WRIC

Networking & Collaboration Event

26 - 27 February 2026
Aarhus, Denmark

Whole-room Indirect Calorimetry

BOOK OF
ABSTRACTS

Steno Diabetes Center Aarhus

UCPH

Novo Nordisk Foundation CENTER FOR BASIC METABOLIC RESEARCH

SABLE SYSTEMS INTERNATIONAL

CARLSBERG FOUNDATION

Danish Diabetes and Endocrine Academy

AARHUS UNIVERSITY

Program

Thursday 26 February 2026

10:30 – 11:00 Arrival and Registration	
11:00 – 11:15 Opening Session	
11:15 - 11:30	**Manfred Müller,** *Kiel University, Germany* History of whole-room indirect calorimetry research in humans
Session 1 - NUTRITION	
11:30 - 12:15	**Keynote by Anja Bosy-Westphal,** *Kiel University, Germany* From Energy Turnover to Metabolic Resilience: Lessons from Whole-Room Calorimetry Studies
12:15 -12:30	**Christine Henriksen,** *University of Oslo, Norway* The effect of lifestyle intervention on weight, body composition and resting metabolic rate in adults with overweight: A single-group pre-post study
12:30 - 12:45	**Emma Helmy,** *Columbia University Irving Medical Center, USA* Evaluating the impact of Ultra processed Foods on Energy Metabolism Under Controlled-Feeding Condtions
12:45 - 13:00	**Jens Hohwü Voigt,** *Steno Diabetes Center Aarhus, Denmark* Milk fat globule membrane in a novel high-fat spread does not acutely affect postprandial lipidemia in healthy individuals – A randomized, double-blind crossover trial
13:00 - 14:00 Lunch and Tours of the WRIC Rooms	
Session 2 – THERMOGENESIS (**Steno Thursday)**	
14:00 -15:00	**Keynote by Kong Chen,** *National Institute of Diabetes and Digestive and Kidney Diseases, USA* The mysteries of energy metabolism: Tales from metabolic chambers
15:00 - 16:00 Poster Session with coffee and cake	
Session 3 – ANALYSIS	
16:00 - 16:20	**Paolo Piaggi,** *University of Pisa, Italy* From Raw Sensors to Energy Expenditure: The WRIC Data Pipeline

Program

Thursday 26 February 2026

	Continued: Session 3 – ANALYSIS
16:20 - 16:35	**Rebecca Dörner,** *Kiel University, Germany* From Validation to Application: Lessons Learned from the Kiel-WRICs
16:35 - 16:50	**Nina Ziegenbein,** *Steno Diabetes Center Aarhus, Denmark* A Modular Software Toolbox for Reproducible Processing of Metabolic Data using Whole-Room Indirect Calorimetry Data
16:50 - 17:05	**Simon Bøggild Hansen,** *Steno Diabetes Center Aarhus, Denmark* Effects of glucocorticoid receptor agonism on whole body metabolism
	GROUP PHOTO
19:00 -	**Networking Dinner, Madklubben Aarhus** (15min walk from the hotel) Hack Kampmanns Plads 1-3, 8000 Aarhus C

Friday 27 February 2026

	Session 4 - EXERCISE
09:00 - 09:45	**Keynote by Bret Goodpaster,** *Advent Health, USA* Novel Aspects of Human Metabolism Revealed by Whole room calorimetry
09:45 – 10:00	**Wouter Bijnens,** *Maastricht University, the Netherlands* Proof of concept of a hypoxic whole room indirect calorimeter
10:00 – 10:15	**Elvis Carnero,** *Advent Health, USA* Validity and Reliability of Small Respiratory Chamber to Assess Exercise
	10:15 - 10:45 Coffee break
	10:45 – 12:00 Networking Session
	12:00 – 13:00 Lunch break
	Sessions 5 - PERSPECTIVES
13:00 -13:15	**Gillian Larik,** *Maastricht University, the Netherlands* From respiration to fermentation: Short-term fiber mixture supplementation alters fermentation gas patterns measured using a modified respiration chamber system

Program

Friday 26 February 2026

	Continued: Session 5 – PERSPECTIVES
13:15 - 13:30	**Frédéric Gachon,** *Steno Diabetes Center Aarhus, Denmark* Disruption of circadian metabolism in liver and psychiatric diseases
13:30 - 13:45	**Guy Plasqui,** *Maastricht University, the Netherlands* Current and future focus of room calorimetry research at the Metabolic Research Unit Maastricht
13:45 - 14:00	**Sascha Heinitz,** *Leipzig University, Germany* Implementation and Validation of Two Whole-Room Indirect Calorimeters in Leipzig
	14:00 - 14:30 Coffee and cake
14:30 - 15:15	**Panel Debate - Anja Bosy-Westphal, Kong Chen, Bret Goodpaster** Where Do We Go from Here? Challenges, Lessons, and Future Perspectives
	15:15 – 15:30 Closing Remarks and Farewell

Keynote Speakers

Anja Bosy-Westphal

Professor of Human Nutrition, Christian-Albrechts-University of Kiel, Germany.
Prof. Bosy-Westphal is an internationally recognized expert on human energy balance and its role in the prevention and treatment of cardiometabolic and endocrine diseases. Her work combines advanced body composition analysis with WRIC-based studies to elucidate mechanisms underlying metabolic regulation.

Kong Chen

Co-Director, Metabolic Clinical Research Unit Section Chief, Energy Metabolism Section Director, Human Energy & Body Weight Regulation Core National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), NIH, Bethesda, MD
Dr. Chen is a pioneer in human energy metabolism research and the lead author of the only published reporting guidelines for whole-room indirect calorimetry (WRIC). His groundbreaking work on thermoregulation and physical activity regulation has substantially advanced understanding of how energy metabolism impacts nutrition and chronic disease.

Bret Goodpaster

Scientific Director, AdventHealth Translational Research Institute Professor, University of Central Florida College of Medicine, Orlando, FL
Dr. Goodpaster is a leading researcher in the pathophysiology of human aging, obesity, diabetes, and exercise biology. He has extensive experience in conducting and analyzing metabolic studies using WRIC and has made seminal contributions to understanding insulin resistance and skeletal muscle metabolism.

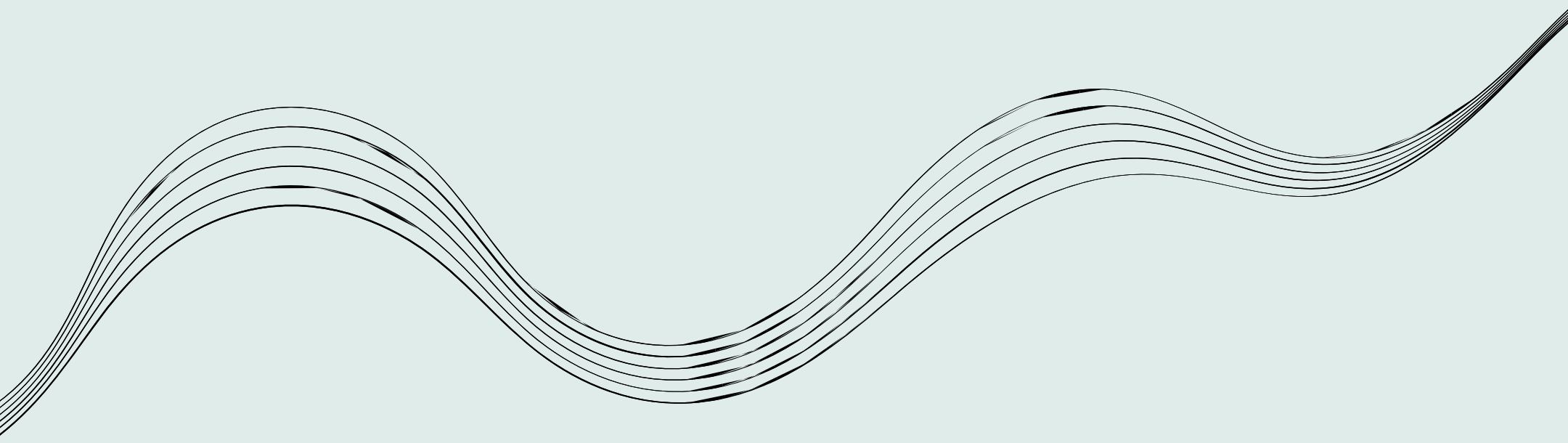
Early-Career Excellence Awards

We are pleased to recognize and celebrate the excellent presentations at this year's conference through two awards.

Two prizes will be awarded to early-career researchers in recognition of outstanding presentations: One for the **best poster presentation** and one for the **best oral presentation**.

All presentations by early-career researchers are eligible for consideration.

The winners of the competition will be announced in the award ceremony during the farewell session on Friday, where the winners will receive their prizes.



We are very grateful to **Sable Systems** for generously sponsoring the prizes for our early-career researches.

SABLE SYSTEMS INTERNATIONAL

Poster Abstracts

P1:
Analysis and reporting of continuous nonprotein respiratory quotients based on percent relative cumulative frequency curves: implications for definitions of metabolic flexibility.

Authors:
Eleonora Poggiogalle[1], Christelle Guillet[2], Yves Boirie[2], Abdul G Dulloo[3], Courtney M Peterson[4], Eric Ravussin[5].

[1]Department of Experimental Medicine, Sapienza University, Rome, Italy.
[2]Human Nutrition Unit, Clermont Auvergne University, Clermont Ferrand, France.
[3]Department of Endocrinology, Metabolism & Cardiovascular System, Faculty of Science & Medicine, University of Fribourg, Fribourg, Switzerland.
[4] Department of Nutrition, Harvard T.H. Chan School of Public Health, Boston, MA, USA.
[5]Pennington Biomedical Research Center, Louisiana State University, Baton Rouge, LA, USA.

Keywords:
Metabolic flexibility, respiratory quotient, percent relative cumulative frequency curves.

Abstract:
Based on findings from animal studies, some authors relied on the calculation and use of the percent relative cumulative frequency (PCRF) curves for either respiratory quotient (RQ) or oxygen volumes (VO_2). This method and its relative graphical representation are not routinely used in human studies on whole-room indirect calorimetry. Our proposal is to expand that method to human studies, to represent and analyze data from the metabolic chamber, displaying clearly any implications for metabolic flexibility and energy balance. Relying on PCRF curves for RQ, the slopes and the changes in slopes are somewhat related to metabolic flexibility. The objectives of the study are: improving the PRCF model by separating the effects of metabolic flexibility and inter-individual differences in mean 24-hour RQ, and providing a clearer definition of how to define metabolic flexibility using metabolic chamber data.
Chamber data could be analyzed using the PCRF curves for RQ as well as energy expenditure stratified by body mass index, sex, and/or age, and especially macronutrient composition in case of dietary interventions. One limitation to be acknowledged, this analytic approach requires a large number (>1000) of data points. In addition, reporting of continuous nonprotein RQs based on PCRF curves may offer an exhaustive graphical representation of data over 24-h. Translational research can be prompted with application examples from both calorimetric cages and metabolic chambers.

References:
Riachi M, Himms-Hagen J, Harper ME. Percent relative cumulative frequency analysis in indirect calorimetry: application to studies of transgenic mice. Can J Physiol Pharmacol. 2004 Dec;82(12):1075-83. doi: 10.1139/y04-117.

Longo KA, Charoenthongtrakul S, Giuliana DJ, Govek EK, McDonagh T, Distefano PS, Geddes BJ. The 24-hour respiratory quotient predicts energy intake and changes in body mass. Am J Physiol Regul Integr Comp Physiol. 2010 Mar;298(3):R747-54. doi: 10.1152/ajpregu.00476.2009.

Poster Abstracts

P2:
Validity and reproducibility of a whole-room indirect calorimeter for measurement of the thermic effect of food

Authors:
Mina Marie Minge, MSc Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo, Oslo, Norway
Christine Henriksen, PhD Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo, Oslo, Norway
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Rune Blomhoff, PhD Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo, Oslo, Norway and Department of Clinical Service, Division of Cancer Medicine, Oslo University Hospital, Oslo, Norway
Franziska Anna Hägele, PhD Department of Human Nutrition, Institute of Human Nutrition and Food Sciences, Kiel University, Kiel, Germany
Rebecca Dörner, PhD Department of Human Nutrition, Institute of Human Nutrition and Food Sciences, Kiel University, Kiel, Germany
Russell Rising, PhD D & S Consulting Services Inc, Research and Development, New York, NY, USA
Stine Marie Ulven, PhD Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo, Oslo, Norway
Thomas Olsen, PhD Department of Nutrition, Institute of Basic Medical Sciences, University of Oslo, Oslo, Norway

Keywords:
Energy expenditure, metabolism, thermic effect of food, whole-room indirect calorimetry, postprandial energy expenditure

Abstract:
Whole-room indirect calorimeters (WRICs) measure respiratory exchange, energy expenditure, and macronutrient oxidation. The thermic effect of food (TEF) that occurs after food intake due to digestion, absorption, and storage of nutrients, is an important component of daily energy expenditure, but difficult to quantify using metabolic carts. This study evaluated the validity and reproducibility of a 7209L WRIC for TEF measurement. Technical validation was performed with 7-hour propane combustion tests (n=5), and biological reproducibility was tested in 10 healthy subjects (6 men, mean age 33.5 ± 10.3 years) in replicate 7-hour measurements, after a 3-day run-in protocol. Coefficient of variation (CV) and intraclass correlation coefficient (ICC) were calculated for ventilation rates of O2 (VO2) and CO2 (VCO2), respiratory exchange ratio (RER; VCO2/VO2), postprandial energy expenditure, and TEF. Technical validation showed good validity with CVs ranging from 0.23% for RER to 1.74% for energy expenditure. For biological reproducibility, CVs were 3.42%, 1.97%, 2.58%, 3.07%, and 27.48% for VO2, VCO2, postprandial RER, postprandial energy expenditure, and TEF, respectively. ICCs were excellent for VO2 (96%), VCO2 (98%), and postprandial energy expenditure (96%), but poor for TEF (24%). In conclusion, the 7209L WRIC is technically valid and reproducible for ventilation rates and postprandial energy expenditure but showed lower reproducibility for TEF.

Poster Abstracts

Results. The trial commenced in August 2025. At the time of manuscript submission, five participants have been enrolled. Based on prior data, a total of 34 participants is required to evaluate the improvement in mean energy balance by 100 kcal with a power >0.80, assuming a
standard deviation of 200 kcal. The final analyses will include energy balance, changes in body weight, components of EE, ad libitum energy intake, and circulating hormones involved in appetite regulation and satiety.
Conclusion. This trial evaluates whether energy balance can be achieved during repeated stays in a WRIC and provides a detailed assessment of the performance of two newly installed WRIC systems.

Poster Abstracts

P3:
Short-term adaptation to a ketogenic diet in endurance-trained athletes: effects on body composition, substrates utilization, muscle glycogen, and endurance performance

Authors:
Paoli A.1, Charrier D.1, De Lima-Junior D.2, Montanari A.1,3, Cerullo G.1, Givralli J.1, Canato M.1, Bassetto F.3, Vindigni V.3, Marcora S.2, Moro T.1

1Department of Biomedical Sciences, University of Padova, Padova, Italy,
2 Department for Life Quality Studies, University of Bologna, Bologna, Italy,
3 Plastic and Reconstructive Surgery Unit, Department of Neurosciences, University of Padova, Padova, Italy.

Keywords:
Oxygen consumption, respiratory quotient, muscle glycogen, muscle biopsy

Abstract:
Background: The ketogenic diet (KD) is increasingly adopted in endurance sports for its potential to enhance fat oxidation and spare muscle glycogen, yet the effects of short-term adaptation on glycogen availability and high-intensity performance remain uncertain. The ergogenic relevance of nutritional ketosis—through greater fat/ketone use and altered fatigue perception—also requires clarification. This study examined the impact of a 10-day KD on: (1) metabolic and physiological responses to a glycogen-depletion protocol, and (2) subsequent high-intensity endurance performance under glycogen-depleted conditions in trained athletes.

Methods: Fourteen endurance-trained participants (age 29.1 ± 5.4 y; VO_2max 57.7 ± 7.4 mL·kg^{-1}·min^{-1}) completed a 7-day standardized mixed diet before randomization to KD (<5% CHO; 2.0 g·kg^{-1}·day^{-1} protein) or control diet (CD; 55% CHO; 2.0 g·kg^{-1}·day^{-1} protein) for 10 days with habitual training. Body composition was assessed via DXA and BIA. After an overnight fast, athletes performed 2 h cycling at 55% peak power to induce glycogen depletion. VO_2, RQ, and substrate use were recorded every 15 min. Muscle biopsies (vastus lateralis) were taken pre- and post-exercise for glycogen analysis. High-intensity performance was evaluated with a time-to-exhaustion (TTE) test.

Results: KD induced greater reductions in total body water (−3.0% vs +0.8%), intracellular water (−3.0% vs +0.9%), and body mass (−3.0% vs +0.5%) than CD. Fat oxidation during exercise increased markedly in KD (+102%) vs CD (−2%), while gross efficiency declined(−2.0% vs +0.3%). TTE decreased in KD (−7 min) but improved in CD (+7 min), indicating impaired high-intensity performance.

Conclusions: Ten days of KD enhance fat oxidation and reduce body mass and body water but appear to lower exercise efficiency and impair high-intensity endurance performance. Ongoing analyses, including muscle glycogen data and increased sample size, will clarify the mechanisms involved.

Poster Abstracts

P4:
Norepinephrine neurons in the NTS are important for gravitostat signaling

Authors:
Jovana Zlatković[1], Adrià Dalmau Gasull[2], Daniel Hägg[2], Ferran FontGironès[2], Jakob Bellman[2], Björn Meister[3], Vilborg Palsdottir[2], Johan Ruud[2], Claes Ohlsson[2], Suzanne L. Dickson[2], Fredrik Anesten[2], John-Olov Jansson[2]

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[3] Karolinska Institutet, Stockholm, Sweden

Keywords:
Obesity, neuro-metabolism, body weight regulation, neural mapping

Abstract:
In previous studies, we observed that increasing body load in obese rodents induces a sustained reduction in body weight and food intake. These findings suggested the existence of a load-sensitive, homeostatic regulatory mechanism contributing to body weight control, which we have termed the “gravitostat”. We further hypothesized that this feedback regulation involves central nervous system pathways.
To test this hypothesis and identify neuronal populations involved in loadinduced signaling, mice and rats fed a high-fat diet were implanted intraperitoneally or subcutaneously with capsules weighing approximately 15% (load) or 2.5% (control) of body weight. Three to five days after implantation, neuronal activation in selected brain and brainstem regions was assessed by immunohistochemical detection of FosB. Weighted capsule implantation, both subcutaneous and intraperitoneal, induced robust FosB expression in neurons of the medial nucleus of the solitary tract (mNTS), a region known for metabolic integration. These neurons expressed tyrosine hydroxylase and dopamine-β-hydroxylase, consistent with a norepinephrine phenotype. Selective ablation of norepinephrine neurons in the mNTS attenuated the load-induced reduction in body weight and food intake. In conclusion, increased body load reduces body weight and food intake via activation of norepinephrine-producing neurons in the mNTS, identifying a central neural pathway mediating load-dependent bodyweight regulation.

P5:
Energy & substrate metabolism during 8-hour continuous exposure to varying combinations of humidity, air quality and indoor temperature

Authors:
Cynthia Ly1, Stefan Flagner2, Paris Sklavakis Fotopoulus1, Wouter van Marken Lichtenbelt1, Rick Kramer2, Hannah Pallubinsky1, and Guy Plasqui1 1 Department of Nutrition and Movement Sciences, Institute of Nutrition and Translational Research in Metabolism, Maastricht University, Maastricht, The Netherlands 2 School of Architecture, Civil and Environmental Engineering, École Polytechnique Fédérale de Lausanne, Fribourg, Switzerland 3 Department of the Built Environment, Eindhoven University of Technology, Eindhoven, The Netherlands

Poster Abstracts

P5:
Energy & substrate metabolism during 8-hour continuous exposure to varying combinations of humidity, air quality and indoor temperature

Authors:
Cynthia Ly[1], Stefan Flagner[2], Paris Sklavakis Fotopoulus[1], Wouter van Marken Lichtenbelt[1], Rick Kramer[2], Hannah Pallubinsky[1], and Guy Plasqui[1]
1 Department of Nutrition and Movement Sciences, Institute of Nutrition and Translational Research in Metabolism, Maastricht University, Maastricht, The Netherlands
2 School of Architecture, Civil and Environmental Engineering, École Polytechnique Fédérale de Lausanne, Fribourg, Switzerland
3 Department of the Built Environment, Eindhoven University of Technology, Eindhoven, The Netherlands

Keywords:
Heat, Humidity, Air Quality, Thermophysiology, Metabolism

Abstract:
With increased airtightness and insulation of naturally ventilated buildings, air flow is dependent of window operation and air tightness, especially during hotter periods of the year. Along with lowered air exchange, there is also an increased accumulation of volatile organic compounds (VOCs) and bioeffluents emitted by occupants. Moreover, many indoor activities including cooking, showering, exercises and other activities lead to increase in moisture. These added compounds in the air may affect thermophysiological responses as well as energy and substrate metabolism. Extreme heat can impair heat dissipation resulting in physiological changes including decreasing metabolic rates to cope with the added heat gain. Therefore, this study aimed to examine the combined effect of indoor air quality or humidity and heat on energy and substrate metabolism during acute but prolonged exposure (>8h). The main research objective was to examine how high relative humidity (30% vs 70%) or reduced ventilation (100L/s vs 500L/s) in combination with heat affects physiological parameters at neutral room temperatures (23 or 25°C) or high temperatures (32 or 35°C). Participants underwent 4 different conditions on 4 different test days with at least 2 days in-between in 2 separate studies. Participants were blinded to the humidity or ventilation levels. The samples consisted of 18 and 22 healthy adults of both sexes between 18-39 years. The main physiological measures were core temperature (CT), skin temperature (ST), heart rate (HR), oxygen consumption (VO_2), expired carbon dioxide (VCO_2), and energy expenditure (EE). Each test day consisted of 8 hours in a climate controlled metabolic chamber (OMNICAL, Maastricht Instruments) at Maastricht University. Average metabolic rates over 8 hours did not differ significantly between sessions with varying temperature and humidity levels or ventilation levels combinations.

Poster Abstracts

P6:
Constant-Routine Protocol Reveals an Endogenous Circadian Rhythm in Diet-Induced Thermogenesis Among Adults with Overweight/Obesity

Authors:
Nina Vujovic[1,2,5], Han-Chow E. Koh[1,2,5,*] Su Wei Heng[1], Priyanka Panjwani[1], Charlotte Van Zee, Wei Wang[1,2], Jingyi Qian[1,2], Marta Garaulet[3,4], Frank A.J.L. Scheer[1,2,*]
1 Medical Chronobiology Program, Division of Sleep and Circadian Disorders, Departments of Medicine and Neurology, Brigham and Women's Hospital, Boston, MA, USA
2 Harvard Medical School, Boston, MA, USA
3 Department of Physiology, Regional Campus of International Excellence, University of Murcia, Murcia, Spain
4 Biomedical Research Institute of Murcia, IMIB-Arrixaca UMU, University Clinical Hospital, Murcia, Spain
5 These authors contributed equally

Keywords:
Energy expenditure, circadian rhythm, constant routine protocol, thermic effect of food

Abstract:
This study determined if there exists an endogenous circadian rhythm in DIT and what its timing is, especially in a highly-relevant population – people with overweight/obesity. To test for an endogenous circadian rhythmicity in DIT, i.e., unmasked from daily behavioral and environmental cycles, 16 adults (12 males; mean±SD age, 36±11years; BMI, 28.8±2.4kg·m-2) completed a gold-standard circadian protocol. This was achieved by a Constant Routine (CR) protocol consisting of 36h of continuous wakefulness, semi-recumbent body posture, physical rest, and dim light, and with identical, isocaloric test meals every six hours. DIT was assessed by repeated indirect calorimetry following each identical test meal matched for fasting duration. Endogenous circadian rhythmicity in DIT was quantified both without and with adjustment for the individual endogenous circadian rhythm in fasting energy expenditure (fasting EE).
The peak-to-trough amplitude in normalized DIT was ~44% of the mean and with a peak and trough in the biological morning and evening, respectively (p=0.005; equivalent to ~8AM/~8PM, respectively). After adjusting for the endogenous circadian rhythm in fasting EE, the circadian rhythm remained significant with remarkably similar circadian timing, although with slightly reduced amplitude (~7AM/~7PM; ~29%; p=0.026). This uncovered endogenous circadian rhythm in DIT, in people with overweight/obesity, highlights the relevance of food timing as a contributing factor in energy regulation.

Poster Abstracts

P7:
Feasibility, Reproducibility and Cold-Induced Energy Expenditure using Whole-Room Calorimetry in Adults and Children

Authors:
Paige Cheveldayoff, Bader Alamri, Dongdong Wang, Rogelio Cruz Gonzalez, Aaron Thomas, Norm Konyer, Michael D. Noseworthy, Hertzel C. Gerstein, Zubin Punthakee, Gregory R. Steinberg, Katherine M. Morrison.

Abstract:
Context: To understand energy balance, whole-room indirect calorimetry (WRIC) allows for accurate measurement of energy expenditure (EE).
Objectives: To examine the relationship between cold-induced resting EE and brown adipose tissue (BAT) activity measured by MRI, evaluate WRICS performance and feasibility of use in children and adults.
Methods: The WRICS was equipped with a Promethion High-Definition Room Calorimetry system. Technical validation utilized N_2 and CO_2 gas infusions. Healthy adults (n=21)and children aged 8-17 years (n=18) attended two 4-hour WRIC visits (one week apart) and one MRI visit. Resting EE at 25°C (REE25) was compared between visits and to REE at 18°C (REE18). Recruitment and completion rates were examined. BAT activity was assessed by MRI as the decline in supraclavicular proton density fat fraction during 18°C cold exposure.

Results: Gas infusion testing confirmed high accuracy (RER=0.99; 95% CI 0.991–0.996). Study completion rates were high (Adults: 20/21; Children: 18/18). REE25 was consistent between visits (Adults: 1.68 vs 1.66 kcal/min, p=0.77; Children: 1.57 vs 1.51 kcal/min, p=0.31) with good reproducibility (ICC Adults: 0.766; Children: 0.887). Cold exposure increased REE by 0.21 kcal/min (adults) and 0.07 kcal/min (children). BAT activity was correlated with REE18 in adults (r=0.49, p=0.04).
Conclusion: WRICS use was feasible in adults and children. The WRICS measurement was accurate, measures of REE were reproducible and changes in EE during cold were measurable, and related to BAT activity, supporting the usefulness of this system in the assessment of EE in response to interventions in adults and children.

Poster Abstracts

P8:
Linking Whole-Body Metabolic Flexibility to PBMC Mitochondrial Phenotypes in Adults With Obesity Receiving GLP-1 Therapies

Authors:
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Department of Nutrition Sciences, University of Alabama at Birmingham, Birmingham, Alabama USA 35233

Keywords:
Metabolic flexibility, whole room indirect calorimetry, energy expenditure, anti-obesity medications

Abstract:
Glucagon-like peptide-1 (GLP-1) receptor agonist therapies produce clinically meaningful weight loss and consistently shift whole-body utilization toward greater fat oxidation1. Whole-room indirect calorimetry (WRIC) studies demonstrate that these substrate utilization changes occur largely independent of alterations in energy expenditure, even after adjustment for body composition. These findings highlight metabolic flexibility—the capacity to appropriately transition between carbohydrate and lipid oxidation—as a clinically relevant phenotype dissociable from total energy expenditure. However, respiratory exchange ratio (RER), the primary index of metabolic flexibility, is an integrated output that cannot resolve the cellular mechanisms underlying altered fuel utilization.
This protocol will integrate high-precision WRIC with peripheral blood mononuclear cell (PBMC) mitochondrial phenotyping in adults with obesity receiving GLP-1 receptor agonist therapy. The objective is to link whole-body metabolic flexibility to cellular bioenergetics. Under strict weight-stabilized conditions, participants will complete WRIC
assessments with a standardized high-fat meal test at baseline and following achievement of approximately 10% weight loss. Primary whole-body outcomes include sleeping, 24-hour, and postprandial RER dynamics, with energy expenditure analyzed using standard adjustment for body composition. Concurrently, PBMCs collected in the fasted and postprandial state will undergo high-resolution respirometry to quantify mitochondrial oxidative capacity, substrate-linked respiration, coupling efficiency, and reserve capacity. Longitudinal within-person analyses will determine whether changes in mitochondrial phenotype track with whole-body substrate oxidation. The protocol enables mechanistic interrogation of whether GLP-1–associated shifts in metabolic flexibility reflect remodeling of mitochondrial oxidative function in humans.

Poster Abstracts

P9:
CHamber-based Assessment of Metabolic PhenotypeS (CHAMPS): A reproducibility blueprint for multiple room comparisons

Authors:
Christopher Colvin[1], Silvia Yesenia Lopez Torres[1], Bre McDonald[1], Erica Wohlers[2], Jon Moon[2], Samuel LaMunion[3], Kelly Berg[1], Holly Wyatt[1], Barbara Gower[1], Kathryn J. Whyte[1]

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Key words:
Whole room indirect calorimetry, energy expenditure, reproducibility, Methods

Abstract:
Whole-room indirect calorimetry (WRIC) provides the most precise and integrative assessment of human energy expenditure (EE) and substrate oxidation over 24 hours, yet variability in chamber design, protocol execution, and analytic approaches limits of reproducibility and cross-study comparability. CHamber-based Assessments of Metabolic PhenotypeS (CHAMPS) is a comprehensive human phenotyping methodological framework designed to rigorously evaluate the reliability and feasibility of WRIC measurements across multiple chamber configurations and study conditions. CHAMPS will enroll adults to undergo repeated, standardized chamber stays across a three-room WRIC suites with different room volumes (range: 5K L-26K L), optimized for both extended and short-term metabolic assessments. Participants will complete multiple 23–36-hour calorimeter sessions incorporating controlled feeding, resting energy expenditure (REE), thermic effect of food (TEF), exercise, and sleep. Primary outcomes include within-subject and between-calorimeter variability in total EE, REE, TEF, exercise EE, and respiratory exchange ratio (RER), quantified using intraclass correlation coefficients and Bland–Altman analyses. Secondary objectives evaluate the feasibility of extended participant run-in periods and energy balance stabilization required to detect small but biologically meaningful metabolic changes in future intervention trials. These findings will inform best practices for calorimeter qualification and study design while also providing the infrastructure needed to support mechanistic studies of obesity heterogeneity. By integrating rigorous run-in procedures, standardized meals, behavioral controls, biospecimen collection, and high-resolution gas exchange data, CHAMPS serves as a foundational framework enabling standardized metabolic phenotyping and scalable harmonization for future multisite investigations.

Transport guide

Here you'll find a transport guide to help you around Aarhus.

1. Arriving in Denmark

By Train - Aarhus is well connected by Denmark's national rail network, as well as to Germany. Direct trains from Copenhagen take about 3–3.5 hours and the direct trains from Hamburg take 4-5 hours. Trains arrive at Aarhus Central Station in the city centre. For timetables and tickets please go to www.dsb.dk. Trains from or through Germany can be booked through Deutsche Bahn instead.

Copenhagen Airport (CPH, Kastrup Airport) is the largest airport in Denmark. From there you have easy rail or bus access to Aarhus:

- Direct train from Copenhagen Airport to Aarhus Central runs frequently and takes about 3 hours. For timetables and tickets please go to www.dsb.dk. Book early for discounted DSB Orange tickets (valid only for the selected departure).

- Direct long-distance buses run from Copenhagen Airport to Aarhus in about 4 hours. The bus drives onto a ferry, where you can get off the bus and walk around the ferry. Book via Kombardoexpressen. If you are more comfortable on land, you can also take a Flixbus.

2. Arriving at Billund Airport

The airport bus Bus 912x goes directly from Billund airport to Aarhus. It takes about 1,5 hours and usually scheduled to leave every hour.
You can check the schedule on Midttrafik or Google Maps.

You can also find the bus schedule on the schedule board before the exit door at the airport.
The bus stop is just in front of the exit gate of the airport.

You can buy the ticket on Rejseplanen app or website, or from the driver on the bus (card payment possible). The ticket price is around 164-172 DKK.

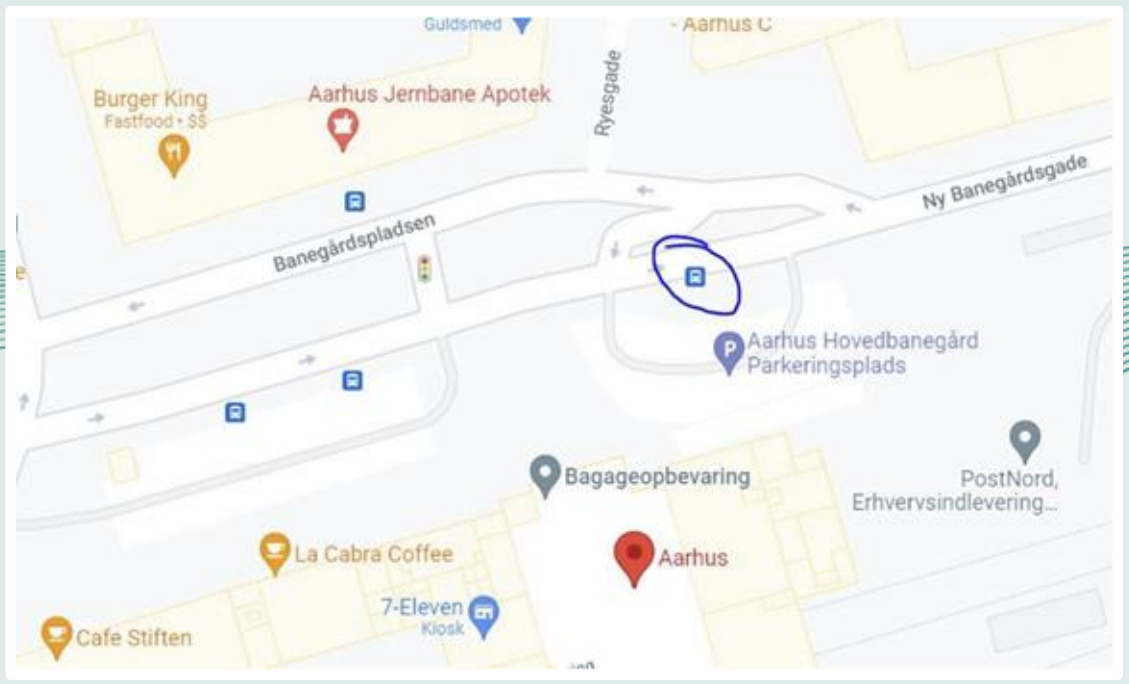
You will be dropped off at Aarhus Rutebilstation, which is also where the bus starts when leaving for Billund airport.

Airport bus 912x from Billund.

Transport Guide

3. Arriving at Aarhus airport

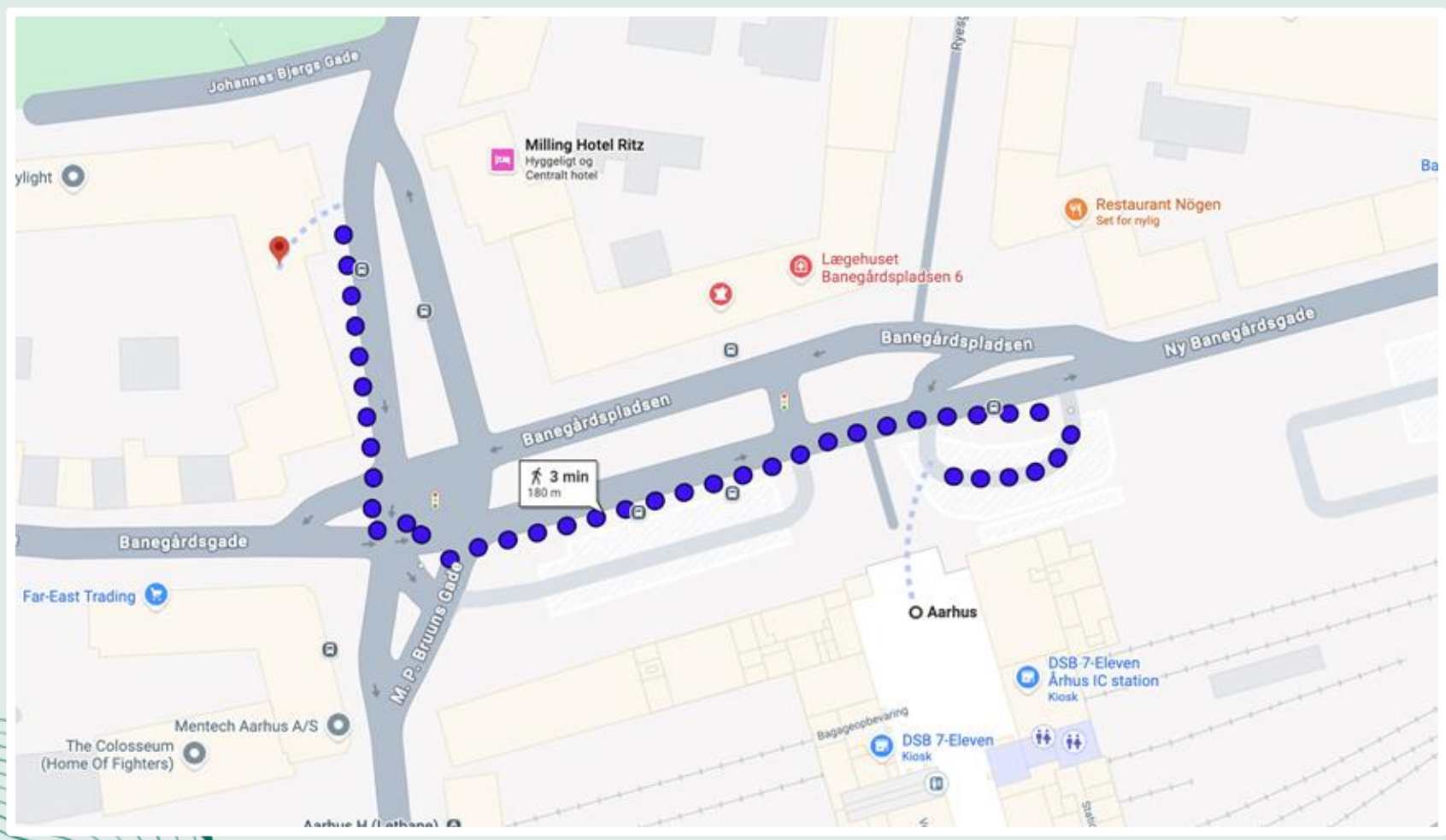
The airport bus Bus 925x leaves just outside the arrival hall and brings you directly to Aarhus Central Station (Aarhus H), which is also where the bus starts when leaving for Aarhus airport. Busses run in connection with flight arrivals, so you generally won't need to wait long, and the bus waits if the flight is delayed. The bus takes ~45–50 minutes. You can buy your tickets on the bus or from the Midttrafik App which will cost 115 DKK.



Drop-off/pick-up spot for bus 925x at Aarhus H.

3. From Aarhus H to The Scandic Mayor

The Scandic Mayor is walking distance from Aarhus H. We suggest using Google Maps when moving around in Aarhus.



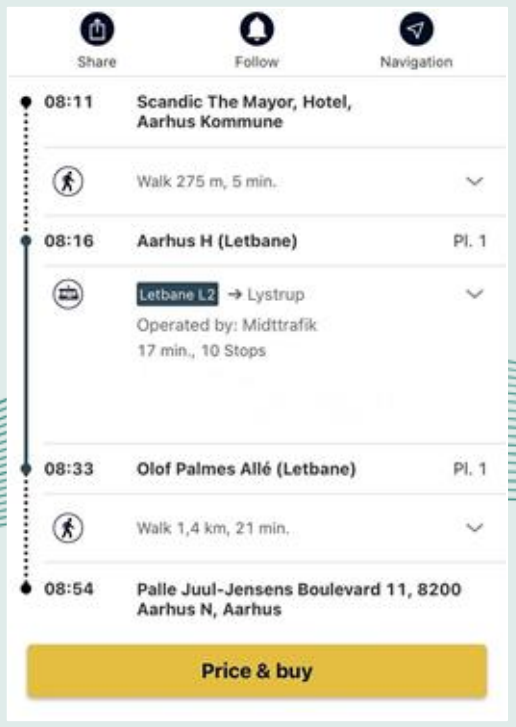
Walking route from Aarhus H to The Scandic Mayor.

Transport Guide

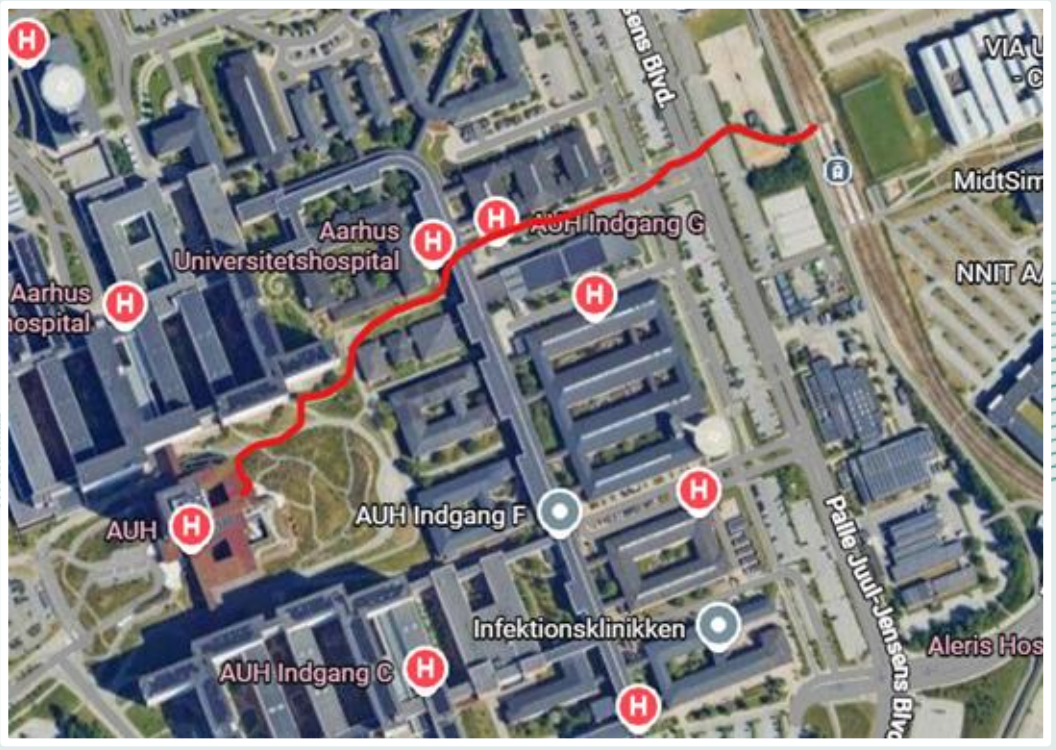
4. From The Scandic Mayor to SDCA

When travelling from the hotel til Steno Diabetes Center Aarhus with public transportation, we suggest two options.

We recommend you take Letbanen (L2 → Lystrup) from Aarhus H. Tickets for Letbanen can be bought at the platform or at Rejseplanen. You should get off at "Aarhus Universitetshospital (Letbane)". When you arrive at the stop Thursday morning, we will have people there to show you the shortest way to the hospital.
When taking Letbanen back to Aarhus it should be L2 → Odder.



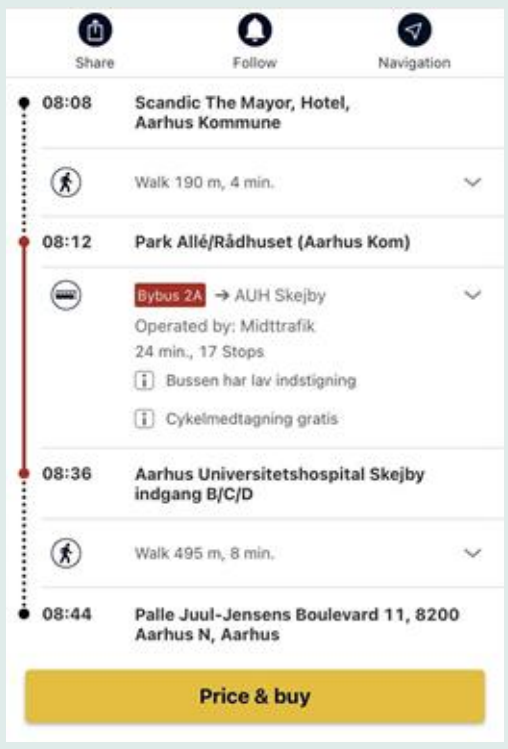
Example of route plan in Rejseplan App.



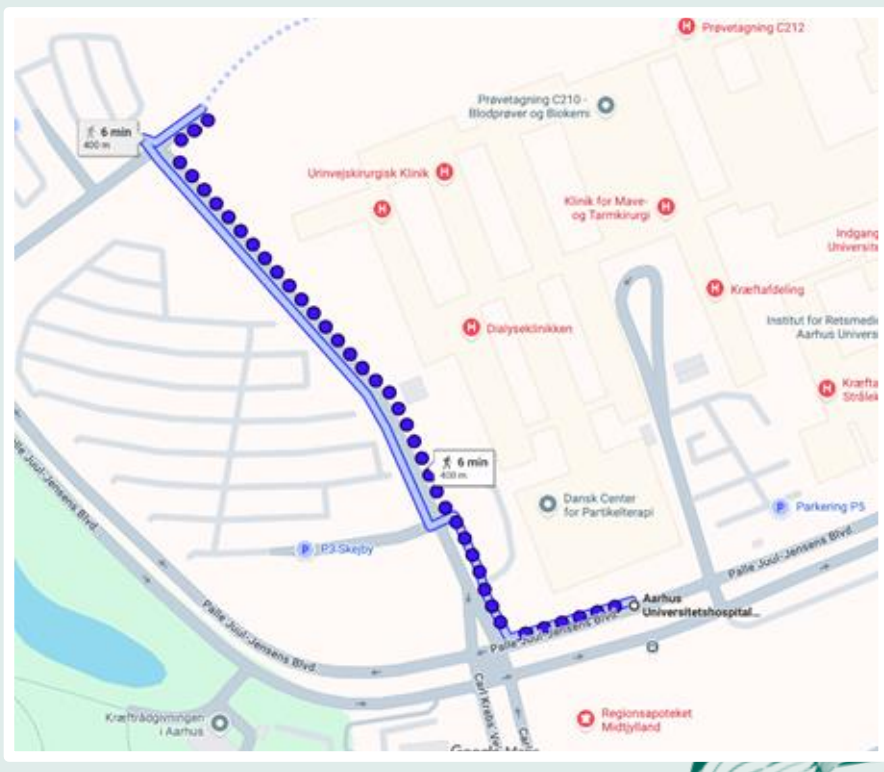
Walking route from Letbanen stop to SDCA

Alternatively, Bus 2A leaves 200 meters from the hotel, at the stop "Park Allé/Rådhuset (Aarhus Kom)". The drive takes ~ 35 minutes. You should get off at "Aarhus Universitetshospital Skejby indgang B/C/D". From here there is ~ 6 minutes by foot to SDCA. Tickets can be bought directly at Rejseplanen, on the route you would like to take or in the Midttrafik app or webshop.

The bus leaves every 10 minutes in the morning and every 15 minutes in the evening.



Example of route plan in Rejseplan App.



Walking route from the bus stop to SDCA

Aarhus Guide

We hope you are looking forward to your stay in Aarhus aka "The city of smiles". We have collected a few recommendations, but we highly recommend to check out Visit Aarhus for more inspiration.

1. Attractions and museums

At ARoS, you can experience modern art (e.g. Boy), works by Skagen Painters, and a panoramic view of Aarhus from the rainbow rooftop. **We will leave a voucher for free entrance to ARoS at the reception of the hotel.**

Enjoy a walk through Den Gamle By, an open-air museum with recreations of Danish towns from the 18th century to today.

KØN is a cultural history museum focusing on gender and equality. Its café is cute and accessible even if you do not visit the exhibitions.

At Moesgaard, you can explore archaeology and Viking history in an award-winning building.

2. Walks with a view

Enjoy a walk through the University Park and explore the two small lakes at campus – imagine the park being filled with 40,000 students during the annual "Kapsejlads".

Riis Skov offers a nature experience in the city, with beautiful ocean views of Aarhus Ø.

In the southern part of the city, you can spot deer and other wildlife in Marselisborg Dyrehave, while also enjoying views of the sea.

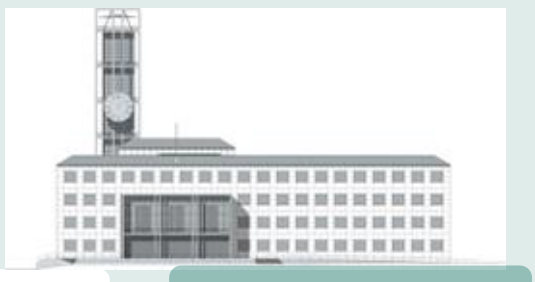
3. Cafés

La Cabra is for the coffee nerd. Here, you can get great guidance on different beans while also enjoying their amazing pastries.

For the workaholic, we recommend Lynfabrikken - a spot where concentration meets cozy, and where breaks from the laptop should include drinks and snacks.

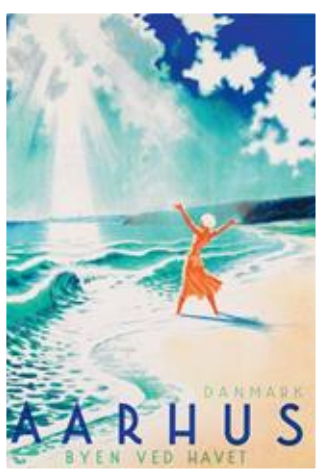
If you are a true explorer, visit Salling Roof Top. Here you can combine your café need with a panoramic view of Aarhus.

PS: If you are lucky, some bakeries still have "Fastelavnsboller"! Check out this guide to find the best in town and get ready for a true hunt.



Aarhus Town Hall

ARoS



Aarhus Ø

Aarhus University

Thank you

to the sponsors who made this WRIC event possible!

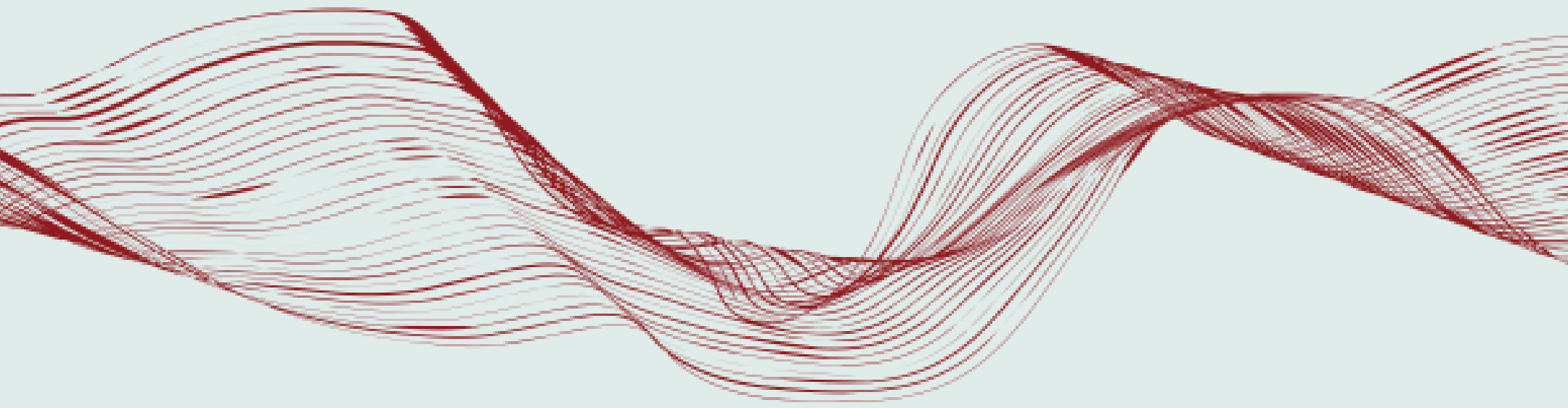
We are incredibly grateful for the support from the DDEA and the Carlsberg Foundation. Without their support this event would not have been possible.

Additionally, we want to thank Sable Systems for their sponsorship. Please visit their stand during the event.

We also want to thank everyone who signed up for this event. We are very excited to welcome you all and hopefully have two great days in Aarhus.

With best wishes and gratitude from the organizing committee:

Nina Ziegenbein, M.Sc., PhD student, Steno Diabetes Center Aarhus, Aarhus
Jens Hohwü Voigt, MD, PhD student, Steno Diabetes Center Aarhus, Aarhus
Jens Lund, M.Sc., PhD, PhD, Postdoc, Novo Nordisk Center for Basic Metabolic Research, Copenhagen
Zach Gerhart-Hines, PhD, Associate Professor, Novo Nordisk Center for Basic Metabolic Research, Copenhagen



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CARLSBERG FOUNDATION

Danish Diabetes and Endocrine Academy

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