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Predicting dementia: role of dementia risk indices

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Abstract

There are currently more than 5 million people in the USA living with Alzheimer's disease and other forms of dementia, and prevalence is expected to triple over the next 40 years. As new strategies for prevention and treatment are developed, it will be critically important to be able to identify older adults who do not currently have dementia but have a high risk of developing symptoms within a few years so that they can be targeted for monitoring, prevention and early treatment. In other fields, prognostic models and risk indices are often used to identify high-risk individuals (e.g., Framingham Heart Index and Breast Cancer Risk Assessment Tool). The objective of this paper is to describe the development of Dementia Risk Indices and to discuss the potential for these tools to be incorporated into clinical and research settings for the identification of individuals with a high risk of dementia.

Keywords

dementia; prevention; risk assessment; risk factors

Importance of early detection

The looming dementia epidemic is one of the most important public health issues that our nation will face in the coming years. The prevalence of Alzheimer's disease – the most common form of dementia – in the USA is currently more than 5 million, and a new person develops the disease every 70 s [101]. By 2050, it is anticipated that 10 million baby boomers will have developed dementia, resulting in a prevalence of 11–16 million [1]. The costs of this epidemic – both economically and in terms of the suffering of affected individuals and their caregivers – could be crippling to our economy and national productivity. It is estimated that the direct and indirect costs of dementia to Medicaid, Medicare and businesses amounts to almost US \$150 billion each year [101].

Despite these gloomy predictions, this is also a time of tremendous discovery and optimism in the field of dementia research. Several medications have been approved for dementia treatment, including acetylcholinesterase inhibitors (donepezil, galantamine and rivastigmine) primarily for mild-to-moderate dementia and the NMDA receptor antagonist memantine for moderate-to-severe dementia [2]. Although these medications do not clearly alter the progression of the disease, they do provide important symptomatic relief in many individuals. In addition, basic science research is growing closer to understanding the mechanisms underlying Alzheimer's

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disease and other dementias and has identified numerous new therapeutic targets. Several new classes of drugs are in Phase II and III clinical trials, and there is hope that they will have disease-modifying effects and will stop or even reverse disease progression [3].

In addition, there is excitement surrounding the potential to prevent or delay the onset of dementia. Dementia has a long preclinical period in which neurodegenerative changes may occur in the brain for many years without resulting in obvious cognitive impairment. Therefore, interventions that stop the progression of neurodegeneration have the potential to prevent the disease from ever becoming symptomatic. Similarly, as the incidence of dementia increases exponentially with age – approximately doubling every 5 years after the age of 65 years [4] – an intervention that could delay the onset of symptoms by as little as 1 or 2 years could prevent millions of people from ever developing symptoms within their lifetimes [5]. In addition to new medications being developed, strategies for prevention and delaying onset of dementia could include control of mid-life cardiovascular disease and cardiovascular risk factors and adoption of healthy lifestyle choices such as eating a brain-healthy diet and living an ‘engaged’ lifestyle that includes physical, social and mental activity [6].

As new strategies for treatment and prevention of dementia are developed, it will be critically important to be able to identify older adults who do not currently have dementia but have a high risk of developing symptoms within a few years so that they can be targeted for monitoring, prevention and early treatment. Most currently available tools, such as the Mini-Mental State Examination [7] and Mini-Cog [8], are designed to screen for prevalent dementia. However, it also is important to develop and validate tools to identify individuals who are currently asymptomatic but have a high risk of developing symptoms within their lifetimes.

Risk indices in other settings

Prognostic models – or risk indices – are tools that combine information regarding the known (or hypothesized) risk factors for a particular outcome to produce risk estimates for individuals [9–11]. Typically, risk indices are developed as statistical models that use a weighted scoring system to predict an individual’s risk of experiencing a given event within a given time frame based on their risk factor profile.

The Framingham Heart Index is perhaps the most well-known and widely used risk index. It uses a person’s age, diabetes status, smoking status, blood pressure and cholesterol level to predict risk of experiencing a major coronary event within 10 years [12]. A patient’s Framingham Index score can be combined with their history to determine the need for other tests, such as an ECG, an exercise stress test or a thallium scan, with more definitive diagnosis provided by cardiac catheterization and angiography. In addition, individuals who have high Framingham Index scores but are currently free of disease are often referred for intervention or prevention strategies such as smoking cessation, nutritional counseling or exercise programs.

Similarly, the Breast Cancer Risk Assessment Tool uses information regarding a woman’s age, race, reproductive history, family history of breast cancer and biopsy history to predict her risk of developing invasive breast cancer within 5 years [13,14]. This tool can be used clinically to help determine whether annual or biennial screening should be recommended and whether genetic testing should be considered. In a research setting, it can be used to identify high-risk women for inclusion in prevention trials. Risk indices also have been developed to identify those with a high risk of diabetes [15,16] and overall mortality in both hospitalized [17] and community-dwelling elders [18].

Development of dementia risks

Over the past several decades, numerous dementia risk factors have been identified, although it is not clear whether all of them are causally associated with dementia risk. Age is well established as the most important risk factor for dementia [4], but a large number of other risk factors have been identified, including other demographic factors (gender [19], education [20] and race/ethnicity [21]), cardiovascular risk factors (diabetes [22], hypertension [23] and stroke [24]), genetic factors (*APOE* [25]), lifestyle factors (physical [26] and mental activity [27], diet [28], smoking [29] and alcohol consumption [30]), psychosocial factors (depressive symptoms [31] and social activity [32]), cognitive function (low-normal performance on standard tests) [33], physical function (ability to perform daily activities) [34], physical performance (performance score [35] and abnormal gait [36]), biomarkers (inflammatory markers [37] and cystatin C [38]) and MRI findings (hippocampal atrophy, white matter disease and ventricular atrophy) [39,40], among others. The goal of a risk index is to determine which combination of factors is most predictive of future risk.

Two dementia risk indices have recently been developed. The first was a Mid-Life Dementia Risk Score developed in Finland that is designed to be administered to middle-aged adults (40–64 years) [41]. This tool uses a combination of age, gender, education, physical inactivity and history of obesity, hypertension and hypercholesterolemia to predict risk of dementia 20 years later (Table 1). The accuracy of the Mid-Life Dementia Risk Score based on the statistical measure of accuracy in which 1.0 is perfect and 0.5 is no better than guessing (c statistic) was 0.77. Inclusion of the genetic risk factor *APOE* only slightly improved the accuracy of the index (c statistic: 0.78). In addition, 1% of individuals with the lowest mid-life risk scores developed dementia over 20 years compared with 16% of those with the highest mid-life risk scores. Since this index requires information regarding disease status in mid-life, it may be especially helpful for identifying middle-aged individuals who could be targeted for aggressive treatment of cardiovascular risk factors and behavioral interventions.

The second dementia risk index, developed by our group, is a Late-Life Dementia Risk Index that is designed to be administered in older adults (age 65 years or older) [42]. It uses a combination of demographic, cognitive, behavioral, functional, medical, genetic, cerebral MRI, and carotid artery ultrasound measures to predict risk of developing dementia within 6 years (Table 1). The c statistic was 0.81, which was slightly higher than that observed for the Mid-Life Dementia Risk Score. In addition, the Late-Life Dementia Risk Index achieved greater separation between the low- and high-risk groups in terms of actual dementia risk; 4% of subjects with low scores developed dementia within 6 years compared with 23% of subjects with moderate scores and 56% of subjects with high scores.

The Late-Life Dementia Risk Index was initially developed to be a ‘gold-standard’ for predicting dementia risk in late life. However, it includes several measures that may be somewhat costly and time consuming to obtain, such as cerebral MRIs, carotid artery ultrasound and *APOE* genotype. The Late-Life Index may prove to be useful when extensive clinical testing is being planned or has already been performed or in research settings when it is important to obtain the most accurate prediction of risk possible. However, it may be impractical to administer in many clinical and research settings. Therefore, we are also in the process of developing an abbreviated Brief Dementia Risk Index that will focus on identifying measures that predict dementia risk with high accuracy and could be easily administered by a nurse or research assistant.

It is interesting to note the similarities and differences between the mid- and late-life indices. Older age, lower education/cognitive performance and *APOE* *ε4* genotype were identified as important risk factors in both indices. The other factors included in the Mid-Life Score were

primarily cardiovascular risk factors (obesity, hypertension, hypercholesterolemia and inactivity). By contrast, the Late-Life Index included several measures that could be viewed as measures of the impact of mid-life risk factors on the brain and other organs (e.g., mid-life hypertension might lead to late-life white matter disease on an MRI; mid-life hypercholesterolemia might lead to late-life internal carotid artery thickening). Consistent with other studies, high BMI was identified as a risk factor in the Mid-Life Score while low BMI was identified as a risk factor in the Late-Life Index.

Next steps

An important limitation of both the Mid-Life Dementia Risk Score and the Late-Life Dementia Risk Index is that they have not been independently validated in other study populations. The Mid-Life Score was developed in a relatively homogeneous population in Finland, while the Late-Life Index was developed in a community-based study performed in four US cities. Efforts are underway to validate these tools in other settings before they are used widely in clinical settings.

Once these tools have been validated, it will be important to examine their impact on research, clinical care and patient outcomes. Will Dementia Risk Indices provide a cost-efficient strategy for enrolling high-risk individuals in clinical trials of new pharmacologic or behavioral intervention studies? Once new interventions and preventions are identified, could these tools be used to target therapies toward those at greatest risk? Will clinicians use Dementia Risk Indices as part of routine practice? If so, will these tools enable earlier identification of patients with dementia and earlier treatment of symptoms? Will this improve quality of life? Could Dementia Risk Indices be helpful for motivating middle-aged or older adults to make healthier lifestyle choices such as engaging in more physical, mental and social activity? Will patients want to know their risk of dementia?

Dementia risk indices are a new class of tools that are likely to evolve over the next several decades. As they are finely tuned and validated, it is likely that they will be incorporated into routine clinical and research practice and will be used primarily to quickly and efficiently identify individuals with a high risk for dementia who can then be referred for more frequent monitoring and early intervention when needed.

Conclusion

Dementia is a common and costly condition, and prevalence is expected to triple over the next 40 years. However, there is hope that new pharmacologic and behavioral interventions will prevent/delay symptom onset or slow/stop disease progression. As new strategies for treatment and prevention of dementia are developed, it will be critically important to be able to target them in a cost-efficient manner toward those individuals who are most likely to benefit. Dementia Risk Indices are tools that could be used in clinical and research settings to identify individuals who do not currently have full-blown dementia but have a high risk of developing diagnosable symptoms within their lifetimes. These tools may have a variety of uses, including identifying high-risk individuals for clinical trials, determining whether a patient should be monitored more closely for symptom onset and early treatment, motivating positive lifestyle changes and answering questions raised by concerned individuals and family members.

Future perspective

Dementia, similar to cardiovascular disease, is a multifactorial, progressive illness that has both presymptomatic and symptomatic phases. Over the next 10–20 years, it is likely that new strategies for the prevention and treatment of dementia will be developed. Simultaneously, biomarkers and imaging techniques will make it possible to more accurately diagnose

Alzheimer's disease and other dementias earlier in the course of the disease, possibly even in the presymptomatic phase. Dementia Risk Indices will play an important clinical and research role by helping to identify high-risk individuals who should be referred for more frequent monitoring or targeted for new behavioral and pharmacologic interventions as they are developed.

Executive summary

Importance of early detection

- There are currently more than 5 million individuals in the USA with Alzheimer's disease and other forms of dementia, and prevalence is expected to triple by 2050.
- As new strategies for treatment and prevention of dementia are developed, it will be critically important to be able to identify older adults who do not currently have dementia but have a high risk of developing symptoms within a few years so that they can be targeted for monitoring, prevention and early treatment.

Risk indices in other settings

- Prognostic models – or risk indices – are tools that combine the known (or hypothesized) risk factors for a particular outcome to predict an individual's risk of experiencing that outcome within a given time frame.
- The Framingham Heart Index and the Breast Cancer Risk Assessment Tool are two risk indices that are commonly used in clinical and research settings.

Development of dementia risk indices

- The Mid-Life Dementia Risk Score is designed for use in middle-aged adults (40–64 years) and uses a combination of age, education, gender, physical inactivity and history of obesity, hypertension and hypercholesterolemia to predict risk of dementia 20 years later.
- The Late-Life Dementia Risk Index is designed for use in older adults (65 years or older) and uses a combination of demographic, cognitive, behavioral, functional, medical, genetic, cerebral MRI and carotid artery ultrasound measures to predict risk of developing dementia within 6 years.
- An abbreviated Brief Dementia Risk Index also is being developed and validated.

Next steps

- Both the Mid-Life Dementia Risk Score and the Late-Life Dementia Risk Index are being validated in other study populations prior to widespread clinical use.
- Once validated, it will be important to determine whether these Dementia Risk Indices improve research efficiency, clinical practice or patient outcomes.

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Bibliography

Papers of special note have been highlighted as:

▪ of interest

▪▪ of considerable interest

1. Hebert LE, Scherr PA, Bienias JL, Bennett DA, Evans DA. Alzheimer disease in the US population: prevalence estimates using the 2000 census. *Arch. Neurol* 2003;60(8):1119–1122. [PubMed: 12925369]
2. Raina P, Santaguida P, Ismaila A, et al. Effectiveness of cholinesterase inhibitors and memantine for treating dementia: evidence review for a clinical practice guideline. *Ann. Intern. Med* 2008;148(5):379–397. [PubMed: 18316756]
3. Rosenberg RN. Translational research on the way to effective therapy for Alzheimer disease. *Arch. Gen. Psychiatry* 2005;62(11):1186–1192. [PubMed: 16275806]
4. Jorm AF, Jolley D. The incidence of dementia: a meta-analysis. *Neurology* 1998;51(3):728–733. [PubMed: 9748017]
5. Brookmeyer R, Gray S, Kawas C. Projections of Alzheimer's disease in the United States and the public health impact of delaying disease onset. *Am. J. Public Health* 1998;88(9):1337–1342. [PubMed: 9736873] ▪ Describes that delaying onset of Alzheimer's disease by as little as 1 or 2 years could prevent millions of individuals from ever developing symptoms.
6. Qiu C, De Ronchi D, Fratiglioni L. The epidemiology of the dementias: an update. *Curr. Opin. Psychiatry* 2007;20(4):380–385. [PubMed: 17551353]
7. Folstein MF, Folstein SE, McHugh PR. 'Mini-mental state'. A practical method for grading the cognitive state of patients for the clinician. *J. Psychiatr. Res* 1975;12(3):189–198. [PubMed: 1202204]
8. Borson S, Scanlan J, Brush M, Vitaliano P, Dokmak A. The mini-cog: a cognitive 'vital signs' measure for dementia screening in multi-lingual elderly. *Int. J. Geriatr. Psychiatry* 2000;15(11):1021–1027. [PubMed: 11113982]
9. Hanley JA, McNeil BJ. The meaning and use of the area under a receiver operating characteristic (ROC) curve. *Radiology* 1982;143(1):29–36. [PubMed: 7063747]
10. Harrell FE Jr, Lee KL, Califf RM, Pryor DB, Rosati RA. Regression modelling strategies for improved prognostic prediction. *Stat. Med* 1984;3(2):143–152. [PubMed: 6463451]
11. Harrell FE Jr, Lee KL, Mark DB. Multivariable prognostic models: issues in developing models, evaluating assumptions and adequacy, and measuring and reducing errors. *Stat. Med* 1996;15(4):361–387. [PubMed: 8668867]
12. Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H, Kannel WB. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998;97(18):1837–1847. [PubMed: 9603539] ▪ Describes development of the original Framingham Heart Index, which uses an individual's age, diabetes status, smoking status, blood pressure and cholesterol level to predict risk of experiencing a major coronary event within 10 years. The Framingham Heart Index is widely used in clinical settings as a simple method for identifying high-risk individuals and targeting them for intervention and prevention.
13. Gail MH, Brinton LA, Byar DP, et al. Projecting individualized probabilities of developing breast cancer for white females who are being examined annually. *J. Natl Cancer Inst* 1989;81(24):1879–1886. [PubMed: 2593165] ▪ Describes development of the Breast Cancer Risk Assessment Tool, which uses information regarding a woman's age, race, reproductive history, family history of breast cancer and biopsy history to predict her risk of developing invasive breast cancer within 5 years.
14. Gail MH, Costantino JP, Pee D, et al. Projecting individualized absolute invasive breast cancer risk in African American women. *J. Natl Cancer Inst* 2007;99(23):1782–1792. [PubMed: 18042936]
15. Lindstrom J, Tuomilehto J. The diabetes risk score: a practical tool to predict Type 2 diabetes risk. *Diabetes Care* 2003;26(3):725–731. [PubMed: 12610029]
16. Schulze MB, Hoffmann K, Boeing H, et al. An accurate risk score based on anthropometric, dietary, and lifestyle factors to predict the development of Type 2 diabetes. *Diabetes Care* 2007;30(3):510–515. [PubMed: 17327313]

17. Walter LC, Brand RJ, Counsell SR, et al. Development and validation of a prognostic index for 1-year mortality in older adults after hospitalization. *JAMA* 2001;285(23):2987–2994. [PubMed: 11410097]
18. Lee SJ, Lindquist K, Segal MR, Covinsky KE. Development and validation of a prognostic index for 4-year mortality in older adults. *JAMA* 2006;295(7):801–808. [PubMed: 16478903]
19. Gao S, Hendrie HC, Hall KS, Hui S. The relationships between age, sex, and the incidence of dementia and Alzheimer disease: a meta-analysis. *Arch. Gen. Psychiatry* 1998;55(9):809–815. [PubMed: 9736007]
20. Stern Y, Gurland B, Tatemichi TK, Tang MX, Wilder D, Mayeux R. Influence of education and occupation on the incidence of Alzheimer's disease. *JAMA* 1994;271(13):1004–1010. [PubMed: 8139057]
21. Tang MX, Cross P, Andrews H, et al. Incidence of AD in African-Americans, Caribbean Hispanics, and Caucasians in northern Manhattan. *Neurology* 2001;56(1):49–56. [PubMed: 11148235]
22. MacKnight C, Rockwood K, Awalt E, McDowell I. Diabetes mellitus and the risk of dementia, Alzheimer's disease and vascular cognitive impairment in the Canadian Study of Health and Aging. *Dement. Geriatr. Cogn. Disord* 2002;14(2):77–83. [PubMed: 12145454]
23. Qiu C, Winblad B, Fratiglioni L. The age-dependent relation of blood pressure to cognitive function and dementia. *Lancet Neurol* 2005;4(8):487–499. [PubMed: 16033691]
24. Zhu L, Fratiglioni L, Guo Z, et al. Incidence of dementia in relation to stroke and the apolipoprotein E ϵ 4 allele in the very old. Findings from a population-based longitudinal study. *Stroke* 2000;31(1):53–60. [PubMed: 10625715]
25. Corder EH, Saunders AM, Strittmatter WJ, et al. Gene dose of apolipoprotein E type 4 allele and the risk of Alzheimer's disease in late onset families. *Science* 1993;261(5123):921–923. [PubMed: 8346443]
26. Lindsay J, Laurin D, Verreault R, et al. Risk factors for Alzheimer's disease: a prospective analysis from the Canadian Study of Health and Aging. *Am. J. Epidemiol* 2002;156(5):445–453. [PubMed: 12196314]
27. Wilson RS, Mendes De Leon CF, Barnes LL, et al. Participation in cognitively stimulating activities and risk of incident Alzheimer disease. *JAMA* 2002;287(6):742–748. [PubMed: 11851541]
28. Luchsinger JA, Noble JM, Scarmeas N. Diet and Alzheimer's disease. *Curr. Neurol. Neurosci. Rep* 2007;7(5):366–372. [PubMed: 17764625]
29. Anstey KJ, von Sanden C, Salim A, O'Kearney R. Smoking as a risk factor for dementia and cognitive decline: a meta-analysis of prospective studies. *Am. J. Epidemiol* 2007;166(4):367–378. [PubMed: 17573335]
30. Mukamal KJ, Kuller LH, Fitzpatrick AL, Longstreth WT Jr, Mittleman MA, Siscovick DS. Prospective study of alcohol consumption and risk of dementia in older adults. *JAMA* 2003;289(11):1405–1413. [PubMed: 12636463]
31. Jorm AF. History of depression as a risk factor for dementia: an updated review. *Aust. NZ J. Psychiatry* 2001;35(6):776–781.
32. Fratiglioni L, Wang HX, Ericsson K, Maytan M, Winblad B. Influence of social network on occurrence of dementia: a community-based longitudinal study. *Lancet* 2000;355(9212):1315–1319. [PubMed: 10776744]
33. Tierney MC, Yao C, Kiss A, McDowell I. Neuropsychological tests accurately predict incident Alzheimer disease after 5 and 10 years. *Neurology* 2005;64(11):1853–1859. [PubMed: 15955933]
34. Peres K, Helmer C, Amieva H, et al. Natural history of decline in instrumental activities of daily living performance over the 10 years preceding the clinical diagnosis of dementia: a prospective population-based study. *J. Am. Geriatr. Soc* 2008;56(1):37–44. [PubMed: 18028344]
35. Wang L, Larson EB, Bowen JD, van Belle G. Performance-based physical function and future dementia in older people. *Arch. Intern. Med* 2006;166(10):1115–1120. [PubMed: 16717174]
36. Verghese J, Lipton RB, Hall CB, Kuslansky G, Katz MJ, Buschke H. Abnormality of gait as a predictor of non-Alzheimer's dementia. *N. Engl. J. Med* 2002;347(22):1761–1768. [PubMed: 12456852]
37. Haan MN, Aiello AE, West NA, Jagust WJ. C-reactive protein and rate of dementia in carriers and non carriers of Apolipoprotein APOE4 genotype. *Neurobiol. Aging* 2008;29(12):1774–1782. [PubMed: 17540481]

38. Sundelof J, Arnlov J, Ingelsson E, et al. Serum cystatin C and the risk of Alzheimer disease in elderly men. *Neurology* 2008;71(14):1072–1079. [PubMed: 18824671]
39. Kuller LH, Lopez OL, Newman A, et al. Risk factors for dementia in the cardiovascular health cognition study. *Neuroepidemiology* 2003;22(1):13–22. [PubMed: 12566949]
40. Vermeer SE, Prins ND, den Heijer T, Hofman A, Koudstaal PJ, Breteler MM. Silent brain infarcts and the risk of dementia and cognitive decline. *N. Engl. J. Med* 2003;348(13):1215–1222. [PubMed: 12660385]
41. Kivipelto M, Ngandu T, Laatikainen T, Winblad B, Soininen H, Tuomilehto J. Risk score for the prediction of dementia risk in 20 years among middle aged people: a longitudinal, population-based study. *Lancet Neurol* 2006;5(9):735–741. [PubMed: 16914401] • Describes development of the first dementia risk index, the Mid-Life Dementia Risk Score, which uses a combination of demographic and cardiovascular risk factors to predict an individual's risk of developing dementia 20 years later with high accuracy.
42. Barnes DE, Covinsky KE, Kuller LH, Lopez OL, Yaffe K. Predicting an individual's risk of developing dementia: the Cardiovascular Health Cognition Study. *Neurology*. 2009 DOI:10.1016/j.jalz.2007.04.356 (Epub ahead of print). • Describes development of Late-Life Dementia Risk Index, which is the first dementia risk index specifically designed to be used in older adults. This tool uses a combination of demographic, cognitive, behavioral, functional, medical, genetic, cerebral MRI and carotid artery ultrasound measures to predict an individual's risk of developing dementia within 6 years with high accuracy.

Website

101. Alzheimer's Association Alzheimer's Disease Facts & Figures 2009 (Accessed 6 July 2009) www.alz.org/national/documents/report_alzfactsfigures2009.pdf • Informative document that provides an excellent summary of current knowledge regarding Alzheimer's disease including prevalence, incidence, costs, risk factors, symptoms and treatments.

Table 1

Current prognostic indices for dementia.

Mid-life dementia risk score	Late-life dementia risk index
Older age	Older age
Lower education	Low Modified Mini-Mental State score
Male gender	Low Digit Symbol Substitution Test score
High BMI (>30 kg/m ²)	Low body mass index (<18.5 kg/m ²)
Mid-life hypertension (systolic BP > 140 mm Hg)	≥1 <i>APOE</i> <i>e4</i> allele
Mid-life hypercholesterolemia (>6.5 mmol/l)	MRI white matter disease
Physical inactivity	MRI enlarged ventricles
	Internal carotid artery thickening (≥2.2 mm)
≥1 <i>APOE</i> <i>e4</i> allele	Coronary artery bypass surgery
	Slow physical performance (time to put on and button shirt > 45 s)
	Lack of alcohol consumption