Beyond cut-points: Introducing a novel accelerometer metric that captures the physical activity intensity distribution

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Overall activity level, defined as average acceleration over a 24 h period, is directly measured and comparable across studies. However, it tells us little about the intensity distribution. It is important to capture both overall activity and the intensity distribution as, for some health markers, it appears the volume of activity is more important than the intensity, but for others the converse appears to be true.

Herein we introduce a new metric, the intensity gradient, that: captures the entire intensity distribution; does not rely on calibration protocols (that, by nature, are population- and protocol-specific); and is independent of overall activity level, thus can be used alongside average acceleration.

The intensity gradient is taken from the log-log regression line of the negative curvilinear relationship between intensity and time accumulated at that intensity. To demonstrate its potential we applied it to two datasets: 1669 adolescent girls, and 295 adults with type 2 diabetes. The intensity gradient was negatively associated with body fatness in the girls and positively associated with physical function in the adults; associations were independent of average acceleration and co-variates. In contrast, moderate-to-vigorous physical activity was not independently associated with body fatness or physical function.

In summary, collectively the average acceleration and the intensity gradient provide a complementary description of a person’s entire activity profile, facilitating investigation of the relative importance of intensity and volume of activity for a given outcome. Crucially, the metrics are not subject to the error and population-specificity associated with converting acceleration into physical activity outcomes.