ICAMPAM 2019
Poster Abstracts

Wednesday, June 26th: Day 2

1-01 Continuous Overall Net Physical Activity (CONPA): An exploration of activity variability

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Measures of physical activity (PA) variability over time may offer novel insights into the relationships between PA and health outcomes. There have been some studies of rest-activity patterns, but none have looked at the actual fluctuations in activity across hours. We explored activity variability and its relationship with physical functioning (six-minute walk distance) in 88 sedentary, obese adults with type two diabetes. Analysis: Accelerometry data were collected using the Actigraph Score?. Physical activity variability was calculated using Continuous Overall Net Physical Activity (CONPA). and defined as the standard deviation of the n hour differences in activity counts (AC). Differences between any observation (AC) and the AC n -hours later were calculated for 4 & 12 hours. CONPA 4 and 12 were chosen to assess both short and longer epochs of intraday activity fluctuations. Higher CONPA values indicate more activity variability. The sample was analyzed together, then split into low and moderate activity levels based on average activity counts per minute per day. Results: Participants accrued only 5.5 min of daily MVPA and Physical function was low (477 m). Physical function was associated with average daily light activity (r = .223), MVPA (r=.226); CONPA 4 (r=.295) and CONPA 12 (r=.320); age (r=-.312) and BMI (r=-.295), All p< 0.05). When divided by group, all relationships remained significant except for BMI in the low activity group. In the moderate activity group, only BMI predicted 6MWD (r=-.457, p < .01). In further regression analyses among the low activity group, 6MWD was predicted by MVPA, age, and both CONPA 4 (r2 = .251) and CONPA 12 (r2 = .237). Discussion: Among the most sedentary adults, activity variability may offer additional strength in predicting physical function. This is the first exploration into use of activity variability. Further analyses, using larger data sets, may help to better define its use in activity analyses.

1-05 Objectively measured 24-hour movement behaviors in children with chronic disease: a case-control study

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Background: Time spent in 24-hour movement behaviors (physical activity, sedentary behavior, sleep) is important to health and wellbeing in childhood, but levels of these behaviors in children with chronic disease is unknown.

Objectives: To quantify levels of 24-hour movement behaviors objectively in children with four common chronic diseases, and to test whether these differed from their healthy peers. Methods: An observational case-control study included 160 child aged from 3-10 years old; 80 children with chronic disease; 20 with type 1 diabetes mellitus (T1DM), 20 with juvenile idiopathic arthritis (JIA), 20 with congenital heart disease (CHD), 20 with cystic fibrosis (CF); pair-matched individually for age, sex, and timing of measures with 80 healthy children Main outcomes and measures: Habitual time spent in movement behaviors and step counts all measured with the activPAL accelerometer over 7 days. Comparisons against recommendations were made and differences between the groups with chronic disease and controls examined Results: Time in physical activity and step counts per day were significantly lower in the T1DM and CHD groups compared to controls. Only 20/80 children with chronic disease and 29/80 controls met the daily step count recommendations. Time spent sedentary was also consistently higher in children with chronic disease, though this reached significance only for children with CF compared to controls. Time spent asleep was slightly greater in the children with chronic disease, significant only for the group with JIA. Sleep disruption was consistently greater in those with chronic disease, reaching significance for groups with T1DM, CHD and CF Conclusions: For some groups with chronic disease, 24-hour movement behaviors differ substantially from recommendations, and slightly but systematically from their healthy peers. Optimising levels of 24-hour movement behavior should confer a number of benefits for child health, developmen and wellbing

1-09 Changes in chronological within day patterns of physical behaviour with age

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Objective To develop descriptors of within day chronological patterns of physical behaviour including upright and sedentary time. To compare these patterns across different age groups: Primary (P) (n=43, 9-11y) and Secondary school children (S) (n=37, 12-13y), younger adults (<50y) (n=26) and older adults (≥50y) (n=20). Methods Physical behaviour (upright time and sedentary time) was objectively recorded using a body worn device (activPAL3) for minimum 3 weekdays in summer. The sequencing of upright time and sedentary time was analysed to calculate the time spent in the following patterns: UC - Continuous upright behaviour >10mins UB - Periods of largely upright behaviour >5mins with short sedentary breaks <2mins Fidget - Rapidly changing behaviour with each sedentary or upright period lasting <1min SB - Sedentary periods >5mins, with short upright breaks <2mins SC - Continuous sedentary behaviour >10mins Results Daily duration of continuous behaviour patterns was higher in adults than children: UC (P:114mins, S:107mins, <50y:153mins, ≥50y:174mins); SC (P:209mins, S:277mins, <50y:374mins, ≥50y:382mins). Daily Fidget time was substantially higher in children than adults (P:27mins, S:20mins, <50y:6mins, ≥50y:4mins). However, there were no statistical differences between groups for daily behaviour patterns with breaks UB (P:70mins, S: 49mins, <50y:63mins, ≥50y:55mins) and SB (P:124mins, S:157mins, <50y:137mins, ≥50y:126mins). Conclusion There were significant differences in outcomes with adults demonstrating higher volumes of patterns with continuous upright or sedentary behaviour (UC, SC) and lower volumes of rapidly changing behaviour (Fidget). The defined behaviour patterns incorporate chronological patterns of upright and sedentary behaviour. These new descriptors will, therefore, enhance our understanding of how patterns of physical behaviour are constituted under free-living conditions.

1-11 Defining walking bouts in free-living activities

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Background: Physical activity guidelines recommend that adults should engage in 30 minutes of moderate intensity physical activity on at least five days every week, in continuous bouts of at least 10 minutes; this includes activities such as brisk walking. It has been shown that uninterrupted continuous walking can be difficult to achieve in free-living settings. Being able to assess the compliance to physical activity guidelines can depend on how continuous walking is defined; however, there remains the question on how to deal with interruptions in walking events. The aim of this study was to use an event-based approach to help define what constitutes a break in continuous walking bouts. Methods: Twenty-four university staff wore an activPAL activity monitor for 7-days. The activPAL quantified the cadence of all walking events and the time spent walking. The walking event files were extracted using MATLAB: duration, number of steps, and cadence of all walking bouts were calculated. Moderate to vigorous

physical activity (MVPA) was defined as a cadence of 100 steps/min. Walking bouts were combined by adding the duration of the interruption between the walking bouts to the walking duration of each walking bout: average cadence was calculated for the entire period (total steps divided by total duration including the interruption). If the resulting average cadence was above the MVPA threshold, then the next interruption and walking bout was considered until it fell below the threshold. Results: The total time spent in MVPA increased from 4,700 minutes to 5,090 minutes for all participants, when interruptions were considered. Only 16.7% (4 participants) did not achieve the minimum requirement of engaging in at least 30 minutes of moderate intensity activity per day, regardless of the interruptions. Conclusions: This method provides a robust method for redefining continuous walking bouts without making any assumptions on minimum length of walking bout or interruption.

1-13 Detecting interruption during moderate intensity walking by waist- and wrist-mounted accelerometer

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OBJECTIVES: The purpose of the present investigation was to develop a novel algorithm for detecting the interruption during the moderate intensity continuous walking by wrist-mounted accelerometer Actigraph-GT3X+. METHODS: Twenty-four younger individuals participated in the present investigation (9 women and 15 men, 22+/-1 years old of age, 167.4±7.0 cm of height, 60.5±9.5 kg of body weight, 19.8±8.1 % of body fat). All subjects walked outdoor ground for one minute at the speed of the 70 meter/min, sandwiching with the resting period, by three time schedule, 1st; four bouts of walking for 15 seconds (17.5 m), 2nd; two bouts of walking for 30 seconds (35 m), 3rd; one continuous walking for 60 seconds (70 m). The total time was not differ among 3 conditions by controlling the resting period. All subjects wore the Actigraph-GT3X+ (Actigraph, FL) at their waist and wrist at the dominant side. Accelerometers were set at 30 Hz of sampling rate with 1 sec of epoch length. The data were analyzed by ActiLife software, and the activity counts was used for the present investigation. RESULTS: The number of steps and the activity counts were significantly different by the wearing location, regardless of the experimental condition ($p<0.05$), there were significant associations among 3 conditions within same wearing location. The total activity counts for total experimental period (walking plus resting period) differ significantly across the three condition, and was positively associated with the number of walking bouts ($p<0.01$). The magnitude of difference for the activity counts between the three walking conditions was significantly larger in the accelerometer on the wrist compared with that on the waist. CONCLUSION: The results of the present investigation suggest that an accelerometer can detect the interruption during the moderate intensity walking, and the wrist would be a better location than the waist.

1-19 Feasibility of ambulatory monitoring devices in monitoring the rehabilitation of elderly patients after hip fracture treatment

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Each year approximately 19.000 patients above 65 years are hospitalized with a hip fracture in the Netherlands. The goal of hip fracture treatment is functional recovery of the patient to the pre-fracture state. Currently, functional recovery is suboptimal in 53% of the patients. More insight in the patients' rehabilitation process is expected to enable further optimization of rehabilitation treatment. The aim of this study is to assess the feasibility of ambulatory monitoring devices to continuously monitor physical activity behavior of elderly patients after hip fracture treatment. Based on a multi stakeholder requirement analysis, the Fitbit Charge and MOX Activity Monitor are chosen to monitor physical activity. To assess the feasibility of the sensors, patients wore them during the whole rehabilitation trajectory; Fitbit around the wrist and MOX just above the knee. The wearing comfort was assessed, and the following parameters were measured to assess if a change in physical activity could be monitored: number of steps, heart rate, longest activity block, and number of active and sedentary minutes. At the moment 38 elderly patients are included (21 analyzed). The preliminary results of the Fitbit (n=12) and MOX (n=9) show that both sensors do have the potential to monitor changes in physical activity as the activity parameters increase in the course of the rehabilitation and the heart rate decreases. However, the results also show that the

feasibility of the Fitbit in the elderly population was suboptimal. The Fitbit is, in contrast to the MOX, not able to count the number of steps correctly when walking with a rollator, because no arm movements are made. With regard to the wearing comfort, both sensors are well tolerated. In conclusion, the Fitbit and the MOX do have the potential to monitor the rehabilitation process of patients with a hip fracture. The next step is to develop a system that gives feedback to the patient and the caregiver.

1-21 Metal ion concentrations after hip resurfacing and physical activity: Correlation with high intensity and walking speed but not daily steps.

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Background: Total hip resurfacing arthroplasty (HRA) using metal-on-metal articulations has been widely abandoned due to high revision rates caused by adverse tissue reactions to metal ions released by wear. Wear should be related to implant use and thus physical activity (PA), but this correlation has not been investigated. However, doctors and HRA patients at risk of adverse reactions would benefit from knowing if and which activities may be safe or not. Methods: Patients with unilateral HRA (n=17, m/f= 13/4, age: 55.1 ±10.5 years) were included. Blood cobalt (Co) and chromium (Cr) ion concentrations were determined at 10 ±1 years follow-up. During the 4 subsequent days, PA was assessed using a 3D accelerometer (X8M-3, GCDC) skin-worn on the lateral thigh. The signal was post-processed using previously validated algorithms to derive parameters such as daily steps, sit-stand transfers (SST), walking cadence and high intensity peak counts (>3g) to correlate them with ion levels (linear regression analysis, adjusted for age, BMI, cup size and inclination). Results: Median (±ICQ) Co and Cr ion concentration were 25.0 ±13.0 nmol/L and 38.0 ±28.0 nmol/L. Daily median PA values were: steps: 5577 ±2269, cadence: 92.2 ±15.5 1/min, SST: 34.5 ±18.0, >3g peak counts: 70 ± 693. Higher Co ion levels were correlated with more high intensity peak counts (β= 0.13, p= 0.001) and a higher number of SST (β= 5.8, p= 0.042). Excluding the subject with the highest Co level (428 nmol/L) for sensitivity analysis, also revealed that high ion levels and cadence were correlated (β= 0.61, p= 0.037). Other PA parameters were not correlated. Discussion & Conclusion: In wear of HRA, specific activities like SST or qualitative aspects of PA behaviour like intensity or walking speed seem to matter more than the quantity of low intensity activities like walking. This suggests that patients may safely engage in such activities to achieve important general health benefits or quality of life.

1-23 The feasibility of ambulatory physical activity monitoring devices in studies on soldiers

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Armed Forces are using data on soldiers' physical demands for training and injury mitigation decisions. Information on accuracy, wear-comfort and feasibility is key to choosing the appropriate measurement system. The aim of a NATO HFM 260 collaboration study was to investigate these parameters for different devices used in military organizations to assess heart rate and energy expenditure. This paper is focused on feasibility. ActiHeart (AH; CamNTech, UK), Hidalgo EQO2 (EQ; Equivital, UK), fçnix 3 (F3; Garmin, USA), GENEActive (GA; Activinsights, UK), Axiamote PADIS 2.0 (AP; Axiamo, CH), Everion (EV; Biovotion, CH), and Blue Thunder (BT; IMeasureU, NZ) were investigated. Presented data are based on the hard- and software available as of January 11 2017. Human resources were determined by the time needed for sensor preparation, calibration, fitting and data downloading. Wear-comfort was assessed by questionnaire among 32 Swiss Army trainees. For run-time determination, data collection was set to an epoch time of 30 seconds. GA needed the fewest resources (208 USD and 2 min per subject), followed by F3, AP and EV (449 to 820 USD and 5-11 minutes per subject). The most cost and time expensive devices were AH, EQ and BT (1054 to 1533 USD and 13 to 22 minutes per subject). Wearing comfort was rated highest in AP followed by F3, EV and AH. AH, AP and GA provided measurements of 7 continuous days or more. EQ and EV provided measurements of at least 24 hours, while F3 and BT ran only 20 and 6 hours. Tracking in real-time was available for EQ, EV and BT. The greatest overall feasibility score was found in EV, AP and GA (fig. 1).

Together with information about measurement accuracy, the present study helps decision makers to choose systems for ambulatory physical activity monitoring in soldiers. However, the technology is rapidly changing and the hard- and software of the investigated devices have likely changed and improved since the January 2017 versions tested.

1-27 Exploration of ActiGraph GT9X primary accelerometer data stability

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Background: Accelerometer-based physical activity monitors are routinely used to assess physical activity (PA) and sedentary behaviors (SB). There are, however, several known issues with accelerometer sensors including baseline offset and sensor drift. Currently, these calibration issues are being addressed by auto-calibrating data during post-processing. This is not always possible so convention dictates using a "stock" correction factor derived from a separate trial for the same serial number device. Objective: Thus, the purpose of this study was to examine the intra-device variability trial-to-trial to better understand the consequences of using this method to correct raw sensor data. Methods: Ten ActiGraph GT9X devices were fully charged, initialized to sample at 90 Hz with the inertial measurement unit (IMU) enabled, and idle sleep mode disabled. Devices were placed on a table top and left to collect data until the battery was depleted. Baseline offset was defined as the mean vector magnitude (VM) of the first 10-minutes of the collection period. Drift was defined as the mean VM of the first 10-minutes minus the mean VM from the last 10-minutes of the collection period. This process was repeated four separate times with each device. Results: Intra-device baseline offset trial-to-trial ranged from 1.5-34.5 milli-g (mg; Figure 1A). Intra-device sensor drift trial-to-trial ranged from 0.7-11.9 mg (Figure 1B). Conclusion: There is a high degree of intra-device variability for baseline offset and sensor drift between trials indicating the use of a single stock value to correct data from the same serial number device may be introducing additional error instead of reducing error as intended. Both issues should be considered when correcting raw data rendering current practices insufficient to make robust corrections. It is recommended to calculate correction factors each time a device is used to achieve greater data stability following post-processing.

1-31 Calibration of wrist and hip worn accelerometers raw acceleration cut-points for the assessment of sedentary behaviour and physical activity in 5-7 years old children

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Objective: This study aimed to validate sedentary behaviour (SB), moderate physical activity (MPA) and vigorous physical activity (VPA) cut-points for wrist and hip-worn ActiGraph devices in 5-7 year old children. Methods: Children (n=49, 45% females) were recruited from a primary school. Children wore an ActiGraph GT9X, set to record at 100Hz and 1s epoch, on both wrists and the right hip during a standardised protocol (10 tasks ranging from lying to running), and during recess. Data from children who completed all activities (n=32) were used to develop and cross-validate cut-points: data from 22 children were analysed with receiver operating characteristic (ROC) curves using direct observation as a criterion reference to develop SB, MPA and VPA cut points for all accelerometer placements; 10 children were used to cross-validate the generated cut-points. Youden and Distance cut-points, Area under the ROC curve (AUC), percentage of agreement (%Ag) and Cohens Kappa (CK) were calculated. Results: SB cut-points ranged from 18-71 mg for non-dominant wrist (AUC=0.721-0.958, %Ag=71.6-80.4%,CK=0.44-0.60); 28-76 mg for dominant wrist (AUC=0.611-0.943;%Ag=70-78%,CK=0.40-0.55) and from 11-46 mg for hip (AUC=0.611-0.955,%Ag=66.6-80.9%,CK=0.34-0.60). MPA cut-points ranged from 105-174 mg for non-dominant wrist (AUC=0.793-0.975,%Ag=89.8-91.9%,CK=0.74-0.78); 80-182 mg for dominant wrist (AUC=0.754-0.968,%Ag=87-91.4%,CK=0.68-0.76) and from 50-88 mg for hip (AUC=0.733-0.969,%Ag=90.3-91.4%,CK=0.75-0.76). VPA cut-points ranged from 229-533 mg for non-dominant wrist (AUC=0.797-0.969,%Ag=88.9-92.7%,CK=0.62-0.69); 227-542 mg for dominant wrist (AUC=0.807-0.969,%Ag=89.2-92%,CK=0.62-0.66) and from 166-305 mg for hip (AUC=0.872-0.980,%Ag=91.3-93.9%,CK=0.68-0.74). Conclusions: Non-dominant wrist and hip accelerometers had similar accuracy in SB and MPA classifications, while hip accelerometers were slightly more accurate in VPA classification. Dominant placement had the lowest accuracy.

1-33 Modeling behavior of volleyball players for analysis and interactive multimodal feedback

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The purpose of this project is to create new forms of volleyball training using multimodal sensor data and pressure sensitive in-floor displays to provide analysis and feedback in an interactive manner. For this purpose a preliminary experiment was performed using data from IMUs (3D acceleration, 3D angular velocity, 3D magneto meter and air pressure), subjects performed basic volleyball actions such as under hand serve, overhead pass, serve, forearm pass, one hand pass, smash and underhand pass. Action classification was done using linear discriminant analysis (LDA) and 10-fold cross validation. The classification was performed using data collected from 3 volleyball players (expert, mediocre and beginner) each wearing 3 IMUs (wrists and head) performing typical volleyball actions with F-measure as high as 0.72. The presented results show the effectiveness of the approach, as a high F-measure was achieved with a small amount of collected data. In the future, the aim is to use the IMUs based configuration to further refine the trained models to classify the basic volleyball actions in terms their quality and use action recognition as primitive data points to develop algorithms to model team strategies during different stages of a volleyball match. In addition to analyzing individual player and team performance and providing valuable feedback to coaches, such algorithms can also be used in providing interactive and multimodal feedback to players during and after training sessions and matches. Another possible future enhancement is to pre-process the raw signal data into higher level features e.g. segment orientation and use the processed feature set for classification purposes.

1-35 Machine learning categorizes total knee replacement patients by likelihood of functional improvement at three-months post-surgery based on preoperative instrumented timed-up-and-go tests

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Objective: Wearable sensors have enabled objective functional data collection from patients before total knee replacement (TKR) and at clinical follow-ups post-surgery whereas traditional evaluation has solely relied on self-reported subjective measures. The timed-up-and-go (TUG) test has been used to evaluate function but the test is commonly measured using total completion time (TCT), which does not asses joint function or test completion strategy. Methods: Patients scheduled for TKR (n=70) were recruited and instrumented with a wearable sensor system while performing three TUG test trials. Remaining study patients (n=68) also completed three TUG trials at their three-month follow-up. Custom developed software was used to segment recorded tests into sub-activities and extract 54 functional metrics to evaluate op/non-operative knee function. All preoperative TUG samples and their standardized metrics were clustered into two unlabelled groups using the k-means algorithm. Both groups were tracked forward to see how their early functional parameters translated to functional improvement at their three-month assessment. Test TCT was used to estimate overall functional improvement to relate findings to existing literature. Results: Preoperative clustering separated two groups with different test TCT (n=46 vs n=22 with means 13s vs 22s). Of the faster preoperative group, 63% of patients maintained their time, 26% improved, and 11% worsened whereas of the slower preoperative group, 27% maintained, 64% improved, and 9% worsened. Conclusions: This work has demonstrated that machine learning has the potential to find patterns in preoperative functional parameters that can predict functional improvement after surgery. While useful for assigning labels to the distinguished clusters, TCT was not among the top distinguishable metrics between groups at three months which highlights the necessity for these more descriptive performance metrics when analyzing patient recovery.

1-37 Recognition of human activities using plantar pressure measurements: a smart-shoes study

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Background: Commercial devices dedicated to the monitoring of physical activity rely on acceleration-sensing and usually include an activity recognition algorithm before being able to estimate the energy expenditures. The recent development of multi-sensing wearable technologies increases the ubiquity of measurements, allowing a more continuous and accurate monitoring. In the present study, a smart-shoes device has been developed for the recognition of daily life activities. Method: The smart-shoes prototype consists in sneakers equipped with home-made insoles featuring 7 pressure sensors (i.e.14 for one pair). Sixteen subjects wore the smart-shoes and performed the following 9 activities: cycling, doing housework, going down stairs, going up stairs, running, sitting, standing, upslope walking, walking. For each activity, 4 minutes of plantar pressure data have been collected at a 100Hz sampling rate. A total of 110 data features, has been extracted using a 10-second sliding window protocol. The whole data set has been spit in two groups: training and validation. Several machine learning algorithms (CubicSVM, BaggedTree, FineKNN, etc.) have been used on the training group to obtain a variety of prediction algorithms. Then the algorithms have been tested on the validation group. Result: The BaggedTree model showed the best predictions. The model accuracy was 93% for the training stage and 82% for validation. Most of the errors are "upslope walking" (error score: 66%) classified as either "walking" (55%) or "standing" (23%). The design of a higher level prediction algorithm combining the 10-sec window predictions for each 1-min period increases the percentage of good predictions up to 88%. Conclusion: The recognition of human activities can be done using plantar pressure information at a good percentage of valid predictions. In the future, smart-shoes may assist the existing wearable technologies resulting in more accurate predictions of energy expenditures.

1-39 Portable monitoring for air pollution exposure assessment during active transportation: procedures, technology integration and data harmonization of diverse sources.

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Background:Even though the evidence in regards the adverse effects of exposure to air pollution and the health benefits of walking and cycling is still controversial, it seems to be that the effects of active transport outweigh the risks associated with higher levels of air pollution exposure. The complexity in the assessment of air pollution exposure lies in their spatial heterogeneity due to pollution levels vary within the same city. In Chile, sources of air pollution are very diverse, highlighting in residential areas, for example, wood burning for heating. This pollution source contributes to exceeding recommendations for air quality, mainly those particulates which diameters are less than 2.5 and less than 10 µm (PM2.5 and PM10). A study aimed to integrate results from multiple technology resources was designed to address the need for an individual-level multimodal assessment for air pollution exposure while people is moving to places. Methods: This study describes procedures used in data processing from diverse sources using time harmonization strategies, the integration of technology such as GPS for location, accelerometry data and heart rate monitoring to estimate physical activity intensity during active transportation and air pollution concentrations in defined routes. This study will be conducted from March onwards at Temuco, which is one of the twenty most polluted cities in America. Their spatial heterogeneity is very high, facing periods of high concentration of particulate matter during the winter and periods of low concentration during the summer, therefore measurements will be conducted in all seasons of the year. Results: data processing procedures and harmonisation will be described. Preliminary findings will be presented, including practical examples of in route measures as well as the integration of technology used in selected routes.

1-41 Comparison of sedentary time between thigh-worn and wrist-worn accelerometers

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Background and aims: Wrist-worn accelerometers are gaining popularity in assessing sedentary time but their accuracy in identifying sedentary time is scarcely studied. The aim of this study was to compare daily sedentary time estimates between wrist-worn and thigh-worn accelerometers. Methods: The study population consisted of 259 participants (mean age 63 years, SD 0.9, 82% women) from the Finnish Retirement and Aging Study (FIREA).

Participants simultaneously wore an Axivity AX3 accelerometer on their mid-thigh and an Actigraph wActiSleep-BT accelerometer on their non-dominant wrist for minimum of 4 days in free-living conditions. For thigh accelerometer, sedentary time was defined by Acti4 software as sitting time, i.e. when thigh inclination was above 45°. For wrist accelerometer, two definitions of daily sedentary time were used: 1) the Koster cutoff point, ≤1853 counts per minute and 2) Euclidian Norm Minus One (ENMO) acceleration by the GGIR method <30 mg. Results: Compared to daily sedentary time estimates obtained from thigh-worn accelerometers, daily sedentary time was 63 min (95% CI 53 to 72) lower by the Koster cutoff point and 66 min (95% CI 55 to 78) higher by the GGIR method. Correlation was high (r=0.78) for the Koster cutoff point and moderate (r=0.58) for the GGIR method (Figure 1). The limits of agreement for daily sedentary time between thigh-worn and wrist-worn accelerometers were large (Koster: from -117 to 242; GGIR: from -332 to 200 min), but the differences between daily sedentary time obtained from thigh-worn accelerometers and the Koster cutoff point did not depend on the level of the daily sedentary time. Conclusions: Absolute values of daily sedentary time obtained from wrist-worn accelerometers should be interpreted with caution. However, wrist-worn accelerometers are valuable in comparisons between individuals and examining individual changes in daily sedentary time.

1-43 From measurement to intervention: an Intervention Mapping approach for data-driven sedentary behavior consulting

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[1]Maastricht University

Prolonged sitting in the workplace is a risk factor for non-communicable diseases and psychological malfunctioning and should be minimized. In this presentation, the development of a sedentary behavior (SB) reduction intervention will be discussed. An Intervention Mapping approach was applied to develop a tailored, half-automatized eHealth intervention to reduce SB. The Intervention Mapping protocol helped to guide the program developers from problem definition, through outcome specifications, to the intervention "UPcomplish". UPcomplish is a vitality professional who coaches individuals based on their activity data as well as their motivational factors to achieve their goals. A validated outcome measurement, the "VitaBit" SB toolkit, set the basis for behavioral monitoring and tailoring of the intervention content. Pilot tests were conducted to adapt the intervention content based on individual needs, and a program evaluation is planned. Evidence from psychological theories, literature and a pilot test has shown that awareness, psychological support, norm perceptions and knowledge about SB and its consequences are important determinants for SB. Thereby, a combination of multiple behavior change methods, such as tailoring and monitoring, was translated into practical applications. A gamification aspect in the intervention was proposed by participants as potential solution for sustained behavioral change. SB research (as opposed to physical activity research) is still at the beginning and there is little knowledge about the importance of decreasing SB (e.g. by interrupting sedentary bouts). eHealth promotion and gamification might be useful to decrease SB on the long term. This project is a first step to reduce another independent health risk factor.

1-45 Compositional analysis of sedentary behavior and physical activity during work and leisure among male and female office workers

Elin Johansson[1], Svend Erik Mathiassen[1], Charlotte Lund Rasmussen[2], Eugene Lyskov[1], David Hallman[1]

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Objective: To determine the extent to which male and female office workers differ in their time-use composition of sitting behaviors (SB) and physical activity (PA) during work and leisure. Methods: SB and PA was measured using thigh-worn accelerometers for up to 8 full days in 77 male and 104 female office workers. Daily time-use compositions during work and leisure were described in four exhaustive categories, i.e. sitting in short (<30 min) and long (¡Ý30 min) bouts, standing, and active behaviors. Following a compositional data analysis procedure, isometric log-ratios (ilr) were calculated to express time in sitting relative to non-sitting, short relative to long sitting bouts, and standing relative to active behaviors. Differences between sexes (men and women) and domains (work and leisure) were examined on the basis of these ilrs using ANOVA. Results: At work, time spent sitting in short bouts, long bouts, standing, and active was, on average, 34%, 36%, 22% and 8% among men and 31%, 37%,

24% and 8% among women. Corresponding proportions during leisure were 34%, 25%, 28% and 13% among men and 29%, 28%, 31% and 12% among women. Time spent sitting relative to non-sitting differed significantly between work and leisure (ilr sitting-vs-non-sitting, $n^2p=0.09$, $p<0.01$). During leisure, men used proportionally more time than women in short sitting bouts (ilr short-vs-long, $n^2p=0.06$, $p<0.01$) and spent more time in active behaviors relative to standing (ilr standing-vs-active, $n^2p=0.04$, $p<0.01$). No significant sex differences were observed during work ($p>0.05$). Conclusions: The leisure behavior observed among men is probably more beneficial for health than that observed for women. However, both men and women spent a major proportion of their time sitting, both at and outside their office work, and they were, in general, only little active. Thus, both men and women could benefit from interventions to reduce SB and increase PA both at work and during leisure.

1-47 Long-term continuous activity profiling in a technology supported physical lifestyle intervention

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Objective Long-term activity tracking present researchers with the possibility to capture weeks or even months of data from participants, without repeat visits or follow-up. However, while this allows greater understanding of participants and their interaction with studies and interventions, the volume of data collected presents a new challenge in data cleaning and processing. 86 participants engaged in a 12-week technology supported lifestyle intervention (EuroFIT). Methods The study utilised the Activator, a pocket worn wireless activity tracker developed for the project. Participants could monitor their performance using a mobile app that also uploaded Activator data to the cloud. Results The data was downloaded and cleaned. A valid week was defined as containing at least 4 valid days, a valid day required at least 14 hours of wear time (see figure). The Cleaning algorithm removed all participants without valid baseline and end of intervention data. As example, one participant had a mean baseline and end step count of 5,890 and 5,590 steps, respectively. Using these measures only, for this participant the intervention can be considered unsuccessful. However, if the participant's activity profile over the course of the intervention is considered, an average of 8,070 steps is found for the previous three weeks, with a linear regression resulting in 7,924 steps at the end week. This highlights the rich physical activity profile that continuous activity tracking can provide and how two approaches to 'objective' physical behaviour measurement can result in a 40% difference over baseline. Conclusions Continuous activity data has both advantages and challenges. With discrete measurement sessions a few days of atypical behaviour can easily bias a participant's results. Examination of continuous activity profiles highlights the impact of seasonal holiday activity patterns and continuous profiling makes reactivity to the measurement experience less likely to occur.

1-49 A free-living investigation of methods to estimate moderate-to-vigorous physical activity from an actigraph accelerometer

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BACKGROUND: Despite the proliferation of body-worn sensors to assess moderate-to-vigorous physical activity (MVPA), processing accelerometer data collected from free-living (FL) individuals remains a challenge. OBJECTIVE: This investigation examined the accuracy and precision of existing ActiGraph accelerometer (AG) data processing methods to estimate MVPA in FL settings. METHODS: Forty-eight participants (45.8% male, mean±sd age: 20.4±1.3 years, BMI: 23.2±3.5 kg·m-2) wore an AG on their right hip and non-dominant wrist during four, 1-hour FL sessions. Sessions were video-recorded and coded using a direct observation (DO) system that provided a criterion measure of activity intensity category. Ten AG data processing methods were applied to estimate MVPA (Figure 1, x-axis). Mixed models were used to assess the difference between model estimated and DO measured MVPA mins. RESULTS: DO identified 12.8 MVPA mins/session. Sed sphere was the only method to accurately estimate MVPA mins (bias [95% confidence interval] = 1.0 [-0.4, 2.5] mins). MVPA was overestimated using Decision tree and Random forest methods (5.9 [3.3, 8.5] and 4.0 [2.2, 5.7] mins, respectively). Crouter, Sasaki, Hildebrand, Troiano, Freedson, soj-3x and soj-1x methods significantly underestimated MVPA (mean bias range: 7.5 to 1.6 mins, mean false negative range: 9.6 to 4.2 mins/session). CONCLUSIONS: Sed sphere (wrist) was the only method to

accurately estimate MVPA mins. Simple cut-points (Freedson) and more complex machine learning methods (Soj-1x and Soj-3x) applied to hip AG data provided the most precise MVPA estimates. Future work should develop methods like Sed sphere and Soj-3x to further improve estimates of MVPA using wrist-worn accelerometers. Supported by NIH NIDDK R01DK110148.

1-51 Sedentary behavior negatively impacts sleep quality in college students as derived from accelerometry

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BACKGROUND: Sleep is essential for overall health, and can impact academic performance. Prior research has shown reduced sleep time in college students. Physical activity (PA) and sedentary behavior may impact sleep quality, but has not been examined extensively in this population. PURPOSE: To examine PA and sedentary behavior variables in relation to sleep quality and body composition in college students. METHODS: Eighty-one female (n = 53) and male (n = 28) college students [20.2 ± 1.5 yr; Body mass index (BMI) = 25.1 ± 4.74] underwent body composition analysis via dual-energy x-ray absorptiometry, and 7-day objective PA and sleep assessment via accelerometry. Spearman's rho was used to analyze the relationship between study variables. RESULTS: Average total time in sedentary minutes per day was associated with less sleep time ($r = -0.25$, $p < 0.05$), shorter sleep latency ($r = -0.25$, $p < 0.05$) and greater number of awakenings per night ($r = 0.28$, $p < 0.05$). Average total time in sedentary breaks per day was associated with increased sleep time ($r = 0.25$, $p < 0.05$), longer sleep latency ($r = 0.26$, $p < 0.05$) and fewer awakenings per night ($r = -0.25$, $p < 0.05$). Moderate-to-vigorous intensity PA minutes (MVPA) and steps per day were associated with lower BMI ($r = -0.25$ and -0.28, $p < 0.05$ for MVPA and steps, respectively), percent fat ($r = -0.36$ and -0.34, $p < 0.01$ for MVPA and steps, respectively) and visceral fat ($r = -0.29$ and -0.42, $p < 0.01$ for MVPA and steps, respectively. CONCLUSIONS: Poor sleep quality has previously been linked to poor health outcomes. Results suggest that sedentary behavior worsens sleep quality and conversely, by decreasing sedentary behavior through PA breaks, sleep quality can be improved. This is one of the first studies to show a relationship between PA and sleep variables in a college-age population.

1-53 Does a school-based standing desk intervention modify classroom standing and sitting time and physical activity during waking hours over a full school year?

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Objective: Children are increasingly spending extended time sedentary at school and during leisure time. In an effort to combat this increase in sedentary behaviour, school-based interventions have sought to replace conventional desks with standing desks. Recent studies have found that the installation of standing desks in classrooms can significantly increase classroom standing time and reduce sitting time in the short term. This study examined whether standing and sitting time, and physical activity levels throughout the day (waking hours), were maintained over a full school following the installation of standing desks. Methods: A repeated measures, within-subjects crossover trial was conducted. Participants started the school year using either a standing desk or traditional seated desk for 21 days before swapping desks for another 21 days. This pattern of alternate use of standing and seated desks was maintained over the full school year. Accelerometry data (one thigh and one hip accelerometer) were collected during the last seven days of the 21-day period at the start and at the end of the school year for both sitting and standing conditions. Mix models were used to analyse the accelerometry data. Results: Twenty-three male students (aged 10-11 years) participated in the study. Data collected from the start of the school year showed that standing time was about 20 mins/school day higher ($p < 0.001$) and sitting time was about 20 mins/day lower ($p < 0.05$) when standing desks were used. There was no overall change in daily physical activity levels. Data analysis for the end of school year is ongoing and will be completed in February 2019. Conclusions: Results of this study will indicate whether students maintain sitting and standing patterns when intermittently using a standing desk for a full school year and also whether overall physical activity levels increase as students adapt to standing for longer during the school day.

1-55 Step count to characterize physical activity in people with Parkinson?s disease

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Introduction: Many people with Parkinson's disease (PD) fail to achieve recommended physical activity guidelines. A daily step threshold to predict achievement of activity guidelines exists for older adults, but not for people with PD. This study aimed to determine differences in disease severity, functional performance and activity patterns between people who did/did not reach a daily step count of 7,000 steps; and to determine the ability of this threshold to predict achievement of activity recommendations in people with PD. Methods: Physical activity of 50 people with mild-moderate PD (66±8 yrs) was monitored over four days using an accelerometer (activPAL3). Participants were divided into two groups based on average daily step count (active ≥7,000, inactive <7,000). Personal characteristics, disease factors, physical function and patterns of physical activity (number and duration of activity bouts of varying intensities and continuity) were compared between groups. The ability of this step threshold to predict achievement of physical activity recommendations was calculated. Results: A total of 44% of participants were classified as active and 56% as inactive. There was no difference between groups in measures of disease severity. A faster Timed Up and Go time in the active group was the only difference in physical function between groups ($p = 0.035$). All bouts of discontinuous and continuous moderate to vigorous physical activity were greater in number and length in the active group, except the length of discontinuous moderate intensity bouts. The 7,000 step/day threshold had a 73% positive predictive value and a 79% negative predictive value in correctly identifying those who achieve activity recommendations. Conclusion: Factors influencing daily steps taken are complex and each individual with PD may have differing influencing factors. A 7,000 step/day guideline could be suggested to people with PD to predict the attainment of physical activity guideline

1-59 Free-living physical activity one year following total knee arthroplasty in patients with osteoarthritis

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[1]University of Salford Manchester, [2]Stockport NHS Foundation Trust, [3]King Khalid University Hospital, [4]University of Salford, [5]Princess Nora bint Abdul Rahman University, KSA

Introduction: Improvement in physical activity (PA) is often expected following total knee arthroplasty (TKA) in patients with osteoarthritis. Few studies have used objective methods to investigate such changes in detail. Aim: To objectively explore changes in volume and patterns of PA following TKA and to compare those findings with PA recommendations. Methods: 33 patients waiting for TKA were recruited. They wore activPAL monitors for a period of 7-8 days: before surgery, and at 6- and 12-months following surgery. Time spent in activities: sedentary, standing and stepping, and number of steps was calculated. Event files contained information for all bouts of stepping, including the time each bout began, number of steps and its duration. This was used to analyse patterns. The accumulated time spent in Moderate to Vigorous Physical Activity (MVPA) (>100 steps/min) prior to TKA, and 6 and 12 months post-TKA, was explored for all bout lengths and for bouts ≥10 minutes. Results: The stepping times and numbers of steps improved at 6 and 12 months compare to pre-TKA ($p < 0.000$). The stepping time increased from pre-TKA by 11.48 ±2.05 minutes at 6 months and by 22.66 ±2.24 minutes at 12 months. Steps increased at 6 months by 613 ± 89 steps and at 12 months by 1,934 ± 105 steps. The time spent in MVPA, all bout lengths, improved at 6 and 12 months post-TKA compared to pre-TKA ($p < 0.000$). Median changes were from 6.6 minutes (pre-TKA) to 10.5 minutes (6 months post-TKA) to 41.7 minutes (12 months post-TKA). Only 24% of the participants met global PA recommendation of 150 minutes MVPA per week for all bout lengths, and only 6% of the participants met recommendations in bouts ≥10 continuous minutes. Conclusion: This is the first study to explore post-TKA activity levels in detail. Stepping time, numbers of steps increased, but most participants did not meet the PA guideline recommendation. To improve compliance with guidelines behavioral interventions may be needed.

1-65 Influence of activity monitor intervention on physical activity, dietary intake and psychological state in young adult women

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OBJECTIVE: To assess the effects of increased physical activity (PA) at the lactate threshold (LTPA), which is the minimum relative intensity to improve cardiorespiratory fitness and would ultimately reduce the cardiovascular disease risk, using an activity monitor (AM) on daily PA, and whether there is a concomitant reaction on dietary intake and psychological stress. METHODS: Twenty-three women, aged 32±8 years, were randomly assigned to a 12-week of intervention group that wore an AM (LifecorderPLUS, Suzuken), which displays the PA duration at/above a preset intensity, and were instructed to increase their LTPA from the baseline level (depended on ages: 160-180 min/week), or a control group that wore the AM (with a step count display) and were instructed to maintain their usual lifestyle. Individual LT was measured by an exercise test. Nutrient intake was evaluated using a food-frequency questionnaire. Mood state and depressive symptoms were assessed by the POMS-Brief form and CES-D scale, respectively. RESULTS: A high compliance in increment of LTPA was observed in intervention group (99% of the goals set on average). LTPA and moderate-to-vigorous intensity PA were significantly increased compared with the baseline values for the intervention group (5±4 vs. 24±5 min/d, and 29±17 vs. 42±10 min/d). In contrast, no significant group×period interactions were observed for total energy intake and macronutrients intake. Moreover, no obvious intervention effects on the mental state-related variables were found. CONCLUSIONS: These results indicated that the AM based intervention ameliorates quality of PA in the group of young adult women. Furthermore, a strenuous PA, such as increasing LTPA, is not likely to cause deleterious effects on dietary intake or induce psychological stress.

Thursday, June 27th: Day 3

2-02 Timing of activity patterns are associated with perceived physical fatigability in older adults

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Introduction: Fatigability is common in older adults and known to accelerate age-related decline in physical function. Physical fatigability may be moderated by physical activity (PA). When in the day PA most strongly relates to fatigability remains unknown. We propose three measures of PA timing to assess their relationship with physical fatigability in older adults. Methods: PA was assessed using free-living ActiGraph GT3X+ data from 61 older adults (70-91yrs) in the Developmental Epidemiologic Cohort Study (DECOS). Activity counts were aggregated in 60-second epochs and log-transformed. Perceived physical fatigability was measured with the Pittsburgh Fatigability Scale (PFS, 0-50 score, higher fatigability≥15). Three measures, calculated in 4-hour time bins, included: mean activity, standard deviation (SD) of mean activity across days, and relative activity ([mean activity at each bin]/[the sum of mean activity]). Multiple regression (adjusted for age, sex, BMI, and usual 6m gait speed) assessed associations between PA measures at each time bin and PFS scores. Results: Adults with higher PFS (n=24, 40%) were older, had higher BMI, and lower PA ($p<0.05$ for all) compared to lower PFS. Higher mean PA from 12pm-4pm was associated with lower PFS scores ($\beta=-0.33$, $p=0.03$, adj. $R2=0.21$) and higher relative PA from 12am-4am was associated with higher PFS scores ($\beta=2.14$, $p=0.04$, adj. $R2=0.26$). SD PA was not associated with PFS score. Conclusion: Evaluating timing of PA patterns in older adults may reveal PA phenotypes associated with fatigability status. Specifically, less day-time absolute PA was associated with higher fatigability. Higher relative PA from 12am-4am suggests that shifts toward nighttime PA may play a unique role in higher perceived fatigability. Relative measures of activity control for participant-specific differences in overall activity, standardizing PA across the sample. Our findings highlight new measures to understand timing of PA in older adults.

2-06 Association between mortality and time-use composition of the 24 hour day

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[1]Biomathematics and Statistics Scotland, [2]Glasgow Caledonian University, [3]Australian Catholic University, [4]Glasgow Caledonian University, Ghent University

Introduction: Previous prospective studies of the association between mortality and physical activity (PA) have generally not fully taken into account other movement behaviors. A compositional approach accounts for co-dependency between PA behaviors and considers the relative scale of time-use data. Methods: A prospective analysis of NHANES 2005-06 on N=1468 adults (d=135 deaths) between ages 50-79 was undertaken using compositional Cox regression. Daily time spent in sedentary behavior (SB), light intensity (LIPA) and moderate to vigorous physical activity (MVPA) was determined from waist-mounted accelerometer data (Actigraph 7164) and supplemented with self-reported sleep data to determine the time-use composition of the day. The association of the time-use composition with mortality was assessed through a model selection process involving nested sets of confounding variables and covariates. Results: The composition of time spent in SB, LIPA, MVPA and sleep was statistically significantly associated with mortality rates after allowing for age and sex effects ($p < 0.001$), and the association remained significant when other lifestyle factors were added ($p < 0.001$). The association was driven primarily by the ratio of MVPA to other behaviors, however significant changes in mortality risk are attributable to LIPA relative to SB and Sleep, and SB relative to Sleep. The balance between Sleep and SB however ceased to be statistically significant after incorporating lifestyle factors. Conclusions: The results demonstrate an association between survival rates and the physical activity composition of the day, which remains statistically significant after allowing for other lifestyle factors. Relative time allocated to MVPA in the daily time-use composition reveals as a key player, but time spent in LIPA relative to SB and sleep is also a significant factor. Our method is readily extensible to other questions in time-use epidemiology.

2-08 Compositional data group based trajectory analysis for physical behaviours.

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Purpose: Advancing modeling approaches for describing how behaviors change over time is needed to better understand the life course risk of health behaviors and to evaluate the efficacy of interventions. In the last decade, trajectory analysis has attracted growing interest with the increasing availability of longitudinal data from cohort and experimental studies. Our aim was to develop group-based trajectory methods for compositional data (i.e., wearable monitor data collected over 24 hours to better understanding dynamic changes in daily physical activity, sleep, time use, and dietary intake. Methods: Group based trajectory assumes that a sample is composed of distinct groups, each with a different trajectory. Group based trajectory involves in a first stage to estimate these trajectories and groups. Group membership is then used to build statistical models linking the trajectory with either outcomes or correlates. We used the k-means clustering framework to identify trajectory and group membership. Compositional data at each time point were entered using isometric log-ratio coordinates into the clustering algorithm so that their similarity is adequately assessed. Compositional geometric means were calculated for each group and were used to summarize and compare trajectories. The algorithm was tested against synthetic data representing the trajectory of 24 hour activity measured at 3 time points over 10 years. Results: Our proposal was able to isolate trajectories of 24 hours activity (sleep, sedentary behavior, light and moderate physical activity) in a principled way. Trajectories were then used as exposure for synthetic obesity outcomes to show how the output of the clustering analysis can be used to understand how to link trajectories with health outcomes. Conclusions: Group based trajectory analysis for compositional data is possible using a k-means clustering approach. Open source R code for this is available at http://www.OpenCoda.net.

2-12 Automatic identification of valid wear days in thigh worn accelerometer data

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Objective Data cleaning is an essential first step in analysing accelerometer data, both to determine if the accelerometer was worn and whether it was worn correctly. For large datasets, manual cleaning of individual data files is unrealistic. This study describes an algorithm which uses the expected location of the accelerometer on the thigh to automatically validate the data based on known activity behaviours. Methods For each calendar day, the acceleration data were segmented into 15 second containers. For each container, the average orientation of the accelerometer was converted to pitch and roll and quantised onto the six faces of a cube (labelled using the numbers on a dice). The cumulative time spent and sum of accelerations in each dice face were calculated for each day to identify stepping and sitting orientations. In addition, the total time spent in consecutive low noise periods longer than an hour was used to determine non-wear. The outputs from the algorithm can be visualised on a daily spiral plot. Results The cumulative acceleration value proved to be too simple a metric to identify the stepping dice face, with long transport periods being misidentified as the stepping orientation. A basic stepping algorithm was therefore applied to all dynamic containers to filter out transportation. The visualisation in the figure shows an example containing both non-wear sections and incorrect wear of the device. Conclusions Applying the daily validation provides the ability to automatically identify and remove problematic days which fail to meet the wear criteria, prior to event classification. Further, this approach allows for automatic correction when the device has been attached orthogonally to the thigh but with the incorrect axis orientation. This approach was developed to identify valid calendar days only, and challenges remain in separating short non-wear periods, and multiple reattachments of the device in different orientations in the same day.

2-14 Validation of a novel lightweight template-based algorithm for free-living gait detection.

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Background and Objectives: Wearable-based free-living walking assessment methodologies require a valid and robust means of gait classification (GC) before further detailed gait quantification can take place [1]. A suitable GC algorithm is one that can perform in as wide a variety of contexts as possible and accurately capture valid gait. Such versatility is vital in free-living conditions. This study aimed at validating a template-based method for free-living gait detection. Methods: 10 healthy adult subjects wore an accelerometer (AX3, Axivity) on the lower back and a synchronised GoPro camera on the trunk for two separate one-hour epochs [2]. Videos were annotated and represented the gold standard for validation and performance quantification (sensitivity and specificity) of a lightweight versatile gait detection algorithm in various contexts. The algorithm uses the convolution of the vertical signal and a sinusoidal template with a frequency within the typical ambulation range (~2.5Hz). Applying a threshold to the resultant signal produces a binary signal for GC, Fig 1a. GC Performance indicators, ROC curves and associated AUC values were calculated as well as Spearman's correlation (rho) for number of bouts detected. Results: The novel algorithm had good performance (accuracy 87%, sensitivity 72%, specificity 84%, AUC=0.78) and rho=0.8 ($p<0.001$) with slight positive bias. We contextualised GC performance: short indoors bouts were associated with lower sensitivity whereas shuffling, turning and other activities e.g. cycling were more often associated with lower specificity. Conclusions: We successfully validated a novel lightweight algorithm for free-living gait detection, the algorithm performed very well in many contexts. Although this interesting method shows some promise, further work should aim to improve accuracy by incorporating personalised template parameters. References: [1]Taborri, Sensors 2016 [2]Hickey, Physiological measurement 2016

2-16 Accuracy of first-person point-of-view video from a body-worn camera as a criterion for free-living human physical behavior activity type and context labeling

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Researchers use body-worn, camera-based first-person (FP) point-of-view (POV) momentary image sampling and second-person (SP) continuous free-living (FL) video to train motion-based algorithms that detect human physical behavior. While the former may not capture the continuity of natural behavior, the latter increases researcher burden and limits training data. Continuous FPPOV FL video from wearable cameras may be a suitable alternative, but its validity is untested. Purpose: Test the validity of FPPOV FL continuous video against SPPOV FL video. Methods: Twelve subjects (age= 59.6 ± 8.5 years, BMI= 27.8 ± 5.9 kg/m^2) engaged in fixed, uncontrolled, continuously performed sedentary and physical activity FL behavior (48.0 ± 9.2 min). Participants wore a small camera on their shirt collar and were video recorded from an SP perspective. Both FP and SP videos were post-processed by independent researchers to obtain unbiased continuous time-stamped labels of posture (e.g., sit, stand), whole body movement (e.g., walk, cycle), and upper limb activity (e.g., phone use) in the context (e.g., shopping, location) of the behavior. Percent correct FPPOV labels were computed against the criterion SPPOV labels for every second. Results: Wearable video cameras accurately captured: i) postures 93.1 ± 3.1% of the time (95% CI: 91.3, 94.7), ii) whole body movement 91.6 ± 3.9% of the time (95% CI: 89.4, 93.7), iii) upper limb activity 83.7 ± 7.8% of the time (95% CI: 79.5, 88.0), and iv) all 3 labels simultaneously 75.3 ± 8.9% of the time (95% CI: 70.4, 80.1). Conclusions: FPPOV video has a limited ability to capture upper limb activity because hand motion may not always enter the view of a front-facing wearable camera. Training physical behavior algorithms on signals labeled from such video may be suitable for recognition algorithms aimed at detecting some gross whole-body movement. Determining the optimal location to wear an FPPOV camera may be required to enhance label validity.

2-18 The Light-intensity Physical Activity Trial (LiPAT); lowering cardiovascular disease risk in type 2 diabetes through increasing light-intensity physical activity

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Individuals with type 2 diabetes (T2D) have an increased risk of cardiovascular diseases (CVD). Physical activity (PA) is an important modifiable CVD risk factor and increased PA has been shown to positively impact cardiovascular health in individuals with T2D, but compliance to exercise programs is poor. Light-intensity PA (LiPA) is also associated with a decreased CVD risk. But the evidence in individuals with T2D is conflicting. LiPAT is a 12-month randomized controlled trial in individuals with T2D to investigate the effectiveness of LiPA in lowering arterial stiffness as estimated by aortic pulse wave velocity and carotid distensibility. The trial will randomise 160 individuals with T2D (40-65 years) in an intervention or control group. The intervention group will receive a wrist-worn accelerometer (Xiaomi®), connected with a smartphone-app, designed by the research team, to give the participant information about their walking pattern and number of steps a day. The research team will have direct access to the data. Based on their baseline activity (number of steps) participants will receive an individual goal to increase the overall daily step count throughout the intervention period and the smartphone-app will support them to achieve their goal. The intervention will further include four interactive workshop aimed to increase LiPA and telephone coaching every two weeks in the first three months and monthly in the last three months. The control group will also receive four interactive workshops. Measurements will take place four times (baseline, month 3, month 6, month 12). Aortic stiffness is the primary outcome and is assessed by means of aortic pulse wave velocity and carotid distensibility measurements. Secondary outcomes include PA and sedentary behaviour (activPAL), microcirculation function (fundoscopy and skin laser Doppler flowmetry), blood pressure, metabolic health, body composition, physical functioning, quality of life and depressive symptoms.

2-20 Effects of progressive intensity exercise training on glycemic control and free-living physical activity in older adults with prediabetes

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PURPOSE: Aerobic exercise is recommended to improve glycemic control; however, the optimal intensity of exercise for older adults with prediabetes is unknown. The objective of this study is to compare the effects of 12 weeks of moderate vs. high intensity aerobic exercise on glycemic control and free-living physical activity (PA) behavior in older adults. METHODS: 14 older adults (10F; 66.4±5.1 yrs) with prediabetes (HbA1c 5.7-6.4% or fasting glucose 100-125 mg/dl) were randomized to 12-weeks of supervised aerobic exercise (45-min sessions 4 days/wk) at either moderate (MOD: 60-65% HRmax) or vigorous (VIG: 80-85% HRmax) intensity. Participants wore a continuous glucose monitor (CGM, Dexcom) and an ActivPAL monitor for 1 week at baseline and week 12. Measures of glycemic control (mean and percent of day with glucose ≥140mg/dL) were quantified over the wear period. PA behaviors were characterized as total sitting time, non-exercise PA (>1.5 METs accumulated in bouts of <10 min; NEPA) and exercise PA (≥3.0 METs accumulated in bouts ≥10 min; Exercise-PA) were assessed using the ActivPAL. Because this study is ongoing, only descriptive statistics are presented. RESULTS: MOD (n=6) decreased mean 24 hour glucose -7.8±9.8 mg/dl (mean±SE) and percent of day ≥140mg/dL -9.5±17.4%, whereas, VIG (n=8) increased mean 24 hour glucose 3.4±1.9 mg/dl and percent of day ≥140mg/dL 1.8±3.2%. As designed, exercise-PA increased in both MOD and VIG (15.3±7.3 and 17.1±5.4 min/d, respectively). There was no change in NEPA in either group. Sitting time increased in VIG (40±30 min/d) but not in MOD (-7±35 min/d). CONCLUSION: If these preliminary data are confirmed, findings may suggest that moderate intensity exercise is superior to vigorous intensity exercise for glycemic control in older adults with prediabetes, but the effects appear to be modest. A more comprehensive lifestyle intervention may be needed to improve glycemic control in this population.

2-22 Accuracy of heart rate and energy expenditure estimations of wrist-worn and arm-worn Apple Watches

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Background: The purpose of this study was to examine the accuracy of heart rate (HR) and energy expenditure (EE) estimates by the Apple Watch Series 1 worn both on the wrist (WW) and the upper arm (AW). Methods: Thirty healthy, young adults (15 females) wore the two monitors while participating in a treadmill maximal exercise test. The WW was placed on the participant's non-dominant wrist, and the AW was placed on the participant's non-dominant upper-arm, using a commercially available armband. Criterion measures were obtained from the Parvo Medics TrueOne 2400 Metabolic Cart (MetCart) and an electrocardiograph (ECG). Results: We used two one-sided equivalence tests (TOST) with mean criterion values ± 10% as the upper and lower equivalence bounds. HR estimations of AW were equivalent to the ECG HR values for the entire sample, for males, and for females, at all exercise intensities. The AW also had mean absolute percent error (MAPE) of less than 2.5% for all groups at all intensities. HR estimations of the WW were equivalent to the ECG values for most groups, except for males at light and very vigorous intensities, and females at light and very vigorous intensities. WW HR estimates had MAPEs ranging from 3.61% (females at very light intensity) to 14.97% (males at very vigorous intensity). For the entire sample, the AW had equivalent EE estimations to the MetCart and had a MAPE of 39.63%. The WW EE estimations were not equivalent for the entire sample, with a MAPE of 32.28%. Both the AW and the WW overestimated EE for females and underestimated EE for males. Conclusion: Wearing the Apple Watch Series 1 on the upper arm is associated with improvements in the MAPE for HR estimations versus placements on the wrist. The upper arm placement, however, is not associated with improved MAPE for the EE estimations when compared to a criterion measure.

2-24 The relationship between actual physical activity and perceived physical functioning and disease activity in persons with ankylosing spondylitis

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BACKGROUND:Physical activity (PA) has several health-related benefits. However, the amount and intensity of PA in persons with Ankylosing Spondylitis (AS) can be limited due to pain, stiffness and limitations in mobility.While clinical treatment primarily focuses on decreasing disease activity, the relationship with PA is not well known It is expected that by medicinally decreasing disease activity, patient reported outcome measures such as (perceived) physical functioning and disease activity improve. It is hypothesized that improvements in these PROMs,increase the amount and intensity of actual daily PA.AIM:The relationship between physical functioning and disease activity and the intensity and amount of daily PA in persons with AS. METHOD:12 persons with AS wore a tri-axial accelerometer for 7 consecutive days before and after 9 months treatment with tumor necrosis factor inhibitor.Actual PA was described as: I. daily activity as the vector magnitude of counts per minute (CPM) and II. intensity of PA in minutes spent in sedentary,light,moderate and vigorous activity. physical functioning and disease activity were reported on a 1-10 point scale by the BASDAI and BASFI questionnaires, also before and after treatment.RESULTS:Total datasets of ten participants were available (mean±sd:46±15yrs;82±10kg;1.8±0.1m).physical functioning (BASFI) improved with median scores from 6.7 to 4.8 and disease activity (BASDAI) from 7.1 to 5.1.This was accompanied by an increase in daily PA with 30% from 532 to 686 CPM. Regarding the intensity of PA,median sedentary time decreased from 573 to 516 minutes per day and moderate PA increased from 20 to 37 minutes per day.No significant correlations between changes in BASFI, BASDAI and PA were found.CONCLUSION:These results suggest that improvements in physical functioning and disease activity are also accompanied by an increase in daily PA.The amount and intensity of PA increased sufficiently to exceed the recommended PA guidelines.

2-26 Advancing the measurement of physical activity in outdoor, public environments using high-tech video capture and analysis

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Objective: Enhance physical activity (PA) assessment in public, outdoor environments. Methods: Counts of individuals performing PA on sidewalks and in parks were compared between traditional observations conducted on-site and expert reviews of videos obtained simultaneously using a wearable video device (WVD). A subsample of the park videos was analyzed using deep convolutional neural networks (CNNs) (e.g., computer analysis) to automatically count park users. Intraclass correlation coefficient (ICC) and the Bland-Altman method were used to assess agreement among approaches. The feasibility of using an unmanned aerial vehicle (UAV) to count park users was also explored. Results: Park observations: 676 distinct observations were made in 14 parks. The ICCs indicated good to excellent reliability between traditional observation and expert reviews for counts of women and men and counts within the age, race/ethnicity, and exercise intensity categories. In the subsample of 42 observations, good reliability for total counts was found between expert reviews and computer videos analysis (ICC = .827; $p<0.001$). Bland-Altman indicated that traditional observation and computer analysis both underestimated total counts as the number of individuals observed increased. Sidewalk observations: 900 min of observations were made along 90,000 linear feet of sidewalks. The ICCs indicated excellent reliability between traditional observation and expert reviews of videos for counts of walkers, runners, and cyclists. Bland-Altman indicated there was a tendency for overestimation of walkers and an underestimation of runners by traditional observation as the number of individuals observed increased. UAV: A specific protocol was developed to accurately count individuals in parks using UAV-obtained videos. Conclusions: This study supports the use of WVDs, deep CNNs, and UAVs for improving the assessment of PA in public, outdoor environments.

2-28 A measurement of post-stroke arm activity in daily life: An exploration study using a low-cost commercial wearable device

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According to studies regarding post-stroke patients, voluntary arm use in daily life is important and meaningful for recovery. However, the functional recovery of upper extremity is usually claimed by using hospital-based assessments. Previously, researchers have developed reliable and valid devices using accelerometers and electrical goniometer to measure daily arm activity. However, the device was not wireless and the recording capacity was only three days. Recently, the activity monitors were implemented to quantify post-stroke daily arm activity, yet the activity monitors were costly in relation to personal use at home. The purpose of this study was to demonstrate the usage of a low-cost commercial wearable device (CWD) to capture post-stroke arm activity in daily life. The CWD chosen for this study was proven to be the best solution based on its price. In addition to the lesser cost of the device, its battery usage can last approximately up to one month along with a large recording capacity. During this study, we asked post-stroke patients to wear the CWD on both wrists for twenty-four hours for a consecutive period of seven days. Additionally, motor activity log (MAL), a semi-structured interview assessing the post-stroke arm activity in daily life served as the concurrent comparison. Daily counts captured by the CWD for both arms were recorded and the activity ratio of affected to unaffected arm was calculated by recruiting twenty-two patients. Significantly, less activity of the affected arm was found ($p=0.001$) and the activity ratio was 0.77 ± 0.34, indicating the internal validity of CWD. Moreover, the activity ratio was moderately correlated to MAL ($rho=0.432$, $p=0.045$), indicating the external validity of CWD. We demonstrated acceptable internal validity and external validity for the CWD chosen for this study. The commercial wearable devices may provide an objective and real-world index for post-stroke arm use in daily life.

2-30 Understanding criteria for classifying children as physically active: a comparison of self-report and device-derived measures.

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Background: physical activity (PA) recommendations suggest that children should accumulate at least 60 minutes of moderate-to-vigorous PA (MVPA) per day to achieve optimal health benefits. However, these recommendations have been derived from self-reported data. The aim was to compare and assess the agreement between PA estimates obtained from self-reported and accelerometer data in children. Methods: students aged 8 to 16 were recruited from randomly selected classes from schools in two cities. The participants wore an ActiGraph GT3X+ (AG) on the hip in 7 consecutive days. Participants that wore the AG at least 10 h/day in 7 days were included in the analysis. Evenson cut-points were used for identifying time spent in MVPA. Two criteria derived from accelerometry were used to classify the participants as physical active based on: 1) daily accumulation (≥60 minutes of MVPA on each of the 7 days) and 2) an average day (≥60 minutes of MVPA/day). Participants answered: "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?", and were classified as physically active if they reported being active "in all 7 days". The percentages of participants classified as active with the different methods were compared using proportion tests and the agreement was tested using kappa. Results: In total, 837 participants completed the study, but only 247 (29.5%) had valid data (12.3±1.33 years; 46.5% female). 7.7% were physically active based on self-report. When using AG data, only 0.8% were active in all 7 days, while 9.8% met the guidelines when the average method was used. The agreement between self-reported measures and both device-derived criteria, active in all days (kappa=0.082, p=0.011) and average method (kappa=0.156, p=0.114) were poor. Conclusion: important differences and poor agreement were observed between the different methods that should be considered when analysing data and comparing or reporting results.

2-32 Development of an arm activity tracker that applies direct personalized feedback based on objectively measured arm use data to stimulate the use of the affected arm after stroke

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OBJECTIVE Because arm use is an important treatment target in stroke rehabilitation, our research group developed an upper-limb activity monitor (ULAM) to estimate arm use in daily life after stroke. The ULAM consists of two wrist-worn accelerometers and an accelerometer on the leg to estimate arm use during sitting and standing. The aim of this study is to design an arm activity tracker that applies direct personalized feedback based on objectively measured arm use data to stimulate the the use of the affected arm after stroke. METHODS This study consists of three steps: 1) To transform the principles of the ULAM into an initial design of the arm activity tracker; 2) to optimize the design by interviews with therapists (n=20) and patients (n=30); 3) computer-based open-loop evaluations of the feedback algorithm. RESULTS Fig. 1 shows the design of the arm activity tracker, which is based on the ULAM and the interviews. The system gives direct feedback via the device on the affected arm. Therapists can adjust feedback settings and read data from the system to monitor and coach the patient. The device sets personalized daily goals on two objectively measured parameters: 1) total use of the affected arm during sitting/standing; 2) the ratio between the use of both arms during sitting/standing. The system evaluates with a personalized frequency whether patients are on track to achieve the goals by estimating an activity target line. When patients are not on track, the device sends a reminder consisting of a vibrotactile trigger and a visual message. When patients are on track, the system sends a reward consisting of a vibrotactile trigger and a visual message. The device also sends a reward when the goals have been achieved. CONCLUSIONS Based on an initial design and interviews we designed an arm activity tracker that applies direct personalized feedback to stimulate arm use. Computer-based open-loop evaluations of the feedback algorithm are in progress.

2-36 Activity classification models developed in controlled laboratory settings: how well do they generalise to free-living conditions?

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Background: Classification of activity behaviours using raw accelerometer data is becoming more prominent. Almost all classification algorithms are developed using data collected in controlled laboratory settings which may not be generalisable to free-living conditions. This study examined how machine learning models trained on laboratory data performed on free-living data, and how model accuracy changed when retrained with additional free-living data. Methods: In a lab setting 80 participants (40 adults, 40 children) were equipped with two Axivity AX3 accelerometers worn on their thigh and lower back. They performed a series of activities (e.g. sitting, standing, walking, running, lying) that were captured by a video camera (criterion measure). Thirty new participants (15 adults, 15 children) wore the same accelerometers and a wearable video camera that recorded their free-living movement behaviours. Using the lab data, a random forest was trained to classify each activity using various features of the accelerometer data (e.g. axis means). This model was used to predict activities from the free-living dataset. A second model was trained with both lab and free-living data, and accuracy was estimated using leave-one-out-cross validation. Results: For adults, the accuracy of the lab-trained model was 99.0% (95% CI: 98.8-99.2) but dropped to 88.6% (88.1-89.1) when applied to free-living data. Similarly, the child model dropped from 97.8% (97.6-98) to 92% (91.6-92.5). Retraining the models with additional free-living data improved the free-living accuracy to 98.1% (97.9-98.2) in adults and 97.2% (97-97.4) in children. Conclusions: Activity classification models developed in a laboratory setting showed up to 10% decline in accuracy when applied to free-living data. Accuracy improved when models were retrained with additional free-living data. Future studies should include free-living data when training classification models to ensure their generalisability.

2-38 Confirmation of self-reported ambulatory exercise bouts during ecological momentary assessment

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Ecological Momentary Assessment (EMA) is a method of capturing intensive longitudinal data used to describe within-person temporal, contextual, and psychosocial antecedents and correlates of repeated health behaviors. Accelerometry is advised with EMA of physical activity (PA) and exercise to supplement retrospective PA survey items and to provide a measure of total PA inclusive of the subconscious and habitual PA that are under-reported. Additionally, accelerometry would allow for the confirmation that self-reported (SR) ambulatory exercise (running/walking) occurred as reported (time frame, duration, intensity). OBJECTIVE: Determine the proportion of SR ambulatory exercise bouts that can be confirmed using visual inspection (VI) of accelerometer data. METHODS: Participants (N=29, age 24±6y) completed four mobile surveys/d for 14-d (82% response rate) denoting exercise type and duration over the preceding 4-h while wearing an ActiGraph GT3X+ (AG) on the hip (14.0±3.5h/d). AG data were downloaded and the Crouter 2-Regression Model (C2RM) was applied to determine a min-to-min coefficient of variation (CV). To confirm SR exercise bouts, survey meta-data (date, time-stamp) and SR bout durations were used to guide VI of C2RM data within the corresponding 4-h time blocks by two independent reviewers (inter-observer agreement=99.3%). SR bouts were confirmed when C2RM CV ranged between 1% and 10% continuously per 10s epoch and VI bouts were within ± 20% of the SR duration. Descriptive statistics and frequency analyses were conducted. RESULTS: 34 of 139 SR bouts were confirmed for duration (SR=27±16 min and VI=26±17 min). Of those, 29 were confirmed for intensity (14 walking and 15 running). For the 105 unconfirmed cases, no continuous bouts matching SR durations were observed. CONCLUSION: Due to the large number of unconfirmed bouts, survey items should be adjusted for improved SR exercise reporting. The feasibility of this process may be limited by large sample sizes.

2-40 Association between objectively assessed activity data and mortality risk: a 15-year follow-up using a compositional data analysis approach

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The objective of this study is to investigate the effects of reallocating time to sedentary behaviors (SB), light-intensity physical activity (LPA), and moderate-to-vigorous intensity physical activity (MVPA) on all-cause mortality, in a cohort with 15 years follow-up time, using compositional data analysis. In total 851 participants (56% women) provided objective physical activity data using an Actigraph 7164 accelerometer and were followed for 15 years. Data on all-cause mortality were obtained from Swedish registers. Cox proportional hazards models estimated hazard ratios (HR) of mortality. The effect of reallocating time between behaviors was explored based on a compositional data analysis approach. The cox regression model showed a significant ($p<0.001$) positive association between time spent in SB relative to time in LPA and MVPA, and a significant ($p=0.018$) negative association between time spent in LPA relative to time in SB and MVPA, with all-cause mortality. Substituting time spent in LPA or MVPA with time in SB increased the hazard for all-cause mortality, with greater effect found for MVPA (20 min replacement; HR 1.26) than for LIPA (20 min replacement; HR 1.06). Replacing time spent in SB, reduced the hazard of all-cause mortality to a similar extent, when substituting time in LPA (30 min replacement; HR 0.91) or MVPA (30 min replacement; HR 0.90). In conclusion, our results highlight a lack of a symmetric effect between substituting time between different movement behaviours and mortality risk. Consequently, in a public health perspective, it is recommended to replace SB with LPA or MVPA. Compared to results from isotemporal substitution methods we found smaller effect sizes for replacing time with another type of movement behaviour. The difference may be related to that isotemporal substitution methods use absolute measures and do not model the relative distribution of time spent in different movement behaviours.

2-42 Relationship between aerobic fitness indicators and intra-abdominal pressure in healthy adult women

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Objective: Exercise increases intra-abdominal pressure (IAP) acutely, which may impact the pelvic floor of women. Further, IAP responses to exercise are not routinely assessed and they demonstrate high variability among women. Understanding other measures related to IAP during exercise would aid in understanding the potential impact that acute exercise and corresponding elevated IAP may have on the pelvic floor. Therefore, the objective of this study was to investigate the relationship of heart rate and rating of perceived exertion (RPE) with IAP during a standard progressive treadmill test. We also describe the trend of IAP by predicted aerobic fitness across levels of exercise. Methods: Twenty-four women who were regular exercisers participated in the study (mean age: 24.7 (5.4) years; body mass index: 22.5 (2.2) kg/m²). Intra-abdominal pressure was measured using a validated transducer placed in the upper vagina. Heart rate by monitor and RPE were collected during the first 3 stages of the standard Bruce treadmill protocol. Relationships of heart rate and RPE with IAP were determined by Pearson correlation coefficients. Predicted aerobic fitness values for each person were ranked and displayed in tertiles with IAP by treadmill stage. Results: There was a significant relationship between heart rate and IAP ($r = 0.67$, $p < 0.001$) and RPE and IAP ($r = 0.60$, $p < 0.001$) across all 3 treadmill stages. Tertiles of predicted aerobic fitness displayed similar trends with IAP during treadmill stages as other acute measures of fitness. Conclusion: Given the strong, positive relationships of heart rate and RPE with IAP it seems that these aerobic fitness indicators could be used as proxy measures of IAP during acute exercise. Further, aerobic fitness may be a potential factor in explaining IAP variability among women and could improve the approach to future research on exercise intensity and pelvic floor health.

2-44 Actigraph GT9X wear time and steps in elementary school children: Influence of using step feedback on the device display

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Unlike previous Actigraph devices, the GT9X Link has a visual display that can show accumulated steps in real time. However, users can choose to display current time, steps and current time, or a blank screen. When using the GT9X to measure physical activity (PA) in children, providing step feedback might increase compliance with device wear but may also cause reactive changes in children's behavior and overestimation of habitual PA. Objective: To compare GT9X wear time and PA in elementary school children randomly assigned to receive a device displaying steps and time (D-ST) vs. a time-only display (D-T). Methods: Forty-three children (6-10 yrs; 51.2% female) were instructed to wear a GT9X on their waist during waking hours for 7 days. Device wear was estimated using the Choi algorithm and 23 days with <1 hour of wear were excluded from analyses. From the remaining data (n=278 days), daily wear time, steps, and moderate-vigorous intensity activity (MVPA) were calculated and Mean±SD values compared across display groups (n=20 D-ST; n=23 D-T). Statistical significance of group differences was determined adjusting for age and gender. Results: Duration of device wear was similar between groups (D-ST=11.2±2.4 vs. D-T=11.5±2.5, p=.56) as was the number of days with at least 8 hours of wear (D-ST=4.9±1.5 vs. D-T=5.6±1.6, p=.14). Daily steps (D-ST=8789±2972 vs. D-T=8866±3051, p=.59) and MVPA (D-ST=60.6±25.8 vs. D-T=60.6±24.7, p=.69) were also comparable across groups. Larger, but not statistically significant, group differences were observed on weekend days (daily steps: D-ST=5504±3868 vs. D-T=6407±3295, p=.39; MVPA: D-ST=38.8±35.6 vs. D-T=48.0±27.8, p=.31). Conclusions: Among elementary school children, step feedback on the Actigraph GT9X display does not appear to influence the duration of device wear or activity participation during wear. Future studies should examine whether similar results are observed among older children and when the GT9X is worn on the wrist.

2-46 Using Bluetooth sensing to determine co-location of workers

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Objective: Determining the context in which workers are active and sedentary offers opportunities for workplace activity interventions. Previously, wrist- and thigh-worn ActiGraph Link receivers accurately measured physical context (office /not) by detecting wall- and/or desk- mounted beacons via Bluetooth (F-scores > .95). To explore measurement of social context, we tested whether the ActiGraph Link, initialised as beacon and receiver simultaneously (BR) could detect proximity between two co-workers (in the same office/not) using a protocol depicting real-life workplace scenarios in a desk-based setting. Methods: Two participants wore four ActiGraph Link accelerometers each (one on each wrist and thigh) initialised to immediately record Bluetooth signals at 10 s intervals as BR. Ground truth was tested using event-tagging software (Dartfish application) on a hand-held device. The protocol collected data for 42 participant conditions lasting up to 120 s each (24/18 in same/different rooms; mix of participant movement and orientation). Accuracy versus the ground truth per 10 s interval (in same room Yes/No) was tested (F-score, sensitivity, specificity). Device conditions affecting detection were explored by leaving devices on the same desk varying several parameters (sampling interval, time since initialisation, and BR/receiver only). Results: Overall accuracy in determining worker co-location was low, with low sensitivity and good specificity (F-score= .33 and .11; sensitivity = .15 and .08; specificity = .97 and .98 for the thigh and wrist, respectively). Exploration of device conditions showed sensitivity varied with time since initialisation (.14 for the first h and .72 for the first 12 h the next day) and to a limited extent if any with the other factors. Conclusions: Co-location of workers was not detected accurately, likely due to device factors. Accuracy when using delayed initialisation, allowing devices to desynchronise, should be investigated.

2-48 Comparison of available ActiGraph cut points for accelerometer data acquired from children

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Objective: To compare results obtained for time spent in sedentary behaviour (SED), light physical activity (LPA), moderate-to-vigorous physical activity (MVPA) obtained from applying all cut points offered for analysis of children's accelerometer data using ActiLife software. Methods: Young children (N=102; mean 3.51.2 yrs) were asked to wear an Actigraph wGT3X-BT accelerometer on the right hip for 7 days, 24 hours/day. Wear time validation was performed to remove non-wear periods. For statistical analyses, a minimum of 3 days, 6 hours/day was required (mean wear time=1116 mins). Sleep was included in SED time for this analysis. All cut points offered by ActiLife for children were applied to the same data set after completion of wear time validation. Two of these cut points were developed for counts obtained from the vector magnitude (VM); all others were developed for counts recorded from a single axis. Paired samples T-tests were conducted to analyze differences in mean time spent in SED, LPA and MVPA for the following cut points: Freedson Children, Puyau Children, Mattocks Children, Evenson Children, Pate Preschoolers, Trost Toddlers, Pulsford Children, Butte Preschoolers, Butte Preschoolers (VM), Johansson Preschoolers, Johansson Preschoolers (VM). Results: Paired samples T-tests revealed significant differences between all sets of cut points for all intensity levels. The smallest difference was found between the Johansson and Johansson (VM) cut points (1.0 mins for MVPA), and the largest difference (144.1 min for SED) was reported when the Butte (VM) and Johansson cut points were compared. Figure 1 illustrates time spent in SED, LPA and MVPA following the application of each cut point algorithm. Conclusion: Choice of cut point used on children's accelerometer data has a significant impact on measures of time spent in SED, LPA and MVPA; consensus on their use would improve interpretation of accelerometer results and facilitate comparisons across studies.

2-50 Accelerometer-derived physical activity levels in cancer survivors: a meta-analysis

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Objective: Accelerometer-based physical activity (PA) measurement is becoming increasingly common in the cancer survivorship context. This study synthesized the published estimates of daily moderate-to-vigorous PA (MVPA), light PA and sedentary time, and factors that influence PA participation in cancer survivors. Methods: Major databases (Medline, PubMED, EMBASE, PEDro, Scopus, CINAHL and Cochrane) were searched up to October 2018 for articles on accelerometer-based PA in cancer survivors. Study characteristics and results were extracted, random effects meta-analysis and meta-regression analysis were applied. Results: 41 studies representing 5,379 cancer survivors were included (mean age 59 years, 77% female). Overall, cancer survivors engaged in 29.8 min (95%CI 24.5-34.2; k=41; n=5379) of MVPA, 4.5 hr (95CI% 4.1-4.9; k=23; n=3523) of light PA and 9.0 hr (95%CI 8.4-9.6; k=27; n=4146) of sedentary time. This equates to 2.8% (95%CI 2.3-3.4%), 30.5% (95%CI 25.3 - 35.7%) and 65.9% (95%CI 62.0 - 69.7%) of time spent in MVPA, light PA and sedentary time, respectively. Regarding daily MVPA estimates, there were significant differences between studies using Actigraph accelerometers (73%) (24.5 min, 95%CI 19.7-29.4), RT3 accelerometers (17%) (42.8 min, 95%CI 32.0 - 53.6) and SenseWear Armband accelerometers (7.3%) (61.5 min 95%CI 44.7-78.3) (p-value<0.001). There was no evidence of an effect of device brand on estimations of light PA. Older age and lung cancer diagnosis (vs. breast cancer) were associated with less MVPA in meta-regression analysis (β=-0.9, 95%CI =-1.7 to -0.06, p=0.02 and β=-19.3, 95%CI =-42.2 to -1.5, p=0.04, respectively). Conclusions: Cancer survivors spend two thirds of their day engaged in sedentary behaviour, but only a fraction of their time is spent in MVPA. Estimates of MVPA varied considerably by accelerometer-type, highlighting the need for future work which can acquire raw accelerometer data and harmonise accordingly.

2-52 Equivalency of sleep estimates from three research-grade accelerometers worn on the non-dominant and dominant wrist

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Objectives Use of proprietary algorithms to obtain sleep estimates from accelerometers limits comparability and synthesis of sleep data from different accelerometer brands across studies. These algorithms also require self-reported sleep onset and offset information. This study aimed to investigate if sleep estimates can be considered equivalent between the Axivity, GENEActiv and ActiGraph raw acceleration accelerometers whether worn on the non-dominant or dominant wrist and in presence or absence of a sleep log. Methods Accelerometer data from forty-seven young adults (age (mean±SD) 24.5±4.5 years, BMI 23.6±3.8 kg/m²) were included in analyses. Participants wore an Axivity, GENEActiv and ActiGraph on each wrist 24 hours a day for 4-7 days. Sleep estimates (sleep duration, time in bed, sleep efficiency, sleep onset and waking time) were generated using the open-source GGIR package. Agreement of sleep estimates between accelerometer brands and between wrist, with and without a sleep log was determined using pairwise 95% equivalence tests (±10% equivalence zone), intra-class correlation coefficients with 95% confidence intervals and limits of agreement. Results Sleep estimates from all three accelerometer brands at both wrists and in presence or absence of a sleep log were within the ±10% equivalency zone. Mostly good to excellent ICCs were observed for sleep efficiency, sleep onset and waking time outcomes and ICCs for sleep duration and time in bed outcomes varied from poor to good. The mean bias was generally low, however the LoA values for sleep duration and time in bed outcomes were large indicating wide individual variability. Conclusions Sleep outcomes were equivalent between the Axivity, GENEActiv and ActiGraph irrespective of the placement of the monitor or availability of a sleep log when identically processed using GGIR package. However, evidence of individual variability suggests that caution is required when interest is in individual level sleep data

2-54 Physical activity and anthropometric measures of body composition, muscle strength and muscle mass in colorectal cancer survivors up to 2 years post-treatment: a longitudinal analysis

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Introduction: Increased adiposity and impaired muscle strength are associated with a worse prognosis and quality of life after colorectal cancer. We investigated longitudinal associations of light physical activity (LPA;<3 METs) and moderate-to-vigorous physical activity (MVPA; ≥3 METs) with body composition, muscle strength and muscle mass in colorectal cancer survivors, from 6 weeks to 2 years post-treatment. Methods: 325 Dutch colorectal cancer patients were included at diagnosis and followed up at 6 weeks (n=267), 6 months (n=216), 1 year (n=170), and 2 years post-treatment (n=75). Time spent on LPA and MVPA (hours/week) was self-reported. Anthropometric measures included body mass index (BMI), waist-hip-ratio (WHR), skinfolds-based body fat percentage (%BF), maximum handgrip strength and mid-upper arm muscle area (MUAMA). Mixed-model analysis was performed to analyze overall and inter- and intra-individual associations of LPA and MVPA with the anthropometric measures over time. Results: At 6 weeks post-treatment, participants (68.3% male; mean age: 66.8y) reported a median of 7.5 hours/week LPA and 6.3 hours/week MVPA. Mean BMI was 27.6 kg/m2 and mean handgrip strength was 42.4 kg in men and 24.5 kg in women. LPA, MVPA, BMI, handgrip strength and MUAMA increased post-treatment, while WHR and %BF remained similar. In confounder-adjusted longitudinal analysis, significant small inter-individual associations were observed for more LPA and MVPA with lower BMI (beta: -0.1 kg/m2 per hour/week LPA; 95% CI: -0.1,0.0; and -0.3 per hour/week MVPA; -0.6,0.0), and for more LPA with higher grip strength (0.2 kg per hour/week; 0.1,0.3). No significant associations were found in the overall and intra-individual longitudinal analysis. Conclusion: Our results suggest that intra-individual changes in LPA and MVPA after colorectal cancer may not be associated with body composition, muscle strength and muscle mass. Further research using objective accelerometer data is needed.

2-56 Sedentary behaviour peaks at 4-5 years of age in a longitudinal, population-based study of children with cerebral palsy followed between 1.5 and 12 years

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Objective: Children with cerebral palsy (CP) have low physical activity (PA) and high sedentary behaviour (SB), though natural history is largely unknown. We aimed to determine PA and SB in ambulant children with CP at pre-adolescence, and describe change in SB from 1.5-12 years (y) according to the Gross Motor Function Classification System (GMFCS). Methods: 91 children with CP, GMFCS I-III were included with ≥1 valid free-living accelerometry measure from 2 overlapping longitudinal cohort studies. There were 157 valid records across 5 time points (1.5-2, 2.5-3, 4, 5 and 8-12y). Children wore an ActiGraph GT3X+ accelerometer for ≥3 days. At 1.5-5 and 8-12y, time in SB was determined using validated cutpoints. At 8-12y, time in moderate-vigorous PA (MVPA) was determined using GMFCS-specific, validated cutpoints. Effect of GMFCS and SES on SB and MVPA at 8-12y was examined using one-way ANOVA, two sample t-test for sex and linear regression for age and BMI. Generalised estimating equations were used for effect of time on SB. Results: At 8-12y (n=28), children spent 354 (55) min/d in SB and accumulated

44 (22) min/d MVPA with no association between SB and GMFCS (p=0.28). Children at GMFCS III averaged 14 min/d MVPA which was significantly less than children at both GMFCS I (54 min/d; p <0.001) and GMFCS II (47 min/d; p=0.01). No associations were found for age, sex, BMI and SES. Between 1.5-12y (n=91), SB increased, peaking at 4y in children at GMFCS I (mean difference [MD]=61 min/d, p=0.01) and 5y in children at GMFCS II (MD=115 min/d, p=0.003) and III (MD=110 min/d, p≤0.001), compared to 1.5-2y. Conclusions: In ambulant children with CP, SB increases over time, peaking at 4-5y. GMFCS-specific cutpoints revealed that ambulant children with CP at 8-12y may accumulate more MVPA than previously estimated, and spend almost 6 h/d in SB. Current interventions to promote PA target pre-adolescents, however the optimal intervention window could be as early as 4y.

2-60 Stepping Behavior compensation after 12 weeks of exercise training in de novo parkinson's disease: Effects of intensity

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Exercise is recommended to delay the progression of motor symptoms in Parkinson's disease (PD). However, whether exercise induces a compensatory response in non-exercise physical activity in patients with PD is not known. OBJECTIVE: To determine the effect of two different endurance exercise intensities on non-exercise stepping behavior. METHODS: Participants with de novo PD (N=128; mean SD age: 64 9) were randomized to 1 of 3 groups for 6 months: (1) moderate-intensity exercise (MOD, 60-65% HRmax), (2) vigorous-intensity exercise (VIG, 80-85% HRmax), or (3) waitlist control (CON). The exercise groups performed treadmill exercise 4 days/week for 30 minutes at the prescribed intensities. An Actigraph GT3x (AG) was worn on the right hip for 1 week at baseline and end of the 6-month intervention to assess stepping behavior both during exercise bouts and non-exercise time. Differences between groups were determined using linear mixed models with repeated measures. RESULTS: Participants wore the AG for 6.2±1.0 days (mean±SD) and average daily wear time was 795±97 min/day. There were no significant between-group differences in wear time before or after the intervention. At baseline, participants accumulated 5306±2855 daily steps/day with a wide range in daily step counts 763-15739 steps/day). While participants increased steps taken during exercise at 6 months, (MOD: 1284.0±949.9 steps, VIG: 1395.2±1172.8 steps; no significant difference between groups), total non-exercise daily steps were significantly lower at 6 months compared to baseline in both MOD and VIG (baseline: 5445.3±2802.1, 6 months: 4299.8±2230.7 steps, p<0.0001). CONCLUSIONS: Regardless of exercise intensity, a 6-month exercise training program had no effect on total daily step counts in patients with de novo PD. These data suggest that patients compensated by reducing ambulatory behavior during non-exercising periods of the day.

2-62 Accelerometer-measured physical activity during school day - different methods for the segmentation of lesson time and recess time

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Objective: In order to separate lesson time and recess time in school-based physical activity (PA) intervention studies, it is possible to use student curricula or observe the real situation during school days. The aim of this study was to test the accuracy of curriculum-based school-day segmentation for accelerometer-measured PA. Methods: Forty boys and girls from grades 5 and 6 were monitored and observed for two school days. PA was measured with a GT3X+ accelerometer (hip, 60 Hz). Sedentary time (ST), light PA (LPA) and moderate-to-vigorous PA (MVPA) were analysed using cut-points (15 s epoch) by Evenson et al. (2008). In each of the two classes, an observer recorded the actual starting and ending times of lessons, recesses, lunch time and transitions between these activities. Curriculum- and observation-based segmentations were compared regarding PA. Results: Curriculum-based segmentation resulted in 4 min overestimation (45 vs. 41 min) in actual academic lesson times. This caused significant differences in lesson-time PA at all intensity levels (ST: -5 %, p<0.001; LPA: +19%, p<0.001; MVPA + 44%, p<0.001). No difference was found in recess time PA in the comparison of methods. Conclusions: School-based interventions have been identified as a cost-effective strategy of increasing children's PA (Abu-Omar et al. 2017). As different parts of a school day vary greatly in nature and in levels of PA, there is interest in segmenting school

days accordingly (Brooke et al. 2014). If the segmentation for PA measurements is done based on curriculum, then it is likely that significant amounts of MVPA will happen during transitions before or after lessons. The results of the present study show that the method of school day segmentation particularly affects MVPA results. Therefore, these comparisons should be interpreted with care. References Brooke et al. Sports Medicine 2014. Evenson et al. Journal of Sport Sciences 2008. Abu-Omar et al. Preventive Medicine Reports 2017.

2-64 Self-assessment of outdoor walking using a sports watch

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Objectives: Gait analysis is typically based upon data obtained from cameras, electronic mats, or body worn sensors in a laboratory setting. However, data obtained from a sports watch during outdoor walking can be used to calculate gait variables. The objective of this presentation is to present a simple procedure that can be used by health professionals in a rehabilitation setting or by patients during unsupervised rehabilitation to obtain basic spatial and temporal gait variables using a mainstream sports watch with GPS and step counter. Methods: Data were collected using a Garmin Forerunner® sports watch synchronized with a Garmin Connect? mobile app. Beginning and end of the chosen test distance were activated by pressing a key while walking at a steady state. Data displayed in the mobile app included Distance (=d), Time (=t), Step length (=l), Gait speed (=d/t), and Cadence (=60d/lt). Number of steps (=d/l), Step time (=t/n), and Walk ratio (=dt/60n2) can readily be calculated from the raw data. Results: This testing procedure was introduced to a person early post-stroke. A distance of approx. 350 m embedded in a longer outdoor practice walk was chosen for testing. The person performed a series of self-administered tests during the first 100 days post-stroke wearing the same pair of shoes on all testing occasions. Results were registered after each session and used as incentive during early rehabilitation. Conclusions: This test procedure is suited for self-administered testing of impaired walking under real-life environmental conditions, returning basic spatial and temporal gait variables, as a means of assessment and an incentive in a rehabilitation setting or under unsupervised rehabilitation.

3-01 Social disengagement level is associated with time spent supine during the day in older adults

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Objective. Social engagement is related to an active life style and is protective against loneliness, depression, and cognitive decline. Here we aimed to evaluate the relationship between social disengagement and objective measures of physical activity (PA) patterns using a body-worn sensor. Methods. 62 community-living adults (age 69.5±7.3, 55% men, 55% in the early stages of Parkinson's disease, PD) were studied. Cognitive function (MOCA), The International PA Questionnaires short form (IPAQ) and the Social Disengagement Index questionnaire (SDI) were assessed. Daily living PA measures were extracted from an accelerometer taped to the lower back for 7 days. The % time spent supine and walking, total physical daily-living activity (SVM) and step counts were calculated, averaged per day. Man Whitney U tests and ANCOVA evaluated the association between SDI levels and daily-living PA patterns. Results. SDI and daily-living PA levels were similar in those with and without PD ($p>0.433$). SDI level was not correlated with age, gender, MOCA scores, IPAQ scores, step counts, % time walking or SVM, but was related ($p=0.026$) to the % time spent supine (even after adjustment to age and gender). Subjects who were more socially engaged spent 6.6% in the supine position during the day, while those who were most socially disengaged spent 14.1% of the day supine (see Fig. 1). In contrast to SDI scores, IPAQ scores were correlated with % time spent supine and most of the daily-living activity parameters. Conclusions. Social engagement is strongly related to time spent supine during the day but is not associated with step counts or total daily-living PA. This differential association may be due to structured exercise (IPAQ). Given the well-known consequences of sedentariness, future studies should evaluate the impact of interventions that target both social engagement and fitness on daily-living PA patterns.

3-03 Tri-axial thigh-worn accelerometers for 24-hour monitoring of physical behaviour in adults: A systematic scoping review

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Introduction Although movement-related physical behaviours (e.g. walking, running, cycling, sitting and standing) are key determinants of health, there are still fundamental gaps in our understanding. Thigh-worn accelerometers worn over 24-hours can accurately characterise multiple dimensions of such behaviours. The aim of this scoping review is to summarise the research to date utilising tri-axial, thigh-worn accelerometers that describe 24-hour measurements of free-living physical behaviour in adults Methods We searched Medline and Embase. Eligibility criteria included observational studies of free-living samples of at least 100 adults who wore thigh-worn tri-axial accelerometers that utilized 24-hour activity monitoring protocols. Data extraction included study characteristics, protocols for accelerometry data collection and processing, health outcomes and data sharing methods. Results Of the 7389 articles identified through the search, 40 were deemed eligible for inclusion. These 40 articles contained data from 13 different cohorts (~7246 participants) primarily from the Netherlands, UK and Denmark. The accelerometer used most often was the ActivPAL3 (6 cohorts), followed by the Actigraph GT3X (5 cohorts). Most cohorts asked participants to wear the accelerometer for 7 days. Reviewed studies processed accelerometry data using a mixture of commercial ActivePAL software and custom Matlab software. Cardiovascular and musculoskeletal outcomes were the most commonly collected health parameters. Only one cohort mentioned the availability of data-sharing. Conclusions Studies utilising 24-hour tri-axial thigh-worn accelerometery protocols have predominantly used either: ActivePAL accelerometers and manufacturer-provided ActivePal software; or Actigraph GT3X accelerometers and custom Matlab software. This scoping review provides directions for future harmonisation efforts of studies that examine associations between physical behaviours and health

3-05 Thigh accelerometry: measured walking cadence at work and leisure

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Objective Walking is the most common physical activity type in adults and thus, the physical activity with the largest public health impact. A walking cadence of >100 steps/min is considered the threshold for moderate intensity. Few studies have examined domain-specific cadence, specifically during walking, using thigh worn accelerometry. The aim of this study was to describe walking cadence at work and leisure among blue- and white-collar adults. Method This study was based on thigh-worn accelerometer data from 1062 workers (587 men and 475 women, primarily blue-collar workers) in Denmark. Time spent walking was defined using the custom-made and validated Acti4 software, and categorized into different walking cadence bands. Descriptive statistics (mean and standard deviation (SD)) were calculated for work and leisure time spent (in minutes) at six walking cadence categories from 80 to 140 steps/min (SPM) in 10 steps/min increments. Results On average, the workers spent 75 min/day (SD=39) and 47 min/day (SD=22) walking at work and leisure, respectively. At both work and leisure, most walking time was spent at 100-110 SPM (means of 25 min/day (SD=15) and 14 min/day (SD=8)). More walking time was spent at a higher cadence (i.e. ≥120 SPM) at work (mean of 32 min/day (SD=21) compared to during leisure time (mean of 20 min/day (SD=12)). Conclusion Domain is an important differentiator of walking behaviour. The workers walked more and at a higher cadence at work compared to leisure time. This finding highlights the need to differentiate between work and leisure domains when investigating walking and assessing its health effects.

3-09 Application of a shallow convolutional neural network for activity recognition from leg-instrumented wearable sensors

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Objective: Emergence of low-cost wearable systems has permitted extended data collection for unsupervised subject monitoring. Recognizing individual activities performed during these sessions gives context to recorded data and is an important first step towards automated motion analysis. Convolutional neural networks (CNNs) have been used with great success to detect patterns of pixels in images for object detection and recognition. This work proposes using a CNN to recognize activities from time-series orientation data encoded as coloured images. Methods: Twenty healthy subjects were instrumented with a previously developed wearable sensor system consisting of four inertial sensors mounted above and below each knee. Each subject performed predefined static activities: standing, sitting in a chair/cross-legged, kneeling on left/right/both knees, squatting and laying on their back. Data from each sensor were synchronized, windowed, and encoded as coloured images. Performance on previously seen subjects was evaluating by combining all subjects' data and partitioning into training and testing sets. Estimations of unseen subject performance were evaluated using ten-fold validation, leaving out a non-repeating pair of subjects each fold for testing. Results: With all data combined and only 15% used for training, an accuracy of 99.62% was obtained. Increasing the training portion to 70% did not increase accuracy. The mean accuracy over ten folds of unseen subject testing was 92.14% with 7.37% standard deviation. Conclusions: Activity recognition using accelerometer signals fails to provide sufficient data to distinguish static activities. The proposed method operating on lower limb orientations has been shown to distinguish eight static activities with exceptional accuracy, even when tested on unseen subjects. The algorithm still performed better on previously seen subjects, highlighting the benefit for a brief calibration procedure before longer unscripted sessions.

3-11 Eye movement classification with EOG and motion sensors in instrumented eyewear

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A fast algorithm has been developed, to classify eye movements and blinks, from the signals provided by eyewear-mounted sensors. The sensors (JINS Inc., Tokyo) measured electrooculography (EOG) by means of two electrodes mounted on the bridge of the user glasses, and acceleration of the head, at a constant rate of 100 Hz. An adaptive filter combining a low-pass filter, linear regression and Wiener filtering was used to remove motion artefacts from the EOG data streams. Batches of 20 seconds of data were decomposed by DB4 wavelets into 8 levels of detail. The root mean square of the signal obtained by reconstructing the 3rd-to-5th levels was used to identify and distinguish horizontal and vertical movements, and the value of the 8th level was used to classify the orientation of the movement (left vs. right, or up vs. down). The sensitivity of the algorithm to detect movements was greater than 90% in all directions, and a specificity between 70% and 90%, depending on the direction of the movement. The artefacts of head motion could be successfully removed at slow rotational velocities, compatible with normal visual tasks at rest. Quick movements without clear directional features were classified as blinks, without false detections (100% specificity) but low sensitivity (35%). This algorithm runs at high speed, with the possibility of providing real-time feedback of eye movements from normal eyewear

3-12 Obtaining the vertical displacement of the center of masses during the sit to stand test using accelerometers integrated in a Rapsberry Pi

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A fast algorithm has been developed, to obtain the vertical displacement of the center masses (CoM) during the sit to stand test (S2S), using the accelerometry signals registered by a Rapsberry Pi. The sensor (MPU-9250) is an inertial sensor with a sampling frequency of 100 Hz attached to L4-L5 of the subject. The signal from the accelerometer has depends on the inclination and the acceleration of the sensor. We assume that the inclination

of the subject depends on of the vertical position of the user along the sit and stand movement and how fast the gesture is made. Taking this restriction into account, a function has been defined that must be minimized given known position and velocity. A warping function has been defined to set to the different times required by users to exert the whole movement and the position has been defined as a function of the warping function. From this expression we obtain analytical expressions of velocity and acceleration. Therefore, once the position is obtained optimization, we avoiding the drift associated with usual methods employing double integration from the acceleration signal. The validation of this algorithm has been carried out with 5 subjects with knee prostheses and 5 subjects with hip prostheses, using the sensor with the Raspberry Pi and simultaneously with the MVN Analyze software from Xsens. The results of the validation is that there is an error less than 1 cm of the vertical displacement during this gesture with an ICC (3.1) greater than 0.8. The algorithm can provide a real-time feedback of a gesture of daily life of relevance in the clinical environment to provide information on the functional status of people.

3-13 Accelerometry frequency filtering in free-living physical activity measurement

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Introduction: Applying wider frequency filters than the most commonly used ActiGraph filter (AG) has shown to improve assessment of physical activity (PA) intensity in laboratory setting, with better capture of high intensity PA and with less variation within and between age-groups during locomotion at the same speed. This is explained biomechanically by wider filters allowing more relevant acceleration signals to pass related to the mechanical work performed. However, wider filters may be susceptible to noise generated during free-living, which occurs as accelerations of low amplitude and high frequency. This study explored the optimal low-pass frequency filter that captures most of the relevant acceleration with only minimal effect of noise. Methods: Apart from the standard AG band-pass filter (0.29-1.63 Hz), modified filters with low-pass cut-offs at 4 Hz, 10 Hz or removed was analyzed. Calibrations against energy expenditure was performed with lab-data from children and adults to generate filter-specific intensity cut-points for comparison. Free-living accelerometer data from children in the Swedish part of the IDEFICS-I.Family study and adults in the Swedish LIV-2013 study was processed using the different filters and intensity cut-points. The influence of noise was evaluated by the degree of addition of acceleration at the sedentary intensity level (SED) and misclassification of SED compared to the AG filter. Results: There was a contribution of acceleration related to PA at frequencies up to 10 Hz. The contribution with the wider filters was more pronounced at the moderate and vigorous PA levels, although additional acceleration also occurred at SED. The classification discrepancy between AG and the wider filters was small at SED (1-2 %) but very large at the highest intensities (>90 %). Conclusion: The present study suggests an optimal low-pass frequency filter with a cut-off at 10 Hz to include all acceleration relevant to PA with minimal effect of noise.

3-15 Modeling agreement for binary intensive longitudinal data: validation of the MOX® in patients with chronic organ failure

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Background: Wearable activity monitors permit to measure our physical condition in real time and in our natural environment. For example, the MOX® is an activity monitor developed as an objective alternative to questionnaires in the assessment of progresses during the revalidation process of patients with chronic organ failure. It is therefore essential to establish that the MOX® is reliable and valid. To this end, 10 patients were videotaped while their body activity (non-weight bearing or weight bearing) was continuously recorded during one hour of unconstrained activity with the MOX®, worn simultaneously on the leg and on the trunk for comparative purposes. Method: We developed a new partial-Bayesian statistical method to study real-time agreement between a device and a reference method using sequential kappa statistics defined on small time intervals. Our method can be easily implemented in standard Bayesian software (e.g. Jags). Results: The real-time agreement levels between

MOX® recordings and human observation of body activity on the videotape every second (reference method) is depicted in Figure 1 with 95% credibility intervals. We found that the agreement levels with the video assessments were lower and unsatisfactory when the MOX® was worn on the leg (red) rather than on the trunk (purple). That difference was however not observed in laboratory settings on healthy subjects. Conclusion: The MOX® should be better placed on the leg than on the trunk. Discussion: The new statistical method developed permits to study real time agreement levels and factors influencing them. This study also shows the importance of studying reliability and validity of devices in real conditions on the target population. Subjects may behave differently in real life settings as compared to laboratory settings, impacting reliability/agreement levels.

3-19 Concurrent validity and reliability of a field measure for peak whole-body power during sit-to-stand transfer in older adults

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Background: Muscle power is a key determinant for the sit-to-stand transfer (STS). Aim: Determine the validity and reliability of a field measure for peak whole-body power during the STS in older adults. Methods: Fourteen healthy adults (77.3±5.0 years of age, 12 females), who could safely stand up from a chair without arm support were included in this study. Whole-body power and knee power were measured during the five-times sit-to-stand transfer (5-STS). Participants performed the 5-STS according to the standardised protocol and were instructed to change their STS strategy to mimic frail older adults. Kinematic data were obtained using a body-fixed inertial motion sensor (MoveTest) and were validated with the gold standard (motion capture system in combination with two force plates). Results: Peak whole-body power estimated with the MoveTest and gold standard were highly correlated, with low relative errors (0.01-14.5%) and acceptable absolute errors (9.2-14.9%) over movement strategies, indicating that the MoveTest is a valid measure for peak whole-body power. In addition, no systematic differences and excellent intra-class-correlation value (0.89) indicated that the MoveTest is a reliable measure during the standardised 5-STS. Discussion: Peak whole-body power was moderately related to peak knee power and this relation weakened when STS strategy changed, suggesting that peak knee power is not a key determinant during the 5-STS. Our results need to be validated for more frail older adults. Conclusion: Since the MoveTest is small and easily applicable, it seems feasible to implement this test in the current health care system as an indicator of peak whole-body power in healthy older adults.

3-21 Robust and reliable gait recognition in neurological clinical practice

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We describe an automated approach, to easily track patients regaining their walking ability while recovering from neurological diseases (e.g. stroke). Objective measures derived from gait data permits to adjust the rehabilitation process. For use in clinical practice two key requirements have to be fulfilled: (i) the system needs to be applicable in terms of ease of use and performance; (ii) the derived measures need to be accurate. Today marker-based tracking systems (e.g., Vicon) constitute the gold standard in terms of precision (deviations of marker positions are < 1 mm). This precision comes with a penalty regarding the time needed to perform measurements and post-process the data which limits the clinical applicability. Thus we propose a marker-less tracking system (DynMetrics) permitting to perform recordings in a far shorter time interval with suitable accuracy. For evaluating (i) the usability of DynMetrics, physiotherapists were asked to use the system on patients 4 times. Usability was scored using the System Usability Scale (USC) and semi-structured interviews. The physiotherapists rated DynMetrics with an acceptable usability after the 4th use, whereas the usability of the DynMetrics system at first sight is insufficient for two out of the five physiotherapists. In order to judge the reliability of the system, a comparison of DynMetrics with Vicon (gold standard) was conducted. We calculated the tracked positions of subjects' joints by DynMetrics and those taken from Vicon. Positioning data and derived gait parameters (e.g., xCOM) returned by DynMetrics were found to be in good accordance with the reference system. Both studies showed encouraging results. With respect to reliability we found that the system can deliver gait data with sufficient precision in order to measure

the centre of mass to the base of support relation. Concerning system usability, the convenient provision of elementary as well as more advanced (xCOM) metrics were appreciated.

3-23 Validation of move-4 accelerometer for the assessment of physical behavior

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Objective: Negative effects of sedentary behavior on human somatic and mental health independent from physical activity is recently a major public health issue. Therefore, devices to assess both aspects of physical behavior with high validity are needed. The aim of the study was to investigate the validity of the move-4 accelerometer for the assessment of physical behavior. Methods: Twenty healthy university employees and students aged 25.7±4.55 yrs wore six move-4 accelerometer (attached at distinct positions: ankle, thigh, hip, chest, upper arm, wrist), one ActivPAL micro (AP; attached at the thigh) and one ActiGraph GT3X+ (AG; attached at the waist) across 26 hours. In particular, participants performed 32 conditions with a duration of 2-5 min that were structured in full-standardized (e.g., lying back), semi-standardized (e.g., natural sitting) and functional activities (e.g., vacuuming). Direct observation (DO) via video analyses (resolution: 1-second) served as the criterion measure. After the laboratory session, participants wore the accelerometers for 24 h under free-living conditions. Results: We found an overall agreement of sedentary time between move-4 classification (thigh sensor) and DO of >90%. The overall agreement between AP and DO was >90%, between AG and DO >80%. Using the Bland and Altman method, the mean difference between the move-4 and DO was -10 steps (limits of agreement -51 - 31 steps). Difference between AP and DO was -26 steps (limits of agreement -85 - 33 steps), and difference between AG and DO was -73 steps (limits of agreement -143 - 37 steps). Moreover, analysis of free-living data revealed that the AG significantly (P <.01) overestimate sedentary time. Conclusions: The move-4 is a valid accelerometer revealing high agreements in measuring sedentary behavior comparable to established devices in the field and low deviation from DO in measuring steps. Thus, we found the move-4 to be a valid tool for the

3-25 Effects on physical activity duration with a digital behavior change tool

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INTRODUCTION: Globally, 23-55% of the adults are not enough physically active 1. To focus on the least physically actives generates the most benefits, and therefore, a behavior change application, App&Move, for physically inactive adults was developed and showed promising results 2. PURPOSE: to study if App&Move is able to extend the longest periods of physical activity during 4 weeks. METHODS: 23 students/ employees (9 w/14 m) were recruited by convenience selection at a university, Sweden. Criteria: 18-64 years, physically inactive (<150 min/week), sedentary occupation, uses Android smartphone, understands Swedish and were healthy. App&Move measures PA in minutes per day. The participants self-monitored PA with App&Move (Mdh/Delphie LST AB), for 4 weeks. RESULTS: 2 participants were excluded (missing data). Results illustrated in figure 1: the longest PA period in mean min/day, each day for week 1 and week 4 (a), the longest PA period in mean min/week for each participant, week 1 and week 4 (b). Figure 1: the longest PA period in mean min/day, each day for week 1 and 4 (a), and the longest PA period in mean min/week for each participant, week 1 and week 4 (b). CONCLUSIONS: This study using App&Move, indicate that most of the participants extends the longest PA period from baseline to week 4. The longest PA period have increased during 5 of 7 days, and 13 participants have increased their longest PA period from baseline to week 4 (average 2.3 min). Supported by: ESS-H+, Mälardalen University. References 1. WHO. (2017)Global Health Observatory (GHO) data, Prevalence of insufficient physical activity, https://www.who.int/gho/ncd/risk_factors/physical_activity_text/en/ 2. Åkerberg, A., Söderlund, A., Lindén, M. (2018). The development and usability evaluation of an interactive health technology solution, for encouragement of physical activity in inactive adults based on the user perspective. J of Tech in Beh Sc, 1-13.

3-27 Objective angle measurement on cervical vertebrae based on a gyroscope

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INTRODUCTION: Nowadays, in Mexico, most of the rehabilitation interventions use non-objective measuring tools. This mainly because the quantitative devices are too expensive. For patients who undergo cervical vertebrae lesion's therapy; usually, these measurements are required to be in real-time. Therefore, there is a need to perform objective measurements. This work aimed to develop a low-cost device for automatic measurements in the cervical whiplash's therapeutic interventions. METHODS: The head's angle sensor consisted of a small electronic gyroscope (LY530ALH). The device is capable of recording the trajectory of the flexion angle, extension angle, and lateral flexion angle of the head over the cervical vertebrae. The platform "Arduino Uno" was used to acquire the gyroscope's signal, whereas "Matlab" was used to process the data and to display the angle information in real time. The sampling frequency was 50 Hz. An adjustable ad-hoc harness was designed to attach the sensor correctly (posterior region of the skull, over the lambdoid between occipital and parietal bones). RESULTS: The system was calibrated and validated with ten non-pathological volunteers, who signed the informed consent's letter. Agreement between a standard goniometer and the developed device was assessed using the correlation coefficient and the Bland and Altman method. Calibration, for flexion, extension, and lateral flexion, showed a good agreement, with a difference lower than 10%. The device got a resolution of one degree. The sensitivity and specificity of the sensor were evaluated and a ROC curve was obtained. Sensitivity for a cut-off angle equal to 30°, 40°, and 20° were 100%, 87%, and 100% respectively. CONCLUSIONS: The system showed a satisfactory resolution and, excellent sensitivity and specificity. The developed device could be a useful tool to assess the head's angle on cervical whiplash's patients who undergo therapeutic intervention. Acknowledgments: DAIP-CIIC 319/2018.

3-29 ActiGraph? GT3X+ & wGT3X-BT: Measurement Agreement and the influence on classification of physical activity

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OBJECTIVE: To assess physical activity (PA) in epidemiological studies in free-living conditions, esp. in youth, accelerometers are widely used (Jekauc et al., 2014). According to a technological development, several different devices are available (Troiano et al., 2014). Within the Motorik-Modul-Study PA is assessed with ActiGraph? GT3X+ (AGT) and wGT3X-BT (AwGT) (Woll et al., 2017). Therefore, the purpose of this study was to measure the agreement of AGT and AwGT and their influence on classification of PA. METHODS: 20 adults (6; age: 25.9 ± 3.2 yrs; height: 177.8 ± 9.6 cm; weight: 73.18 ± 11.1 kg) completed six stages of 3 min starting with 4 km/h and increasing speed by 2 km/h per stage on a treadmill (Woodway) wearing a belt with two devices per type (AGT, AwGT). Counts per second (cps) for vertical axes (VA) were measured and classified using the algorithms of Freedson (1998) to determine MVPA. Differences and their proportion to the mean as well as limits of agreement (LoA) (Bland et al., 1999) have been calculated for each stage. RESULTS: Table 1 shows the differences between both devices, which are less than 1% of the mean counts of AGT and increase with speed. MVPA classification matches for both devices. CONCLUSION: Differences between the devices are marginal and not relevant for the classification of MVPA. Therefore, both accelerometers can be used in the same study. For comparing effects between subjects differences should be greater than the here reported LoA. REFERENCES: Bland et al. (1999). SMSR, 8, 135-160. Freedson et al. (1998). JSAMS, 30(5), 777-781. Sasaki et al. (2011). JSAMS, 14(5), 411-416. Jekauc et al. (2014). B&G, 30(2), 14-18. Troiano et al. (2014). Br J Sports Med, 48, 1019-1023. Woll et al. (2017). JoHM, 2(S3), 66-73.

3-31 Cleaning, evaluating, and scoring actigraphy data: There has to be a better way

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Study objectives: Actigraphy data are commonly prepared for analysis through a manual process of cleaning, incorporating sleep times from diaries, summarizing over valid days, and aggregating across participants. We developed a SAS program to automate the process (AS; automated scoring). Our objective is to assess if the faster AS can yield results comparable to manual scoring (MS). Methods: Using 7-day actigraphy data (Actigraph GTX3) from 25 chronic kidney disease patients and 23 age-matched healthy older adults, data were cleaned manually with actigraphy software (Actilife), removing sleep hours based on a self-reported diary. Valid days were summarized excluding the first and last partial days as well as days with less than 8 hours of wear-time. Then, we scored the same measures with AS, programmed with SAS statistical software using raw, hourly data for all participants. We excluded a fixed set of sleep hours-- 12-5am and otherwise followed the same criteria used in MS. Valid hours were defined as having either kcal OR steps ≠ 0, valid days ≥ 8 valid hours, > 7 valid days were discarded. Finally, we compared MS and AS using percent agreement, intraclass correlations (ICC), and Bland-Altman plots. Results: Across all 48 subjects, both MS and AS identified 326 valid days of wear with agreement on 83% of individuals. MS produced a mean daily kcal of 396±257 compared to 401±260 based on AS, ICC=.99 ($p<.001$). Comparable results were found for daily steps, MS 5506±3355, AS 5549±3356, ICC=.99($p<.001$). Bland-Altman plots of the weekly average kcal and steps demonstrate small discrepancies for MS vs AS; 94% showed differences <1000 steps and all kcal differences were <100. Conclusion: The AS computerized method found similar results to manual scoring and can be adjusted for different populations and criteria. This method has the potential to save time, decrease human error, and ensure consistent decision making when scoring actigraphy data for analysis.

3-33 Using recurrence quantification analysis to translate lab-based studies into free-living domains in wrist-worn accelerometry

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Purpose: This work introduces a new set of features for activity classification in wrist-worn accelerometry based on Recurrence Quantification Analysis (RQA). The RQA features show high classification ability as well as the ability to generalise to unseen populations with no significant decrease in performance. This study seeks to address a major limitation in many accelerometry studies - their inability to generalise to different populations than they were trained on (specifically, transitioning from lab-based data to free-living data). Methods: Data was gathered with a thigh-mounted ActivPal and a wrist-mounted GENEActiv accelerometer, from 16 participants in a lab-based protocol (lasting 3 hours) and 47 participants in a free-living protocol (lasting 7 days). Physical activity classification models made use of features from the current state of the art (SOA) methods and features based on RQA. Their performance on the trained populations and their ability to generalise to unseen populations were evaluated against each other. Results: The performance of the RQA and the SOA features were approximately equal in the lab and free-living data (F1-scores: SOA: Lab: 0.864, SOA: Free: 0.759 against RQA: Lab: 0.890 and Free: 0.743). When investigating the different features sets ability to generalize to unseen populations (by training on data from one protocol and evaluating on another) the RQA based features outperformed the current SOA features (F1-scores: RQA: Lab-to-free: 0.691 and Free-to-lab: 0.844 against SOA: Lab-to-free: 0.625 and Free-to-Lab: 0.436). Conclusion: The RQA features allow for a greater ability to generalize to unseen data than the current SAO features, without a reduction in performance. This increased ability to generalize may help to resolve the current inability to translate lab-based studies into free-living domains.

3-35 Comparison of sensing systems and walking tasks for classification of parkinson's diseases using gait

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BACKGROUND AND OBJECTIVES: Parkinson's disease (PD) is one of the most common neurodegenerative diseases. Gait impairment in PD is typical and linked with increased fall risk and poor quality of life. A plethora PD gait biomarkers can be quantified [1, 2]. Performance comparability of machine learning (ML) studies has been challenging because based on different gait analysis systems, walking tasks and cohorts. The objective of this study was to compare the performance of a ML model on data collected with two different sensing systems and walking tasks. METHODS: Gait assessment was performed on 93 people with PD (age:69±10years, on average 18 months from diagnosis) and 103 healthy controls (age:72±7years) recruited from the ICICLE-GAIT study. Participants walked at their normal pace: (i) for 2-minute on a 25m oval circuit (continuous task (CT)), (ii) 4 times along a 10m walkway (intermittent task (IT)), Fig 1. 14 gait characteristics were evaluated using an instrumented mat (GAITRite) placed in the circuit [3] and from a single accelerometer (Axivity, AX3) attached on the lower back [1]. Support vector machine (SVM-RBF) is trained and performance was evaluated using Area Under the Curve (AUC) with 10-fold cross validation. RESULTS: For the CT, the model based on AX3 (AUC:82.04±10.33%) significantly outperformed GAITRite (AUC:73.58±10.03%, p<.001). Similar results were achieved for the IT: AX3 AUC (74.28±10.77%), GAITRite (70.16 ± 11.47%, p=.011). CONCLUSIONS: We showed the impact of different gait systems and different walking protocols on SVM performance. Overall SVM-based PD classification with AX3 is better than GAITRite in both walking tasks with optimal performance achieved during a 2-minute CT. These findings suggest that the choice of sensing system and walking task is important to achieve maximum classification accuracy and may have direct impact on ML models. REFERENCES: [1]Del Din et al JBHI 2016 [2]Caramia et al JBHI 2018 [3]Lord et al JOG-Series A 2013

3-37 Validity evidences of ecological momentary assessment to measure participating in physical activity and sedentary behavior

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This study was to examine the validity of physical activity (PA) and sedentary behavior (SB) levels measured by ecological momentary assessment (EMA) based on a real-time self-report by mobile phones. Ninety-eight middle-aged participants completed Global Physical Activity Questionnaire (GPAQ) and physical activity log as well as wearing an accelerometer for 4 days. In the meantime, EMA was conducted through the mobile phone, and eight EMA surveys were prompted each day asking about current activity type, the intensity, and the place to do (home, indoor except for home, and outdoor). Those collected data were classified into sedentary behavior, leisure, housework, transportation, and other activities. Pearson correlation coefficients were calculated for determining convergent validity evidence among the measures with EMA. The linear associations of EMA and GPAQ with accelerometer estimates were statistically significant ($p<0.05$) for SB (EMA: r=-0.3176), leisure (EMA: r=0.2796; GPAQ: r=0.2488), transportation (EMA: r=0.2030; GPAQ: r=0.2097), and moderate-to-vigorous PA (EMA: r=0.2460; GPAQ: r=0.2479). Consequently, the mobile EMA showed similar correlation of moderate-to-vigorous PA and higher correlation with SB to accelerometer estimates than GPAQ. A further study is need to scrutinize the validity evidence of the mobile EMA to measure PA and SB in free-living settings.

3-39 Single vs multiple-answer questions to assess travel school mode among children: how much information is being lost?

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Background: Active school travel (AST) is often measured using self-report methods through questionnaires administered in schools. Diverse questions including single- or multiple-answer have been developed to assess

AST, but considerations must be taken before choosing a question when you are providing a list of responses. The aim of this study was to compare single- vs multiple-answer questions asking about children travel modes to and from school. Methods: In this study, children were asked to answer a questionnaire that included 2 questions of AST separated from each other. Question 1 was a single-answer question (Q1) asked "During the last week at school, the main part of your journey to school was by:" Five categories: a) walking b) cycling c) by bus, microbus, d) by car e) other, in which children had to choose only one category. In Question 2 (multiple-answer question; Q2) children reported more than one category if they combined modes "During the last week at school, this journey was by:" and five categories: a) walking b) cycling c) by bus d) by car e) by school van. Descriptive statistics, pairwise correlation and kappa coefficient were used to compare Q1 and Q2. Results: In total 546 (12.89 (0.76) years) children completed the questionnaires. Overall, the level of agreement between Q1 and Q2 unimodal was high (82.3% κ=0.585) and the pairwise correlation coefficient was r=0.723. However, when the multimodal component of Q2 was considered, it was able to identify those children who walked and at the same time they combined travel modes (71.13%). Children who travelled by school van reported in only 25% of cases they used other travel mode. Most of children (90%) who travelled by bicycle, also combined modes. Those children who reported travel by car, 30.6% also reported other modes and all children (100%) who reported travel by bus also combined modes. Conclusion: Although the correlation of the two questions is high, some information is missing when using

3-41 Direct observation of attentiveness and fidgeting while using a stand-biased desk in elementary school children

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Standing desks have recently become an option to decrease children's sedentary behavior (SB) while in school. However, it is not clear whether use of a standing desk will alter fidgeting attention in the classroom. PURPOSE: To determine whether stand-biased desks, compared with sitting desks, will alter attention and fidgeting behavior in grade 3, 4, and 6 elementary school children throughout the academic year. METHODS: This study employed a within-classroom crossover design, with teacher-determined allocation for seating. At baseline all students were in a sitting desk, then 50% of the students were assigned to a stand-biased desk. Cross over occurred after nine weeks. Direct observation (DO) documented posture, activity, attention, and fidgeting behaviors. DO was completed for 5-seconds every 30-seconds for a 5-minute observation window (total 50-seconds observation), and was repeated three times at baseline (September and post assessment I and II (December and April). Chi-square test of association and Fisher's exact test were used to determine the difference in the percentage of time spent sitting, attending and fidgeting when students were using the sitting versus standing desk. Significance was set at α=.05. RESULTS: Data were collected on 21 3rd, 36 4th, and 38 6th graders (41% female). At baseline, there were significant differences in fidgeting behavior across the three grades (p=0.007), and girls were more attentive than boys (p=0.018). As a result of the intervention, standing desks resulted in less sitting at post I and II (p<.0.05), however desk type did not alter attentiveness or level of fidgeting at either time point. CONCLUSIONS: Standing desks did not have a negative influence on student attentiveness or the amount of fidgeting performed in the classroom while still reducing sitting time. Standing desks can positively contribute to the sedentary behavior profile of elementary school children without negatively influencing classroom behavior.

3-43 Examining the relationship between objectively measured human and dog activity

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BACKGROUND: Despite claims suggesting that dog ownership is associated with human moderate-to-vigorous physical activity (MVPA) the relationship has been understudied. OBJECTIVE: This investigation examined the relationships among self-reported time spent dog walking, objectively measured human MVPA and objectively measured dog activity. METHODS: Thirty-three dog owners (90.1% female, mean±sd age: 45.1±15.3 years, BMI: 27.2±5.3 kg·m-2) wore an ActiGraph GT3X+ (AG) on their right hip and logged all PA, including dog walking, for 7 days. Participant dogs (age: 5.8□3.7, 11 small-sized, 12 medium-sized, 10 large-sized) wore a Fitbark activity tracker

(FB) which measures total activity in "points". AG data were processed using Freedson cutpoints to estimate MVPA mins/week. Simple linear models were fit to assess the relationships among time spent dog walking, MVPA mins/week and FB points/week. RESULTS: Dog walking accounted for 270±171.6 mins/week (4.2% of total time) and participants achieved 408±221.8 MVPA mins/week (6.4% of total time). Dog walking was significantly associated with MVPA mins/week (p = 0.005). On average, an increase of 3.06 minutes of MVPA min/week was observed for every 5-minutes of dog walking/week. MVPA mins/week was also highly correlated with FB points (r = 0.61). Of the dog's total FB points/week (44,281.4±19,919 points), 35.2±18.3% were accumulated during dog walking bouts. CONCLUSIONS: There is a relationship between human and dog activity, which could be leveraged to increase human MVPA. Future interventions targeting increases in MVPA should consider the role of the human-animal bond on changing physical behavior.

3-45 What about a bout? Daily stepping behavior of healthy middle to older aged adults

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Average daily step count is frequently used as a measure of habitual activity level. For example, a weekly average of 10,000 (10k) steps/day is often used as a benchmark to classify individuals as sufficiently active or not. Given the law of averages, it is likely even individuals who accumulate ≥10k steps/day, contain days within their weekly profile that do not reach 10k steps. However, the within subject variability of daily step counts is not well understood, nor is how (e.g., bouted vs. non-bouted) steps are accumulated on high vs. low stepping days. The purpose of this study was to characterize the stepping behavior of healthy adults by 1) evaluating the within subject variability of daily step counts and 2) summarizing bouted vs. non-bouted stepping behavior on days with high (≥10k) vs low (<10k) steps. Methods This study made use of accelerometry data collected in NCI's iData Study. Healthy middle- to older-aged men and women wore the activPAL activity monitor for 7 days. Results Across all participants (669, age=64(6)), 150 were classified as sufficiently active (weekly stepping ≥10k steps/day), while 519 were insufficiently active (<10k steps/day). In sufficiently active individuals, mean (SD) number of low stepping days was 2.4 (1.9) compared with 5.6 (1.8) for insufficiently active. Bout duration categories, by daily stepping volume, were not significantly different for sufficiently and insufficiently active (Figure). Conclusion Sufficiently and insufficiently active individuals did not achieve the 10k -step benchmark on 36 and 84% of monitored days, respectively. Regardless of weekly profile classification, little time was spent in bouts ≥5m on low stepping days (<10k steps). This study suggests that the daily bouted stepping profile on high vs. low stepping days is similar for sufficiently and insufficiently active individuals and that the frequency of expression of high vs. low stepping days largely influences habitual activity classification.

3-47 Prolonged sedentary pattern variables derived via activPAL versus ActiGraph cut points in children

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Objective. To compare the thigh-worn activPAL (AP) and hip-worn ActiGraph processed using the common 100 cpm cut point (AG) for assessing patterns of prolonged sedentary time in children. Methods. AP and AG were worn concurrently by 195 8-12 year olds for ≥8 hours/day on 4.6±1.9 days/participant. Time spent in sedentary bouts lasting ≥30 minutes, break rate, usual bout duration, and alpha were assessed. Mean difference (bias), Mean Absolute Deviation (MAD), and Intraclass Correlation Coefficients (ICCs) were used to investigate agreement between devices. Biases and MADs ≥20% and ICCs ≤0.40 were considered poor. Standardized associations of each sedentary pattern variable with waist circumference and obesity (vs. normal weight; based on BMI %ile) were compared between devices, adjusted for wear time and demographics. Results. All agreement values were poor: biases were |43.6%|-|71.9%|, MADs were 47.5%-75.6%, and ICCs were .013-.282. For both AP and AG, none of the 4 pattern variables was significantly associated with waist circumference or obesity. However, the magnitude and/or direction of associations differed between devices for break rate, usual bout duration, and alpha. For

example, the odds of being obese (vs. normal weight) for every additional break/sedentary hour decreased by 13% when using AP, but increased by 10% when using AG. Conclusions. Although sedentary pattern variables are often derived in children using AG, they do not have good agreement with the same variables derived from AP. AG generally overestimates breaks and underestimates bout duration. In addition, both the magnitude and direction of associations with adiposity can differ based on the device used. These differences between devices may account for some of the inconsistency in findings regarding associations between sedentary patterns and adiposity in youth and should be considered when interpreting findings from sedentary pattern studies.

3-49 Children's physical activity in parks: use of accelerometer to assess park use in low-income and racial/ethnic diverse communities in New York City

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Objectives: This study aims to describe the use of devices to assess children's physical activity and locations within parks. Methods: Target population was children (5-10 years old) in six parks in New York City, USA (NYC). Parks were selected according to the population density by race/ethnicity (Latino and Asian) and the surrounding census block groups having a median household income at 80% of the county's median. Each park must feature at least one playground and sports field/court. Children wore accelerometer (Actigraph GT3x+) while in the park (1s epochs) a minimum of 15 minutes in Spring and Summer 2017. Parents/guardians of each child were surveyed about park use characteristics and demographics. Surveys were offered in English, Spanish or Simplified Chinese, and a translator was present. Data collection occurred one day, per park, per season. Results: A final sample of 228 participants, average of 28 per park (min=24; max=32), completed surveys in English language (53%), Spanish (24%), and Chinese (23%). Mean age for children was 7 years old (SD=1.7), mostly male (52%) and Latino (43%). Total wear time during park visit was a mean of 27 minutes (min=3.5min; max=62min). Proportion of total activity was mostly moderate (61%) and light (33%) with no significant differences per age, gender, race/ethnicity, day of the week or when stratified by park type ($p>0.05$). Conclusions: Use of devices for assessment of free-living settings such as parks was well received by the community. The need for a translator is evident as almost half of participants chose a non-English language. Overall physical activity levels show children are moderately active during park visits.

3-51 Comparison of StepWatch and ActiGraph wGT3X+ step counts under treadmill walking, outdoor level walking, and daily living conditions in patients with symptomatic peripheral artery disease

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Objective. The aim of this study was to compare step counts recorded by two research grade devices (the StepWatch pedometer [SW] and the ActiGraph wGT3X+ accelerometer [AG]) in patients with symptomatic peripheral artery disease (PAD) under three different walking conditions. Methods. Twenty-four PAD patients completed a maximal treadmill walking test (TW) at 3.2 km/h (+2%-grade/2min), a 40-to-60 min outdoor level walking (OW) session (including symptom-limited walks and free recovery durations), and a 7-day free-living measurement (DL) while wearing both the SW (ankle) and the AG (hip). Step counts were recorded using 10-s epochs for the SW and a 30-Hz sampling rate for the AG. SW step counts were obtained by doubling the recorded strides. AG step counts were processed using both the Normal Filter (AG-NF) and the Lower Frequency Extension filter (AG-LFE). For the DL condition, individual daily step count averages were obtained using valid days (i.e., with AG-LFE wear time ≥600 min); only patients who had ≥4 valid days were used for further analysis. For each walking condition, rho coefficients, mean percent errors (MPE), mean absolute percent errors (MAPE), and Bland and Altman plots were used for the following comparisons: AG-NF vs. SW; AG-LFE vs. SW; AG-NF vs. AG-LFE. Results. Correlations were very high (rho ≥0.90) regardless the condition tested. However, when considering MPE [95% CI], AG-NF underestimated SW step counts during TW (-24.5% [-31.8; -16.0]), OW (-5.5% [-7.2; -3.7]) and DL (-44.0% [-47.8; -40.3]). AG-LFE was not different from SW for TW and OW with a MAPE <2% but overestimated SW step counts during DL with a MPE [95% CI] of 25.5% [17.2; 33.1]. Results for AG-NF vs. SW were similar to those for AG-

NF vs. AG-LFE. Conclusion. SW and AG-LFE, not AG-NF, provide comparable step counts during TW and OW conditions in PAD patients. However, AG-LFE provides higher step counts than SW during DL assessment (Funding: CORECT 2013).

3-55 Prediction of total energy expenditure and physical activity level using a triaxial accelerometer with a classification algorithm of ambulatory and non-ambulatory activities

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Objective: Accurate prediction methods of total energy expenditure (TEE) and physical activity level (PAL) in elderly have not been established. Therefore, a triaxial accelerometer with a classification algorithm of ambulatory and non-ambulatory activities was validated against the doubly labeled water method in Japanese elderly under free-living conditions. Methods: Independent elderly aged 65 to 85 years were recruited from a cohort study in Tokyo and complete data were obtained from 67 participants. TEE was evaluated by doubly labeled water method and basal metabolic rate (BMR) was determined by Douglas bag method. During the study period, they wore a triaxial accelerometer (Omron Healthcare, Active style Pro HJA-350IT), which can discriminate ambulatory and non-ambulatory activities with a gravity-removal physical activity classification algorithm (Oshima, 2010) and can accurately predict intensity of various types of physical activity (Ohkawara, 2011) and TEE (Murakami, 2016) in adults under 60 years old. BMR was predicted using an equation for Japanese adults (Ganpule. 2007). The accelerometer predicts TEE from the predicted BMR and PAL based on estimated metabolic equivalent values. Results: Average PAL was 1.82±0.21. There was no significant difference in PAL between gender. BMR was slightly overestimated in men and underestimated in women by the predictive equation. On the other hand, PAL was substantially underestimated, especially in women, although predicted and measured PAL was moderately correlated. As a result, TEE was significantly underestimated by the accelerometer in both genders, mainly due to the underestimation of PAL. Conclusions: The accelerometer, which can accurately predict TEE in adults under 60 years old, underestimates TEE and PAL for elderly. This is in line with our previous results (Park, 2017 and unpublished data), which indicate that the accelerometer underestimates physical activity intensity for elderly.

3-57 Physical behaviours and chronotype in people with type 2 diabetes

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Aim: To describe the physical activity and sleep profile of people with type 2 diabetes (T2DM) and examine whether this differs by chronotype preference. Methods: Adults with T2DM, recruited from the Midlands, UK, wore a GENEActiv accelerometer on their wrist for 7 days. GENEActiv .bin files were analysed with R-package GGIR. Chronotype preference was assessed with the morningness-eveningness questionnaire. Multiple linear regression analyses assessed whether chronotype preference was associated with physical behaviours, independently of potential co-variates (age, sex, ethnicity, diabetes duration, sleep duration). Results: 354 adults were included (40% female, mean age 64.1 ± 9.0 y, mean BMI 31.5 ± 5.3 kg·m-2). Mean daily overall acceleration was 22.0 ± 7.2 mg, mean acceleration during the most active 1h of the day was 55.4 ± 30.4 mg, mean MVPA was 23.0 ± 26.2 mins/day, 6.3 ± 1.1 h/day were spent asleep and sleep efficiency was 85.4 ± 7.9%. 25% of the cohort were definitely morning chronotype and 25% definitely evening chronotype. Evening chronotypes had lower mean daily acceleration (-3.41mg, 95% CI -5.58 to -1.25), lower mean acceleration during their most active 1h of the day (-12.76mg, -23.65 to -1.89), lower MVPA (-10.37mins/day, -19.05 to -1.69) and higher sedentary time (45.23 mins/day, 21.80 to 68.66) compared to morning chronotypes as well as less time sleeping (-27.81mins/day, -46.68 to -8.94) and a lower sleep efficiency score (-2.60%, -4.78 to -0.42). Conclusions: This cohort showed low levels of physical activity and sleep duration (excluding waking periods) was less than the recommended 7-9h for adults. Those with a preference for eveningness (i.e., go to bed late and get up late) were less active and slept less than those with a preference for morningness (i.e., go to bed early and wake up early). This population, in particular those with an evening chronotype, would benefit from an intervention designed to improve these physical behaviours.

3-59 Association between physical activity and fitness in 5 to 11 years school children

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Background Nowadays, obesity in childhood is growing up and physical inactivity is considered as an important cardiometabolic risk factor. The aim is to analyse the relation between physical activity (light, moderate and vigorous) and fitness parameters (cardiorespiratory fitness [CRF], speed-agility and strength) in school children from 5 to 11 years. Methods A cross-sectional analysis from two cohorts, MOVI-daFit (9-11 years children) and MOVI-da10 (5-6 years children), was performed. Both cohorts were studied in five schools located in Cuenca, Spain. The variables considered for this analysis were: 1) CRF as VO2max calculated from Course Navette using Leger formula; 2) speed-agility as time needed to perform 4x10 meter test; 3) lower limbs strength, using jump test divided by weight (kg); 4) physical activity measured with wrist accelerometer (GENEActiv Original). Partial correlation analyses between physical activity and fitness parameters were performed separately by sex and adjusted by age using SPSS v24. As note, negative correlation coefficient in speed-agility means better results. Results Our results showed that both girls' and boys' CRF (r= 0.315 and r= 0.262), speed-agility (r= -0.254 and r= -0.167) and strength (r= 0.239 and r= 0.113) increase with vigorous physical activity, being higher in girls than in boys. Furthermore, girls' and boys' CRF (r= -0.188 and r= -0.164), speed-agility (r= 0.087 and r= 0.243) and strength (r= -0.245 and r= -0.040) decrease with light physical activity. Conclusions In conclusion, more time of moderate-vigorous exercise instead of only moderate physical, suppose an improvement both CRF, strength and speed-agility. These results are important for design future physical exercise programs, showing that higher levels of physical activity are strongly associated with fitness parameters, being both, physical activity and fitness, associated with less cardiometabolic risk.

3-61 The physiological demands of cycling on an electrically supported tricycle

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Background: Adults are recommended to engage in moderate-intensity activity (3-6 MET/min) for 150 minutes per week to improve cardiovascular fitness (Haskell, et al., 2007). Research showed that riding an electrically assisted bicycle (e-bike) leads to at least 3 MET/min, even with high support settings, and can thus result in health benefits (Louis, Brisswalter, Morio, Barla, & Temprado, 2012). For people with disabilities, impaired balance or low cycling-confidence electrically assisted tricycles (e-trikes) can provide opportunity to engage in active transport (Hickman, 2015). Knowledge about the physiological demand of e-trike cycling at varying support levels could aid users of e-trikes in managing the pedal support settings and cycling speed leading to health benefits is not yet available. Objective: The goal of this research is analysing the physiological demand during e-trike cycling at three different support levels and two speeds (12 km/h and 18 km/h). We measure physiological demand with oxygen consumption (VO2) and heart rate (HR). Secondarily, we relate VO2 and HR to pedal force, cadence, and power output of the engine. We expect a difference in physiological demand between support levels, with a larger difference at higher speed. Methods: Twenty healthy subjects cycle on an e-trike with low, medium and high support at 12 and 18 km/h and without support at 12 km/h for at least three minutes per condition to achieve steady state VO2 and HR. We record VO2 using a Cosmed gas analyser and HR with a Polar heart rate belt. The e-trike records pedal force (N), cadence (rpm), and engine power output (W). Results and conclusion: Preliminary results are expected in April and final results will be presented at the conference. Results will give insight in the difference in physiological demand between e-trike and e-bike cycling and can assist e-trike users in reaching the recommended 150 minutes of moderate-intensity activity per week.

3-63 Differences in total activity and activity intensity proportions across levels of physical functionality

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Wearable activity monitors to assess physical activity (PA) have become common as of late. However, some individuals present with movement limitations, so it is not clear how common PA assessment approaches work across levels of functionality. PURPOSE: To determine differences in PA accelerometer outcome metrics across levels of functionality. METHODS: Participants (N=90; male=37) completed a nine activity modified physical performance test (MPPT) to determine participant functionality as Group 1) no functional limitations (MPPT>31; n=42; mean age=48.1 yrs), Group 2) some functional limitations (MPPT 25-31; n=32; mean age=60.8 yrs), and Group 3) functionally limited (MPPT<25; n=16; mean age=63.2 yrs). Following the MPPT, participants wore a hip-mounted accelerometer for 24-hrs excluding sleep. Accelerometer data were summarized over 60-seconds and average counts per minute (CPM) were calculated. Activity intensity proportion estimations were calculated by dividing minutes in each activity intensity derived from the Freedson formula by total wear time. Differences in CPM and activity intensity proportions (sedentary, light, moderate, vigorous) were calculated via a one-way ANOVA with pairwise comparisons and Bonferonni adjustments. RESULTS: Mean±SD CPM across groups were: Group 1) 340.4±199.3, Group 2) 262.5±161.4, Group 3) 139.9±64.5. Group 3 had significantly less CPM than Group 1 ($p<0.001$). Group 1 spent a significantly greater proportion of time in moderate PA (0.036±0.031) compared with Group 3 (0.006±0.007, $p=0.001$). Group 3 spent a significantly larger proportion of time in sedentary behaviors (SB, 0.734±0.078) than Group 1 (0.659±0.088, $p=0.006$) and Group 2 (0.660±0.077, $p=0.007$). CONCLUSION: As functionality decreases, total movement decreases and SB increases. However, it is unclear whether this is a consequence of algorithm precision across heterogeneous populations, or a finding of those with limitations present with a different PA metric profile.

4-02 Cross-sectional associations between sleep duration, sedentary time, physical activity, and obesity among Czech school-aged children using compositional analyses: Preliminary results.

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Background A holistic approach is required to assess the health effects of sleep, sedentary behaviour (SB) and physical activity (PA). Objective The objective of this study was to examine differences in sleep duration, SB, moderate-to-vigorous PA, and obesity between: (1) boys and girls, (2) non-obese and obese children, and children from different grades of schools - elementary first stage (EFS), elementary second stage (ESS) and secondary schools (SS). Methods The participants were 9-19-year-old girls and boys (n=575; 56% girls), whose sleep duration, SB and PA were measured during the school year over 7 days, by 24 hours. ActiGraph GT9X+ (ActiGraph LLC, FL) were worn on non-dominant wrist. The R package GGIR was used to calibrate accelerometer data, compute the metric ENMO, and estimate the number of minutes in MVPA. BMI z-scores were computed using age- and sex-specific WHO reference data. Differences between sleep, PA and obesity were analyzed by ANOVA using SPSS 23.0 (Inc, Chicago IL). Results Boys spent significantly more time in MVPA (76.0 min/day) than girls (69.5 min/day) and there were there were no significant differences in sleep and total PA. Similarly, there were no differences in all behaviours between obese and non-obese children. Children from EFS accumulated significantly more sleep time (6.6 hrs/day) than children from ESS (6.3 hrs/day) and those from SS (5.9 hrs/day). Similarly, the children from EFS accumulated more total PA (ENMO) (44.5±10.6 mg/day) than children from ESS (35.9±10.8 mg/day) and those from SS (31.6±8.6 mg/day), and children from EFS spent significantly more time in MVPA (81.8±28.6 min/day) than children from ESS (73.8±32.6 min/day) and those from SS (67.9±28.8 min/day). Conclusions Preliminary findings suggest that total PA and MVPA are declining over school grades. There were no differences in movement/non-movement behaviour between non-obese and obese children.

4-04 Semi-automatic processing of manual entries in the online 24-hour time use survey of the German National Cohort

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Objective: As physical activity plays a major role in the prevention of chronic diseases, valid measurement of activity levels and patterns is crucial. Time use instruments inquire about all previous-day activities and yield information on duration, intensity, and context of habitual activity and sedentary behavior. Methods: The German National Cohort is a population-based prospective study of 200,000 men and women aged 20-69 years initiated in 2014. The study collects time use data using the cpar24 (computer-based 24-hour physical activity recall). Participants can choose from 262 activities that are linked to the corresponding MET (metabolic equivalent of task) value from the Compendium by Ainsworth et al. This facilitates estimation of time spent sedentary, in light, moderate or vigorous activities and corresponding energy expenditure. Further, participants have the option to manually add individual activities in a free-text field. To obtain MET-values for these entries, string matching methods were applied, which compare character vectors in an automated fashion. Agreement between manual entries and assigned activities was assessed in consideration of context and intensity. Results: In preliminary data, 189 participants (0.17%) used the option to manually add an activity and of these, 60% were older than age 50 years. In total, 46.4% of manual entries could be automatically assigned a matching activity from the Compendium. Additionally, our algorithm mapped 22.0% free-text entries to various proposed activities. Conclusion: In large-scale assessments of physical activity, string matching represents a useful tool to reduce the workload associated with assigning appropriate activities and MET values to text information provided online by study participants. String matching may also help minimize potential selection bias because participants using the free-text field were mostly over age 50 years.

4-08 Estimation of metabolic equivalent values of daily activities using heart rate monitor and anthropometry measures

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Objective: To estimate metabolic equivalent (MET) of daily activities, including low intensity activities, from heart rate (HR) and subject characteristics without calibration for each individual. Methods: Forty-two volunteers aged from 21 to 55 years performed 20 kinds of daily activities from low to vigorous intensity activities. The HR was measured with a HR monitor and energy expenditure was determined by the Douglas bag method. The resting HR was measured in the supine condition. The resting HR and HR during each activity were converted from the recorded RR-interval and the average values during the measurement were obtained. The multiple regression analysis was performed to develop an estimation model of METs with 8 potential predictors such as % heart rate reserve (%HRR) and sex. The contributing parameters were selected by best-subset techniques considering collinearity. Leave-one-out method was used to validate the estimation model. Wilcoxon signed-rank test was conducted to compare the estimated and measured METs. Results: %HRR, resting HR, BMI, and sex were selected to develop the model to estimate METs. %HRR showed the highest contribution in the model. Resting HR also largely contributed to the prediction. The coefficient of determination of the model (R2) was very high. The average %difference of METs in low activities was around 7% and around 3 % in total activities. When compared between measured and estimated METs in all activities, there was no significant difference between measured and estimated METs in all activities, meaning the model obtained good estimation results. While the largest difference was observed for document arrangement while sitting. Ascending stairs and descending stairs also showed relatively large differences. Conclusion: The results showed heart rate combined other variables can be used for estimating METs value of daily activities including low intensity activities.

4-10 Travel choices: identifying periods of seated car travel using an accelerometer

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Objective Car travel can be an important contributor to daily sedentary time. The dynamic accelerations caused by the motion of the car and interaction with the road surface are present in the raw acceleration signal. The aim of this study was to identify and test key features of this signal to develop a robust algorithm to identify periods of seated car travel. Methods Participants (n = 26, mean age = 30.5 years) wore an activPAL for 7 days and were directly observed in a free-living setting for two hours on two occasions. Using a thigh-worn accelerometer to discriminate between upright and sedentary prevented misclassification of upright light activities. Raw accelerometer data were summarised into 15 second containers and aligned with direct observations. Acceleration magnitude (AM) was calculated using the sum of the absolute difference between acceleration samples across each container. Results In all instances of car travel the mean of the containers' AM was higher than a given threshold. However, 11 bouts of sitting were incorrectly identified as car travel. Three were removed by using the median containers' AM instead, reducing the effect of small periods of high dynamic activity. On further examination, two secondary features were identified which reduced the number of false positives to two. The lower decile AM excludes bouts with large periods of low dynamic acceleration absent in car travel, while maximum AM excludes bouts with periods of dynamic acceleration greater than that seen in car travel. Conclusions Three key features of the acceleration signal were found to identify seated travel (5% of observed sedentary time) and minimise false positives in free living subjects: the median, lower decile and maximum 15s AM per sedentary bout. We also identified sedentary activities, such as furniture assembly, whose dynamic acceleration met the same criteria. These confounding activities contributed to 0.4% of observed sedentary time.

4-14 Validity of harmonised self-reported physical behaviours in UK Biobank: a doubly labelled water study

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UK Biobank includes multiple instruments reporting various self-reported behaviours which can be used collectively to provide an estimate of physical activity (PA) volume. Our objective was to derive PA volume by calibrating self-report data to wrist accelerometry and examine validity against PAEE assessed using the gold standard doubly labelled water (DLW) method. Our validation study included 53 participants with complete self-report data and DLW-assessed PAEE. PA volume expressed as average daily wrist acceleration (milli-g) was derived using a mutually-adjusted prediction equation from the self-reported behavioural variables in the accelerometry subsample (n=91653) of the UK Biobank cohort. We further converted PA volume from milli-g to PAEE using a previously published equation derived in 1050 UK adults. We examined the validity of self-predicted vs DLW-assessed PAEE using Pearson correlation, mean bias, root mean square error (RMSE) and 95% limits of agreement. The self-reported behaviours explained approximately 4% variance of daily average acceleration in both women (n=54914) and men (n=42874) in the UK Biobank subsample. Following conversion from milli-g, mean(SD) predicted PAEE was 41.4(3.9) kJ/day/kg with range 33.1 to 51.0 kJ/day/kg. Mean(SD) of the criterion DLW-assessed PAEE was 51.8(17.4) kJ/day/kg with range 8.6 to 90.8 kJ/day/kg. Comparing predicted PAEE with DLW-assessed PAEE, mean bias was -10.5 kJ/day/kg (95%CI: -14.8, -6.1), RMSE was 18.8 kJ/day/kg (36% of the mean DLW-assessed estimate), and 95% limits of agreement were -42.0 to 21.1 kJ/day/kg. Predicted PAEE and DLW-assessed PAEE were moderately correlated (r=0.51; p=.0001). Harmonisation of multiple self-reported behavioural variables using wrist accelerometry produces a single estimate of PA volume with good relative validity vs PAEE from gold-standard assessment; however absolute validity is weak. The prediction equation can be used to rank PA volume in the full UK Biobank cohort.

4-16 Quantity and quality of ambulatory activity in people with parkinson's disease and healthy controls

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Background and Aim: Gait assessment in the clinic may not reflect actual mobility during daily life. In this study, we investigated quantity and quality of ambulatory activity (AA) in people with Parkinson's Disease (PD) and Healthy Control subjects (HC) over a week of continuous monitoring in daily life. The aims of the study are twofold: 1. To determine if quantity of AA is different between people with PD and HC, and 2. To determine which gait metrics are different between PD and HC. Methods: We recruited 28 people with mild-moderate idiopathic PD (67±5), and 30 age-matched HC subjects (63±9) to date. Subjects wore three inertial sensors (Opals, APDM) attached to both feet and the lumbar region for a week of continuous monitoring. From the data, we derived about 40 gait metrics and 10 turn metrics. Mann-Whitney U test was performed to detect significant differences between the two groups with significance of α=0.01. Results: Preliminary analyses of continuous monitoring of AA for a week showed that quantity of AA (such as bouts per hour, percentage active during data collection, and strides per hour) was not statistically significant between people with PD and HC. However, several gait metrics related to quality of AA were statistically significant. Specifically, gait speed and turn angle was slower in PD than HC with p=0.00026, and p=1e-7, respectively. Further, pitch at initial contact was lower in PD compared to HC (p=0.00007). Variability in various metrics was also larger in people with PD than HC. Specifically, variability in percentage of single limb support, terminal swing, stride length, swing duration, pitch at initial contact, stance duration was higher in PD than HC ($p \leq 1e-5$). Conclusions: The preliminary results show that the quantity of AA is not different between PD and HC, but the quality of AA is different. Also, the continuous monitoring might help in capturing the fluctuations throughout the day, and thus help in optimizing an intervention.

4-18 Device assessed physical activity in a clinical trial of participants with malignant pleural effusion: a sub-study of the Australasian Malignant PLeural Effusion (AMPLE)-2 randomized trial.

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Objective Treatment for malignant pleural effusion (MPE) is palliative. Device-assessed physical activity is a novel outcome measure for comparing MPE interventions. Our objective was to examine differences in activity levels between treatment groups in a clinical trial of patients with MPE. Methods AMPLE-2 was an open-label multi-centre clinical trial (n=87). Patients with confirmed symptomatic MPE were treated with an indwelling pleural catheter and randomised to aggressive (daily) or symptom-guided pleural drainage for 60 days. Participants enrolled at the lead site (Perth, Australia) were invited to participate in an accelerometry substudy (Actigraph GT3X accelerometer; 7-day continuous waist-wear protocol). A valid assessment was defined as ≥ one day with ≥ 10 hours of waking wear time. Inter-group differences in physical activity at follow-up (60-day assessment) were compared (Mann-Whitney U test). Results 45 participants were eligible for the accelerometry sub-study: mean age 67 years; 56% male; 73% had thoracic cancer. At baseline, 45 (100%) returned the accelerometer; 37 (82%) had valid data. At the follow-up, 23 (62%) completed valid assessment [reasons: deceased (n=5), declined (n=5), and invalid assessment (n=4)]. At both time-points average waking wear time was >13 hours/day, and number of valid days was >4. At follow-up, patients treated with aggressive drainage spent a lower percent of time/day in sedentary activities (median 64% [61-68] vs 73% [IQR 71-82]; p=0.002) and a higher percent of time/day in light activities (34% [31-38] vs 26% [17-28]; p=0.001). There was no inter-group difference in moderate-vigorous physical activity (median 0% [0-1] vs 0% [IQR 0-3]; p=0.883). Conclusions Participants who wore the device had good compliance, however this decreased over time. Participants with daily drainages had better device measured physical activity profiles at follow-up suggesting better control of symptoms is associated with more physical activity.

4-20 It's your turn: The measurement of turning in free-living stepping

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Objective In clinical populations turning is considered an important measure of ability, often gauged by the Timed Up and Go (TUG) test and L Test. Continuous measurement of turns during free-living stepping activities could provide a clinically important measure of ability and participation. In this study we developed a wearable device capable of quantifying ambulatory turning in free living. Real world application device criteria were small size, seven-day recording period and 45° turn resolution. Methods Outside of direct observation, typical turn detection approaches utilise GPS or gyroscope sensors. These have an active power consumption of 1000 times that of accelerometers commonly found in wearable activity trackers. We have used a tri-axial magnetometer with power consumption only 100 times that of an accelerometer. Unlike gyroscopes, an absolute signal is obtained from the magnetometer allowing a low measurement frequency, close to that of stepping, to be used to significantly reduce power demand. An algorithm was developed to fuse raw accelerometer and magnetometer signals into usable heading data using only free-living data without pre-calibration. We proposed the following as clinically relevant measures: Steps per turn (SPT) = mean step count between each turn greater than 45°, and Turns per minute (TPM) = mean turn greater than 45° count per minute, taken over a stepping bout. Results We achieved eight-day real-world activity profile capture while detecting 30° stepping turns. Trials with a healthy subject demonstrated 2.8 SPT and 14.4 TPM and 11.9 SPT and 6.9 TPM for indoor and outdoor walking, respectively. A significant difference for both SPT and TPM ($P < 0.05$). Conclusions We achieved our design criteria, and could reliably capture turning. SPT and TPM were demonstrated to separate indoor and outdoor walks. It is theorised these measures will help quantify ability and participation in ambulatory activities across a range of populations.

4-22 Signatures of knee osteoarthritis in the temporal and fractal dynamics of human gait

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Osteoarthritis of the knee (KNOA) is characterized by progressive cartilage deterioration causing pain and function loss. Symptoms develop late with limited disease-modifying opportunities. Imaging and biochemical analyses for detection of KNOA are expensive and labor-intensive. Continuous movement tracking could aid in detecting onset and/or worsening of symptoms. We used a three-dimensional accelerometer (49 x 40 x 14 mm; length, width x height; weight: 30 gr), i.e. KXSD9 tri-axis Digital Accelerometer with a Texas Instruments microcontroller capable of monitoring positional displacements expressed in amount of gravitational inertial force (g) in anteroposterior, mediolateral and vertical or cranial-caudal directions. Subjects were instructed to wear the accelerometer at all times during a full week to investigate kinematic differences in KNOA patients, weight-matched healthy volunteers and obese KNOA patients. Knee osteoarthritis was established radiographically and corroborated using magnetic resonance imaging. The total amount, type and level of activity did not differ significantly between groups. The temporal activity pattern during the day was however significantly different with a bimodal signature in healthy volunteers only. Sequence analyses revealed more time to recuperate after dynamic activity in both KNOA groups. Analysis of walking bouts revealed significant differences in stride interval dynamics, indicative of gait naturalness, only in healthy volunteers. Temporal activity, sequence and walking patterns were independent of body weight. We thus provide for the first time evidence of temporal specific kinematic signatures in amount and quality of movement also in stride interval dynamics between people with and without KNOA independent of body weight. These findings could allow early and non-intrusive diagnosis of OA enabling concordant treatment.

4-24 Effect of increased physical activity with novel technology to reduce weight in subjects with metabolic syndrome.

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Objectives: Physical activity (PA) interventions have been proved effective diminishing cardiovascular risk indicators. These days, information and communication technologies play a key part on practically everybody's routine, and therefore, lifestyle interventions using these technologies should be more easily accepted and effective. Consequently, the aim of this systematic review and meta-analysis is to study the effect of PA interventions through mobile health technologies on anthropometrics' parameters in a population with cardio-metabolic risk. Methods: A systematic review was carried out through PubMed, Scopus and Web of Science databases; covering articles published in English and Spanish between inception and December 2018. Inclusion criteria consisted on: experimental studies (randomised controlled trials (RCTs) or controlled pre-post studies) measuring the effectiveness of increasing PA with technology assisted lifestyle interventions to reduce body mass index (BMI), weight and waist circumference (WC) in patients with metabolic syndrome or prediabetes. Results: Five articles were assessed for further analysis. Despite their differences between programmes and populations, most trials suggest a positive effect of technology assisted interventions on: BMI, weight and WC as it is shown in Figure 1. Conclusions: It can be concluded that increasing PA with technology assisted lifestyle interventions are effective diminishing anthropometric cardiometabolic risk factors in patients with metabolic syndrome or prediabetes. Although further research is needed in order to get more consistent evidences, these results show potential as mobile technologies are joining multiple medical assistance areas getting to reduce the number of in-person consults with even better results and therefore decreasing healthcare costs in the long term.

4-26 People with low cardiorespiratory fitness are physically the most active ? with relation to their individual fitness

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Introduction: Adults should do at least 150 min a week of moderate intensity, or 75 min a week of vigorous intensity aerobic activity or an equivalent combination of both. Bouts of any duration may be included in the accumulated total time of physical activity (PA). The intensity of PA can be defined in absolute and/or relative terms. It has been proposed to use thresholds relative to individual fitness in PA monitoring when measuring the population adherence to the recommendation. Methods: 1162 adults (493 men, 669 women), aged 18-74 years participated in the study. Their VO2max was predicted with 6 min walking test and they used a hip-worn accelerometer for one week during waking hours. The participants were divided into VO2max thirds by age groups and sex. Acceleration data was analyzed in 6 s epochs (RAW6), and for each epoch, intensity in MET (metabolic equivalent) values was calculated. Additionally, MET values were smoothed with 1 min (EMA1), 5 min (EMA5) and 10 min (EMA10) exponential moving average of epoch-wise values. The relative intensity threshold for moderate activity was 40 % and that for vigorous activity 60 % of the aerobic capacity reserve. Results: In women, the lowest VO2max third had the highest adherence to recommendation with RAW6 [85% (low fit); 59 % (middle): 54% (high fit)], EMA1 (59%; 43%; 41%), EMA5 (42%; 35%; 29%) and EMA10 (35%; 26%; 25%). In men, the lowest VO2max third was the most active with RAW6 and EMA1 and the highest VO2max third with EMA5 and EMA10. The proportions for men were for RAW6 (65%; 40%; 44%), EMA1 (40%; 28%; 36%), EMA5 (26%; 24%; 33%) and EMA10 (22%; 21%; 35%). Conclusion: The lowest fitness third was the most active when the PA intensity was analyzed with relative fitness thresholds, and short analyzing time periods (RAW6 and EMA1) particularly in men. Therefore, less fit persons have to utilize more of their aerobic capacity on daily basis just to keep up with their daily routines and the others.

4-30 Activity recognition and energy expenditure accuracy differences according to the number of accelerometer devices and body placement

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Objective: To predict the type and metabolic intensity of physical activities of accelerometer sensors using different body placements and their combinations. Methods: 93 older adults (75.5 ± 3.5 years old) completed 32 scripted activities in a controlled-lab environment. Participants wore a total of five accelerometer sensors placed on the dominant side: ankle, thigh, hip, wrist, and upper arm. Raw accelerometry data was used to classify: sedentary vs non-sedentary, locomotion vs non-locomotion, and lifestyle vs non-lifestyle activities. Additionally, metabolic equivalents (METs) values of the activities were measured using the portable indirect calorimetry. Random forest algorithms for regression and classification were used for analyses. F1 score and root mean square errors (rMSE) metrics were used to report on the performance. Results: The use of all five sensors combined enhanced the overall classification as compared to the use of single sensors. There were slight improvements with all five sensors when classifying activities as sedentary vs. non-sedentary (up to 58.1%), locomotion vs. non-locomotion (up to 1%), and lifestyle activity vs. non-lifestyle (up to 14.3%). The highest F1 score was reported for locomotion activity recognition (F1 score=0.98), followed by lifestyle (F1 score=0.88), and sedentary (F1 score=0.68) activity recognition. The hip placement achieved better results compared to other body positions and the wrist position performed well in classifying lifestyle and locomotion activities. Estimating METs from all sensors combined resulted root mean square errors (rMSE) of 0.88 METs. Conclusions: The performance of recognizing physical activities with accelerometers can be enhanced by increasing the number of body placements, but this benefit is attenuated when classifying activities into broader categories. The number and placement of accelerometer sensors need to be carefully considered when planning future research or public health initiatives

4-34 Capturing accelerometer outputs in healthy volunteers under normal and simulated-pathological conditions

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Background: People with chronic diseases often have walking impairments mainly due to pain. Their physical activity data is valuable, but often collected using subjective measures such as questionnaires. Patient activity tracking, using wearables, is a possible objective measure. We studied healthy volunteers to assess whether the activity classification accuracy differs for those with normal and (simulated) pathological gait. Methods: 30 healthy participants were recruited from Leeds University to do 6 pre-defined activities under two conditions, normal and (simulated) pathological, in a gait lab. The activities were: lie down, sit, stand, stand-to-sit, walk, and climb stairs. Activities were classified as static, dynamic or transition. Activities were captured using a wrist-worn MOX accelerometer (Maastricht Instruments, NL). Data were analysed based on the Activity-Recognition-Chain process. Accelerometer data were divided into 2-second windows and labelled by hand. We trained 4 random forests to classify: (i) activity class, (ii) activity task trained on normal condition, and (iii) activity class, (iv) activity task trained on pathological condition. Bootstrapped 95% confidence intervals were determined by repeating classification 50 times, where the data were randomly split into 75% train and 25% test sets. We calculated the accuracy, defined as the percentage of correct predictions. Results: Classifier (i) had an accuracy of 97±5.33% and 42±3.51% when validated on normal data and on simulated pathological data respectively. Classifier (ii) had an accuracy of 90±5.33% and 17±2.35% when validated on normal data and on pathological data respectively. Classifier (iii) and classifier (iv) had an accuracy of 94±5.46% and 80±5.51% respectively. Conclusions: Algorithms developed on normal data are not accurate for pathological conditions. To evaluate pathological conditions, classifier algorithms should be developed using data from the target population.

4-38 Exploration of spatiotemporal variation in preschooler?s schoolyard physical activity

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Global positioning systems (GPS) plus accelerometry have been used to describe how children's physical activity varies by schoolyard location, but it is important to account for temporal changes in where and how actively children play when analyzing GPS and accelerometry data. Our purpose was to explore spatiotemporal approaches to understanding patterns of preschoolers' schoolyard physical activity. Sixteen children at one preschool wore a QStarz BTQ1300-ST GPS (5-sec epoch) and an ActiGraph wGT3X-BT accelerometer (15-sec epoch) at the waist during 2-3 outdoor periods per day, for 2-3 days. A spatiotemporal weights matrix was generated so that points within 3 meters (space) and 2 minutes (time) were considered neighbors. Global Moran's I was used to determine if space-time clustering in vertical axis counts was present, then the Getis-Ord G* statistic was calculated to detect locations of significant hot (high vertical axis counts) and cold (low vertical axis counts) spots. The Mann-Kendall statistic was calculated for each bin in a space-time cube to identify trends in the number of points in each location over time. There was evidence of global (overall) clustering for all measurement periods. Some locations afforded both high and low levels of physical activity, just at different points in time, resulting in locations with both hot and cold spots during a single outdoor period, and variation in the location of clusters between outdoor periods. The space-time cube indicated that where children spent time also changed over the outdoor period. Similar to research in older youths, we demonstrated that physical activity varies by schoolyard location, but we highlight the importance of the temporal component, as location of play and physical activity changed over the course of provided outdoor time. Future research can use this approach to identify locations and times that may be salient points of intervention during provided outdoor time.

4-40 Apples to apples? A comparison of existing data processing and reduction protocols on accelerometer metrics in children with type 1 diabetes mellitus

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OBJECTIVE: The objective of this study is to examine the effects of existing, recently published data processing and reduction protocols on commonly reported accelerometer metrics in youth with type 1 diabetes mellitus (T1D). METHODS: A total of 24 children (8-17 yrs) with T1D wore an ActiGraph GT3X accelerometer over the right hip for 7 consecutive days. Participants were asked to complete a log book for wear time. Downloaded data were cleaned and analyzed in accordance with protocols described in 7 accelerometry studies in youth with T1D (Sarnblad, 2004; Trigona, 2010; Maggio, 2010; Garcia, 2012; Sundberg, 2012; MacMillan, 2014; Nguyen, 2015). Wear time, sedentary time, moderate-to-vigorous physical activity (MVPA), and average daily axis 1 counts were compared across protocols using one-way repeated measures ANOVA. RESULTS: Study-specific wear time criteria led to the exclusion of 1 (Trigona) to 7 (Maggio) participants. This resulted in discrepancies in total number of days included in subsequent analyses, with a range of 102 d (60.7%, Maggio) to 163 d (97.0%, Trigona) of a possible 168 d. Significant differences were observed in sedentary time ($F(6,78)=25.500$, $p<0.001$), ranging from [mean(SD)] 7.5(1.8) hr/d (Sarnblad) to 11.5(1.6) hr/d (Trigona). Average daily MVPA was only reduced in Garcia compared with Nguyen (mean and 95%CI difference of -30.0 [-10.1,-50.0] min/d), Trigona (-22.6 [-2.7,-42.6] min/d), and Sarnblad (-24.2 [-3.7,-44.7] min/d; ME $F(6,78)=5.469$, all $p<0.02$). There were no differences in average daily axis 1 counts ($F(6,68)=0.248$, $p=0.86$). CONCLUSIONS: The choice of epoch, wear validation, and monitoring time criteria led to meaningful differences in days used in analysis, and in turn, sedentary and MVPA time. These findings suggest that the currently reported accelerometer-based outcomes in T1D should not be compared across studies, and highlight need for further data harmonization.

4-44 Comparison of two objective measures of children's classroom postural behaviors

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Accelerometers (ACC) and Direct Observation (DO) are two valid approaches to objectively measuring children's physical activity behaviors. However, it remains unclear how these measurement methods compare when assessing postural behaviors in a classroom setting. OBJECTIVE: To compare two commonly employed objective measures of children's behavior in the assessment of classroom posture while using either a seated or stand-biased desk, which incorporated an elevated stool and fidget bar for foot placement. METHODS: Postural and activity behaviors of children in grades 3, 4, and 6 from a single elementary school were assessed with a hip-worn ACC (inclinometer function) and DO while using a seated or stand-biased desk in the classroom. DO was performed 5-s every 30-s across 5-min (total 50-s DO samples). Proportion of time sitting was compared between ACC and DO. Proportion of time engaging in lower limb fidgeting while sitting, measured by DO, was also calculated. Mixed effects models were used to determine if a significant interaction (α=0.05) occurred between sitting, fidgeting, and desk type. RESULTS: Across 180 observations DO showed a higher proportion of time sitting than ACC (average difference 27.67%; $p<0.0001$). There was a significant interaction ($p=0.0484$) between stand-biased desk use and fidgeting, with more fidgeting increasing the difference between DO and ACC measured sitting. In seated desks, estimations of DO and ACC sitting were not impacted by fidgeting. CONCLUSIONS: In a seated desk, DO consistently measured a greater proportion of time sitting than ACC, and this was not impacted by lower limb fidgeting. Using a stand-biased desk, greater amounts of fidgeting while sitting on a stool, led to a greater difference between these two methods of measurement. Postural behaviors of children associated with stand-biased desk use may affect the ability to measure sitting in a classroom setting.

4-46 Cohort profile: the Australian Breakthrough Cancer (ABC) Accelerometer Sub-Study

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Introduction: The Australian Breakthrough Cancer (ABC) Study is one of the largest epidemiological studies in Australia to investigate the roles that genes, lifestyle and environment play in the development of cancer and other chronic diseases. We are currently collecting accelerometer-based estimates of physical activity, sedentary behaviour and sleep for a subsample of ABC Study participants. Method: More than 51,000 Australian residents, aged 40-74 years, completed the ABC Study's online baseline questionnaire (sociodemographic, lifestyle, medical history), and provided a saliva sample; about 10,000 participants also provided a blood sample. The ABC Accelerometer Sub-Study (ACM) is recruiting approximately 4,000 adults from participants who have provided blood. Participants wear two devices (waist-worn Actigraph GT3X+ during waking hours and thigh-worn activPAL continuously 24h/d) for 7 consecutive days. Results: To date we have invited 3,067 ABC participants; 2,018 consented and were sent devices; a1,788 have completed the ACM data collection. Valid data (from ≥4 continuous days) have been received from 1,737 for Actigraphs and 1,677 activPALs. Our Sub-Study participants are reasonably representative of the broader ABC Study cohort (age=60±8 yrs); 52% women; 67% from metropolitan areas; 48% with university education). We are on-track to complete ACM recruitment by the end of 2019. Discussion: The ACM Sub-Study will initially allow us to validate self-report measures specifically for this cohort, plus enable cross-sectional and compositional analyses focusing on a broad range of health-related outcomes. We will seek funding to undertake further waves of data collection for the Sub-Study. Additional data collection will provide detailed information on time trends in sleep and movement behaviours in middle-aged and older Australian adults, and better understand the interplay between these behaviours, other lifestyle factors, personal attributes and genetics.

4-48 Towards improved physical activity monitoring: collecting physical activity and sedentary behaviour data in Dutch adults using commonly-used questionnaires as well as an accelerometer

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Objective: This study is part of the 'European Union Physical Activity and Sport Monitoring System' (EUPASMOS), in which 22 European Union Member States participate, and has two objectives. Firstly, it aims to assess the validity, reliability and comparability of physical activity questionnaires that are commonly used in Europe. Secondly, it examines the feasibility to implement device-based measurements of physical activity and sedentary behaviour into the Dutch monitoring system, as requested by the Dutch ministry of Health, Welfare and Sports. Methods: Between February and July 2019, approximately 5000 randomly selected Dutch adults will be invited to participate through an invitation letter. Participants will complete an online questionnaire with questions about demographics and self-reported health, as well as four commonly used physical activity questionnaires and the questionnaire that is currently used in the Dutch monitoring system. Subsequently, participants will receive the UKK RM42 accelerometer by mail and wear it for seven consecutive days on their right hip (during the day) and on their non-dominant wrist (overnight). In sub-studies, participants will 1) wear the accelerometer solely on their wrist, and 2) visit a research center for instructions. We will assess the influence of recruitment strategies and accelerometer placement on response and compliance. In addition, we will analyse the validity, reliability and comparability of the different measurements. Results: We expect to collect questionnaire and accelerometer data of approximately 1000 Dutch adults. We will present the objectives of the EUPASMOS project and preliminary results regarding recruitment, response and compliance. Conclusions: This study will provide insight into the validity, reliability and comparability of commonly-used physical activity questionnaires. In addition, this study will guide the development of the Dutch physical activity and sedentary behaviour monitoring system.

4-50 On placement, location and orientation of wrist-worn tri-axial accelerometers during free-living measurements

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Purpose: Over the past decade, wearable accelerometers have become a standalone tool for the objective assessment of physical activity (PA). In free-living studies, researchers place accelerometers according to protocol on a pre-defined body location (e.g. non-dominant wrist). However, protocols are not always followed correctly, and participants move the sensors between wrists or reattach them in a different orientation. Such protocol deviations often result in PA miscalculation. Methods: We propose an approach, PLOE ("Placement, Location and Orientation Evaluation method"), to recognize changes in position of wrist-worn sensors during free-living activities. The key idea of PLOE leverages the observation that one's hands are pointed downward during standing and pointed mostly horizontally while sitting. PLOE estimates the spatial orientation during sitting and standing using median acceleration in one day intervals. The obtained orientation determines the actual sensor position. Finally, we compare the estimated position with the study protocol and identify discrepancies. We apply PLOE to the measurements collected from 45 older adults wearing ActiGraph GT3X+ accelerometers on the left and right wrist for 7 full days. We used activPAL to provide indications of sitting and standing activities as a "gold standard". Results: With PLOE we found that 15.6% of participants wore accelerometers violating the protocol for one or more days. Cumulatively, participants wore sensors on the opposite hand during 6.9% days of simultaneous wear (see Figure 1). Analysis of vector magnitude counts revealed that during the periods of discrepancies there was a miscalculation of daily PA by more than 20%. Conclusion: Our findings show that changes in device location have a significant effect on PA estimates. Identified violations to the protocol are incorporated at the analysis stage to provide less biased estimates of PA. In our future work we will extend PLOE to other sensor location

4-52 The associations between nighttime sleep and physical activity intensities in preschool-aged children

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Objective: The aim of the study was to investigate the associations between different physical activity (PA) intensities and sleep quality in preschool aged children. Methods: Preschool aged children (N=30; 4.4±0.9 yrs) were instructed to wear an Actigraph wGT3X-BT accelerometer on their right hip for 7 days, 24 hours/day. Body anthropometrics were obtained at baseline. Periods of non-wear were removed during processing using wear time validation in the ActiLife software. For statistical analyses, a minimum of 3 days, 6 hours/day of wear time was required (mean wear time=1194 mins). The Butte Preschoolers cut point was applied to determine PA intensities. The percentage of wear time spent in light physical activity (%LPA) and moderate-to-vigorous physical activity (%MVPA) were calculated. Wear compliance for sleeping periods was cross-referenced with parental report logs, with a minimum of 4 nights per subject included in the analyses. The Sadeh et al. algorithm was applied to classify 1 min epochs as either wake or sleep and sleeping periods; "start" defined as 5 consecutive epochs of sleep and "end" marked by 10 consecutive epochs of wake. Sleep efficiency (SE) was calculated as the amount of time an individual spent awake during a sleep period. Pearson correlation analyses were used to assess the relationship between PA intensities and SE. Results: Preschool aged children had a mean SE of 96.7%± 1.6% and spent on average of 14.0%± 2.9 of total wear time in LPA and a mean of 8.8%±2.4 in MVPA. Correlation analyses revealed statistically significant correlations ($p<0.05$) between different PA intensities and sleep efficiency; %LPA and SE were positively correlated (r=.563) as was %MVPA and SE (r=.423). Conclusion: More time spent in LPA and MVPA was associated with greater sleep efficiency, meaning less wake time during sleeping periods, for preschool aged children. This study suggests that children who are more physically active also experience better quality sleep.

4-54 An insulin-delivery closed-loop system for people with Type 1 diabetes (artificial pancreas) : performances with physical activity announcement

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Objective:Type 1 Diabetes is a chronic disease affecting about 2 million people in Europe, resulting in large variations in glycaemia. The treatment is based on insulin injections, and its efficiency depends on various factors including Physical Activity (PA). In usual clinic practice, PA may lead to hypoglycemia which is the main barrier to PA practice for insulin-dependent subjects. The artificial pancreas DBLG1 System from Diabeloop SA is a closed-loop system which automatically optimizes the insulin delivery. The present study evaluates its ability to maintain hypoglycemia control during PA. Method:A 3-month dataset (blood glucose proxy with continuous glucose monitoring (mg/dL)) of 63 Type 1 diabetes patients (39 female, age: 48.2 +/-13.4 years old) wearing DBLG1 System was used on this study. The characteristics of PA events were provided by the user (start time, duration and perceived intensity), which modified the inner settings of the algorithm. To assess the performance of the system after PA disturbances, we computed the time in hyperglycemia (>180 mg/dL) and hypoglycemia (<80 mg/dL) in the 12-hour periods after the end of a PA (PA period) and 12h periods without any PA (no-PA period). Results:A total of 1248 PA events is reported: 40% / 41% / 19% for intensity low / moderate / high. The median number of PA per week is 1 (min=0, max=9.8). The median duration of PA is 60 min (min=8, max=480). Taking into account PA reduces the risk of hypoglycemia with a median percentage of time of 0%, quartiles [0, 5.5] for PA periods, and 0% [0, 6.5] for no-PA periods. This is obtained to the expense of the time in hyperglycemia: 28.8 %[10.6, 44.7] for PA periods, and 22.2%[8.5, 38.5] for no-PA periods. Conclusion:We show here that the performances in hypoglycemia of DBLG1 System do not deteriorate with announced PA. To go further and to lighten the burden of the patients, we intend to gather information from accelerometer data to automatically feed the system with PA.

4-56 Accelerometer-measured physical activity of 5-year-old children: comparing the amount of light and moderate to vigorous intensity physical activity using different ActiGraph cut points

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We analysed the amount of light and moderate to vigorous intensity physical activity (MVPA) in 5-year-old children using three different ActiGraph cut points. We also evaluated the proportion of children meeting the PA recommendations of 60 min of MVPA per day (World Health Organization [WHO] 2010) and 180 min of light, moderate or vigorous PA (LMVPA) per day (Finland 2016). The data were collected in 2013−17 as a part of the Finnish Gestational Diabetes Prevention Study (RADIEL). During these follow-up measurements, the children were 5 years old on average. The children's PA was monitored using an ActiGraph (wGT3X-BT) accelerometer worn on the hip for 7 days. Valid data were required to include at least 8 h of data per day for at least 3 days (2 weekdays + 1 weekend day). Valid data were obtained for 249 children (52% boys) and analysed using different ActiGraph cut points suggested for use in this age group, as follows: Cut point A was that of Butte et al. (2013; vector mode), cut point B was that of Evenson et al. (2008) and cut point C was that of Van Cauwenberghe et al. (2011). Using the cut points A, B and C, the amounts of light PA (mean ± standard deviation) were 273 ± 36, 295 ± 236 and 54 ± 13 min/day, while the amounts of MVPA were 89 ± 26, 72 ± 22 and 70 ± 21 min/day, respectively. The proportions of children meeting 60 min of MVPA per day were 85%, 68% and 66%, and the proportions of children meeting 180 min of LMVPA per day were 100%, 100% and 5%, respectively, using these cut points. The selection of the cut points significantly influences the amount of light PA and MVPA, as well as the proportion of children meeting the PA recommendations. Consensus on how to operationalise the fulfilment of the PA recommendation based on accelerometer measurements among preschool children is essential. Butte et al. Med Sci Sports Exerc 2013 Evenson et al. J Sports Sci 2008 Van Cauwenberghe et al. Int J Pediatr Obes 2011

4-60 Sex and age differences in device-measured sedentary behavior and physical activity in community dwelling older adults

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Objectives: To explore sex and age differences in older adults' device-measured pattern of sedentary time and physical activity (PA), and to compare fulfilment of recommended PA between measured and self-reported PA. Methods: In total, 606 community dwelling older adults (64% women), in age groups 66, 81-87 or 90+ y, from the population study Swedish National study on Aging and Care in Kungsholmen wore an activPAL for one week (w) during waking hours (≥4 d with ≥10 h) to assess pattern of sedentary (sitting/lying) time and stepping/walking. Stepping cadence ≥100 steps/min was considered moderate-to-vigorous PA (MVPA); standing and stepping <100 steps/min were considered light intensity PA (LPA). Self-report PA derived from two questionnaire items was compared with steps/d and min/w in MVPA. Statistical methods were logistic and quantile regression, Cohen's Kappa (K), and Spearman's correlations (rho). Results: On average, 60% of wear time was spent sedentary, 36% in LPA, and 4% in MVPA. Median usual sedentary bout duration was 30 min and median steps/d was 8402. Women spent median 35 min less sedentary and 35 min more in LPA than men, adjusted for age and wear time, while steps/d, MVPA and usual sedentary bout duration did not vary by sex. Older age was associated with more sedentary time, lower MVPA and steps/d, and with slightly but statistically significant less LPA and longer usual sedentary bout duration. The prevalence of meeting PA recommendations ranged from 59% (≥150 min/w MVPA) to 68% (≥7000 steps/d) to 83% by self-report (active in MVPA every day or several days/w), with limited agreement between self-report and device-measured PA (K=0.23, 0.27 and rho=0.30, 0.33 vs MVPA, steps/d). Conclusions: We found significant sex differences in sedentary time and LPA in older adults, but not in MVPA, in contrast to previous findings from self-report. Device-based measurement adds value to population studies, providing richer and different data to self-report.

4-62 Posture and activity classification in non-ambulant children and adolescents with Cerebral Palsy

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Machine learning (ML) approaches have emerged as a more accurate alternative to processing accelerometer data than traditional cut-point methods in ambulatory youth with Cerebral Palsy (CP). However, to date, no studies have examined the accuracy of ML classification approaches in non-ambulatory children and adolescents with CP and severe neuromuscular impairment. Purpose: To evaluate and compare activity classification models trained on data from single, two, and three monitor placements in non-ambulatory children and adolescents with CP. Methods: Activity classification models were trained on wrist, hip, and thigh accelerometer data from 11 children (11.0±3.0y). Time, frequency, and activity fragmentation features were extracted from the VM with tilt angle in 5 sec windows. Activities were classified as Lying, upper limb activity (UL), walking with mobility aid (WMA), wheelchair propulsion (WC), and riding modified bicycles (Cycle). A total of 21 models were trained and evaluated by varying number of features using MRMR feature selection and supervised learning algorithm. Performance (accuracy) was evaluated using LOSO-CV. Results: The best performing classifier for single, two, and three monitor placements was wrist RF (26 features, CV = 79.09%), wrist+hip RF (26 features, CV = 92.08%) and wrist+hip+thigh SVM (28 features, CV=90.4%). F-score was very good to excellent for Lying (.84-.99), UL (.79-.89), WMA (.84-.96), and WC (.82-.88). Recognition of Cycle for wrist placement was limited (.54), however inclusion of two and three monitors considerably improved recognition (.83-.88). Conclusion: While all classifiers provided very good recognition accuracy, classifiers trained on multiple placements yielded better performance than single placement; two and three monitor placements provided comparable results.Activity classification models will help researchers to evaluate the success of interventions that aim to promote physical activity in non-ambulatory children