**24-hour population-level activity patterns: application of relative versus standard reference frame**

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**Background**: Population-level analysis of physical activity levels reveals a 24-hour pattern determined by the alignment of each individual's activity with a common reference point, i.e., the 24-hour standard timeframe. In this way, each person's day begins at midnight. At the population level, we see a gradual increase in activity during the morning. However, the reference for this is relatively arbitrary. We hypothesised that a different pattern of 24-hour activity would emerge if, instead of using the standard timeframe, we used a timeframe defined for each individual, relative to the time the individual got out of bed.

**Methods:** Using activity data from 30 university employees, recorded over 7 days using an activPAL3, we synchronised the start of each 24-hour period to the point at which each individual got out of bed. Time upright (standing and stepping) per 30 minute epoch was plotted.

**Results:** The population-level profile of upright time based on the standard timeframe appears as a bell curve of activity (Figure 1A). Activity was low during the night, followed by a gradual increase in activity from 5 a.m. Activity peaked at ~10 a.m. with a second peak at ~5.30 p.m. Using the relative timeframe, there was a clear peak in activity within the first 30 min of getting out of bed (Figure 1B). Activity levels remained broadly stable for ~11 hours, with a gradual decline thereafter.

**Discussion:** Using a timeframe relative to the time an individual wakes up has important implications for understanding population level behaviours: most individuals show a clearly defined pattern that is different from the activity pattern derived from the 24-hour standard timeframe. These data might provide a better description of activity patterns within populations.