2022 Conference Research Master Human Movement Sciences

Monday August 29, 2022

Tuesday August 30, 2022

Location: Auditorium (O2 Building)
(VU Campus map: https://vu.nl/en/about-vu/more-about/vu-campus-map)

Monday August 29

09.00-09.20	**Coffee**	
09.20-09.30	**Opening Dr. Huub Maas**	
09.30-10.20	**Keynote speaker – Dr. Pieter Meyns** **"Current knowledge on balance in children with cerebral palsy; perspective based on the Systems Framework for Postural Control"**	
10.20-10.40	**David Gotti**	The YAP-TEAD-MST1 positive feedback loop potentiates virus-induced apoptosis
10.40-11.10	**Break + Coffee**	
11.10-11.30	**Britt van Hees**	Measuring pelvic floor muscles following involuntary contraction via TMS: protocol development and preliminary testing
11.30-11.50	**Kai Man**	Measuring strength and fatigue resistance of elbow flexors using dynamometry in men and women, a cross-sectional study
11.50-13.00	**Lunch**	
13.00-13.50	**Keynote speaker - Dr. Karin Gerrits** **"Personalized training of physical fitness in rehabilitation: from science to practice"**	
13.50-14.10	**Anne Strating**	Quantity over quality: Mitochondrial alterations in type 1 diabetes mellitus
14.10-14.30	**Braeden Charlton**	Skeletal muscle damage and inflammatory response after exercise in Post-Acute Sequelae of Covid-19 with post-exertional malaise
14.30-14.50	**Tom Kerkhoff**	Determinants of exercise intolerance and post-exertional malaise in patients with post-acute sequelae of COVID-19
15.00-15.30	**Break + Coffee**	
15.20-15.40	**Matthijs van der Laan**	Aerobic exercise capacity and training adaptation is not impaired in active people with adequately controlled type 1 diabetes mellitus
15.40-16.00	**Roosmarijn Brenninkmeijer**	Walking on slopes and lateral inclines: the effect of prosthetic foot stiffness on gait stability in transtibial amputees

Tuesday August 30

9.30-10.10	**Coffee**	
10.10-11.00	**Keynote speaker – Margit M. Bach (PhD student)** **"A Running Start"**	
11.00-11.20	**Cara Knott**	The Effects of Aging on Corticomuscular Coherence during Bimanual Precision Tasks
11.20-11.40	**Aslan Bellmann**	Assessing muscle co-activation dynamics by counting motor evoked potentials
11.40-12.00	**Nienke Haakma**	Exploring sweat as an information-rich biofluid: Validation of the fluidic patch sweat sampling technique
12.00-13.00	**Lunch**	
13.00-13.10	**Announcement by Director AMS Institute (Prof. Richard Jaspers)**	
13.10-13.30	**André Brito Valente**	Can irisin reverse the Warburg effect in melanoma cells?
13.30-13.50	**Michelle Verhoeven**	From Marker to Markerless: Validating DeepLabCut for 2D Sagittal Plane Gait Analysis in Adults and Toddlers
13.50-14.30	**Break + Coffee**	
14.30-14.50	**Nienke Heida**	Quantifying signs of motor fatigability during prolonged walking in multiple sclerosis patients using kinematics, kinetics, and electromyography
14.50-15.00	**Closing**	
15.00	**Drinks**	

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Abstracts
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Current knowledge on balance in children with cerebral palsy; perspective based on the Systems Framework for Postural Control

Dr. Pieter Meyns

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Balance is a prerequisite to perform daily functional activities and independent mobility. As such, the maturation of balance control determines at what time challenging skills and new milestones can be acquired over the course of human development. Given its importance in achieving new and challenging skills, it is not surprising that balance (control) is often addressed in the rehabilitation of different patient populations with movements disorders or affected motor control. To assess balance or evaluate the effect of a balance training program in a patient population, a specific measure of balance is often selected based on the availability, user-friendliness, or general use in clinics or research. Although each specific measure can be informative and insightful, this type of research does not always provide a clear and full picture of the balance profile or the effectiveness on the different aspects/domains of balance for the population studied. In the current presentation I will show the current knowledge on balance in children with cerebral palsy and by doing so I will address the terminology used in balance research and the complexity and encompassing subdomains of balance control.

The YAP-TEAD-MST1 positive feedback loop potentiates virus-induced apoptosis

David Gotti

Dr. R.C.I. Wüst; Dr. K. Maedler

Background: The Hippo pathway classically regulates embryonic development and organ size. Lately, it became also known within complex metabolic and immunological networks, which are involved in many diseases, such as diabetes. A modulation of this pathway can protect pancreatic β-cells from diabetogenic insults. Both, MST1 (Mammalian Sterile 20-like kinase), one of the Hippo core kinases, and YAP, the transcriptional coactivator Yes associated protein, have been linked to immune modulation, but with opposite functions in a cell-dependent manner. A poor understanding of this pathway during viral infection and its feedback loops remains. Considering the severe increase in COVID-19 mortality with type 2 diabetes, there is an urgent need for bridging this knowledge gap.
Objectives: 1) To discover a feedback loop from YAP to MST1 (2) Whether this feedback loop is TEAD-mediated. (3) How this feedback loop regulates viral infection in pancreatic β-cells.
Methods: YAP adenoviral transduction or YAP plasmid transfection was used to overexpress YAP in rat INS-1E cells. The relation between YAP and its transcription factor TEAD (TEA domain) was studied through disruption of their interaction using: (1) Verteporfin, (2) YAP-S94A plasmid or (3) TEAD inhibitor plasmid. The diabetogenic enterovirus CVB4 (Coxsackievirus) was used for infection.
Analysis: Statistical significance was determined using a two-tailed Student's t test (p-value ≤ 0.05), with data from at least 3 independent experiments.
Results: (1) YAP potentiated viral infection in pancreatic β-cells seen by increased viral protein (VP1) and apoptosis (cleaved caspase-3). (2) YAP overexpression increased MST1 independently of viral infection. (3) YAP-mediated MST1 upregulation required YAP-TEAD binding. (4) YAP overexpression downregulated TBK1 (TANK-binding kinase).
Conclusion: These novel results show the existence of a TEAD-mediated positive feedback loop from YAP to MST1, which potentiates viral infection. The constitutive absence of YAP in mature pancreatic β-cells may provide a protection from excessive viral responses.

Measuring pelvic floor muscles following involuntary contraction via TMS: protocol development and preliminary testing

Britt van Hees

Prof. Dr. A. Pool-Goudzwaard; Dr. H. Maas

Pelvic floor dysfunction (PFD) is a life-altering problem, causing impairments in bowel, bladder and sexual function. It is unknown whether PFD is driven solely by the central nervous system, or if local changes in the properties of pelvic floor muscles (PFMs) also play a role. Taking an integrated approach with neuromechanics, by investigating the electromechanical delay (EMD) and silent period (SP) of the PFMs via single-pulse transcranial magnetic stimulation (TMS), may provide insight into this debate. The EMD correlates with a muscle's stiffness, and local changes in muscle activation states or physiology can be inferred. TMS elicits reproducible involuntary contractions, which enable more robust EMD measurements, and also generates a SP, i.e., a suppression in the EMG signal following a MEP that represents cortical and spinal inhibitory mechanisms.

Our long-term research goal is to use the EMD and SP measures to determine the extent that local PFM adaptations perpetuate PFD in women. Since these metrics have not been reliably applied to PFMs, our first research aim was to develop a protocol to measure EMD and SP in the PFMs of healthy women using single-pulse TMS. Our second research aim was to perform preliminary testing of the protocol in order to establish a basis for a future proof-of-concept study. Using literature and experimental data, best practices for TMS, sensor application, contraction conditions, and data analysis methods are presented. We then show preliminary test results of the fully applied protocol in one healthy female participant. Finally, we discuss the merits and limitations of the protocol and preliminary findings.

We are the first to measure PFM-based EMD and SP using synchronous vaginal EMG and pressure sensors. Challenges regarding TMS non-responsiveness and breathing contamination require additional attention, however our protocol can be directly applied to a future proof-of-concept study.

Measuring strength and fatigue resistance of elbow flexors using dynamometry in men and women, a cross-sectional study

Kai Man

Dr. K. Gerrits

Objectives: The aim of this project was to develop a performance test of the elbow flexors using dynamometry. Maximum voluntary contraction (MVC) and fatigue threshold (FT) was determined. We hypothesized that this test was able to detect differences between men and women. In addition, test-retest reliability was determined.
Design: This study used a cross-sectional design.
Subjects: This study included 16 healthy untrained males and females aged between 18 and 50 years old.
Methods: The participants underwent a MVC measurement followed by an incremental protocol. The test ended when the participant failed to deliver performance. The participants were tested on two occasions for test-retest reliability analysis.
Analysis: Measurement was recorded and stored for offline analysis. After filtering and rectifying signals, FT was determined when EMG/force ratio was disproportionally increasing. Intra-class correlation (ICC), a Bland & Altman plot (B&A), and minimal detectable difference (MDD) was determined for reliability.
Results: On both occasions males scored 39% higher in MVC compared to females ($p<0.001$). MVC were comparable with an ICC of r = 0.98, $p<0.00$ and B&A plot showed 95% datapoints between limits of agreement (LOA) and no linearity (R^2 = 0.04, $p=0.46$). MDD_{MVC} was determined at 1.66 Nm. In FT measurements, males scored 20% lower than females ($p=0.13$). FT were comparable with an ICC of r = 0.75, $p<0.001$ and B&A plot showed 100% datapoints between LOA, no linearity (R^2 = 0.07, $p=0.43$). However, all participants scored lower on the second occasion leading to a consistent difference between measurements. MDD_{FT} was determined at 3.99 %MVC.
Conclusions: This study shows that the arm dynamometer is able measure differences in MVC between untrained healthy men and women. FT determination was possible but not convincing. Too many factors were influencing results. Nevertheless, there was a pattern of a clear trend.

Personalized training of physical fitness in rehabilitation: from science to practice

Dr. Karin Gerrits

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Training of physical fitness (PF), including strength and endurance training is considered a key-element of rehabilitation for many patients to improve activities of daily living (ADL). For instance patients with neurological disorders such as stroke and MS benefit form PF training as it improves muscle strength and aerobic capacity, thereby enhancing gait and exercise performance. This beneficial effect of PF training extents to various other patient populations, such as after COPD, cancer, amputees, neuromuscular disease, and more recently, also patients after COVID-19. In addition, it applies to rehabilitation of even more vulnerable patients such as frail elderly during geriatric rehabilitation or during intensive care treatment. Besides the benefits for functioning/performance PF training has also shown to help reduction of risk factors for cardiovascular disease such as high blood pressure and is part of the Dutch physiotherapy-guidelines for stroke, COPD and Covid-19.
Despite the overwhelming evidence, implementation of PF is still sub-optimal in many rehabilitation centres, where traditional PF training of patients frequently lacks evidence based programs or is prescribed and executed based on more general guidelines. Besides, the exact programming of PF varies between rehabilitation centres. This may partly relate to the prevailing gap between science and practice. Exercise science usually addresses development of new scientific knowledge but *implementation* of this knowledge into clinical practise requires different and specific implementation activities. This seems especially relevant for implementing personalized PF in rehabilitation that usually deals with complex disorders in patients with sometimes severe limitations.
This lecture will discuss the various analogous effects of PF training for different patient populations, discuss the current state of implementation in the Dutch rehabilitation centres and highlights how implementation science and practice can help improving the application of exercise knowledge into rehabilitation practice.

Quantity over quality
Mitochondrial alterations in type 1 diabetes mellitus

Anne Strating

Dr. R.P. Goulding; Dr. R.C.I. Wüst

People with Type 1 diabetes mellitus (T1DM) have poorer exercise tolerance and slower oxygen uptake kinetics as compared to healthy individuals. Mitochondrial impairments might underlie the exercise intolerance in T1DM patients, and a recent study suggests mitochondrial impairments in T1DM muscle. Nevertheless, a clear understanding of these mitochondrial alterations in human skeletal muscle is lacking. **Purpose**: The present study therefore aimed to examine any differences in mitochondrial metabolism, function, and morphology between T1DM patients and controls matched for sex, body mass index (BMI), age, and previous level of physical activity. **Methods**: Muscle biopsies from T1DM patients (N=16) and controls (N=11) were taken from the vastus lateralis. Mitochondrial respiration was assessed by a substrate-uncoupler-inhibitor titration (SUIT) protocol using a high-resolution respirometer (Oroboros O2k, Innsbruck, Austria). Biopsies frozen in liquid nitrogen were sectioned and stained for succinate dehydrogenase (SDH) activity and fiber type composition. Mitochondrial ultrastructure was assessed using transmission electron microscopy (TEM). **Results**: We found no difference in parameters for maximal oxygen uptake, or absolute mitochondrial respiration. Nevertheless, analysis of images captured by the TEM revealed more disorganized, loose, and unclear cristae in mitochondria of T1DM patients (T1DM 3,76±0,30 vs CON 3,38±0,15 p=0,0380). In addition, OXPHOS capacity normalized to SDH activity was reduced in T1DM patients, especially of complex II (T1DM 58,32±21,40 vs CON 82,90±35,72 47 pmol mg^{-1} s^{-1}, p=0,0454). **Conclusion**: These results show morphological changes in mitochondria of T1DM patients. These ultrastructural changes are accompanied by a relative reduction in OXPHOS capacity. Nevertheless, absolute respiration capacity and exercise capacity are preserved, suggesting that mitochondria of T1DM patients might have adapted to different strategies to meet metabolic demand.

Skeletal muscle damage and inflammatory response after exercise in Post-Acute Sequelae of Covid-19 with post-exertional malaise

Braeden Charlton

Dr. R.P. Gouldin;, Dr. R.C.I. Wust; M. Eggelbusch

Background: Typical acute Covid-19 infection resolves within 2-3 weeks in most healthy individuals with seemingly minimal long-term effects. However, it is estimated that between 10-30% of infections result in symptoms persisting longer than 12 weeks, and upwards of years following initial infection. The persistence of symptoms is known as long Covid or post-acute sequelae of Covid (PASC). Commonly associated with PASC is chronic fatigue and post-exertional malaise. My current research aimed to investigate skeletal muscle mitochondrial function, muscle morphology, beta-amyloid deposition, and systemic and local inflammation.
Methods: Muscle biopsies and blood were obtained from PASC patients and controls before and after a ramp-test protocol to induce post-exertional malaise. Mitochondrial respiration was evaluated in permeabilized fibres using a substrate-uncoupler-inhibitor titration protocol on the Oroboros Oxygraph2K. Muscle biopsies were sectioned and stained for a variety of markers including succinate dehydrogenase (SDH) activity, beta-amyloid, capillaries, nuclei, macrophages, natural killer cells, and B-cells. Blood plasma was utilized for relative quantification of mtDNA using qPCR.
Results: No differences in respiration data were found in the pre to post conditions for either group, however PASC patient groups should significantly lower in NADH-linked respiration, Succinate-linked respiration, Oxidative Phosphorylation, and Electron Transport System respiration. No differences were found in SDH activity between groups. Beta-amyloid deposition did not significantly change before or after exhaustive exercise, however there was a significantly higher amount of beta-amyloid deposition in both pre- and post-exercise in the PASC group than the control group. Pathology scores were not different between groups at pre- or post-exercise. Relative mtDNA concentrations were not different between groups at either time point.
Conclusion: Despite some reports suggesting PASC is psychosomatic, my current research indicates that PASC patients suffer from reduced mitochondrial respiration and have higher amounts of beta-amyloid deposition. More research is needed to understand the cascade of events resulting in PASC, particularly in the chronic fatigue and post-exertional malaise phenotype.

Determinants of exercise intolerance and post-exertional malaise in patients with post-acute sequelae of COVID-19

Tom J. Kerkhoff

Dr. R.C.I. Wüst

Many COVID-19 patients, instead of recovering normally, suffer from prolonged symptoms (>3 months), called post-acute sequelae of COVID-19 (PASC). However, the underpinning mechanisms of the primary symptoms, fatigue, exercise intolerance and post-exertional malaise (PEM) are currently unknown. These symptoms significantly complicate the rehabilitation process, as moderate exercise is the cornerstone for rehabilitation in virtually all chronic diseases. The first objective to define the limitations to exercise tolerance and their magnitude in PASC patients, compared to healthy controls. The second objective is to identify the responses after the induction of PEM and its effect on daily life in PASC patients.
Twenty-six patients with PASC that experience PEM from the post-COVID clinic of the Amsterdam UMC, and twenty-five matched healthy controls were recruited. Patients filled in two questionnaires, the Fatigue Severity Scale (FSS) and the Multidimensional Fatigue Inventory (MFI), scored there perceived fatigue from 1 to 10 and received a heartrate monitor and an activity monitor for two weeks. During a subsequent visit, a cardiopulmonary exercise test with Near Infra-Red Spectroscopy (NIRS; to assess the ratio between oxygen consumption and delivery) is performed. Aerobic variables and power output was measured during a ramp incremental exercise test. Maximal oxygen uptake ($\dot{V}O_{2max}$) is 27.28 ± 7.69 $ml \cdot kg^{-1} \cdot min^{-1}$ in the patients and 37.15 ± 6.76 $ml \cdot kg^{-1} \cdot min^{-1}$ in the controls. Maximal power output (PO) was 195 ± 59 Watts in the patients and 269 ± 60 Watts in the controls. Muscle deoxygenation during peak exercise is lower in patients (69.42 ± 23.62% [HHB]) than in the controls (84.06 ± 11.35% [HHB]). PASC patients feel more fatigued than controls, suggested in the FSS, MFI, without differences in between before and after exercise. The self-reported fatigue was also higher in patients and increased after exercise. The amount of steps taken per day is significantly lower in patients (42.69 ± 1924 steps) compared to healthy controls (6340 ± 1924 steps), without differences in between before and after exercise. Last of all, the heart rate and heart rate variability are not different between patient and controls. Therefore, exercise intolerance in PASC patients is explained by the inability to subtract oxygen from the blood to the muscles, which results in a lower exercise tolerance in PASC patients. The causes for the responses after exercise, causing PEM, are not so clear, since we don't see a difference in heart rate variability and therefore chronic inflammation and the perceived fatigue measured in the questionnaires also don't differ after heave exercise, while they do on the self-reported fatigue scale. Further research is necessary to truly understand the ongoing processes causing the PEM.

Aerobic exercise capacity and training adaptation is not impaired in active people with adequately controlled type 1 diabetes mellitus

Matthijs van der Laan

Dr. R.C.I. Wüst; Dr. R.P. Goulding

Introduction: Literature indicates a reduced exercise capacity in people with type 1 diabetes mellitus (T1DM), also in those exceeding physical activity guidelines. This suggests that adults with T1DM are less responsive to exercise training, but this is yet unclear.
Purpose: To compare aerobic exercise capacity between people with T1DM and matched healthy controls both before and after an exercise training intervention.
Method: 18 people with T1DM (HbA1c 6.4±0.7%) and 16 matched healthy controls performed a maximal ramp incremental test on a cycle ergometer. A subgroup of 9 people with T1DM (HbA1c 6.4±0.5%) and 11 matched healthy controls performed a maximal ramp incremental test both before and after a 4-week moderate-intensity aerobic exercise training intervention.
Results: There was no difference between T1DM and controls for peak power output (T1DM 3.9±0.7 vs. CON 3.6±1.1 $W.kg^{-1}$), peak oxygen uptake ($\dot{V}O_{2peak}$) (T1DM 38.8±11.1 vs. CON 42.6±7.8 $ml.kg^{-1}.min^{-1}$), gas exchange threshold (GET) (T1DM 28.0±7.8 vs. CON 30.4±4.8 $ml.kg^{-1}.min^{-1}$), amplitude of muscle deoxygenation (T1DM 55±24 vs. CON 58±18 % of peak), and time constant of $\dot{V}O_2$ kinetics ($\tau\dot{V}O_2$) (T1DM 25±5 vs. CON 36±20 s) (all $p>0.05$). In the training intervention subgroup there was no difference in training adaptation between T1DM and controls for peak power (T1DM pre: 3.5±1.0, post: 3.6±1.1 vs. CON pre: 4.1±0.6, post: 4.4±0.7 $W.kg^{-1}$), $\dot{V}O_{2peak}$ (T1DM pre: 37.7±9.7, post: 38.4±9.8 vs. CON pre: 45.2±7.6, post: 47.0±7.2 $ml.kg^{-1}.min^{-1}$), GET (T1DM pre: 27.0±5.8, post: 29.1±6.7 vs. CON pre: 31.6±4.5, post: 33.9±4.5 $ml.kg^{-1}.min^{-1}$), and $\tau\dot{V}O_2$ (T1DM pre: 36±20, post: 28±9 vs. CON pre: 25±5, post: 24±3 s) (all $p>0.05$).
Conclusions: This study demonstrates that aerobic exercise capacity is not impaired in active people with T1DM with adequate glycemic control compared to matched healthy controls and demonstrates for the first time that adaptation of aerobic exercise capacity to aerobic training is not impaired in this population.

Walking on slopes and lateral inclines: the effect of prosthetic foot stiffness on gait stability in people with a transtibial amputation

Roosmarijn Brenninkmeijer

Dr. S.M. Bruijn; Dr. M.R. Prins

Introduction: People with a transtibial amputation have an increased fall risk compared to able-bodied people. Slopes – uphill and downhill – and lateral inclines – left and right cross-slopes – further increase that fall risk. Prosthetic foot stiffness can affect gait stability and this effect on gait stability might be different for slopes and lateral inclines than for level-ground walking.
***Objectives*:** The aim of the current study is to investigate the effect of prosthetic foot stiffness in people with a unilateral transtibial amputation on gait stability, on slopes and lateral inclines.
Methods: An assumed relatively flexible glass-fibre and an assumed relatively stiff carbon-fibre prosthetic foot were mounted to a stationary frame and the stiffness was calculated from the Moment-angle curves of the estimated prosthetic ankle joint in dorsi-plantarflexion and ab-adduction direction. Ten people with a unilateral transtibial amputation walked on a treadmill on level-ground, ±6° slopes and ±6° lateral inclines, with each prosthetic foot in a quasi-randomised order. The mediolateral and anteroposterior Margins of Stability (MoS_{ML} and MoS_{AP}) and Local Divergence Exponent (LDE) were calculated as measures of gait stability.
Statistics: 2x3 factorial repeated measures ANOVAs tested for effects of the two prosthetic feet, slope and lateral incline and their interactions on the MoS_{ML}, MoS_{AP}, and LDE.
***Results*:** The carbon-fibre foot had a 20.8% higher dorsi-plantarflexion stiffness than the glass-fibre foot. Contrary, the glass-fibre foot had a 39.4% higher ab-adduction stiffness than the carbon-fibre foot. Contrary to the hypotheses, I found no significant effect of the prosthetic feet on the MoS_{ML} and MoS_{AP}, or an interaction effect between foot and surface angle. The LDE was significantly larger for the glass-fibre foot, than for the carbon-fibre foot on lateral inclines.
***Conclusions*:** Even though the difference in stiffness between the feet can be considered substantial, this difference did not show an effect on the MoS, only on LDE. It would be possible that a larger stiffness difference would show a substantial effect on gait stability on slopes or lateral inclines.

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A Running Start

Margit M. Bach

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The first part of this presentation will be about my trajectory from Research Master student to my current Postdoc position. I will focus on how I had a running start when my Research Master project turned into my PhD project with a specific focus on how the Research Master prepared me for a scientific career. I will end this part of the talk with the transition into the Postdoc position I am currently in.

The second part of the presentation will be an overview of my PhD thesis. Children start walking around 12 months of age and from there they learn to run. What are the determining factors of children's ability to run and is it possible to determine the maturity of their running patterns in children younger than 9 years? In adults, running is mostly defined as having a flight phase – can the same definitions be used in children? I will show you that this is in fact not appropriate. Do children have a running start?

The Effects of Aging on Corticomuscular Coherence during Bimanual Precision Tasks

Cara Alexandra Knott

Dr. B. van Wijk; Prof. Dr. A. Daffertshofer

As our society becomes older, age related changes in the brain and muscles occur. To investigate how functional connectivity between these is altered, we can look into corticomuscular coherence (CMC). Our main objective was to investigate how age influences CMC during a bimanual precision tasks. I hypothesized that CMC will be found at lower frequencies in the older group, that older individuals will have overall higher coherence, that beta-band CMC will be reduced during dynamic force and increased during static force, and that beta-band CMC will be higher when there is a lower motor output error. In total, 19 healthy young (20-30 years) and 19 healthy elderly (60-77 years) individuals participated in this study. Participants performed a bimanual or unimanual pinch grip task with dynamic or static force. This was in the form of a computer trial where a circle on a screen was followed upward for 5 seconds and then held static force at the top of the screen for 3 seconds. The required level of precision to successfully complete the tasks was varied, and EEG/EMG were recorded (FDI and FPB muscle). Electrodes over the motor cortex revealing the highest cortical power and coherence in the alpha (8-12 Hz) and beta (13-30 Hz) were selected for analysis. CMC was calculated between FDI muscle and and contralateral hemisphere, using six electrodes for each side. Cortical power was investigated for the same lateral electrodes, and a second central cluster of nine electrodes. The right and left sides were averaged in both cases. Results were examined via 2x2 mixed repeated measures ANOVAs for Age x Condition (precision level) and Age x Force type (dynamic/static). Elderly participants revealed a higher error than younger participants. Further, elderly individuals revealed higher alpha-band CMC than younger individuals. In all participants, lower cortical power and CMC was observed in the beta-band during the dynamic phase. Beta-band CMC and alpha-band power increased in the static phase. Based on this, higher alpha-band CMC seems to be a mechanism involved in healthy aging.

Assessing muscle co-activation dynamics by counting motor evoked potentials

Aslan Bellmann

Prof. Dr. A. Daffertshofer; Dr. S. Bruin

Human motor control arguably relies on the propagation of neural commands to groups of muscles, called synergies. In non-human primates, considerable evidence for muscle synergies stems from neural stimulation research. Meanwhile, in humans, evidence is still scarce. We applied transcranial magnetic stimulation to twenty subjects, recording electrophysiological responses from eight muscles acting on the fingers and the wrist. We hypothesized that muscles which are frequently used together might be grouped into synergies and thus have a higher tendency for co-activation. Previous studies used the Jaccard index to quantify co-activation in this context. We argue that the Jaccard index is not suitable for this purpose as it is biased by the excitability of individual muscles, and that pointwise mutual information should be used instead. Applying both measures to our data, we find a greater Jaccard index between thumb and index finger muscles and between wrist flexors, whose grouped activation is expected in everyday life during precision grip and wrist flexion, respectively. However, greater pointwise mutual information was only evident between wrist flexors. Therefore, it appears that the frequent co-activation of thumb and index finger muscles might be due to their high response probabilities, rather than due to synergistic coupling.

Exploring sweat as an information-rich biofluid
Validation of the fluidic patch sweat sampling technique

Nienke Haakma

Dr. J.J. de Koning

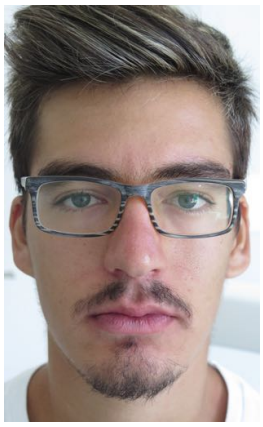
Introduction. Recently, human thermoregulation and, more specifically, sweating have received more scientific interest, as a result of a growing demand for sweat diagnostics and monitoring in health care and sports, as well as an increasing relevance due to climate change. Investigation of sweat poses some challenges, that are sought to be overcome with the development of novel sweat sensors, such as the fluidic patch sweat sampling technique. With this technique, sweat accumulating on the skin is flushed out of the patch's fluid channel using a pump system. This study aims to validate the fluidic patch technique for sweat rate and composition measurements.

Methods. The ventilated capsule and absorbent patch techniques served as reference measure for sweat rate and composition, respectively. Ten participants completed a four-step exercise protocol on a bicycle ergometer with ambient conditions of 33°C and 65% relative humidity. During the steps, exercise intensity was set at 55%, 65%, and 75% HR_{max}, with the final step being a recovery period. Sweat was sampled from the scapulae simultaneously with the three different techniques. Samples were analysed for sodium, chloride, and potassium content. Levels of agreement between the techniques were evaluated using simple linear regression, *R-squared* computation, and Bland-Altman plots.

Results. Sweat rate comparison yielded an *R-squared* of 0.56. For sweat content, *R-squared* values were 0.59, 0.63, and 0.03 for sodium, chloride, and potassium, respectively.

Discussion. A previous study found a much higher level of agreement (*R-squared* = 0.96) in sweat rate between the fluidic patch and ventilated capsule technique, possibly resulting from application of a less challenging passive-heating strategy. In addition, in some of our experiments, erroneous data was introduced due to pump system malfunctioning. With optimisation of the pump system, the fluidic patch could become a very valuable technique, that could greatly contribute to enhancing our understanding of human thermoregulation and sweating.

Can Irisin reverse the Warburg Effect in melanoma cells?



André Filipe do Brito Valente

Prof. Dr. R.T. Jaspers

Background: Exercise's anti-tumorigenic properties derive greatly from myokine secretion. Irisin, a myokine identified by Bostrom and colleagues (2012), was found to be upregulated by PGC-1α and AMPK. Although irisin is associated with hypertrophy, cell proliferation, increased glucose uptake and metabolism, it exerts pro-apoptotic effects in cancer cells via downregulation of PI3K/Akt signalling pathway. Given the role of PI3K/Akt in cancer metabolism, irisin could have a direct and/or indirect role in counteracting the Warburg Effect. We aim at unfolding a link between irisin and cancer metabolism. We hypothesize irisin inhibits cancer cell proliferation by downregulating expression of key glycolytic markers, including PKM2, GLUT1, LDHA, HK2 and MCT1/4.

Methods: B16F10 cell cultures were grown in a RPMI-based medium. First culture cycle comprised two time points – 24 and 72 hours –, three groups treated with different concentrations of irisin and later stained with EdU. A concentration of 2.5 ug/mL of irisin in a 24-hour period produced optimal results. Second culture cycle concerned one control group and one treatment group with a concentration of 2.5 ug/mL of irisin for 24 hours. Cells were lysed and used for qt-PCR analysis.

Results: qt-PCRs of the genes of interest failed to show any significant results. Nevertheless, based on the results from the EdU staining, it is clear irisin markedly inhibited melanoma cell proliferation when the latter were exposed to treatment for 24 hours. In the control group, 60.53 $\pm$ 3.99% of cells were found to be in an active proliferative state, compared to the group treated with 2.5ug/mL of irisin, in which only 32.43 $\pm$ 5.80% of cells were proliferating ($p<0.01$).

Conclusion: Although irisin did not affect the genes involved in the Warburg effect, we showed its potential to inhibit melanoma cell proliferation. Further research should look into possible interactions between irisin and PI3k/Akt signaling pathways, or even investigate whether irisin has the potential to enhance the (adaptive) immune response in melanoma. Every cancer, however, is unique, and irisin has been showed to have different roles depending on the cancer type being studied. Its role in possibly inhibiting the Warburg effect in other cancers should not yet be dismissed.

From Marker to Markerless: Validating DeepLabCut for 2D Sagittal Plane Gait Analysis in Adults and Toddlers

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***Objectives*:** This study investigated the validity of DeepLabCut in extracting kinematic data from 2D sagittal plane videos of adult gait as well as toddlers taking their first steps.
***Design*:** Participants took approximately 30 strides of overground and 100 strides of treadmill walking, performed at comfortable walking pace. The conditions were recorded with and without Vicon markers placed according to a customized full-body VST model.
***Subjects*:** Data of 16 healthy adults and 15 toddlers recorded within two weeks after onset of independent walking were included.
***Methods*:** A Vicon set-up was used to collect 3D data, serving as a gold standard marker-based method. This was compared to 2D data obtained from DeepLabCut through network training on recorded videos, using either 25% or 75% of participants as input. For the toddlers, previously recorded data were used.
***Analysis*:** The normalized joint angles and spatiotemporal parameters, including stride length and velocity as well as several clinical parameters, were calculated. Statistical outcomes for the spatiotemporal parameters were intraclass correlation coefficient for absolute agreement (ICC(A,1)), Pearson's correlation coefficient (r), and bias and limits of agreement (bias±LoA). The ICC(A,1), root-mean squared error (rmse), and coefficients of determination (R^2) were used for the normalized angles.
***Results*:** Overall, the results were poor for the 25% model, whereas the 75% showed a good (ICC(A,1)≥0.60) or excellent (ICC(A,1)≥0.75) agreement for most outcome measures. This was supported by improvements for either the r and bias±LoA or rmse and R^2 values.
***Conclusions*:** DeepLabCut is a valid tool to acquire gait kinematic data from 2D sagittal plane videos in adults and toddlers providing that several requirements are met. Most importantly, the input to the model should be sufficiently diverse to create a robust model and landmark occlusion should be avoided as much as possible. The low influence of the markers on the found validity in this study shows the potential for DeepLabCut being used outside lab environments.

Quantifying motor fatigability during prolonged walking in people with multiple sclerosis

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Background: People with multiple sclerosis (PwMS) experience a decline in motor performance during prolonged walking, known as walking-related motor fatigue. This motor fatigability affects the ability to sustain activities of daily living. To gain a better understanding of the walking problems, it is important to accurately quantify motor fatigability during walking.
Objectives: The main aim is to investigate the effects of prolonged walking on signs of motor fatigability, as quantified by kinematic and kinetic gait parameters and electromyography (EMG). Secondary aims of this study are; first to examine the relationship between muscle fatigue of the plantarflexors and push-off power and the relationship between muscle fatigue of the m. tibialis anterior and ankle dorsiflexion angle, and second to examine the relationship between the number of calf raises during the single-leg heel rise test, push-off power and muscle fatigue of the plantarflexors.
Subjects: Eighteen PwMS (>18 years) with a definite diagnosis with MS, experiencing ambulatory problems, able to walk for 6-minutes and relapse free for the past 30 days.
Methods: PwMS performed a prolonged walking protocol on a instrumented treadmill. Subjects walked for 6-minutes at comfortable walking speed (6CWS), followed by 6-minutes at fast walking speed (6FWS) and another 2-minutes at comfortable walking speed (2CWS-post). Motor fatigability of the most- and least affected leg is quantified as a change in kinematics, kinetics and EMG over time. Both the end of 6CWS (6CWS-end) and 2CWS-post are compared to the start of 6CWS (6CWS-start). Muscle fatigue is measured as change in EMG median frequency (EMG-mf) and EMG root mean square (EMG-rms). The single-leg heel rise test was performed before the walking protocol.
Results: The analysis is still in progress. Primary results of Repeated Measures two-way ANOVA of the maximal ankle push-off power does show significant differences between the most- and least affected leg ($p<0.01$) but no differences were found in the effect of time and the interaction between the affected leg and time.