



# Known Unknown: The Uncertainty and Inaccuracy of Consumer Wearable Devices

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## Editorial

The emergence of wearable technologies (e.g., smart watches, fitness trackers, smart clothing and jewelry) has enabled the widespread collection and tracking of data related to many aspects of health and human behavior. While self-tracking is most commonly used to support self-improvement and achievement of personal fitness goals, the process also can also enable better monitoring of physical activity, sleep, and other activities of interest among individuals with chronic medical conditions [1].

Devices intended to promote a healthy lifestyle focus primarily on capturing measures of physical activity and other fitness-oriented metrics are commonly called “activity-” or “fitness-trackers” [2]. The low cost and social desirability of such trackers has contributed to the rapid growth of these products among consumers. Consumer wearables enable the acquisition of personal metrics that support self-monitoring of progress toward individual fitness goals and can also be used to broadcast performance within a peer-group to elicit or provide social support, both of which are strong mediators associated with increases in overall physical activity [3, 4].

Alongside high rates of consumer adoption, activity trackers are being used increasingly by researchers and clinicians to support a range of activities including self-monitoring, reinforcement, goal setting, and measurement among adults [5-10] and youth [11]. Devices are intended to provide accurate feedback and update on progress toward achieving physical activity and weight loss goals.

Despite widespread interest in the use of these technologies across public health and medicine, it is important to establish the validity and reliability of data derived from consumer wearable devices. Our systematic review [12] found that devices measure some things better than others; specifically, the review found high validity in measurement of steps, limited data on accuracy for estimating distance and physical activity, and low validity for estimates of energy expenditure and measurement of sleep duration and efficiency.

While data such as steps, elevation, and heart rate are measured directly using onboard sensors, other aspects of daily feedback provided to users, including distance traveled and energy expenditure are derivative. Outputs from consumer wearable systems that are not directly measured on the device are prone to error. The execution of such functions is shrouded in the mystique of commercial, proprietary algorithms are therefore not fully appreciable.

In January 2016, a class-action lawsuit was filed against Fit bit, claiming “dangerous inaccuracies” in heart rate tracking, especially during exercise [13], which underscores the importance of validating

both direct and indirect measures from such devices, especially if used for research purposes.

Additional, independent validation of native features to establish and monitor progress toward achievement of physical active and weight loss goals is warranted. As consumer adoption of wearables continues to increase and as investigators seek to leverage this trend in contemporary public health intervention design, caution is urged.

Until more details on how these functions are executed is known or manufacturers adopt voluntary data standards, users and researchers alike should seek to calibrate or validate tracker performance whenever possible and until better data are available, consider alternatives to relying on such features as a primary data source.

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