Activity report 2020–2022

ARC
AGING RESEARCH CENTER

Stockholm University

Karolinska Institutet

Our mission

... is to improve the health and well-being of older individuals by contributing to the understanding of the ageing process from a biomedical, psychological, and sociological perspective in relation to life-long social and physical contexts.

ARC conducts research and education and shares research findings within and outside the scientific community.

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Aging Research Center

The Aging Research Center (ARC) was established in 2000 by Karolinska Institutet (KI) and Stockholm University (SU). ARC is internationally renowned for its research on the health status of older adults, trends and inequalities among older people, brain ageing, and prevention of dementia and disability.

Our research questions:

- Why do we age?
- Why do we age so differently?
- How can we decrease disease and disability?
- How can we provide better treatment and care?

Our research areas:

- Morbidity and function
- Health trends and inequalities
- Treatment and care of older people
- Living conditions and social inequalities
- Brain ageing
- Dementia and the body-mind connection
- Environment and health
- COVID-19

Our research activities are characterised by:

- A focus on health in ageing with the goal of preventing, delaying, or decreasing morbidity and disability in old age
- An acknowledgement of the importance of life course processes on health and functioning in old age
- A focus on both individual and social group differences in late life health and disability
- A multidisciplinary approach that includes medical epidemiology, psychology, and social gerontology
- Creation of large databases from population-based studies on ageing and health
- Access to other large databases on ageing via national infrastructure and international collaborations
- Integration of epidemiological and social science studies with clinical and molecular research
- Contributions to improve treatment, social and healthcare of older people
- Neuroscience with a focus on neural correlates of cognitive functions and healthy brain ageing

Photo: Josefin Lindström

Contents

Message from the Director and Division Head

Three years have passed since our last activity report. Years rich in exciting ageing research, activities, and achievements. But also, years affected by restrictions following the coronavirus pandemic. At the beginning of the pandemic, it became evident that older age was a risk factor for becoming severely ill or dying from COVID-19. But the virus's impact on older adults went beyond a higher risk for serious infection. It also included limited access to health and social care and considerable social hardships. In Sweden, as in many other countries, older adults were subjected to greater restrictions than younger adults, for instance on contact with others.

For us and our colleagues at ARC, the pandemic limited our possibility to work in our facilities at the KI campuses. Moreover, it severely affected our data collections, thereby delaying important research findings. On a more positive note, like many other researchers, we have started up new research lines to contribute to COVID-19 research related to, for example post-covid symptoms and collateral damages. Now we are physically back at ARC, and the days are full of activity, carried out with joy, enthusiasm, and curiosity.

Over the last 20 years, ARC has become an internationally well-known multidisciplinary centre, focused on ageing research. This is, of course, due to the excellent research performed by highly qualified and devoted researchers but also reflects fantastic co-workers with supportive working tasks. To successfully run a research centre it is crucial to have good leadership. During 2016-2020, Professor Johan Fritzell served as both Director and Division Head of ARC. It has been a great pleasure for us to work with Johan in the role of Deputy Division Heads (2019-2020). On 1 April 2021, we stepped up to being Division Head (Erika) and Director of ARC (Carin). Around the same time, we also reorganised the structure of ARC and appointed several new research leaders who are very actively involved in the running of ARC.

Like our predecessors, we aim to maintain ARC as a well-positioned national and international research centre and to spread knowledge on ageing to the academic world and the next generation of scholars. To develop and expand the competence within our centre, we aim to continue to increase the collaboration with colleagues at KI and SU, as well as with other research groups. This will further secure ARC as a leading research centre on topics related to the ageing population from a psychological, social, and medical perspective. As the research questions of ageing, health and social inequalities have undoubtedly important practical and policy implications, we will also increase our efforts to communicate relevant results from our research projects to policymakers, interest groups, and to the public. We are grateful that the presidents of KI and SU have decided to continue to support our work to reach these goals.

Photo: Erik Flyg

Carin Lennartsson, Director, and Erika Jonsson Laukka, Head of Division

Organisation

Organisation

ARC – a centre supported by Stockholm University and Karolinska Institutet

Stockholm University (SU) and Karolinska Institutet (KI) founded the Aging Research Center (ARC) in 2000.

The long-term collaboration between SU and KI has enabled researchers at ARC to conduct high-quality interdisciplinary research in areas such as ageing and health, equal living conditions, geriatric epidemiology, and the psychology of ageing. Within these areas, we also contribute to teaching and shared responsibility for undergraduate courses and courses at an advanced level at both universities.

Although ARC is physically and administratively located at KI, the support from SU is significant for all our activities and forms a valuable basis for achieving stability and continuity in our work. It contributes to our interdisciplinary research, facilitates collaborations with researchers at different departments at SU, and favours the use of core facilities at the Stockholm University Brain Imaging Centre to collect data.

During 2022, we have had the pleasure of welcoming Karolinska Institutet's President, Ole Petter Ottersen, as well as Stockholm University's President, Astrid Söderbergh Widding, accompanied by Deputy Vice President for Human Science, Yvonne Svanström, to discuss ARC's organisation, current and future activities, and the collaboration between our two universities.

External steering group

Following the agreement between KI and SU, ARC has an external steering group, with members selected by the two universities. This group meets at least twice a year. The ARC external steering group supports and fosters the activity at ARC. It has an advisory role in budget issues and the overall planning of strategical research orientations and major ARC activities. Current members are:

- **Mårten Palme,** Professor of Economics, SU – Chair
- **Martin Annetorp,** Acting Managing Director of Aging Theme, Karolinska University Hospital, Stockholm County, Health Care Services
- **Bo Burström,** Professor of Social Medicine, KI
- **Maria Ankarcrona,** Professor of Experimental Neurogeriatrics, KI, representative of KI as Head of Department of Neurobiology, Care Sciences and Society (NVS)
- **Johanna Hållén,** Secretary General, PRO (The Swedish National Pensioners' Organisation)
- **Maria Masucci,** Professor of Virology and Deputy Vice-Chancellor for International Affairs, KI
- **Susanne Rolfner Suvanto,** Manager, The Nursing Institute in Sweden
- **Ola Sjöberg,** Professor of Sociology at the Swedish Institute for Social Research, SU
- **Maria Stanfors,** Professor of Economic History, Lund University

Leadership

ARC is a division at the Department of Neurobiology, Care Sciences and Society (NVS) at KI. The Head of Division is Erika Jonsson Laukka, and the director Carin Lennartsson. There are nine research groups within the division, belonging to three scientific areas: Medical Epidemiology, Psychology and Social Gerontology.

Executive group

Since 1 April 2021, ARC has been managed by an executive group, consisting of the Head of Division Erika Jonsson Laukka, the Director/Deputy Head of Division Carin Lennartsson, the Assistant Division Head, with special responsibility for strategic research questions, Chengxuan Qiu, the Economy Coordinator Cecilia Annerholm, and the Safety and Environment representative Maria Wahlberg.

The executive group deals with current issues and implements decisions taken by the ARC internal board, which is led by Head of Division and ARC's Director and consists of research group leaders, professors, representatives from the administrative unit, a postdoc, and a PhD representative. The internal board shares responsibility for scientific, organisational, and financial issues, and meets once per month.

Internal Board

- Erika Jonsson Laukka, Division Head, research group leader – Chair
- Carin Lennartsson, Director, research group leader
- Chengxuan Qiu, Assistant Division Head, research group leader
- Neda Agahi, research group leader
- Lars Bäckman, research group leader
- Amaia Calderón-Larrañaga, research group leader
- Grégoria Kalpouzos, research group leader
- Debora Rizzuto, research group leader
- Weili Xu, research group leader
- Johan Fastbom, Professor
- Laura Fratiglioni, Professor
- Johan Fritzell, Professor
- Cecilia Annerholm, Economy coordinator
- Ellinor Lind, HR administrator
- Federico Triolo, PhD student, junior representative
- Lu Dai, Postdoc, junior representative

ARC administration

The ARC administration consists of Cecilia Annerholm, Economy coordinator, Ellinor Lind, HR administrator, Maria Wahlberg, Safety representative, Maria Yohuang, administrator and Lotte Brandt, Communications officer, supporting management, staff, and affiliates in the day-to-day work at the division.

ARC Staff

ARC employs 23 senior and 28 junior researchers, as well as 18 administrative and technical staff.

Researchers at ARC are divided into nine research groups, representing three scientific areas: psychology (e.g., cognition, structural, functional, and molecular brain imaging); social gerontology (e.g., sociology, public health, social epidemiology, social work) and medical epidemiology (e.g., neurology, epidemiology, psychiatry, geriatrics). In addition, approximately 25 researchers are affiliated to ARC.

Photo: Erik Flyg

Visiting researchers and students

Visiting researchers and students

Despite the pandemic, ARC has had the pleasure to welcome several fellow researchers and students from around the world during the last three years.

Isabel del Cura, family physician and Associate Professor in Epidemiology, coordinator of the Primary Care Research Unit at the Madrid Health Service, Spain. June–September 2022.
Host: Amaia Calderón-Larrañaga.

Maria Forslund, PhD student in Sociology, Stockholm University. November 2019–June 2022.
Host: Johan Fritzell.

Federico Gallo, National Research University Higher School of Economics, Moscow, Russia and Vita-Salute San Raffaele University, Milan, Italy. March 2020–September 2020.
Host: Serhiy Dekhtyar.

Merle Hendel, Master's student in Psychology at Maastricht University, the Netherlands. February 2020–March 2021.
Host: Davide Liborio Vetrano.

Charlotte McNulty, PhD student in Psychology from Umeå University. 2020.
Host: Alireza Salami.

Eline Vespoor, PhD student from Radboud University Medical Center, the Netherlands. 2020.
Hosts: Amaia Calderón-Larrañaga and Anna Marseglia.

Hao Luo, Assistant Professor at the Uni of Hong Kong, PR of China. January–August 2021.
Host: Davide Liborio Vetrano.

Andreja Speh, PhD student in Psychology, University of Ljubljana, Slovenia. November–December 2021 and October 2022.
Host: Erika Jonsson Laukka.

Elena Baldasso, Master's student in Biostatistics at Milano Bicocca University, Italy. September 2022–February 2023.
Host: Davide Liborio Vetrano.

Giuseppe Di Gioia, Medical Doctor and resident in Geriatrics and Gerontology at University of Foggia, Italy. August 2022–January 2023.
Host: Weili XU.

Susanna Gentili, PhD student in Nursing and Public Health at the University of Rome Tor Vergata, Italy. 2022.
Host: Davide Liborio Vetrano.

Caterina Gregorio, PhD student in Biostatistics at Politecnico di Milano, Italy. October 2022–March 2023.
Host: Debora Rizzuto.

Giuliana Locatelli, Master's student in Biostatistics at Milano Bicocca University, Italy. September 2022–February 2023.
Host: Davide Liborio Vetrano.

Chukwuma Okoye, MD and PhD student at University of Pisa, Italy. 2022.
Host: Davide Liborio Vetrano.

Robin Pedersen, PhD student in Psychology, Umeå University. 2022–2023.
Host: Alireza Salami.

Oliver Lampert, Master's student, Stockholm University. January–June 2022.
Host: Ingrid Ekström.

Martina Valletta, MD and resident in Neurology at Sapienza University of Rome, Italy. 2022.
Hosts: Giulia Grande and Debora Rizzuto.

Marek Háša, PhD student, Institute of Communication Studies and Journalism, Charles University, Prague, Czech Republic. Spring 2022.
Host: Carin Lennartsson.

"I had the opportunity to have a position as a guest PhD student in the Social Gerontology group. My stay at ARC gave me the opportunity to deepen my knowledge of ageing, by taking part in the multidisciplinary research field. The warm and encouraging work environment gave me the opportunity to take part in seminars, as well as presenting my own work, both aspects from which I have learnt a lot. I am grateful for the experience and the knowledge it provided me with, both for my thesis work, and for future research projects."

Maria Forslund, PhD student, SU, Sweden.
At ARC: November 2019-June 2022.

"I spent six months at ARC during one of the toughest times in recent years, the first COVID outbreak. Even in such a time, the ARC family made me feel welcomed and at ease. Thanks to their support I managed to produce some of the highest quality research in my career and learned many crucial skills. I hope to visit again soon!"

Federico Gallo, National Research University Higher School of Economics, Moscow, Russia and Vita-Salute San Raffaele University, Milan, Italy.
At ARC: March 2020- September 2020.

"I'm very grateful to have been a part of the ARC team. The time there let me grow, both on a professional as well as personal level. It was a pleasure to work among a talented group of people and I hope to keep in touch for future projects."

Merle Hendel, Master student in Psychology at Maastricht University, the Netherlands.
At ARC: February 2020-March 2021.

"During my master's thesis project, the inspiring environment at ARC helped me grow personally and as a researcher. I made friends and started my career in academia. One day I want to return and present my future work."

Oliver Lampert, Master's Student, SU, Sweden.
At ARC: January-June 2022.

"The interdisciplinary approach to ageing, professional and supportive atmosphere, educational activities, and fika always impress me at ARC. This is my third, and hopefully not last, visit."

Andreja Speh, PhD student, University of Ljubljana, Slovenia. At ARC: November-December 2021 and October 2022.

Photo: Sara Eng

Collaborations and data collections

Collaborations in Sweden

Main collaborator: the Stockholm Gerontology Research Center – Äldrecentrum

ARC has been collaborating for many years with the Stockholm Gerontology Research Center, funded by the Stockholm Region and the City of Stockholm. Via research circles, network meetings, courses, seminars and conferences for managers and personnel in health and social care, the Stockholm Gerontology Research Center aims to create the prerequisites for the use of knowledge on adults' living conditions, health, ill health, and medical and social care needs. These activities also provide important channels and arenas for the discussion, dissemination, and implementation of the results of research carried out at ARC.

Another important channel for ARC's research to reach policymakers, practitioners and the public is the national popular science magazine *Äldre i Centrum* (Older People in Focus). The magazine covers important news and knowledge in the field of older people and ageing, and forms a bridge between research and practice. It is published four times a year, both in print and in a digital version on the website. Researchers at ARC regularly contribute to the magazine, with at least one article per issue. More recently, the editorial office of the magazine has started the *Äldre i Centrum*-podcast, in which our researchers often participate.

The Stockholm Gerontology Research Center and ARC are jointly responsible for the Swedish National Study on Aging and Care in Kungsholmen (SNAC-K), Stockholm. SNAC-K aims to increase knowledge on ageing and health, and provide scientific evidence to develop preventive actions and improve older adults' care. Data from SNAC-K are regularly used in research projects at ARC, resulting in hundreds of scientific articles and several doctoral theses during 2020-2022.

Sweden
Blekinge Tekniska Högskola
Högskolan Dalarna
Jönköping University
Karlstad University
Karolinska University Hospital
KTH Royal Institute of Technology
Linköping University
Lund University
Stockholm University
Umeå University
University of Gothenburg
Uppsala University
Örebro University

Austria
European Centre for Social Welfare Policy and Research, Vienna

Australia
University of New South Wales, Sydney

Belgium
European Commission

Brazil
Universidade Federal do Rio Grande do Sul

Canada
Queen's University, Kingston
University of Waterloo

China
Chinese Academy of Sciences, Institute of Psychology
The Chinese University of Hong Kong
Shandong Provincial Hospital affiliated to Shandong First Medical University
University of Hong Kong

Collaborations around the world

Denmark
Aalborg University
University College Northern Denmark
University of Copenhagen
Roskilde University
Danish Center for Social Science Research (VIVE)

Finland
University of Tampere
National Institute for Health and Welfare (THL), Helsinki
Seinäjoki University of Applied Sciences

France
Institut Pasteur de Lille

Germany
Forschungszentrum Jülich
German Centre of Gerontology (DZA), Berlin
Max Planck Institute for Human Development, Berlin
Otto von Guericke University, Magdeburg
University of Bielefeld

Iceland
University of Iceland, Reykjavik

Italy
Catholic University of Rome
National Institute of Health, Rome
University of Brescia
University of Ferrara
Italian College of General Practitioners, Florence

Luxembourg
Luxembourg Institute of Socio-economic Research, LISER, University of Luxembourg
Cross-national Data Center in Luxembourg (LIS)

The Netherlands
Amsterdam University Medical Center (UMC)
Radboud University
Tilburg University

Norway
Health Services Research Unit, Akershus University Hospital
Norwegian Social Research (NOVA) at Oslo Metropolitan University (OsloMet)
The Arctic University of Norway, Tromsø

Slovenia
University Medical Centre (UKC), Ljubljana

Spain
Autonomous University of Madrid (UAM)
Institute for Health Research Aragón (IIS Aragón)
Institute for Primary Health Care Research Jordi Gol i Gurina (IDIAPJGol)
National School of Public Health
Primary Care Research Unit at the Madrid Health Service
Vall d'Hebron Research Institute (VHIR) Barcelona

Switzerland
ZHAW, Zürich University of Applied Sciences and Arts

UK
Durham University
University of Cambridge
University College London (UCL)
University of Liverpool
University of Sheffield

USA
Harvard University
National Institute on Aging, National Institutes of Health, MD
Syracuse University, Syracuse, NY
University of Illinois, Chicago
University of Michigan, Ann Arbor
University of New Mexico
University of Pennsylvania
University of Southern California (USC Dornsife)
University of Texas

Ongoing data collections

The research conducted at ARC is based on data from several ongoing and completed longitudinal studies (local, national, and international), national registers, and from experimental and clinical studies conducted on a smaller scale.

The ongoing data collections 2020-2022 are:

- **Swedish National Study on Aging and Care in Kungsholmen – SNAC-K**. The goal of SNAC-K is to collect longitudinal population-based data to understand the ageing process, and to identify possible preventive strategies to improve health and care in older adults. PI: Laura Fratiglioni (2001-)
- **The Swedish Panel Study of Living Conditions of the Oldest Old – SWEOLD**. The aim of SWEOLD is to collect relevant, high-quality and up-to-date data about older adults' living conditions and health. PI: Carin Lennartsson (1992-)
- **The IronAge study** investigates the effects of age-related brain iron accumulation on structural, molecular, and functional neural changes and cognitive decline and the genetic, biological and lifestyle factors associated with brain iron accumulation. PI: Grégoria Kalpouzos (2017-)
- **The Long-COVID study** is following up on patients diagnosed with post COVID-19 syndrome. The study aims to identify modifying factors and brain correlates to long-lasting cognitive and olfactory deficits in this group, as well as their prognostic impact for well-being and daily functioning: PI: Erika Jonsson Laukka (2022-)
- **Mechanisms associated with olfactory and cognitive function in ageing** is a data collection programme carried out at the Memory Clinic, Karolinska University Hospital, Solna. The aim of this study is to investigate the associations between olfactory function, cognitive abilities, and dementia. PI: Erika Jonsson Laukka (2022-)
- **Validation of the Health Assessment Tool (HAT) in primary care.** HAT is an easy-to-use instrument that comprehensively appraises health and functioning in older adults. Data on patients aged 60+ years are currently being collected in six different urban, semi-rural and rural primary care centres across Sweden to examine the validity and feasibility of implementing HAT in routine primary care. PI: Amaia Calderón-Larrañaga (2022-)

Researchers from ARC are also involved in conducting two large positron emission tomography (PET) projects in Umeå, with the aim to study the dopaminergic system in ageing:

- **COBRA** – the Cognition, Brain, and Aging project. PI: Lars Bäckman.
- **DyNAMIC** – Dopamine, Age, Connectome and Cognition. PI: Alireza Salami.

Other data sources

Our research is also built on studies run by national and international collaborators, as well as record linked data from the following national registers from The Swedish National Board of Health and Welfare and Statistics Sweden, covering all Swedish residents 65 years and older, 2006-2020. This register database includes information from the Swedish Prescribed Drug Register, the Patient Register, the Social Services Register, the Cause of Death Register, the Education Register, the LISA Register (socioeconomic data) and the Total Population Register.

We are also involved in qualitative studies, such as FUTUREGEN. This study investigates how entwined gender inequalities in health and caregiving/receiving evolve across generations in connection with cultural and social contexts and individual realities, and how identified sex/gender inequalities may evolve in the future. PI: Stefan Fors (2020-2022).

Infrastructure

NEAR – The National E-infrastructure for Aging Research

NEAR is a unique and innovative research infrastructure that currently comprises 15 major longitudinal population-based studies on ageing and health in Sweden. It is a multidisciplinary resource including 180,000 individuals aged 50 years or over who have been followed up for between 10 and 52 years.

NEAR is a consortium – a national collaboration between eight Swedish universities: Karolinska Institutet, University of Gothenburg, Lund University, Umeå University, Jönköping University, Blekinge Institute of Technology, Uppsala University and Stockholm University. The infrastructure was financially supported by the Swedish Research Council in 2018 and 2022.

Collaboration contributes to empowering ageing research

The infrastructure will empower ageing research in Sweden by providing substantial added value to the field: a broad, multidisciplinary research perspective that cannot be achieved with the individual databases; and increased sample size and variation, which enhance representativeness and generalisability – a critical mass of data that opens new research avenues and supports innovation.

The ultimate goal is to contribute to identifying sustainable intervention strategies for better health and care for older people.

History and future

Phase I – 2018-2022
During the first five years, we have focused on build up and establishment. A consortium has been established, NEAR fundaments and management are in place and the first use of NEAR data began in 2019.

Today there are 12 ongoing research projects based on NEAR harmonised data.

Phase II – 2023-2028
In 2023, NEAR will enter the next phase. NEAR-Phase II has two main goals: (1) Consolidate NEAR functionality, and (2) Expand the infrastructure by promoting NEAR use in the scientific community and outside academia. NEAR-Phase II is developed as a natural complement to the first phase, and will follow the same fundamental concepts, framework, organisation, and structure.

TEAM

The Director of NEAR is Professor Laura Fratiglioni. NEAR has been led by a Steering Board that includes one representative from each of the NEAR databases. The NEAR Operational group comprises a Scientific Coordinator, Database Manager, Statistician, Scientific Communicator, and a Data Scientist.

Research

Major findings in the last three years

Multimorbidity and frailty

Older adults' health is complex, and no single indicator can reliably capture the health heterogeneity of ageing populations. Measures of functioning and disability, along with lab tests and environmental characteristics, are particularly relevant for older adults and can improve the prediction of negative outcomes when added to clinical diagnoses. In this regard, the predictive role of chronological age may not be performing so well (*Salignon et al., 2022*). The Health Assessment Tool (HAT), a multidimensional global health score built by researchers at ARC, is a good example of a reliable multidimensional prognostic tool able to predict future health trajectories and healthcare utilisation patterns (*Straatmann et al., 2020)*.

The heterogeneity of health is greater in older than in younger ages; this diversity is a singularity of older age. Moreover, older people with equal health status at earlier ages follow different trajectories over time, and their needs diverge according to which path they are on (*Calderón-Larrañaga et al., 2021a;* ***Figure 1***). Thus, the health of older people can be viewed as a continuum, and needs to be investigated longitudinally.

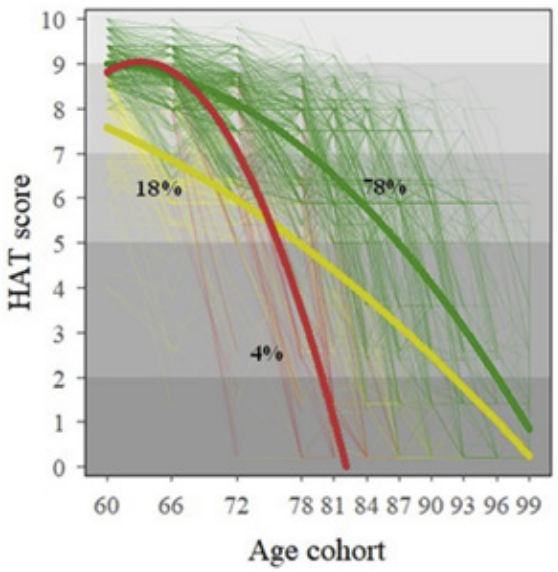


Figure 1. Individual (dotted) and average (solid) Health Assessment Tool (HAT) score trajectories for the general SNAC-K population. Percentages indicate the share of the population belonging to the slow declining (green), average declining (yellow), and fast declining (red) health trajectories (Calderón-Larrañaga et al., 2021a, *Aging*).

We have shown that diseases tend to aggregate in the same person due to similar pathophysiological mechanisms and/or shared risk factors, which leads to multimorbidity (i.e., two+ chronic diseases) patterns, characterised by chronic disorders that systematically cluster together beyond chance. The evolution over time of such multimorbidity patterns is dynamic and heterogeneous, and is associated with different prognoses *(Vetrano et al., 2020; **Figure 2**)*. Furthermore, specific multimorbidity clusters have, for instance, been shown to differentially impact disability, dementia *(Grande et al., 2021a)*, institutionalisation *(Marengoni et al., 2021)* and frailty *(Tazzeo et al., 2021)*.

To better understand the clinical evolution of people with multimorbidity we have explored several biological and physiological factors that lead to an accelerated chronic diseases development and accumulation, such as biomarkers of homocysteine metabolism *(Calderón-Larrañaga et al., 2020a)*, body mass trajectories *(Calderón-Larrañaga et al., 2021b)*, sleep disturbances *(Sindi et al., 2020)*, or kidney function *(ongoing project)*.

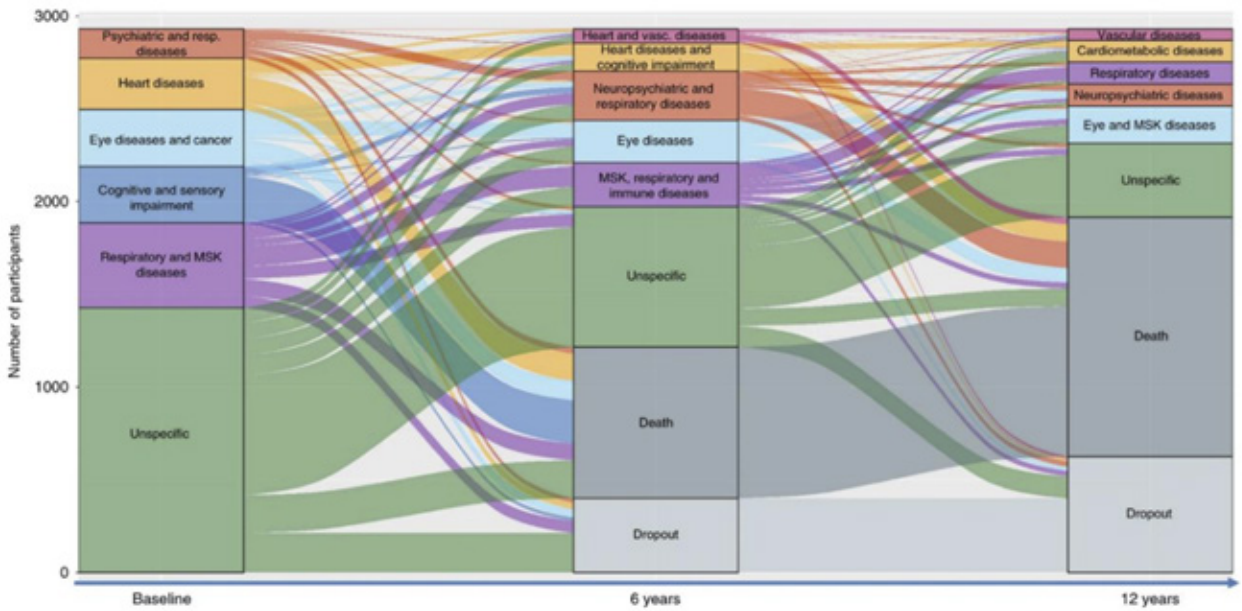


Figure 2. Evolution of multimorbidity clusters and clinical trajectories of older adults with multimorbidity over 12 years in the SNAC-K study. The height of the boxes and the thickness of the stripes are proportional to the amount of people belonging to the cluster and moving from the cluster, respectively. MSK musculoskeletal (Vetrano et al., 2020, *Nature Communications)*.

Health trends and inequalities

The existence and persistence of socioeconomic inequalities in health are among the most robust findings in health research. They have been observed for centuries, and reducing them has been on the political agenda in Sweden for decades. Yet, health inequalities have continuously increased in Sweden since the 1990s. In three recent studies, we examined trends in health inequalities with the newest available data and with a focus on the older segments of the population *(Fors et al., 2021; Rehnberg et al., 2022; Sundberg et al., 2021)*.

Overall, we found continuous improvements in life expectancies and lower mortality rates in the Swedish older population, but these improvements were more rapid in higher socioeconomic positions, measured by either income or education. When considering income inequalities, Fors et al. (2021) showed that the gap in remaining life expectancy at age 65 between the lowest and the highest income quartiles grew by more than a year between 2006 and 2015. This widening income gap in old-age life expectancy was primarily driven by a more rapid improvement in life expectancy among those with higher incomes. Similarly, Rehnberg et al. (2022) showed that income inequalities in mortality increased between 1995 and 2017, which was mainly driven by larger reductions in mortality risks in the upper part of the income distribution *(Rehnberg et al., 2022, **Figure 3**)*. Examining trends in different age groups, we found that relative inequalities, i.e., differences in the risk of dying expressed as a ratio, increased in Sweden among persons aged 30–64 years, whereas both absolute inequalities, i.e., differences in death rates, and relative inequalities increased among persons aged 65–79 years. In the oldest age group (80+ years), relative and absolute inequalities were smaller than in the younger population.

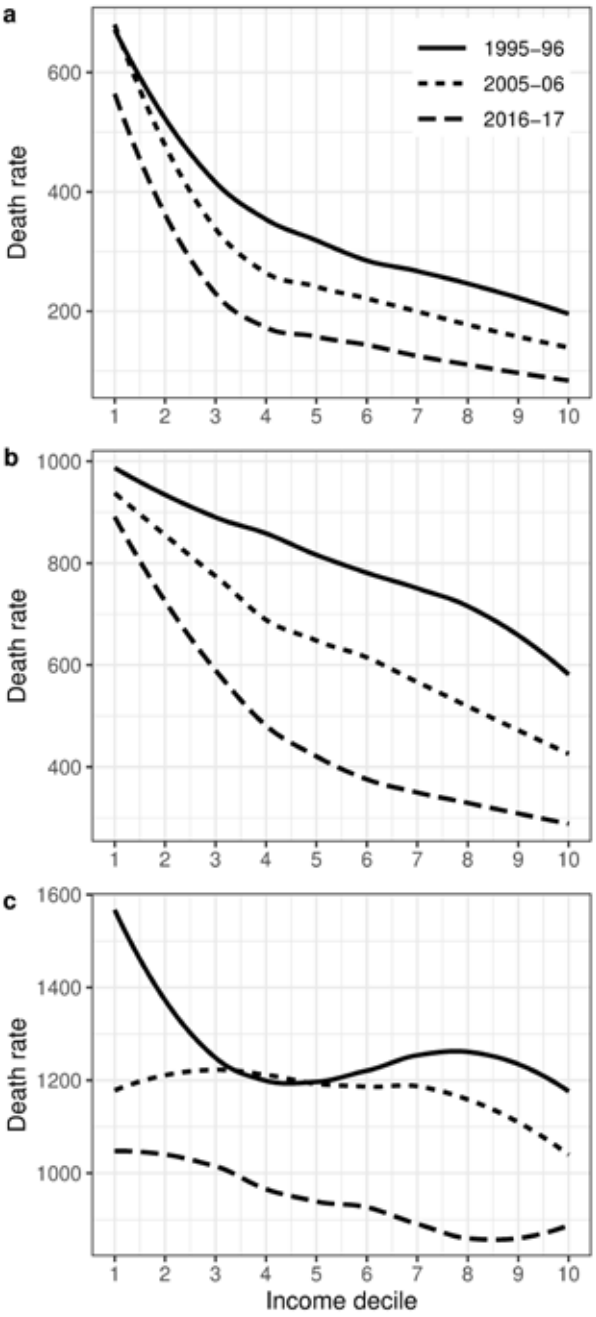


Figure 3. Age-standardised death rate by income decile in 1995–1996, 2005–2006 and 2016–2017 for persons aged (a) 30–64 years, (b) 65–79 years, and (c) 80+ years (Rehnberg et al., 2022, *BMJ Open*).

Looking at differences between educational groups, Sundberg et al. (2021) showed that old-age life expectancy increased in all educational groups in the older population but that this increase was larger in groups with higher education. Additionally, it was found that disability-free life expectancy (expected years of life without disability) increased for everyone except men with lower education. Similar to the previous studies, this study also showed a more pronounced improvement in higher educational groups *(Sundberg et al., 2021)*.

There are many potential explanations for the persistence of health inequalities today. Hypotheses range from macro level to micro level: how societies are structured – leading to social inequalities in living conditions and resources more generally, the design and generosity of welfare state programmes, as well as individual health behaviours and their genetic predispositions. One of the largest societal changes during the second half of the 20th century is the increase in the proportion of the population who go on to higher education. Enroth et al. (2022) examined to what extent increasing inequalities in life expectancy was attributable to increasing education in four Nordic countries. The findings showed that life expectancy increased at all ages and in all educational groups. Between 10 and 37% of the gains in life expectancy could be attributed to more people having longer education. However, like the findings in all reported studies, inequality in life expectancy between educational groups persisted or increased over time, which highlights the need to continue to monitor health inequalities in older adults.

Health in older ages is shaped by the life-course exposure to several individual and contextual factors. For example, both mid and late-life overweight/obesity are associated with increased risk of cardiometabolic multimorbidity, independent of genetic and early-life environmental factors. A favourable lifestyle could mitigate the adverse impact of overweight/obesity on cardiometabolic diseases *(Guo et al., 2021a)*.

The same determinants are also responsible of some secular health trends as the declining dementia incidence observed in central Stockholm from the 1980s to 2010s. Improvement in cognitive reserve (e.g., increased education and work conditions) and cardiovascular health could partially contribute to the observed decreasing dementia incidence *(Ding et al., 2020, **Figure 4**)*.

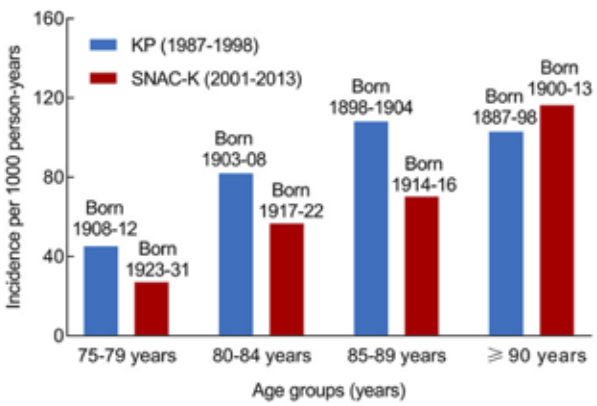


Figure 4. Incidence rates of dementia in the KP cohort (1987-1998) and the SNAC-K cohort (2001-2013) stratified by age groups and year of birth. KP = Kungsholmen project; SNAC-K = Swedish National Study on Aging and Care in Kungsholmen (Ding et al., 2020, *Alzheimer's & Dementia*).

Treatment and care of older people

1. Long-term care

Mortality is being postponed to older ages and most deaths in high-income countries now occur at ages around 85. While many people live well into advanced ages, deaths after age 80 are seldom sudden and a key question for social policy is to what extent longer lives entail a period of functional loss, dependency and need for long-term care.

Using individually linked nationwide Swedish registers, we mapped out the total use of long-term care (homecare and institutional care) during the last two years of life for all persons who died in November 2015 aged 67 years or older (*Meinow et al., 2020)*.

Results showed that, despite the decline of long-term care (LTC) in Sweden during the past two decades, almost 70% of the men and over 80% of the women used LTC before death. Proportions of LTC users were higher among individuals who lived alone compared with those cohabiting *(Meinow et al., 2020, **Figure 5a)***. The incidence of institutional care accelerated during the last three months of life *(Meinow et al., 2020, **Figure 5b**)*.

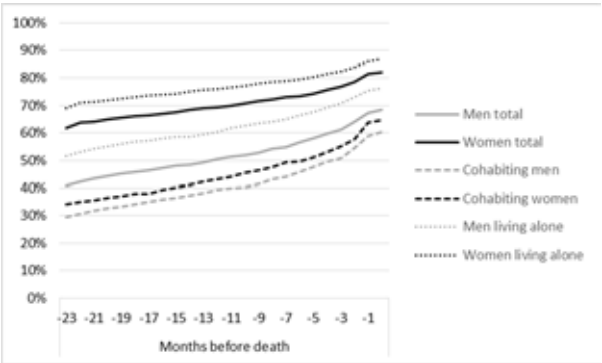


Figure 5a. Proportion of women and men with LTC (home-care or institutional care) during the last two years of life, by household type (Meinow et al., 2020, *Journal of the American Medical Directors Association*).

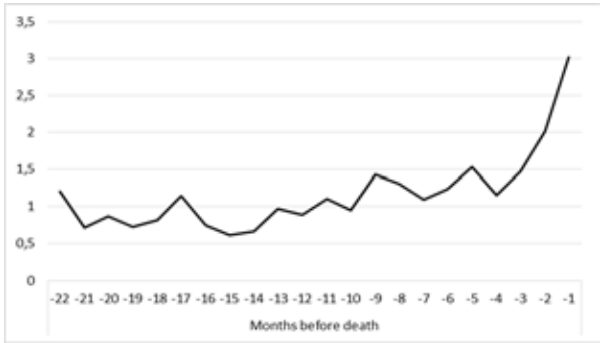


Figure 5b. Incidence rate of institutional care during the last two years of life (Meinow et al., 2020, *Journal of the American Medical Directors Association*).

Women used LTC to a larger extent and for a longer period than men. A substantial part of women's greater use of LTC was due their higher age at death and because they more often lived alone. Considering these factors, women used LTC on average for 15.6 months and men for 14.1 months out of their last two years of life. The length of stay in institutional care was 7.2 months for women and 6.2 months for men, respectively (*Meinow et al., 2020*).

Given that survival rates continue to increase, the association between older age at death and LTC use suggests that policy makers will have to deal with an increased pressure on the LTC sector. Yet, increased survival among men could imply that more women will have access to spousal caregivers, although very old couples may have limited capacity for extensive caregiving at the end of life.

2. Integrated care

The health problems of older people are often characterised by multi-morbidity and frailty in combination with multiple functional (physical and cognitive) limitations. This results in increased needs of services from multiple providers, such as the family, local authorities, and various clinics within the regions. Continuity, integration, and coordination between health and social care providers are essential to adapt to the needs of an ageing population.

Integrated care is thought to increase efficiency, quality, and safety while still controlling the costs of care, and is advocated as a possible solution to some of the challenges of an ageing society. One Swedish example of an integrated care model, internationally known as a prime example, is the TioHundra organisation in Norrtälje. The Norrtälje Model is a cooperation between the local authorities responsible for healthcare and social care. We have investigated the impact of integrated care on trends in the rate of emergency department (ED) visits, hospitalisations for ambulatory care sensitive conditions (ACSC), patient-reported outcomes, cost of inpatient care, polypharmacy, and inappropriate drug use (*Agerholm et al., 2021, 2022; Doheny et al., 2020, 2021, 2022*).

We found that the implementation of an integrated care system between health and social care in Norrtälje did not have any negative impact on the investigated outcomes. We found some positive changes; however, they were modest, and the interpretation of the results were complicated by intervening policy changes in both health and social care in the study period following the implementation of the integrated care model. The implementation of integrated care was associated with a modest change in the trend of ED visits in Norrtälje, though the rate remained higher than in the rest of Stockholm (*Doheny et al., 2020*). There was a positive impact on admissions for ACSC; however, it was not significant in comparison with standard care (*Agerholm et al., 2021*). We found no evidence that the introduction of integrated care affected the cost of inpatient care (*Doheny et al., 2022*). There were no significant differences in the trend changes between different socioeconomic groups. We also found no effect of integrated care on the risk of polypharmacy and inappropriate drug use, suggesting that national guidelines are followed in both settings (*Doheny et al., 2021*). To investigate the effect of integrated care on patient reported outcomes, we made comparisons between patients undergoing total hip replacement in integrated care and in standard care and found no significant effect of integrated care on the patient-reported outcomes (*Agerholm et al., 2022*).

Both healthcare and long-term care developments have been under scrutiny within the large-scale Nordic programme Social Inequalities in Ageing (SIA). A chief characteristic of the Nordic welfare model is that the health and long-term care system is based on the principle of ensuring care on equal terms for the entire population according to need – a principle of universality. Key findings from the SIA reveal that universalism has become weaker in most respects, particularly so in Finland and Sweden. Policy analyses show that many changes seem to be incremental, implemented through prioritisation of resources and in many cases without any larger policy reform. Ultimately, these piecemeal changes have led to an expansion of family care and private for-profit actors within health and social care (marketisation), with increased inequalities across gender and social class as a consequence (*Fritzell et al., 2022*).

Living conditions and social inequalities

There is an increasing focus on loneliness and social isolation among older adults in both research and policy. Based on the SWEOLD study, we have previously shown that about 10-15% of Sweden's oldest population experience feelings of loneliness often or nearly always and, contrary to what is often assumed, there has been no increase in loneliness during the past decades (*Dahlberg et al., 2018*). However, as highlighted in an editorial summary by Dahlberg (2021), some research has pointed towards an increase in loneliness during the pandemic.

A systematic review identified a total of 120 unique risk factors for loneliness, for example, social isolation (*Dahlberg et al., 2022*). Moreover, negative associations between loneliness, social isolation and health are well established, and adults experiencing loneliness and social isolation are not only at risk of poor health and well-being but also of premature mortality. Contributing to this research, one of our studies shows that social isolation was more strongly associated with mortality than with feelings of loneliness (*Lennartsson et al., 2021*). In addition, our research has shown that older adults living alone had poorer mobility and psychological health, less financial security, fewer social contacts, and more loneliness than older adults living with others. Furthermore, the mortality risk among people living alone increased over time (*Shaw et al., 2020*). Thus, social integration should be a prioritised target for activities and services involving older adults.

Another aspect of older adults' living conditions that we have investigated is major life-events, such as retirement and loss of significant others, and how the living situation changes surrounding these events. With regard to alcohol consumption, we found that most people did not change their consumption in connection to major life-events. However, about one-tenth reported heavy drinking both before and after severe illness or death in the family or divorce, and another tenth had elevated probability of heavy drinking before the event (*Agahi et al., 2022*). Heavy alcohol consumption might have particularly adverse health consequences in older ages, and is therefore crucial to monitor.

Brain ageing

People's individual cognitive capabilities differ, and differences widen as people age. At ARC we focus on understanding the reasons for these differences. Why do some 80-year-olds have better memory than 35-year-olds? Why do some people maintain a youthful brain, but others develop dementia? How does behaviour over life course affect brain changes? Several factors typically interact to cause faster cognitive decline and dementia, and some factors can protect against cognitive deterioration.

1. Ageing-related decline in dopamine

Brain cells communicate via neurotransmitters, such as dopamine, which supports many molecular mechanisms important for cognition. However, the degree of average age-related change in dopamine receptor availability remains unclear, due to the paucity of longitudinal data. Consequently, the shared and unique contributions of changes in dopamine, grey matter, and white matter to changes in cognitive performance in old age are unknown. This means that current foundations for research on ageing, brain, and cognition are imperfect and possibly erroneous.

Addressing this issue, the Cognition, Brain, and Aging (COBRA) project is a longitudinal study that follows 181 persons who are between 63 and 67 years at baseline across 10 years, with three measurement occasions. The protocol includes several indicators of episodic memory, working memory, and speed. Multiple brain measures are assessed using molecular, functional, and structural brain imaging (i.e., dopamine D2 receptors, markers of grey- and white-matter integrity, brain activity at rest and during working-memory performance).

The first follow-up data collection of COBRA was completed in 2019 (n = 129), and publication on five-year changes in brain and cognition are starting to emerge. Karalija et al. (2022) reported age-related decline in both striatal and extrastriatal D2 receptor availability. Importantly, the magnitude of decline was around half of what has been estimated in previous cross-sectional work, suggesting overestimation of D2 decline in cross-sectional data. D2 losses were related to white-matter lesion progression and reductions in cortical perfusion, probably in a reciprocal fashion. Vikner et al. (2022) examined progression of markers of small-vessel disease (arterial pulsatility, perivascular space dilation, white-matter lesions). Lead-lag analyses indicated that expression of perivascular space dilation and white-matter lesions may precede increases in pulsatility. Thus, elevated pulsatility appears to be a late manifestation, rather than a risk factor for cerebral small-vessel disease. Nyberg et al. (2022) classified persons into having stable or declining working memory over five years. The classification was based on both in-scanner n-back data and offline testing of working memory *(Nyberg et al., 2022, **Figure 6**)*. The stable and declining groups exhibited maintained versus reduced functional activity in prefrontal cortex (*Nyberg et al., 2022, **Figure 7**)*. Further, the groups also differed in hippocampal volume, ventricle size, and caudate D2 binding, suggesting that preserved working-memory functioning may be one of several indicators of general brain maintenance in ageing.

Data collection for the third and final wave of measurement in COBRA is currently ongoing. Access to these data will obviously be vital in determining trajectories of changes in brain and cognition in old age.

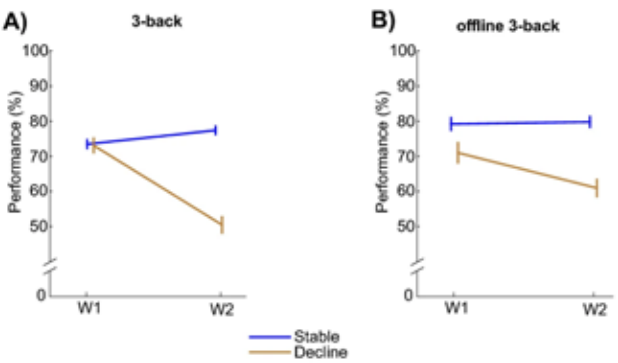


Figure 6. Heterogeneity in working memory (WM) trajectories. Longitudinal 3-back trajectories (A, B) classified individuals into stable versus declining WM. (Mean ± 1SE). W = Wave (Nyberg et al., 2022, *Scientific Reports*).

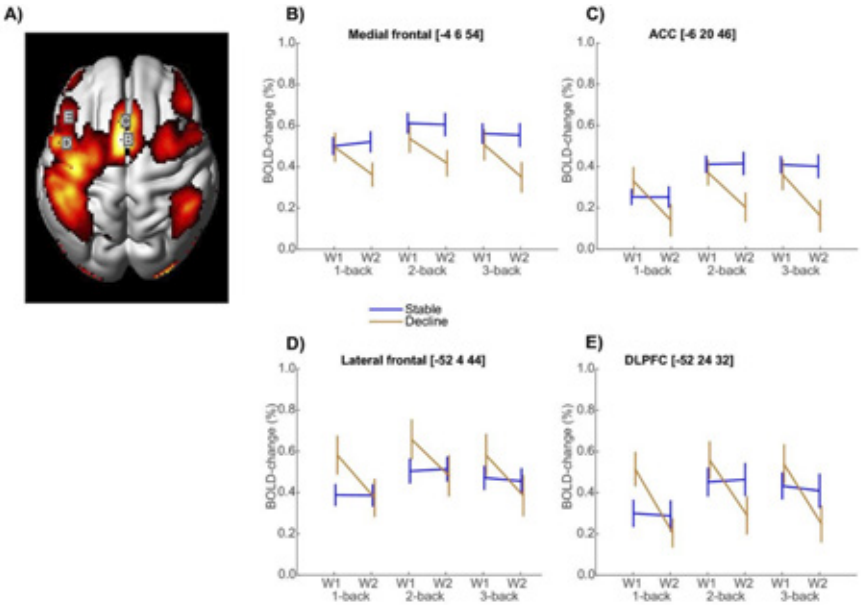
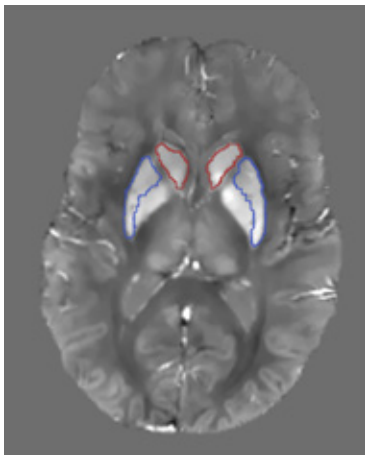


Figure 7. Functional brain activity during n-back tests of WM. (A) Brain regions showing differential BOLD signal during n-back in stable and declining persons (pFWE < 0.05); (B-E) Significant group differences in prefrontal cortex longitudinal trajectories. (Mean ± 1SE). W = Wave (Nyberg et al., 2022, *Scientific Reports*).

2. Brain iron in ageing

Iron is an abundant and important metal involved in many biological mechanisms, from oxygen transportation through the blood to neurotransmitter production. However, at high levels, iron is toxic and leads to cellular death. High iron load in the brain in old age has been related to deleterious outcomes, such as worse cognition, disturbances in neural activity, and neurodegeneration. Most studies were cross-sectional and limited in terms of research questions, which prevented understanding potential determinants of iron accumulation, evaluation of true increase of iron over time as people age, and its effects on behavioural outcomes. The IronAge protocol started in 2016-2017 and involved 208 healthy individuals aged 20 to 79-years-old. These individuals underwent (1) Magnetic Resonance Imaging (MRI) of the brain to measure iron, among other properties of the brain, (2) an extensive battery of cognitive tests, and (3) physiological assessment and blood sampling. Moreover, they completed a series of questionnaires about health and lifestyle habits. One hundred and thirty-five participants came for a follow-up assessment three years later, in 2019-2020, with exactly the same protocol to complete.

From these data we showed that genetics influence not only iron levels in the blood but also brain iron levels, with mutations in the HFE genes being related to higher levels of iron in putamen (Kalpouzos et al., 2021). We also demonstrated that neuroinflammation, as measured with MR spectroscopy and myoinositol, contributed to the deleterious impact of striatal iron overload on brain activity and performance during a working-memory tasks in older adults *(Salami et al., 2021)*. Importantly, using longitudinal data, we showed a significant increase of iron in striatum and prefrontal cortex over three years *(Gustavsson et al., 2022)*. The increase of iron in prefrontal cortex was related to more deleterious changes in working-memory abilities. Using a genetic polymorphism acting as a proxy for endogenous dopamine (COMT Val158Met), we also discovered that older individuals with presumably less dopamine (Val/Val) accumulated more iron in both striatum and prefrontal cortex than individuals with more dopamine *(Met carriers; Gustavsson et al., 2022, **Figure 8**)*. These studies contribute to elucidating mechanisms related to determinants of iron accumulation in the brain, and its effects on cognition.



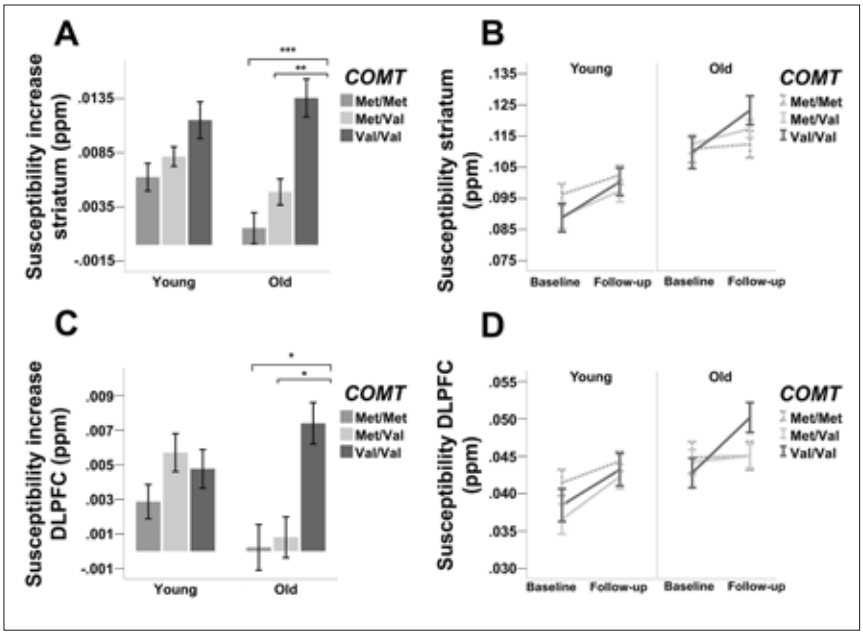


Figure 8. Left: Example of a QSM (quantitative susceptibility mapping) image. Higher signal intensity denotes higher iron load. Striatum is represented by caudate (red outline) and putamen (blue outline).
Right: Accumulation of iron [susceptibility increase in parts per million (ppm)] in (A,B) striatum and (C,D) dorsolateral prefrontal cortex (DLPFC). Error bars ± 1 SE.
(*p < 0.05, **p < 0.01, ***p < 0.001)
(Gustavsson et al., 2022, *Frontiers in Human Neuroscience*).

3. Predictors of Cognitive and Olfactory Decline and Early Markers of Dementia

Increasing age is associated with decline in different cognitive abilities. Age is also the strongest risk factor for impairment in the sense of smell, olfaction. In a study of the predictors of olfactory decline in ageing, multiple health-related factors were associated with accelerated decline, with the most robust associations being found for age, diabetes, and being an *APOE* ε4 carrier (*Ekström et al., 2020*). It has been proposed that age-related olfactory loss may in part be explained by effects of cumulative exposure to inhaled toxins during the lifespan. However, population-based studies investigating the relationship between air pollution and olfactory ability are scarce. As in the previous study, participants in the population-based SNAC-K project were repeatedly assessed with a standardised test of olfactory ability across 12 years. We evaluated associations between exposure to common air pollutants and longitudinal change in olfactory ability. Outdoor exposure levels to two major airborne pollutants (particulate matter ≤2.5µm, PM2.5 and nitrogen oxides, NOx) were estimated for each participant at their residential addresses. On average, persons who had been subjected to comparatively high air pollution exposure had faster rates of olfactory decline than residents with low air pollution (*Ekström et al., 2022,* ***Figure 9***). Our findings support the notion that air pollution may be one of the underlying causes of olfactory loss in ageing.

Sensory impairments, and their relationship with cognition, have been under scrutiny for years. Using data from the Memory and Aging project in the US, we showed that episodic memory and odour identification show similar ageing trajectories. Three distinct patterns were characterised by 1) average performance in both functions stable over time; 2) decline in odour identification only; and 3) joint decline in both functions (*Dintica et al., 2021).*

Cognitive deficits and cognitive decline are often present many years before a clinical diagnosis of dementia can be made and can be used as early-markers of dementia. Participants in the population-based SNAC-K study were repeatedly assessed with

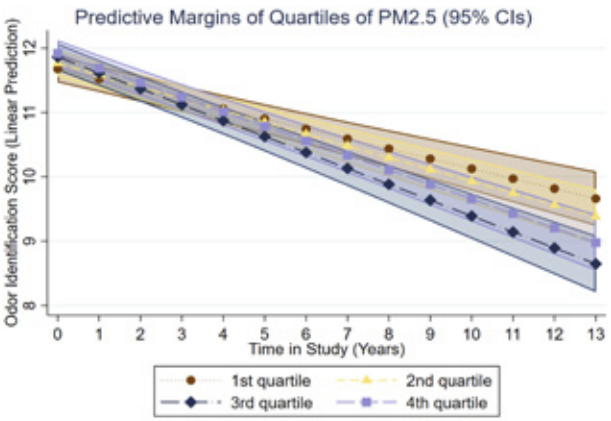


Figure 9. Results of multi-adjusted linear mixed models on associations between quartiles of air pollution in PM2.5 and intercept and change (score/year) in odour identification (Ekström et al., 2022, *Environmental Health Perspectives*).

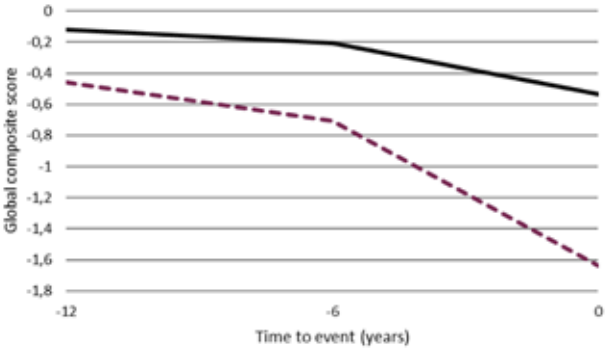


Figure 10. Rates of cognitive decline in dementia-free and preclinical dementia groups across 12 years from piecewise mixed-effects models for a global cognition composite score (Payton et al., 2022, Alzheimer's & Dementia).

a cognitive test battery across 12 years. We found that perceptual speed performance was the strongest individual cognitive predictor 12 years before dementia diagnosis. Six years before diagnosis, a combined model of verbal fluency, episodic memory and perceptual speed performance was highly predictive of subsequent dementia (Payton et al., 2020). In another study, we evaluated whether rate of cognitive decline can also help identify individuals with high probability of future dementia. On average, persons who later developed dementia exhibited faster rates of cognitive decline 12-6 years before diagnosis compared to the reference group, and a further acceleration of decline closer to diagnosis *(Payton et al., 2022,* ***Figure 10****)*. Participants classified as fast decliners 12-6 years before diagnosis showed increased risk of dementia in the following six years. The main conclusion from this study was that being a fast decliner, especially in several cognitive domains, is associated with increased likelihood of dementia in the coming years (*Payton et al., 2022*).

Dementia and the body-mind connection

1. Cardiovascular burden

Several modifiable risk factors have been identified as putative targets of effective intervention in dementia. One of the most intriguing relationships is the one between cardiovascular burden and dementia. We have shown that several modifiable risk factors have been identified as putative targets of effective intervention in dementia. One of the most intriguing relationships is the one between cardiovascular burden and dementia. We have shown that: 1) Alzheimer's disease and ischemic stroke share risk profiles (low level of education, sedentary lifestyle, and heart diseases) and protective factors (high levels of psychological well-being, leisure-time mental and physical activity, and a rich social network) (*Wang et al., 2021*);
2) an increasing number of cardiometabolic diseases (i.e., type 2 diabetes, heart disease, and stroke) dose-dependently accelerate cognitive decline and increase the risk of cognitive impairment and its progression to dementia *(Dove et al., 2022;* ***Figure 11)****;*
3) having an ideal cardiovascular health (CVH) profile, and ideal behavioural CVH profile in particular, from midlife onwards is associated with a reduced risk of dementia as compared with people having poor CVH profile (*Liang et al., 2020*); and 4) higher resting heart

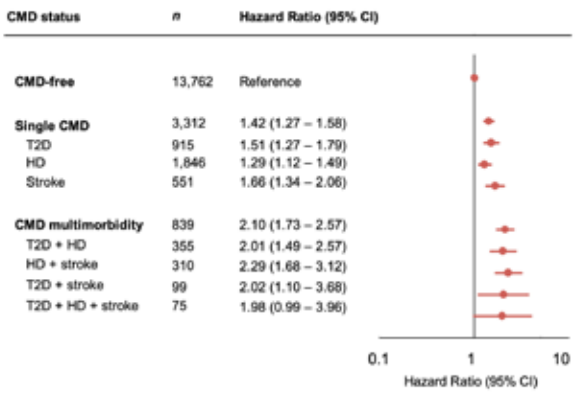


Figure 11. Association between cardiometabolic diseases, and their combination, and dementia onset. CMD = cardiometabolic disease; T2D = Type 2 diabetes; HD = heart diseases (Dove et al., 2022, *European Heart Journal*).

rate (RHR) is associated with increased risk of dementia and accelerated cognitive decline independent of major cardiovascular diseases (*Imahori et al., 2022*) and that orthostatic hypotension, even asymptomatic, is associated with increased risk of dementia and accelerated progression from cognitive impairment, no dementia (CIND) to dementia in older adults (*Xia et al., 2021).*

Further, we have explored the potential neuropathological mechanisms underlying such associations and found that: 1) vascular brain ageing accelerates as people age, driven primarily by accumulation of white-matter hyperintensities (*Li et al., 2022*); 2) cardiovascular disease (e.g., atrial fibrillation) is associated with accelerated progression of white-matter hyperintensities and ventricular enlargement among older adults (*Ding et al., 2021*); and 3) favourable global CVH profiles in older adults are associated with slower vascular brain ageing (*Li et al., 2023*). Taken together, these findings highlight the importance of adhering to favourable CVH profiles and preventing cardiovascular morbidity to promote healthy brain ageing.

2. Nutrition and metabolism

Several nutritional aspects and metabolic conditions have been explored as possible risk factors and boosters for the development of dementia and cognitive decline. Diabetes seems to increase the risk of both ischemic stroke and post-stroke dementia, but also the dementia risk in stroke patients (*Shang et al., 2020*). The risk effect is especially relevant when diabetes is poorly controlled (glycated haemoglobin ≥7.5%), which doubles the risk of cognitive impairment and triples the risk of its progression to dementia. Finally, we detected a U-shaped association between body weight change and dementia in older adults, as both large weight gain and loss were associated with a three-fold higher risk of dementia (*Guo et al., 2021b*).

3. Reserve and resilience

Our earlier work has demonstrated that engagement in mental, social, and physical activities may have a beneficial effect on cognitive health in older adults (*Fratiglioni et al., 2020*). It has long remained unclear whether cognitive benefits associated with reserve are universal or if they are non-uniformly distributed depending on individuals' genetic risk profiles or clinical health status. In previous work, we have shown that the dementia risk reduction associated with systematic engagement in stimulating activities throughout the entire life course was indeed similar in individuals with and without genetic predisposition to dementia. Furthermore, we have shown that activity engagement was able to mitigate the risk of dementia associated with diabetes (*Marseglia et al., 2020*), suggesting that it could be a viable strategy even in individuals with suboptimal cardiometabolic health. Integrating measures of brain structure and brain pathology, we tried to understand the mechanisms underpinning the resilience and found that an operationalisation of reserve based on residual cognitive performance may represent a more direct measure of cognitive reserve than an activity-based approach (e.g., *Gallo et al., 2021*)

4. Mild cognitive impairment

Mild cognitive impairment (MCI), a transitional cognitive phase between normal cognition and overt dementia, represents an important window of opportunity to intervene and avoid or delay the development of dementia. Data from a collaborative project in China (MIND-China) revealed that MCI affects over a quarter of rural-dwelling older adults, of which over four-fifths are of the amnestic type, and that MCI was associated with illiteracy, being farmers, and stroke, but not with *APOE* genotype (*Cong et al., 2022*).

In addition, we found that rural older adults with cognitive impairment, no dementia (CIND) are twice as likely to progress to dementia as people without CIND, and that female sex, low education, stroke history, and low social support are associated with accelerated progression from normal cognition to CIND or dementia (*Ren et al., 2022*).

5. Depression in old age

Depression in old age is both common and undertreated, leading to severe consequences for the individuals, their families, and the healthcare systems. We explored the interplay between multimorbidity and depression and found that the structure of depressive symptoms is influenced by specific clinical conditions and their combinations (*Triolo et al., 2021;* ***Figure 12***), but the speed of multimorbidity development was affected by the presence of depressive symptomatology (*work in progress*). This suggests considerable overlaps between depression and somatic health in old age, hinting at the possibility that both could be a product of accelerated biological ageing.

We also explored the role of early-life financial strain and late-life social engagement to understand how the risk of depression evolves throughout life and found that social engagement in late life may attenuate the burden of depressive symptoms due to financial strain in childhood (*Triolo et al., 2020*).

Environment and health

If the detrimental impact of air pollution on the respiratory, cardiovascular, and cerebrovascular systems has been consistently pointed out, evidence on the negative impact of air pollution on brain health has only recently started to accumulate. By using the SNAC-K data, our group has shown a 50% increased hazard of dementia per interquartile range difference in average pollutant levels at residential address (*Grande et al., 2020;* ***Figure 13***). While stroke explained nearly 50% of air pollution-related dementia cases, people exposed to air pollution and affected by heart failure or coronary heart disease had the highest risk of dementia. Moreover, we also found an increased risk of progression from cognitive impairment to dementia in subjects with long-term exposure to air pollution (*Wu et al., 2022*). Finally, we have observed that people who live in the more polluted areas in central Stockholm had a faster cognitive decline, especially those older than 80 years (*Grande et al., 2021b*). The results from these studies open new research avenues for dementia prevention.

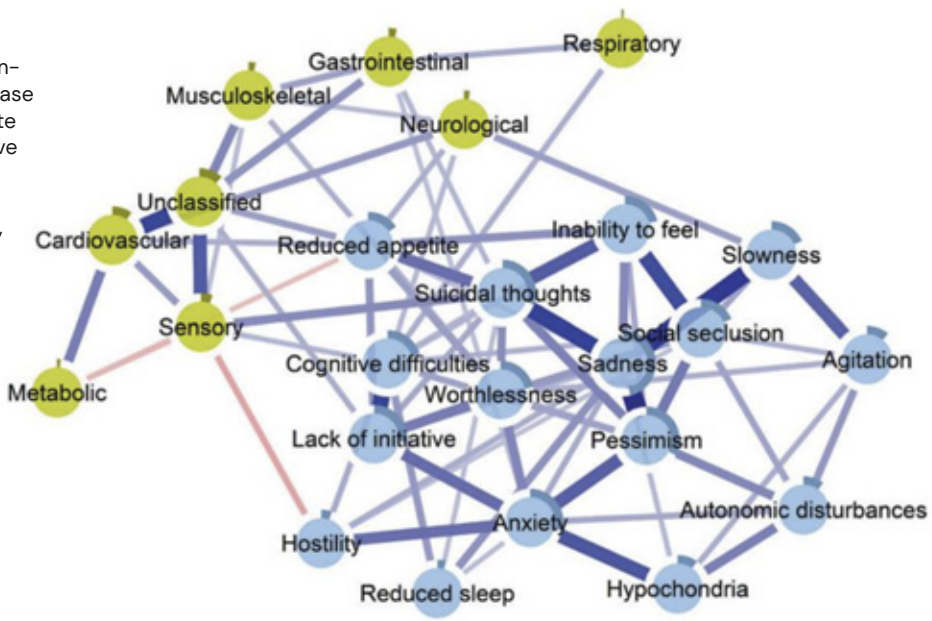


Figure 12. Network of depressive symptoms with nodes for system-specific clusters of somatic disease burden. Blue connections indicate positive correlations; red, negative correlations; thickness of lines is proportional to the strength of the correlation (Triolo et al., 2021, *Translational Psychiatry*).

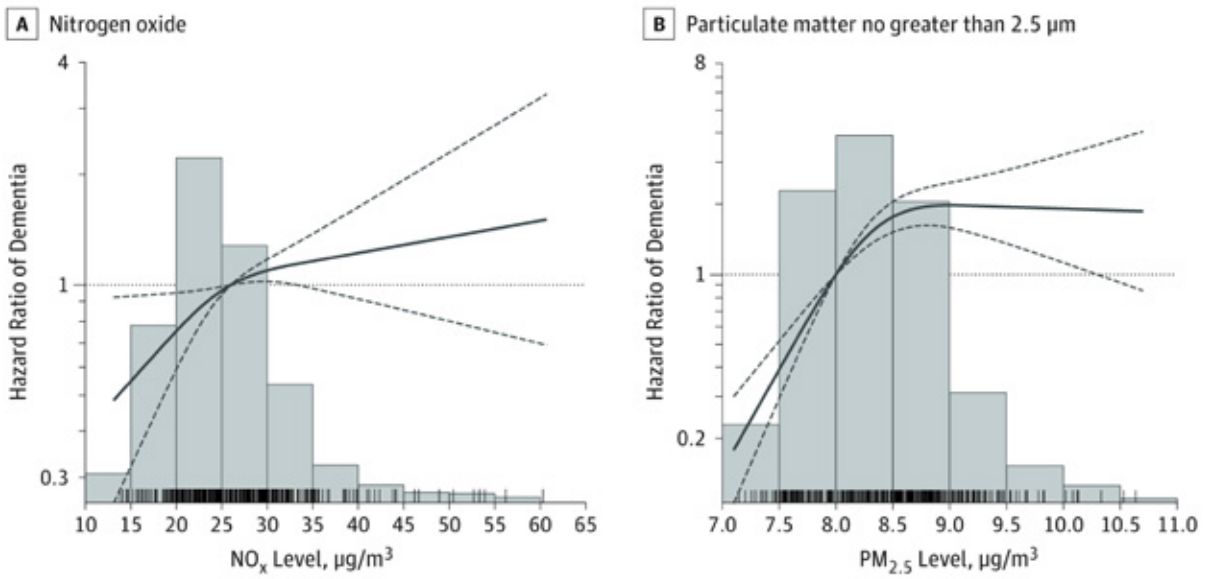


Figure 13. Association between Particulate Matter no greater than 2.5 µm (PM2.5) and Nitrogen Oxide levels and dementia in the SNAC-K study (Grande et al., 2020, *JAMA Neurology*).

The SNAC-K COVID-19 project

This project explored the indirect harms or collateral damage due to COVID-19 restrictions on older adults' health to learn how to better protect them in future epidemic events. The results indicate that, in addition to an excess mortality (*Calderón-Larrañaga et al., 2020b*), COVID-19 and its related restrictions during the first half of 2020 have also resulted in changes that negatively affected the health and lives of older people living in central Stockholm, in terms of psychological burden, reductions in social and physical activities, and decreased medical and social care use (*Beridze et al., 2022*). Moreover, our findings highlight the role of pre-pandemic physical functioning as well as social network as possible modifiable sources of resilience against COVID-19-like symptoms (*Saadeh et al., 2022*), depressive burden (*Triolo et al., 2022*), and reduced physical activity (*Sjöberg et al., 2022*) associated with the pandemic. When introducing restrictions, we emphasise the need for a predefined, evidence-based strategy to provide support, both during the pandemic and once the outbreak is overcome, to those who are most susceptible to these consequences (*Calderón-Larrañaga et al., 2020c*). The findings from this project contribute to the still-open debate on the strategies adopted against the pandemic and how to improve our strategies in future events of similar character and magnitude.

Photo: Maria Leck

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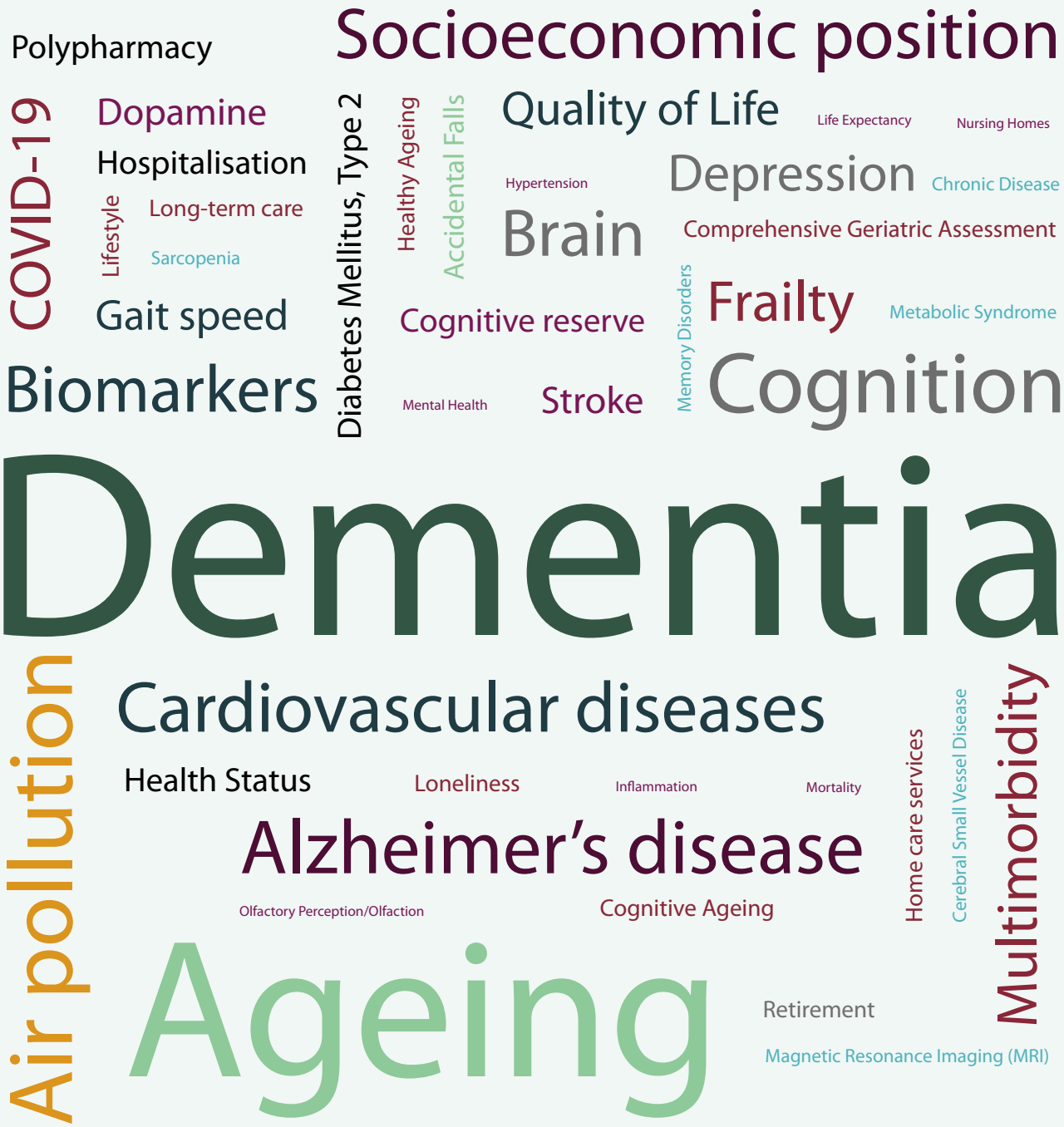
Polypharmacy
Socioeconomic position
COVID-19
Dopamine
Hospitalisation
Lifestyle
Long-term care
Sarcopenia
Gait speed
Biomarkers
Diabetes Mellitus, Type 2
Healthy Ageing
Accidental Falls
Quality of Life
Life Expectancy
Nursing Homes
Hypertension
Depression
Chronic Disease
Brain
Comprehensive Geriatric Assessment
Cognitive reserve
Memory Disorders
Frailty
Metabolic Syndrome
Mental Health
Stroke
Cognition
Dementia
Air pollution
Cardiovascular diseases
Health Status
Loneliness
Inflammation
Mortality
Alzheimer's disease
Olfactory Perception/Olfaction
Cognitive Ageing
Home care services
Cerebral Small Vessel Disease
Multimorbidity
Ageing
Retirement
Magnetic Resonance Imaging (MRI)

Scientific production in numbers

Journals in which ARC researchers have most frequently published their studies during 2020–2022

Alzheimer's and Dementia (20)

The Journals of Gerontology Series A (17)

Aging Clinical and Experimental Research (15)

Journal of Alzheimer's Disease (14)

Aging (12)

BMJ Open (9)

Scandinavian Journal of Public Health (9)

Cerebral Cortex (8)

International Journal of Environmental Research and Public Health (8)

Neurobiology of Aging (8)

Scientific Reports (8)

European Journal of Ageing (7)

NeuroImage (7)

Age and Ageing (5)

Archives of Gerontology and Geriatrics (5)

Journal of the American Medical Directors Association (5)

The Journals of Gerontology Series B (5)

European journal of public health (4)

Frontiers in aging neuroscience (4)

Neurology (4)

PLoS One (4)

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Impact

Scientific impact

The major scientific impact is achieved by the publication of studies in peer-reviewed journals (see Research chapter for a summary of the major findings). Furthermore, ARC researchers participate in numerous research networks and have an extensive network of collaborators, both nationally and internationally. Another important channel for achieving scientific impact is attending national and international workshops and conferences, where we share and discuss our results with the scientific community. ARC researchers also frequently organise symposia and workshops. A selection of these activities is presented below.

Dopamine as a neural substrate of reward prediction and psychopathology – Nobel mini-symposium, 8-9 November 2022

The symposium brought together researchers from Germany, the Netherlands, UK and USA, and first proposed that dopamine neurons signal reward prediction errors with some influential researchers who have developed this idea further. The research has both important preclinical and clinical implications. Organised by Marc Guitart-Masip, ARC at the Department of Neurobiology, Care Sciences and Society, and Predrag Petrovic from the Department of Clinical Neuroscience and sponsored by the Nobel Assembly at KI.

NEAR's annual workshop, 18-19 October 2022

Twelve different universities gathered at KI on 18-19 October 2022 for NEAR's annual workshop. The focus was collaboration with the purpose to create more opportunities to work together in the future, learn more about other infrastructures' work and what we can learn from one another.

SIA final conference, 6 September 2022

The Social Inequalities in Ageing programme (SIA), funded by NordForsk, held its final conference at Skeppsholmen, Stockholm on 6 September 2022. Researchers from each work package presented the research conducted and highlighted findings. Professor Martijn Huisman, Amsterdam UMC and Vrije Universiteit, provided a much-appreciated keynote talk on the concept of resilience. Close to 200 papers have been published over the years, most recently a special section in the *European Journal of Ageing*. Most importantly, leading ageing researchers across the Nordic countries have been gathered, and a great number of junior researchers have been involved.

Conference: Aging Brain – Memory, Plasticity and Dopamine, 26 August 2022

Erika Jonsson Laukka (ARC), Martin Lövdén (University of Gothenburg), and Lars Nyberg (Umeå University) took the initiative to organise a conference in honour of Professor Lars Bäckman, who holds a professorship in Cognitive Neuroscience at ARC. The event took place on 26 August 2022 and was held at KI, in Eva & Georg lecture hall in Biomedicum. The programme included three sessions on Memory and Ageing, Plasticity and Ageing, and Dopamine and Ageing, during which several presentations were made by both national and international researchers specialising in these particular fields.

SNAC 20-Year Jubilee retreat, 24-25 June 2022

Researchers and the data collection staff working with the Swedish National Study on Aging and Care (SNAC) met at Djurönäset, Stockholm, during a two-day retreat on 24-25 May 2022. Examples of the 20-year-long outstanding research activities were presented. Moreover, researchers and the data collection staff had the unique opportunity to jointly discuss future challenges and lines of action. Mårten Lagergren, the promoter of the SNAC project in the beginning of the 2000s, attended the retreat. After 20 years, the SNAC study is more important than ever, thanks to the relevance, comprehensiveness, and long follow-up of the collected data. SNAC has been, is and will be key to answering some of the key priority challenges concerning the health and well-being of older people.

I-CARE4OLD consortium meeting, 7-8 June 2022

Researchers from all over Europe, Israel, the United States and Canada gathered at KI to discuss the research and latest developments in the I-CARE-4OLD project, an EU-funded project launched in 2021.

I-CARE4OLD aims to enable individualised care for older persons with complex chronic conditions, by developing a state-of-the-art decision-support tool for healthcare professionals. Davide Liborio Vetrano, work package leader in the project and leader of the KI team, together with Lu Dai and Amaia Calderón-Larrañaga, from the ARC, hosted the meeting.

Nordic Welfare Forum 2021: The Nordic model and social sustainability, 8-9 December 2021

Johan Fritzell gave a keynote speech on the impact of social policy on the pandemic. The various social policy systems have never faced so many changes in such a short period of time, and this applies both in the Nordic countries and the rest of Europe. He presented data and analyses from the European Social Policy Network (ESPN), which is the European Commission's network of experts.

The second Swedish Meeting for Alzheimer Research

The second Swedish Meeting for Alzheimer Research was held at KI on 21 April 2022. It was organised by the Center for Alzheimer Research (CAR) at KI, where ARC is one of the participating divisions. It brought together researchers from all of Sweden, experts in Alzheimer's diseases and related disorders.

Societal impact

ARC is involved in a range of outreach activities with the purpose of sharing knowledge and promoting understanding and awareness of ageing research in the public domain. In this section we highlight some of the activities and events organised, with the aim of informing the public, policy makers and society at large.

In late June 2020, the Swedish Government established a national Commission to examine the management of COVID-19 in Sweden, initially focusing on the situation among older people. Professor Mats Thorslund was part of the Swedish Corona Commission, as one of eight members.

ARC researchers Laura Fratiglioni, Mats Thorslund and Pär Schön were three out of 15 appointed to the Council on Geriatric Research at the Ministry of Health and Social Affairs. The purpose of the council was to foster communication between researchers and the government. (2020-).

ARC researchers have long been part of the European Social Policy Network (ESPN), consisting of national experts aiming to provide high-quality and timely independent information, advice, analysis, and expertise on social policy issues in the EU. In particular, the ESPN supports the European Commission in monitoring progress towards the EU social protection and social inclusion objectives, including the European Pillar of Social Rights and the European Semester. The Swedish team is led by Johan Fritzell and includes ARC researchers Pär Schön and Josephine Heap.

Lena Dahlberg was a member of the EU COST Action "Reducing Old-Age Social Exclusion: Collaborations in Research and Policy (ROSEnet)", engaging researchers, policy stakeholders and older adults in 41 countries to increase the scientific understanding of social exclusion and address the disconnect between research and policy. ROSEnet focused on exclusion in economic, social, services, civic rights, and community domains.

ARC researchers Carin Lennartsson, Josephine Heap and Neda Agahi were appointed by the organisation MIND to contribute with their expertise and knowledge to co-author the report En ålderdom att längta till? Rätten till psykiskt välbefinnande - oavsett generation. The report was published in 2020.

Lena Dahlberg and Carin Lennartsson were commissioned by the Nordic Council of Ministers to write a report on loneliness. The report, Ensamhet bland äldre personer I Norden, was published in August 2020.

Clinical and public health impact

KI established resource teams for support during the COVID-19 pandemic

The resource teams have different areas of expertise and gave support to society in general as well as internally. They also served to quality-assure whatever action was taken, especially regarding rapid-response actions. Laura Fratiglioni and Carin Lennartsson are part of the Resource team for the health of the population of older people during COVID-19. (May 2020)

Risk factors and treatment of COVID-19 among older people is one of the topics in Forte's new series "Forte Fokus"

In the series "Forte Fokus", the Swedish Research Council for Health, Working Life and Welfare (Forte) asked a few researchers to summarise their research related to the pandemic. One of the texts is about risk factors and treatment of COVID-19 among older people, written by Laura Fratiglioni, Alexander Darin-Mattsson, Lisa Harber-Aschan, Serhiy Dekhtyar, Debora Rizzuto, Davide Liborio Vetrano, and Amaia Calderón-Larrañaga, all from ARC. (October 2020).

National indicators improve quality of drug therapy among older people

Our longstanding research in the area of geriatric pharmacology and pharmacoepidemiology, and subsequent participation in the development of national indicators for quality of drug therapy among older people, have likely played a significant role in the reported continuous improvement in the quality of drug use among older people since 2005 (Socialstyrelsen 2019).

Through the software routines developed by us to analyse quality of drug use based on data from the Swedish Prescribed Drug Register, we regularly assist the National Board of Health and Welfare and the Swedish Association of Local Authorities and Regions (SALAR, SKR) in their regular comparisons of the quality of healthcare. These measurements have had an important role in the successful national initiatives to improve drug use in older adults in Sweden.

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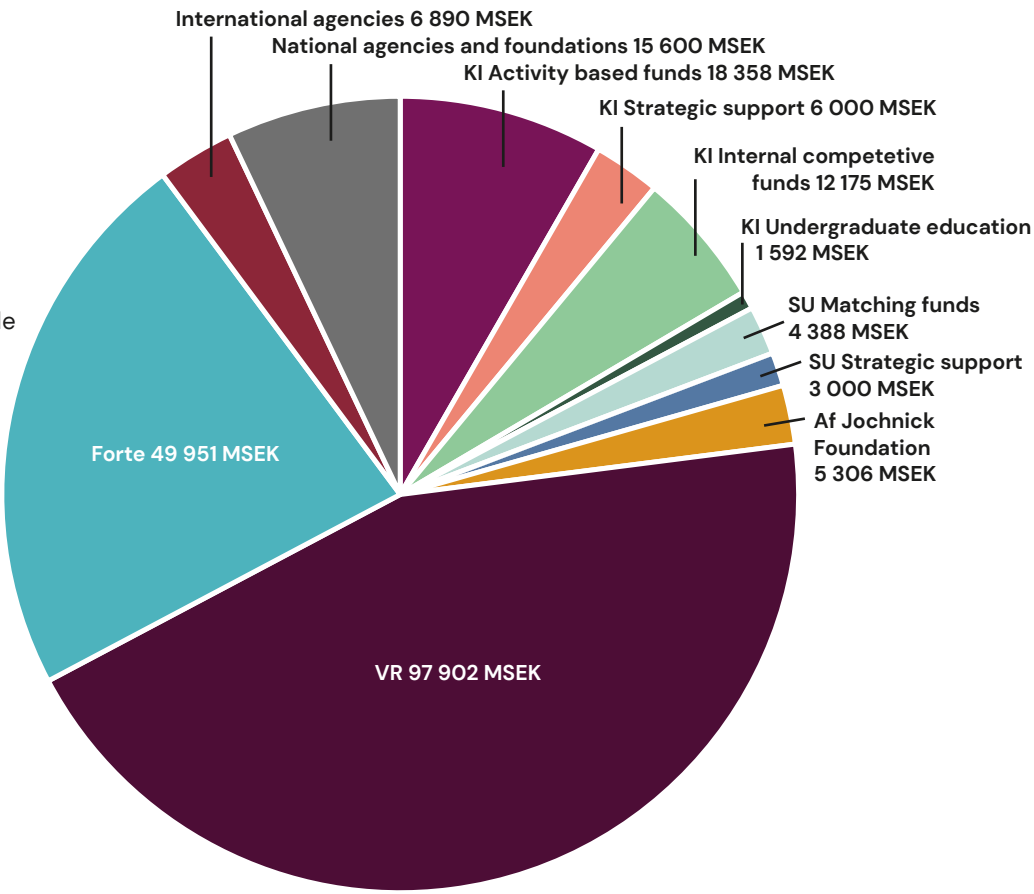
- FORMAS (a Swedish research council for sustainable development)
- Forte (Swedish Research Council for Health, Working Life and Welfare)
- STINT (Swedish Foundation for International Cooperation in Research and Higher Education)
- Stiftelsen Sigurd o Elsa Goljes minne
- Konung Gustaf V:s och Drottning Victorias Stiftelse
- Luxembourg Institute of Socio-Economic Research (LISER)
- Merck & Co
- NordForsk
- Norges Forskningsråd (Research Council of Norway)
- Riksbankens jubileumsfond
- Stiftelsen Gamla tjänarinnor
- Stiftelsen Ragnhild & Einar Lundströms Minne
- Systembolaget
- Fredrik och Ingrid Thurings Stiftesle
- Triton Advisers (Sweden) AB
- Vetenskapsrådet (The Swedish Research Council)
- The Wallenberg Foundations



Major external research grants

European Union

Davide Liborio Vetrano: "AFFIRMO (Atrial Fibrillation integrated approach in Frall, multimoRbid and poly-Medicated Older people)".
5,000,000 SEK (2021-2025).

Davide Liborio Vetrano: "I-CARE4OLD (Individualized CARE for OLDer persons with complex chronic conditions in-home care and nursing homes)".
3,000,000 SEK (2021-2025).

FORMAS

Carin Lennartsson: "The Swedish Panel Study of Living Conditions of the Oldest Old – SWEOLD COVID-19".
2,500,000 SEK (2020-2021).

Forte

Neda Agahi: "Aging in flux: How changing behaviors and lifestyles in the new cohorts are reshaping old age".
4,620,000 SEK (2021-2023).

Neda Agahi, Johan Fritzell and Tine Rostgaard (SU): "Why are some people resilient when faced with adversities in later life and others not?".
1,644,000 SEK (2022-2024).

Janne Agerholm: "Health literacy among older adults: Exploring older people's prerequisites for understanding health information and making informed health choices".
4,979,000 SEK (2023-2025).

Amaia Calderón-Larrañaga: "Older adults' contribution to informal caregiving: temporal trends, profiles and adverse health consequences".
4,950,000 SEK (2022-2024).

Amaia Calderón-Larrañaga: "Effectiveness of interventions to address the negative health outcomes of informal caregiving to older adults: an umbrella review".
993,000 SEK (2020-2021).

Megan Doheny: "Untangling the relationship between health and social care spending in the last year of life".
2,000,000 SEK (2023-2024).

Laura Fratiglioni: "Aging through life: Identifying new pathways for living longer and healthier".
9,000,000 SEK (2020-2022, grant continuation).

Johan Fritzell: "Inequality dynamics over the life course: Family and policy influences".
11,200,000 SEK (2020-2022, grant continuation).

Johan Fritzell: "Social Inequalities of Ageing (SIA)".
29,700,000 NOK (2015-2022).

Giulia Grande: "Promoting cognitive health by exploring intergenerational differences in cognitive trajectories among Swedish older adults".
2,000,000 SEK (2023-2024).

Johan Rehnberg: "Improving population health in the older population: is there a trade-off between efficiency and equity?".
2,400,000 SEK (2020-2022).

Debora Rizzuto: "SoundMIND – effects of noise on cognition and mental health".
4,991,000 SEK (2023-2025).

Pär Schön: "Ageing in place – from policy to practice. Consequences of the de-institutionalisation of Swedish eldercare for older people and their family members".
3,680,000 SEK (2022-2024).

Davide Liborio Vetrano: "Trajectories of care needs and care transitions after age 60: the interplay between individuals' frailty, their environment, and personal perspectives".
6,014,000 SEK (2021-2025).

Weili Xu: "Understanding the complex and progressive care needs of older adults with cognitive disorders to provide timely and personalized care delivery".
6,080,000 SEK (2021-2025).

Joint China-Sweden Mobility program – Travel grant

Chengxuan Qiu: "Reducing global burden of dementia via strengthening translational research across sociocultural settings".
440,000 SEK (2020-2023).

Marianne och Marcus Wallenberg Stiftelse

Marc Guitart-Masip: "Quantifying prior beliefs for affective decision making and their relation to symptoms of depression".
6,00, 000 SEK (2021-2025).

Johan Fritzell: "Health and mortality in older Europeans – A matter of cash and care?".
3,800,000 SEK (2018-2022).

MSD-Karolinska partnership

Davide Liborio Vetrano: "Impact of lower respiratory tract infections on older individuals' global health status and healthcare utilization".
1,200,000 SEK (2022-2023).

Riksbankens Jubileumsfond

Ingrid Ekström: "HARMFUL CONSEQUENCES OF SMELL LOSS IN OLDER AGE: a longitudinal population-based study".
2,850,000 SEK (2023-2025).

Goran Papenberg: "The Role of DNA Methylation in Dopaminergic Neuromodulation of Cognitive Aging".
3,518,000 SEK (2021-2023).

Alireza Salami: "Can reduced dopamine availability and disrupted functional brain connectome serve as biomarkers for cognitive decline in aging?".
5,913,000 SEK (2021-2023).

Stiftelsen 1759

Serhiy Dekhtyar: "SNAC-K: Depression and chronic disorders in the elderly".
3,500,000 SEK (2023-2025).

Vetenskapsrådet

Amaia Calderón-Larrañaga: "Monitoring older adults' health for preventive and early interventions: use of the Health Assessment Tool (HAT) in the Swedish primary care setting".
2,400,000 SEK (2021-2024).

Laura Fratiglioni: "Collateral damage of COVID-19 in older adults: short and long-term health consequences of the epidemic outbreak".
2,400,000 SEK (2022-2024).

Laura Fratiglioni and Debora Rizzuto: Renewal of the research infrastructure for NEAR.
171,443,000 SEK (2022-2028).

Marc Guitart-Masip: "Mapping the neural and computational traces of lack of controllability and their relevance for depression".
2,400,000 SEK (2022-2024).

Grégoria Kalpouzos: "Role of brain iron and microbleeds in cognitive and physical function in a population-based study on aging: A deep-learning approach".
4,920,000 SEK (2022-2024).

Erika Jonsson Laukka: "Long-term follow-up of individuals with long-lasting cognitive deficits following mild COVID-19".
2,400,000 SEK (2023-2025).

Erika Jonsson Laukka: "Olfactory function, cognitive aging, and dementia".
4,800,000 SEK (2021-2024).

Erika Jonsson Laukka: "Long-lasting cognitive and olfactory deficits following mild COVID-19 – modifying factors, brain correlates and prognostic impact for well-being and daily functioning".
2,000,000 SEK (2021-2025).

Carin Lennartsson: "Cash and care. Intergenerational transfers in the families of the oldest old and their consequences for inequality".
4,200,000 SEK (2020-2022).

Goran Papenberg: "Mechanisms of Cognitive Aging: The Roles of Brain Iron Accumulation and Neuroinflammation".
5,800,000 SEK (2020-2023).

Chengxuan Qiu: "Chronic hypoxia as a possible pathway linking clinical conditions of the heart, lungs, and blood with accelerated brain aging".
4,800,000 SEK (2021-2024).

Davide Liborio Vetrano: "Biomarker signatures of progressing multimorbidity: in pursuit of personalized approaches to clinically complex older individuals".
5,200,000 SEK (2021-2025).

Weili Xu: "Reducing Dementia Risk in Older Adults Affected by Cardio-Metabolic Disease".
2,400,000 SEK (2022-2024).

Photo: Victor Selis

Education

Education

Education and courses

ARC researchers are responsible for and involved in several courses at KI and SU.

Undergraduate (first cycle)

Aging, Working Life, and Health, 7.5 credits, Department of Public Health Sciences, SU. Charlotta Nilsen, Harpa Sif Eyjólfsdóttir, Johan Rehnberg, Josephine Heap. Fall 2020–2022.

Samhälle och hälsa, 4.5 credits, Psychology Programme, KI. Neda Agahi. Fall 2020–2022.

Utvecklingspsykologi, Moment 2, Åldrande, 3.0 credits, Psychology Programme, KI. Erika Jonsson Laukka. Fall 2020–2022.

MASTER'S (second cycle)

Geriatric Epidemiology, 1.5 credits, module for the Master's programme in Public Health Epidemiology, KI. Chengxuan Qiu. Fall 2020–2022.

Public Health Science – Concepts and Theories, 7.5 credits, Master's programme in Public Health Sciences, KI. Janne Agerholm and Megan Doheny. Fall 2020–2022.

Life-course Perspectives on Ageing and Health, 7.5 credits, Master's programme in Public Health Sciences, SU. Stefan Fors, Louise Sundberg, Jonas Wastesson, Malin Ericsson, Spring 2020–2022.

DOCTORAL (third cycle)

Application of Epidemiological Approaches to Aging Research, 1.5 credits, bi-annual course, KI. Amaia Calderón-Larrañaga and Debora Rizzuto, Spring 2021.

Public Health Implications of an Aging Population, 3.0 credits, Public Health Sciences Programme, KI. Neda Agahi, Charlotta Nilsen. Fall 2020.

Public Health Research – Concepts and Theories, 3.0 credits, Public Health Sciences Programme, KI. Janne Agerholm, Megan Doheny. Fall 2020 and 2022.

Integration of Neuroimaging and Cognition in Normal Aging and Dementia, 2.0 credits, KI. Grégoria Kalpouzos and Goran Papenberg, Spring 2020.

Doctoral students' education and activities

ARC Juniors

At ARC, doctoral students, post docs, research assistants, visiting researchers and interns are commonly referred to as "ARC Juniors". This network organises a variety of educational and social activities.

During the period 2020-2022, ARC has had 22 doctoral students. Together with other junior staff they regularly take doctoral courses at KI and other universities as part of their education, as well as taking on teaching roles for bachelor's and master's level courses. Students have also presented their work at various scientific conferences, both locally and internationally, such as the Nordic Congress of Gerontology (NKG), the Annual Meetings of the Gerontological Society of America (GSA), the European Union Geriatric Medicine Society (EuGMS) Congress or the Alzheimer's Association International Conference (AAIC).

ARC juniors serve as representatives in internal, as well as external, structures and organisations, such as the Doctoral Students Association, the ARC Internal Board, the KI Pedagogical Strategy Group, the Swedish National Graduate School on Ageing and Health (SWEAH) Board and Medicinska Föreningen, to name a few.

ARC Juniors Journal Club

Since 2020, ARC Juniors have been self-organising and attending monthly Journal Club meetings at ARC. A volunteer selects a paper that is of potential interest to all three scientific areas at ARC, presents it and discusses its implications with the whole group. Juniors are going to continue running the Journal Club throughout the upcoming year.

ARC Junior Retreat 2022

Close to 30 junior researchers at ARC attended a two-day retreat at Yasuragi, a resort in Nacka, on 30-31 May 2022. The agenda included a session on career options within academia, delivered by Eric Westman, Professor and vice head of the Department of Neurobiology, Care Sciences and Society (NVS) at KI, and head of the Division of Clinical Geriatrics. A session on career options outside academia was delivered by representatives from the Karolinska Institutet Career Service, and a lecture on Decoloniality, Ethnicity and Ageing Research was given by Ahmad Abbadi, research assistant at ARC.

The retreat also included scientific exchange between the Social Gerontology, Psychology and Medical Epidemiology scientific areas at ARC, and team-building activities to foster better communication among junior research staff.

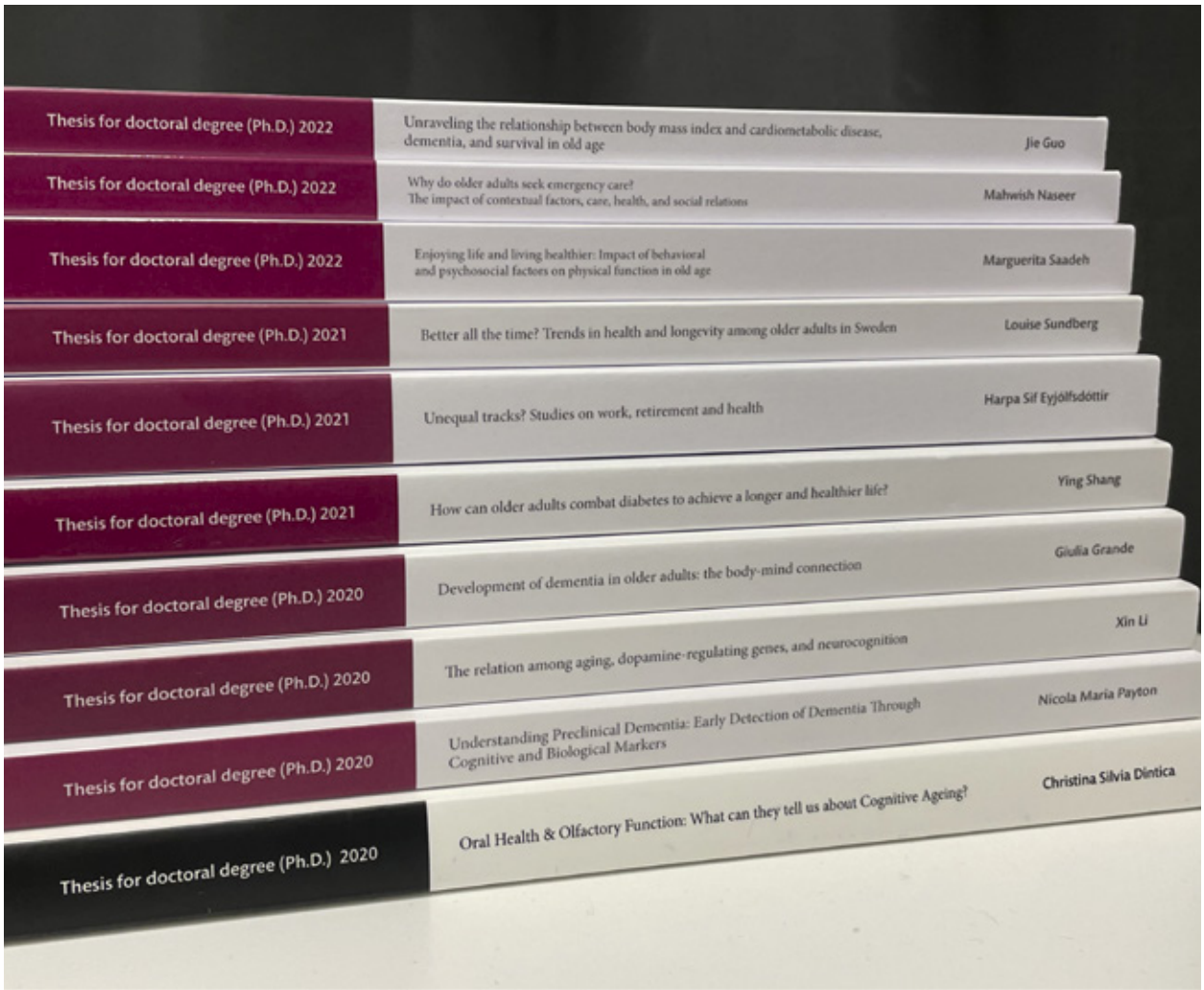
Swedish National Graduate School on Ageing and Health (SWEAH)

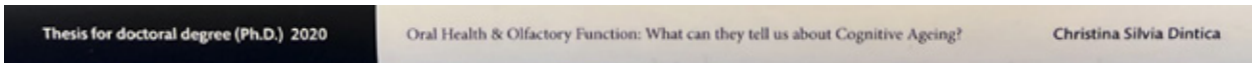
Some of our doctoral students are part of the Swedish National Graduate School on Ageing and Health (SWEAH). SWEAH was founded in 2014 and is a consortium consisting of 12 higher education institutions coordinated by Lund University. The overarching long-term goal of SWEAH is to develop and strengthen the recruitment base of future leaders in research on ageing and health. KI has been one of the partners from the start, with doctoral students from ARC, as well as Departments of Global Public Health, Medical Epidemiology and Biostatistics, and the Division of Clinical Geriatrics. Between 2020 and 2022, 11 of our doctoral students were affiliated with SWEAH.

In 2022, a new platform for postdoctoral career development – SAIN (SWEAH Alumni Interdisciplinary Network) – was created by Charlotta Nilsen, Malin Ericsson (both at ARC), Caroline Hasselgren and Catharina Melander, postdocs affiliated with SWEAH.

PhD theses 2020–2022

Between 2020 and 2022, 10 doctoral students at ARC defended their theses.

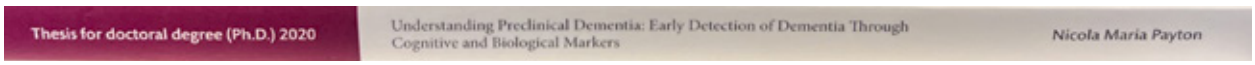




Christina Dintica – 8 May 2020

Oral Health & Olfactory Function:
What can they tell us about Cognitive Ageing?
Main supervisor: Weili Xu

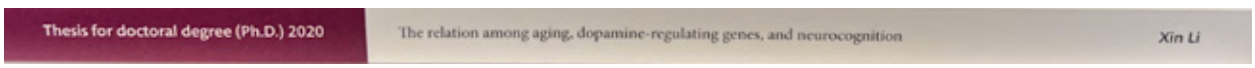
The focus of the thesis is on what oral health and olfactory function can tell us about cognitive ageing. Specifically, whether these factors could be predictors or risk factors for accelerated cognitive ageing. Having poor oral health has been found to be associated with a more rapid decline in cognitive function and with lower brain volume in older adults. Moreover, olfactory impairment predicted decline in cognitive function and lower volumes in the medio-temporal brain structures. The results suggest that maintaining good oral health in old age may be important for cognitive health later in life. In addition, experiencing loss of smell could indicate underlying neurodegeneration, and should therefore be investigated by a physician.



Nicola Payton – 8 October 2020

Understanding preclinical dementia:
Early detection of dementia through cognitive and biological markers
Main supervisor: Erika Jonsson Laukka

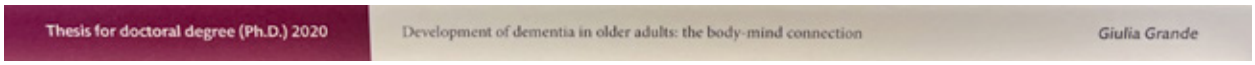
The main aim of the thesis was to look at how cognition changes during the stage of dementia before a clinical diagnosis (the preclinical phase) and how these preclinical markers, both cognitive and biological, can be used to identify people who are more likely to develop dementia in the future. We found evidence of a long preclinical phase to dementia, up to 12 years before a diagnosis, where faster decline in cognition (particularly episodic memory and verbal fluency) could be used to differentiate those in the preclinical stage from those who were ageing normally. As dementia progresses over a long period before diagnosis, being able to detect people likely to develop dementia or already in the early stages is crucial. If we can identify those people most suitable for clinical trials or lifestyle interventions, then we can improve our chances of preventing or treating dementia in the future.



Xin Li – 28 October 2020

The relation between aging, dopamine-regulating genes, and neurocognition
Main supervisor: Jonas Persson

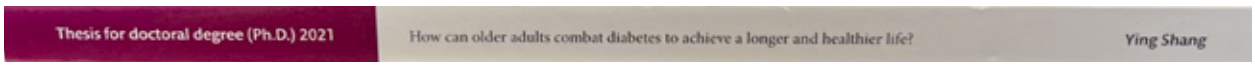
When people get old, they often feel it is increasingly harder to concentrate, and become slower and more inflexible during the tasks that require focused attention, storing information in the face of distractions and fast switching according to the changing goals. These cognitive functions are collectively referred to as working memory. The aim of this thesis is to understand the mechanisms of the age-related impairment in working memory at both neural and genetic levels. Our studies provide insights to better understanding the mechanism of cognitive decline in ageing. We hope that this knowledge can serve as a basis for future studies that focus on the practical implications. The goal of all brain ageing research is to prevent cognitive impairment in older adults, improve their brain health, and to achieve successful brain ageing.



Giulia Grande – 11 December 2020

Development of dementia in older adults: the body-mind connection
Main supervisor: Debora Rizzuto

To date, no pharmacological interventions have been shown to be effective in curing dementia, and therefore the identification of modifiable risk factors is now considered a priority. We found that the assessment of motor function in individuals with cognitive impairment allows a more accurate and timely prediction of future dementia. This result was supported by the fact that fast cognitive and motor decline in older adults was accompanied by a mixed and rapidly developing brain pathology. The studies also focused on the importance of comorbidities and air pollution on the risk of developing dementia. Among other things, we found that older adults with neuropsychiatric and cardiovascular diseases displayed the greatest risk of developing dementia. Further exploring the relation between body and mind related conditions could be essential in identifying at risk populations and biomarkers for incipient dementia, and thus, in advancing our understanding of dementia in older adults.



Ying Shang – 16 April 2021

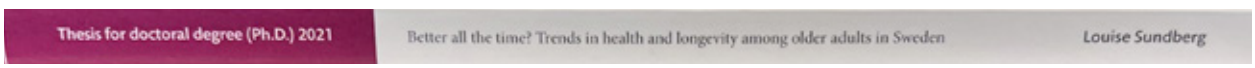
How can older adults combat diabetes to achieve a longer and healthier life?
Main supervisor: Weili Xu

I have focused on the impact of prediabetes and diabetes on health and survival among older adults, as well as modifiable factors that could prolong disability-free survival among older adults with diabetes. We found that, aside from the traditional complications, such as stroke and cardiovascular diseases, diabetes is associated with a higher risk of dementia secondary to stroke and can accelerate physical function decline and disability progression over time. This decline in physical function might start already during prediabetes. Yet, one out of five older adults with prediabetes could revert to normoglycemia with lifestyle modifications such as weight management. We also found that diabetes is related to the risk of disability or death among older adults, but a healthy and socially active lifestyle may attenuate this risk and prolong disability-free survival. This underscores the need for regular check-ups for cardiovascular health and monitoring of functionality for older adults with prediabetes.

Harpa Sif Eyjólfsdóttir – 24 May 2021

Unequal tracks? Studies on work, retirement and health
Main supervisor: Carin Lennartsson

The focus has been to look at how health and socioeconomic status influence age of retirement, and in turn, if and how prolonged working life can affect health in later life for different socioeconomic groups. We have found that limitations in physical functioning were not as predictive of retirement today as they used to be a few decades ago, especially for women. We also found that most people maintained their pre-retirement self-rated health and physical working capacity during the transition to retirement, and for some years after retirement. However, a small group, characterised by poor working environment and low socioeconomic status, experienced decline in health after retirement. It is therefore important for policymakers to recognise that those who have poor working environment and lower socioeconomic position might not have the health capacity to prolong their working life. Current and future policy reforms might have to be adapted for people with many years in the labour market in harmful working conditions.



Louise Sundberg – 24 November 2021

Better all the time? Trends in health and longevity among older adults in Sweden
Main supervisor: Stefan Fors

The health status of the ageing population has become one of the major public health concerns today, as the number of older people increases in both absolute and relative terms, and life expectancy continues to increase. The increase in life expectancy observed today is mainly the result of improved survival in old age, and as old age is a major risk factor for disease and disability, a major question of concern is to what extent increasing life expectancy comes with years with or without disability. The overarching aim of this thesis is to assess whether the increasing old age life expectancy in Sweden has been accompanied by years with or without disability, and to what extent the development differs by gender and education. In addition, the ages and causes of death that drive the increase in life expectancy are investigated. Finally, the burden of disability at exceptional old age is explored in countries with different mortality selection.

Marguerita Saadeh – 22 September 2022

Enjoying life and living healthier: impact of behavioral and psychosocial factors on physical function in old age
Main supervisor: Amaia Calderón-Larrañaga

Higher levels of behavioural, psychological, and social well-being may contribute to delaying the age-related decline in physical function, both independently but even more so when high levels across different domains coexist. This highlights the existence of synergistic effects across domains and confirms the multidimensionality of successful ageing. Moreover, the slower decline of behavioural, psychological, and social versus functional well-being domains may suggest that the former could act as potential compensatory mechanisms of physical health deterioration. The studies included in this project intend to identify new pathways to decrease or delay functional decline among healthy older adults by providing evidence on the potential functional benefits of increasing their behavioural, psychological, and social well-being.

Mahwish Naseer – 14 October 2022

Why do older adults seek emergency care? The impact of contextual factors, care, health, and social relations
Main supervisor: Lena Dahlberg

The focus has been to explore factors explaining emergency care use among older people, factors at the individual level (e.g., health status, living arrangements, social relations, care receipt) and at the contextual level (e.g., the proportion of older persons in the total population, annual social care expenditures, and the distance to the emergency department). In my thesis, greater proportions of persons 80 years or older in the total population, and shorter distance to the emergency department, increased the risk of emergency visits. To understand emergency care use in older people we must thus consider the context in which they live. Adequate social and outpatient healthcare could potentially reduce the avoidable emergency care visits. An increase in the use of emergency care indicates ineffective social and healthcare systems, limited resources, and collaboration, and how care is organised.

Jie Guo – 10 November 2022

Unraveling the relationship between body mass index and cardiometabolic disease, dementia, and survival in old age
Main supervisor: Weili Xu

Overweight and obesity, commonly defined as a body mass index (BMI), affect more than half of older adults. However, the association between BMI and health outcomes in old age is unclear. The aim is to describe the trajectories of BMI as well as other anthropometric measures in old age. Both large BMI loss and gain are related to an increased risk of dementia. Moreover, both mid- and late-life overweight/obesity may shorten chronic disease-free survival among older adults. These findings suggest that mid and late-life high BMI and substantial BMI changes can predict adverse health outcomes in old age. Among older adults, keeping a normal and primarily stable BMI can help to prevent detrimental health outcomes and extend a healthy lifespan.

Photo: Nerissa Björk

Activities

International Forums and seminar series

ARC International Forums are seminars with internationally renowned experts in the field of ageing that take place at ARC every term, usually in connection with an expert's visit in the capacity of a thesis opponent, dissertation committee member or for other special engagements.

The International Forums are typically two-hour events that include an extensive discussion with the speaker. Examples of past International Forum presenters are, among others, Luigi Ferrucci, Scientific Director of the NIA – National Institute on Aging at NIH, Washington, Michelle Kelly-Irving, Research Professor at INSERM, France, and Rachel Whitmer, Associate Director of Alzheimer's Disease Center at the University of California (Davis).

A total of 65 ARC seminars and international forums were held at ARC between 2020-2022.

ARC has also been active in presenting at the Center for Alzheimer's Disease (CAR) seminar series. CAR is a hub for all research with relevance for Alzheimer's disease and other dementias at KI, of which ARC is one of the founders.

Outreach activities

Arts and Science project between ARC and Fotoskolan STHLM

An Arts and Science project resulted in a photo exhibition and open lectures. This was a collaborative project between ARC (Carin Lennartsson, Isabelle Von Saenger, Erika Augustsson) and the Stockholm School of Photography. (25 February-4 March, 2020).

Educational activities and lectures

Josefin Wångdahl has held several educational activities within the public sector on the topic of health literacy. Examples include a lecture at the HFS Network (nätverket Hälsofrämjande hälso- och sjukvård) and educating employees within the County Administrative Board of Skåne.

Media and popular science

ARC researchers frequently participate in the media, giving interviews, writing articles, or participating in podcasts in the more traditional channels such as Swedish Television (SVT), Swedish Radio (SR) or Swedish papers or magazines.

ARC regularly contributes to the national magazine Äldre i Centrum, based at the Stockholm Gerontology Research Center. The magazine, covering health and disease in ageing and presenting important happenings in the field, features an ARC-spread in every issue (four per year). ARC researchers also contributed to issue #3/2021 of Äldre i Centrum, featuring an historical review of the SNAC study, one of Sweden's large population studies focusing on older people, which in 2021 celebrated 20 years.

ARC researchers are also featured in KI's podcast Medicinvetarna...

- Carin Lennartsson in episode #100 where the topic is about 100-year-olds. (2022).
- Neda Agahi in episode #71 answering the question "Do old people drink more nowadays than before?". (2021).
- Lena Dahlberg in episode #38 on the association between loneliness and health. (2020).

... and in KI's popular science magazine *Medicinsk Vetenskap:*

- Johan Fritzell is interviewed in an in-depth article on health equity in issue #3, 2022
- Erika Jonsson Laukka is interviewed in #3, 2021 on how to boost our intelligence.
- Lena Dahlberg appears in a short film produced by Medicinsk Vetenskap (2020).

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