was found in 17.8% of participants, 34.6% described themselves as unhealthy, and 16.3% were experiencing clinical depression. Body mass index classified as overweight/obese was found in 34.6% of participants, and being underweight was seen in 26%. Dependent older adults comprised 12.7% and 25.6% of the total population as measured by ADL and IADL, respectively. One or more chronic conditions were seen in 46.6% of the population, and 47% had low engagement in physical activities.

Bivariate analyses show that low immediate word recall was associated with older age, being female, having had low education, living in a rural setting, living outside Sumatra and Java, being of poor perceived economic status, being underweight, having low life satisfaction, and low social capital, being lonely, reporting dependency (measured by ADL and IADL), and having clinical depression. Moderate -- but not high or low -- physical activity was protective, as -surprisingly- was reporting more chronic health conditions as established by a medical professional. Falls, insomnia, and tobacco use had no association with memory impairment (Table 2).

Multivariate logistic analyses using the stepwise backward method showed that 70-79 years old and more than 80 years old increased risk of memory impairment 1.74 times (95% CI: 1.49-2.04) and 4.97 times (95% CI: 3.53-7.02), respectively (Table 3). Being female was also associated with low immediate recall (AOR: 1.2, 95% CI: 1.02-1.41). Older adults who had never married

or had been separated, divorced, or widowed had an increased risk of 1.26 times greater for memory impairment than married or co-habiting older adults. Low immediate recall score was also associated with having had low education (AOR: 3,57, 95% CI: 2.66-4.8), living in a rural area (AOR: 1.39, 95% CI: 1.2-1.6), being underweight (AOR: 1.27, 95% CI: 1.07-1.5), low life satisfaction (AOR: 1.36, 95% CI: 1.14-1.62), low social capital (AOR: 1.23, 95% CI: 1.03-1.46), and dependency measured by ADL (AOR: 1.3, 95% CI: 1.05-1.61) and IADL (AOR: 1.3, 95% CI: 1.1-1.54). Having clinical depression was associated with an increased risk of 1.25 times (95% CI: 1.04-1.51, compared to non-depressed) for a low immediate recall score. Being overweight/obese (AOR: 0.81, 95% CI: 0.68-0.97) was a protective factor against a low immediate recall score. Engaging in moderate physical activity (AOR: 0.81, 95% CI: 0.66-0.98, vs. engaging in little or high physical activity) showed a decreased risk for low immediate recall scores as did -counter-intuitively- self-perceived poor health (AOR: 0.73, 95% CI: 0.62-0.85), but not chronic health conditions, falls, insomnia, socioeconomic status or region (Java, Sumatra or other islands).

Discussion

Aging is often accompanied by memory impairment. We assessed short-term episodic memory measured using an immediate recall score found in other studies to indicate later dementia risk. Our findings showed that an older age independently increased the risk of getting a low score on the immediate recall test suggestive of memory impairment. Many other studies also showed older age to be associated with memory and other cognitive impairments, as measured using various measurement tools, such as the Clinton Assessment Procedure for the Elderly (CAPE), the Montreal Cognitive Assessment, and locally validated formal neuropsychological

instruments, such as the Hopkins Verbal Learning Test and Mini-Mental State Examination.[22–29] Older adults tend to recall fewer words using fewer search strategies and more shallow attention due to impaired cognitive control processes.[30] Tasks with a higher cognitive load also have more age-related impairment than the less demanding tasks, such as recognition tests. A study comparing episodic memory plasticity between children and older adults showed that older adults had lower plasticity in episodic memory and a decline in strategic and associative components of episodic memory.[31] Strategic elements refer to the ability to encode and retrieve a memory, while associative components integrate memory features to create a coherent interpretation. Being female was a risk factor for low immediate recall, which was in contrast with several studies that showed women tended to perform better on episodic memory tests than men.[32,33] Being married or co-habiting was a protective factor in our research independently, even after adjusting for other covariates, including social capital and economic status. Other studies have shown that increased social support might prevent negative outcomes on cognitive ability among the widowed.[34] Also, being unmarried (never married, separated, divorced, and widowed) might adversely affect the economic status, which could explain why the economic status was not included in the final analysis.

Having had less education increased the risk of having a low immediate recall ability, which is also shown in other studies.[35] High education helps maintain episodic memory with advancing brain pathology and aging by altering brain networks, improving efficiency, capacity, and flexibility by recruiting alternative networks to support the primary networks.[35] Education also helps create better vocabularies allowing substituting in word-finding issues, a higher level of abstraction, and broader strategies in memory processing.[36] Despite having low education, frequently engaging in cognitive activities, such as reading books, magazines, or newspapers;

doing word games, such as crosswords, puzzles, and scrabble; attending educational lectures or courses and writing can help compensate for the educational differences. This effect increased cognitive performance even more in the lower education group than in the high education group.[37] In addition, in the present study, engaging with such psychosocial activities ('social capital') was maintained independently in backward stepwise regression analyses. Living in a rural area was associated with a negative impact on immediate recall. The associations between living in non-urban settings and poor cognitive outcomes may be partly explained by educational disadvantages and less access to medical facilities and resources essential to maintain and promote physical and cognitive health.[38] These findings can provide useful local interventions to improve cognitive functioning.

Low life satisfaction increased the risk of low immediate recall scores, which is consistent with another study conducted in Sweden that showed that low life satisfaction was associated with impaired episodic memory.[39] Older adults who report high life satisfaction tend to pursue various activities and have opportunities for interaction and maintaining social relations.[40] A low immediate recall score was also associated with functional dependency, which was similar to a study evaluating associations between several cognitive domains and ADL-IADL. Executive function and episodic memory have the strongest significant associations with functional performance, especially in 'doing laundry,' 'doing simple domestic chores,' and 'preparing meals.'[41] The execution of these activities requires abilities related to identification and following through with different steps necessary to achieve the final goals (e.g., different steps to prepare meals) or recalling information (e.g., remembering what house cleaning was already done).[42] Those who are dependent would perhaps also have less opportunity and physical and mental ability to engage with psychosocial activities and build up social capital. The association

between clinical depression and memory impairment was found to be independently significant in our study, which was similar to findings from other studies.[43-45] Depressed older adults may have ruminative thoughts that draw attention away from episodic memory tasks (e.g., recall test). Depression in older adults has a different impact compared to young adults, whose cognitive capacity could be adequate to compensate for the depressive effects on encoding, storage, and retrieval of information. Depression also creates a lower affective intensity, decreasing memory processing based on emotional stimuli.[43,44] Recall task performance was found to be more difficult in depressed older adults compared to performance on a recognition task, in which the former requires more attention and cognitive control. At the same time, the latter involves more passive detection.[45] Untreated depression could serve as a chronic illness in damaging the physiological brain structure and cognitive function and engaging less in psychosocial and physical activity.[43] In addition, as suggested above, dependency and low life satisfaction (a key characteristic of depression) may have explained the association of depression and recall in multivariate analyses. Our findings show that obesity lowered the risk of lower immediate recall, and other studies showed mixed results regarding this matter.[46–48]

Being underweight was a risk factor in our study, which is consistent with other literature, where being underweight is a robust risk factor for poor cognition. This could be a proxy of nutritional deficiency and life-long deprivation. Mechanisms responsible could relate to frailty (including disease susceptibility), which is often co-morbid with cognitive impairment. In other studies, being underweight was also associated with more difficulty in performing IADLs, chronic diseases, mental disorders, and sarcopenia.[49] As diagnosed by a medical professional, chronic health conditions had a bivariate association protective association, but this could be because only the more affluent and urban older people had good access to these resources. Importantly,

both economic status and chronic health conditions were not significant in multivariate analyses involving rural living and education.

Lastly, only moderate physical activity was associated with a reduced risk of memory impairment compared to high or low physical activity, which was not significant. In many studies, physical activity was associated with a reduced risk of episodic memory impairment.[50-54] Previously, we found a dose-dependent effect, with more moderate and vigorous physical activity being most protective in a UK study.[54] Moderate exercise can facilitate episodic memory function by enhancing neuronal excitability, improving attentional resource allocation for encoding, increasing hippocampal activity, increasing brain-derived neurotropic factor (BDNF), enhancing dendritic spine growth, and ultimately, modulating long-term potentiation and synaptic plasticity.[50,55] Chronic exercise also increased neurogenesis, gliogenesis, and angiogenesis.[54] In terms of exercise, aerobic-based physical activity was strongly associated with episodic memory function, while resistance-based physical activity showed mixed results.[53]

Conclusion

This study provides data regarding memory impairment assessed by immediate recall scores and its associated risk and protective factors among older adults in Indonesia. Lower immediate recall score was associated with older age, being female, or non-married (unmarried, separated, divorced, or widowed), having obtained low education, living in a rural area, being underweight, low life satisfaction, low social capital, dependency, and having clinical depression. Being moderately physically active and being overweight were protective factors against the risk of low

immediate recall scores. Increasing education and continued engagement of older adults in educational, social, and moderate physical activities, improving physical and mental health, preventing underweight (and frailty), and maintaining functional ability might help modify the episodic memory trajectories and hopefuly reduce dementia risk, especially in non-married older females in rural areas, however, consideration of the limit of the study should be done.

Limit of the study

The strength of this study was that it involves a large national data set and includes the immediate recall score as an episodic memory indicator. However, there were several limitations. This study used self-reported measurements that tend to be subjective and a cross-sectional study design. For instance, only in multivariate analyses had people who complained more of poor subjective health better memory performance. Reverse causation can also explain some associations (e.g., not engaging in psychosocial activities because of reduced memory function) but are difficult to control in observational studies.

Ethical Issue

The IFLS surveys and procedures were reviewed and approved by Institutional Review Boards (IRBs) in the United States at RAND corporation and in Indonesia at the University of Gadjah Mada (UGM) for IFLS-3, IFLS-4, and IFLS-5. All requirements for consent for older adults were met and approved by those IRBs before the work could begin.

Data Availability

Data employed in this study are publicly available by registering requests at RAND (https://www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html).

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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References

1. World Health Organization [WHO]. *World Population Ageing 2019*. Geneva: WHO; 2019.

2. International AD, Wimo A, Ali G-C, et al. World Alzheimer report 2015: the global impact of dementia: an analysis of prevalence, incidence, cost and trends. London: Alzheimers International;2015 Available from: https://www.alzint.org/resource/world-alzheimer-report-2015/ [Accessed 2021 Jul 22]

3. Yaffe K, Fiocco AJ, Lindquist K, et al. Predictors of maintaining cognitive function in older adults. *Neurology*. 2009;72(23). Available from: https://n.neurology.org/content/72/23/2029.short [Accessed 2021 Jul 22].

4. Suriastini NW, Turana Y, Supraptilah B, et al. Prevalence and risk factors of dementia and caregiver's knowledge of the early symptoms of alzheimer's disease. *Aging Med Healthc*. 2020;11(2):60–6.

5. Runge SK, Craig BM, Jim HS. Word recall: cognitive performance within internet surveys. *JMIR Ment Health*. 2015;2(2):e20.

6. Gavett BE, Horwitz JE. Immediate list recall as a measure of short-term episodic memory: insights from the serial position effect and item response theory. *Arch Clin Neuropsychol*. 2012;27(2):125–35.

7. Derby CA, Burns LC, Wang C, Katz Mj, Zimmerman ME, L'Italien G, Guo Z, Berman RM, Lipton RB. Screening fot predementia AD: Time-dependent operating characteristics of episodic memory tests. *Neurology*. 2013;80:1-8.

8. Younan D, Petkus AJ, Widaman KF, Wang X, Casanova R, Espeland MA, et al. Particulate matter and episodic memory decline mediated by early neuroanatomic biomarkers of Alzheimer's disease. *Brain*. 2019;0:1-14. DOI: 10.1093/brain/awz348

9. Downey LA, Simpson T, Timmer J, Nolidin K, Croft K, Wesnes KA, Scholey A, Deleuil S, Stough C. Impaired verbal episodic memory in healthy older adults is marked by increased F2-Isoprostanes. *Prostaglandins Leukot Essent*. 2018. DOI: 10.1016/j.pleafa.2018.02.001

10. Hiscox LV, Johnson CL, McGarry MDJ, Schwarb H, Beek EJR, Roberts N, Starr JM. Hippocampal viscoelasticity and episodic memory performance in healthy older adults examined with magnetic resonancr elastography. *Brain Imaging Behav*. 2020;14:175-85. DOI: 10.1007/s11682-018-9988-8

11. Pause Bm, Zlomuzica A, Kinugawa K, Mariani J, Pietrowsky R, Dere E. Perspectives on episodic-like memory and episodic memory. *Frin Behav Neurosci*. 2013;7(33):1-12. DOI: 10.3389/fnbeh.2013.00033

12. Olaya B, Bobak M, Haro JM, Demakakos P. Trajectories of verbal episodic memory in middle-aged and older adults: Evidence from the English Longitudinal Study of Ageing. *J Am Geriatr Soc*. 2017. DOI: 10.1111/jgs.14789

13. Strauss J, Witoelar F, Sikoki B. *The fifth wave of the indonesia family life survey: overview and field report: volume 1* [Internet]. RAND Corporation; 2016. Available from: http://www.rand.org/pubs/working_papers/WR1143z1.html [Accessed 2021 Jul 1]

14. Pengpid S, Peltzer K, Susilowati IH. Cognitive functioning and associated factors in older adults: results from the indonesian family life survey-5 (IFLS-5) in 2014-2015. *Curr Gerontol Geriatr Res*. 2019 Feb 3;2019:e4527647.

15. Katz S, Ford AB, Moskowitz RW, et al. Studies of illness in the aged: the index of adl: a standardized measure of biological and psychosocial function. *JAMA*. 1963 Sep 21;185(12):914–9.

16. Lawton MP, Brody EM. Assessment of older people: Self-maintaining and instrumental activities of daily living. The Gerontologist. 1969;9(3, Pt 1):179–86.

17. World Health Organization [WHO]. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *The Lancet*. 2004 Jan;363(9403):157–63.

18. Craig CL, Marshall AL, Sjöström M, et al. International Physical Activity Questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc*. 2003 Aug;35(8):1381–95.

19. Andresen EM, Malmgren JA, Carter WB, Patrick DL. Screening for depression in well older adults: evaluation of a short form of the CES-D. *Am J Prev Med*. 1994 Mar 1;10(2):77–84.

20. Yu L, Buysse DJ, Germain A, et al. Development of short forms from the PROMIS™ sleep disturbance and sleep-related impairment item banks. *Behav Sleep Med*. 2012 Jan 1;10(1):6–24.

21. Buysse DJ, Yu L, Moul DE, et al. Development and validation of patient-reported outcome measures for sleep disturbance and sleep-related impairments. *Sleep*. 2010 Jun 1;33(6):781–92.

22. Holz AW, Nunes BP, Thumé E, et al. Prevalence of cognitive impairment and associated factors among the elderly in Bagé, Rio Grande do Sul, Brazil. *Rev Bras Epidemiol*. 2013 Dec;16(4):880–8.

23. Millán-Calenti JC, Tubío J, Pita-Fernández S, et al. Prevalence of functional disability in activities of daily living (ADL), instrumental activities of daily living (IADL) and associated factors, as predictors of morbidity and mortality. *Arch Gerontol Geriatr*. 2010 May 1;50(3):306–10.

24. Wang J, Xiao LD, Wang K, et al. Cognitive impairment and associated factors in rural elderly in North China. *J Alzheimers Dis*. 2020 Jan 1;77(3):1241–53.

25. Yao Y-H, Xu R-F, Tang H-D, et al. Cognitive impairment and associated factors among the elderly in the shanghai suburb: findings from a low-education population. *Neuroepidemiology*. 2010;34(4):245–52.

26. Kim H-J, Hong S, Kim M. Living arrangement, social connectedness, and life satisfaction among korean older adults with physical disabilities: the results from the national survey on persons with disabilities. *J Dev Phys Disabil*. 2015 Jun 1;27(3):307–21.

27. Woo J, Ho SC, Lau S, et al. Prevalence of cognitive impairment and associated factors among elderly Hong Kong chinese aged 70 years and over. *Neuroepidemiology*. 1994;13(1–2):50–8.

28. Hilal S, Ikram MK, Saini M, et al. Prevalence of cognitive impairment in Chinese: epidemiology of dementia in Singapore study. *J Neurol Neurosurg Psychiatry*. 2013 Jun 1;84(6):686–92.

29. Gondim AS, Coelho JM, Cavalcanti A de A, et al. Prevalence of functional cognitive impairment and associated factors in Brazilian community-dwelling older adults. *Dement Neuropsychol*. 2017 Mar;11:32–9.

30. Wagnon CC, Wehrmann K, Klöppel S, Peter J. Incidental learning: a systematic review of its effect on episodic memory performance in older age. *Front Aging Neurosci*. 2019. Available from: https://internal-journal.frontiersin.org/articles/10.3389/fnagi.2019.00173/full [Assessed 2021 Jul 26].

31. Shing YL, Lindenberger U. The development of episodic memory: lifespan lessons. *Child Dev Perspect*. 2011;5(2):148–55.

32. Herlitz A, Rehnman J. Sex differences in episodic memory. *Curr Dir Psychol Sci*. 2008;17(1):52-6.

33. Lei XY, Hu Y, McArdle JJ, et al. Gender differences in cognition among older adults in China. *J Hum Resour*. 2012;47(4):951-71.

34. Zhang Z, Li L, Xu H, Liu J. Does widowhood affect cognitive function among chinese older adults. *SSM Popul Health*. 2018;doi.org/10.1016/j.ssmph.2018.100329.

35. Mungas D, Fletcher E, Gavett BE, et al. Comparison of education and episodic memory as modifiers of brain atrophy effects on cognitive decline: implications for measuring cognitive reserve. *J Int Neuropsychol Soc*. 2021 May;27(5):401–11.

36. Angel L, Fay S, Bouazzaoui B, et al. Protective role of educational level on episodic memory aging: An event-related potential study. *Brain Cogn*. 2010 Dec 1;74(3):312–23.

37. Lachman ME, Agrigoroaei S, Murphy C, Tun PA. Frequent cognitive activity compensates for education differences in episodic memory. *Am J Geriatr Psychiatry*. 2010 Jan 1;18(1):4–10.

38. Johnson KE, Sol K, Sprague BN, et al. The impact of region and urbanicity on the discrimination-cognitive health link among older blacks. *Res Hum Dev*. 2020 Jan 2;17(1):4–19.

39. Enkvist Å, Ekström H, Elmståhl S. Associations between functional ability and life satisfaction in the oldest old: results from the longitudinal population study Good Aging in Skåne. *Clin Interv Aging*. 2012;7:313–20.

40. Heo J, Stebbins RA, Kim J, Lee I. Serious leisure, life satisfaction, and health of older adults. *Leis Sci*. 2013 Jan 1;35(1):16–32.

41. Ansah JP, Chiu CT, Wei-Yan AC, et al. Trends in functional disability and cognitive impairment among the older adult in China up to 2060: estimates from a dynamic multi-state population model. *BMC Geriatr*. 2021 Jun 22;21(1):380.

42. de Paula JJ, Diniz BS, Bicalho MA, et al. Specific cognitive functions and depressive symptoms as predictors of activities of daily living in older adults with heterogeneous cognitive backgrounds. *Frontiers in Aging Neuroscience*. 2015; https://doi.org/10.3389/fnagi.2015.00139

43. Evans J, Charness N, Dijkstra K, et al. Is episodic memory performance more vulnerable to depressive affect in older adulthood? *Aging Neuropsychol Cogn*. 2019 Mar 4;26(2):244–63.

44. Zahodne LB, Nowinski CJ, Gershon RC, Manly JJ. Depressive symptoms are more strongly related to executive functioning and episodic memory among african american compared with non-hispanic white older adults. *Arch Clin Neuropsychol*. 2014 Nov 1;29(7):663–9.

45. Pauls F, Petermann F, Lepach AC. Episodic memory and executive functioning in currently depressed patients compared to healthy controls. *Cogn Emot*. 2015 Apr 3;29(3):383–400.

46. Loprinzi PD, Frith E. Obesity and episodic memory function. *J Physiol Sci*. 2018 Jul 1;68(4):321–31.

47. Ahn S, Mathiason MA, Lindquist R, Yu F. Factors predicting episodic memory changes in older adults with subjective cognitive decline: a longitudinal observational study. *Geriatr Nur (Lond)*. 2021 Jan 1;42(1):268–75.

48. Nilsson L-G, Nilsson E. Overweight and cognition. *Scand J Psychol*. 2009;50(6):660–7.

49. Xiang X, An R. Body weight status and onset of cognitive impairment among US middle-aged and older adults. *Arch Gerontol Geriatr*. 2015;60:394-400.

50. Canivet A, Albinet CT, André N, et al. Effects of BDNF polymorphism and physical activity on episodic memory in the elderly: a cross sectional study. *Eur Rev Aging Phys Act*. 2015 Dec 29;12(1):15.

51. Hayes SM, Alosco ML, Hayes JP, et al. Physical activity is positively associated with episodic memory in aging. *J Int Neuropsychol Soc*. 2015 Nov;21(10):780–90.

52. Loprinzi PD, Frith E, Edwards MK. Resistance exercise and episodic memory function: a systematic review. *Clin Physiol Funct Imaging*. 2018;38(6):923–9.

53. Loprinzi PD. Association between habitual physical activity on episodic memory strategy use and memory controllability. *Health Promot Perspect*. 2019 Jan 23;9(1):65–70.

54. Shi D, Geng F, Hu Y, Xu Q. Physical activity modulates the effect of cognitive control on episodic memory. *Front Psychol*. 2020. Available from: https://www.frontiersin.osrg/articles/10.3389/fpsyg.2020.00696/full [Accessed 2021 Jul 30]

55. Ponce P, Loprinzi PD. A bi-directional model of exercise and episodic memory function. Med Hypotheses. 2018 Aug 1;117:3–6.

Table 1. Variable characteristics

Variables	Categories	Frequency (%)
Total Samples		4236 (100)
Age	60-69	2976 (70.3)
	70-79	1074 (25.3)
	≥ 80	186 (4.4)
Sex	Male	2105 (49.7)
	Female	2131 (50.3)
Marital Status	Married/Cohabiting	2820 (66.6)
	Never married, separated, divorced, widowed	1416 (33.4)
Education	High	634 (15)
	Low	3602 (85)
Residential Status	Urban	2153 (50.8)
	Rural	2083 (49.2)
Region	Sumatera	535 (12.6)
	Jawa	3314 (78.2)
	Others	386 (9.1)
Socioeconomic Status	Rich	1120 (26.4)
	Medium	1690 (39.9)
	Poor	1426 (33.7)
Immediate Recall Score	High	2912 (68.8)
	Low	1324 (31.2)
ADL	Independent	3696 (87.3)
	Dependent	540 (12.7)
IADL	Independent	3153 (74.4)
	Dependent	1083 (25.6)
Body Mass Index	Underweight	1100 (26)
	Normal	1739 (41)
	Overweight/Obese	1397 (33)
Life Satisfaction	Yes	3481 (82.2)
	No	755 (17.8)
Subjective Health Status	Healthy	2770 (65.4)
	Unhealthy	1467 (34.6)
Social Capital	High	3488 (82.3)
	Low	748 (17.7)
Loneliness	No	3736 (88.2)
	Yes	500 (11.8)
Tobacco Use	Never, Former	2816 (66.5)
	Yes	1420 (33.5)
Depression	No	3545 (83.7)
	Yes	691 (16.3)
Chronic Condition	None	2261 (53.4)

	One or more	1975 (46.6)
Physical Activities	High	950 (22.4)
	Moderate	1286 (30.4)
	Low	2000 (47.2)
Falls	No	3728 (88)
	Yes	508 (12)
Insomnia	No	3793 (89.5)
	Yes	443 (10.5)

Table 2. Prevalence and bivariate analysis of factors associated with immediate recall score in Indonesian older adults

Variables	Categories	Immediate Recall Score		Unadjusted OR (95% CI)
		Moderate-High (3-10)	Low (0-2)	
Age	60-69	2234 (76.7)	743 (56.1)	Reference
	70-79	624 (21.4)	450 (34)	2.17 (1.87-2.51)***
	≥ 80	54 (1.9)	132 (10)	7.28 (5.25-10.09)***
Sex	Male	1525 (52.4)	580 (43.8)	Reference
	Female	1388 (47.6)	743 (56.2)	1.401 (1.24-1.6)***
Marital Status	Married/Cohabiting	2048 (70.3)	771 (58.3)	Reference
	Never married, separated, divorced, widowed	864 (29.7)	552 (41.7)	1.7 (1.48-1.94)
Education	High	577 (19.8)	57 (4.3)	Reference
	Low	2335 (80.2)	1267 (95.7)	5.52 (4.17-7.31)***
Residential Status	Urban	1623 (55.7)	530 (40)	Reference
	Rural	1289 (44.3)	794 (60)	1.89 (1.66-2.16)
Region	Sumatera	383 (13.2)	152 (11.5)	Reference
	Jawa	2281 (78.3)	1033 (78.1)	1.14 (0.93-1.4)
	Others	248 (8.5)	138 (10.4)	1.41 (1.06-1.86)**
Socioeconomic Status	Rich	816 (28)	304 (23)	Reference
	Medium	1194 (41)	496 (37.5)	1.11 (0.94-1.32)
	Poor	903 (31)	524 (39.6)	1.56 (1.31-1.84)***
Body Mass Index	Underweight	640 (22)	460 (34.7)	1.56 (1.33-1.82)***
	Normal	1190 (40.9)	549 (41.5)	Reference
	Overweight/Obese	1082 (31.2)	315 (23.8)	0.63 (0.54-0.74)***
Life Satisfaction	Yes	2462 (84.5)	1019 (77)	Reference
	No	450 (15.5)	305 (23)	1.64 (1.39-1.93)***
Subjective Health Status	Healthy	1886 (64.8)	883 (66.7)	Reference
	Unhealthy	1026 (35.2)	440 (33.3)	0.92 (0.8-1.05)
Social Capital	High	2459 (84.4)	1029 (77.8)	Reference
	Low	454 (15.6)	294 (22.2)	1.55 (1.32-1.83)***
Loneliness	No	2590 (88.9)	1146 (86.6)	Reference
	Yes	322 (11.1)	178 (13.4)	1.25 (1.03-1.52)*
ADL	Independent	2596 (89.1)	1101 (83.2)	Reference
	Dependent	317 (10.9)	223 (16.8)	1.66 (1.38-2)***
IADL	Independent	2262 (77.7)	891 (67.3)	Reference
	Dependent	650 (22.3)	433 (32.7)	1.69 (1.46-1.95)***

Tobacco Use	Never, Former	1932 (66.3)	883 (66.7)	Reference
	Yes	980 (33.7)	440 (33.3)	0.98 (0.86-1.13)
Depression	No	2475 (85)	1070 (80.8)	Reference
	Yes	438 (15)	254 (19.2)	1.34 (1.13-1.59)***
Chronic Condition	None	1484 (51)	777 (58.7)	Reference
	One or more	1428 (49)	547 (41.3)	0.73 (0.64-0.83)***
Physical Activities	High	649 (22.3)	301 (22.7)	Reference
	Moderate	937 (32.2)	349 (26.4)	0.8 (0.67-0.97)**
	Low	1326 (45.5)	674 (50.9)	1.01 (0.93-1.29)
Falls	No	360 (12.4)	148 (11.2)	Reference
	Yes	2552 (87.6)	1176 (88.8)	0.89 (0.73-1.09)
Insomnia	No	2613 (89.7)	1180 (89.1)	Reference
	Yes	299 (10.3)	144 (10.9)	1.07 (0.87-1.32)

* p-value <0.05
** p-value<0.01

Table 3. Backward stepwise logistic regression analysis of factors associated with immediate recall score in older adult

Variables	**Categories**	**Low Immediate Recall Score**
		Adjusted OR (95% CI), *p-value*
Age	60-69	Reference
	70-79	1.74 (1.49-2.04), <0.001
	≥ 80	4.97 (3.53-7.02), <0.001
Sex	Male	Reference
	Female	1.2 (1.02-1.41), 0.031
Marital Status	Married/Cohabiting	Reference
	Never married, separated, divorced, widowed	1.26 (1.07-1.49), <0.001
Education	High	Reference
	Low	3.57 (2.66-4.8), <0.001
Residential Status	Urban	Reference
	Rural	1.39 (1.2-1.6), <0.001
Body Mass Index	Underweight	1.27 (1.07-1.5), 0.006
	Normal	Reference
	Overweight/Obese	0.81 (0.68-0.97), 0.018
Life Satisfaction	Yes	Reference
	No	1.36 (1.14-1.62), 0.001
Subjective Health Status	Healthy	Reference
	Unhealthy	0.73 (0.62-0.85), <0.001
Social Capital	High	Reference
	Low	1.23 (1.03-1.46), 0.024
ADL	Independent	Reference
	Dependent	1.3 (1.05-1.61), 0.018
IADL	Independent	Reference
	Dependent	1.3 (1.1-1.54), 0.002
Depression	No	Reference
	Yes	1.25 (1.04-1.51), 0.02
Physical Activities	High	Reference
	Moderate	0.81 (0.66-0.98), 0.031
	Low	1 (0.84-1.2), 0.967