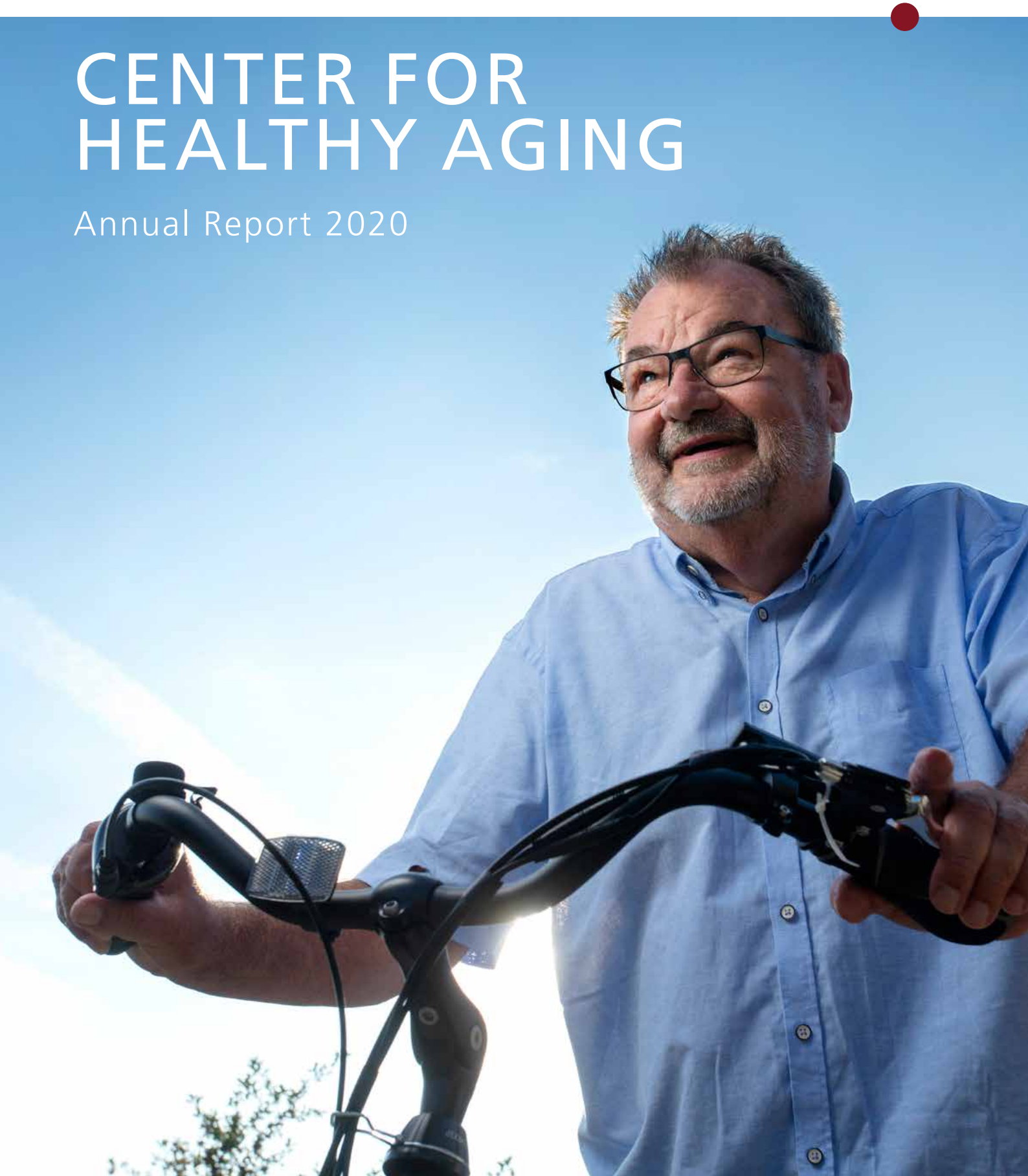
UNIVERSITY OF COPENHAGEN
CENTER FOR HEALTHY AGING

CENTER FOR HEALTHY AGING

Annual Report 2020



Facts of Center for Healthy Aging in brief

External funding in 2020 (excluding the main grant from Nordea-fonden)	74,295,089 DKK
Publications	2009-2019: 1830 2020:188
PhD projects (completed)	2009-2019: 181 2020: 15
Post-doctoral projects	2009-2019: 132 2020: 31
Recruitment	2009-2019: Nationally and internationally recognized senior researchers: 9 New group leaders: 10
International summer school 2011-2019	IARU Summer School on Interdisciplinary Aspects of Healthy Aging
International networking (selected)	IARU EIT Health Alliance for Healthy Aging
Communication and outreach (selected)	2015-2019: People's Political Festival 2017-2019: Culture Night at SUND 2017-2019: Keep Your Brain Healthy 2019: Dissemination Conference: Physical activity and aging – from research to practice 2020: Outreach project: From Worklife to Retirement – Public event with relevant stakeholders: ´Livssituationer og overgange i alderdommen´
Awards (selected)	Bispebjerg Hospital Grand Hagedorn Prize 2020 European Union – Horizon 2020

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EXECUTIVE SUMMARY

We have reached the end of 2020 and what a year it has been. Just when we thought the worst was over, we were hit by a new wave of COVID-19 (CV-19) as we approached the end of the year. The CV-19 pandemic has had a major impact on every one of us, but perhaps a greater impact our visiting international colleagues, who tend to have a limited social network in Copenhagen and Denmark. Although we need to be vigilant and practice social distancing, we also need to stand closer together than ever before. Our own research at the Center for Healthy Aging (CEHA) has shown over and over again that meaningful social interactions and participation in social networks and/or activities correlate with positive health outcomes. Therefore, I encourage everybody to recognize this and help each other cope with the social isolation we are all facing in these challenging times. Let's hope 2021 brings us success and new strength, as we overcome adversity by working together.

Research close to practice

Throughout the world, every nation is or will soon be facing the challenge of population aging, with age demographics shifting towards more and more elderly and fewer middle-aged and young individuals in all human populations worldwide. As a result, it is more critical than ever that we understand how to promote and achieve healthy aging. Because this is the main focus and main research interest of the Center for Healthy Aging, our work is more important than ever. Thanks to the financial support of Nordea-fonden, we are well-positioned to play a critical role in addressing this urgent, top-priority societal challenge.

The complexity of aging

Aging is a complex, multidimensional process that can only be understood with a sophisticated interdisciplinary toolbox. As we learn and understand human aging more thoroughly, our ability to develop interventions that promote individual and societal health and well-being will improve, even as population demographics continue to change over time. In order to build the needed expertise, tools and understanding, the Center pursues basic and clinical research in diverse disciplines and embraces cross-cutting, aging-related interdisciplinary studies, from neurobiology to public health to epidemiology and all relevant social science disciplines. Furthermore, the Center emphasizes and promotes collaborations built on public/private partnerships and/or projects involving scientists from different institutions in all countries and regions of the world.

The Center is recognized internationally for the high quality of its research and its impressive publication record, including more than 2000 articles in top-tier peer-reviewed journals over the last 12 years. Our research findings drive our effort to address the societal challenges of population and individual aging.

Because of our reputation for ground-breaking high quality research, Center researchers receive generous external funding and frequently win prestigious scientific awards. In 2020, Professor Ian Hickson received an award of 45,000,000 DKK from the Danish National Research Foundation.

Enabling change in society

One of the Center's top priorities is to educate the next generation of basic scientists, clinicians and health sector professionals and prepare them to conduct leading-edge interdisciplinary aging-related research. For example, the Center is partner in the educational campus component of the EIT Health Initiative, whose focus is healthy living and active aging. The Center also offers courses on innovation and entrepreneurship in the EIT Health PhD Programme. The Center's educational portfolio includes undergraduate, Master's and PhD programs, an international summer school, and Massive Open Online Courses (MOOC) on the Coursera platform. The Center's Network for Young Scholars (NYS) organizes seminars on career development, hosts networking events to bring students and young researchers together, and works with the PhD Academy for Interdisciplinary Aging Research (PAIAR) to develop and organize PhD level courses.

Center researchers, spearheaded by Morten Scheibye-Knudsen, organized in Copenhagen 1-4 September 2020. At this conference, leaders in the aging and longevity fields described their latest findings relevant to the molecular, cellular and organismal basis of aging and aging-related interventions. More than 1000 scientists attended the Conference.

The Center for Healthy Aging emphasizes a citizen-centric and impact-oriented approach to create a strong framework for healthy aging by engaging all key stakeholders. An example is the Copenhagen Center for Clinical Age Research (CopenAge) led by Professor Flemming Dela in collaboration with Professor Charlotte Suetta (Department of Clinical Medicine) on rehabilitating the elderly.

In addition, the Center has embarked on a series of collaborative projects in local communities. An example is a collaboration led by outreach director Anéh Hajdu on the transition from working life to retirement in three Danish municipalities (Aarhus, Vejle and Vordingborg). The purpose of the project is to ensure that short-educated seniors get enhanced healthcare and maintain a higher quality of life as they transition to retirement, by increasing personal contact and promoting social engagement and physical activity.

The above paragraphs mention only the highlights of the Center's many ongoing activities, which are too numerous to describe in this short summary. After another year at the Center for Healthy Aging, we persevered and had many successes despite many challenges associated with the CV-19 pandemic, and we look forward to a prosperous and productive future that builds on our strong foundation for many years to come. We continue to work diligently to ensure that our research benefits the citizens of Denmark and other countries around the world.

Professor Lene Juel Rasmussen, Executive Director

VISION, MISSION AND STRATEGIC GOALS

Major demographic changes are occurring across the globe: most notably, the proportion of elderly individuals has been increased and continues to increase in virtually all human populations and all countries. It is predicted that 20 percent of the global population will be older than 60 years of age by 2050, and that the number of people over the age of 80 will have tripled[1]. In developed countries of the world, the average human lifespan increased more than two-fold during the 20th century, and it is estimated that average life expectancy of newborns will gradually increase to close to 100 years during the 21st century. These trends are associated with significant economic, cultural, medical, social, and public health challenges, that will affect individuals, communities, and entire nations, and whose implications are only just beginning to be fully understood and appreciated. Aging itself is a leading risk factor for nearly all major chronic diseases, which increase co-morbidity and drive increases in healthcare costs[2]. In Denmark, the latest population projections estimate that the proportion of the population over the age of 65 will increase from 18 percent in 2018 to 24 percent in 2042, after which it will decline slightly (source: Statistics Denmark). Consequently, population aging is considered by many to be one of the most urgent societal challenges of the coming decades; therefore, better tools for promoting 'healthy aging' are urgently needed[3].

From an individual perspective, longer life can be seen as a good thing, if a person's quality-of-life is maintained for a longer period of time. In that case, population aging will not necessarily be or become a societal burden, as many of us fear it will be on a personal level. Rather, high-functioning elderly individuals could be an asset and a new societal resource, contributing to the workforce or to civil society as retirees and volunteers.

Vision and mission

Since its inception, the Center for Healthy Aging has consistently improved our understanding of aging at the cellular, individual and societal level, brought together researchers with diverse disciplinary backgrounds, trained many doctoral and post-doctoral students, and promoted healthy aging by engaging with a wide range of stakeholders. Extensive epidemiological, imaging, and physical exercise studies have made it possible for researchers at the Center to identify health-promoting interventions. Furthermore, our communication and outreach efforts have engaged lay audiences and increased awareness of the importance and value of healthy lifestyle choices.

The Center for Healthy Aging is now embedded within the University of Copenhagen, an arrangement that brings numerous mutual benefits. The university provides substantial financial support, including salaries of senior faculty and staff, co-financing of PhD scholarships, and state-of-the-art research facilities for the Center's interdisciplinary research, involving primarily members of the Faculty of Health and Medical Sciences and the Faculty of Social Sciences.

Vision and mission

The Center's vision is to discover and understand biological, social, psychological, and cultural processes of aging and learn how to translate our research findings into preventive action.

Our mission is to conduct leading-edge research on major aspects of aging, to train young scientists in aging and aging-related research, and to develop health promotion tools for preventing age-related decline and disease; all of which is aimed at improving the health and quality of life for citizens of Denmark and beyond.

Strategic goals:

- to undertake cutting-edge, multidisciplinary research on aging;
- to understand human aging at the individual and societal levels;
- to challenge negative discourse on aging, frailty, and promote more positive discourse focused on energy, resilience, intrinsic capacity and (psychosocial) functional abilities;
- to communicate policy-relevant research and concrete recommendations to the relevant stakeholders in government and other sectors in Denmark and beyond;
- to promote public discourse on aging through innovative outreach activities.

The location and structure of the Center, embedded at the University of Copenhagen, is an optimal arrangement that maximizes the opportunity for synergistic interactions between Center researchers with distinct background, expertise and training in Health / Medical and Social Science disciplines. Center scientists

have access to extensive resources, including the Novo Nordisk Foundation Center for Protein Research (www.cpr.ku.dk); the Novo Nordisk Foundation Center for Basic Metabolic Research (metabol.ku.dk); the Copenhagen Center for Health Research in the Humanities (core.ku.dk); the Center for Health Economics and Policy (chep.ku.dk); the Challenge platform (www.dataforgood.science/challenge-platform), and the Center for Chromosome Stability (ccs.ku.dk). Furthermore, the Center for Healthy Aging provides edducation and training in aging research (e.g. PhD dissertations, PhD courses, master level activities; see "Educational activities", pp. 35) for the entire University community. The strong and abundant synergies between the Center and the larger University of Copenhagen academic community are a huge asset, making us stronger, more productive and more resilient.

NOTES

1 Population Division, DESA, United Nations: www.who.int/news-room/fact-sheets/detail/ageing-and-health
2 Global status report on non-communicable diseases 2010, WHO: www.who.int/nmh/publications/ncd_report_full_en.pdf
3 Horizon 2020 Societal Challenges 1: Health, Demographic Change and Wellbeing and Strategic Foresight which acknowledges the demographic trend of aging is reiterated as putting increased pressure on health systems

CENTER FOR HEALTHY AGING'S UNIQUE APPROACH

The following characteristics (see Fig. 1) highlight the uniqueness of this Center:

Interdisciplinarity

The Center for Health Aging conducts interdisciplinary research on the highly complex process of aging, drawing on the expertise of our professional staff in multiple disciplines. We take this approach because human aging encompasses challenges and problems that belong to the realms of biology, health, medicine, psychology, sociology, economics, and many other scientific and non-scientific disciplines.

Researchers from the Center for Healthy Aging study the impact of genetic factors, social class, lifestyle, and education on aging, as individual factors or in combination with each other. The number of publications co-authored by the Center's researchers continues to increase, as does the number of collaborative research projects between the Center's scientists and their national and international colleagues. These collaborations are critical, because they stimulate creativity, productivity and faster progress by promoting synergy between participating groups.

The Center emphasizes interdisciplinary collaborations among the Center's scientists and with their national and international colleagues because we understand that collaboration stimulates creativity and growth, leading to synergy between the participating groups. We hope that this approach will hasten progress and allow each researcher to accomplish more than he or she could accomplish working independently.

Taken together, the strong infrastructure provided by the Center for Healthy Aging embedded in the University of Copenhagen, the strong leadership team and the many well-established international collaborations (see "International and national collaboration", pp. 32 for more details), it is clear that the success of our interdisciplinary research Center is virtually ensured.

Holistic approach

The Center for Healthy Aging seeks to understand all aspects of aging – biological, social, psychological, and cultural – at all levels, from the cell to the individual to the population level. This approach to understanding aging is quite unique and only a few institutions around the world are in a position to take this approach.

Scientific excellence

We promote rigorous and innovative research on aging by bringing together top international scientists to address important questions from multiple perspectives. We have established a common conceptual framework, which applies to Center researchers independent of their specific discipline; this ensures that we stay focused on our top priorities and successfully translate research findings into innovative health-promoting interventions.

Capacity building

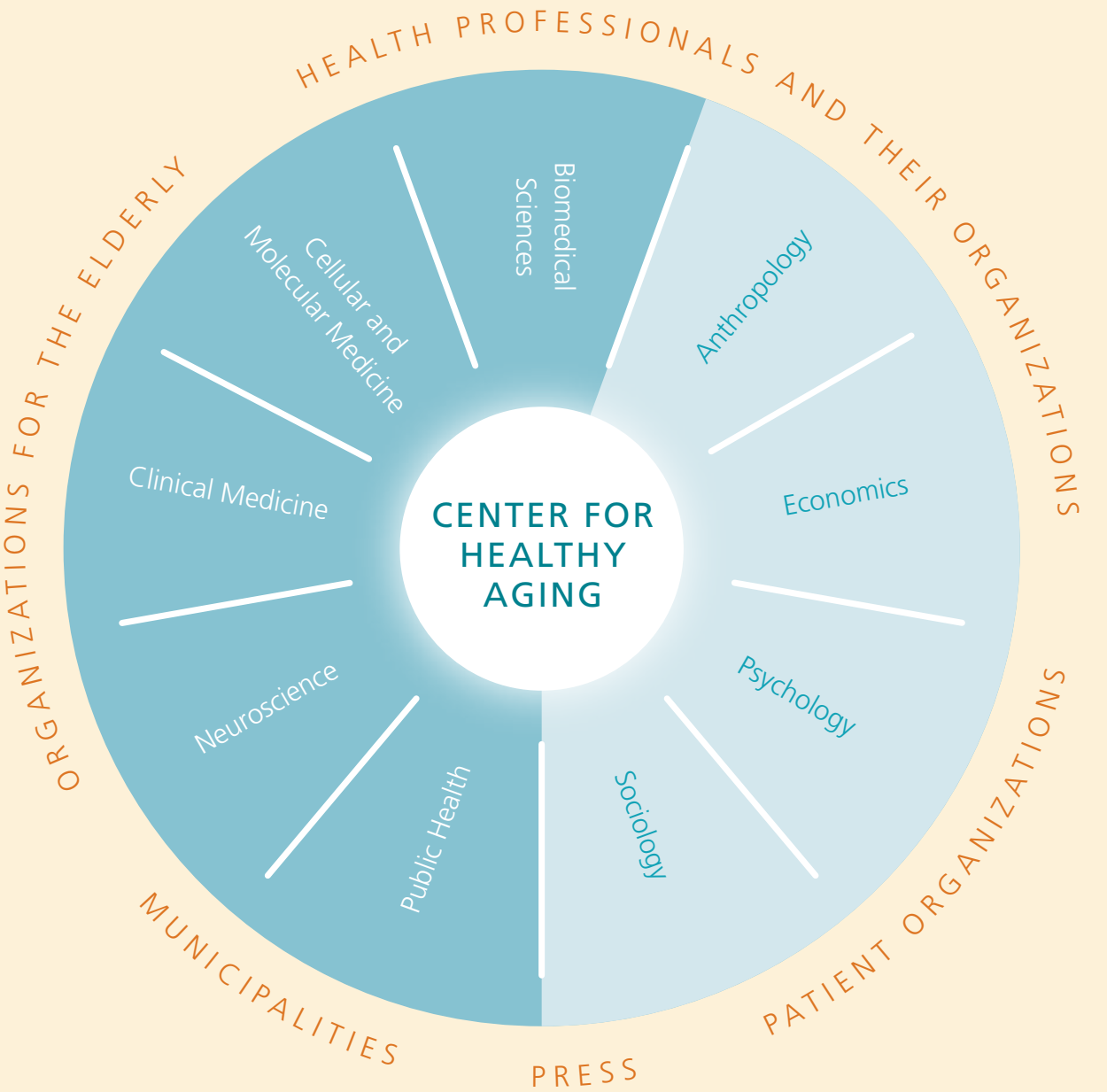
We train the next generation of aging researchers via our high-quality educational programs, with an emphasis on a holistic approach. We also emphasize excellent communication and pursue outreach activities that educate and engage the media, citizens, and stakeholders.

Outreach

We engage a wide range of stakeholders including the Danish public, policymakers, municipalities, and businesses. Our goal is to communicate our research in a clear and effective manner, and ultimately, implement collaborative interventions and policies that promote healthy aging.

Evolving norms and challenging stereotypes

The Center for Healthy Aging is a dynamic entity, ready and willing to adapt and respond to an evolving landscape of ever-changing scientific and societal issues. The Center is committed to educating citizens, health professionals and all stakeholders, and to challenging intentional and unintentional "ageism". While the habitual view assumes that dependence and disability is inevitable in late life, we feel that now more than ever, as societal norms evolve, this assumption needs to be questioned and challenged.



Faculty of Health and Medical Sciences
Faculty of Social Sciences
STAKEHOLDERS

Figure 1. Center for Healthy Aging's approach is interdisciplinary and holistic, and focuses on engaging with multiple stakeholders through impactful communication and outreach.

ORGANIZATION, MANAGEMENT AND INTERNATIONAL RECRUITMENT

Organization

Research at the Center for Healthy Aging is organized into three multidisciplinary research tracks (I-III), involving scientists affiliated with eight departments in two University of Copenhagen Faculties (Social Sciences and Health and Medical Sciences) and three hospitals in Greater Copenhagen (Amager and Hvidovre Hospital, Rigshospitalet – Glostrup, and Bispebjerg and Frederiksberg Hospital). Biomedical researchers, including the secretariat, occupy a 'centralized' workspace on the 2nd and 3rd floor of the Mærsk Tower. Center researchers affiliated with the Faculty of Social Sciences and clinicians who work primarily at area hospitals do not have primary workspace in the Mærsk Tower; however, these scientists interact regularly with their colleagues in the Center's focal hub at the Mærsk building.

Management and Advisory Board

The administrative duties of Center for Healthy Aging are carried out by the Executive Director, a Steering Committee and Administrative Staff. The Executive Director Lene Juel Rasmussen, Deputy Director Rudi Westendorp and Outreach Director Anéh Hajdu report to the Dean of the Faculty of Health and Medical Sciences, Ulla Wewer, who is the grant owner. The Center is embedded within the Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences. Operational tasks at the Center, including strategic planning and development, and coordination between tracks, are executed by the Executive Director. The administrative staff manage logistics and help coordinate center activities and programs.

The main oversight committee for Center for Healthy Aging is the Steering Committee. The committee members include group leaders of each of the three research tracks, as well as the Outreach Director (see "Appendices" for list of members, pp. 11). The Steering Committee provides oversight for research activities, strategic planning, and outreach. The Chair of the Steering Committee is the Executive Director and the Co-Chair is the Deputy Director.

Center for Healthy Aging's management is supported by an International Advisory Board, which reports to the Dean. It includes eleven distinguished scientists, representing broad scientific expertise relevant to the Center's research (see "Appendices" for list of members, pp. 11). The Advisory Board advises the Center management team regarding strategic objectives and development; recruitment, program feasibility, progress, outreach and other aspects relevant to the Center's success and performance. The Advisory Board also serves as inspirator, playing an active role in facilitating opportunities for networking and collaborations involving Center scientists and their colleagues in the international aging research community. The Board advises on scientific goals to ensure that Center research programs meet the highest international standard and achieve optimal scientific impact.

The Steering Committee meets approximately eight times a year, while the Center's management and staff meet with the Advisory Board annually.

Staff

As of 31 December 2020, Center for Healthy Aging had 52 full and part-time employees (funded by the Nordea-fonden grant) plus 194 employees supported by sources other than Nordea-fonden (e.g., the University of Copenhagen). The 246 staff at the Center includes: 56 senior researchers; 31 postdocs; 8 guest researchers; 55 PhD students; 14 research assistants; 59 bachelor/master/pregraduate research students; and 10 lab technicians. In 2020, 15 PhD projects were completed at the Center. Research and research support staff included 137 from Track I, 63 from Track II, and 61 from Track III.

International recruitment

Center for Healthy Aging did not recruit international staff in 2020.

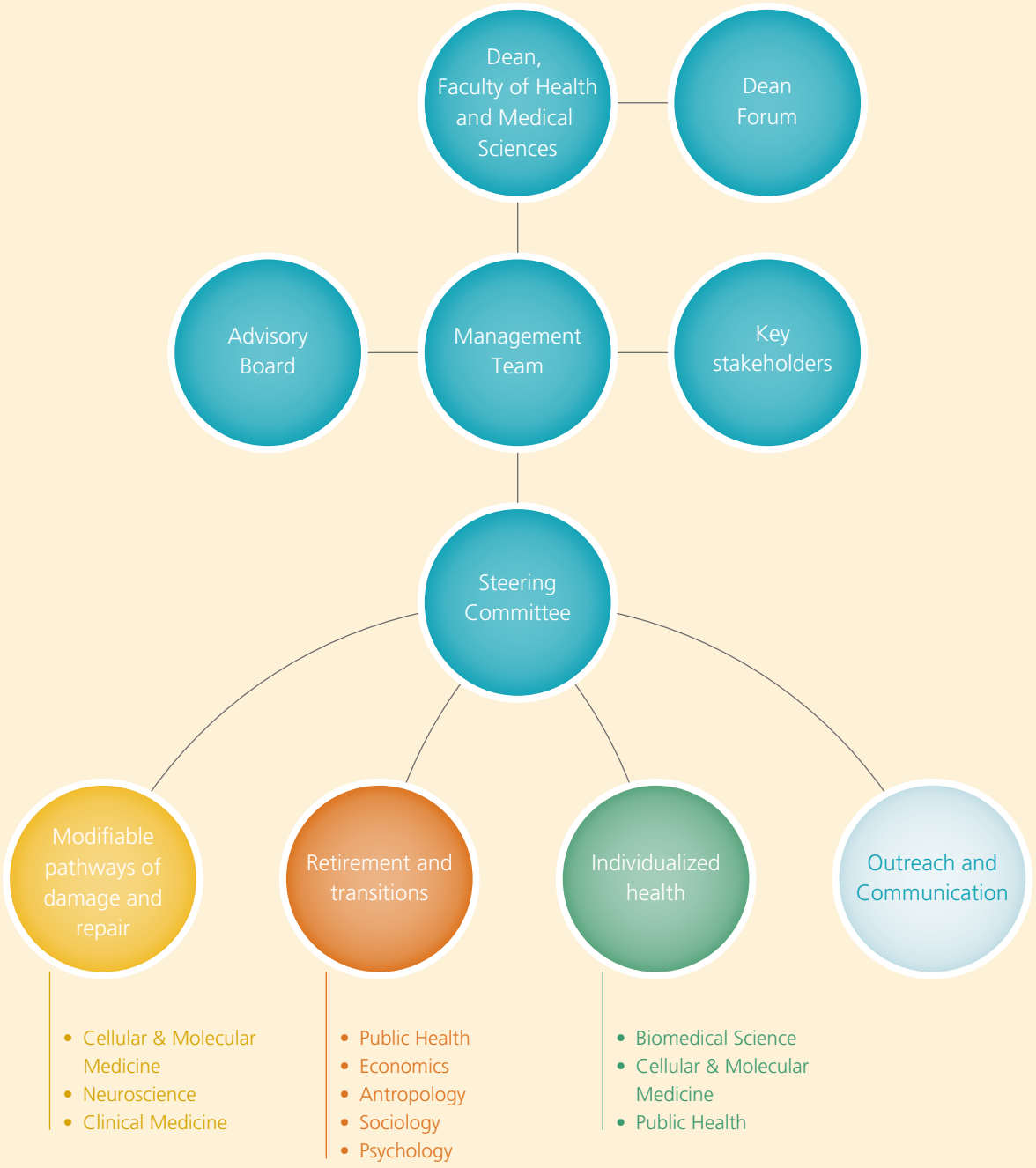


Figure 2. Center for Healthy Aging's organization. Departments associated with a track are listed below the respective track.

RESEARCH

The Center for Healthy Aging promotes healthy and successful aging on all levels, from cells to organisms to populations, through its leading-edge interdisciplinary research programs and outreach activities. The Center acquires evidence-based knowledge and understanding of human aging and uses this knowledge to develop preventive interventions and health-promoting activities that benefit elderly individuals, their families and their communities.

RESEARCH IN NUMBERS

Number of publications: 188
PhD students (completed): 15
Media mentions: 94
External funding (excluding the main from Nordea-fonden): 74,295,089 DKK

RESEARCH TRACK I

MODIFIABLE PATHWAYS OF DAMAGE AND REPAIR IN AGING

GROUP LEADERS

Michael Kjær, Department of Clinical Medicine, Faculty of Health and Medical Sciences
Discipline: Skeletal muscle and tendon tissue, aging, physical activity, injury

Simon Holst Bekker-Jensen, Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences
Discipline: Cell stress responses, signal transduction, MAP kinases, DNA damage response, aging

Ian Hickson, Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences
Discipline: Aging, chromosome stability, DNA repair, age-associated disease

Martin Lauritzen, Department of Neuroscience and Pharmacology, Faculty of Health and Medical Sciences and Department of Clinical Neurophysiology, Rigshospitalet, Glostrup, Denmark
Discipline: Aging, human brain function and neurodegenerative disorders

Andres Lopez-Contreras, Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences
Discipline: DNA damage, replication stress, mouse models, cancer

Lene Juel Rasmussen, Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences
Discipline: Aging, human molecular biology, mitochondrial biology, DNA repair and genomic stability, nucleotide metabolism

Morten Scheibye-Knudsen, Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences
Discipline: Aging, accelerated aging, aging interventions

Linda Hildegard Bergersen, Department of Neuroscience, Faculty of Health and Medical Sciences
Discipline: Aging, physical activity, human brain function

Rationale, focus, and aims

Every day, the human body experiences cycles of tissue breakdown, damage, or trauma followed by subsequent regeneration, recovery, or repair to re-establish homeostasis. Track I investigate the effect of aging on these processes in both skeletal muscle and brain.

Organizational developments

Andres Lopez-Contreras has left CEHA by the end of 2020 to take up a position at CABIMER (Andalusian Molecular Biology and Regenerative Medicine Centre).

Key achievements

Track I researchers completed a 1-year physical training intervention study, the LISA Project (see "Intervention studies and interdisciplinary projects", pp. 23). The intervention was completed with a very low drop-out rate as well as good compliance.

Overview of key research achievements

- We discovered brain precapillary sphincters and revealed that they play a role controlling brain circulation.
- We revealed that age-related decreases in whole brain grey matter and white matter are associated with decreases in IQ and speed-assessed tasks, higher rates of familial myocardial infarct, less physical activity, and poor mental health.
- We reported that the temporal dynamics of evoked brain activity could be used as an indicator of cognitive impairment.
- Sites of chromosome instability associated with folate deprivation were identified at high resolution.
- NAD^+ supplementation can suppress several age-related diseases including neurodegeneration.
- Contributed to understanding the role of CD38 in age-related decrease in NAD^+ abundance.
- Demonstrated that an extra copy of *Chek1* protects mice from replication stress but does not affect lifespan.
- Demonstrated that the tumor suppressor ATRX is an important regulator of the stability of chromosomal common fragile sites.
- In elderly individuals participating in resistance training, pre-activation of satellite cells increased the number of satellite cells but did not increase hypertrophy. This suggests that at least

one factor other than the number of satellite cells limits the capacity for muscle hypertrophy in the elderly.
- In the elderly, denervated muscle fibers display an embryonic configuration, which could be a useful marker for evaluating interventions that target denervated muscle fibers.
- Protein supplementation in well-nourished elderly, does not improve muscle mass, size or function *per se*. However, resistance training increases muscle strength and volume and reduces abdominal and whole body fat in elderly individuals.

Selected publications

Navarro JF, Croteau DL, Jurek A, Andrusivova Z, Yang B, Wang Y, Ogedegbe B, Riaz T, Støen M, Desler C, Rasmussen LJ, Tønjum T, Galas MC, Lundeberg J, Bohr VA. Spatial transcriptomics reveals genes associated with dysregulated mitochondrial functions and stress signaling in Alzheimer's disease. *iScience*. 23(10):101556. Doi: 10.1016/j.isci.2020.101556. *eCollectio*n 2020 Oct 23. PMID: 33083725. 2020.

du Mee DJM, Bak M, Østergaard E, Rasmussen LJ. Mitochondrial dysfunction induced by variation in the non-coding genome – A proposed workflow to improve diagnostics. *Mitochondrion*. 53:255-259. Doi: 10.1016/j.mito.2020.05.013. PMID: 32497723. 2020.

Grubb S, Cai C, Hald BO, Khennouf L, Fordsmann J, Murmu R, Jensen AKG, Zambach S, Lauritzen M. Precapillary sphincters maintain perfusion in the cerebral cortex in health and constrict in a migraine model. *Nat Commun*. 2020 Jan 20;11(1):395. Doi: 10.1038/s41467-020-14330-z. PMID: 31959752.

Cunnane SC, Trushina E, Morland C, Prigione A, Casadesus G, Andrews ZB, Beal MF, Bergersen LH, Brinton RD, de la Monte S, Eckert A, Harvey J, Jeggo R, Jhamandas JH, Kann O, la Cour CM, Martin WF, Mithieux G, Moreira PI, Murphy MP, Nave KA, Nuriel T, Oliet SHR, Saudou F, Mattson MP, Swerdlow RH, Millan MJ. Brain energy rescue: an emerging therapeutic concept for neurodegenerative disorders of ageing. *Nature Rev Drug Discov*. Sep;19(9):609-633. Doi: 10.1038/s41573-020-0072-x. PMID: 32709961, 2020

Garribba L, Bjerregaard VA, Özer Ö, Goncalves Dinis M, Wu W, Sakellariou D, Pena-Diaz J, Hickson ID and Liu Y. Folate stress induces SLX1- and RAD51-dependent mitotic DNA synthesis at the fragile X locus in human cells. *Proc. Natl. Acad*. Sci. U. S. A. 117, 16527-16536. Doi: 10.1073/pnas.1921219117. PMID: 32601218, 2020.

Covarrubias AJ, Kale A, Perrone R, Lopez-Dominguez JA, Pisco AO, Kasler HG, Schmidt MS, Kwok R, Heckenbach I, Wiley CD, Wong HS, Gibbs E, Iyer SS,Basisty N, Wu Q, Kim IJ, Silva E, Vitangcol K, Shin KO, Lee YM, Riley R, Ben-Sahra I, Ott M, Schilling B, Scheibye-Knudsen M, Ishihara K, Quake SR, Newman J, Brenner C, Campisi J, Verdin E; Senescent cells promote tissue NAD^+ decline during aging via the activation of CD38+ macrophages.; *Nature Metabolism*. Nov 2020

Karlsen A, Soendenbroe C, Malmgaard-Clausen NM, Wagener F, Moeller F, Senhaji Z, Damberg K, Andersen JL, Schjerling P, Kjaer M, Mackey AL. Preserved capacity for satellite cell proliferation, regeneration, and hypertrophy in trhe skeletal muscle of healthy elderly men. *FASEB J* 34: 6418-6436, 2020.

Gylling AT, Eriksen CS, Garde E, Wimmelmann CL, Reislev NL, Bielser T, Ziegler AK, Andersen KW, Bauer C, Dideriksen K, Baekgaard M, Mertz KH, Bayer ML, Bloch-Ibenfeldt M, Boraxbekk CJ, Siebner HR, Mortensen EL, Kjaer M. The influence of prolonged strength training upon muscle and fat in healthy and chronically diseased older adults. Exp Gerontol. 136: 110939-110953, 2020.

Soendenbroe C, Bechshøft CJL, Heisterberg MF, Jensen SM, Bomme E, Schjerling P, Karlsen A, Kjaer M, Mackey AL. Preserved capacity for satellite cell proliferation, regeneration, and hypertrophy in the skeletal muscle of healthy elderly men. FASEB J 34: 6418-6436, 2020.

Vind AC, Snieckute G, Blasius M, Tiedje C, Krogh N, Bekker-Jensen DB, Andersen KL, Nordgaard C, Tollenaere MAX, Lund AH, Olsen JV, Nielsen H, Bekker-Jensen S. ZAK? Recognizes Stalled Ribosomes through Partially Redundant Sensor Domains. Mol Cell. May 21;78(4):700-713.e7. Doi: 10.1016/j.molcel.2020.03.021. Epub 2020 Apr

PhD dissertations completed in 2020

Thomas Lau Hansen: Mitochondria in Aging and Disease – a holistic investigation of the interplay between hallmarks of aging and the many ways mitochondrial dysfunction affects genome stability

Peng Song: DNA mismatch repair and its multiple roles in maintenance of genomic stability

Zhiquan Li: DNA Repair Communicates with Mitochondria in Healthy Aging and Neurodegeneration

Matilda Dahlquist: Cell-specific interrogation of local blood flow, oxygen consumption and gamma activity in whisker barrel cortex with age

Kiyana Zarnani: Healthy ageing, beyond a bigger brain

Anna Constance Vind: Molecular Mechanisms of the Ribotoxic Stress Response

Peter Tran: The mechanisms behind the development of tendinopathy: Early strucutural, inflammatory, nociceptive and clinical changes

AnnSofie Thorup Olesen: The effect of aging and training on IMCT

Jacob Bülow: The ageing skeletal muscle: Effect of training and protein supplementation

Kenneth Mertz: Preservation of muscle mass and function through protein supplementation and exercise

Cheng Zhang: Tendon composition and turnover – Is it uniform throughout the tissue?

Anne Theil Gylling: Physical activiy as an intervention for age related loss of muscle mass and function, the LISA study: A randomised controlled trial

Adam El Mongi Jørgensen: Human cartilage growth, regional turnover in vivo, and the effect of exercise in late-stage osteoarthritis

RESEARCH TRACK II

RETIREMENT AND TRANSITIONS

GROUP LEADERS

Karsten Vrangbæk, Department of Public Health, Faculty of Health and Medical Sciences
Discipline: Health policy and health economics

Marco Piovesan, Department of Economics, Faculty of Social Sciences
Discipline: Social preferences, self-control problems, unethical behavior, peer effects, and behavioral contract theory

Rikke Lund, Department of Public Health, Faculty of Health and Medical Sciences
Discipline: Social epidemiology, public health and life course

Stine Møllegaard, Department of Sociology, Faculty of Social Sciences
Discipline: Life course perspectives, social demography, genetics

Paul Conway, Department of Psychology, Faculty of Social Sciences
Discipline: Occupational health psychology (OHP), including workplace bullying, work-related stress, sickness presenteeism, ageing at work, mental health at work, and work motivation

Line Hillersdal, Department of Anthropology, Faculty of Social Sciences
Disciplines: Obesity, cancer, aging, food and eating, welfare technology, personalised medicine, interdisciplinarity, cultures of science, the body in biomedical contexts, prevention and complex intervention research

Nete Schwennesen, Department of Anthropology, Faculty of Social Sciences
Discipline: Anthropology of life and health, aging, technologies, community studies

Maria Kristiansen, Department of Public Health, Faculty of Health and Medical Sciences
Discipline: Health services research, mixed-methods, intervention studies, personcentred care, and inequality

Rationale, focus, and aims

Retirement is a critical life transition that can have profound consequences for an individual's health and well-being. The aim of this research track is to analyze how behavior and social context interact and shape successful responses to critical transitions in later life. We will use retirement as a key example, but will extend the analysis to include other aging-associated transitions such as onset of disease, bereavement, functional decline or change in living conditions. This will enable us to gain a broader understanding of the antecedents, dynamics, and consequences of these transitions. Such knowledge is critical for developing deeper insight into aging as a process that reflects constant interaction between social and biological stress factors, as well as social and biological factors that support resilience and damage repair. Based on the results of these explorations, we will collaboratively develop interventions and outreach projects that support elderly individuals as they navigate critical transitions in later life.

Organizational developments

Laura Pirhonen has started as postdoc in the Section for Health Services Research. She works on health economic analysis of retirement trends and data-collection for the Copenhagen Aging and Midlife Biobank (CAMB) cohort.

Research assistant Anna Munk Sigsgaard was hired as research assistant in the Section of Social Medicine. She will mainly work on CAMB2 survey preparation and later data analysis.

Key achievements

Key achievements in 2020 include the start of many new projects and groups that have not previously been part of Center for Healthy Aging. The individual groups have been developing project frameworks, specific strategies and focus areas and recruiting skilled research staff.

Other key achievements include the development of internal management and coordination structures as well as engaging with external project partners. Track II researchers have successfully applied for supplementary funding (see "Overview of key research achievements", pp. 17).

These activities have established a firm platform for specific research projects and groups and fieldwork and data collection has already begun, in collaboration with research partners.

Furthermore, we have been actively engaged in communicating with a wide range of stakeholders, in an effort to strengthen the societal impact of our work.

Overview of key research achievements

- Maria Kristiansen became member of the Scientific Committee in the Danish Cancer Society
- Maria Kristiansen was granted a Research Collaborator Appointment at the Mayo Clinic, Minnesota, US
- Maria Kristiansen became a board member, Fonden Ensomme Gamles Værn (the EGV Foundation)
- Maria Kristiansen hosted a webinar panel debate under the 75th UN General Assembly virtual events
- Rikke Lund and colleagues participated in a workshop and a separate oral at the European Public Health Association and World Public Health Conference in October 2020.
- Rikke Lund participated in the scientific advisory board meeting for the Gerontology Research Center (GEREC) at the University of Tampere, Finland, February 2020.
- Textbook on Medical Sociology published September 2020 (in Danish Medicinsk Sociologi) Munskgaard/Gyldendals forlag, track II researchers Rikke Lund and Charlotte Juul Nilsson editors and authors of several chapters on 1) social relations and health, 2) life course, health and ageing 3) models and measures of health and function.
- Track II researchers Karsten Vrangbæk and Maria Kristiansen contributed to development of the ACUTE CAG, which is co-chaired by Lene Juel Rasmussen, together with researchers from the Capital Region;
- The visit to Japan by Karsten Vrangbæk, Nete Schwennesen and Henriette Langstrup as part of the grant "Technology assisted healthy aging in Denmark and Japan" awarded by the Danish Agency for Science and Higher Education was postponed due to CV-19. The visit is planned for 2021 instead.

Selected publications

Nabe-Nielsen K, Fuglsang NV, Larsen I, Nilsson CJ. CV-19 risk management and emotional reactions to CV-19 among school teachers in Denmark: Results from the CLASS Study. Accepted for publication in Journal of Occupational and Environmental Medicine, December 2020.

Srivarathan A, Lund R, Christensen U, Kristiansen M. Social Relations, Community Engagement and Potentials: A Qualitative Study Exploring Resident Engagement in a Community-Based Health Promotion Intervention in a Deprived Social Housing Area. Int. J. Environ. Res. Public Health 2020, 17(7), 2341; Doi: 10.3390/ijerph17072341

Foverskov E, Petersen GL, Pedersen JLM, Rod NH, Mortensen EL, Bruunsgaard H, Lund R. Economic hardship over twenty-two consecutive years of adult life and markers of early ageing: physical capability, cognitive function and inflammation. European Journal of Ageing. 2020;17:55-67. Doi: 10.1007/s10433-019-00523-z

Jørgensen, TSH, Allore, H, Elman, MR, Nagel, C, Zhang, M, Markwardt, S & Quiñones, AR 2020, 'Annual Wellness Visits and Influenza Vaccinations among Older Adults in the US', *Journal of primary care & community health*, bind 11. Doi: 10.1177/2150132720962870

Jørgensen, TSH, Siersma, V, Lund, R & Nilsson, CJ 2020, 'Mortality Following Trajectories of Mobility Limitations: The Modifying Impact of Social Factors', *Journal of Aging and Health 2020*, bind 32, nr. 3-4, s. 134-142. Doi: 10.1177/0898264318809787

Jensen AN, Bonnén KB, Kristiansen M. "We don't talk about his heart": Narrative sense-making and long-term readjustment among older out-of-hospital cardiac arrest survivors and their spouses. Resuscitation Plus, in press, 2020.

Schwennesen, N. In between bricolage and repair: Fragile connections and digital entanglements in dementia care, in Alexander Peine, Louis Neven, Wendy Martin, Barbara Marshall (eds) Socio-Gerontechnology: Interdisciplinary critical studies of ageing and technology. Routledge (In press)

Christensen, L.K.T. (2020). Crafting Valued Old Lives: Quandaries in Danish Home Care. Phd series, Department of Anthropology, Copenhagen University (May 2020)

Kristiansen M, Jensen AN, Norredam M, Srivarathan A. Targeting Preventive Home Visits to Older Adults in Disadvantaged Communities: Perspectives of Professionals. Health & Social Care in the Community, in press, 2020.

Sandholdt CT, Cunningham J, Westendorp RGJ, Kristiansen M. Towards inclusive healthcare delivery: potentials and challenges of human-centred design in health innovation processes to increase healthy aging. International Journal of Environmental Research and Public Health, in press, 2020.

PhD dissertations completed in 2020

Else Foverskov: Social inequality in cognitive ageing

Loa Kristine Teglgaard Christensen: Crafting Valued Old Lives: Quandaries in Danish Home Care.

RESEARCH TRACK III

INDIVIDUALIZED HEALTH

GROUP LEADERS

Flemming Dela, Department of Biomedical Sciences, Faculty of Health and Medical Sciences
Discipline: Diabetes, metabolism, physical activity, exercise, cardio-vascular diseases, mitochondrial physiology

Rudi Westendorp, Department of Public Health, Faculty of Health and Medical Sciences
Discipline: Geriatric medicine and all disciplines related to aging research

Jørn Wulff Helge, Department of Biomedical Sciences, Faculty of Health and Medical Sciences
Discipline: Aging, training, insulin resistance, metabolism, inactivity

Vilhelm Bohr, Department of Cellular and Molecular Medicine, Faculty of Health and Medical Sciences
Discipline: Aging, DNA repair, neuroscience, metabolism, neurodegeneration

Rationale, focus and aims

Individualized health entails focusing on individual responses to interventions and life-course trajectories, i.e. zooming in on the biological, psychological, and social factors that determine individual characteristics, such as those resulting in "responders" and "non-responders". In this research track, we will broaden the understanding of the phenotypic characteristics that render every individual unique. We will also explore how the classic determinants of chronological or biological age in nature may be different from an individual's understanding and experience of age. The findings will offer explanations for different outcomes among individuals exposed to the same intervention. In the future, average values for groups will be less important than individual responses, and individualized health will have a major impact on how trajectories of aging and life-course exposures are understood.

Organizational developments

Associate Professor Julien Ochala, PhD, from Kings College, London has been recruited to Xlab. We also welcome postdoc. Jenni Laitila and Research assistant, MSc Eva Frederikke Høy Helms. Technician Thomas Beck has rejoined the Xlab group and Amy Clothworthy has been appointed as assistant professor at Department of Public Health University of Copenhagen.

Key achievements

Our primary goal is to thoroughly understand human aging and diseases associated with aging. This is directly relevant to the societal challenges associated with population aging. For example, Xlab has fruitful scientific collaborations with clinical geriatric departments in the Capital Region of Copenhagen and Region Sealand, resulting in the establishment of CopenAge (copenage.ku.dk). CopenAge is a research center for clinical studies on aging by both basic and clinical research scientists.

Amy Clotworthy played a major role echoing the voice of older adults under the CV-19 lockdowns, i.e. the 'standing together project'. This has had several outlets in the media, as well as in the scientific literature.

Rudi Westendorp made a significant contribution, working with health authorities to develop strategies to respond to the CV-19 pandemic in Denmark and the Netherlands.

Overview of key research achievements

- The ability to metabolize lipids during exercise may decrease with aging;
- Peak fat oxidation rates during exercise are similar in the different phases of the menstrual cycle;
- Statin treatment has a different and opposite effect on mitochondrial respiratory capacity in muscle and blood cells;
- The "body-age" concept has been developed through data acquired in two experiments (2 x 100 subjects) in collaboration with DTU Health Tech. The model has been published and the concept is currently being validated in "real-life" scenarios;
- Metabolomic signatures for dissimilar modes of exercise were developed;

- The thyroid hormone receptor alpha in skeletal muscle is essential for T3-mediated increase in energy expenditure;
- Low-grade inflammation was not detected in formerly obese males, but infiltrating macrophages were detected in adipose tissue;
- Breast cancer patients benefit from a program of intense exercise, but the benefit was lost when the frequency of training sessions decreased;
- Beta-aminoisobutyric acid is released by contracting human skeletal muscle and may regulate secretion of pancreatic insulin;
- The effect of training on mitochondrial function in adipose tissue is depot-specific;
- A precursor to NAD^+ does not alter mitochondrial respiration, content or morphology in skeletal muscle from obese and insulin-resistant men.
- Eccentric exercise is a feasible and effective training modality to increase muscle mass and function in elderly people;
- Myonuclear domain sizes have a functional ceiling;
- Changes in the distribution and positioning of myonuclei influence protein synthesis and function in muscle fibres;
- Adeno-associated viral vectors targeting tubulin are efficient therapeutic interventions for centronuclear myopathies;
- NAD^+ supplements may influence mitochondrial function in liver;
- Antioxidant supplements may affect insulin sensitivity in elderly individuals;
- Age-related macular degeneration reflects accumulation of molecular damage in the eye/retina and the systemic inflammatory response to that damage;
- Hormones from interlinked as well as different hypothalamic-pituitary-target gland axes interact in healthy older individuals;
- Senescence occurs at different levels in different human tissues/organs from the same individual, as previously observed in animal models;
- A 1-year treatment with levothyroxine had no effect on bone health in older adults with subclinical hypothyroidism;
- The impact of disabilities that interfere with (I)ADL on life satisfaction in community-dwelling older people decreases with age independent of psychosocial factors;
- In adults aged 80 years and older with subclinical hypothyroidism, treatment with levothyroxine, compared with placebo, was not significantly associated with improvement in hypothyroid symptoms or fatigue;
- Empirical support for evaluating whether perceived stress increases the risk of dementia in old age;
- Neither night shift work nor long working hours increase dementia risk;
- Evidence for a link between senescence in skin and immune cells in individual patients is limited.
- Age-dependent alterations in mitochondrial morphology and DNA damage response in mouse and C. elegans models of human tauopathy.
- Statin studies in humans: no interference with exercise training ability; Q10 supplements do not affect mitochondrial function; delineating the history of statin use as a treatment in Denmark;
- The ability to combust lipids is of major importance for performance in long-term endurance exercise;
- High intensity interval training is tolerable and improves insulin sensitivity in patients with type 2 diabetes;
- Teamsports, such as handball and football, elicit favorable health effects in elderly people;
- Mitochondrial function in skeletal muscle and adipose tissue influences risk of ischemic heart disease but is not involved in the acute phase of cardiac arrest;
- Reablement services for older adults are not a new innovation but have existed in time and space under different names.
- Studied the impact of 'self-help' interventions on ageing and eldercare in Denmark.
- Developed a two-level model for age-related macular degeneration.
- Identified sources and differential effects of colorectal cancer screening in Denmark and Scandinavia.
- Health care expenditure in the last five years of life is driven by morbidity, not age.
- Further evidence for thyroid hormone therapy not being effective for treating older adults with subclinical hypothyroidism

Selected publications

Narici M, De VG, Franchi M, Paoli A, Moro T, Marcolin G, Grassi B, Baldassarre G, Zuccarelli L, Biolo G, di Girolamo FG, Fiotti N, Dela F, Greenhaff P, Maganaris C. Impact of sedentarism due to the CV-19 home confinement on neuromuscular, cardiovascular and metabolic health: Physiological and pathophysiological implica-

tions and recommendations for physical and nutritional countermeasures. *Eur J Sport* Sci 1-22. 2020.

Morville Th, Sahl RE, Moritz Th, Helge JW, Clemmensen C. Plasma Metabolome Profiling of Resistance Exercise and Endurance Exercise in Humans. In press, *Cell Reports*. Nov. 2020.

Regnersgaard S, Knudsen AK, Lindskov FO, Mrantinkovic M, Pressel E, Ingersen A, Dela F. Down stair walking: A simple method to increase muscle mass and performance in 65+ year old healthy people. *Eur J Sport Science*, In press 2020.

Cramer A, Prasad V, Eftestol E, Song T, Hansson KA, Dugdale H, Sadayappan S, Ochala J, Gundersen K, Millay D. (2020) Nuclear numbers in syncytial muscle fibers promote size but limit flexibility. Nature Comm. 11:6287

Massana Muñoz X, Kretz C, Silva-Rojas R, Ochala J, Menuet A, Romero NB, Cowling BS, Laporte J. (2020) Physiological impact and disease reversion for the severe form of centronuclear myopathy linked to Dynamin. JCI Insight. 5:e137899

Brandão BB, Madsen S, Rabiee A, Oliverio M, Rocha AL, Ruiz GP, Ferrucci DL, Monteiro L, Davanzo GG, Branquinho JL, Razolli D, Pinto S, Nielsen TS, Festuccia WT, Martins AS, Guerra BA, Knittel TL, Søgaard D, Larsen S, Helge JW, Velloso LA, Emanuelli B, Kornfeld J-W, Pearce EJ, Moraes-Vieira PMM, Ronald Kahn C, Vienberg SG, Zierath JR, Treebak JT, Mori MA. Dynamic Changes in DICER Levels in Adipose Tissue Control Metabolic Adaptation to Exercise. *PNAS*; Sep 8; 202011243. Doi: 10.1073/pnas.2011243117, 2020.

Fontana D, Mauri M, Renso R, Docci M, Crespiatico I, Rost LM, Jang M, Niro A, Dáliberti D, Massimino L, Bertagna M, Zambrotta G, Bossi M, Citterio S, Crescenzi B, fanelli F, Cassina V, Corti R, Salerno D, Nardo L, Chinello C, Mantegazza F, Mecucci C, Magni F, Cavaletti G, Bruheim P, Rea D, Larsen S, Gambacorti-Passerini C, Piazza.: 2020. ETNK1 mutations induce a mutator phenotype that can be reverted with phosphoethanolamine. *Nat Commun 11(1):* 5938. Doi:10.1038/s41467-020-19721-w, 2020.

Chrois KM, Dohlmann TL, Sogaard D, Hansen CV, Dela F, Helge JW, Larsen S. Mitochondrial adaptations to high intensity interval training in older females and males. *Eur J Sport Sci*;20:135-145, 2020.

PhD dissertations completed in 2020

No PhD dissertations completed for Track III in 2020.

INTERVENTION STUDIES AND INTERDISCIPLINARY PROJECTS

Outreach project: From Worklife to Retirement

(This project was formerly called 'The 3. Good Age')

KEY PARTICIPANTS

- Anéh Christina Hajdu, Outreach Director, CESA Management
- Astrid Pernille Jespersen, Associate Professor, SAXO Institute (Director of Copenhagen Centre for Health Research in the Humanities)
- Tenna Jensen, Associate Professor, SAXO Institute (Copenhagen Centre for Health Research in the Humanities)
- Kamilla Pernille Johansen Nørtoft, Associate Professor, SAXO Institute (Copenhagen Centre for Health Research in the Humanities)
- Anne Theil Gylling, postdoc (Track I)
- Uffe Nymark Breum, Head of department, Health promotion and prevention; Vejle Municipality
- Susanne Brøchner Væring, Manager at Frivillighedshusene, Aarhus Municipality
- Sys Skive, Manager of prevention and rehabilitation, Vordingborg Municipality

According to Statistik Denmark (www.dsk.dk), approximately 40.000 Danish citizens retire every year and take the journey from active workforce to retirement. Based on previous scientific results from CESA research projects, this partner-driven project will be carried out in close collaboration and dialogue with the citizens of three Danish municipalities: Vordingborg, Vejle and Aarhus. The aim is to develop concepts and models that support Danish citizens in their transition from worklife to an active retirement. When daily routines are formed and experienced outside a traditional work environment, some people experience joy and inspiration. Using creative ideas and new practices, these individuals find ways to fulfill new and old dreams – build new friendships and communities.

However, both research and practical experience in the three municipalities in Vordingborg, Vejle and Aarhus show that retirement for a substantial number of citizens can be a critical life transition with profound and long-term negative effects on health and wellbeing. These citizens experience and characterizes the transition and their retirement as a period of loneliness, with inner turmoil, loss of identity and lack of direction.

This outreach project aims to improve the retirement experience by encouraging citizens to prepare for it well in advance. The targeted citizens for the project are less well-educated (with few or no years of advanced study), and they are representative residents of Vordingborg, a small town in rural Denmark, Vejle, a medium-sized Danish town, and Aarhus, the second largest city in Denmark. These citizens tend to be less willing to reach out and form new relations and are less eager to engage in new activities (e.g. volunteer work). Furthermore, this target group typically held low-paying jobs, performed physically demanding work, and experienced job insecurity.

Using approaches based on co-creation and involvement, the goal is to encourage retiring citizens in the main target group to participate in local activities, get involved in their local community, and actively make lifestyle related decisions, in order to maintain and improve their quality of life during the transition to and for many years after retirement. This includes physical activities, regular exercise, social activities, volunteer work, activities related to their former workplace etc.

The project will develop in incremental steps over three years and will build on the 'improvement-model'. The project expects to enroll approximately 4,000 citizens from the three municipalities, including 30 senior ambassadors, 300 test persons, 900 citizens and 3,000 participants in local activities.

The project will be conducted as a collaboration between CESA scientists and representatives from the three municipalities. The project will also draw on experience and knowledge of other organizations and collaborators, including Sundhedsstyrelsen, Ældresagen etc.

The outcomes will include a series of recommendations and evidence-based models, developed using the 'promising practice' approach developed by The National Board on Health and Welfare (Socialstyrelsen). It is expected that this study could be replicated in other Danish municipalities and have an impact on the national retirement agenda.

Due to the CV-19 pandemic, a substantial number of meetings, activities and visits to local associations and organizations have been postponed or delayed and it is expected that most

social activities involving civil society will be restricted for some time to come. Therefore, the project partners are developing alternative ways to engage with retiring citizens and new retirees, through workplaces, larger organizations and digital platforms. The project partners remain optimistic that they will reach their stated goals within the project period.

KEY ACTIVITIES

- Governance structure model has been defined and approved by Steering Committee
- Communication strategy has been developed and endorsed
- Graphic design and visual identity were implemented
- Literature review has been conducted and discussed
- Evaluation model was developed
- Cooperation agreement signed
- 50 x 1:1 interviews conducted in Vordingborg with men age 52-65 with short or no education
- Collaboration established with unemployment insurance funds and unions e.g. HK, FOA, 3F, Metal and NNF
- Collaboration with municipal workplaces established e.g HR departments
- Digital Platform, AktivSammen established to disseminate information about activities and communities for citizens 60 +
- Process begun to build a digital platform for virtual guidance of senior citizens
- Dialogue with Komiteen for sundhedsoplysning regarding the concept 'Lær at tackle'
- Public talks presented at KLs digital: tilmeld.kl.dk/aeldre-livestream/conference
- Workshop developed for presentation at Sundhedsdage (postponed due to CV-19)
- Column in Kommunal Sundhed
- Planned seminar among the partners to strengthen collaboration and mutual tracks

Identification of predictors for cognitive function

KEY RESEARCHERS

- Martin Lauritzen, Professor (PI, Track I)
- Erik Lykke Mortensen, Professor (Track II)
- Lene Juel Rasmussen, Professor (Track I)
- Merete Osler, Professor (Not affiliated with Center for Healthy Aging)
- Rikke Lund, Associate Professor (Track II)
- Egill Rostrup, Associate Professor (Track I)
- Krisztina Benedek, Consultant (Track I)

What impact will this proposed research have on human health?

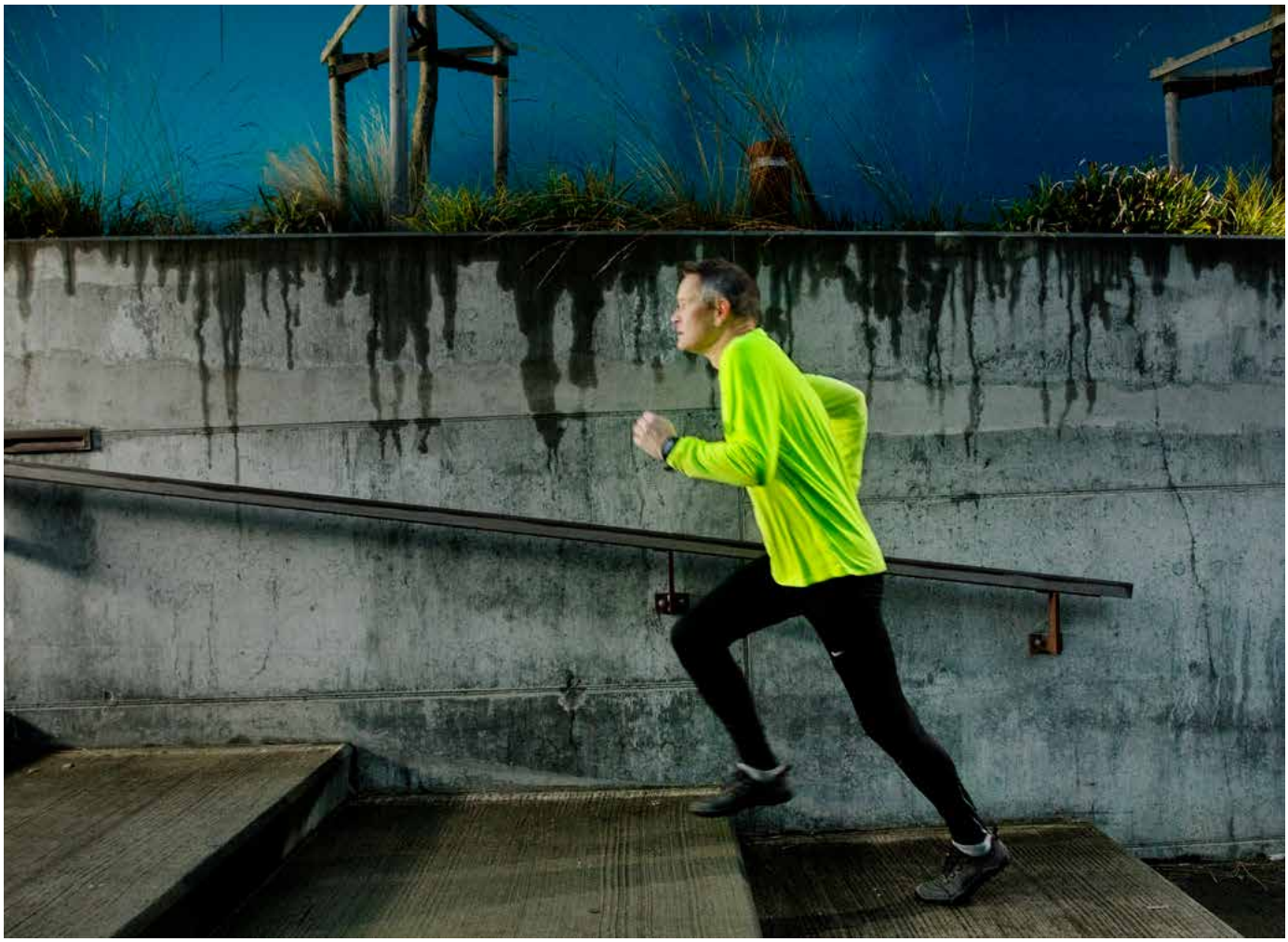
The proposed research is expected to 1) improve understanding of human aging, including aging-related neurological disease, AD and other dementias; 2) facilitate the search for effective, personalized anti-aging interventions; and 3) provide tools that enable individuals to live healthier lives. The potential impact of this project on human health is very high, in that it directly addresses societal concerns and challenges related to worldwide population aging.

This research program explores the cumulative effect of morbidity on brain function at different life stages in a Danish Birth Cohort composed of Danish men born in 1953. The primary aim is to identify factors that influence or predict cognitive function, especially as relevant to cognitive decline in middle or late life.

Methods: Cognitive test scores at a single point in time in midlife reflect individual differences in age-related decline, as well as inherent individual differences in cognitive ability/potential throughout life. Members of the Copenhagen Metropolit Cohort were cognitively-assessed as young adults at time of conscription. A subset of this cohort was also tested for cognitive function in midlife (i.e., CAMB 2009). These data and new data collected since 2010 at the National Hospital (Rigshospitalet) in Copenhagen include structural and functional MRI studies, cerebral rhythmic activity (EEG) patterns, evidence of inflammation, sleep data and molecular and genetic data that shed light on the role of genetic risk factors in cognitive decline. The project is a collaboration with other groups in the Center for Healthy Aging, other Institutions in the Capital region of Denmark and nationally, and research groups in other countries including but not limited to Oxford University. Several predictive markers for aging-associated cognitive decline have been identified. The findings from the human studies have been replicated in rodents, and provide important mechanistic information on brain aging.

Progress and results: We have examined cognitive performance of more than 520 males from the Metropolit birth cohort one or more times. The test-persons were without evidence of differences in IQ when cognitive function was assessed at draft board examination (baseline), but important differences were detected and documented when data was collected at 58 years old and at age 61-63. All the participants were invited to participate in a follow-up study, which includes a comprehensive assessment of cognitive function and other tests to be administered from 2018 through 2021. In addition to follow-up examinations of previously-tested men, the cohort of test-persons was enlarged to include 319 individuals. These and other data were analyzed, revealing differences in sleep quality, mitochondrial function, nucleotide metabolism, telomere length and structural and functional MRI when test-persons were stratified according to higher or lower cognitive performance. In addition, we have shown that EEG correlates of visual short-term memory in older age vary with adult lifespan cognitive development and provide a clinical tool that can be used to examine cognitive status in old age. In animal model systems, we have identified unique features of brain repair mechanisms in astrocytes linked to aging and dysregulation of interneurons during normal aging. Data collected in a rodent model system also show that activity of the mitochondrial complex 1 decreased and mitochondrial size heterogeneity increased; these observations suggest that lower mitochondrial quality may be an early sign of brain aging. Most recently, we demonstrated that brain astrocyte activity increases in aged rodents, which may be relevant to understanding brain frailty in older individuals.

Conclusions: We identified potential markers of middle and late life cognitive decline in a birth cohort of Danish men. Additional studies are underway to confirm the results, demonstrate reproducibility and to increase sensitivity and specificity of biomarker assays. Ultimately, we envision that these novel findings will lead to novel strategies or tools for diagnosing and preventing brain aging, thus promoting healthier late life years for the elderly.



Intervention project on physical activity – LISA Project

KEY RESEARCHERS

- Michael Kjær, Professor (PI, Track I)
- Erik Lykke Mortensen, Professor (Track II)

The study has significant societal importance, in that it evaluates and could in future predict the long-term effects of interventions based on physical strength training in elderly individuals at or near retirement age.

In this multidisciplinary randomized controlled trial (clinicaltrials.gov: NCT02123641), a blinded assessor allocated the participants to either a) supervised, heavy resistance training (HRT, n=149, 3/wk), b) moderate intensity resistance training (MIT, n=154, 3/wk) or c) non-exercise activities (CON, n=148). All 451 participants were randomized (62-70 yrs, women 61%, ≈80% with a chronic medical disease) and 419 were included in the intention-to-treat analysis (n=143, 144 and 132; HRT, MIT and CON). Changes in muscle power (primary outcome), strength and size, physical function, body composition, hippocampus volume and physical/mental well-being were analysed.

All participants in the LISA project completed a 1-year intervention, during which the drop out rate was 6% and 83% of the subjects in the HRT and MIT groups completed at least 66% of all training sessions. All subjects have been re-assessed at 2 years (1 year since the end of the intervention) and 60% of subjects were re-assessed at 4 years (3 years since the end of the intervention).

Leg extensor power (primary outcome) was unchanged in all groups indicating that training had no effect. However, strength training had positive effects on several secondary outcomes including isometric knee extensor strength and muscle mass. For subjects in the HRT group, cross-sectional area of vastus lateralis muscle increased, and whole-body fat percentage and visceral fat content decreased. In addition, chair-stand performance and 400 m walking time improved in all groups. Hippocampus volume decreased in all groups over time with no influence of strength training, whereas mental health (SF-36) improved more in HRT than MIT.

Conclusions: Together, the results indicate that leg extensor power did not change in response to long-term supervised strength training; however, this type of training was effective in both healthy and chronically-diseased elderly individuals who were compliant, inducing consistent changes in physiological parameters of muscle strength, muscle mass and abdominal fat.

Social relations and healthcare utilization among middle-aged and older people: an implementation and registry-based study in Denmark

KEY RESEARCHERS

- Anne Sophie Bech Mikkelsen, PhD Student (Track II)
- Maria Kristiansen, Associate Professor (Track II)
- Rikke Lund, Professor (Track II)

This Track II project explores the relationship between social relations and healthcare utilization among Danish middle-aged people by linking cohort data with data from Danish national registries. This is supplemented by qualitative data on individual and contextual factors affecting the implementation of a group-based life story intervention among frail older people in nursing homes in Denmark. Finally, a systematic review of effects of group-based interventions to enhance social relationships among older people in nursing home settings has been completed. Preliminary findings indicate that interventions in nursing home settings hold potential for enhancing social relations among residents; however, there is mixed evidence for efficacy in the current scientific literature. Qualitative findings indicate that professionals find the intervention successful and relevant. While the participants expressed satisfaction, they also indicated that they did not establish new relationships as a result of the intervention. Preliminary findings also indicate barriers for successful implementation of the intervention, such as; 1. Differences in physical capacity and cognitive function among participants, 2. Lack of time (for the healthcare professionals) and 3. Competing activities at the nursing homes. We expect the results to improve understanding of patient use of healthcare services, which could inform implementation of future interventions targeting frail older people in nursing homes. Co-author of this study, Anne Sophie Bech Mikkelsen, submitted these results as part of her PhD thesis in June 2020. Thesis defense was planned for fall 2020.

Health, well-being and social relations in a changing neighborhood (STRIT)

KEY RESEARCHERS

- Rikke Lund, Professor (Track II)
- Abirami Srivarathan, PhD Student (Track II)
- Siv Nygaard, PhD Student (Track II)
- Catharina Thiel Sandholdt, Postdoc (Track II)
- Gritt-Marie Hviid Malling, Research Assistant (Track II)
- Maria Kristiansen, Associate Professor (Track II)

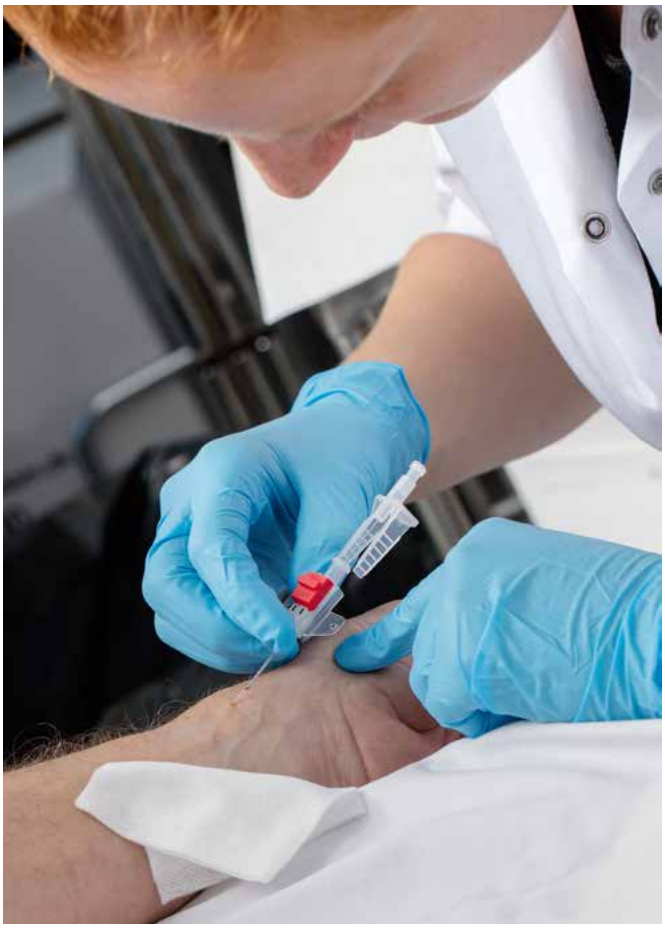
"Health, Well-being and Social Relations in a Changing Neighborhood" (in Danish: "Sundhed, Trivsel og Relationer i Taastrupgaard", STRIT) is a mixed-methods longitudinal study initiated in January 2018. The study investigates changes in well-being, health and social relationships in a large social housing community in the Høje Taastrup municipality, and it builds on a previous intervention study conducted under CEHAII in the same community. The community is undergoing large-scale (900 mill. DKK) changes over the coming years in the built environment/housing, recreational areas, infrastructure and institutions. At the same time, the community has been affected by recent policy changes related to the so-called "ghetto act" that envisions similar restructuring of the built environment and changes in population demographics in selected areas across Denmark. How such changes will affect residents of this and similar communities is unknown.

The 4-year longitudinal study spans the period before, during and after these structural changes to the community are implemented. In the observational parts of the study, annual surveys in 8 languages and qualitative interviews as well as register-based information are used to explore effects of structural changes on health, well-being and relationships from the point of view of middle-aged and older adults living in the community. Register-based data from a similar community located in the same municipality was used as a control/comparison population. Based on the initial needs assessment and with user-involvement, healthy aging interventions were then developed and evaluated in close collaboration with the community, key stakeholders from the municipality and volunteer organizations.

The second wave of surveys were administered between September 2019 and December 2019. The survey corps included 12 interviewers speaking Danish and one of the other available seven languages. Interviewers went door-to-door and administered the survey to all residents > 45 years old. During the data collection, the interviewers experienced a certain "research fatigue" and frustration among the residents regarding the demolition process, which appeared to create reluctance to participate in the survey. The data collection process was evaluated in January 2020 and all metadata from residents and interviewers have been documented and will be used as appropriate.

The first intervention was implemented in 2019. It focused on building relations between residents and increasing well-being and community belonging through shared experiences organized by the STRIT-project. In collaboration with the residents living in the area, it was decided that the first intervention should consist of four bus trips to destinations outside the area of Taastrupgaard, through which the residents hoped to improve existing and develop new relationships with their neighbors, while meeting on neutral ground. The bus trips were a great success and it was observed that residents during the intervention-period became more open and interactive towards each other.

The second intervention will be implemented in 2020, and will draw heavily on the knowledge and relations established in the first intervention, as access to the field – especially in disadvantaged neighborhoods – are central to all qualitative studies. Therefore, a key element of this intervention is to draw on already-formed relations between residents and researchers, and more importantly to draw on existing relations within the resident group. As with the first intervention, the second intervention will focus on community-belonging and what we define as community collectives. This will be done by generating community narratives using graphical facilitation on both individual and collective levels.



LIFESTAT

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  Ian Hickson, PhD, Professor (Track I)
  Steen Larsen, DMSci, Associate Professor (Track III)
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  Sofie R. Lau, PhD
  (Not affiliated with Center for Healthy Aging)

LIFESTAT is an interdisciplinary project that leverages approaches and knowledge from medicine, the humanities and the social sciences to analyze the impact of statin use on health, life-style and well-being in a cohort of Danish citizens. The impetus for the study is the fact that 600,000 Danes take statins in order to lower blood cholesterol and reduce risk of cardiovascular disease (CVD). Nearly 40% of these individuals are being treated with statins based only on their high blood cholesterol; in these individuals, statins are prescribed for the purpose of 'primary prevention' of CVD. However, the potential benefit of treatment with statins should be considered in light of evidence that statin-use has serious and prevalent side-effects, including skeletal muscle cell death, muscle pain, and low exercise tolerance, which in turn discourages adherence to recommended regimens for regular exercise. Furthermore, glucose intolerance (a risk factor for type 2 diabetes) can be seen as a side-effect of statin use.

Objective: To study the biological consequences of statin use, focusing on muscle metabolism and function.

Approach: Three studies on approximately 150 patients: 1) Cross-sectional study on statin-users with and without myalgia and control subjects (not taking statins). 2) Eight week study of statin-users given or not given Co-enzyme Q10 supplement. 3) Eight week longitudinal study including a physical activity intervention (supervised cycling 3x per week for 8 weeks).

Methods: Clinical and biochemical analyses were conducted to quantify insulin sensitivity and secretion, fitness and muscle strength, blood chemistry, muscle and fat metabolism, mitochondrial respiration and mitochondrial ROS.

Goal: To identify potential mechanism(s) underlying statin-induced myalgia.

Status: Primary funding came from the University of Copenhagen UCPH Excellence Programme and it was funded for 5 years (2013-2017). The majority of data has been published (including 7 PhD dissertations), however some data are still in process and some papers are under submission. Full list of publications can be seen at lifestat.ku.dk and further information at kolesteroldialog.dk.

Eccentric training for healthy elderly people

KEY RESEARCHERS

Faculty of Health and Medical Sciences

- Flemming Dela, MD, DMSci, Professor (PI, Track III)
- Signe Regnersgaard, Student (Track III)
- Anna K. Knudsen, Student (Track III)
- Filippa O. Lindskov, Student (Track III)
- Marija Mrantinkovic, Student (Track III)
- Eckart Pressel, MD Chief Physician (Not affiliated with Center for Healthy Aging)

Eccentric exercise is of particular interest in the search for effective methods for preventing sarcopenia. However, the potential benefit of additional workload during eccentric exercise is not well studied. The objective of this study was to investigate the applicability and muscle response to eccentric training, where healthy elderly study subjects performed descending stair-walking with and without extra weight vs ascending stair-walking without extra weight. Study participants (N=32, mean age 70±3 yrs) were randomly assigned to a group performing concentric work by ascending stair walking (CON), a group performing eccentric work by descending stair walking (ECC) or a group performing eccentric work by descending stair walking while carrying 15% of bodyweight as extra weight in a weight vest (ECC+). The intervention lasted for 3 or 6 weeks over 9 or 18 total sessions, respectively. We found that the ECC+ group reported no increase in perceived exertion and demonstrated improved muscle function and performance after only 9 sessions. Furthermore, the results indicate that eccentric exercise is superior to concentric exercise, as measured by performance on the 6 minute walk test and assessment of leg strength.

Biological age: A reinforced health tool to combat obesity

KEY RESEARCHERS

Faculty of Health and Medical Sciences

- Jørn Wulff Helge, PhD, Professor (PI, Track III)
- Karina Husted, PhD Student (Track III)
- Pernille Hulst, Master Student (Track III)
- Mathilde Fogelstrøm, Master Student (Track III)
- Steen Larsen, Associate Professor (Track III)
- Flemming Dela, Professor (Track III)
- Jens Christian Brings Jacobsen, Associate Professor (Not affiliated with Center for Healthy Aging)
- Kaj Åge Henneberg, Associate Professor (Not affiliated with Center for Healthy Aging)

Biological age is widely used as a health tool, but validation and documentation of its significance is insufficient. Here we study biological age as used in private workplace health companies and in the fitness and health industry. Furthermore, we sample a broad dataset on biological age to optimize and check quality of measurement, allowing us to subsequently validate the measurements in a "real-life" lifestyle-intervention. Overall, we intend to qualify the application and utilization of biological age to support better lifestyles.

CHALLENGE – Big data

KEY RESEARCHERS

- Majken Jensen, Professor (Track III)
- Laust Mortensen, Professor (Track III)
- Rudi Westendorp, Professor (PI, Track III)
- Lene Juel Rasmussen, Professor (Track I)
- Vilhelm Bohr, Professor (Track III)
- Morten Scheibye-Knudsen, Associate Professor (Track I)
- Amy Clotworthy, Assistant Professor (Track III)
- Sasmita Kusumastuti, Postdoc (Track III)

The continuous increase in life-expectancy and lengthening of disease trajectories are causing profound upheaval at the individual and societal levels. The majority of people >65 years old suffer multiple morbidities and polypharmacy is the rule. Age is the most important single risk factor for many diseases, including diabetes, cancer and dementia, but it is often ignored as the underlying causal mechanism. Our vision is to better understand the process of human aging, to interfere in the biomolecular process, and to prevent and delay the onset of morbidity. The mission is to bring together excellent researchers with complementary expertise in order to go beyond traditional reductionist approaches to understanding human aging. The research goal is to develop novel methods to generate high-throughput computer-assisted analyses of exceptional datasets.

First, we will analyze the life-histories of individuals with fast and slow aging trajectories to identify contributing life events, rather than attempting to predict outcomes. Second, we will detect the pathological, morphological and molecular biomarkers of aging in samples of human tissue, generating unprecedented opportunities for (nested) case control studies and Mendelian randomization for causal inference. Third, using statistical- and actual sampling methods, and study of experimentally perturbed biological systems, we will decipher the molecular interplay between nuclei and mitochondria in aging cells.

We intend to establish a durable and flexible systems-wide-strategy that will open up opportunities to obtain a fuller understanding of the aging process and aid the search for specific diagnoses, personalized therapies and healthier lives.

The study is a collaboration with Leibniz Institute for Prevention Research and Epidemiology, which is developing a new machine-learning method called recurrent neural networks for time-to-event predictions with competing risks. Based on that method, the following four fundamental principles were incorporated into our study design: 1. The goal is to predict probabilities of using chronic care services at time points in the future for older individuals. Therefore, it is a time-to-event or survival outcome and censoring is applied to take into account when individuals move in or out of the municipality etc. 2. Other events can occur before the event of interest, e.g. death or hospitalization. Therefore, we applied competing risks in modelling the algorithms. 3. Prediction is based on progression of predictive markers over time, such as medical history for the last five years. Therefore, our methods incorporate and assess the required variables. 4. We anticipate collecting and analyzing a large volume of data. Copenhagen Municipality will provide insight on how they deliver care to older persons and will provide data which will be used to improve the machine-learning algorithms.

COMMUNICATION AND OUTREACH

'The Decade of Healthy Aging' was launched by the WHO in December 2020, as a new platform and campaign to accelerate collaboration and to bring together governments, civil society, international agencies, professionals, academia, the media, and the private sector for ten years of concerted, catalytic and collaborative action to improve the lives of older people, their families, and the communities in which they live.

The emergence of the SARS-CoV2 virus and the far-reaching impact of the CV-19 pandemic have reinforced the importance of a global aging agenda and raised awareness of the living conditions of the elderly, who are especially vulnerable and differentially susceptible to severe disease or death from CV-19.

In Denmark, age-related topics such as elder care in nursing homes and retirement models, conditions and the rights of the elderly have been discussed widely in news articles, public debates and seminars, and these discussions are having significant impact on an institutional, governmental and national political level.

Throughout 2020, CEHA researchers discussed topics such as dignity, self-determination, prevention of loneliness, separation from family members and lack of equal access to health care. Interest and awareness of partnership-alliance on social inequality and the need for equity in healthcare has increased and arrived on the national political agenda, as reflected in new CEHA initiatives e.g. collaborations and a board member seat for CEHA researcher Maria Kristiansen in *Ensomme Gamles Værn* (the EGC Foundation).

Researchers and alumni from the Center have actively participated in debates, seminars and workshops and published articles on some of these topics (e.g. Ældretopmødet arranged by The Ministry of Health and Elderly, DanAge, FOA, KL). Thus, we are actively engaged in research on the isolation and loneliness of elderly in nursing homes before and during the CV-19 pandemic.

Throughout 2020 and based on the demographic changes there has been much discussion of the retirement age and the need for a more flexible model for this important life transition. An official Pension Commission was formed and tasked with modernizing the private and public Danish pension models, moving towards a model that accommodates seniors who want to remain active in the workforce after they reach the traditional retirement age. The Commission will also investigate models that support early retirement, especially for those in physically-demanding professions.

In parallel, CEHA researchers have reviewed international trends in retirement policies as they prepare for a new round of the CAMB survey data collection in the spring of 2021. The survey data will provide detailed data on current preferences and choices of Danish citizens regarding retirement. Retirement preferences will be analyzed and linked to information about health and quality of life, which could identify predictors of the optimal (or preferred) age for retirement.

It is expected that the Ministry of Health and Elderly will, within the next year launch new reforms focused on sustainable health and welfare for the elderly. 2021 is an election year in the 98 Danish municipalities and 5 regions, which makes it to strengthen our collaboration and engagement with Danish municipalities.

With increased awareness of global population aging and an emphasis on global actions, the Center for Healthy Aging has a golden opportunity to engage and make multidisciplinary, aging research play an active role by participating and influence the global agenda on aging, which we hope will lead to better conditions for the elderly in Denmark and internationally.

Outreach to secure higher quality

For years, Center for Healthy Aging has worked strategically to put knowledge about healthy aging on the agenda and ensure that aging research is prioritized when politics is formed and health decisions and recommendations are carried out targeting specific challenges and citizens.

It is a strategic decision to accelerate communication and collaboration with stakeholders to form and promote mutual projects, and activities so help solve some of the challenges facing the health care system, municipalities, general practitioners, rehabilitation centers and other agencies that provide elder care.

CV-19-related restrictions have led to the cancellation of most public group events, including science fairs and festivals; clearly, this has limited the ability of students and researchers to engage in dialogue, share results and network in informal venues and eliminated opportunities for CEHA scientists and staff to engage with the public and stakeholders. Many of these arenas have also served as platforms for young researchers to highlight their accomplishments and improve their communication skills.

While the Danish Science Festival (Forskningens Døgn), Copen-

hagen Culture Night, the Peoples Political Festival at Bornholm, Cph DOX and the Bloom festival did not take place in 2020, CEHA scientists have tried to find ways to stay in touch with the general public and other stakeholders.

Within CEHA and with other departments at the University of Copenhagen, meetings and workshops have been held to narrow down challenges and form ideas for future outreach projects based on interdisciplinary research and including different angles on potential solutions. Some have been defined and send as applications for further funding, some are formed as discussion papers and visionary proposals for further investigation.

A concrete example is educational material and a book on biological aging targeted to high school students, as part of the A-level curriculum on with biology and biotechnology. This book will be published by Gyldendal in the spring of 2021.

Another more substantial example is a partner-driven three-year outreach-project called "From Worklife to Retirement" (described on page 26), formed and carried out in close collaboration with Vordingborg, Vejle and Aarhus municipalities with the aim to secure a good and conscious transition for citizens with no or short educational background.

National arena for stronger collaboration

Through 2020 Center for Healthy Aging has taken initiative to investigate opportunities to form a new national and partner driven platform to conduct basic aging research and application-oriented research that meets societal needs. A series of meetings were held with CEOs and management in organizations, pension companies, and government agencies that provide services to the elderly. For example, the National Association of Municipalities (KL) and Danish Regions and selected patient organizations and municipal decision-makers have expressed a need and openness to form new mutually important areas for further collaboration. Several funds have also been approached about forming a patient- and citizen-oriented alliance on aging. The response has been very positive so far. The Center is also seeking dialogue with other Danish universities and will intensify this effort in the coming year. Our goal is to formulate a clear path forward, stronger collaborations, and a mutual vision for all of Denmark, to become the best country in the world in which to grow old, whether you are an actively-employed elder citizen, a patient, an employer or a pensioner.

Messaging *active aging* through media

In close collaboration with the communication department at the Faculty of Health and Medical Sciences, the Center has continued to facilitate and build bridges between researchers and journalists. New research results are regularly disseminated to the public, using the mainstream media and through internal channels at the university. Due to the Center's reputation and prominence, Danish and international journalists seek us out for inspiration and assistance, and to make contact with scientists who have the most up-to-date information on aging-related issues and concerns. Similar to earlier years, in 2020, the Center was featured and garnered high profile coverage in local Danish newspapers, radio programs, TV and other media targeting health professionals.

INTERNATIONALIZATION AND NETWORKING

The Center for Healthy Aging collaborates actively with institutions and networks in Denmark and around the world. These collaborations increase visibility and awareness of the Center and play a key role in strategic recruitment at all levels. Below, we describe some of these collaborations.

IARU – International research cooperation

The Center for Healthy Aging is closely linked with the prestigious International Alliance of Research Universities (IARU, www.iaruni.org), an important alliance in which the University of Copenhagen participates. The association between Center for Healthy Aging and IARU is a cornerstone in the efforts to internationalize the Center, and is a valuable networking opportunity for members of the Center. IARU and the Center regularly arrange joint meetings and workshops and IARU is a forum for enhancing collaboration and promoting future research activities that involve IARU member universities. One example is the joint research initiative IARU Aging, Longevity & Health (ALH). The other IARU members are Australian National University, ETH Zurich, National University of Singapore, Peking University, University of California, Berkeley, University of Cambridge, University of Cape Town, University of Oxford, University of Tokyo, and Yale University.

As part of the IARU cooperation, Center for Healthy Aging also hosts an annual summer course on *Interdisciplinary Aspects of Healthy Aging* (see "IARU Summer School – Interdisciplinary Aspects of Healthy Aging", pp. 42). Unfortunately, the Summer School was canceled in 2020 due to CV-19.

IARU Aging, Longevity & Health network

Since 2014, the ALH initiative has been led by a Steering Committee. The aim is to increase engagement across IARU campuses and to promote joint activities and funding opportunities for IARU ALH participants within the international aging research community. The Committee intends to meet once per year and was chaired by University of Oxford until fall 2019. Professor Nicolas Cherbuin from Australian National University (ANU) was recently appointed Chair of the Committee for the 2019-2021 period. The Committee members in 2020 were:

- Prof. Lene Juel Rasmussen, University of Copenhagen
- Prof. Nicolas Cherbuin, Australian National University (current chair)
- Prof. Angelique Chan, National University of Singapore
- Prof. Katsuya Liijima, The University of Tokyo
- Dr. Louise Lafortune, University of Cambridge
- Prof. Sarah Harper, University of Oxford
- Prof. David Lindeman, University of California, Berkeley
- Prof. Xiaoying Zheng, Peking University
- Dr. Sebastiana Kalula, University of Cape Town

On 29 October to 1 November 2019, ANU hosted the 6th ALH Steering Committee Research Meeting in Canberra, at which time ANU assumed chairmanship of the ALH Steering Committee. In addition, a number of initiatives and goals were discussed. These included 1) identifying an impactful journal for publishing a IARU research paper; 2) the need for a document on the importance of interdisciplinary international collaborations on aging-related topics; and 3) the need for a leaflet outlining IARU activities, targeting stakeholders.

In addition to the ALH Steering Committee Research Meeting, four symposia sessions featuring 12 ANU and national speakers were held covering four themes: Chronic Disease, Brain Aging, Cognitive Decline, & Longevity; Work, Retirement & Health; Aging in Asia; and Mental Health & Wellbeing. The symposia were attended by more than 150 delegates, including senior staff from government departments.

Detailed information on IARU ALH can be found at www.iaruni.org/research-initiatives/aging.

New IARU online course in Sustainable Aging

In 2020, the Center for Healthy Aging initiated a new IARU collaboration together with The University of Tokyo: Sustainable Aging – An online IARU course. In the fall of 2020, CEHA received financial support from the University of Copenhagen and IARU to offer this graduate course during week 15, 12-16 April 2021.

The focus of the course is: What is sustainable aging, what shapes it, how do we move towards realizing the goal of healthy lives and well-being during old age for all, and what can we learn by taking a global, comparative approach to this challenge? Students from universities that are not IARU members are eligible for the course. All IARU universities are encouraged to send lecturers and speakers to participate in the course. The course is listed on

the IARU and CEHA website, and will be announced on other relevant websites and through other media channels.

EIT Health

In 2014, the European Institute of Innovation and Technology (EIT) launched a call for Knowledge and Innovation Communities (KICs), as part of the larger European Union (EU) research initiative, Horizon 2020. The aim of KICs is to encourage stakeholders in education, technology, research, business, and entrepreneurship to establish excellence-driven partnerships and provide innovative solutions to tackle the grand challenges (health, climate, bio economy, etc.) facing the EU. The winning consortium – EIT Health – today consists of more than 60 core partners (plus approximately 80 associate partners). These include leading businesses, public partners, research centers, and universities from 14 EU countries (including University of Copenhagen). At the University of Copenhagen, Center for Healthy Aging is a central player.

The goal of EIT Health is to promote entrepreneurship and develop innovations in healthy living and active aging, providing Europe with new opportunities and resources to improve quality of life and healthcare. This will be achieved by delivering products, services, and concepts designed to improve quality of life and contribute to the sustainability of healthcare across the EU. EIT Health revolves around three programmes: 1) *Accelerator* for business development, 2) *Campus* for education, and 3) *Innovation Projects* to support new ideas. Since the launch of EIT Health, Center for Healthy Aging has been involved in several activities in the *Campus Programme*.

PhD programme on aging

During 2020, Center for Healthy Aging has been part of a pan-European doctoral programme, Epidemiology of Ageing and Dementia Prevention, PhD Label (EpiDEMPrev), that brings together an EIT Health consortium consisting of academic and non-academic partners. This programme will train a new generation of PhD-level specialists in gerontology, neuroscience, and epidemiology, with the goal of establishing competencies in innovation and entrepreneurship.

As part of the doctoral programme, the Center offered an online PhD course on the methodology of ageing research. The course included in-depth lectures from international renowned experts on molecular and cellular processes of ageing: *Why do we age – Molecular models of ageing*, and was led by associate professor, Claus Desler.

The course was a great success. Nine PhD students from partner universities and 11 PhD students from Danish and Scandinavian universities participated in the course, which took place from 25-27 May 2020. For more information, visit the PhD programme page on the EIT Health website at the following URL: eithealth.eu/project/eit-health-ageing-phd-school

Networks on aging research
Alliance of Healthy Aging (AHA)

Center for Healthy Aging is a member of the Alliance for Healthy Aging, a partnership of the Mayo Clinic Robert and Arlene Kogod Center on Aging, the University Medical Center Groningen and the Newcastle University Institute for Ageing. The Alliance holds annual meetings dedicated to translational research on aging. The objective is to bring together scientists, clinicians and engineers, and to provide a forum for the exchange of ideas.

MouseAge

To ensure rapid progress, suitable mouse models are needed for basic preclinical studies on aging and for testing interventions for age-related pathologies. Coordinated interdisciplinary action is needed to standardize methodologies and guidelines for testing and evaluating interventions in mice, to protect animal welfare, and to define endpoints. A centralized model for storing and disseminating information about these models and technologies is also needed. Accordingly, MouseAge – in which Center for Healthy Aging participates – was launched in 2014 as a European COST Action network for preclinical testing of interventions in mouse models of aging and age-related diseases. This Action proposes to set-up a highly interactive and flexible European network of scientists with diverse expertise, clinicians, and industrial partners, who will be tasked to reach consensus around standardization for testing preclinical interventions in mice. MouseAge will also consolidate information on best practices across leading European institutions and laboratories, maximize efficiency, and provide a platform to help train the next generation of scientists. More information at mouseage.org.

Facing the challenge of an aging population with Groningen

The Faculty of Health and Medical Sciences at the University of Copenhagen and the Faculty of Medical Sciences at the University of Groningen signed a Memorandum of Understanding (MoU) in August 2019, creating opportunities for stronger collaboration on aging research, involving education and exchange of students between the two institutions.

The new agreement paves the way for more cooperation at the university and center levels. In fact, the agreement is primarily based on an already existing collaboration on biological aging involving researchers from Center for Healthy Aging. During the last 10 years, the Center has worked closely with the University of Groningen. The challenge of an aging population is to a great extent the same across borders, which is why international collaboration and knowledge-sharing are especially important in the field of aging. This collaboration emphasizes outreach and dissemination. In future, there are plans to expand the partnership to fields other than aging.

Collaboration in research on aging with Birmingham

In 2019, Center for Healthy Aging laid the foundation for increased cooperation with the well-recognized aging center at the University of Birmingham, MRC Arthritis Research UK Centre for Musculoskeletal Ageing Research. The two centers will conduct cutting edge research in the field of aging, building on their complementary and highly-skilled competencies and expertise in aging research. The strong synergies between the two aging research programs are expected to result in productive research collaborations. Joint PhD courses and a student exchange program are also being discussed.

INTERNATIONAL AND NATIONAL COLLABORATION

Research collaborations

Center for Healthy Aging has an active collaboration with the National Institute on Aging at National Institutes of Health (NIH/NIA) via Professor Vilhelm Bohr, who is a group leader in track III. Professor Bohr has been instrumental in the establishment of Center for Healthy Aging. The close collaboration with Professor Bohr has enhanced the Center's ability to recruit accomplished scientists to the Center over many years, such as Professors Ian Hickson and Linda Bergersen and Associate Professor Morten Scheibye-Knudsen. The association with Professor Bohr also increased CEHA's access to infrastructure at the NIH/NIA.

Within Denmark, Center for Healthy Aging's researchers collaborate closely with research groups at the Novo Nordisk Foundation Center for Protein Research and the Novo Nordisk Foundation Center for Basic Metabolic Research, University of Copenhagen.

Furthermore, Karsten Vrangbæk heads the Center for Health Economics and Policy (CHEP) at University of Copenhagen and is part of the steering group for Copenhagen Center for Regulatory Science at University of Copenhagen.

Center for Healthy Aging researchers also have multiple collaborations with clinical departments at several Danish hospitals in the Greater Copenhagen area. These collaborations are crucial for the success of several Center for Healthy Aging projects, such as LISA and LIFESTAT. See "Intervention studies and interdisciplinary projects", pp. 25 and 28 for details.

The Center's researchers also have strong collaborations with Danish Universities. Internationally, research collaborations have been established at the following universities and networks:

- Medical University of Bialystok, Poland
- Oroboros Instruments, Innsbruck, Austria
- Department of Medical Physiology, Faculty of Medicine, University of Granada, Granada, Spain
- Medical Faculty Uppsala University, Sweden
- University of Barcelona
- University of Salzburg
- University of Nottingham
- European College of Sport Science
- Charles University, Prague
- Institute of Health and Medical Research, France
- The Mayo Clinic, USA
- Contestation of Health and Wellbeing in the Nordic Countries, Network with University of Turku, Umeå University and University of Oslo
- Usher Institute of Population Health Sciences and Informatics, Univeristy of Edinburgh
- GEREC, University of Tampere, Finland
- RUBICON, EU supported exchange of Ph.D. students
- Chromavision, EU founded research network
- RIBBDD, Research Initiative on Brain Barriers and Drug Delivery
- The Brain Initiative
- The Norwegian Centre on Healthy Ageing (No-Age)

Stakeholder networks

Center for Healthy Aging researchers are represented in and provide expertise to a wide range of stakeholder networks. Examples are:

- The Danish Cancer Society's Scientific Committee – Biology & Clinic (KBVU-BK) Committee *(Lene Juel Rasmussen)*
- Vice Chair of Clinical Academic Group (CAG), Advisory body *(Lene Juel Rasmussen)*
- Associate to Centre for Ageing Research and Education, Duke-NUS Medical School, Singapore, Advisory body *(Lene Juel Rasmussen)*
- Executive Advisory Committee Mayo Clinic Robert and Arlene Kogod Center on Aging, Advisory body *(Lene Juel Rasmussen)*
- Honorary Professor at Deakin University, Melbourne, Australia Advisory body *(Lene Juel Rasmussen)*
- Elected member of The Norwegian Academy of Science and Letters. Advisory body *(Lene Juel Rasmussen)*
- Editorial Board member of the journal Mitochondrion, Board member *(Lene Juel Rasmussen)*
- The Danish Society for Molecular Medicine (DK), Board member *(Lene Juel Rasmussen)*
- International Alliance of Research Universities (IARU), Steering committee *(Lene Juel Rasmussen)*
- Qiushi Visiting Professor at Zhejiang University, Hangzhou, China, Advisory body and mentor *(Ian Hickson)*
- The Lundbeck Foundation Research Initiative on Brain Barriers and Drug Delivery, University of Copenhagen, Director *(Martin Johannes Lauritzen)*
- Committee for Neurology and Clinical Neurophysiology,

Copenhagen, Capital region of Denmark, Member of board of directors *(Martin Johannes Lauritzen)*
- COSBID, a large multi-centre study of the importance of brain injury depolarization for the outcome of patients with trauma, haemorrhage and stroke, Founding member of the steering committee *(Martin Johannes Lauritzen)*
- IBS Centre for Neuroscience Imaging Research, Sungkyunkwan University, South Korea, International Scientific Advisory board member *(Martin Johannes Lauritzen)*
- Max-Planck Institute for Cognitive Neuroscience, Leipzig, International Scientific advisory board member *(Martin Johannes Lauritzen)*
- Journal of Cerebral Blood Flow & Metabolism, Consulting Editor *(Martin Johannes Lauritzen)*
- Academia Europaea, Member *(Martin Johannes Lauritzen)*
- The Longevity Vision Fund, Advisory board member *(Morten Scheibye-Knudsen)*
- Frontiers in Aging, Chief editor *(Morten Scheibye-Knudsen)*
- Deep Longevity Inc. Advisory board member *(Morten Scheibye-Knudsen)*
- Lundbeck Foundation, Member of executive board and research board *(Michael Kjær)*
- Helsefonden, Member of research board *(Michael Kjær)*
- Weimann foundation, Head of research board *(Michael Kjær)*
- Journal "Translational Sports Medicine", Wiley, Editor in chief *(Michael Kjær)*
- Portuguese Research Foundation, Participant in the evaluation panel for research grants *(Andres Lopez-Contreras)*
- Danish Cancer Society, Member of the scientific committee *(Maria Kristiansen)*
- Fonden Ensomme Gamles Værn (the EGV Foundation), Board member *(Maria Kristiansen)*
- Danish Heart Foundation, Scientific committee *(Maria Kristiansen)*
- Norwegian Cancer Society, Member of assessment committee *(Karsten Vrangbæk)*
- Geronotolgy Research Center (GEREC) at University of Tampere, Scientific advisory board *(Rikke Lund)*
- The international socio-gerontechnology network, Founding board member *(Nete Schwennesen)*
- 'LIVSTEGN: Overvågningsteknologier for et trygt og værdigt liv med demens', Advisory board member *(Nete Schwennesen)*
- Safety technologies for people with cognitive disabilities, Danish social board, Advisory board member *(Nete Schwennesen)*
- Proactive Care for the Elderly with Dementia (PACE), Innovation Fund Denmark, Advisory board member *(Nete Schwennesen)*
- Center for Elder Care and Dignity, Danish Board of Health, Advisory board member *(Nete Schwennesen)*
- ECSS Executive Board, currently President elect *(Jørn Wulff Helge)*
- Arla Food for Health (stopped by end of October 2020), Member of steering committee *(Jørn Wulff Helge)*
- BBH Center for Translational Research, Member of board *(Jørn Wulff Helge)*
- BMI Institute Leadership Team, Member *(Jørn Wulff Helge)*
- AXA Research Fund, President of scientific board *(Tom Kirkwood)*
- McMaster Institute for Research on Aging, International scientific advisory board *(Tom Kirkwood)*
- University of Toulouse, INSPIRE program, International scientific advisory board *(Tom Kirkwood)*
- Charles University, Prague, Czech Republic, International scientific advisory board *(Flemming Dela)*
- European College of Sport Science, Chairman of scientific board and committee *(Flemming Dela)*
- CopenAge, Co-founder and board member *(Flemming Dela)*
- Physical activity and sport in clinical medicine, impact, Co-chair, clinical academic group *(Flemming Dela)*
- Academy of Finland, Center of Excellence program, Panel member *(Flemming Dela)*

Collaboration with municipalities

Much of Center for Healthy Aging's research depends on dialog with citizens and health professionals who work with citizens in the municipalities. Therefore, municipalities are important collaborative partners for the Center, given their political influence and administrative responsibility in societal areas relevant to health and aging. In 2020, CEHA initiated a series of visits and dialogues focused on strategic and innovative solutions to meet citizens- and patient centered needs (e.g. Herlev, Holbæk, Frederiksberg, Municipalites together with KL and the Danish Regions).

The Center's researchers collaborate on research projects with the following municipalities:

- Copenhagen Municipality, Researcher (Nete Schwennesen, Maria Kristiansen)
- Ærø Municipality, Researcher (Line Hillersdal)
- Åbenrå Municipality, Researcher (Nete Schwennsen)
- Vordingborg, Vejle and Aarhus Municipality are involved in a partner driven outreach-project (Anéh Christina Hajdu, Astrid Jespersen)

The following are examples of collaborations involving Center researchers and Danish municipalities.

Stay CONNECTed; Digital technologies and rehabilitation in Danish dementia care

The aim of this project is to investigate ethnographically the digitalization of dementia care. The point of departure is the implementation of new digital technologies, such as surveillance, communication and sensory technologies, and the use of qualitative methods such as participant observations and interviews. The goal is to explore how these technologies shape care, relationships and human life in general. The project is implemented in home care settings and nursing homes in close collaboration with project partners. The project runs from 2018-2020 and partners include the Danish Alzheimer Society, Copenhagen Municipality and Åbenrå Municipality, and is funded by the Velux Foundation.

From Worklife to Retirement: An outreach-project developed and driven in a partnership between three municipalities and CEHA.

Based on scientific results and findings from past research projects, this partner-driven project will gather knowledge and develop concepts and models to support citizens during the transition from an active work life to an active retirement. The project is carried out in close collaboration and dialogue with the citizens of Vordingborg, Vejle and Aarhus municipalities.


VALUE PROP


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EDUCATIONAL ACTIVITIES

The Center for Healthy Aging emphasizes education of the next generation of aging researchers. To this end, the Center provides the highest quality educational resources to students and young scientist trainees, and makes concerted effort to recruit top notch junior and senior scientists, whose research interests align with our research goals and philosophy. As described above, undergraduate and graduate level courses on aging are offered and there are many opportunities for postdoctoral studies under the mentorship of the Center faculty.

PhD dissertations

Below, examples of dissertations from the three tracks are described. Complete lists of dissertations are available at pp. 15, 17 and 21.

Cell-specific interrogation of local blood flow, oxygen consumption and gamma activity in whisker barrel cortex with age.

Matilda Dahlquist, Track 1, 2020

This PhD thesis examined the role of parvalbumine (PV) fast-spiking interneurons and pyramidal cells for brain electrical activity, blood flow and oxygen metabolism using optogenetic techniques in transgenic adult and aged mice. We report that the brain's ability to generate network activity at high frequencies is decreased in aged mice, but this is not due to reduced responsivity of interneurons and pyramidal cell or a change of their properties but related to other features of synaptic transmission. The study also revealed that local rises in brain oxygen use was related to excitation of neuron and not to the network activity that they generated. Lastly, we report that synchronisation of PV interneurons may restore gamma activity from old to adult levels, in support of the viewpoint that the brain activity that underlies cognitive tasks may be facilitated by mental training.

Social inequality in cognitive ageing

Else Foverskov, Track II, 2020

The aim of this thesis was to advance our understanding of social inequality in cognitive ageing, primarily by clarifying the role of early cognitive ability as a potential confounder. The findings support the existence of social inequality in later life level, change and pathological change of cognitive ability. Concurrently, the findings suggest that the effect of social indicators on the level of later life cognitive ability and dementia will be exaggerated without adjustment for early life cognitive ability.

No dissertations completed for Track III in 2020.

PhD courses

Center for Healthy Aging researchers also taught or contributed to several PhD courses:

- *Aging from a cross disciplinary perspective* (2.4 ECTS), organized by the PhD Academy for Interdisciplinary Aging Research (PAIAR), UCPH, 2-4 December 2020. Course directors: Claus Desler (Track I), Jakob Agergaard (Track I), and Sasmita Kusumastuti (Track III) Lectures delivered by senior and junior researchers from all research tracks (Tracks I-III)
- *The good scientific presentation – From attractive posters to inspiring talks*, UCPH, 4-6 March and 5-7 October 2020 (bi-annual course). Course director: Claus Desler (Track I)
- *Why do we age? Molecular and cellular models of ageing*, UCPH, 25-27 May 2020. Course director: Claus Desler (Track 1)
- *Immunometabolism, from bench to bedside*, University of Copenhagen, 14-16 September 2020. Course director: Claus Desler (Track 1)
- Lecture on theories in migration (3.9 ECTS), organized by MESU (Research Center for Migration, Ethnicity and Health), UCPH, 24-28 February 2020.

Post graduate level

- *Muscle injury*, Post-graduate course for MD's on Sports Orthopedics and Sports Medicine, Danish Medical Doctors Organization (DADL), Copenhagen, May 2020, Michael Kjær (Track I)
- *Job seeking in hospitals after phd, PhD course "After the phd?"*, Faculty of Health and Medical Sciences, University of Copenhagen, April, May and Nov 2020, Michael Kjær (Track I)
- Motion i reumatoloisk perspektiv og Idrætsmedicin, Resident course in Rheumatology, Aalborg, Oct 2020, Michael Kjær (Track I)

Master level

- Module leader of and teacher at Master of Neuroscience Course: Cells and Circuits, autumn 2020.
- Molecular Biomedicine Master Course *'Cell cycle'*, UCPH, October 2020 (3 hours). Ian Hickson (Track I)

- Human Biology Master Course, UCPH, September 2020 (3 hours). Ian Hickson (Track I)
- *Targeting DNA repair for Aging Interventions*. Biology of Aging course at the University of Lethbridge, Canada. November 2020. Morten Scheibye-Knudsen (Track I)
- IARU summer school *Interdisciplinary Aspects of Healthy Aging* (5 ECTS), UCPH, 1-19 July 2020. Course directors: Rudi Westendorp (Track III), Claus Desler (Track I), Maarten Rozing (Track I), and Maria Kristiansen (Track II). Lectures delivered by senior and junior researchers from all research tracks (Tracks I-III). – (Partly cancelled due to CV-19)
- *Elective course on gerontology*, MSc Medicine and MSc Public Health, University of Copenhagen. Charlotte Juul Nilsson (Track II).
- Lecture on life course health and ageing. MSc Medicine course on Statistics, Epidemiology and Medical Sociology. Rikke Lund (Track II).
- Master Course, Science of behavior Change. Lectures deleivered by Marco Piovesan (Track II)
- Course on *Statistics, Epidemiology and Medical sociology* (SEMS), Msc Medicine, University of Copenhagen, course leadership, lectures and class teaching Rikke Lund and Charlotte Juul Nilsson and 2020 (Track II)
- Supervision of Master dissertations (Political Science) with a focus on Management of Nursing Homes and Long term effects of Cancer treatment. Karsten Vrangbæk (Track II).
- Supervision of several master projects (BSc and Msc Medicine and BSc and MSc Public Health) Rikke Lund and Charlotte Juul Nilsson (Track II)
- Supervision of three Master theses (Medicine) with a focus on Social Adversities and aging, and aging in a vulnerable population of older people. Rikke Lund (Track II).
- Supervision of 5 Master students and 7 internships focusing on diversity-sensitive healthcare for older patients, multi-morbidity, and migration and aging. Maria Kristiansen (Track II).
- Supervision of three Master students on individual preferences, retirement and health, and experts' forecasts of RCT results, Sarah Zaccagni (Track II)

Center for Healthy Aging perspectives have also been integrated into several graduate level courses, e.g. *Health systems and innovation* at the joint UCPH/CBS Innovation in Health Care master program and the course *Health systems and the Nordic Welfare State* at Department of Political Science, UCPH.

Pre graduate level

- Teaching in the course: *Clinical Course on Neurology and Neurosurgery* for 10th semester medical students (Track I)
- Teaching in the course: *Structure and function of the central nervous system* for 3rd semester medical students (Track I)
- *Gross Medical Anatomy*, Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, spring and fall semester 2020. Morten Scheibye-Knudsen (Track I)
- *Energiomsætning*, 4th semester), Medicine, Faculty of Health and Medical Sciences, University of Copenhagen, June 2020, Michael Kjær (Track I)
- *Fysisk aktivitet og inaktivitet, Inaktivitet og sygdomsudvikling, og Kroniske sygdomme og Fysisk træning*, Cand.scient.san, Faculty of Health and Medical Sciences, University of Copenhagen, Nov 2020, Michael Kjær (Track I)
- *Health and wine*, LIFE, Faculty of Science, Univ of Copenhagen, Sept 2020, Michael Kjær (Track I)
- *Kroiniske sygdomme & Fysisk træning* – Bevægeapparatet, Human Physiology, 8. semester, Faculty of Science, University Copenhagen, March 2020, Michael Kjær (Track I)
- *Ethical dilemmas within Medicine* – Doctors role viewed in Film and Litterature, 11.sem, Medicine (40 hour, head of course), Faculty of Health and Medical Sciences, University of Copenhagen, feb-may and sept-dec 2020, Michael Kjær (Track I)
- *Film and medical ethics*, Course on Narrative Medicine, 2.sem, Faculty of Medicine, University of Southern Denmark, Odense, Oct 2020, Michael Kjær (Track I)
- *Cell and Tissue Biology* (10 ECTS). 3rd semester students from DTU and KU. Organized by Simon Bekker-Jensen (Track I). Lectures delivered (among others) by Simon Bekker-Jensen (Track I) and Claus Desler (Track I). Teaching provided by Melanie Blasius (Track I) and Anna Constance Vind (Track I) [approximately 75 students]
- *Matrix Biology course*, Faculty of Health and Medical Science, University of Copenhagen, Chloé Yeung and Costanza Montagna (Track I)
- Supervision of several bachelor projects (BSc and and BSc and Health) Rikke Lund and Charlotte Juul Nilsson (Track II)
- Supervision of three BA students on individual preferences, retirement and health, and experts' forecasts of RCT results. Sarah Zaccagni (Track II)
- *Energy and Exercise Physiology*, Medicine, 4th semester. Course leadership (Track III).
- Life style exercise (in Danish Livsstilsøvelse, energiomsætningsøvelse) (Track III).
- Supervision of several students from: Sports Science, Public Health, Human Biology, Medicine, Biomedicine and international students from Gothenburg University (Track III)

Center for Healthy Aging researchers also supervise master and bachelor level students who are affiliated with various departments at the University of Copenhagen.

Other dissemination activities

- Lecture at Folkeuniversitetet. *Hjernens aldring – kan den påvirkes af det, vi spiser?* 15 September 2020. Speaker: Morten Scheibye-Knudsen (Track I)
- Lecture at Folkeuniversitetet. *Hjernens aldring – kan den påvirkes af det, vi spiser?* 17 November 2020. Speaker: Morten Scheibye-Knudsen (Track I)
- Lecture at Folkeuniversitetet. *Hjernens aldring – kan den påvirkes af det, vi spiser?* 24 November 2020. Speaker: Morten Scheibye-Knudsen (Track I)
- Karsten Vrangbæk has delivered a presentation in KL's livestream-serie: "Livssituationer og overgange i alderdommen" on October 28
- Karsten Vrangbæk has presented at internal dialogue meetings with Pension Denmark and PKA
- Online lecture and animation for WHO International platform on aging in the context of migration, winter 2020. Maria Kristiansen (Track II)
- Maria Kristiansen, in collaboration with the Health and Happiness Foundation, hosted a webinar panel debate on "Making digital work for older citizens" under the 75th UN General Assembly virtual events, fall 2020 (www.youtube.com/watch?v=wUCC3em7WOA)
- During the lockdown, the online outreach and speaker forum SpeakerBee, by Lars Seier Christensen, was initiated. Maria Kristiansen presented on "Hvad sker der derinde på sygehuset",

summer 2020. (speakerbee.dk/watch?v=Y2ctTPmtT1)

- Maria Kristiansen published a blog article in Kommunal Sundhed, fall 2020, reporting on practice implications of a study into older survivors of cardiac arrest
- Maria Kristiansen published an article on rehabilitation services for people living with Parkinson Disease in the magazine Parkinson Nyt, summer 2020.
- Lecture on compassionate care, speciallægeuddannelsen in obstetrics and gynaecology, Spring and fall 2020. Maria Kristiansen (Track II).
- Presentation of the results of the RCT on CV-19 to the panel of experts working for the Danish Ministry of Health. Sarah Zaccagni (Track II)
- Interview published on Weekendavisen ("Samfunds sind eller egotrip?", May 2020). Sarah Zaccagni (Track II)
- Karsten Vrangbæk has appeared in TV and radio interviews and has contributed with interviews to a number of newspaper articles.
- Presentation; Sårbare ældre, sociale relationer og teknologisk innovation i en Coronatid at the: Administrative board meeting, Region of Southern Denmark. 1 December, 2020. Kristina Grünenberg
- Presentation at public webinar: 'Kunsten at røre gennem en skærm – En samtale om nærvær og relationer i digitale rammer' 8 October 2020. Organized by DJØF og The faculty of Social Science, University of Copenhagen. Line Hillersdal
- Hillerdal and Schwennesen: Networks established, multiple meetings held and funding applications formulated with key stakeholders (Copenhagen Municipality, Ærø Municipality; Health Innovation Southern Denmark: Healthcare Denmark; Korea Aging Friendly Industry (Busan, South Korea); Innovation Center Denmark (Danish Embassy) Seoul, South Korea; Department of Rehabilitative & Assistive Technology, National Rehabilitation Research Institute, Seoul, South Korea.
- Grünenberg was affiliated to the international interdisciplinary research network; Materialities of Care, Coordinated by the University of York. UK.
- New contacts established with stakeholders; Frederiksberg municipality and Gladsaxe municipality.
- Schwennesen held three keynote presentations: 'Digital entanglements and fragile connections in dementia care work in Denmark' at the international symposium 'Ethical aspects of digital solutions in nursing care. An interdisciplinary and cross-sectoral dialogue', Heidelberg Faculty of Medicine (September 2020). 'The vital materialism of remote monitoring in physical rehabilitation', at the international online symposium 'Materialities of Age and Ageing: Discussions at the intersection of age studies and science and technology studies' (July 2019). 'Antropologiske perspektiver på teknologi og overvågning', at the Danish Board for safety Technologies, (May 2020)
- Schwennesen has contributed to the report: 'Forskning i praksis – erfaringer fra forskning med brugerinddragelse og forskning i samarbejde med kommuner og almen praksis, udgivet af Velux Fonden og Sektion for Tværsektoriel Forskning, 2020.
- Videnskab.dk. Contribution on measuring maximal oxygen uptake; www.youtube.com/watch?v=UB0R7w8BxTA
- Book. Football as Medicine against type 2 diabetes and metabolic syndrome. Editors, P. Krustrup and D. Parnell. Contribution Chapter 2; Maysa Vieira de Sousa, João Brito, Magni Mohr, George a Nassis, Jørn Wulff Helge, Svein Arne Pettersen, Thomas Rostgaard Andersen and Peter Krustrup. Football as medicine against type 2 diabetes and metabolic syndrome. Page 25-40. Routledge, Taylor & Francis Group. Jan, 2020.
- Podcast about Endurance training by Dr. Fitness aka. Anders Nedergaard. Released 29 February 2020.
- Lecture at Ubberup højskole 20/10 in relation to collaboration on experiments.
- Contribution to Patient Innovation Bootcamp: Boosting Patient Entrepreneurship together with Copenhagen Business School (EIT health ID: 20405, 40 participants), Rudi GJ Westendorp (Track III)
- Contributing to Executive MBA program, Imperial College, London, UK (EIT health, 25 participants), Rudi GJ Westendorp (Track III)
- Interviewed for the Morgan Stanley podcast, "Now, What's Next?", discussing the sociocultural implications of the CV-19 pandemic, and how it may affect mental health, social relationships, and the world around us – podcasts.apple.com/us/podcast/now-whats-next/id1246402780
- AAGE/Somatosphere blog post, "As visiting restrictions continue, elders in Danish plejehjem are experiencing a 'stolen spring'" – anthropologyandgerontology.com/as-visiting-restrictions-continue-elders-in-danish-plejehjem-are-experiencing-a-stolen-spring
- Article in *Faglige Seniorer*, "Researchers: Corona has given older people worries and poorer quality of life"
- Article in *Kommunal Sundhed*, "A stolen spring shows that the elderly should have social contact and not live in loneliness" – kommunalsundhed.dk/et-forsoemt-foraar-viser-at-aeldre-skal-have-social-kontakt-og-ikke-leve-i-ensomhed
- Article in *Altinget*, "Center for Healthy Aging: The government overlooks older people's right to self-determination" – www.altinget.dk/aeldre/artikel/center-for-sund-aldring-regeringen-overser-aeldres-ret-til-selvbestemmelse?fbclid=IwAR08tpcois5XoTQwmZY2_v4cjmS-8pN-LPlI3H4a-cIGC33itdebgnBiG3E
- Article in *Altinget*, "Professors: Corona fatigue is occurring within the population" – www.altinget.dk/sundhed/artikel/professorer-coronaudmattelse-melder-sig-i-befolkningen?fbclid=IwAR3BSpbyc6LSupF816TWiDpeO5CQq4-YbsECWd-NDLpb-OFJjXReb7FLOVKI
- UCL Medical Anthropology blog post, "Viral solidarity and the reinvention of a welfare state: Reflections from Denmark" – medanthucl.com/2020/04/09/viral-solidarity-and-the-reinvention-of-a-welfare-state-reflections-from-denmark/?fbclid=IwAR2L94PLjRjT9_qkHUi4o1jXNMwVjnVnLqaruBGmGW-d1R5d-5S6stf9OxrU
- Interviewed about survey results from the 'Standing together' project, which indicated that people between the ages of 65–85 reported being less lonely during the lockdown than the general population:
  - DR Radioavisen – www.dr.dk/radio/p4/radioavisen/radioavisen-2020-04-18-10-00
  - Jyllands-Posten Indland – jyllands-posten.dk/indland/ECE12083995/aeldre-er-mindre-ensomme-end-befolkningen-som-helhed-i-coronatiden

RESEARCH TRAINING AND DISSEMINATION ACTIVITIES

IARU Summer School – Interdisciplinary Aspects of Healthy Aging

The IARU Summer School – Interdisciplinary Aspects of Healthy Aging was cancelled in 2020 due to CV-19.

Center for Healthy Aging hosted the 9th annual summer course on *Interdisciplinary Aspects of Healthy Aging* taking place from 1-19 July 2019 at the University of Copenhagen. The summer course provides students with the opportunity to explore diverse research methods across different disciplines and to work with students from all over the world. Summer school courses emphasize interdisciplinary knowledge and approach and provide an opportunity for research experience in the field of aging. At the end of the summer school session, students write a grant application under the supervision of the course faculty. This requires use and/or consideration of interdisciplinary research methods and provides hands-on experience with the process of developing a research program/agenda that addresses critical questions or problems in study and understanding of aging.

This year, the course faculty consisted of Professor Rudi Westendorp (Track III), Associate Professor Maarten Rozing (Track I), Associate Professor Claus Desler (Track I), and Associate Professor Maria Kristiansen (Track II). Together, they executed an interesting course programme, mainly with lecturers from Center for Healthy Aging but also with contributions from Professor Nicholas Cherbuin from Australian National University, Dr Marco Demaria and Associate Professor Jochen Mierau from University of Groningen, and Associate Professor Louise Lafortune from University of Cambridge.

The summer course is part of the IARU Courses initiative (previously known as the IARU Global Summer Program), and among the 26 participating students, 19 students represented the four IARU universities Australian National University, University of Tokyo, Peking University, and University of Copenhagen.

Network for Young Scholars

Network for Young Scholars (NYS) in Center for Healthy Aging is a network for all young researchers affiliated with the center. The vision is to build a platform for Research Assistants, PhD Students and postdocs to promote educational and research activities in the field of aging, and for social networking for these young scientists. In 2020, NYS arranged one *PI Lunch*, where young researchers met with the Center's affiliated Principal Investigators to discuss career development in an informal setting. Due to CV-19, NYS had to cancel the two scheduled *Research Pitch Battle X Friday Bar*, where contestants had planned to pitch their research in front of an audience. Typically, these events have relatively high numbers of participants and are attended by young researchers from across the three research tracks. In 2020, the NYS steering group had six members, including:

- PhD Student Anna Constance Vind (Track I)
- PhD Student Michael Ben Ezra (Track I)
- PhD Student Zhiquan Li (Track I)
- PhD Student Casper Søndenbroe (Track III)
- Research Assistant Sarah Zaccagni (Track II)
- Academic Officer Ida Marie Bergman Rasmussen (Secretariat)

More information can be found at healthyaging.ku.dk/education/network-for-young-scholars.

PhD Academy for Interdisciplinary Aging Research

Center for Healthy Aging's PhD Academy for Interdisciplinary Aging Research (PAIAR) aims to develop and organize high-level interdisciplinary PhD courses in the field of aging research. These courses are internationally-recognized. The intent is to strengthen the focus on aging research now and in the future. The courses primarily target the Center's PhD students, but are open to all students at the University of Copenhagen as well as students from other universities in Denmark or other countries. In 2020, the PAIAR steering group consisted of:

- Assoc. Professor Claus Desler (Track I)
- Postdoc Jakob Agergaard (Track I)
- Postdoc Sasmita Kusumastuti (Track III)
- Academic Officer Ida Marie Bergman Rasmussen (Secretariat)

More information can be found at healthyaging.ku.dk/education/phd-academy-paiar.

Workshops

In 2020, Center for Healthy Aging canceled all workshops in the Mærsk Tower due to CV-19.

Seminars and academic events

CEHA/BRIC seminars

Center for Healthy Aging hosts or co-hosts academic events to facilitate dissemination of data and promote discussion. Since 2014, Center for Healthy Aging and the Biotech Research & Innovation Centre (BRIC), University of Copenhagen, has organized a research seminar series on important topics in biological sciences. This seminar series features international speakers at the forefront of their respective fields, who present seminars on research and/or technologies that are having a major impact on biological and biomedical sciences. Approximately 50 participants usually attend these seminars, which are usually followed by small group discussions between guest speakers, PhD students and postdocs.

In 2020, BRIC/CEHA seminar speakers included:

- *Chromatin Dynamics: Histone variants and Chaperone*. Speaker: Geneviève Almouzni, CURIE Institute, France, 9 January 2020
- Dealing with DNA damage during the cell cycle. Speaker: Marcel Van Vugt, Medical Oncology Department, University Medical Centre Groningen, Netherlands, 16 January 2020
- Subversion of DNA damage responses by a stealth pathogen: The Typhoid mode. Speaker: Daniel Humphreys, Sheffield University, UK, 6 February 2020
- Cortical layer with no known function. Speaker: Zoltan Molnar, University of Oxford, UK, 14 February 2020
- "Tell me mirror what is wrong": pancreatic cancer and exocrine cell differentiation. Speaker: Ilse Rooman, Vrije Universiteit, Brussel, 5 March 2020

Selected scientific dissemination activities

- Martin Lauritzen (Track I): Neurovascular biology of capillary control. The Beijing Research Institute for Brain Disorders, January 2020. Cerebral blood flow in ageing. VasCog Virtual half-day meeting, 2020.
- Ian Hickson (Track I) Abcam Conference on 'Genetic Recombination', April, 2020
- Ian Hickson (Track I) University of Dundee, UK. 'How fragile sites maintain their stability in human cells', October, 2020
- Lene Juel Rasmussen (Track I): Metabolic control of DNA repair in age-related diseases, India, 2020, Virtual International Conference on Advances in Mitochondrial Medicine and Translational Research
- Lene Juel Rasmussen (Track I): Mitochondrial function in age-related diseases, London 2020, Virtual conference
- Lene Juel Rasmussen (Track I): "Healthy Brain Aging: understand the hallmarks of aging and intervene", Nansen lecture, Oslo 2020, Virtual conference
- Lene Juel Rasmussen (Track I): "Metabolic control of DNA repair in age-related diseases", Copenhagen 2020, The 7th Annual Aging Research and Drug Discovery Meeting
- Lene Juel Rasmussen (Track I): "Why we succeed", Oslo 2020, No-Age virtual conference
- Morten Scheibye-Knudsen (Track I) (Organizer): 7th Aging Research and Drug Discovery meeting (www.agingpharma.org), semi-virtual, >2200 participants, 65 speakers.
- Morten Scheibye-Knudsen (Track I): "Interventions for Premature Aging", Leiden University Medical Center, Netherlands
- Morten Scheibye-Knudsen (Track I): "Deep learned drugs for DNA repair", Pfizer, Boston, USA
- Morten Scheibye-Knudsen (Track I): "Accelerated Aging and the Quest for Interventions", NIH, USA
- Morten Scheibye-Knudsen (Track I): "Interventions for Healthy Aging", Groningen, Netherlands
- Simon Bekker-Jensen (Track I): "Cellular stress responses – signals, sensors and outcomes", seminar at University of Hamburg, 2020.
- Andres J Lopez-Contreras (Track I): Invited speaker at CABIMER International Workshop. Seville (Spain), 2020.
- Tendon loading and unloading: From physiology to pathology. Symposium at Scandinavian Congress for Sports Medicine. Copenhagen, Jan 31, 2020, Michael Kjær (Track I)
- Exercise and Clinical Physiology: The Copenhagen tradition. Saltin International Wedinar, Univ British Columbia, Vancouver, Canada, Oct 8, 2020, Michael Kjær (Track I)
- August Krogh Nobel Laureate: 100 years Anniversary. American Physiological Society, Integrated Physiology on Exercise, Austin, Texas, US, Oct 10, 2020, Michael Kjær (Track I)
- Cellular and molecular adaptation of tendon to exercise. American Physiological Society, Integrated Physiology on Exercise, Austin, Texas, US, Oct 12, 2020, Michael Kjær (Track I)
- August Krogh. Nobelprisen i 1920: Musklernes iltforsyning i hvile og under arbejde, August Krogh Symposium, Videnskabernes Selskab, København, Nov 21, 2020, Michael Kjær (Track I).
- Panel participant: Ældres digitale parathed, workshop arr. af Centre for Interaction Research and Communication Design, April 29th 2020, Line Hillersdal (Track II)
- Presentation: Ageing as a Risk Factor: Epistemic and Ethical Implications of Biomarkers of Aging and Age-related Disease, at the annual research seminar, UCPH and University of Wageningen collaboration in Amsterdam, Feb 2020, Line Hillersdal (Track II)
- Maria Kristiansen (Track II): Seminar with keynote on person centered care at the Mayo Clinic, March 2020
- National Board of Health presentation, January 2020 of life course research with a focus on social inequalities in ageing (Rikke Lund,track II)
- Rikke Lund (track II), workshop and separate oral presentation EUPHA/WPHC (World Public Health Conference) October 2020
- Panel; 'Caring for the Senses' organized for international VITAL conference (quality, vitality and health in the 21st century), Conference postponed until 2021, due to CV-19. Organised by Kristina Grünenberg, Line Hillersdal, Inge Kryger and Ida Winther Wenzel.
- Grünenberg was an invited speaker at the conference "Body Images", University of Konstanz, Jan. 2020.
- Schwennesen was a Panel convener (together with Daniel Lopez Gometz & Joanna Latimer) at the European Association of Science and Technology Studies (EAST) annual conference. Panel 73 'Growing old in a more-than-human world: Materialities of care and interspecies entanglements' (September 2020).

- Presentations at international conferences: Schwennesen presented (with Daniel Lopez Gometz). 'Interspecies entanglements and politics of relationship in care homes', at the European Association of Science and Technology Studies (EAST) annual conference (September 2020), McGahey presented 'Waiting for God: Living at the End of Life.' At the Irish Anthropological Association Annual Conference 26-27 November.
- Panel; 'Caring for the Senses' organized for international VITAL conference (quality, vitality and health in the 21st century), Conference postponed until 2021, due to CV-19.
- Hillersdal presented: "Affective spaces of doing sameness and difference together"/ panel: "Affects, emotions, and feelings in data, analysis, and narrative" for the 4S/EASST 2020, Prague (18.-21.08.2020) (Track II)
- Speaker, Scandinavian Sports Medicine Congress on 31 January 2020. "How high can we go? Limitations in the muscular oxidative capacity" in Symposium "VO2max – how high can we go?", Jørn W. Helge (Track III)
- Speaker, ECSS virtual meeting, 28 October 2020 at 9.25 CET. "Whole body and skeletal muscle maximal fat oxidation: biochemical theories and evidence" in symposium "Maximal Fat Oxidation: New Methodology, Insight, and Performance Relationships", Jørn W. Helge (Track III)
- Speaker, New York Academy of Sciences, New York, April 2020, Vilhelm A. Bohr (Track III)
- Speaker, Oslo University, Norway, March 2020, Vilhelm A. Bohr (Track III)
- Speaker, Salk Institute, San Diego, USA, February 2020, Vilhelm A. Bohr (Track III)
- Speaker, "Alpine skiing – cardio-metabolic health benefits?" Scandinavian Sports Sciences congress, Copenhagen, Denmark. 4.-6. Feb, 2020, Flemming Dela (Track III)
- Speaker: "Exercise and physical activity in aging T2DM patients – What can be achieved? And how?" ESC Preventive Cardiology 2020, Malaga, Spain, 2 – 4. April 2020, Flemming Dela (Track III)
- Shaping a predictor algorithm together with Trinity college Dublin, Ireland and Medtronic enterprise (EIT Health ID: 19131), Rudi GJ Westendorp (Track III)
- Member COVID advisory committee Sunhedstyrelsen, Copenhagen (April through July), Rudi GJ Westendorp (Track III)
- Advice on COVID for Ministry of Health, The Hague, Netherlands (May), Rudi GJ Westendorp (Track III)
- Advice for National Centre of Expertise for Long-term Care, Netherlands (Aug), Rudi GJ Westendorp (Track III)

Table 2. NUMBER OF INDIVIDUALS FROM VARIOUS CATEGORIES THAT WERE TRAINED (ONGOING) BY CENTER FOR HEALTHY AGING IN 2020

Pregraduate research / BA / MA students	59
Research assistants	14
PhD students	55
Postdocs	31

MAJOR GRANTS AND PRIZES

External funding

Table 3. ADDITIONAL FUNDING OBTAINED IN 2020, DKK
(excluding the Nordea-fonden grant)

FUNDED BY	FUNDING
European Union – Horizon 2020	2,200,000
Danish National Research Foundation	45,000,000
Novo Nordisk Foundation	148,330
Købmand Svend Hansen og hustru Ina Hansens Fond	50,000
2020 CV-19, Danish Ministry of Higher Education and Science	1,862,100
2020 Læge Sofus Carl Emil Friis og Hustru Olga Doris Friis' Legat	1,000,000
Project grant for Bioscience and Basic Biomedicine, Novo Nordisk Foundation	2,500,000
Augustinus Foundation	400,000
Kulturministeriet (Ministry of culture)	397,000
Bispebjerg Hospital grant	146,000
Hagedorn Prize	1,250,000
Center for Economic Behaviour and Inequality	80,000
Department of Economics (University of Copenhagen)	120,000
Department of Public Health (University of Copenhagen)	70,000
Nordea Foundation	547,000
Helsefonden	300,000
Ensommes Gamles Værn	300,000
Velliv Foundation	100,000

FUNDED BY	FUNDING
Beckett Fonden	100,000
Innovation Fund Denmark (shared w/co-PI):	1,072,000
The Joint Committee for Nordic research councils in the Humanities and Social Sciences	314,000
The Danish Sclerosis Foundation (shared w/co-PI)	296,000
Karen Elise Jensens Fond (shared w/co-PI)	3,000,000
HelseFonden shared w/co PI	350,000
VELUX Foundation	350,969
Novo Nordisk Foundation	889,676
CACHET (Syncsense)	210,900
CACHET (Ventriject)	251,763
Novo Nordisk Foundation	4,611,500
Ventriject ApS	320,000
InnovationsFonden	120,000
EIT Cross KIC	465,000
Carlsberg Foundation Fellowship	5,000,000
BMI Internal project	50,000
Anti Doping Danmark	189,750
Torben & Alice Frimodt Fond	20,001
Aase og Ejnar Danielsens Fond	100,000
Aase og Ejnar Danielsens Fond	75,000
Dagmar Marshalls Fond	30,000
Total	**74,295,089**

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