Emerging collaborative research platforms for the next generation of physical activity, sleep and exercise medicine guidelines: the Prospective Physical Activity, Sitting, and Sleep consortium (ProPASS)

Galileo Galilei's quote '*measure what is measurable, and make measurable what is not so*' has particular relevance to health behaviours, such as physical activity (PA), sitting and sleep, whose measurement during free living is notoriously difficult. To date, much of what we know about how these behaviours affect our health is based on self-report by questionnaires which have limited validity, are prone to bias and inquire about selective aspects of these behaviours. Although self-reported evidence has made great contributions to shaping public health and exercise medicine policy and guidelines until now,[1] the ongoing advancements of accelerometry-based measurement and evidence synthesis methods are set to change the landscape. The aim of this editorial is to outline new directions in PA and sleep-related epidemiology that open new horizons for guideline development and improvement; and to describe a new research collaboration platform: the Prospective Physical Activity, Sitting, and Sleep consortium (ProPASS) (figure 1).

Figure 1

FEASIBLE RESEARCH TECHNOLOGY AT SCALE, BIG CONSORTIA

Measurement technology used in epidemiology has made measurable what *was not so* until recently. Several population-based studies use accelerometers that are worn by participants for 24 hours a day for a whole week, offering unprecedented insights into the health attributes of PA, sitting and sleep. One of the most exciting aspects of accelerometers is that they show great promise for capturing *nearly complete* accounts of movement behaviour, including posture and activity type detection.[2]

However, advanced measurement methods and optimal evidence synthesis are not synonymous. Individual accelerometry studies have limited generalisability beyond the specific country, population and setting, and usually have low statistical power to address detailed research questions. For example, none of the National Health and Nutrition Examination Survey (NHANES) accelerometry studies[3] have been able to study potentially metabolic health-enhancing sporadic short (<2–3 min) bursts of higher intensity incidental PA,[4] likely because of the sparsity of such data. Like any other field, classic systematic reviews of accelerometry inherit the problems of source studies and their conclusions may not be robust.[5] We need to think differently when it comes to consolidating, analysing and interpreting new formats of accelerometry data. As John Ioannidis' *BJSM* editorial succinctly put it, the next generation of evidence in exercise medicine and PA involves large consortia of individual participant data that are harmonised retrospectively or prospectively.[5] Prospective harmonisation (ie, agree on same or similar measurements across different studies prior to data collection), in particular, is an extremely powerful tool as it can overcome heterogeneity, which is one of the largest obstacles for rigorous evidence synthesis.[5] The value of consortia goes beyond producing more robust and generalisable knowledge, there is also a strong economic argument. The value of every dollar, pound or euro tax payers and research funders invested in the original studies is multiplied through further use of the data resources to inform better public health and clinical practice guidelines.

A NEW CONSORTIUM

The momentum generated by successful accelerometry consortia (eg, International Children's Accelerometry Database[6]) and large epidemiological studies like NHANES[3] and the UK Biobank[6] that used waist or wrist mounted accelerometers inspired the genesis of the ProPASS.[7] ProPASS is a research collaboration platform that aims to bring together existing and future observational studies of thigh-worn accelerometry. Although each accelerometer placement site has both strengths and challenges, the ProPASS choice of site was far from accidental: the unique appeal of the thigh-worn method is that it provides information on multiple dimentions of movement behaviour, including movement intensity (eg, light, moderate and vigorous PA) and posture (eg, sitting/lying, standing). Activity types such as cycling, running and stair climbing can also be extrapolated by thigh-attached sensors[2] and integration with other important behaviours such as duration and timing of sleep can provide unique insights on lifestyle and health.[8] Information about such tangible aspects of human behaviour has immediate relevance to people's daily lives; and is easier for clinicians, policymakers and the public alike to understand, 'digest' and hopefully seek to improve.

The ultimate scientific objective of ProPASS is to produce evidence on the associations of PA, sitting, and sleep and long-term health outcomes and longevity. As of February 2019, ProPASS is supported by 12 international cohorts totalling over 70 000 participants (table 1). To safeguard consortium feasibility, longevity and faster growth, ProPASS is not restricted to one specific model of accelerometer; any triaxial device that outputs raw acceleration and is worn on the thigh is suitable—an approach we have validated empirically.[9] The ProPASS cohorts are rich in health outcome data, many contain genotypic information, and most can be linked to administrative health and mortality records, opening up a huge variety of possibilities to generate new knowledge.

Table 1 Accelerometry studies supporting the Prospective Physical Activity, Sitting, and Sleep consortium (ProPASS)

Main study Name/country	Leading institution	Geographical coverage of the study	Participants (n)	Sex	Population/age range (accelerometry measurement)	Accelerometry device	Years (accelerometry measurement)
Australian Longitudinal Study on Women's Health/ Australia	The University of Queensland and The University of Sydney	Australia	(target) ≈3250	Women	General population/45–50 years	ActivPAL3 and ActivPAL4 micro	2019–2020
1970 British Birth Cohort Study/UK	Loughborough University and University College London	UK	≈5500	Both	General population/47–49 years	ActivPAL3 micro	2016–2018
Copenhagen City Heart Study/Denmark[10]	Frederiksberg Hospital, Copenhagen	Two districts of Copenhagen	≈2000	Both	General population/18 years or older	Actigraph GT3X	2011–2015
Danish PHysical ACTivity cohort with Objective measurements (DPHACTO) Study[11]/Denmark	National Research Centre for the Working Environment, Copenhagen	Denmark	≈1000	Both	Workers in manufacturing, cleaning and transportation companies/18–67 years	Actigraph GT3X	2012–2014
Danish Observational Study of Eldercare work and musculoskeletal disorderS (DOSES)[12] Study/Denmark	National Research Centre for the Working Environment, Copenhagen	Greater Copenhagen region	≈500	Both	Eldercare workers/18–67 years	Actigraph GT3X	2013–2014
Finnish Retirement and Aging Study (FIREA)/ Finland[13]	University of Turku	Southwest Finland	≈280	Both	General population/ occupational cohort/59–65 years, 60–64 years	ActivPAL3	2015–2020
Health 2016 Study/Denmark	Centre for Clinical Research and Prevention, Frederiksberg	Western part of Greater Copenhagen	≈800	Both	General population/18–69 years	Axivity	2016–2017
The Nord-Trøndelag Health Study (HUNT 4)[14]/Norway	Norwegian University of Science and Technology	Northern part of Trøndelag region	≈40 000	Both	General population/18 years or older	Axivity 3	2017–2019
The Maastricht Study[15]/The Netherlands	Maastricht University	South of The Netherlands	≈9000	Both	General population (oversampling of people with type 2 diabetes)/40–75 years	ActivPAL3	2010–2019
Swedish CArdioPulmonary bioImage Study (SCAPIS)[16] Ad-On Gothenburg/Sweden	University of Gothenburg	Gothenburg region	≈500	Both	General population/50–64 years	Axivity AX3	2017
Swedish CArdioPulmonary bioImage Study (SCAPIS)[16] Ad-On Umeå/Sweden	Umeå University	Umeå region	≈2500	Both	General population/50–64 years	ActivPAL3	2016–2018
Swedish CArdioPulmonary bioImage Study (SCAPIS) Ad-On Uppsala[16]/Sweden	Uppsala University	Uppsala region	≈5000	Both	General population/50–64 years	Axivity AX3	2015–2018

CALL FOR COLLABORATION

New research collaboration platforms have paved the way for the next generation of evidence on PA-related behaviours and health. Recording detailed and accurate objective accounts of daily movement behaviour and posture is now feasible in large epidemiological studies. To fully capitalise on the opportunities offered by such methodological progress at least two essential conditions need to be met: breaking down silos to integrate research paradigms across PA domains, and tight interdisciplinary collaboration. Meeting ProPASS' objectives is dependent on these conditions.

In this editorial we invite researchers from any discipline who have collected or are considering to collect thigh-worn accelerometry data in observational studies to contact us. We also invite scientists with an interest in health-related data consortia, as well as health professionals and policymakers to help us form a ProPASS research agenda with maximal relevance to patients, the public and health policy. There is no question in our mind that such a research agenda is a prerequisite for the success of ProPASS and any other effort aimed at shaping the next generation of PA, sitting, sleep and exercise medicine guidelines.

Get in touch to discuss opportunities for your existing or future studies to join ProPASS (email: propass.consortium@sydney.edu.au). Join our mailing list (www.propassconsortium.org) to stay updated about future events and activities.

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