Department of Biomedicine:

1. Group leader and supervisor: Associate Professor Klaus Eyer, eyerk@biomed.au.dk

Project: Resolving simultaneous and sequential secretion of individual polyfunctional immune cells in health and disease

Description:
In our research, we develop and apply novel technologies for functional single-cell analysis. Recently, we have developed a system that allows us to measure cytokine polyfunctionality (i.e., the secretion of multiple cytokines simultaneous or sequentially) on the single-immune cell level on a throughput of around 10-100'000 cells per experiment over time. Having now access to this novel parameter, the dynamics of polyfunctionality, we would like to study the usefulness of this parameter in defining, stratifying and altering immune response in health and disease in this project. You will get in contact with single-cell technologies, droplet microfluidics, immunoassays and flow cytometry during your stay in our lab.

2. Group leader: Associate Professor Maria Andreasen, maruaj@biomed.au.dk

Supervisor: Qian Liu

Project: Effects of PSMα2 peptide on biofilm associated MRSA infections

Description:
The infective ability of the opportunistic pathogen Staphylococcus aureus, also known as methicillin-resistant S. aureus (MRSA), is directly linked to biofilm mediated resistance to host immune response and antibiotics. The structural component of biofilms is comprised of aggregated phenol-soluble modulin (PSM) peptides and the occurrence of these renders the biofilm impossible to disassemble, and hence it also becomes impossible to treat the infection pharmacologically. Unlike the other PSM peptides PSMα2 only aggregates at extreme pH values or when cross-seeded. Using fluorescence plate-reader techniques along with biophysical techniques such as transmission electron microscopy, circular dichroism and microdiffusion the effects of PSMα2 peptide in the MRSA biofilm is studied.

3. Group leader and supervisor: Associate Professor Eugenio Gutiérrez Jiménez, eugenio@cfin.au.dk

Project: Effect of hyperglycemia induced by high-fat diet in brain microcirculation and its role in Alzheimer's disease development.

Description:
Obesity is a major cause of type 2 diabetes, evidenced by hyperglycemia. These two diseases are also associated with the development of Alzheimer's disease (AD). We hypothesize that the natural evolution of AD is accelerated by both diseases due to disturbances in the brain vasculature. Using in-vivo two-photon imaging measurements of the brain microcirculation in mouse models, we aim to understand the effect of high-fat diet-induced hyperglycemia in an animal model of AD.

4. Group leader and supervisor: Associate Professor Joanna Kalucka
   Joanna.kalucha@biomed.au.dk

Project: Endothelial dysfunction in fatty liver disease

Description:
Impaired vascular remodeling promotes hypoxia and inflammation leading to increasing occurrences of cardiovascular disorders. Therefore, malfunctional blood vessels have become a clinically recognized as life-threatening incidence in human. Given the emerging importance of understanding the biology of blood vessels in different tissues, by using a molecular approach like: endothelial cell culture, CRISPR/Cas9, qPCR, Western Blot and immunohistochemistry techniques, we aim to characterize endothelial cells endothelium and the role fatty liver disease

Department of Clinical Medicine:

5. Group leader and supervisor: Professor Claus Lindbjerg Andersen, cla@clin.au.dk

Co-supervisor: Christina Demuth

Project: The genomics of colorectal cancer

Description:
The project aims to describe the genomic alterations of colorectal cancer, and to explore if this information can be used to define genetically distinct subgroups of colorectal cancer with impact on patient prognosis. You will analyze our existing whole exome and whole genome tumor DNA sequencing dataset from more than 1900 patients to determine the compendium of genomic alterations of colorectal cancer.

Good computer skills and an interest in programming/bioinformatics will be an advantage.

6. Group leader and supervisor: Associate Professor Iben Lyskjær, iben.lyskjar@clin.au.dk

Supervisor: Johanne Ahrenfeldt

Project: Epidemiological study of Kidney Cancer

Description:
We are currently conducting a detailed epidemiological study of kidney cancer in Denmark from 1991 to 2021. Our goal is to characterize the current landscape of kidney cancer in Denmark and how it has changed over the past 30 years.

This will provide valuable insights that can enhance the understanding and management of kidney cancer and guide our future research toward the right patient groups.

Your project could concentrate on a particular timeframe or a specific parameter across the entire duration. For instance, it could delve into aspects like comorbidity, survival rates, or the incidence of metastatic progression.

7. Group leader: Associate Professor Iben Lyskjær, iben.lyskjar@clin.au.dk

Supervisor: Laura Iisager/Johanne Ahrenfeldt

Project: Investigation of the immune system's role in the progression of renal cancer.

Description:
This project involves T cell receptor sequencing of renal cancer patient samples. Using the bioinformatic language R, differences between relapsing and non-relapsing patients will be analysed, and correlated to clinical outcome measures with the aim of identifying predictive and prognostic biomarkers.

8. Group leader and supervisor: Associate Professor Nicolai Juul Birkbak nbirkbak@clin.au.dk

Project: Investigating biological age as a driver of cancer initiation and progression

Description:
This project aims to explore the role of biological age in cancer initiation, development and progression. To investigate this, you will be given access to public datasets containing methylation, gene expression and mutation data from cancer patients and from a large collection of normal samples. Good computer skills and an interest in bioinformatics will be an advantage.

9. Group leader and supervisor: Professor Lars Dyrskjøt lars@clin.au.dk

Project: The role of the immune system and previous infections on outcome and treatment response in bladder cancer

Description:
The composition and functional status of cells in the tumor microenvironment as well as previous infections with e.g. CMV have been shown to be important for patient outcome and treatment response in cancers, including bladder cancer. In this project, you will contribute to ongoing research focusing on the tumor microenvironment of bladder cancer patients treated with immunotherapy (BCG). Specifically, you will analyze spatial proteomics and transcriptomics data from these patients with the aim to characterize the tumor microenvironment and latent viral infections to investigate correlations to patient outcomes and treatment response.

An interest in bioinformatics/programming is advised.

10. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Associate Professor Deirdre Cronin Fenton, PhD, dc@clin.au.dk

Project: The impact of overweight and obesity on response to immunotherapy in cancer patients

Description:
This systematic literature review and meta-analysis will evaluate the impact of overweight/obesity compared with normal weight on response to immunotherapy in cancer patients. The primary focus is to assemble the evidence from clinical trials investigating the response to immunotherapy. The review will include all types of solid tumours, but not haematological cancer. Immunotherapy will include all types of treatment except for vaccines.

11. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Associate Professor Deirdre Cronin Fenton, PhD, dc@clin.au.dk

Project: Factors impacting treatment adherence in breast cancer

Description:
This systematic literature review will investigate factors that influence patient adherence to endocrine therapy in breast cancer survivors. Such factors could include comorbidities, low socioeconomic position, concurrent drug use, stage of disease, etc. For this to be empirical BA, the student will need to conduct a meta-analysis.

12. Group leader and supervisor: Professor Vera Ehrenstein, MPH, DSc, ve@clin.au.dk

Project: What's in a name? Topics in study design

Description:
Even experienced epidemiologists may get their study design wrong: there are multiple published papers describing a cohort study, which is actually a cross-sectional study. Using published examples, we will prepare a tutorial on this topic and submit it for publication to a peer-reviewed journal. Using data on pregnancy outcome as an example, will work with simulated dataset to compare risks that would be computed in a cohort study with prevalence that is computed in a cross-sectional study. Be prepared that it might cause a debate!

13. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Professor Alma B. Pedersen, MD, PhD, DMsc, abp@clin.au.dk

Project: The impact of mental disorders on the chronic opioid use after hip fracture

Description:
The systematic literature review and meta-analysis will evaluate the impact of common mental disorders on the continuous and chronic opioid use after hip fracture surgery.

14. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Professor Alma B. Pedersen, MD, PhD, DMsc, abp@clin.au.dk

Project: Social inequality in chronic opioid use after hip fracture

Description:
The systematic literature review and meta-analysis will evaluate the association between socioecomic status (SES) and the continuous and chronic opioid use after hip fracture surgery. Studies using individual-level and area-based SES measures will be analysed.

15. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Oleguer Plana-Ripoll, PhD, Associate Professor, opr@clin.au.dk

Project: The impact of lifestyle factors on the association between mental disorders and mortality

Description:
Individuals with mental disorders have an average reduction in life expectancy of around 7 years in women and 10 years in men, compared to those without mental disorders. This excess mortality might be explained, at least partly, by a higher prevalence of health-risk behaviours among those with mental disorders (such as smoking, poor diet, alcohol consumption, or lack of physical activity). The main aim of this systematic literature review and meta-analysis will be to summarise the current evidence on the role of these lifestyle factors in the association between mental disorders and mortality.

16. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Associate Professor Oleguer Plana-Ripoll, PhD, opr@clin.au.dk

Project: The impact of lifestyle factors on the association between mental disorders and "lifestyle diseases"

Description:
Individuals with mental disorders have an average reduction in life expectancy of around 7 years in women and 10 years in men, compared to those without mental disorders, and this is mostly explained by deaths related to medical diseases. The excess in comorbidity and subsequent mortality might be explained, at least partly, by a higher prevalence of health-risk behaviours among those with mental disorders (such as smoking, poor diet, alcohol consumption, or lack of physical activity). The main aim of this systematic literature review and meta-analysis will be to summarise the current evidence on the role of these lifestyle factors in the association between mental disorders and subsequent "lifestyle diseases" (e.g. COPD, live cirrhosis, lung cancer, cardiovascular diseases).

17. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Associate Professor Oleguer Plana-Ripoll, PhD, opr@clin.au.dk

Project: The role of socioeconomic position on the association between mental disorders and "lifestyle diseases"

Description:
Individuals with mental disorders have an average reduction in life expectancy of around 7 years in women and 10 years in men, and these estimates depend on socioeconomic position. Importantly, most of the excess mortality is explained by deaths related to medical diseases, but the role of socioeconomic position in the association between mental disorders and subsequent comorbid conditions has not been quantified. The main aim of this systematic literature review and meta-analysis will be to summarise the current evidence on the role of socioeconomic position (e.g. income, education) in the association between mental disorders and subsequent "lifestyle diseases" (e.g. COPD, liver cirrhosis, lung cancer, cardiovascular diseases).

18. Group leader: Professor Vera Ehrenstein, MPH, DSc ve@clin.au.dk

Supervisor: Professor Christian Fynbo Christiansen, MD, PhD, consultant, cfc@clin.au.dk

Project: Temporal trends in use of lipid-lowering drugs in Denmark

Description:
Lipid-lowering drugs may be associated with acute kidney complications, but also with long-term decreased risk of kidney diseases. The aim of this project is to describe any temporal changes in the use of different types of lipid-lowering drugs during the last decades. The project will use aggregated data on prescribed medicine in Denmark.

19. Group leader: Professor Vera Ehrenstein, MPH, DSc, ve@clin.au.dk

Supervisor: Professor Christian Fynbo Christiansen, MD, PhD, consultant, cfc@clin.au.dk

Project: Do treatment bundles improve the prognosis of acute kidney injury?

Description:
Acute kidney injury occurs in 20% of hospitalized patients. Consensus treatment for acute kidney injury is mainly supportive and includes a consensus-defined bundle of care including among other discontinuation of nephrotoxic drugs and appropriate fluid treatment. The aim of this project is to conduct a systematic review and meta-analysis of studies examining the prognostic impact of AKI care bundles on the prognosis.

20. Group leader: Associate Professor Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Victor Pando-Naude, post-doc Center for Music in the Brain

Project: Timing rhythm in Parkinson's disease

Description:
In this project, we evaluate sensorimotor and timing mechanisms in the brain by comparing a group of participants with Parkinson´s disease and matched controls. PD is a neurological condition that affects dopaminergic function in the basal ganglia (BG) related to motor behaviour which leads to deficits in the perception and production of temporal tasks, i.e., rhythm. This study includes rhythmic perceptual (auditory) and production (tapping) tasks and hypothesizes that differences between groups will further support the theory that auditory, sensorimotor, and timing abilities depend on the normal function of the BG circuitry with audio-motor coupling (or entrainment) as the framework to study such mechanisms.

21. Group leader: Bjørn Petersen, assoc. professor, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Kira Vibe Jespersen, assoc. professor, Center for Music in the Brain

Project: Music and insomnia

Description:
Sleep problems are highly prevalent in modern society, and many people listen to music as a sleep aid. In this project, we map the reasons people use music for sleep as well as the characteristics of sleep music. Furthermore, we investigate the neurophysiological mechanisms underlying the impact of music on sleep.

22. Group leader: Bjørn Petersen, assoc. professor, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Massimo Lumaca assoc. professor, Center for Music in the Brain

Project: The cognitive roots of music universals

Description:
Rhythmic structure is a core aspect of human music that has fascinated researchers across various scientific and humanistic disciplines. Why do nearly all music traditions of the world feature rhythms with a systematic organization? A prominent proposal on this subject holds that rhythmic structure evolves by 'adapting', in the course of successive generations, to general capacity limits of the human brain, shared across all humans. However, the proposal lacks an empirical support from cognitive science. By employing whispers chain methods that mimic in the laboratory the transmission of music (e.g. from parents to offspring), together with a battery of cognitive and perceptual tests, I will investigate how the limits of our memory and perception shape the evolution of rhythmic structure in music.

The student will be responsible for:

- Analysing the results of the experiments (testing relationship between rhythmic measurements, cognitive and perceptual scores)
- Drawing conclusions about how human cognitive constraints shape music.

This is a great opportunity for the BA student to gain experience in conducting research in cognitive science.

23. Group leader: Boris Kleber, assoc. professor, Center for Music in the Brain, boris.kleber@clin.au.dk

Supervisor: Anna Zamonano, assistant professor, Center for Music in the Brain

Project: Exploring the Influence of Motivation and Decisions on Pain Processing

Description:
This bachelor student project aims to explore the intricate relationship between motivation, decisions, and their impact on pain and performance among musicians and general population. Understanding how motivation serves as a driving force to relief pain is pivotal for enhancing training methodologies and overall performance. By employing a comprehensive analysis and incorporating insights from psychology, pain and music neuroscience, this project aims to shed light on the psychological dynamics that influence performance artists, providing valuable insights to optimize pain treatment strategies.

24. Group leader: Bjørn Petersen, assoc. professor, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Leonardo Bonetti, assoc. professor, Center for Music in the Brain

Project: Using music to investigate the neural correlates of memory for temporal sequences in dementia

Description:
Dementia is a complex neurodegenerative condition characterized by memory impairment and cognitive decline. Despite substantial research on memory deficits in dementia, our understanding of the neural basis of memory for temporal sequences and its trajectory from a healthy state to dementia remains limited. Thus, the aim of this project is to collect and analyze the neural data underlying different memory subsystems (i.e. automatic sensory memory, short-term, long-term and working memory) indexed by musical paradigms. The project will combine magnetoencephalography (MEG), magnetic resonance imaging (MRI) and behavioral measures.

25. Group leader: Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Alexandre Celma-Miralles, assist. professor, Center for Music in the Brain

When does our brain develop musicality?

Description: This project wants to explore how our musical brain develops in childhood, to understand why music becomes an enjoyable experience in adulthood. It focuses on the neural processing of essential musical features, such as harmonic pitch, timbre, beat and meter, at ages between 6 and 12. It also aims to stablish links between the development of these melodic and rhythmic features and behavioral measures, such as auditory discrimination and sensorimotor synchronization. To do so, we will review, select, (re-)design and test some electroencephalographic (EEG) and behavioral paradigms that provide information about musical features, such as finger-tapping synchronization, mismatch negativities1 and frequency-tagged responses2. The student will be involved in (i) researching the EEG/behavioral paradigms for children, (ii) piloting them in young adults, and (iii) reporting preliminarily analyses of the obtained neural and behavioral measures.

*This project can be for both modalities of BA thesis: experimental (i,ii,iii) or theoretical (i)

a) https://www.sciencedirect.com/science/article/pii/S1074742714000082
b) https://www.frontiersin.org/articles/10.3389/fnins.2016.00229/full

26. Group leader: Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Alexandre Celma-Miralles, assist. professor, Center for Music in the Brain

Project: How does the brain deal with polyrhythms?

Description: This project aims to explore how our musical brain generates predictions of sounds inside polyrhythmic auditory stimuli (i.e., rhythms with two competing periodic events at distinct tempo coinciding in each cycle). Inside polyrhythms, there is a natural tendency to group temporal events into binary chunks1 to perceive the beat to which we move (Møller, Stupacher, Celma-Miralles, & Vuust, 2021). To stablish links between rhythmic grouping in the brain and behavioral measures, we will record automatic electroencephalographic (EEG) responses to listening to

polyrhythms and sensorimotor synchronization responses by finger-tapping to these rhythms. The EEG analyses involve mismatch negativities (i.e., event-related potentials predicting events) and frequency-tagging2, while the finger-tapping analyses involve circular statistics. The student will be involved in (i) understanding the EEG/behavioral paradigms and the related literature, (ii) helping to record the data or to analyze the anonymized data, and (iii) reporting the preliminarily obtained neural and behavioral results with their general implications.

*This project can be for both modalities of BA thesis: experimental (i,ii,iii) or theoretical (i,iii)

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0252174

https://www.biorxiv.org/content/10.1101/2021.02.15.431304v1.full

27. Group leader: Bjørn Petersen, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Cecilie Møller, Center for Music in the Brain

Project: Rhythm in the brain

Description:
Rhythms are all around us. Many everyday events and actions are structured in time, such as walking, talking and making music. We also possess internal rhythms that vary considerably across individuals. When asked to tap a regular rhythm, e.g., with a finger on a tabletop, some people will do so at a rather slow rate while others may prefer faster rates. We refer to this as an individual's spontaneous motor tempo (SMT). Here, students will either work with existing SMT datasets or take part in designing and collecting data for pilot studies exploring the influence of SMT on various aspects of (music) perception, cognition, behaviour and/or other psychological phenomena depending on the students' own ideas and interests. Some knowledge of music and R is a clear advantage, yet a high level of commitment and access to helpful R tutorials can be equally useful. Groupwork (2-3 students) is highly encouraged.

28. Group leader: Bjørn Petersen, assoc. professor, Center for Music in the Brain, bjorn.petersen@clin.au.dk

Supervisor: Boris Kleber, assoc. professor, Center for Music in the Brain

Projekt: Self-Emotion Elicitation through Modified Speech (SEEMS): Exploring the Emotional Impact of Voice Feedback

Description:
SEEMS investigates the intriguing relationship between our voice's emotional tone and our mood, focusing on how altered voice feedback can influence our emotional state. Despite the extensive research on verbal speech processing, the non-verbal emotional cues transmitted through our voice remain underexplored. SEEMS leverages a novel digital audio platform to modify the emotional tone of participants' voices in real-time, aiming to uncover the neurocognitive and neurobiological mechanisms behind self-perceived emotional expressions. By analyzing brain activity while participants listen to their own voice—altered to sound happier or sadder—SEEMS seeks to reveal how these changes affect emotional states and brain dynamics. This project has the potential to deepen our understanding of the complex interplay between the expression and experience of emotions, offering new insights into how our brain generates emotions.