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)

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TITLE

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)

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TEXT

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).

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 have used accelerometers to wear 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 aspect of accelerometers is that they show great promise for capturing *nearly-complete* accounts PA, 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 NHANES accelerometry studies[3] has been able to study potentially metabolic health-enhancing sporadic short (<2-3 minutes) bursts of higher intensity incidental PA[4], likely because of the sparsity of such data. Classic systematic reviews of accelerometry inherit the problems of source studies and their conclusions are often not 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 that harmonise and pool existing studies.[5] Prospective harmonisation (i.e. 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 such 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 maximised 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 (e.g. International Children's Accelerometry Database[6]) and large epidemiological studies like NHANES[3] and the UK Biobank[7] that used waist or wrist mounted accelerometers inspired the genesis of the Prospective Physical Activity, Sitting, and Sleep consortium (ProPASS)[8]. 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 not only on movement intensity (e.g. light, moderate and vigorous PA), but also on posture (e.g. sitting/lying, standing). Behaviours such as cycling, running, and stair-climbing can also be extrapolated by thigh attached sensors[2] and integration with other important behaviours such as sleep (duration and timing) can provide unique insights on lifestyle and health[9]. Information about such tangible aspects of behaviour has immediate relevance to people's daily lives; and is easier for clinicians, policy makers, 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 twelve 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, but any tri-axial device that outputs raw acceleration and is worn on the thigh is suitable- an approach we have validated empirically[10]. 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 for generation of new knowledge.

Call for collaboration

New research collaboration platforms have paved the way for the next generation of evidence on PA-related behaviours and health. Detailed and accurate objective accounts of daily movement behaviour and posture are now feasible in large epidemiological studies. Meeting ProPASS' objectives will be determined by at least two essential conditions: breaking down the silos to integrate research paradigms across PA domains; and tight multidisciplinary collaboration.

In this editorial we invite researchers from any discipline who have collected or are considering collecting 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 policy makers, 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 physical activity, sitting, sleep, and exercise medicine guidelines.

Get in touch to discuss opportunities for current or future studies joining the consortium (e-mail: propass.consortium@sydney.edu.au), and join our mailing list (www.propassconsortium.org) to stay updated about future events and activities.

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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	Number of Participants (n)	Sex	Population /Age Range (accelerometry measurement)	Accelerometry Device	Years (accelerometry measurement)
Australian Longitudinal Study for Women's Health / Australia	The University of Queensland and The University of Sydney	Australia	(target) ≈ 3,250	Women	General population / 45-50 years	ActivPAL3 and ActivPAL4 micro	2019-20
1970 British Birth Cohort Study / UK	Loughborough University and University College London	UK	≈ 5,500	Both	General population / 47-49 years	ActivPAL3 micro	2016-18
Copenhagen City Heart Study / Denmark [3]	Copenhagen City Heart Study, Frederiksberg Hospital, Copenhagen	Two districts of Copenhagen	≈ 2,000	Both	General Population /18 years or older	Actigraph GT3X	2011-2015
Danish PHysical ACTivity cohort with Objective measurements (DPHACTO) Study [4] / Denmark	National Research Centre for the Working Environment, Copenhagen	Denmark	≈ 1,000	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)[5] Study/ Denmark	National Research Centre for the Working Environment, Copenhagen	Greater Copenhagen region	≈ 500	Both	Eldercare workers / 18 to 67 years of age	Actigraph GT3X	2013-2014
Finnish Retirement and Aging Study (FIREA) / Finland[6]	University of Turku	Southwest Finland	≈ 280	Both	General Population /Occupational cohort / 59-65 60-64	ActivPAL3	2015-2020
Health2016 Study / Denmark	Centre for Clinical Research and Prevention, Frederiksberg	Western part of Greater Copenhagen	≈800	Both	General Population / 18-69	Axivity	2016-2017

The Nord-Trøndelag Health Study (HUNT 4) [7] / Norway	Norwegian University of Science and Technology	Northern part of Trøndelag region	≈ 40,000	Both	General Population / 18 years or older	Axivity 3	2017-19
The Maastricht Study [8] / The Netherlands	Maastricht University	South of The Netherlands	≈ 9,000	Both	General Population (Oversampling of people with Type 2 Diabetes) / 40-75	ActivPAL3	2010-2019
Swedish CArdioPulmonary bioImage Study (SCAPIS) [9] Ad-On Gothenburg / Sweden	University of Gothenburg	Gothenburg region	≈ 500	Both	General Population / 50-64	Axivity AX3	2017
Swedish CArdioPulmonary bioImage Study (SCAPIS) [9] Ad-On Umeå / Sweden	Umeå University	Umeå region	≈ 2,500	Both	General Population / 50-64	ActivPAL3	2016-2018
Swedish CArdioPulmonary bioImage Study Ad- On Uppsala (SCAPIS) [9] / Sweden	Uppsala University	Uppsala region	≈ 5,000	Both	General Population / 50-64	Axivity AX3	2015-2018

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