

## Biographical sketch (CV)

**Name:** Behnam Sabayan

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### Training background

**Fellowship:** Vascular Neurology, Massachusetts General Hospital/Brigham and Women's Hospital, Harvard Medical School, Harvard University, 2020-2021

**Residency:** Neurology, Feinberg School of Medicine, Northwestern University, 2017- 2020

**Internship:** Medicine, Feinberg School of Medicine, Northwestern University, 2016- 2017

**Post-doctorate:** Heart-Brain Axis: Leiden University Medical Center, Leiden, Netherlands /National Institute on Aging (NIH/NIA), Bethesda, USA, 2016

**Doctorate (PhD):** Clinical Neuroscience: Leiden University Medical Center, Leiden, Netherlands (PhD Thesis: Cardiovascular and Hemodynamic Contribution to Brain Aging), 2014

**Master of Science (MSc):** Ageing & Vitality, Leiden University, Leiden, the Netherlands, 2011

**Medicine (M.D):** Shiraz University of Medical Sciences, Shiraz, Iran, 2009

### Languages

English, Persian, Dutch

### Positions and Employment

2021– Assistant Professor, School of Public Health, University of Minnesota

2021– Vascular Neurologist, HealthPartners Neuroscience Center

2020–2021 Vascular Neurology Fellow, Massachusetts General Hospital, Harvard University

2017–2020 Resident Physician, Adult Neurology Residency, McGaw Northwestern Memorial Hospital

2016–2017 Intern, Internal Medicine, McGaw Northwestern Memorial Hospital

2014–2016 Post-doctoral research fellow Leiden University/NIH-NIA Bethesda

### Other Experience and Professional Memberships/Appointments

2021 – Member of multi-media learning committee at *American Academy of Neurology (AAN)*

2021 – Member of e-learning committee at *American Academy of Neurology (AAN)*

2019 – Member, *American Neurological Association (ANA)*

2018 – 2021 Neurology Resident/ Fellow Editorial team member

2018 – Associate editor, *Journal of Alzheimer Disease (JAD)*

2016 – Member, *American Academy of Neurology (AAN)*

2016 – Member, *International Society to Advance Alzheimer's Research and Treatment (ISTAART)*

2015 – Member, *American Heart Association (AHA)/American Stroke Association (ASA)*

2015 – Executive board member, *International Society of Vascular Behavioral and Cognitive Disorders*

2014 – 2016 Lecturer, *Leyden Academy on Vitality and Ageing*

2014 – 2016 Instructor, *Leiden University Medical Center*

2014 – 2016 Research mentor, *Post-graduate education in Aging, Leiden University Medical Center*

2009 – Member, *National Elites Foundation Iran*

2009 – 2012 Instructor in research methodology, *Shiraz University*

2006 – 2009 Head of Student Research Committee, *Shiraz University*

### Honors and awards

2020 – Elected Member, *Alpha Omega Alpha (AOA)* society  
 2020 – Resident Teacher of the year Award, Northwestern Medicine, Neurology  
 2020 – Resident Investigator of the year Award, Northwestern Medicine, Neurology  
 2020 – Champaign Award for 90%+ national performance in RITE exam  
 2019 – Resident for Exemplary Model of Professionalism by Medical Students  
 2016 – “Out of Box Idea” award on the Heart-Brain connection  
 2014 – PhD with high degree of honor (*cum laude*)  
 2010 – Educational scholarship from Leyden Academy on Vitality and Ageing  
 2009 – NIHES-Erasmus/Rotterdam scholarship, winter Program on clinical epidemiology, 2009  
 2008 – National award as the distinguished graduate in Medicine  
 2008 – Young Investigator Research award, 14th International Razi Festival  
 2006– Outstanding medical student, Shiraz university of Medical Sciences

### Peer reviewed published papers (selection, out of 72 peer-reviewed papers)

1. **Sabayan B**, Isaacson R, Rost N. Preventive Neurology: An Emerging Field Toward Brain Health. *Neurology*. 2021; 27;10.1212
2. Shahjouei S, ..., **Sabayan B**, Salehizadeh S, Saberi A, Sepehrnia M, Vahabizad F, Yasuda TA, Ghabaee M, Rahimian N, Harirchian MH, Borhani-Haghighi A, Azarpazhooh MR, Arora R, Ansari S, Avula V, Li J, Abedi V, Zand R. SARS-CoV-2 and Stroke Characteristics: A Report From the Multinational COVID-19 Stroke Study Group. *Stroke*. 2021;52(5):e117-e130.
3. Moonen JE, **Sabayan B**, Sigurdsson S, van Buchem MA, Gudnason V, Meirelles O, Launer LJ. Contributions of Cerebral Blood Flow to Associations Between Blood Pressure Levels and Cognition: The Age, Gene/Environment Susceptibility-Reykjavik Study. *Hypertension*. 2021;77(6):2075-2083.
4. **Sabayan B**, Westendorp RGJ. Neurovascular-glymphatic dysfunction and white matter lesions. *Geroscience*. 2021;43(4):1635-1642.
5. **Sabayan B**, Lineback C, Viswanathan A, Leslie-Mazwi TM, Shaibani A. Central nervous system vascular malformations: A clinical review. *Ann Clin Transl Neurol*. 2021;8:504-522.
6. Vojinovic D, ..., **Sabayan B**, Vasan RS, Ikram MA, Stott DJ, Ala-Korpela M, Jukema JW, Seshadri S, Kettunen J, Kivimaki M, Esko T, van Duijn CM. Association of circulating metabolites in plasma or serum and risk of stroke: Meta-analysis from seven prospective cohorts. *Neurology*. 2020, 2;10.1212
7. **Sabayan B**, Moghadami M, Assarzagdegan F, Komachali SH, Poorsaadat L, Babaeepour Z, et al. COVID-19 Respiratory Illness and Subsequent Cerebrovascular Events, the Initial Iranian Experience. *J Stroke Cerebrovasc Dis*. 2021;30:105454.
8. Mahinrad S, **Sabayan B**, Garner CR, Lloyd-Jones DM, Sorond FA. N-Terminal Pro Brain, N-Terminal Pro Atrial Natriuretic Peptides, and Dynamic Cerebral Autoregulation. *J Am Heart Assoc*. 2020 20;9:e018203.
9. Zonneveld MH, Noordam R, Grond JV, **Sabayan B**, Mooijaart SP, Mcfarlane PW, Jukema JW, Trompet S. Ventricular Repolarization is Associated with Cognitive Function, but Not with Cognitive Decline and Brain Magnetic Resonance Imaging (MRI) Measurements in Older Adults. *J Clin Med*. 2020 26;9:911.
10. Lo JW, ..., **Sabayan B**, et al; Stroke and Cognition (STROKOG) Collaboration. Profile of and risk factors for poststroke cognitive impairment in diverse ethnoregional groups. *Neurology*. 2019 10;93:e2257-e2271
11. Gardiner SL, Trompet S, **Sabayan B**, Boogaard MW, Jukema JW, Slagboom PE, Roos RAC, van der Grond J, Aziz NA. Repeat variations in polyglutamine disease-associated genes and cognitive function in old age. *Neurobiol Aging*. 2019 pii: S0197-4580, 30280-5.

12. Rostamian S, de Haan S, van der Grond J, van Buchem MA, Ford I, Jukema JW, **Sabayan B**. Cognitive Function in Dementia-Free Subjects and Survival in Old Age: The PROSPER Study. *Am J Med*. 2019 pii: S0002-9343(19)30515-7.
13. Mahinrad S, Ferguson I, Macfarlane PW, Clark EN, Stott DJ, Ford I, Mooijaart SP, Trompet S, van Heemst D, Jukema JW, **Sabayan B**. Spatial QRS-T Angle and Cognitive Decline in Older Subjects. *J Alzheimers Dis*. 2019;67(1):279-289.
14. Mahinrad S, Bulk M, van der Velpen I, Mahfouz A, van Roon-Mom W, Fedarko N, Yasar S, **Sabayan B**, van Heemst D, van der Weerd L. Natriuretic Peptides in Post-mortem Brain Tissue and Cerebrospinal Fluid of Non-demented Humans and Alzheimer's Disease Patients. *Front Neurosci*. 2018;12:864.
15. Ferguson IT, Elbejjani M, **Sabayan B**, Jacobs DR Jr, Meirelles O, Sanchez OA, Tracy R, Bryan N, Launer LJ. N-Terminal pro-Brain Natriuretic Peptide and Associations With Brain Magnetic Resonance Imaging (MRI) Features in Middle Age: The CARDIA Brain MRI Study. *Front Neurol*. 2018;7;9:307.
16. Wolters FJ, Segufa RA, Darweesh SKL, Bos D, Ikram MA, **Sabayan B**, Hofman A, Sedaghat S. Coronary heart disease, heart failure, and the risk of dementia: A systematic review and meta-analysis. *Alzheimers Dement*. 2018, pii: S1552-5260(18)30026-8.
17. **Sabayan B**, Sorond F. Reducing Risk of Dementia in Older Age. *JAMA*. 2017, 16;317:2028.
18. Rostamian S, van Buchem MA, Jukema JW, Gussekloo J, Poortvliet RKE, de Craen AJM, **Sabayan B**. Lower Performance in Orientation to Time and Place Associates with Greater Risk of Cardiovascular Events and Mortality in the Oldest Old: Leiden 85-Plus Study. *Front Aging Neurosci*. 2017, 27;9:307
19. van der Velpen IF, Yancy CW, Sorond FA, **Sabayan B**. Impaired Cardiac Function and Cognitive Brain Aging. *Can J Cardiol*. 2017;33:1587-1596.
20. Bertens AS, **Sabayan B**, de Craen AJM, Van der Mast RC, Gussekloo J. High Sensitivity Cardiac Troponin T and Cognitive Function in the Oldest Old: The Leiden 85-Plus Study. *J Alzheimers Dis*. 2017;60:235-242.
21. Mahinrad S, Vriend AE, Jukema JW, van Heemst D, Sattar N, Blauw GJ, Macfarlane PW, Clark EN, de Craen AJM, **Sabayan B**. *J Alzheimers Dis*. 2017;58:275-283.
22. **Sabayan B**, van Buchem MA, Sigurdsson S, et al. Cardiac and Carotid Markers Link with Accelerated Brain Atrophy: The AGES-Reykjavik Study. *ATVB*. 2016;36:2246-2251.
23. Smit RA, Trompet S, **Sabayan B**, et al. Higher Visit-to-Visit Low-Density Lipoprotein Cholesterol Variability Is Associated with Lower Cognitive Performance, Lower Cerebral Blood Flow, and Greater White Matter Hyperintensity Load in Older Subjects. *Circulation*. 2016;134:212-21.
24. van der Velpen IF, Feleus S, Bertens AS, **Sabayan B**. Hemodynamic and serum cardiac markers and risk of cognitive impairment and dementia. *Alzheimers Dement*. 2016. pii: S1552-5260,32933-8.
25. Mahinrad S, de Craen AJ, Yasar S, van Heemst D, **Sabayan B**. Natriuretic peptides in the central nervous system: Novel targets for cognitive impairment. *Neurosci Biobehav Rev*. 2016; 68:148-56.
26. Ogliari G, Smit RA, Westendorp RG, Jukema JW, de Craen AJ, **Sabayan B**. Visit-to-visit blood pressure variability and future functional decline in old age. *J Hypertens*. 2016, 34:1544-50.
27. Mahinrad S, Jukema JW, van Heemst D, Macfarlane PW, Clark EN, de Craen AJ, **Sabayan B**. 10-Second heart rate variability and cognitive function in old age. *Neurology*. 2016 22;86:1120-7.
28. Wijsman LW, de Craen AJ, Trompet S, **Sabayan B**, et al. High-sensitivity cardiac troponin T is associated with cognitive decline in older adults at high cardiovascular risk. *Eur J Prev Cardiol*. 2016;23:1383-92.
29. **Sabayan B**, van Buchem MA, de Craen AJ, et al. N-terminal pro-brain natriuretic peptide and abnormal brain aging: The AGES-Reykjavik Study. *Neurology*. 2015;85:813-20.
30. Rostamian S, van Buchem MA, Westendorp RG, Jukema JW, Mooijaart SP, **Sabayan B**, de Craen AJ. Executive function, but not memory, associates with incident coronary heart disease and stroke. *Neurology*. 2015;85:783-9.



31. Ogliari G, Mahinrad S, Stott DJ, ..., **Sabayan B**. Resting heart rate, heart rate variability and functional decline in old age. *CMAJ*. 2015;187: E442-9.
32. Ogliari G, Westendorp RG, Muller M, ..., **Sabayan B**, de Craen AJ. Blood pressure and 10-year mortality risk in the Milan Geriatrics 75+ Cohort Study: role of functional and cognitive status. *Age Ageing*. 2015 ;44:932-7.
33. Ogliari G, **Sabayan B**, et al. Age- and Functional Status-Dependent Association Between Blood Pressure and Cognition: The Milan Geriatrics 75+ Cohort Study. *J Am Geriatr Soc*. 2015;63:1741-8.
34. Wijsman LW, de Craen AJ, Muller M, **Sabayan B**, et al. Blood Pressure Lowering Medication, Visit-to-Visit Blood Pressure Variability, and Cognitive Function in Old Age. *Am J Hypertens*. 2016;29:311-8.
35. **Sabayan B**, van der Grond J, Westendorp RG, van Buchem MA, de Craen AJ. Accelerated progression of white matter hyperintensities and subsequent risk of mortality: a 12-year follow-up study. *Neurobiol Aging*. 2015;36:2130-5.
36. **Sabayan B**, Westendorp RG. Blood pressure control and cognitive impairment--why low is not always better. *JAMA Intern Med*. 2015 ;175:586-7
37. **Sabayan B**, van Buchem MA, Sigurdsson S, et al. Cardiac Hemodynamics are Linked With Structural and Functional Features of Brain Aging: The AGES-Reykjavik Study. *J Am Heart Assoc*. 2015 ;4:e001294.
38. Peter van Vliet P, **Sabayan B**, Wijsman LW, et al. NT-proBNP, blood pressure and cognitive function in the oldest old: The Leiden 85-plus Study. *Neurology*. 2014 ;83:1192-9
39. Wijsman LW, **Sabayan B**, van Vliet P, et al. N-terminal pro-brain natriuretic peptide and cognitive decline in older adults at high cardiovascular risk. *Ann Neurol*. 2014 ;76:213-22.
40. Rostamian S, Mahinrad S, Stijnen T, **Sabayan B**, de Craen AJ. Cognitive Impairment and Risk of Stroke: A Systematic Review and Meta-Analysis of Prospective Cohort Studies. *Stroke*. 2014;45:1342-8
41. **Sabayan B**, van der Grond J, Westendorp RG, et al. Total cerebral blood flow and mortality in old age: A 12-year follow-up study. *Neurology*. 2013 ;81:1922-9.
42. **Sabayan B**, Westendorp RG, Grond JV, et al. Markers of endothelial dysfunction and cerebral blood flow in older adults. *Neurobiol Aging*. 2013: S0197-4580,00354-0.
43. **Sabayan B**, Wijsman L, Foster-Dingley J, et al. Association of visit-to-visit blood pressure variability with cognitive function in old age: A prospective cohort study. *BMJ*, 2013 29;347:f4600.
44. **Sabayan B**, Gussekloo J, de Ruijter W, et al. Framingham stroke risk score and cognitive impairment for predicting first-time stroke in the oldest old. *Stroke*. 2013;44:1866-71
45. **Sabayan B**, van Vliet P, de Ruijter W, Gussekloo J, et al. High blood pressures, physical and cognitive function, and risk of stroke in the oldest-old: The Leiden 85-plus Study. *Stroke*. 2013;44:15-20
46. **Sabayan B**, Oleksik AM, Maier AB, et al. High blood pressure and resilience to physical and cognitive decline in the oldest old: Leiden 85-plus Study. *J Am Ger Soc*. 2012;60:2014-9.
47. **Sabayan B**, Jansen S, Oleksik AM, et al. Cerebrovascular hemodynamics in Alzheimer's disease and vascular dementia: a meta-analysis of transcranial Doppler studies. *Ageing Res Rev*. 2012; 11:271-7.
48. **Sabayan B**, Zamiri N, Farshchizarabi S, Sabayan B. Phosphodiesterase-5 Inhibitors: Novel weapons against Alzheimer Disease? *Int J Neuroscience*. 2010 ;120:746-51
49. **Sabayan B**, Foroughinia F, Mowla A, Borhanihighi A. Role of Insulin Metabolism Disturbances in the Development of Alzheimer Disease: Mini Review. *Am J Alzheimers Dis Other Demen*. 2008; 23:192-9.

### **Presentations in international conferences (selection out of 30)**

1. How Common Are Microembolic Signals After Cerebrovascular Events and Are They Related to Recurrent Admissions. International Stroke Conference (ISC 2021)
2. Heart-Brain axis and brain health. International Conference on Neurology & Epidemiology (ICNE 2021)
3. Midlife to Late-Life Changes in Blood Pressure and Cerebral Blood Flow in Old Age: the AGES-Reykjavik Study. International Stroke Conference (ISC 2018)
4. Statin Treatment, Cognitive Function and Risk of Cardiovascular events: Secondary Analysis of the PROSPER Trial. The 6th International Society of Vascular Behavioral and Cognitive Disorders (VAS-COG) Congress. Amsterdam, Netherlands, 2016
5. Left Ventricular Hypertrophy and Cognitive Decline in Dementia-free Older Subjects at Risk of Cardiovascular Disease. AHA Scientific Sessions. Orlando, USA, 2015
6. Serum Troponin T and future risk of dementia: The AGES-Reykjavik Study. Alzheimer's Association International Conference. Washington DC, USA, 2015
7. Short-term heart rate variability and cognitive function in older subjects at risk of cardiovascular diseases. European Society of Hypertension. Milan, Italy, 2015
8. The Link between Serum NT-proBNP and Memory Function in Community Dwelling Older Adults. Alzheimer's Association International Conference. Copenhagen, Denmark, 2014
9. N-terminal pro-brain natriuretic peptide, blood pressure and cognitive decline in the oldest old. International Society of Hypertension Conference. Athens, Greece, 2014
10. Visit-to-visit blood pressure variability, MRI features and cognitive function in old age. The 6th International Society of Vascular Behavioural and Cognitive Disorders (VAS-COG) Congress. Toronto, Canada, 2013
11. Cardiac hemodynamics and brain aging. The 6th International Society of Vascular Behavioural and Cognitive Disorders (VAS-COG) Congress. Toronto, Canada, 2013
12. High blood pressure, physical and cognitive disability and risk of stroke in the oldest old: the Leiden 85-plus study, EFNS Conference, Stockholm, Sweden, 2012
13. High blood pressure and preservation of cognitive function in oldest old: Leiden 85-Plus Study, British Geriatrics Society conference, Brighton, England, 2011
14. Cerebrovascular hemodynamics in Alzheimer's disease and Vascular dementia, VAS-COG Conference, Lille, France, 2011

### **Grants and scholarships**

1. NIH Vascular Contributions to Cognitive Impairment and Dementia (VCID) Trainee Travel Scholarship Award on Future VCID Clinical Trials. 2019
2. International Stroke Conference (ISC 2018) travel grant award.
3. "Out of Box" grant award (€50,000) on the Neuro-endocrine connection in the heart-brain axis, Cardiovasculair Onderzoek Nederland (CVON), 2016
4. Visiting research fellowship (\$4000), National Institute on Aging (NIA), 2013, 2014, 2015
5. Doctorate with distinction (*cum laude*), Leiden University, 2014
6. Grant award (€100,000) on the role of Cardiac function on Cognitive Brain Aging, International Society of Alzheimer Research (ISAO), 2014
7. European educational fellowship (€2500) on autonomic nervous system program, 2012

8. Master of Science scholarship (€12000) from Leyden Academy on Vitality and Ageing, 2010
9. NIHES-Erasmus scholarship, winter Program on clinical epidemiology, 2009
10. Awarded the young investigator research award in 14th International Razi Festival, 2008
11. National award as the distinguished medical student, Ministry of Health and Medical Education, 2008
12. Outstanding medical student of Shiraz university of Medical Sciences, 2006-2007

### **National/International collaborations**

1. 2016-present: STROKOG consortium of longitudinal studies of cognitive disorders following stroke, TIA or small vessel disease.
2. 2014-Present: Collaboration with Milan University in study design, data analyses and interpretation of The Milan Geriatrics 75+ Cohort Study.
3. 2012-Present: Visiting researcher at National Institute of Health (NIH)/National Institute on Aging (NIA), Bethesda, USA, labs of Neuro-epidemiology and Cardiovascular Imaging.
4. 2012-Present: Executive board member of the “International Society of Vascular Behavioural and Cognitive Disorders (Vas-Cog)”.
5. 2011-Present: Collaboration with the PROSPER study group consisting of researchers from the Netherlands, UK and Ireland.

### **Educational Activities**

#### **Mentorship**

##### **PhD students**

*Simin Mahinrad*, MD, PhD, currently post-doctoral fellow, Northwestern University, USA

- PhD thesis: The role of subclinical cardiac biomarkers in development of cognitive impairment and functional decline in older adults

- Publications:

1. Mahinrad S, ....., Sabayan B. *J Alzheimers Dis.* 2019;67(1):279-289.
2. Mahinrad S, ....., Sabayan B. *Neurology.* 2016;86(12):1120-7.
3. Mahinrad S, ....., Sabayan B. *J Alzheimers Dis.* 2017;58(1):275-283.
4. Mahinrad S, ....., Sabayan B. *Neurosci Biobehav Rev.* 2016;68:148-156.

*Giulia Ogliary*, MD, PhD, currently Geriatrician, University Hospitals of Derby, UK

- PhD thesis: Milan Geriatrics 75+ Cohort Study: unravelling the determinants of healthy ageing and longevity

- Publications:

1. Ogliary G, ....., Sabayan B. *J Hypertens.* 2016;34(8):1544-50.
2. Ogliary G, ....., Sabayan B/ de Craen AJ. *Age Ageing.* 2015;44(6):932-7
3. Ogliary G, ....., Sabayan B. *CMAJ.* 2015;187(15):E442-E449.

*Somayeh Rostamian*, MSc, PhD candidate

- Approved thesis:

Cognitive Function, Vascular Events and Mortality in the Old Age

- Publications:

1. Rostamian S, ....., Sabayan B. *Am J Med.* 2019;132(12):1466-1474.e4.
2. Rostamian S, ....., Sabayan B. *Front Aging Neurosci.* 2017;9:307.
3. Rostamian S, ....., Sabayan B/ de Craen AJ. *Neurology.* 2015;85(9):783-9.

4. Rostamian S, ..., Sabayan B. Stroke. 2014 May;45(5):1342-8.

#### **Master students**

- *Isabelle van der Velpen*, MD, currently PhD candidate in Neuro-Epidemiology at Erasmus University, the Netherlands. Published two papers and received one international scholarship while I served as her advisor.

- *Stephanie Feleus*, MD, MSc, currently PhD candidate in Clinical Neuroscience at Leiden University, the Netherlands. Published one paper and received one international scholarship while I served as her advisor.

- *Barbara Verhaar*, MD, MSc, currently PhD candidate in Clinical Neuroscience at Amsterdam University. Awarded a PhD position in Geriatrics while I served as her advisor.

- *Sasmita Kusumastuti*, MD, PhD, currently assistant professor of Epidemiology, Copenhagen University, Denmark. Had one international conference presentation and awarded a PhD position in Epidemiology while I served as her advisor.

#### **Bachelor students**

- *Annelotte Vriend*, MSc, currently working in biomedical industry. Co-authored a paper while I served as her advisor.

- *Sandra de Haan*, MSc, PhD candidate in cell and molecular biology at Karolinska Institute. Co-authored two papers and received one international scholarship while I served as her advisor.

#### Teaching

- Lecturer "Clinical Neurology review course, Northwestern University

- Lecturer "biology of ageing" course, Leyden Academy on Vitality and Ageing, Leiden University

- Lecturer "research proposal writing" course, Leyden Academy on Vitality and Ageing, Leiden University

- Lecturer "clinical aspects of aging" course, Leyden Academy on Vitality and Ageing

- Lecturer "clinical research methodology" workshop, Shiraz University of Medical Sciences

- Lecturer "scientific writing" workshop, Shiraz University of Medical Sciences