### Tuesday, June 21

**Workshops**

<table>
<thead>
<tr>
<th>Time</th>
<th>Workshop Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM</td>
<td>Coffee Break 9:00-9:30AM</td>
</tr>
<tr>
<td>9:30 AM</td>
<td>Pre-Conference Workshop #1 9:30-11:00AM</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>Pre-Conference Workshop #2 9:30-11:00AM</td>
</tr>
<tr>
<td>10:45 AM</td>
<td>Coffee Break 10:00-10:30AM</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>Symposia Session 1 10:30-12:00PM</td>
</tr>
<tr>
<td>11:45 AM</td>
<td>Symposia Session 2 10:30-12:00PM</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Transition Break 12:00-12:15PM</td>
</tr>
<tr>
<td>12:15 PM</td>
<td>Lunch + Sponsor Talks 12:15-1:15PM</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>Workshop Lunch 1:00-2:00PM</td>
</tr>
<tr>
<td>1:15 PM</td>
<td>Pre-Conference Workshop #4 2:00-3:30PM</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Pre-Conference Workshop #5 2:00-3:30PM</td>
</tr>
<tr>
<td>2:45 PM</td>
<td>Pre-Conference Workshop #6 2:00-3:30PM</td>
</tr>
<tr>
<td>3:30 PM</td>
<td>Coffee Break 3:30-4:00PM</td>
</tr>
<tr>
<td>4:00 PM</td>
<td>Pre-Conference Workshop #4 continued 4:00-5:30PM</td>
</tr>
<tr>
<td>5:00 PM</td>
<td>Opening Reception 6:30-8:00PM</td>
</tr>
</tbody>
</table>

### Wednesday, June 22

**Day 1**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM</td>
<td>Welcome 8:30-9:00AM</td>
</tr>
<tr>
<td>9:30 AM</td>
<td>Hans Busmann Lecture Prof. I-Min Lee - Harvard Medical School 9:30-10:00AM</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>Coffee Break 10:00-10:30AM</td>
</tr>
<tr>
<td>10:45 AM</td>
<td>Symposium Session 1 10:30-12:00PM</td>
</tr>
<tr>
<td>11:30 AM</td>
<td>Symposium Session 2 10:30-12:00PM</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Transition Break 12:00-12:15PM</td>
</tr>
<tr>
<td>12:45 PM</td>
<td>Lunch + Sponsor Talks 12:45-1:45PM</td>
</tr>
<tr>
<td>1:15 PM</td>
<td>Keynote - Dr. Jesslyn Dunn - Duke University 1:15-2:15PM</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Transition Break 2:00-2:15PM</td>
</tr>
<tr>
<td>2:15 PM</td>
<td>Coffee Break 2:15-2:45PM</td>
</tr>
<tr>
<td>2:45 PM</td>
<td>Symposium Session 3 2:45-4:15PM</td>
</tr>
<tr>
<td>4:30 PM</td>
<td>Symposium Session 4 2:45-4:15pm</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>Transition Break 4:15-4:30PM</td>
</tr>
<tr>
<td>6:15 PM</td>
<td>Oral Sessions 1-5 4:30-5:30PM</td>
</tr>
<tr>
<td>7:00 PM</td>
<td>Oral Sessions 6-10 4:30-5:30PM</td>
</tr>
<tr>
<td>7:45 PM</td>
<td>Oral Sessions 11-15 4:30-5:30PM</td>
</tr>
<tr>
<td>8:00 PM</td>
<td>Opening Reception 6:30-8:00PM</td>
</tr>
<tr>
<td>8:30 PM</td>
<td>Early Career Researcher Event 5:30-8:30PM</td>
</tr>
</tbody>
</table>

### Thursday, June 23

**Day 2**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM</td>
<td>JMPPB Panel discussion: Getting your research published 6:45-7:45AM</td>
</tr>
<tr>
<td>9:30 AM</td>
<td>Keynote - Dr. Matthew Diamond - FDA 8:00-9:00AM</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>Transition Break 9:00-9:15AM</td>
</tr>
<tr>
<td>10:15 AM</td>
<td>Oral Sessions 16-20 9:15-10:15AM</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>Oral Sessions 21-25 9:15-10:15AM</td>
</tr>
<tr>
<td>10:45 AM</td>
<td>Oral Sessions 26-30 9:15-10:15AM</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>Keynote - Prof. Steve Robinovich - Simon Fraser University 12:00-12:45PM</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Transition Break 12:00-12:15PM</td>
</tr>
<tr>
<td>12:15 PM</td>
<td>Lunch + ISMPB GMM 12:15-1:15PM</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>Workshop Lunch 1:00-2:00PM</td>
</tr>
<tr>
<td>1:15 PM</td>
<td>Keynote - Prof. Rob Motl - University of Illinois Chicago &amp; Dr. Faye Horak - Oregon Health &amp; Science University 1:15-2:45PM</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Transition Break 2:00-2:15PM</td>
</tr>
<tr>
<td>2:15 PM</td>
<td>Coffee Break 2:15-2:45PM</td>
</tr>
<tr>
<td>2:45 PM</td>
<td>Symposium Session 5 2:45-4:15PM</td>
</tr>
<tr>
<td>4:15 PM</td>
<td>Symposium Session 6 2:45-4:15PM</td>
</tr>
<tr>
<td>6:00 PM</td>
<td>Transition Break 4:15-4:30PM</td>
</tr>
<tr>
<td>6:15 PM</td>
<td>Oral Sessions 31-35 4:30-5:30PM</td>
</tr>
<tr>
<td>7:00 PM</td>
<td>Oral Sessions 36-40 4:30-5:30PM</td>
</tr>
<tr>
<td>7:45 PM</td>
<td>Oral Sessions 41-45 4:30-5:30PM</td>
</tr>
<tr>
<td>8:00 PM</td>
<td>Closing Remarks 1:30-2:00PM</td>
</tr>
<tr>
<td>8:30 PM</td>
<td>Poster Session &amp; Social Hour 4:00-6:00PM</td>
</tr>
</tbody>
</table>

### Friday, June 24

**Day 3**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 AM</td>
<td>Keynote - Prof. Mai Chin A Paw - Amsterdam UMC 12:00-12:45PM</td>
</tr>
<tr>
<td>12:00 PM</td>
<td>Keynote - Dr. Rick Troinao - National Cancer Institute 12:45-1:30PM</td>
</tr>
<tr>
<td>12:45 PM</td>
<td>Closing Remarks 1:30-2:00PM</td>
</tr>
</tbody>
</table>

Program subject to change
WELCOME TO ICAMPAM

WELCOME!

After very successful ICAMPAM conferences in Rotterdam, Glasgow, Amherst, Limerick, Bethesda and Maastricht, we are proud to present this next in-person ICAMPAM conference in Keystone, Colorado.

This international conference will provide a forum for researchers to discuss the latest developments in physical behavior monitoring using wearable devices. The conference will serve as a meeting point for young scientists and renowned experts in the field of health sciences, engineering, medical services, physiology, psychology, sports sciences and more.

The organizing committee paid special attention to create a conference program where many young scientists have the opportunity to present their work. We have chosen a format where abstract presentations are an essential part of the program, next to keynote and invited speakers, symposia and workshops. This is to ensure the latest science and discoveries are covered. The relatively small-scale (around 200 participants) conference creates a great opportunity for young scientists to easily engage with renowned experts.

We are excited to host this meeting in the beautiful mountains of Summit County, the heart of Colorado’s playground! We encourage you to visit the local towns of Breckenridge, Frisco, or Vail to get a flavor of living in Colorado Mountain towns. There are plenty of hiking and biking trails throughout Summit County, and for those who are more adventurous, a climb to the top of one of the local “14ers” offers amazing views of the continental divide. For those who wish for a less strenuous adventure with a scenic view, consider a gondola ride to the summit of Keystone’s Mountain Peaks. We are sure you that you will have a memorable stay in our amazing backyard!

Welcome to ICAMPAM 2022 and best regards on behalf of the organizing committee, Ed Melanson and Kate Lyden
Local Co-Hosts, ICAMPAM 2022

WELCOME ON BEHALF OF THE SCIENTIFIC COMMITTEE!

We are truly thrilled to welcome you all to ICAMPAM 2022. Despite the challenges that resulted from the COVID-19 pandemic, the quality and quantity of research related to monitoring physical behavior continue to increase and this is reflected in the conference programming. ICAMPAM features eight excellent keynote speakers, who all have been chosen based on their important contributions to our field. They are world leaders and pioneers in the study and application of the utility of ambulatory devices in clinical populations, epidemiological studies, and clinical trials. We are also pleased to note that we received many high-quality symposium submissions and abstract submissions, both in-person and virtual. Taken together, this combination promises to set the stage for a stimulating and informative conference.

It truly has taken a village to make this conference happen. The scientific committee consists of more than 20 people who helped to select keynote speakers, symposia, pre-conference workshops, and abstracts. The local organizing committee was adeptly led by Ed Melanson and Kate Lyden. They stepped up to take the lead in ensuring a safe conference environment in beautiful Keystone, Colorado. Their contribution to making this all work has been remarkable. We would also like to acknowledge and thank the staff at Podium conference management who have talked us through many contingencies and budget issues and truly made it all happen, resulting in the exciting in-person and virtual programming that you will all experience over the next few days.

Finally, we would like to thank each of you for joining us here in Keystone. We know that traveling these days is a non-trivial experience that can be somewhat challenging. Thanks for making the effort.

On behalf of the scientific committee, we wish you a great conference with lots of opportunities to talk about your science, develop new collaborations and continue to move the field forward!

Sarah Keadle and Jeff Hausdorff
Scientific Committee Leaders

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I am very pleased to be able to welcome you to ICAMPAM 2022 on behalf of the International Society for the Measurement of Physical Behavior (ISMPB). The challenges of the last couple of years have meant that this welcome is long overdue. While we have not met in person for three years, ISMPB has been working hard behind the scenes to continue the work of bringing together great minds from varied backgrounds to further the measurement of physical behaviour. Our principal forum to achieve this is our conference. I have always found ICAMPAM to be a rich environment for establishing collaborations and sparking new ideas. I hope that you will all take away from this meeting new information, novel ideas and strong friendships and collaborations. I look forward to catching up with as many of you as possible over the coming days.

Bronwyn Clark
President, ISMPB

The International Society for the Measurement of Physical Behaviour (ISMPB) is a non-profit scientific society which focuses on the issues related to ambulatory monitoring, wearable monitors, movement sensors, physical activity, sedentary behaviour, movement behaviour, body postures, sleep and constructs related to physical behaviours. Therefore the Society specifically focuses on the objective measurement and quantification of physical behaviours which include:

- all free-living physical behaviours (including sleep) in its different forms (volumes and patterns which could give an indication of quality)
- measurements that are unrestricted, prolonged and unsupervised
- measurements of physiological responses (e.g. energy expenditure) that are directly related to physical behaviours
- a wide range of applications: clinical, public health, behavior sciences, end users etc.

The Society aims to promote and facilitate the study and applications of objective measurement and quantification of free-living physical behaviours and its related constructs (e.g. energy expenditure, context) using wearable devices. The Society is characterised by:

- its multidisciplinary focus; including engineering, signal analysis, physiology, medical sciences, public health, psychology, ergonomics and sports.
- bringing together people from a wide variety of backgrounds and expertise, including researchers, clinicians, therapists, signal analysts, computational scientists and commercial companies.

ISMPB hosts a biennial International Conference on Ambulatory Monitoring of Physical Activity and Movement (ICAMPAM). The first ICAMPAM Meeting took place May 21 – 24, 2008 at the Beurs-WTC Congress Center in Rotterdam, Netherlands.


ISMPB BOARD OF DIRECTORS

President
Dr. Bronwyn Clark
School of Public Health, The University of Queensland, Australia

President-Elect
Professor Alan Donnelly
Department of Physical Education and Sport Sciences, University of Limerick, Ireland

Past President
Professor Malcolm Granat
School of Health Sciences, University of Salford, Manchester, United Kingdom

Secretary
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Department of Neurology, Oregon Health & Science University, USA

Treasurer
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Department of Kinesiology, Michigan State University, USA

Communications Chair
Dr. Miriam Cabrita
Roessingh Research and Development, The Netherlands and University of Twente, The Netherlands

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- Professor Jornn Helbostad
  Department of Neuromedicine and Movement Science, Norwegian University of Science and Technology, Norway
- Professor Jeff Hausdorff
  Movement Disorders Unit at the Tel-Aviv Sourasky Medical center (TASMC), Israel
- Dr. Sarah Keadle
  Department of Kinesiology, California Polytechnic State University, USA
- Dr. Dinesh John
  Health Sciences Department, Northeastern University, USA

Advisory Board Members
- Professor Hans Busmann
  Department of Rehabilitation Medicine, Erasmus MC – University of Rotterdam, The Netherlands
- Dr. Richard (Rick) Troiano
  Epidemiology and Genomics Research Program, National Cancer Institute, USA
- Dr. David Basset, Jr.
  Professor and Interim Department Head, Exercise Physiology, University of Tennessee Knoxville, USA

SCIENTIFIC PLANNING COMMITTEE

Chairs:
Jeff Hausdorff
Sarah Keadle

Committee Members
David Bassett
Johannes Bussmann
Brian Caulfield
Lucy Cesnakova
Sebastien Chastin
Lorenzo Chian
Philippa Dali
Sjaan Gomersall
Andreas Holtermann
Dinesh John
Martina Mancini
Claudia Mazza
Joanne McVeigh
Karin Pfeiffer
Jeffr Sasaki
Jennifer Schrack
Eric Shiroma
Hilide van der Ploeg
Keri Winters

PODIUM CONFERENCE SPECIALISTS

Marisdal De Armond
Brian Groos
Sharon Zwack
GENERAL INFORMATION

CONFERENCE VENUE
Keystone Conference Center
633 Tennis Club Road
PO Box 38
Keystone, CO 80435-0038
Phone: 855-322-1601

CONFERENCE REGISTRATION
In-person registration for the conference includes admission to all sessions including keynotes, symposium sessions, workshops, oral presentations and poster sessions, special panels/presentations. Also included, is the Opening Reception, lunch on Wednesday, Thursday and Friday of the conference, and tea/coffee breaks. In-person attendees may also take advantage of the ICAMPAM Virtual Conference platform (on Whova App) for all on-line programming (including access to all virtual posters) and networking and other engagement opportunities. Access will be available for 90 days.

Virtual registration for the conference includes livestream from the ICAMPAM mainstage in Shavano Peak all day Wednesday, June 22 8:30am - 5:30pm (MDT), recorded presentations from all eight ICAMPAM Keynote Speakers. Virtual attendees may also take advantage of the ICAMPAM Virtual Conference platform (on Whova App) for other on-line programming (including access to all virtual posters) and networking and other engagement opportunities. Access will be available for 90 days.

Virtual registration for the conference includes livestream from the ICAMPAM mainstage in Shavano Peak all day Wednesday, June 22 8:30am - 5:30pm (MDT), recorded presentations from all eight ICAMPAM Keynote Speakers. Virtual attendees may also take advantage of the ICAMPAM Virtual Conference platform (on Whova App) for other on-line programming (including access to all virtual posters) and networking and other engagement opportunities. Access will be available for 90 days.

COVID NOTE:
In light of the elevated infections level of the Omicron variant in Colorado, attendees are strongly encouraged to wear masks in the meeting areas.

HEALTH TIPS:
High elevation, low humidity and stronger ultraviolet rays from the sun combine to create a situation that requires special attention to your health! For recommendations on how to prevent and alleviate high altitude sickness, please see High Country Health Care High Altitude Health Tips.

The mountains of Colorado are among the most beautiful parts of the United States, and we hope you enjoy every minute of your visit. However, some of the very features that make this area so attractive may also cause you problems, unless you are able to recognize the symptoms and know how to prevent them. The following guidelines may assist in managing high altitude sickness:

• Increase fluid intake
• Decrease salt intake
• Moderate your physical activity and get plenty of rest
• Eat frequent small meals high in carbohydrate, low in fat and low in protein
• Reduce alcohol and caffeine intake

DRESS CODE
Dress is casual for all ICAMPAM meetings and social events.

REGISTRATION AND INFORMATION DESK HOURS
The Registration and Information Desk, located in the lobby, will be open during the following dates and times:

Tuesday, June 21
8:30am – 7:00pm

Wednesday, June 22
7:00am – 5:30pm

Thursday, June 23
7:00am – 6:00pm

Friday, June 24
7:00am – 2:00pm

CODE OF CONDUCT
By entering the virtual platform and participating in the ICAMPAM Virtual conference during the following dates and times:

• Tuesday, June 21
8:30am – 7:00pm

• Wednesday, June 22
7:00am – 5:30pm

• Thursday, June 23
7:00am – 6:00pm

• Friday, June 24
7:00am – 2:00pm

ICAMPAM Board Members, Sponsors, Exhibitors and Staff will be identified by appropriate ribbons.

IN-PERSON POSTERS
48 posters will be available for in-person attendees to review starting on Wednesday, June 22 at 10:00am in the Red Cloud Peak. In-person poster presenters will be able to virtually connect with their poster during the following joint Poster Session & Social Hour:

• Thursday, June 23: 4:00 – 6:00pm (MDT)

In-person poster presenters may also be available during coffee breaks at their posters.

If you are unable to connect with an in-person OR virtual poster presenter at any of the above times, open the poster menu in Whova (found under the agenda drop down menu) and refer to the Chat Box to see if the presenters offers any availability virtually or leave a note in the Chat Box for the presenter to connect with you either during ICAMPAM 2022 or afterwards. You may continue to use the Whova App to connect and converse for up to 90 days.

IN-PERSON POSTER INSTALLATION AND DISMANTLE
In-Person poster presenters must set-up and remove their posters during the following times:

Set-up: Wednesday, June 22 8:30 – 10:00am
Dedicated time: Thursday, June 23 4:00 – 6:00pm
Remove: Friday, June 24 10:45am – 12:00pm

Information on Poster Authors (Lead), Poster Numbers and Poster Titles begins on page 43.

CONFERENCE EXHIBITORS
Technical exhibits at ICAMPAM 2022 will be available for viewing in Red Cloud Peak Wednesday, June 22 (7:30am – 5:30pm), Thursday, June 23 (7:30am – 6:00pm) and Friday, June 24 (7:30am – 12:00pm). Attendees will have easy access to exhibitor representatives as these exhibits are located in the coffee area in proximity to the posters.

SOCIETY GENERAL MEMBERSHIP MEETING
The International Society for the Measurement of Physical Behaviours (ISMPB) general membership meeting is scheduled from 12:15 – 1:15pm on Thursday, June 23 in the Shavano Peak. All members of the society and prospective members are encouraged to attend and contribute to the meeting.

ISMPB MEMBERSHIP
Membership in ISMPB is open to everyone from around the world involved in the measurement of free-living physical behaviour.

Membership fees support the mission of ISMPB in creating a vibrant community bringing together people from a wide variety of backgrounds and expertise, including researchers, clinicians, therapists, signal analysts, computational scientists and commercial companies.

HEALTH TIPS:
• Increase fluid intake
• Decrease salt intake
• Moderate your physical activity and get plenty of rest
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POSTER VIEWING INFORMATION
To make the most of the ICAMPAM poster sessions – please review the following information carefully:

ALL POSTERS (both in-person & virtual) have a virtual site for viewing in the ICAMPAM 2022 Whova App; these may be accessed for 90 days from Tuesday, June 21.

VIRTUAL POSTERS VIA WHOVA
All virtual poster presenters have been asked to be available if (time zone permits) at their virtual poster during the following periods so attendees may virtually connect with them:

• Wednesday, June 22: 12:15 – 1:15pm (MDT)
• Thursday, June 23: 4:00 – 6:00pm (MDT)

Posters numbers beginning with a ‘VP-’ indicate this poster is only accessible virtually

(VP-Ezeichnungen einer Europäische Zeit Zone)

Be sure to check the chat box of the virtual poster presenter to see if they’ve left a message as to their available times
CONFERENCE TIMELINES
Registration for the Virtual Conference provides one full day of livestreamed access of proceedings from Shavano Peak Meeting Room on Wednesday, June 22 (Time zone: MDT). Recorded presentations from all ICAMPAM 2022 Keynote Speakers (posted approximately 24hrs after the presentation and available for 90 days). Access to all virtual poster sessions (2) and to all on-line poster listings.

VIRTUAL ACCESS TO ICAMPAM 2022
ICAMPAM 2022 will be supported by Whova, the virtual event platform. This multi-faceted event app serves as a platform for attendees who cannot attend in person to experience some of the offerings at ICAMPAM 2022 and provides a means for all attendees to virtually connect and network with poster presenters, speakers, sponsors, exhibitors and other attendees.

USE THIS LINK TO ACCESS ICAMPAM 2022's VIRTUAL COMPONENT: https://whova.com/portal/webapp/icamp_202206/

You can access from your desktop or mobile device; we suggest that you bookmark this hyperlink to the conference. Google Chrome is the recommended browser. Within Whova, you may:
- Access identified livestream events on Wednesday, June 22 from 8:30am - 5:30pm MDT, recordings of keynote presentations, pre-conference workshops, keynotes and posters.
- Connect with fellow conference attendees and conference sponsors.
- Participate in chat spaces, virtual meet ups, topic groups and access messages sent to you by other attendees.

If you need assistance with Whova, please contact Whova support: support@whova.com

Q&A SESSIONS
With the virtual conference platform, you can ask questions through the Q&A function. Technical help with the virtual conference
If you encounter any technical issues during your virtual experience, please contact Whova directly by emailing support@whova.com.

MEMBER BENEFITS
- Register for Society Meetings at reduced registration rates
- Support a vibrant and independent Society
- Become connected with leading experts in the field
- Opportunity to get involved as an ISMPB Committee member
- Vote in annual elections for the Board of Directors
- Stand for election to the Board of Directors
- Eligible for student awards at the Society Meetings (best oral and best poster)
- Access to online resources and conference proceedings
- Opportunity to post news and information on related events

MEMBER CATEGORIES
Regular / Post Doc Members ($150)
Open to any person who is engaged in research related to areas of interest of the Society.

Student Members ($75)
Open to any student enrolled in degree granting programs at institutions of higher education.

The next membership term will run from October 1, 2022 to September 30, 2024.

INTERNET ACCESS
Wireless internet access is available in the Keystone Conference Center. The wireless network connection that delegates should search for on their devices is:
Network: Keystone Conference Center
With password: ICAMPAM

VIRTUAL CONFERENCE PLATFORM
WHOVA EVENT APP
PRE-REGISTRATION
If you have completed your registration for the virtual conference, please enter the platform through the ICAMPAM website, and follow the instructions.

REGISTRATION
If you wish to register and have not yet done so, please register here: https://www.confmanager.com/main_cfm?cid=3956&tid=32

Note: Registrations completed after June 17, 2021, should expect a delay to access the virtual conference platform. Registration does not provide automatic access.

AWARDS
ISMPB will offer three student awards at ICAMPAM 2022. Sensors has generously sponsored two poster awards: one for best in-person poster and one for best virtual poster. An additional award for best Oral Presentation by a student at ICAMPAM 2022 will also be presented. In addition to the monetary prize, winners of the student awards will be invited as guests in the Physical Activity Researcher Podcast. This represents a unique opportunity to talk about ongoing research and reach a broader audience. Winners will be announced onsite at ICAMPAM 2022.

SPECIAL EVENTS
LUNCH DISCUSSION
CRESTONE III/IV
TUESDAY, JUNE 21
1:00 – 2:00PM
Faculty burnout: the science and solutions: As a burnout survivor, and public health professional, Jacqueline Kerr is on a mission to prevent burnout in others. An informal talk followed by a Q & A. Lunch will be provided. Seating is limited - registration is required. Delegate admission is included in your conference fees.

WELCOME RECEPTION
SHAVANO FOYER
TUESDAY, JUNE 21
6:30 – 8:00PM
Join us at the Shavano Foyer to meet up with old friends and be introduced to new ones!
Delegate admission to this Welcome Reception is included in your conference fees. You are welcome to bring a guest if you speak to the Registration Desk, where you will be requested to pay a $20 fee.

EARLY CAREER RESEARCH EVENT
DILLON MARINA
(departure will be from Keystone Conference Centre)
WEDNESDAY, JUNE 22
5:30 – 8:30PM
An opportunity for those at the early stage of their careers to enjoy an evening chartered boat cruise on nearby Lake Dillon while networking with other early career researchers as well as few members of the ICAMPAM board. Light snacks and beverages (alcoholic and non-alcoholic) will be provided. Attendees are advised to bring jackets and warm clothing, as the temperature on the lake may dip in the evening. Admission is included in your conference fees.
Space is limited to the first 25 individuals.

JMPB PANEL DISCUSSION
CRESTONE I & II
THURSDAY, JUNE 23
6:45 - 7:45AM
Getting your research published: join us for a lively discussion in which members of the JMPB editorial board share their publishing experiences both as authors and reviewers. Topics for discussion will cover the full scope of the publication journey, including: writing a solid manuscript, strategies for effective revision, and handling rejection (a normal part of academic publishing). This event should appeal to early career researchers. Seating is limited - must sign up to attend. Hosted by members of the editorial board of the Journal for the Measurement of Physical Behaviour.

POSTER SESSION & SOCIAL HOUR
RED CLOUD PEAK
THURSDAY, JUNE 23
4:00 - 6:00PM
Two hours to interact with poster presenters and mix with ICAMPAM 2022 attendees. Delegate admission to this Welcome Reception is included in your conference fees. You are welcome to bring a guest if you speak to the Registration Desk, where you will be requested to pay a $20 fee.
Workshop 1
Location: Crestone Peak I & II
Rewards and challenges of pairing wearable monitors with criterion measures of energy expenditure
Kong Chen¹, Seth Creasy², Robert Brychta³, Edward Melanson³
¹National Institutes of Health, ²University of Colorado Anschutz
The gold-standards for measuring energy expenditure (EE) under laboratory and free-living settings are whole-room indirect calorimeters and doubly labeled water (DLW), respectively. These methods of measuring EE are generally used for quantifying differences in EE within individuals or across populations and can also be used as criterion measures to develop and validate wearable activity monitors for estimating EE. Conversely, there can be added benefits of integrating wearable devices in EE studies using room calorimetry and DLW. In EE studies aimed at measuring total EE, device-based measures add a dimension of context due to the fine temporal resolution and sensitivity to detect movement intensity which can be used to parse the individual contributors to total EE. The focus of this workshop is to introduce the when, why, and how to integrate wearables to EE studies using room calorimeters and DLW. For example, wearable monitors can be utilized during room calorimetry to better inform components of EE (resting, thermic effect of feeding, activity, etc.). Doubly labeled water studies give an average estimate of total daily energy expenditure over an assessment period. Pairing wearable monitors with DLW, researchers can gain insight into day-to-day, weekday vs. weekend, or inter-day variability in physical activity which may influence overall EE.
1. Using wearable activity monitors in metabolic and nutritional studies. This talk will cover the scope of how activity monitors have been used in different types of applications such as controlled trials and natural histories.
2. Adding wearable activity monitors to whole-room indirect calorimetry studies. This talk will present the methodology of room calorimetry, and the components of daily EE that wearables can help to quantify (e.g., sleep, resting, activity, and thermic effect of feeding).
3. Adding wearable activity monitors to doubly labeled water studies. This talk will present the methodology of DLW and discuss how wearable monitors can help to measure more time-dependent physical activity levels and patterns.

Workshop 2
Location: Crestone Peak III & IV
Using GPS data in physical behavior studies
Alexis Le Faucheur¹, Jasper Schipperijn²
¹Ecole normale supérieure de Rennes, ²University of Southern Denmark
The workshop goals and objectives are:
- To present the basic principles of working with GPS devices as well as the expected accuracy of GPS measurements.
- To demonstrate the use of GPS data for two types of research studies: i) the use of GPS to study the context in which physical activity or sedentary behavior is occurring; ii) the use of GPS with the specific aim of assessing walking during outdoor walking sessions or trips, focusing on a clinical application.
- To explain the main methodological considerations when analyzing GPS data.
- To demonstrate how available online tools can be used to process and merge GPS data with their accelerometer-based measures.

Dr Schipperijn will introduce the basics of working with GPS data and explain GPS data accuracy. He will furthermore demonstrate how GPS data, in combination with accelerometer and GIS data, can be used to assess the context in which physical behavior is occurring. Finally, he will demonstrate how GPS and accelerometer data can be processed using the Human Activity Behavior Identification Tool and Data Unification System (HABITUS).

Dr Le Faucheur together with Dr Schipperijn will introduce the basics of working with GPS data and explain GPS data accuracy. Then, he will demonstrate how GPS data can be used to assess walking during outdoor walking sessions, focusing on a clinical application. Finally, he will demonstrate how GPS speed data can be easily processed using the MAPAM web tool.

Participants will gain a deeper insight in the usefulness of including GPS data in their future studies, learn about collecting and processing GPS data, and will be introduced to tools to process and analyze GPS data. Furthermore, we will provide links to online tools and open-source software for GPS data processing, more specifically:
- HABITUS tool to merge GPS and accelerometer data: https://www.habitus.eu
- Web platform for GPS speed signal analysis of outdoor walking sessions: https://mapam.ens-rennes.fr

Participants will have the opportunity to test using HABITUS and the MAPAM web tool.
Real-world monitoring of mobility and function (e.g. gait) is enabled by wearable devices including inertial measure-ment units (IMUs) that allow to quantify digital mobility outcomes (DMOs). While these devices and the associated DMOs are adopted more and more frequently, there is still limited awareness of how complex it is to ensure their validity and what could hinder comparability of data obtained during surveys. This talk will aim at raising this awareness by sharing the experience we gained as part of Mobilise-D, a project funded by the European Union (EU) as part of the Innovative Medicine Initiative, aiming at fostering regulatory approval and clinical adoption of DMOs.

To reach our aim we will share the complementary and multi-disciplinary experiences from a representative group of researchers involved in the project to discuss the various challenges that they encountered in association to the following activities:

- Experimental protocols for the validation of the DMOs: the Mobilise-D Technical Validation Study
- When thoroughly validating a system for the estimation of real-world DMOs, the optimal trade-off between clinical and technical requirements is necessary. In Mobilise-D, balancing inclusion of multiple pathological cohorts, reference systems and centres significantly increased the complexity of the protocol. This talk will present the protocol of the Technical Validation Study, it will describe instrumentation and type of assessments used, including how acceptability and participants’ opinions regarding the use of technology have been captured. It will also present solutions and challenges faced by the researchers in developing and running the study protocol.
- Identification and characterisation of gold standards for real-world applications
- This talk will outline the methods developed to characterize the gold standard solution and single sensor system used in the technical validation study. In particular, this talk will describe the reference system adopted as gold standard solutions to validate DMOs estimated from a single wearable device in real-world conditions (a wearable multi-sensing system including inertial units, Distance sensors, and Pressure insoles: the INDIP system). The methodology and the adopted workflow to measure reference DMOs will be presented, highlighting strengths and limitations of the system. Challenges faced and solutions devised during the processing of the data collected will be presented.
- A framework to compare and select top performing algorithms for quantifications of DMOs
- Digital mobility outcomes (DMOs) can be obtained through algorithms processing a single sensor’s signals. This talk will present the pipeline (set of algorithms) that has been implemented for the calculation of real-world DMOs (e.g. cadence, step-length and walking speed estimation). But what do to when multiple algorithms are proposed for the evaluation of the same DMO? How can we compare them and select the “best” algorithm for that specific DMO? In this talk, a comprehensive methodology to compare and rank algorithms, depending on the DMO of interest, will be presented and techniques to select the top performers will be indicated.
- The statistical analysis plan: how to validate DMOs?
- This talk will focus on the comprehensive statistical framework developed and implemented within Mobilise-D to ensure DMOs’ validity. Firstly, we will explain how the DMOs are obtained from wearable sensor assessments at lab and real-world contexts by running all available algorithms on an online platform. Considering the nature and level of aggregation of spatiotemporal DMOs and the characteristics of the reference systems, we will present the performance metrics of the analytical pipeline in multiple cohorts (e.g. healthy adults, Parkinson’s Disease, Multiple Sclerosis, Proximal Femoral Fracture (PFF) and Chronic Obstructive Lung Disease (COPD)).
- Interactive visualisation tools to enhance data exploration and interpretation
- How to explore and make sense of large datasets of results obtained from statistical analyses? This talk will present a design for an automated and interactive tool enabling the visual exploration and analysis of multi-variable heterogeneous data. The talk will show the use of this interactive toolbox, focusing on selective DMOs, for data exploration, visualisation of different granularities/ aggregation levels of statistical analyses, and plot generation. It will be shown how this toolbox can facilitate access of data and results interpretation in large heterogeneous datasets. The range of topics that will be covered is highly multi-disciplinary by definition. Each participant will be able to enhance or acquire new skills that would allow them to better navigate in the field of digital health. We will present some new data and results; we will also share our direct experience and tips for overcoming possible similar challenges in future studies. The techniques and analyses presented can be “translated” and applicable to other fields and topics (other than mobility), especially in circumstances where algorithm and DMOs validation is required. We will also share a number of papers and analytical tools that have already been published and shared with the goal of promoting standardisation and adoption.

Workshop 5
Location: Castle Peak I & II

Clinical-research relevant outcomes from free-living Physical Behaviour data - the use of locus of activity, posture allocation and stepping behaviour to define Real World Outcomes (RWO)
Douglas Maxwell1, David Loudon1, Craig Speirs1
1PAL Technologies Ltd.

The goal of this workshop is to provoke discussion and reflection on the use of wearable sensors for the objective measurement of free-living physical behaviours for both epidemiological studies and clinical research. In the first half of the workshop we will consider the importance of:

1. Sensor Location – where on the body can a sensor be worn and how does this impact on the outcomes that can be measured?
2. Sensor Choice - we will review common sensor characteristics (accelerometer, gyrometer, magnetometer, barometer, thermometer) and their strengths and weaknesses as wearable sensors
3. Data Classification - we will reflect on the different techniques commonly used in processing sensor data and the tools used to process data
4. Outcomes – Real world outcomes (RWO) derived from wearable sensor data and, most importantly, their clinical utility

In the second half of the workshop attendees will be provided with example datasets (they can also bring their own data) and a participant led structured discussion will be used to review these data in terms of:

- How can accelerometers be both very effective in measuring how little someone is doing (Sedentary Behaviour and sleep) and how much (Physical Activity)
- Looking beyond the commonly reported daily totals for physical activity and sedentary behaviour we will explore the challenges around defining clinically important measures of ability and participation
- Accelerometers are well suited to the quantification of stepping, the major component of daily physical activity. We will consider how the patterns of step accumulation can be used to characterise the locus of activity and as biomarkers of physical ability and how we might quantify inter-loci travel choices
- We will explore the use of a magnetometer to differentiate household versus community loci of activity based on the frequency of ambulatory direction change
Learning objectives and takeaways
1. Understand what raw data from body-worn sensors looks like and how it can be used to quantify the time spent in the primary physical activities of lying, sitting, standing and stepping
2. Appreciate how body-worn sensor data is processed and the difference between epoch and event-based analysis approaches
3. Be able to distinguish between measures of ability and participation and the clinical importance of this categorization

4:00 – 5:30pm
Workshop 4 (continued)
Location: Crestone Peak III & IV
Validating digital mobility tools: the Mobilise-D experience
Silvia Del Din1, Björn Eskofier1, Lisa Alcock1, Francesca Salis2, Encarna Micó Amigo3, Eran Gazit4, Cameron Kirk1, Alma Cantu1
1Newcastle University, 2Friedrich-Alexander-Universität, 3University of Sassari, 4Tel Aviv Sourasky Medical Center

Workshop 6 (continued)
Location: Crestone Peak I
Clinical-research relevant outcomes from free-living Physical Behaviour data - the use of locus of activity, posture allocation and stepping behaviour to define Real World Outcomes (RWO)
Douglas Maxwell1, David Loudon1, Craig Speirs1
1PAL Technologies Ltd

Please note that the program is subject to change.

TUESDAY, JUNE 21, 2022

8:30am - 7:00pm     Registration Desk Open
Location: Shavano Foyer
9:00 – 9:30am     Morning Coffee
Location: Crestone Foyer

Morning Pre-Conference Workshops
9:00 - 11:00am     Workshop 1
Rewards and challenges of pairing wearable monitors with criterion measures of energy expenditure
Location: Crestone Peak I & II
9:00 - 11:00am     Workshop 2
Using GPS data in physical behavior studies
Location: Crestone Peak III & IV
11:00 - 11:30am     Coffee Break
Location: Crestone Foyer
11:30am - 1:00pm     Workshop 2 continued
Location: Crestone Peak III & IV
11:30am - 1:00pm     Workshop 3
Using git and GitHub to track, disseminate, and maintain your physical behavior code and data
Location: Crestone Peak I & II
1:00 - 2:00pm     Lunch Discussion
Faculty burnout: the science and solutions
Location: Crestone Peak III/IV
Jacqueline Kerr: Behavior Scientist & Burnout Survivor

Afternoon Pre-Conference Workshops
2:00 - 3:30pm     Workshop 4
Validating digital mobility tools: the Mobilise-D experience
Location: Crestone Peak III & IV
2:00 - 3:30pm     Workshop 5
Building consensus and standards for GPS use, processing, analysis, and reporting in human health studies
Location: Castle Peak I/II
2:00 - 3:30pm     Workshop 6
Clinical-research relevant outcomes from free-living Physical Behaviour data - the use of locus of activity, posture allocation and stepping behaviour to define Real World Outcomes (RWO)
Location: Crestone Peak I & II
3:30 - 4:00pm     Coffee Break
Location: Crestone Foyer
**WEDNESDAY, JUNE 22, 2022**

**8:00pm** - **5:30pm**  
Exhibits Open  
Location: Shavano Foyer

**8:30am** - **10:00am**  
Welcome & Keynote Presentation  
Hans Bussmann Lecture: Maximizing the utility and comparability of accelerometer data from large-scale observational epidemiologic studies  
I-Min Lee  Harvard Medical School  
Location: Shavano Peak + Livestream  
This lecture is in recognition of the contribution of Professor Hans Bussmann, who in 2008 organized and ran the first ICAMPAM. This meeting was so successful that it inspired others to organize subsequent highly successful ICAMPAMS. Hans’ visionary and brave initiative led directly to the formation of our Society and our international journal.

**10:00am - 10:30pm**  
Coffee Break  
Location: Red Cloud Peak

**10:30am - 12:00pm**  
Symposia 1 & 2  
**S.1 Spatial analyses with behavioral data**  
Chair: Jasper Schipperijn  University of Southern Denmark  
Moderator: Aaron Hipp  University of Southern Denmark  
Participants: Jordan Carlson  Children’s Mercy Kansas City  
Jing-Huei Huang  North Carolina State University  
Marta Jankowska  Beckman Research Institute  
Jasper Schipperijn  University of Southern Denmark  
Location: Red Cloud Peak

**S.2 Measuring sleep with wearables: The ABC’s of measuring Z’s**  
Chair/Moderator: Seth Creasy  University of Colorado Anschutz  
Participants: John Chase  University of Massachusetts Amherst  
Evan Chinoy  Naval Health Research Center  
Charles Matthews  National Cancer Institute/National Institutes of Health  
Stacey Simon  University of Colorado Anschutz Medical Campus  
Location: Crestone Peak I & II

**12:00 - 12:15pm**  
Transition Break

**12:15 - 1:20pm**  
Lunch with Gold Sponsor Talks and Virtual Poster Time  
Location: Shavano Peak + Livestream

**1:20 - 1:30pm**  
Transition Break

**1:30 - 2:15pm**  
Keynote Presentation  
The digital physiome: Wearables for early disease detection  
Location: Shavano Peak + Livestream  
Jessilyn Dunn  Duke University  
Location: Red Cloud Peak

**2:15 - 2:45pm**  
Symposia 3 & 4  
**5.3 Physical behaviours and health: New methods and insights from large epidemiologic studies using accelerometer**  
Chair/Moderator: Sarah Keadle  California Polytechnic State University  
San Luis Obispo  
Participants: Kelly Evenson  University of North Carolina Chapel Hill  
Amanda Paluch  University of Massachusetts Amherst  
Pedro Saint-Maurice  National Cancer Institute  
Qian Xiao  Texas Health Science Center at Houston  
Location: Crestone Peak I & II

**5.4 Mobility outcomes for clinical trials in cerebellar ataxia: The route from the clinic to daily life**  
Chair: Winfried Ilg  Hertie Institute for Clinical Brain Research  
Participants: Fay Bahling Horak  Oregon Health and Science University  
Winfried Ilg  Hertie Institute for Clinical Brain Research  
Vrutangkumar Shah  Oregon Health and Science University  
Location: Red Cloud Peak

**4:15 - 4:30pm**  
Transition Break

**4:30 - 5:30pm**  
Oral Sessions 1 – 3  
**O.1 Novel statistical approaches and applications**  
Location: Shavano Peak + Livestream  
**O.1.1 Combining compositional data analyses and ecological momentary assessment:**  
Insights on the association between physical behavior on mood in daily life  
Marco Giurgiu  Karlsruhe Institute of Technology  
**O.1.2 Association of gait quality with daily life mobility: An actigraphy and global positioning system based analysis in older adults**  
Anisha Suri  Oregon Health and Science University  
**O.1.3 Unknown distributions: Modelling distributions of real-world walking speed in people with Parkinsons**  
Cameron Kirk  Newcastle University  
**O.1.4 A fully Bayesian semi-parametric Scalar-on-Function Regression (SoFR) with measurement error using instrumental variables**  
Roger Zoh  Indiana University  
**O.1.5 Methods to determine common periods of wear in concurrently worn activity monitors**  
Craig Speirs  PAL Technologies Ltd.  
Location: Red Cloud Peak

**5:30pm**  
Closing Remarks  
Location: Red Cloud Peak
O.2 Clinical applications: Knee and back pain and fatigue
Location: Crestone I & II
O.2.6 Continuous longitudinal monitoring of early physical activity recovery following knee arthroplasty
Scott Small University of Oxford
O.2.7 Patterns of physical activity accumulation as a potential biomarker for low back pain phenotyping
Ruopeng Sun Stanford University
O.2.8 Associations of digital measures of gait with sleep and fatigue: A real world feasibility study
Rana Zia UR Rehman Newcastle University
O.2.9 Applying the Pittsburgh Performance Fatigability Index to a 6-minute walk in older adults
Yujia (Susanna) Qiao University of Pittsburgh

O.3 Physical activity interventions
Location: Crestone III & IV
O.3.11 Detecting and modifying daily inactivity among adults over 60 years using an integrated two-way communication-based near-real-time sensing system: A randomized clinical trial
Diego J Arguello Northeastern University
O.3.12 An empirical approach to understand mHealth application engagement and its associations with daily changes in physical activity in a lifestyle intervention among US Veterans with prediabetes
Krista Leonard Arizona State University
O.3.13 A physical activity intervention results in higher randomness of postural control accelerations during dual-task conditions
Kayla Bohike University of Pittsburgh
O.3.14 Developmental and pilot testing of the ActiveGOALS online physical activity intervention for primary care students
Bonna Rockette-Wagner University of Pittsburgh
O.3.15 Wear fatigue: Does device wear compliance wane over a free-living assessment period?
Samuel LaMunion National Institutes of Health/ NIDDK

5:30 - 8:30pm
Early Career Researcher Event
Location: Off-Site – Dillon Marina

THURSDAY, JUNE 23, 2022
6:45 - 7:45am
JMPB Panel Discussion
Getting your research published
Location: Crestone I & II
Moderator: Philippa Dall Glasgow Caledonian University
Matthew Ahmadi University of Sydney
David Bassett University of Tennessee, Knoxville
Matt Buman Arizona State University
Kimberly Cleveinger National Cancer Institute
Pedro Saint-Maurice National Cancer Institute
Jon Sirard University of Massachusetts Amherst

7:00am - 6:00pm
Registration Desk Open
Location: Shavano Foyer

7:30am
Morning Coffee
Location: Red Cloud Peak

7:30am - 6:00pm
Exhibits Open
Location: Red Cloud Peak

8:00 - 9:00am
Keynote Presentation
The use of device-based monitoring of behaviour and understanding of how academic research laboratories can generate evidence that meets the needs of regulatory stakeholders
Location: Shavano Peak
Matthew Diamond CDRH Digital Health Center of Excellence, FDA

Transition Break

Oral Sessions 4 – 6

O.4 Validation of devices in real world settings
Location: Shavano Peak

O.4.16 Validation of previous-day recall for estimates of duration and context in comparison to activPAL and direct observation
Charles Matthews National Cancer Institute, National Institutes of Health

O.4.17 Comparison of time spent in activity type from the activPAL and video-recorded direct observation
Sarah Keadle California Polytechnic State University San Luis Obispo

O.4.18 Validation of two deep learning methods to estimate aspects of physical activity/ inactivity from accelerometers
John Staudemayer University of Massachusetts Amherst

O.4.19 The acceptability of wearing an activity monitor (activPAL) on the thigh to older adults
Philippa Dall Glasgow Caledonian University

O.4.20 Cumulative and diurnal change in GPS-derived distance as a novel measure of community mobility in older adults
Kate Moored University of Pittsburgh

O.5 Clinical 2
Location: Crestone I & II

O.5.21 Using a wrist-worn sensor to objectively monitor gait quality in people with multiple sclerosis: Initial findings
Eran Gazit Tel Aviv Sourasky Medical Center

O.5.22 Impact of frailty on free-living walking performance in people living with MS
Tobia Zanotto University of Kansas

O.5.23 Objective estimation of disability levels and physical fatigue among people with multiple sclerosis using a single sensor worn during daily-living
Amit Salomon Tel Aviv Sourasky Medical Center

O.5.24 Setting the building blocks for long term remote and continuous real-time monitoring of MS patients in their daily living environment using a wrist-worn smart watch
Nathaniel Shimoni Owlytics Healthcare Ltd.

O.5.25 Activity and rest fragmentation analysis of daily-living physical activity fluctuations among people with MS
Amit Salomon Tel Aviv Sourasky Medical Center
Integrated systems to assess physical behavior
Location: Crestone III & IV

Assessment of activities of daily living using markerless motion capture in a virtual reality setting
Kevin Abbuzzese  Stryker Orthopaedics

Effects on heart rate, physical activity and ambulatory blood pressure from occupational physical activity with and without lifting among farmers in Denmark
Mette Korshøj  Holbaek Hospital

Estimation of metabolic rate during submaximal exercise using heart rate, sex, age, training status and exercise mode in participants with and without a disability
Julia K Baumgart  Norwegian University of Science and Technology

Towards eco-design of self-powered wearable devices: analysis of available energy on the human body for lead-free piezoelectric energy harvester positioning
Damien Horeau  ENS Rennes, SATIE

Exploring effects of central sensitization on gait in chronic low back pain by using machine learning approach
Xiaoping Zheng  University of Groningen

Symposia 5 & 6
5.3 Harmonisation methods of accelerometry and linkage with prospective health data in the ProPASS Consortium: pooling international cohorts for individual participant meta-analyses
Location: Crestone Peak I & II
Chair: Matthew Ahmad  University of Sydney
Participants: Matthew Ahmad  University of Sydney
Andrew Atkins  University of East Anglia
Magnus Svartengren  Uppsala University

5.6 Measuring the interrelationships between dietary intake and physical activity in free-living settings
Location: Crestone Peak III & IV
Co-Chair: Danielle Ostendorf  University of Colorado Anschutz Medical Campus
Co-Chair: Sarah Purcell  University of British Columbia Okanagan
Participants: Derek Havel  University of North Carolina Greensboro
Krista Leonard  Arizona State University
Sarah Purcell  University of British Columbia Okanagan
Edward Sazonov  University of Alabama

Lunch & ISMPB GMM
Location: Shavano Peak

Keynote Presentation
Avoiding catastrophe during a fall: Insights from video capture on the landing strategies of older adults during real-life falls
Location: Shavano Peak
Steve Robinovitch  Simon Fraser University
0.7.33 Development of an externally validated free-living step counting algorithm with deployment in the UK Biobank  
Scott Small  University of Oxford

0.7.34 A step towards more intuitive physical activity prescription: Validity of stepping-based metrics derived from wrist-worn accelerometry  
Ben Mayor  University of Leicester

0.7.35 Comparison of the performances of step counting algorithms in different physical activities  
David Gerstel  ActiGraph

0.8 Technical challenges and considerations  
Location: Crestone I & II

0.8.36 Let the epoch length float for more reliable measurements  
Henri Vähä-Yppy  The UKK Institute of Health Promotion Research

0.8.37 Comparison of a head-worn accelerometer to a hip-worn ActiGraph GT9X for classifying activity type and estimating energy expenditure  
Edward Sazonov  University of Alabama

0.8.38 Comparing ActiGraph CentrePoint Insight Watch, GT9X Link, and wGT3X-BT accelerometers to NHANES 2011-2014 GT3X+ devices using an orbital shaker  
Samuel Lahmunion  National Institutes of Health/ NIDDK

0.8.39 Impact of using a 60, 80, 90, or 100 Hz versus 30 Hz ActiGraph sampling rate on free-living physical activity assessment in youth  
Kimberly Clevenger  National Cancer Institute

0.8.40 Interrelationships between open-source, proprietary, and machine learning-derived accelerometry metrics  
Christopher Moore  University of North Carolina at Chapel Hill

0.9 Physical activity determinants and COVID-19  
Location: Crestone III & IV

0.9.41 Temporal patterns of sitting and non-sitting in normal-weight and overweight Brazilian office workers working from home during the COVID-19 pandemic  
Luiz Augusto Brusaca  Federal University of São Carlos

0.9.42 The impact of UK COVID-19 restrictions on objectively measured physical behaviour  
Alessandra Clarke-Cornwell  University of Salford

0.9.43 Typical day and influence of weekend on accelerometer measured physical activity  
Alexander Burchartz  Institute for Sports and Sports Science, Karlsruhe Institute of Technology

0.9.44 Does context matter? The association between affective states and physical behaviour and its moderation by weather factors measured with ambulatory assessment  
Irina Timm  Institute of Sports and Sports Science, Karlsruhe Institute of Technology

0.9.45 Multiple accelerometer assessed physical behavior across 24-hour period in older adults with different levels of physical fitness: a pilot study during COVID-19 pandemic  
Jan Vindis  Palacky University Olomouc

10:45 - 11:45am  Oral Sessions 10 – 12  
Location: Shavano Peak

0.10 Use of devices in children and adolescents  
Location: Shavano Peak

0.10.46 Active and sitting time precursors to mood in young adults  
Bryony Clark  The University of Queensland

0.10.47 Comparison of youth-specific cut-point and machine learning methods for classifying physical activity intensity from wrist accelerometer data  
Matthew Ahmad  University of Sydney

0.10.48 An objective assessment of toddler physical activity type and context at the childcare center and home  
Cailyn Van Camp  Michigan State University

0.10.49 Validating youth accelerometer methods using direct observation in free-living settings  
Jon Sirard  University of Massachusetts Amherst

0.11 Epidemiologic studies with health outcomes  
Location: Crestone I & II

0.11.51 Impact of patterns of physical activity at pre- and post-diagnosis with mortality of Asian cancer patients: Results mortality of Asian cancer patients: Results of Health Examinees-G study in Korea  
Jaesung Choi  Seoul National University

0.11.52 Association of profiles of objectively-measured physical activity and sedentary behavior with all-cause mortality risk in older adults  
Manasa Shanta Yerramalla  Université de Paris

0.11.53 The association between moderate-to-vigorous physical activity during commuting and metabolic markers  
Abolanle Gbadamosi  University of Salford

0.11.54 Implementation of wrist accelerometer into the National Health and Aging Trends Study (NHATS) to expand physical activity assessment in older adults  
Jennifer Schrack  Johns Hopkins Bloomberg School of Public Health

0.11.55 Multidimensional movement behavior and mortality in older adults from the Whitehall II accelerometer sub-study: A machine learning approach  
Mathilde Chen  Université de Paris

0.12 Clinical applications 1  
Location: Crestone III & IV

0.12.56 Are physical behavior and momentary fatigue bidirectionally associated after subarachnoid hemorrhage merging accelerometer and electronic diary data  
Lianne de Vries  Erasmus University Medical Center

0.12.57 Gait during daily life in men treated with androgen deprivation therapy for prostate cancer: Evidence for accelerated aging?  
Deanne Tibbitts  Oregon Health and Science University

0.12.58 Frequency of inpatient out-of-bed activities by ActiVAC vs. Johns Hopkins highest level of mobility scale after major abdominal surgery  
Mikita Fuchita  University of Colorado
O.12.59  Validation of the Apple Watch and Fitbit for assessing heart rate during rest and wheelchair propulsion in able-bodied participants and wheelchair users
Julia K Baumgart  Norwegian University of Science and Technology

O.12.60  Validation and ranking of algorithms for gait sequence detection in healthy controls and people with Parkinson’s disease
Maria Encarnación Micó Amig  Newcastle University

11:50am - 2:00pm  Box Lunch pick-up
Location: Shavano Foyer
11:45am - 12:00pm  Transition Break
12:00 - 12:45pm  Keynote Presentation
“Let’s dance around the world!”
Location: Shavano Peak
Mai Chin A Paw  Amsterdam UMC
12:45 - 1:30pm  Keynote Presentation
Evolution of public health physical activity applications of accelerometers; a personal perspective
Location: Shavano Peak
Richard Troiano  National Cancer Institute
1:30 - 2:00pm  Student Awards & Closing Remarks
Location: Shavano Peak

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Digital health is rapidly expanding due to surging healthcare costs, deteriorating health outcomes, and the growing prevalence and accessibility of mobile health and wearable technologies. Recent technological advancements make it possible to closely and continuously monitor individuals using multiple measurement modalities in real time. We are collecting and integrating such wearable data with clinical information to gain a more precise understanding of health and disease and develop actionable, predictive health models for improving cardiometabolic and infectious respiratory disease outcomes. We are simultaneously developing open source data science and machine learning tools for the digital health community, including the Digital Biomarker Discovery Pipeline (DBDP), to facilitate the use of mobile device data in healthcare.

Matthew Diamond | Digital Health Center of Excellence, U.S. Food and Drug Administration (FDA)

Matthew Diamond, MD, PhD is the Chief Medical Officer for Digital Health at the CDRH Digital Health Center of Excellence at FDA where he serves as the senior clinical expert for digital health medical devices and provides leadership for digital health policy development for emerging technologies including artificial intelligence. Prior to joining the Agency, Dr. Diamond served on leadership teams of large and small technology companies, including as CMO at Nokia, and as Medical Director at Fossil Group and the startup Misfit Wearables. Dr. Diamond served on numerous advisory boards including at the UMass Amherst Center for Personalized Health Care, and for NGP Capital. As Vice Chair of the CTA Health & Fitness Technology Board of Directors, he promoted public health applications of mobile technology and established an ANSI-accredited standardization committee for digital health technology. Dr. Diamond earned his MD and PhD (biophysics) from the Mount Sinai School of Medicine; he is board certified in rehabilitation medicine and sports medicine and certified in medical acupuncture. A faculty member at NYU, Dr. Diamond is passionate about helping people improve their mobility and performance through a holistic approach to rehabilitation and technology that promotes wellness.

The use of digital health technology for behavioral and physiological measures in clinical investigations of medical products

There is a global academic researcher community developing and validating methods to measure components of real-world physical behavior, gait and sleep using wearable inertial sensors and other connected technologies. Historically, this work has primarily been supported by public health researchers interested in understanding the dose response relationship between physical activity and health. There is now significant interest by those in the medical product development community to use such tools to measure real-world outcomes that are patient-centric, clinically relevant, and ecologically valid. The overarching goal of this keynote address is to accelerate digital health advancements, drive synergy and support patient-focused medical product development by increasing awareness and understanding of how academic research laboratories can generate evidence that meets the needs of regulatory stakeholders.

Steve Robinovitch, Ph.D | Simon Fraser University

Steve Robinovitch, Ph.D is Professor in the Department of Biomedical Physiology and_kinesiology at Simon Fraser University. Steve’s program on Technology for Injury Prevention in Seniors (www.sfu.ca/tips) focuses on the cause and prevention of falls and fall-related injuries in older adults. Steve received his B.A.Sc. in Mechanical Engineering from the University of British Columbia in 1988 and his Ph.D. in Medical Engineering from the DARP from MIT/Harvard in 1995. He worked as an Assistant Professor in-Residence in Orthopedics at the University of California San Francisco before joining SFU in 2000. He has published over 120 peer-reviewed papers, and is a past recipient of a Canada Research Chair, a Scholar Award from the Michael Smith Foundation for Health Research, and a New Investigator Award from CIHR.

Avoiding catastrophe during a fall: Insights from video capture on the landing strategies of older adults during real-life falls

How do older adults avoid injury during a fall? Any fall has the potential to cause catastrophic injury. Yet only about 5% of falls by older adults in long-term care result in serious injury. This talk will review evidence from video footage of over 3000 real-life falls experienced by older adults in long-term care, on how protective “safe landing” responses separate injurious and non-injurious falls.

Jessilyn Dunn | Duke University

Jessilyn Dunn is an Assistant Professor of Biomedical Engineering and Biostatistics & Bioinformatics at Duke University, and Director of the Duke BIG IDEAs Laboratory which is focused on biomedical data science and mobile health for digital biomarker discovery. Dr. Dunn is PI of the CDC-funded CoviDetect study to detect and monitor COVID-19 using mobile health technologies, which is built upon the team’s previous induction detection through the DARPA Prometheus and Biochronicity programs. Dr. Dunn was an NIH Big Data to Knowledge (BD2K) Postdoctoral Fellow at Stanford, an NSF Graduate Research Fellow at Georgia Tech & Emory, and a visiting scholar at the CDC and the National Cardiovascular Research Institute in Madrid, Spain. Her work has been internationally recognized with media coverage from the NIH Director’s Blog to Wired, Time, and US News and World Report.

The digital physiome: Wearables for early disease detection

Digital health is rapidly expanding due to surging healthcare costs, deteriorating health outcomes, and the growing prevalence and accessibility of mobile health and wearable technologies. Recent technological advancements make it possible to closely and continuously monitor individuals using multiple measurement modalities in real time. We are collecting and integrating such wearable data with clinical information to gain a more precise understanding of health and disease and develop actionable, predictive health models for improving cardiometabolic and infectious respiratory disease outcomes. We are simultaneously developing open source data science and machine learning tools for the digital health community, including the Digital Biomarker Discovery Pipeline (DBDP), to facilitate the use of mobile device data in healthcare.
Robert Motl University of Illinois, Chicago

Prof. Robert Motl has systematically developed a research agenda that focuses on physical activity and its measurement, predictors, and consequences in persons with neurological diseases, particularly multiple sclerosis (MS). Prof. Motl has generated a body of research on the validity of common physical activity measures in persons with MS. This has resulted in foundational research on quantifying differences in physical activity, particularly rates of moderate-to-vigorous physical activity, in persons with MS. These two lines of research have provided the basis for examining the outcomes of physical activity in MS, particularly beneficial adaptations in brain structure, cognition, depression, fatigue, walking disability, and quality of life. Prof. Motl has undertaken research on social-cognitive predictors of physical activity that has informed the design of behavioral interventions for increasing physical activity in MS. This agenda serves as a test-bed for application and expansion into other conditions such as spinal cord injury and Parkinson’s disease.

Issues and solutions in the measurement of physical activity and multiple sclerosis: Lessons learned and implications for other neurological diseases.

This presentation will focus on the history and application of accelerometers in persons living with multiple sclerosis, and extension into other populations living with chronic diseases and conditions such as Parkinson’s disease and wheelchair users.

Fay Bahling Horak Oregon Health and Science University

Dr. Horak is the Jay Nutt Endowed Professor of Neurology (Parkinson Center) at Oregon Health and Science University and Chief Scientific Officer of APDM Wearable Technologies, Clio. She is a fellow of the American Physical Therapy Association and neuroscientist who studies neural control and rehabilitation of balance and gait in patients with neurological disorders. Dr. Horak has quantified balance disorders in patients with Parkinson’s disease, Multiple Sclerosis, Vestibular Disorders, Cancer Drug toxicity, age-related high fall risk, etc. Dr. Horak also helped start a small company, that makes body-worn, inertial sensors with software to quantify balance and gait and movement disorder via precision motion monitoring. APDM was recently acquired by Clio, the largest company that provides technology for clinical trials. Recently, her laboratory has been comparing gait and turning characteristics collected passively during natural activities in daily life with characteristics collected during prescribed, clinical tests. She has over 300 peer-reviewed scientific articles and has received numerous awards.

How to select balance and gait outcomes from body-worn sensors for clinical trials on Parkinson’s disease

This presentation will focus on the selection of the balance and gait outcomes derived from wearable devices in clinical trials of Parkinson’s disease.

Mai Chin A Paw Amsterdam UMC

Mai Chin A Paw dreams of a world where children grow up healthy and happy. Such a world provides plenty opportunity for active play, inspiring education and physical activities. She loves to practise yoga and yoga philosophy and dance around the world.

Let’s dance around the world!

I strongly believe that diversity and inclusion in science leads to better science, more innovations and more relevant outcomes that better serves society at large. Historically, scientific research is quite WEIRD (Western, Educated, Industrialized, Rich, and Democratic) and this WEIRDNESS not only applies to study samples but definitely also to researchers themselves. WEIRD research leads to WEIRD results that better serve a small privileged group of WEIRD people, widening inequalities. How does this WEIRDNESS affect measurement of physical behaviour? I believe that collaborating within our small circle of scientific friends with similar backgrounds and perspectives results in bias and hinders innovation. As a result we end up missing out on the valuable holistic viewpoint that more inclusive science would gain.

In this lecture, I am keen to share examples of how I strive to make research on measurement of physical behaviour more inclusive by linking a wide diversity of ideas, perspectives and living environments. More diversity and inclusiveness makes our collective dance more beautiful and impactful!


Richard Troiano National Cancer Institute

Until his recent retirement, Dr. Richard (Rick) Troiano was a Program Director in the Risk Factor Assessment Branch of the Epidemiology and Genomics Research Program in NC’s Division of Cancer Control and Population Sciences (DCCPS). Dr. Troiano promotes the validation and use of accelerometer-based devices in the assessment of physical activity in research and population surveillance. He worked with the 2011-2014 National Health and Nutrition Examination Survey (NHANES) to implement the use of devices in the survey to obtain objective measures of participants’ physical activity-related movement and sleep, as well as body strength, and was the lead on inclusion of accelerometers for the first time in NHANES in 2003-2006. He is interested in promoting improved understanding of the information obtained from devices and self-reports and the analytic implications of different data sources. Dr. Troiano also supports federal efforts to promote health-enhancing physical activity, as evidenced by his service as co-executive secretary for the development of the Physical Activity Guidelines for Americans, 2nd edition. Dr. Troiano also was on detail to the Office of Disease Prevention and Health Promotion as Coordinator for the development of 2008 Physical Activity Guidelines for Americans and to the Office of the Surgeon General to support development of Step it Up! The Surgeon General’s Call to Action to Promote Walking and Walkable Communities. Most recently, he served as a member of Guideline Development Group for the 2020 WHO Guidelines on Physical Activity and Sedentary Behaviour.

Evolution of public health physical activity applications of accelerometers; a personal perspective.

The use of accelerometers to assess physical activity for research and population surveillance has increased rapidly since 2000 with publications on physical activity and accelerometers increasing more than 50-fold. Accelerometer-based measures were included in multiple cohorts and population surveillance. Concurrently, device technology was rapidly evolving as was understanding of the relationship between physical activity behavior and the signal data available from accelerometer-based devices. This talk will provide an overview of significant events over this period as well as address the current challenge of bridging physical activity recommendations based on reported behavior with assessment based on device measures.
Detecting hotspots for physical activity using accelerometry, GPS and GIS

**BACKGROUND AND AIM:** Daily physical activity is not one behavior that takes place in one location; it consists of many different behaviors occurring in different locations. To get a better understanding of the correlates and determinants of physical activity behavior, knowing in which context it occurs can add valuable additional information. With the emerging of methods to combine accelerometer and global positioning system (GPS) The aim of this presentation is to explain how the process of identifying physical activity hotspots works, and demonstrate the method using examples from several studies conducted in Australia and Denmark. METHODS: Data were collected among school-children in Denmark and preschool children in Australia using an accelerometer (ActiGraph GT3X or Axivity) and a GPS (Qstarz BT-Q1000X) for 7 days (5 week days, 2 weekend days) to determine their level of activity and movement patterns. The GPS position was recorded every 15 seconds and their activity level was recorded and 100Hz and compiled into 15 second epochs. Data were merged and processed using HABITUS, an online tool available via the University of Southern Denmark. The processed data-points were imported into the geographical information software ArcGISpro, where optimized hot-spot analyses were conducted to identify the statistically significant spatial clusters GPS points with higher or lower physical activity levels. For each hotspot, we identified the type of area, revealing the built environment characteristics of places with a significantly higher level of physical activity. RESULTS: Physical activity hotspots were identified in the outdoor areas of early care and education centers (ECEC), schoolyards, as well as neighborhoods. In neighborhoods, for schoolchildren, activity hotspots primarily consist of schoolyards, sports facilities and playgrounds between multi-story social housing complexes. For preschool children, activity hotspots were primarily in private yards, ECECs, public parks, and shopping areas. In schoolyards, activity hotspots were primarily at a ball-game areas, climbing areas, and open spaces. For ECECs, activity hotspots were in many different types of areas, but more often in open spaces and areas with large fixed-play-equipment.

**CONCLUSIONS:** Collecting and processing accelerometer and GPS data is time-consuming, but in combination with geographic information tools, it can be very powerful in identifying hotspots for physical activity. These findings suggest that both environmental and psychosocial correlates of activity are often location specific.
space and time. METHODS: 324 children (5-9 years) were recruited in 12 neighborhood parks in New York City and Raleigh/Durham, NC, in spring/summer 2017-2018 to wear accelerometer and GPS for an average of 25 minutes, recording location and activity intensity of play. Caregivers reported demographic information through surveys. The dataset consisted of 38,792 points of accelerometer and GPS data joined at 15-second epochs, along with associated individual characteristics. The density-based clustering method, Multi-scale (OPTICS), identified clusters (i.e., play episodes) that consisted of at least 5 data points (1 minute). Identified clusters were mapped to playspaces in parks, including play areas (e.g., play structures), sport pitches (i.e., courts and fields), in-between features, and areas surrounding parks (e.g., sidewalks). RESULTS: 1,723 play episodes were identified from collected data. On average, a child’s play consisted of five play episodes with a 2.94-minute duration and 17 meters/minute velocity. For each play episode, a child maintained moderate to vigorous intensity physical activity (MVPA) for 28% of the time. Of the 1,723 episodes, 20% were solely in play areas, 6% in sports pitches, 22% strictly in-between features, and 3% were outside of parks within single areas in parks. Average time spent in playspaces in/around parks varied by individual characteristics. Children maintaining an accelerometer average above the MVPA threshold (+573) spent more time in areas designated for play (+6%) and less time in spaces between features (+7%), compared to children less active. Girls spent more time in play areas (+5%) and between features (+4%) whereas boys spent more time in sports pitches (+10%). CONCLUSIONS: Results demonstrate characteristics of play episodes and how spaces in parks are used for children’s play. Findings highlight that children’s free play occurs across spaces, and not necessarily concentrated in areas designated for play, which implies the importance of spatial arrangement of various park features to the diversity and intensity of play. Advancing this methodology could provide valuable information for practitioners to better design play features and their layout that support active and meaningful play.

Symposium II

Wednesday, June 22

10:30am – 12:00pm, Crestone Peak I & II

Measuring sleep with wearables: The ABC’s of measuring Z’s

Chair: Seth Creasy

University of Colorado Anschutz Medical Campus, USA

John Chase

University of Massachusetts Amherst, USA

Sleep and significance of sleep measurement

Sleep in critical for physical, cognitive, and psychological health. Sleep is simultaneously influenced by confounding life factors like stress, diet, and aging and disease. Accurate and precise sleep measurement is crucial for our understanding of the relationships between health outcomes and life factors. Technological advancements in sleep measurement have preceded an era when sleep measurement is widely portable and accessible in clinical, research, and commercial platforms alike. In this talk, we will review the historical progression of sleep measurement from early self-report questionnaires to contemporary sleep measurement tools, including polysomnography and wearable technology (e.g., accelerometers). We will explain why the question of interest dictates what type of sleep measurement device is needed, while highlighting the strengths and limitations of common device-platform combinations. Finally, we will discuss how burgeoning technological advancements, such as the incorporation of biometric signals in portable devices, can improve our understanding of the relationships between sleep and health outcomes across the lifespan.

Stacey Simon

University of Colorado Anschutz Medical Campus, USA

Sleep measurement in research & clinical settings

BACKGROUND AND AIM: Sleep health is a multidimensional concept consisting of a variety of factors such as duration, timing, quality, and satisfaction. Poor sleep health is endemic in individuals across the lifespan: nearly 35% of adults and 78% of adolescent report sleeping less than the recommended amount per night, and sleep complaints are one of the most common mental concerns for pediatricians. Sleep disorders such as obstructive sleep apnea and insomnia are also increasingly prevalent. Thus, the aim of this presentation is to describe measures of sleep health and discuss pros and cons, indications for use, and consideration for special populations. METHODS: A review of objective and subjective measures of sleep health frequently used in research and clinical settings will be provided. RESULTS: Laboratory-based polysomnography is the gold standard for objective sleep evaluation but is expensive, burdensome, requires trained staff to administer and score, and captures only a single night of sleep in an atypical environment.

Alternative devices such as accelerometer-based wrist actigraphy, dry-EEG headbands, and peripheral arterial signaling finger-worn devices can be used in the home environment over extended periods of time but may also be costly or less accurate. CONCLUSIONS: Accurate assessment of sleep health is important for both researchers and clinicians and a number of assessment tools are available for different populations, settings, and outcomes.

Charles Matthews

National Cancer Institute, National Institutes of Health, USA

Integrating physical activity and sleep measurements in epidemiological research

The application of actometry in large scale epidemiologic studies has accelerated the interest among physical activity researchers to investigate the health benefits and risks associated with the full range of behaviors occurring in the 24-hour day, including sleep, physical activity, and sedentary behavior. There are many similarities in studying sleep and physical activity using ambulatory monitors, but there are also important differences that should be considered. This presentation will describe the parallels in measuring the two behaviors as well as the important differences. New state of the art applications of monitor-based measures of physical activity and sleep in large epidemiologic studies will be discussed, with a particular focus on key methodologic questions related to risk for developing cancer and how better assessments of sleep and physical activity may advance our cancer prevention efforts.

Evan Chinoy

Naval Health Research Center, USA

Accuracy and utility of consumer-grade devices for measuring sleep

Recent advances in technology and demand for biometric data have led to the creation of a variety of personal consumer devices that track physiological signals and behavioral patterns, including sleep. Such devices help meet the important need for long-term, automated, real-time sleep tracking, with the added benefits of being less expensive and burdensome than standard research methodologies. Although such technologies have widespread use among the general population for everyday sleep tracking, the algorithms are often proprietary and the claims made by technology companies regarding device accuracy and utility are debated by researchers and clinicians. A related concern is that the ability of researchers to formally evaluate the validity of devices is much slower than the pace of new devices being released onto the consumer market. Despite this research gap, the number of high-quality validation studies has increased recently, helping elucidate the strengths and weaknesses of many new and popular consumer sleep-tracking devices. This includes our lab which, over the past 5 years, has conducted a series of validation studies testing many of the latest consumer sleep-tracking devices, to systematically evaluate their performance under different conditions. In general, our findings show that many, but not all, devices can track sleep-wake patterns on most nights as well as (or slightly better than) the mobile sleep assessment standard methodology, research-grade actigraphy, in healthy individuals under fixed sleep conditions in a controlled laboratory setting, as well as at home with ad libitum sleep schedules and environments. However, consumer devices still display some of the performance limitations inherent to research-grade actigraphy devices, such as low epoch-by-epoch specificity and bias toward underestimating true periods of wake - indicating that device accuracy may be lower on nights with disrupted sleep patterns. We also found that consumer devices are inconsistent in their ability to accurately classify individual sleep stages (i.e., light, deep, or rapid eye movement sleep) and to track irregular sleep schedules (e.g., naps, split sleep). Additionally, our lab has started implementing sleep-tracking devices into real-world operational military environments to evaluate their feasibility for everyday use and utility of their sleep data as inputs into fatigue management platforms to identify potential sleep issues and reduce operational risks. The continued improvement and versatility of new consumer devices strengthens their potential use cases as beneficial alternatives to standard methodologies for tracking real-world sleep patterns, though with some important considerations and limitations.
Physical behaviors and health: New methods and insights from large epidemiologic studies using accelerometry

Pedro Saint-Maurice
National Cancer Institute, National Institutes of Health

Sleep duration, quality, timing, and mortality risk

BACKGROUND & AIM: Most evidence describing the amount of sleep associated with a lower mortality risk comes from studies that used self-reported measures of sleep and includes limited information about other sleep dimensions like sleep quality and timing. This study examined associations between accelerometer-derived sleep duration, quality, timing, and mortality using a large, prospective cohort from the UK Biobank cohort study (n=0.21 million; age 40-69 years [2006-2010]). Approximately 6 years post baseline, 103,712 adults participated in an activity monitoring sub-study and wore an Armitage AK3 wrist-triangular accelerometer over 7-days. Monitor data were processed using the R package GGR to generate sleep duration (hours/day), sleep quality (wake after sleep onset, sleep efficiency), and sleep timing (onset, offset, midpoint) exposures. Data were linked to mortality outcomes including all-cause cardiovascular disease (CVD), and cancer mortality assessed via National Health Service registries in UK with follow-up up to 12/31/19. We first estimated Hazard ratios (HRS; 95% CI) for sleep duration and duration outcomes using cubic splines. Next, we computed HRs for quartiles of the sleep quality and timing exposures in relation to mortality. All models were adjusted for age, sex, race-ethnicity, education, Townsend deprivation index, employment status, lifestyle factors, chronic conditions, functional pain, and general health rating. Sensitivity analysis included examinations of heterogeneity in our sleep duration-mortality associations by demographic and lifestyle variables. RESULTS: Over an average of 5.1 years, 1,762 deaths resulted from CVD (n=1,206), cancer (n=217), and CVD deaths (n=339). Participants slept on average from 23:30 to 7:12, for about 6.92 hours/day, and were awake for 46 minutes. When compared to sleeping 70 hours/d, sleeping less than 6 hours per day was associated with a 14-33% higher risk for all-cause mortality (p<0.01; e.g., HRS hrs/d: 1.23 [0.95, 1.61]); 28-56% higher risk for CVD mortality (p=0.05; e.g., HRS hrs/d: 1.47 [0.98, 2.25]), with no clear associations for cancer mortality (p=0.05). Sleeping less than 6 hours/day (on 3+ nights in a week) was associated with a 20% increased risk for all-cause mortality (HR=1.20 [1.06, 1.36]) when compared to individuals with 0 nights of short sleep. Measures of sleep quality and timing were not associated with mortality risk (p>0.05). Our examinations of heterogeneity showed that sleeping < 6 hours/day was consistently associated with all-cause mortality across demographic and lifestyle subgroups except across quartiles of moderate-vigorous physical activity (physicoenergetics=0). CONCLUSIONS: Accelerometry measured sleep duration, but not the quality or timing of sleep were associated with mortality. These findings suggest that sleeping less than 6.0 hrs/d can increase mortality risk among men, women, young, and older adults.

Qian Xiao
University of Texas Health, SPH, USA

24-hour rest-activity patterns and health

In free-living conditions, sedentary behaviors and sleep are fundamental human movement behaviors organized in a 24-hour rhythmic cycle. These behaviors are orchestrated by the internal circadian timing system, and influenced by common environmental exposures (e.g., light, daily schedules and social interactions). The conventional approach to study diurnal movement behaviors focuses on measures of individual components such as physical activity intensity and volume, duration of sitting, and sleep duration and efficiency. However, there’s been little focus on the timing and rhythmic properties of these behaviors and movement over the 24-hour day. The highly interconnected nature of these behaviors requires an integrated and holistic approach to study the overall patterns of the 24-hour rest-activity cycle. There are various methods that have been developed for characterizing 24-hour rest-activity patterns, including both parametric and nonparametric methods. The former assumes a cosine or cosine-like shape of daily activity patterns and produces rhythmic measures such as amplitude, mesor, acrophase and overall rhythmicity. In contrast, the nonparametric methods have no underlying assumption about activity patterns and derive metrics that measure specific aspects of the rest-activity cycles, such as stability, variability/fragmentation. More recently, an alternative approach to overcome these limitations is the functional principal component analysis (FPCA), which applies flexible algorithms to fit activity data with no a priori assumptions and is able to identify overall rest-activity profiles. In this section, we will discuss different methodologies for characterizing rest-activity patterns using 24-hour actigraphy data, and present two recent studies in the National Health and Nutrition Examination Survey (NHANES), focusing on 1) the associations between cosinor-based rest-activity characteristics and metabolic health; and 2) FPCA-derived rest-activity profiles among US adults. These studies demonstrate the utilization of different methodology for rest-activity measurement, highlight the importance of rest-activity rhythms in health, and identify sociodemographic and socioeconomic correlates of rest-activity patterns in the US population.

Kelly R. Esvenson
University of North Carolina - Chapel Hill, USA

Identifying multicomponent patterns of accelerometer-assessed physical activity and sedentary behavior: The Objective Physical Activity and Cardiovascular Health Study

BACKGROUND AND AIM: Latent class analysis (LCA) is a useful statistical tool to describe patterns of physical behavior (e.g., physical activity (PA) and sedentary behavior (SB)). Single component LCA has been previously applied to accelerometer data to provide unique class assignments for SB and the various intensities of PA. The objective of this study was to explore multi-component LCA to integrate the full spectrum of physical behavior among women age 64 and older in a unique LCA model. METHODS: Participants were from the United States and enrolled in the Women’s Health Initiative Objective Physical Activity and Cardiovascular Health Study. Overall, 6,126 women 64 to 97 years wore an ActiGraph GT3X+ accelerometer at their hip for 4-7 days of adherent wear (defined as >30 hours/day). Using accelerometer data, we assessed time spent in SB (0-10 VM), light (10-23 VM), moderate (23-60 VM), and moderate to vigorous (MVPA) (>60 VM). Multi-component LCA classified women based on all its metrics across time of day in 1-hour windows over the 7-days of wear, averaging across adherent days. RESULTS: Multi-dimensional physical behaviors in minutes/day were: 556 (99) SB, 189 (50) light low, 98 (36) light high, and 50 (34) MVPA. Optimally, 6 classes were identified for the full spectrum of physical behavior, including SB, light low, light high, and MVPA. Class assignments ranged from the highest SB and lowest MVPA (class 1) to the lowest SB and highest MVPA (class 6), both averaged across all 1-hour windows. The percent (%) from the lowest to highest class were similar as 13% (805), 28.0% (1713), 21.7% (1330), 17.1% (1045), 14.0% (858), and 6.1% (375). Slower self-reported walking speed was associated with a lower class (p<0.05). CONCLUSIONS: Unique class assignments for SB and the various intensities of PA were identified using LCA. Capturing the full spectrum of physical behaviors in free-living older women were observed using novel analysis of accelerometer. By identifying heterogeneous patterns which capture a profile encompassing a range of physical behaviors, these methods can be used to find new insights into habitual patterns and intensities for targeted interventions aimed to improve health outcomes, such as enhancing aging resiliency and independence, among older women.

Amanda Paluch
University of Massachusetts Amherst, USA

10,000 steps/day? Closing the gap between common knowledge and scientific evidence

The simplicity of steps/day as a metric makes it appealing for physical activity promotion in clinical and population settings. Summarizing the association of steps and health can advance health promotion guidelines. The Steps for Health Collaborative has compiled data from cohort studies for a meta-analysis with device-measured steps and prospective health outcomes. This presentation will discuss the process of the consortium effort and conducting a harmonized meta-analysis. Analysis on the associations of steps and all-cause mortality will be discussed. This meta-analysis included 15 studies, of which seven were published and eight were unpublished, including nine different step counting devices. The total sample included 47,471 adults, among whom there were 3013 deaths (10.1 per 1000 participant-years) over a median follow-up of 7-years (IQR=4.3-9.9) (297,387 person-years). Quartiles median steps per day were 3553 for quartile 1, 5801 for quartile 2, 7842 for quartile 3, and 10,901 for quartile 4. Compared with the lowest quartile, the adjusted HR for all-cause mortality was 0.60 (95% CI 0.51-0.71) for quartile 2, 0.55 (94-0.62) for quartile 3, and 0.47 (0.39-0.57) for quartile 4. Restricted cubic splines showed progressively decreasing risk of mortality among adults aged 60 years and older with increasing number of steps per day until 6,000-8,000 steps per day and among adults younger than 60 years until 8,000-10,000 steps per day. Taking more steps per day was associated with a progressively lower risk of all-cause mortality, up to a level that varied by age. The findings from this meta-analysis can be used to inform step guidelines for public health promotion of physical activity.
Significance and innovation of wearable technology for clinical trials in ataxia

Spincerebellar ataxias (SCAs) are primarily characterized by excessive postural sway in standing and ataxic gait that reflects impaired dynamic balance control (similar to alcoholic ataxic gait). Rare neurological diseases that affect balance or gait disorders in genetically determine patients with SCA 1, 2, 3 or 6. Standing for 30 seconds with eyes open and with feet together or apart provided the best measures of balance and gait variability from a 2-minute, natural pace walk the best gait measures. I will show how quantitative assessment of the severity of ataxia-specific gait and balance in daily life versus the clinic. I will also introduce an innovative approach to establish scientific and clinical validity of an aggregated, instrumented score for ataxia monitoring fit for an ataxia clinical trial outcome.

Vrutangkumar Shah Oregon Health & Science University, USA

Harmonisation methods of accelerometer and linkage with prospective health data in the ProPASS Consortium: pooling international cohorts for individual participant meta-analyses

A federated data platform provides a novel technological solution that can address some of the most basic challenges in facilitating the access of researchers and other health care professionals to individual level data. Federated data analysis can be used in research environments where data must be analysed but cannot physically be shared with researchers. The presentation will include information on ProPASS’ collaboration with DataSHIELD, an industry partner who had developed a federated software infrastructure. The open-source structure of the platform facilitates research in settings where: 1) co-analysis of individual level data from several studies is necessary but governance restriction prevents the release of required data or renders data sharing unacceptably slow, 2) governance concerns hinder access to a single dataset, 3) researchers wish to actively share information held in their data with others but do not wish to cede control of the governance and/or intellectual property.

Matthew Ahmadi University of Sydney, Australia

The harmonisation of non-accelerometer data in ProPASS: Where we’ve been and where we’re going

This two-part presentation will (1) summarise the methods and outcomes of the harmonisation of metabolic, anthropometric, demographic and behavioural data in ProPASS to date and (2) outline future developments to this process. Part one will describe the process and timeline for harmonisation of the non-accelerometer data, provide illustrative examples of some of the variables that have been harmonised thus far and offer some critical reflections on the challenges and potential solutions that we have encountered. Part two will outline future plans for data harmonisation in ProPASS, addressing some of the challenges outlined in part one. This will include preliminary details on a collaboration with Maestral Research, global leaders in the development of retrospective harmonisation methodology and software.

Matthew Ahmadi University of Sydney, Australia

How to select the balance and gait measure for spinocerebellar ataxia

Recently, we demonstrated how quantitative assessment of the severity of ataxia-specific gait and postural sway impairments from wearable technology can provide highly sensitive performance outcome measures with high face validity to power clinical trials. We tested standing balance and gait characteristics in 150 people with spinocerebellar ataxia and 50 control subjects to identify the most sensitive and specific measures for ataxia. The ataxia patients included 40 with SARA scores <3, that is prodomal ataxia, without clinically observable balance or gait disorders in genetically determine patients with SCA 1, 2, 3 or 6. Standing for 30 seconds with eyes open and with feet together or apart provided the best measures of balance and gait variability from a 2-minute, natural pace walk the best gait measures. I will show how quantitative assessment of the severity of ataxia-specific gait and postural sway impairments from wearable technology could provide many potential performance outcome measures with high face validity to power clinical trials. In this talk, I will focus on how to select several balance and gait outcomes based on expert opinion on the most important clinimetrics for a clinical trial. This novel approach to selecting the best objective measure of balance and gait for cerebellar ataxia can be applied to any diagnostic for any disease.

Matthew Ahmadi University of Sydney, Australia

Conference IV

Symposium IV

Fay Horak Oregon Health & Science University, USA

Significance and innovation in use of wearable technology for clinical trials in ataxia

Spinocerebellar ataxias (SCAs) are primarily characterized by excessive postural sway in standing and ataxic gait that reflects impaired dynamic balance control (similar to alcoholic ataxic gait). Rare neurological diseases that affect balance or gait disorders in genetically determine patients with SCA 1, 2, 3 or 6. Standing for 30 seconds with eyes open and with feet together or apart provided the best measures of balance and gait variability from a 2-minute, natural pace walk the best gait measures. I will show how quantitative assessment of the severity of ataxia-specific gait and balance in daily life versus the clinic. I will also introduce an innovative approach to establish scientific and clinical validity of an aggregated, instrumented score for ataxia monitoring fit for an ataxia clinical trial outcome.

Vrutangkumar Shah Oregon Health & Science University, USA

How to select the balance and gait measure for spinocerebellar ataxia

Recently, we demonstrated how quantitative assessment of the severity of ataxia-specific gait and postural sway impairments from wearable technology can provide highly sensitive performance outcome measures with high face validity to power clinical trials. We tested standing balance and gait characteristics in 150 people with spinocerebellar ataxia and 50 control subjects to identify the most sensitive and specific measures for ataxia. The ataxia patients included 40 with SARA scores <3, that is prodomal ataxia, without clinically observable balance or gait disorders in genetically determine patients with SCA 1, 2, 3 or 6. Standing for 30 seconds with eyes open and with feet together or apart provided the best measures of balance and gait variability from a 2-minute, natural pace walk the best gait measures. I will show how quantitative assessment of the severity of ataxia-specific gait and postural sway impairments from wearable technology could provide many potential performance outcome measures with high face validity to power clinical trials. In this talk, I will focus on how to select several balance and gait outcomes based on expert opinion on the most important clinimetrics for a clinical trial. This novel approach to selecting the best objective measure of balance and gait for cerebellar ataxia can be applied to any diagnostic for any disease.

Matthew Ahmadi University of Sydney, Australia

Harmonisation methods of accelerometer and linkage with prospective health data in the ProPASS Consortium: pooling international cohorts for individual participant meta-analyses

A federated data platform provides a novel technological solution that can address some of the most basic challenges in facilitating the access of researchers and other health care professionals to individual level data. Federated data analysis can be used in research environments where data must be analysed but cannot physically be shared with researchers. The presentation will include information on ProPASS’ collaboration with DataSHIELD, an industry partner who had developed a federated software infrastructure. The open-source structure of the platform facilitates research in settings where: 1) co-analysis of individual level data from several studies is necessary but governance restriction prevents the release of required data or renders data sharing unacceptably slow, 2) governance concerns hinder access to a single dataset, 3) researchers wish to actively share information held in their data with others but do not wish to cede control of the governance and/or intellectual property.

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Andrew Atkin University of East Anglia, UK

The harmonisation of non-accelerometer data in ProPASS: Where we’ve been and where we’re going

This two-part presentation will (1) summarise the methods and outcomes of the harmonisation of metabolic, anthropometric, demographic and behavioural data in ProPASS to date and (2) outline future developments to this process. Part one will describe the process and timeline for harmonisation of the non-accelerometer data, provide illustrative examples of some of the variables that have been harmonised thus far and offer some critical reflections on the challenges and potential solutions that we have encountered. Part two will outline future plans for data harmonisation in ProPASS, addressing some of the challenges outlined in part one. This will include preliminary details on a collaboration with Maestral Research, global leaders in the development of retrospective harmonisation methodology and software.

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In conclusion, studies of emerging and older adults' PA and DI behaviors will be discussed to highlight burden, and the pairing of EMA data with other data (e.g., accelerometers) can use new statistical analyses to consider many practical considerations including how to adequately capture PA and DI, the selection of assessments, participant correlates to elucidate how behaviors unfold across time. Results: The collection of PA and DI via EMA brings validity. Further, patterns of PA and DI likely change across short timescales (e.g., hours), vary across different contexts with the use of retrospective and infrequent assessments which are prone to recall biases and often lack ecological validity. Mobile sensing has been validated in field studies. Methods: An already-existing algorithm that uses information from thigh acelerometer rotation to differentiate lying down from sitting, developed by Lyden et al., was combined with the Acti-4 algorithm and refined. This was validated in a dataset where 47 participants wore two Activity-Ax3 devices for 7 days, one on the leg and one on the back as a reference. The sleep algorithm was developed and optimized on a dataset consisting of 23 single-night polysomnography registrations (PSG), from 15 asymptomatic adults. Then this algorithm was validated on another dataset, in which 71 adult males (age 57 ± 11 years) wore ambulatory PSG equipment and one Activity-Ax3 on the leg simultaneously, while sleeping one night in their homes. Results: Lying down time was identified with a sensitivity of 0.95, specificity of 0.94, and accuracy of 0.94 compared to lying down time, identified by the back accelerometer. The mean difference between the total identified lying down time/day, between the refined algorithm and the back accelerometer was +2.9 (95% limits of agreement -13.0 to +16.0) minutes per day. Sleep was identified with a mean sensitivity of 0.88, specificity of 0.55, and accuracy of 0.80 compared to PSG. Sleep intervals were underestimated by -21 (95% limits of agreement -86 to +44) minutes. Total sleep time was underestimated by -32 (95% limits of agreement -146 to +85) minutes. Conclusions: Acti-4 and the added functionality to identify lying down time and sleep is now integrated into ActiPASS, that is a new streamlined, automated software for processing raw accelerometer data in large batches that fits the need for the PROPASS consortium.

Symposium VI

Thursday, June 23

10:45am - 12:15pm, Crestone Peak III & IV

Measuring the interrelations between dietary intake and physical activity in free-living settings

Co-Chair: Sarah Purcell - University of British Columbia – Okanagan, Canada
Co-Chair: Danielle Ostendorff - University of Colorado, Anschutz Medical Campus, USA

Derek Hevel - University of North Carolina Greensboro, USA

Physical activity and dietary intake measurement via ecological momentary assessment: Practical considerations and potential statistical analyses

Background and Aims: Physical activity (PA) and dietary intake (DI) are repeat occurrence health behaviors that have mental and physical health implications. Yet, traditional measures of PA and DI have been limited in the past with the use of retrospective and infrequent assessments which are prone to recall biases and often lack ecological validity. Further, patterns of PA and DI likely change across short timescales (e.g., hours), vary across different contexts (e.g., environment), and co-occur with other behaviors. Limitations of traditional measures of PA, DI, and correlates may contribute to reductions in the predictive power of theories and techniques of health behavior engagement.

Methods: Ecological Momentary Assessment (EMA) can overcome previous limitations by intensively capturing PA, DI, and correlates to elucidate how behaviors unfold across time. Results: The collection of PA and DI via EMA brings many practical considerations including how to adequately capture PA and DI, the selection of assessments, participant correlates, and the pairing of EMA data with other data (e.g., accelerometers). New statistical analyses can use EMA data to address new questions including how individuals differ from one another and how they differ from their usual levels.

Conclusion: Studies of emerging and older adults’ PA and emerging adults’ DI behaviors will be discussed to highlight practical considerations and potential statistical analyses.

Edward Sazonov - The University of Alabama, USA

Monitoring of energy intake and expenditure with Automatic Ingestion Monitor

Background and Aim: The Automatic Ingestion Monitor (AIM) is a passive food intake sensor requiring no self-report of eating episodes, just compliance with wearing the device. This talk will present our ongoing work on using the AIM for monitoring of energy intake, diet, physical activity, and energy expenditure. Methods: Results from several completed and ongoing studies will be presented, including: 1) An overview of the sensors and operation of the AIM device; 2) Online (real-time) and off-line (postprocessing) models for accurate detection of food intake in free-living and capture of images of the foods being eaten with privacy preservation; 3) Use of AIM data for estimation of energy intake in respect to weighed food records; 4) A novel method for joint recognition of physical activity and energy expenditure from the AIM data. Results: The accuracy of food intake detection in free-living varied from 81.8% to 96.1% for F1-measure in various studies. The AIM was successfully deployed in several studies, including studies in rural and urban Africa, providing reliable data on food consumption. The difference in daily energy intake estimated using sensor and food intake data with respect to weighed food records were (Mean±SD): 0.45±2.50 MJ/d and 3.10±2.87 MJ/d, respectively. The accuracy of physical activity classification was 97%, while the model for energy expenditure produced a 10% mean absolute error. Conclusions: The AIM sensor shows promise as a tool for joint assessment of diet, energy intake, physical activity, and energy expenditure. Further studies are needed to refine the models used in the estimation of energy intake and expenditure.

Krista Leonard - Arizona State University, USA

Methodological considerations in measuring physical activity, energy intake, and resting energy expenditure in the context of an adaptive prenatal weight gain intervention

Challenges associated with measuring prenatal energy balance (e.g., feasibility, misreporting) have limited our understanding of the complex interrelations of the components of prenatal energy balance and its impact on gestational weight gain (GWG) regulation in pregnant women with overweight or obesity (PW-OW/OB). PW-OW/OB are at risk for excessive GWG (i.e., >11.5 kg for overweight and >9.0 kg for obese), which is an independent predictor of adverse maternal (e.g., gestational diabetes and infant [e.g., macrosomia] outcomes and long-term development of obesity. Evidence suggests that excessive GWG is a result of behavioral factors (i.e., high energy intake; to a lower extent, low physical activity). As such, GWG regulation trials have primarily focused on the combined effects of promoting physical activity and moderating energy intake. However, both physical and social challenges can make health behavior changes and subsequent regulation of GWG difficult. Our prior work as well as others have suggested that in addition to energy intake and physical activity, another component of energy balance that is physiologically regulated and contributes to GWG is resting energy expenditure (REE). The lack of evidence regarding the interrelations between the components of energy balance and GWG may partly be attributed to methodological challenges such as a lack of feasible measures that can assess daily physical activity, energy intake, and REE over time, the absence of gold standard protocols for wearable devices, and inaccuracies associated with self-reported measures (e.g., overreporting of physical activity, underreporting of energy intake). The objective of this presentation is to recommend measurement strategies that aim to address these methodological issues to improve the collection of prenatal physical activity, energy intake, and REE data. Incorporating these novel measurement strategies can help future researchers answer the question of how the components of prenatal energy balance are interrelated and how GWG regulation in PW-OW/OB in order to support long-term health for mothers and children. These measurement strategies will be discussed within the context of a longitudinal, adaptive prenatal GWG regulation intervention, Healthy Mom Zone. Dr. Leonard will provide an overview on the importance of understanding components of prenatal energy balance for predicting GWG regulation in PW-OW/OB. She will also discuss data from her research and clinical trials that use new, practical, and cost-effective methods to improve the accuracy of measuring prenatal physical activity, energy intake, and REE via mobile health devices and validated equations. Lastly, Dr. Leonard will provide recommendations for how these measurement techniques can be utilized in future studies aimed at understanding energy balance to prevent excessive GWG.
The CNN Hip Accelerometer Posture (CHAP) method for classifying sitting patterns from hip accelerometers: development and initial validation in a sample of older adults

BACKGROUND & AIM: There is growing interest in using a single wearable device (e.g., hip-worn accelerometer) to measure the full spectrum of 24-h physical behavior, from sitting time and patterns to vigorous physical activity. Traditional cut-points for measuring activity intensity cannot accurately detect postures and postural transitions, often overestimating these transitions and understimating prolonged sitting bouts. To overcome this limitation, we developed the Convolutional Neural Network (CNN) Hip Accelerometer Posture (CHAP) classification method. METHODS: CHAP combines a CNN with a bi-directional long short-term memory network (BiLSTM) and a Softmax output layer for correct sitting or non-sitting posture classification. The CNN was trained using acceleration data from raw hip/hand and thigh/wrist sensors of the CHAP leveraged data from 709 free-living older adults (age ≥65 y) in the Adult Changes in Thought (ACT) study who concurrently wore hip-based ActiGraph GT3X+ and thigh-based activPAL devices for ~7 days. CHAP leveraged data from 709 free-living older adults (age ≥65 y) in the Adult Changes in Thought (ACT) study who concurrently wore hip-based ActiGraph GT3X+ and thigh-based activPAL devices for ~7 days. Non-overlapping 10 s epochs of input ActiGraph data and ground truth sitting vs. non-sitting labels from activPAL data were compiled, and first fed into CHAP’s CNN layer, which automatically learned unique features of the data through repeated iterative processing in each 10 s epoch independently. Next, CNN output features were smoothed with the BiLSTM layer, which overcame the CNN’s assumption of temporal independence between each 10 s epoch to automatically learn temporal features of the data. Finally, all learned features were processed by a Softmax output layer, which assigned final output behavioral classification labels by converting the refined output features from the BiLSTM into probabilities over time. RESULTS: At the minute level, CHAP had higher sensitivity of 83% (vs. 26% for TLBC and 72% for cutpoint) and precision of 83% (vs. 30% for cutpoint and 56% for TLBC). CONCLUSION: CHAP showed outstanding validity for classifying sitting and non-sitting posture in a large, age-matched sample of older adults. This dramatically increases the potential of hip-worn devices to assess sitting time, patterns, and 24-h physical behaviors. Future work will refine the CHAP method in broader age groups.

The CNN data processing tools for estimating sit-to-sit transitions and sitting bout patterns from hip Actigraph data among children and adults

BACKGROUND: Sedentary variables are commonly estimated from hip-worn accelerometer data using counts-based cut-points (e.g., 100 counts per minute [cpm]). However, cut-points do not accurately measure sit-to-sit transitions and sitting bout patterns. Improved processing/classification methods would enrich the evidence base and inform the development of more effective public health guidelines. This presentation will cover the development and evaluation of CHAP (CNN Hip Accelerometer Posture) data scoring/classification method in children and adults. METHODS: Data were from 278 children (up to 4 time points each) ages 8-11y from the Patterns of Habitual Activity Across Seasons (PHASE) study and 977 adults ages 35-90y from the Australian Diabetes, Obesity and Lifestyle ( AusDiab ) and Adult Changes in Thought (ACT) studies. Assessments involved ~70% of concurrently wearing a thigh-worn activPAL (ground truth) and hip-worn Actigraph (test measure). Separately for children and adults, data from two-thirds of the participants were used to train a CHAP deep learning model that classified each 10-second epoch of raw HipActigraph acceleration data as sitting or not sitting, creating comparable information with the ground truth measure (activPAL).

In the remaining one-third of participants, the two CHAP models (child and adult) were evaluated alongside the standard 100cpm method for hip-worn ActiGraph monitors. Performance was tested for each 10-second epoch and for participant-level total sitting time and five sitting bout variables (e.g., mean bout duration). RESULTS: CHAP-child correctly classified 10-second epochs as sitting or not sitting with a mean balanced accuracy of 83.4% (+/- 5.3%) across participants. Sensitivity and specificity were correctly classified with a mean sensitivity of 76.3% (DP=8.3). For most participant-level variables, CHAP-child estimates had a mean absolute percent error (MAE) of ±11% compared to activPAL, and very large correlations with activPAL (r=0.8). For the 100cpm method, most MAPEs were ±30% and most correlations were small or moderate (r=0.6). CHAP-child showed the previously developed older adult algorithm (CHAP-OlderAdult). Balanced accuracy for CHAP-adult was 92.6% and sensitivity for sit-to-sit transitions was 74.4%. MAPE for mean sitting bout duration was 12.2% (vs. 10.6% in children). All correlations were r=0.7. Error was generally consistent across age, sex, and BMI groups. CONCLUSIONS: There was strong validity of the data (CHAP-child) and CHAP-adult. Future work will refine the CHAP method in broader age groups.
Continued use of established approaches to analyzing accelerometer data for the measurement of physical activity: How and why to keep it simple

Chair: Cheryl Howe
Ohio University, USA

Kimberly Clevenger
National Cancer Institute, USA

Using open-source counts and a consensus approach to facilitate continued use of established approaches to analyzing accelerometer data

BACKGROUND AND AIM: Numerous methods for characterizing physical activity participation using accelerometry have been developed and implemented in prior research. A barrier to continued use of these methods in future studies, particularly those employing other device brands, is the frequent reliance on ActiGraph counts, which until recently were generated using a proprietary algorithm. A second, and well-established issue is the ‘cut-point conundrum’ in which the number of available methods makes it difficult for researchers to select which approach is best to use, further limiting comparability across studies. Our purpose is to address these issues through the use of open-source activity counts and a consensus method which pools estimates from multiple classification approaches. METHODS: First, to illustrate the use of open-source counts, we calculated activity counts from 30 participants who wore a GENEActiv and ActiGraph GT9X on their left wrist during two laboratory visits (one structured and one simulated free-living). Second, to illustrate application of the consensus method, we used hip-worn ActiGraph GT9X data from the same 30 adults. Nine methods were used to estimate minutes of moderate-to-vigorous physical activity (MVPA%), including cut-point, two-regression, and machine learning approaches using both count and raw inputs and several length (all outcomes; β = 0.06-0.09). CONCLUSIONS: Compared to SB pattern variables from the cut-point, CHAP-child variables showed marginally stronger associations with obesity outcomes. The strongest associations were seen for median SB bout duration and median SB bout length (all outcomes; β = 0.06-0.09). CONCLUSIONS: To illustrate the use of open-source counts, we calculated activity counts from 30 participants who wore a GENEActiv and ActiGraph GT9X on their left wrist during two laboratory visits (one structured and one simulated free-living). Second, to illustrate application of the consensus method, we used hip-worn ActiGraph GT9X data from the same 30 adults. Nine methods were used to estimate minutes of moderate-to-vigorous physical activity (MVPA%), including cut-point, two-regression, and machine learning approaches using both count and raw inputs and several length (all outcomes; β = 0.06-0.09). CONCLUSIONS: Compared to SB pattern variables from the cut-point, CHAP-child variables showed marginally stronger associations with obesity outcomes. The strongest associations were seen for median SB bout duration and median SB bout length (all outcomes; β = 0.06-0.09).
AUTHORS AND PRESENTERS

All authors (lead and additional) and presenters are listed here for easy cross-referencing to their respective abstract. The full abstract is available in the abstract’s listing in the Whova agenda.

Poster names are indicated as follows:
Poster Type (P = In-person; VP = Virtual) – Poster Number

Those posters identified as VP only indicate presenters residing elsewhere
Those posters identified as VPE identify virtual poster presenters residing in European Time Zones
Those identified with VP only indicate presenters residing elsewhere.

ALL POSTERS (both in-person & virtual) have a virtual site for viewing in the ICAMPAM 2022 Whova App; these may be accessed for 90 days from Tuesday, June 21.

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46TH INTERNATIONAL CONFERENCE ON AMBULATORY MONITORING OF PHYSICAL ACTIVITY AND MOVEMENT | ICAMPAM 2022 - JUNE 21-24, 2022
### ORAL SESSIONS

**Oral Session #1**

**Wednesday, June 22**

4:30 - 5:30 pm

#### O.1 Novel statistical approaches and applications

**Location: Shanavo Peak**

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**O.2.1 Combination of compositional data analyses and ecological momentary assessment: Insights on the association between physical behavior on mood in daily life**

**O.2.2 Association of gait quality with daily life mobility: An actigraphy and global positioning system based analysis in older adults**

**O.2.3 Methods to determine common periods of wear in concurrently worn activity monitors**

**O.2.4 A fully Bayesian semiparametric Scalar-on-Function Regression (SoFR) with measurement error using instrumental variables**

**O.2.5 Methods to determine common periods of wear in concurrently worn activity monitors**

**O.2.6 Continuous longitudinal monitoring of early physical activity and fatigue**

**O.2.7 Patterns of physical activity accumulation as a potential biomarker for low back pain phenotyping**

**O.2.8 Associations of physical activity measures and sleep with fatigue: A real world feasibility study**

**O.2.9 Applying the Pittsburgh performance fatigability index to a 6-minute walk in older adults**

**O.2.10 Detecting and modifying daily inactivity among adults over 40 years using an integrated two-way communication-based near-real-time sensing system A randomized clinical trial**

**O.2.11 Association of gait quality with daily life mobility: An actigraphy and global positioning system based analysis in older adults**

**O.2.12 Detecting and modifying daily inactivity among adults over 40 years using an integrated two-way communication-based near-real-time sensing system A randomized clinical trial**

**O.3.1 Novel statistical approaches and applications**

**O.3.2 Association of gait quality with daily life mobility: An actigraphy and global positioning system based analysis in older adults**

**O.3.3 Development and pilot testing of the ActiveGOALS online real-time sensing system: A randomized clinical trial**

**O.3.4 Development and pilot testing of the ActiveGOALS online real-time sensing system: A randomized clinical trial**

**O.3.5 Clinical applications: knee and back pain and fatigue**

**O.3.6 Continuous longitudinal monitoring of early physical activity recovery following knee arthroplasty**

**O.3.7 Patterns of physical activity accumulation as a potential biomarker for low back pain phenotyping**

**O.3.8 Associations of physical activity measures and sleep with fatigue: A real world feasibility study**

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**O.3.11 Detecting and modifying daily inactivity among adults over 40 years using an integrated two-way communication-based near-real-time sensing system A randomized clinical trial**

**O.3.12 An empirical approach to understand wellbeing association and its engagements with each daily changes in physical activity in a lifestyle intervention among US Veterans with Prediabetes**

**O.3.13 A physical activity intervention results in higher randomness of postural control accelerations during dual-task conditions**

**O.3.14 Development and pilot testing of the ActiveGOALS online real-time sensing system: A randomized clinical trial**

**O.3.15 Wear fatigue: Does device wear compliance vary over a free-living assessment period?**

**O.3.16 Development and pilot testing of the ActiveGOALS online real-time sensing system: A randomized clinical trial**

**O.3.17 Novel statistical approaches and applications**

**O.3.18 Association of gait quality with daily life mobility: An actigraphy and global positioning system based analysis in older adults**

**O.3.19 Development and pilot testing of the ActiveGOALS online real-time sensing system: A randomized clinical trial**

**O.3.20 Continuous longitudinal monitoring of early physical activity recovery following knee arthroplasty**

**O.3.21 Patterns of physical activity accumulation as a potential biomarker for low back pain phenotyping**

**O.3.22 Associations of physical activity measures and sleep with fatigue: A real world feasibility study**
Oral Session #3
Friday, June 24
9:15 - 10:15am

0.7 Measuring steps
Location: Shavano Peak

0.7.21 Changes in brisk stepping cadence are associated with improvements in reliability, MDC95, and MHC in people with non-diabetic hyperglycemia
Phil McBride¹, Joseph Henson³, Charlotte Edwardson³, Melanie Davies¹, Kamlesh Khunti¹, Benjamin Maylor², Thomas Yates¹
¹University of Leicester

0.7.22 Development of an externally validated free-living step counting algorithm with deployment in the UK Biobank
Scott Small¹, Leinart von Fritsch¹, Shing Chain¹, Andrew Creagh¹, Andrew Price³, Sara Khalid³, Aidan Doherthy³
¹University of Oxford

0.7.23 A step towards more intuitive physical activity prescription: Validation of stepping-based metrics derived from wrist-worn accelerometer
Ben Maylor¹, Charlotte Edwardson³, Paddy Dempsey¹, Matthew Paterson¹, Tim Yates¹, Alan Ross-Iovita¹
¹University of Oxford

0.8 Technical challenges and considerations
Location: Crestone l & ll

0.8.29 Impact of using a 60, 80, 90, or 100 Hz versus 30 Hz Actigraph sampling rate on free-living physical activity assessment in youth
Kimberly Clevenger¹, Jan Brandt¹, Karen Mackintosh¹, Karen Pfleffer¹, Alexander Montoya³, Melitta McNarry³
¹National Cancer Institute, University of Southern Denmark, ²Glasgow University, ³Michigan State University, ⁴Alma College

0.8.30 Interrelationships between open-source, proprietary, and machine-learning-derived accelerometer metrics
Christopher Moore¹, Kyle Evenson³, Eric Shimons³, Carmen Guthbertson¹, Julia Buring¹, ³Merrill Lee²
¹University of North Carolina, ²National Institute on Aging, ³Bingham and Women’s Hospital and Harvard Medical School

0.9 Physical activity determinants and COVID-19
Location: Crestone lll & IV

0.9.43 Typical day and influence of weekend on accelerometer measured physical activity
Alexander Burchart¹, Simon Kolb², Stefan Schmidt³, Birta von Haaren-Mack³, Claudia Niessen⁴, Alexander Wolf⁵
¹Karlsruhe Institute of Technology, ²German Sport University Cologne, ³Swansea University, ⁴Michigan State University, ⁵Alma College

0.9.44 Does context matter? The association between affective states and physical activity and its moderation by weather factors measured with ambulatory assessment
Irina Timm³, Markus Reichert³, Ulrich Ebner-Preisner³, Marco Giuriga³
¹Karlsruhe Institute of Technology, ²Ruhr-University Bochum

0.9.45 Multiple accelerometer assessed physical behavior across 24-hour schedules: Comparison of level of physical fitness: a pilot study during COVID-19 pandemic
Jan Vinds³, Denise Nothelrose¹, ³Janka Pelvic³
¹Palacky University Olomouc

0.5 Clinical 2
Location: Crestone Peak I & ll

O.5.24 Setting the building blocks for long term remote and continuous real-time monitoring of MS patients in their daily living environment using a wrist-worn smart watch
Nathaniel Shimony¹, Raz Tamir², Yarden Rotem³, Efrat Yatziz³, Yehudit Michaelis¹, Eran Gazit¹, David Buzaglo¹, Iris Galperin², Jeffrey Hausdorff², Raz Tamir²
¹Tel Aviv Sourasky Medical Center, ²Tel Aviv University, ³University of Texas, ⁴Carnegie Mellon University, ⁵Owlytics Healthcare Ltd.

O.5.25 Activity and rest fragmentation an alias of daily-living physical activity fluctuations among people with MS
Amit Salman¹, David Buzaglo¹, Iris Galperin², Anat Mirelman¹, Keren Regev³, Arnon Kari², Talia Schmitz-Hubsch³, Friedemann Paul³, Hannes Devis³, Jacob Sosnoff², Raz Tamir², Nathaniel Shimony¹, Yarden Rotem³, Yehudit Michaelis¹, Jeffrey Hausdorff²
¹Tel Aviv Sourasky Medical Center, ²Tel Aviv University, ³University of Texas, ⁴Carnegie Mellon University, ⁵Owlytics Healthcare Ltd.

O.5.26 Assessment of activities of daily living using markerless motion capture in a virtual reality setting
Kavish Abirazuva¹, Andre Frehlig¹, Vincent Alpi¹, Sally Lacro¹
³Stryker Orthopaedics

O.5.27 Effects on heart rate, physical activity and ambulatory blood pressure from occupational physical activity with and without lifting among farmers in Denmark
Mette Korsøe¹, Matthiilde Baumann¹, Michael Olsen¹, Ole Mortensen¹
¹Aarhus University

O.5.28 Towards eco-design of self-powered wearable devices: analysis of available energy on the human body for lead-free piezoelectric energy harvester positioning
Damien Heaume¹, Gurun Jedin¹, Jacques Priss¹, Albo-Rahmane Anas Laarouci¹, Aurine Bartusson², Samuel Margueron², Guylaine Poulin-Vitratten², Maximme Bavoecffe², Alexis Brenes³, Elie Lefeuvre³, Florence Razan³
¹ENS Rennes, ²SATIE, ³ENS Rennes, SATIE, ¹French Maxima Center for Pediatric Oncology

O.5.29 Towards eco-design of self-powered wearable devices: analysis of available energy on the human body for lead-free piezoelectric energy harvester positioning
Damien Heaume¹, Gurun Jedin¹, Jacques Priss¹, Albo-Rahmane Anas Laarouci¹, Aurine Bartusson², Samuel Margueron², Guylaine Poulin-Vitratten², Maximme Bavoecffe², Alexis Brenes³, Elie Lefeuvre³, Florence Razan³
¹ENS Rennes, ²SATIE, ³ENS Rennes, SATIE, ¹French Maxima Center for Pediatric Oncology

O.5.30 Exploring effects of central sensitization on gait in chronic low back pain by using machine learning approach
Dawid Gortzel¹, Joe Nguyen¹, Raksh Pilkar¹, Tyler Guthrie¹, Matt Biggs¹, Ali Neshabouri¹, Christine Gus¹
³Charité - Universitaetsmedizin Berlin

O.5.31 Using a wrist-worn sensor to objectively monitor gait quality in people with multiple sclerosis: Initial findings
Eran Gazit¹, Arnon Kari², Keren Regev¹, Iris Galperin², David Buzaglo¹, Nathaniel Shimony¹, Yarden Rotem³, Yehudit Michaelis¹, Raz Tamir², Jeffrey Hausdorff²
¹Tel Aviv Sourasky Medical Center, ²Tel Aviv University, ³University of Texas, ⁴Carnegie Mellon University, ⁵Owlytics Healthcare Ltd.
Poster Session 4
Friday, June 24
10:45 - 11:45am

0.10 Use of devices in children and adolescents
Location: Shavano Peak

0.10.46 Active and sitting time precursors to mood in young adults
Brownye Clark¹, Elisabeth Winikoff¹, Marco Giurgiu², Markus Reichert³, Eric Varenier¹, Fiona Macaulay³
¹The University of Queensland, ªKortersrue Institute of Technology, ²Ruder University Bochum

0.10.47 Comparison of youth-specific cut-point and machine-learning methods for classifying physical activity intensity from wrist accelerometer data
Matthew Ahmad⁴, Stewart Trost⁵
¹University of Sydney, ²The University of Queensland

0.10.48 An objective assessment of toddler physical activity type and context at the childcare center and home
Cailyn Van Camp¹, Darcy Thompson¹, Karin Pfister¹
¹Michigan State University, ²University of Colorado School of Medicine

0.10.49 Validating youth accelerometer methods using direct observation in free-living settings
John Sirard¹, Robert Marcus¹, Marcos Amaulbert-Berriat¹, John Chasa¹, Melanie Cox¹, Nicholas Remillard¹, Patty Fiddleston¹, John Staudenmayer¹
¹University of Massachusetts Amherst

S1 Epidemiologic studies with health outcomes
Location: Crestone I & II

0.11.51 Impact of patterns of physical activity at pre- and post-diagnosis with mortality of Asian cancer patients: Results from Health Examinees-G study in Korea
Jaesung Choi¹, Ji-Young Park¹, Ji-Eun Kim², Mkyong Lee³, Kyounan Lee³, Daehoe Kang³, Aesun Shin³, Ji-Heob Cho³
¹Seoul National University

0.11.52 Association of profiles of objectively-measured physical activity and sedentary behavior with all-cause mortality risk in older adults
Manasa Shanta Yerramalla¹, Mathilde Chen¹, Vincent van Hees², Manasa Yerramalla¹, Mohamed Amin Benadjaoud³, Séverine Sabia¹
¹Seoul National University, ²University of Colorado School of Medicine

0.11.53 The association between moderate-to-vigorous physical activity and wheelchair users
Joja Baumgart¹, Melanie Verger¹, Guy Plasqui², Marius Lyng Danielsson³
¹Aalborg University of Science and Technology, ²Mozzricht University

0.11.54 Implementation of wrist accelerometer into the National Health and Aging Trends Study (NHATS) to expand physical activity assessment in older adults
Jennifer Schrack¹, Vadim Zipunnikov¹, Vicki Freedman¹
¹Johns Hopkins Bloomberg School of Public Health, ²University of Michigan

0.11.55 Multidimensional movement behavior and mortality in older adults from the Whitehall II accelerometer sub-study: A machine learning approach
Mathilde Chen¹, Vincent van Hees², Manasa Shanta Yerramalla¹, Mohamed Amin Benadjaoud³, Séverine Sabia¹
¹Seoul National University, ²University of Colorado School of Medicine

0.12 Clinical applications 1
Location: Crestone III & IV

0.12.56 Are physical behavior and momentary fatigue bidirectionally associated after subarachnoid hemorrhage, merging accelerometer and electronic diary data
Laure de Wriès¹, Elisabeth de Wriès¹, Marco Giurgiu², Fop van Kooten³, Gerard Ribbers³, Majanka Haenienbrok-Kal¹, Rita van den Berg-Emmons³, Hans Bussuman²
¹Erasmus University Medical Center, ²Maastricht University of Technology

0.12.57 Gait during daily life in men treated with androgen deprivation therapy for prostate cancer: Evidence for accelerated aging?
Davina Täbi-Bätti¹, Martina Mancini¹, Sydney Stoylov¹, Ramyar Edami¹, Christopher Palmar¹, Mahmoud El-Gohary¹, Faraz Arak¹, Kerri Winters-Stone³
¹Oregon Health and Science University, ²RPM Wearable Technologies, ³Clio company

0.12.58 Frequency of inpatient out-of-bed activities by ActiPal vs Johns Hopkins highest level of mobility scale after major abdominal surgery
Mikita Fuchita¹, Kyle Ridgeway¹, Edward Melanson²
¹Ara Fernandez-Relinaza²

0.12.59 Validation of the Apple Watch and Fitbit for assessing heart rate during rest and wheelchair propulsion in able-bodied participants and wheelchair users
Jolanta Baumgart¹, Melanie Verger¹, Guy Plasqui², Marius Lyng Danielsson³
¹Aalborg University of Science and Technology, ²Mozzricht University

0.12.60 Validation and ranking of algorithms for gait sequence detection in healthy controls and people with Parkinson’s disease
Maria Encarnación Mici Amigo¹, Martín Ulrich², Anisara Parasche- lonious³, Eran Gazit³, Tecla Bone³, Francesca Salis³, Kristy Scott³, Stefano Berteltetti³, Andrea Cervetti³, Lynn Rochester³, Claudia Mazza³, Silvia Del Din³
¹University of California, ²University of Colorado School of Medicine

0.12.61 Frequency of inpatient out-of-bed activities by ActivPAL vs Johns Hopkins highest level of mobility scale after major abdominal surgery
Mikita Fuchita¹, Kyle Ridgeway¹, Edward Melanson²
¹Ara Fernandez-Relinaza²

0.12.62 Gait during daily life in men treated with androgen deprivation therapy for prostate cancer: Evidence for accelerated aging?
Davina Täbi-Bätti¹, Martina Mancini¹, Sydney Stoylov¹, Ramyar Edami¹, Christopher Palmar¹, Mahmoud El-Gohary¹, Faraz Arak¹, Kerri Winters-Stone³
¹Oregon Health and Science University, ²RPM Wearable Technologies, ³Clio company

0.12.63 Validation and ranking of algorithms for gait sequence detection in healthy controls and people with Parkinson’s disease
Maria Encarnación Mici Amigo¹, Martín Ulrich², Anisara Parasche- lonious³, Eran Gazit³, Tecla Bone³, Francesca Salis³, Kristy Scott³, Stefano Berteltetti³, Andrea Cervetti³, Lynn Rochester³, Claudia Mazza³, Silvia Del Din³
¹University of California, ²University of Colorado School of Medicine

0.12.64 Frequency of inpatient out-of-bed activities by ActivPal vs Johns Hopkins highest level of mobility scale after major abdominal surgery
Mikita Fuchita¹, Kyle Ridgeway¹, Edward Melanson²
¹Ara Fernandez-Relinaza²

0.12.65 Gait during daily life in men treated with androgen deprivation therapy for prostate cancer: Evidence for accelerated aging?
Davina Täbi-Bätti¹, Martina Mancini¹, Sydney Stoylov¹, Ramyar Edami¹, Christopher Palmar¹, Mahmoud El-Gohary¹, Faraz Arak¹, Kerri Winters-Stone³
¹Oregon Health and Science University, ²RPM Wearable Technologies, ³Clio company

0.12.66 Association of profiles of objectively-measured physical activity and electronic diary data
Laure de Wriès¹, Elisabeth de Wriès¹, Marco Giurgiu², Fop van Kooten³, Gerard Ribbers³, Majanka Haenienbrok-Kal¹, Rita van den Berg-Emmons³, Hans Bussuman²
¹Erasmus University Medical Center, ²Maastricht University of Technology

0.12.67 Gait during daily life in men treated with androgen deprivation therapy for prostate cancer: Evidence for accelerated aging?
Davina Täbi-Bätti¹, Martina Mancini¹, Sydney Stoylov¹, Ramyar Edami¹, Christopher Palmar¹, Mahmoud El-Gohary¹, Faraz Arak¹, Kerri Winters-Stone³
¹Oregon Health and Science University, ²RPM Wearable Technologies, ³Clio company

To make the most of the ICAMPAM poster sessions – please review the following information:

ALL POSTERS have a virtual component available for viewing in the ICAMPAM 2022 Whova App; these may be accessed for 90 days from Tuesday, June 21.

VIRTUAL POSTERS via Whova
All virtual poster presenters have been asked to be available at their virtual poster during the following periods so attendees may virtually connect with them:

• Wednesday, June 22: 12:15 - 1:15pm (MDT)
• Thursday, June 23: 4:00 - 6:00pm (MDT)

Be sure to check the chat box of the virtual poster presenter to see if they’ve left a message as to their available time.

IN-PERSON POSTER BOOTH
48 posters will be available for in-person attendees to review starting on Wednesday 22 June in the Red Cloud Peak. In-person poster presenters are to be available at their poster during the following joint Poster Session & Social Hour:

• Thursday, June 23: 4:00 - 6:00pm (MDT)

In-person poster presenters may also be available during coffee breaks at their posters.

If you are unable to connect with an in-person OR virtual poster presenter at any of the above times, open the poster menu (found under the agenda drop down menu) in Whova and refer to the Chat Box to see if the presenter offers any further times of availability virtually or leave a note in the Chat Box for the presenter to connect with you either during ICAMPAM 2022 or afterwards. You may continue to use the Whova App to connect and converse for up to 90 days.
ActivPAL and sleep logs
Lili Kókai¹
¹Erasmus University Medical Center

A review on methodological approaches
P-17  Monitoring postures and motions in hospitalized patients; cardiometabolic diseases in a virtual reality setting
JooYong Park¹, Jaesung Choi¹, Ji-Eun Kim¹, Miyoung Lee², Ji-Yeob Choi¹
¹Oregon Health and Science University, ²APDM Wearable Technology - A Clario Company

P-18  Accelerometer-measured physical behavior as an indicator of perceived work ability
Kari Tokola¹, Henri Väätä-Ypyä¹, Pauliina Husu¹, Harri Sievänen¹, Tommi Vasankari¹
¹The UKK Institute for Health Promotion Research

P-20  Improving energy expenditure estimation with wearables measuring physiological signals
Wouter Bijnen¹, Kenneth Meijer¹, Guy Pasquini¹
¹Measuritech University

P-21  Resting heart rate as biomarker for tracking change in cardiometabolic risk factors of patients: the Fenland Study
Tomas González¹, Justin Jeon¹, Timothy Lindsay¹, Kate Westgate¹, Ignacio Peroni-Ponzio¹, Stefania Holdgate¹, Katriina Katainen-Kuha¹, John Nutt¹, Mahmoud El-Gohary¹, Kristin Sowalsky¹, Martina Mancini¹, Fay Horak¹
¹Oregon Health and Science University, ²APDM Wearable Technology - A Clario Company

P-22  Full-day spontaneous leg movement quantity in infants at high risk for cerebral palsy
Beth A. Smith¹, Federico Gennaro¹, Thubi H.A. Kolobe¹, Laura A. Presser¹
¹University of Southern California, ²Children’s Hospital Los Angeles, ³University of Oklahoma Health Science Center, ⁴The Children’s Hospital of Philadelphia

P-23  Criterion validity of activity monitors and processing methods to assess daily living walking bouts
Adrian Chanteau¹, Antoine Moléan¹, Muriel Pressignon¹, John Nutt¹, Romane Cloutié¹, Angéline Magos¹, Alex Le Faulhe¹
¹University of Rennes

P-24  Exploratory analysis: Number of days required to reliably estimate workplace physical behaviours and sedentary behaviours using three weeks of actiWear complete objective accelerometry
Adam Byllye¹, Brian Carson¹, Alan Donnelly¹
¹University of Limerick

P-25  Gait patterns during daily life by frailty status in older men treated with androgen deprivation therapy for prostate cancer: A cross-sectional study of passive monitoring using novel instrumented socks
Joanne Tibbit¹, Martina Martinis¹, Sybline Stylos¹, Christopher Palmer¹, Ramyar Eslami¹, Mahmoud El-Gohary¹, Fay Horak¹, Kerri Winters-Stone¹
¹Oregon Health and Science University, ²APDM Wearable Technologies, ³A Clario Company

P-26  Scoping review of observational studies of adults with accelerometer measured physical activity and sedentary behavior: the UK-activity Monitor (UKAM) cohort
Kelly Evans¹, Elsina Scherer¹, Kenneth Petras¹, Carmim Cuthbertson², Stephanie Erikman¹
¹University of Liverpool, ²University of North Carolina - Chapel Hill

P-27  Using machine learning to classify sitting and sleep history from raw accelerometer data during simulated driving.
Georgia Tuckwell¹, Charlotte Gupta¹, James Keal², Sally Iveson¹
¹University of Strathclyde, ²University of North Carolina-Chapel Hill

P-28  Context-matched gait variability measures capture longitudinal change in real life walking in degenerative cerebral ataxia
Winfried Lig¹, Martin Giese¹, Matthias Synofzik¹
¹Hertie Institute forClinical Brain Research - University of Tuebingen

P-29  Observation of raw accelerometer data of three different devices using a mechanical orbital shaker
Theresa Schüz¹, Wilhelm Rett³, Simon Pankratz¹, Dominik Schröder¹, Anna Kindmar³, Marius Croll³
¹University of Göttingen, ²Helmholtz Zentrum Berlin für Endl-modern Life Science, ³University of Liverpool

P-30  The arm activity tracker: a wearable system measuring and providing feedback on systemic arm activity in stroke patients.
A.J. Langerak¹, G.R.H. Regterschot¹, K.W. Sells¹, G.M. Ribbers¹, J.B. Bussmann¹
¹Erasmus University Medical Center

P-31  A systematic scoping review on the application of talent classification analysis to accelerometer-assessed physical activity and sedentary behavior
Annie Howard¹, Yumeong Ren¹, Chonghi Di², Melissa Troester¹, Blake Anusiewicz³, Kelly Evangelista¹
¹University of Northern Colorado, ²Fruita Healthcare Research Center, ³University of California

P-32  A comparison of methods for analyzing wrist worn data: data capture among older adults with dementia
John O’Driscoll¹, Sarah Payne¹, Adrienne Jankowski¹, Andrew Shutes-Davis¹, Katie Watson¹, Edmund Seto¹, Debby Tung¹
¹Seaview Institute for Biomedical and Clinical Research

P-33  Comparison of physical activity intensity estimated by direct observation to whole room indirect calorimetry
John Martinza¹, John Staudenmayer¹, Edward Melanson¹, Ann Swart², Scott Steffen²
¹University of Wisconsin, ²University of Massachusetts Amherst, ³University of Colorado Anschutz Medical Campus

P-34  Determination of activity counts using ActiGraph devices
Ali Neshabouri¹, Joe Nguyen¹,李思维², Tytry Guthiers¹, Matt Biggs¹, Jeremy Wyatt¹, Doug Cross¹, Karas Marta¹, Jiao Mijiaoluo¹, Zhane Xiang², Christos Sgouris²
¹ActiGraph, ²MGH/MIT/Harvard, ³Harvard University, ⁴Kellerich Institute of Technology

P-35  An open-source and automated data processing and reporting pipeline for continuous wearable data in adaptive interventions
Doug Arigoval¹, Grant Denmark¹, Gregory Cloutier¹, Carmen Catancena-Stoppa¹, Charles Hillman¹, Arthur Kramer¹, Dinesh John¹
¹Northeastern University

P-36  Activity recognition using body-worn sensors and load- dependent injury risk in Swiss Armed Forces recruits
Rahel Eslami¹, Mahmoud El-Gohary², Fay Horak¹
¹RTI International, ²University of North Carolina - Chapel Hill

P-37  Use of wearable sensors to classify activities of amputees in the real-world for improved K level assessment
Douglas Maxwell¹, Craig Speirs¹
¹Loyola University, ²Medical College of Wisconsin

P-38  Validation of using smart glasses to measure Spatiotemporal gait of patients with Parkinson’s disease
Douglas Maxwell¹, Kenneth Jenkins¹, Ronish Fatheva²
¹Kansy University Medical Center

P-39  Free-living validity of energy expenditure estimates from wrist-worn ActiGraph monitors: A doubly labeled water study
Paul Hobbing¹, Gregory Wolf¹, Robin Skovh¹
¹Children’s Mercy Kansas City, ²Iowa State University

P-40  Agreement among ActiGraph, activPAL, and diary measured time in bed in university students
Matthew Wassall¹, Sibylle Thies¹, Malcolm Granat¹
¹University of Rennes

P-41  Validation of using smart glasses to measure Spatiotemporal gait of patients with Parkinson’s disease
Douglas Maxwell¹, Kenneth Jenkins¹, Ronish Fatheva²
¹Kansy University Medical Center

P-42  Cross-sectional study of passive monitoring using novel instrumented socks
Joanne Tibbit¹, Martina Martinis¹, Sybline Stylos¹, Christopher Palmer¹, Ramyar Eslami¹, Mahmoud El-Gohary¹, Fay Horak¹, Kerri Winters-Stone¹
¹Oregon Health and Science University, ²APDM Wearable Technologies, ³A Clario Company

P-43  Validation of wearable sensors for functional assessment of TKA patients in a clinical setting
Kevin Abbruzzese¹, Jenna Iveson¹, Vanessa Lobasso¹, Jayshni Maharaj², David Lipold³, Price Gabra³
¹Stryker Orthopedics, ²Giffin University, ³Coast Orthopedics

P-44  Agreement among ActiGraph, activPAL, and diary measured time in bed in university students
Matthew Wassall¹, Sibylle Thies¹, Malcolm Granat¹
¹University of Rennes

P-45  Self-report versus accelerometer-derived measurement of physical activity in metabolic breast cancer: how do they compare? Patricia Sheenan¹, Lauren Matthews¹, Kathleen Jensen¹, Weston Morris¹, Melissa Stolly³
¹Loyola University, ²Medical College of Wisconsin

P-46  Comparison of self-reported and accelerometer measured daily sitting time among post-stroke adults with Aphasia
Mary Hidde¹, Kate Lyden¹, Heather Leach¹
¹Medical College of Wisconsin, ²KAL Consulting LLC, ³Colorado State University

P-47  Physical activity, sedentary time, and wear time recorded by accelerometer in a nationwide sample – Results from HoMo wave 3 (2018-2020)
Simon Kolb¹, Alexander Burchartz¹, Leon Kloss¹, Steven Schmidt¹, Alexander Wolf²
¹Kort缩水 Institute of Technology

P-48  The validity of using smart glasses to measure Spatiotemporal gait of patients with Parkinson’s disease
Danny Arigoval¹, Kari Kauppinen¹, Kari kauppinen¹
¹University of St. Thomas, ²University of North Carolina - Chapel Hill

P-49  The validity of using smart glasses to measure Spatiotemporal gait of patients with Parkinson’s disease
Danny Arigoval¹, Kari Kauppinen¹, Kari kauppinen¹
¹University of St. Thomas, ²University of North Carolina - Chapel Hill

P-50  The validity of using smart glasses to measure Spatiotemporal gait of patients with Parkinson’s disease
Danny Arigoval¹, Kari Kauppinen¹, Kari kauppinen¹
¹University of St. Thomas, ²University of North Carolina - Chapel Hill

P-51  The impact of anti-hypertensive medication on the relationship between daily step count and blood pressure
Mark Dunlop¹, Marc Roper¹
¹University of Strathclyde
ACTIGRAPH  BOOTH #5
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Web: theactigraph.com

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Web: camntech.com

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Web: chhs.colostate.edu/hes

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Maastricht Instruments BV provides innovative wearable accelerometer products and indirect calorimetry equipment for healthcare researchers and professionals worldwide.
Web: indirectcalorimetry.net

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The Department of Kinesiology at Michigan State University is dedicated to the study of physical activity and sport across the lifespan, with a special emphasis on youth. We aim to educate individuals to lead physically active and healthy lives, and to prepare individuals for research and leadership positions in educational, sport and clinical settings. In all of our programs, research and practice are intertwined, in our impact-focused labs, in the classroom with renowned faculty and in hands-on applications on campus and beyond. Faculty areas of research interest include a focus on pediatric health and wellbeing, youth sports, motor learning and more.
Web: education.msu.edu/kin

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PAL TECHNOLOGIES  BOOTH #3
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Web: actigraphy.com

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Web: pbr.edu
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Web: mdpi.com/journal/sensors

SHIMMER RESEARCH  BOOTH #6
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Web: shimmersensing.com

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Web: cunorc.org
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