Using Wearable Devices to Assess Physical Behavior in Epidemiologic Research

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In the second issue of the *Journal for the Measurement of Physical Behaviour*, we feature a large surveillance study (Lee et al., 2018) that used a wearable device to characterize physical activity and sedentary behavior in over 16,500 older women who participated in the Women's Health Study. I had the opportunity to interview I-Min Lee, a professor at the Harvard Medical School who is the senior author of this paper. I asked her several questions about this study, which is one of the largest epidemiologic studies that employed a wearable sensor to characterize physical activity and sedentary behavior. She explained why she did this study, her opinion about the value of using a wearable device to assess physical behavior, and her thoughts about future directions for those of us whose research focus is on measuring physical behavior. This interview is followed by a brief commentary by Sarah Kozey Keadle (skeadle@calpoly.edu), an emerging researcher in the Department of Kinesiology at California Polytechnic University, whose research focuses on wearable devices and their application in intervention studies.

Interview With I-Min Lee, ScD, MPH

What prompted you to pursue this work?

I was a member of the 2008 Physical Activity Guidelines Advisory Committee that provided the scientific basis for the 2008 federal physical activity guidelines. In our review of the scientific data, it was clear that physical activity has many health benefits. However, many details of the relationship—how much physical activity, how intense, what duration, how frequently, etc.—were often unclear. Questionnaire assessments of physical activity, while useful and feasible, cannot provide the precision and details that device assessments can; hence, we added device assessments of physical activity and sedentary behavior to the Women's Health Study.

(As an aside: the 2008 guidelines are being updated; the second edition of these guidelines are expected at the end of 2018.)

As an epidemiologist, what is your opinion about future research interested in studying how physical activity and sedentary behavior are associated with health? Specifically, do you think activity monitoring devices should be the method of choice to obtain a more precise exposure assessment? Do self-report measures remain an important tool in large scale studies?

As in much of science, there is no one answer! I think it depends on what the research question is, and feasibility constraints. Many large scale studies will not have the budget to carry out device assessments and will continue to rely on self-report measures. Self-report measures can provide reasonably valid assessments of overall physical activity and moderate-to-vigorous intensity activity, as well as overall sitting. They also can provide the context in which the behavior is carried out—e.g., is it transportation activity or leisure-time activity? Devices are better at measuring light-intensity physical activity, as well as bout duration. However, the devices that are currently in common use for research cannot provide the context of the physical activity.

In your paper, you identified several challenges related to device-measured physical activity and sedentary behavior in population-based studies. What would you recommend to the physical activity measurement research community in terms of their future research pursuits to help advance epidemiologic research that use devices to assess physical activity and sedentary behavior exposure.

I think the most important advance we can make is to standardize our definitions and measures. This issue has certainly been extensively discussed in the measurement research community for a long time. The reason I think it is so important is because from my perspective as a physical activity epidemiologist, no single study will give us “truth” on the physical activity/sedentary behavior and health relationship; it is the totality of evidence that will inform us. And, the totality of evidence relies on our being able to combine data across studies—an impossible feat without standardization of what is measured.

Commentary by Sarah Kozey Keadle, PhD, MPH

Lee and colleagues present a comprehensive overview of data collection methods and preliminary results from the accelerometer sub-study of the Women's Health Study, a prospective cohort of ~18,000 women across the United States (Lee et al., 2018). This study was among the first to collect data using wearable sensors on such a large sample and subsequently the amount of data available globally has increased exponentially. There are now well over 400,000 participants globally with wearable sensor data who are being tracked prospectively (Doherty et al., 2017; German National Cohort, 2014; Wijndaele et al., 2015). Since Women's Health Study data collection commenced in 2011, Lee and colleagues have been leaders in identifying and addressing both opportunities and

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challenges that result from collecting wearable sensor data in large studies (e.g., Keadle, Shiroma, Freedson, & Lee, 2014; Lee & Shiroma, 2014; Shiroma, Kamada, Smith, Harris, & Lee, 2015).

The results of the present study are reassuring—studies using wearable sensors to assess moderate- to vigorous-intensity physical activity in relation to mortality are finding that the shape of the dose–response relationship is consistent with those using self-report questionnaires, but with a larger magnitude of risk estimates (Lee et al., 2018). Moreover, they provide examples of how wearable sensor assessment enables examination of the health-related outcomes associations with light-intensity activity, sedentary time, and patterns of activity within and between days that have not been previously possible.

Lee et al. also identify continued challenges facing the field, including a lack of consensus on methods for data collection (e.g., sensor, body location, determination of a valid day) or data processing method (e.g., algorithm or cut-point) (Lee et al., 2018). The measurement community must find ways to work collaboratively and recognize that resources dedicated to innovation must be matched by resources dedicated to understanding the equivalency of different data collection and processing approaches. This is an exciting time for “next-generation” physical activity epidemiology and papers such as this provide a template for the type of information that needs to be documented and compared between cohorts to ensure the results of these important studies can be translated into evidence-based public health messages.

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