Rebound calculation

Formally, the homoeostatic rebound H_i of an individual i was expressed as:

$$H_i = R_i - \hat{R}_i \tag{1}$$

$$\hat{R}_i = \alpha + \beta B_i \tag{2}$$

Where,

- $\hat{R}$ is the *predicted* sleep *after* treatment ($ZT \in [0, 3]$),
- R is the *measured* sleep *after* treatment ($ZT \in [0, 3]$),
- B is the sleep measured *before* treatment ($ZT \in [0, 3]$), and
- α and β are the coefficients of the linear regression $R_C = \alpha + \beta B_C$ on the control group C.

$$\alpha = \bar{R_C} - \beta \bar{B_C} \tag{3}$$

$$\beta = \frac{Cov(R_C, B_C)}{Var(B_C)} \tag{4}$$

Behavioural state

$$B = \begin{cases} quiescence, & \text{if } V_{max} < T_V \forall i \\ micro\text{-}movement, & \text{if } \sum^i |X_i - X_{i-1}| < T_d \\ walking, & \text{otherwise} \end{cases} \tag{5}$$

Where,

- V_{max} is the maximal velocity,
- T_V the validated threshold under which immobility is scored,
- X is the position along the tube,
- T_d is a threshold of 15 mm on the distance moved above which *walking* is scored.

The T_d was defined empirically based on the observation of a bimodal distribution of the total distance moved in a minute.

Relative position

$$position = \frac{X - Q_{0.01}(X)}{Q_{0.99}(X - Q_{0.01}(X))} \tag{6}$$

Where, Q_n is the quantile function.

First and last percentiles were used instead of minimum and maximum to avoid the possible effect of spurious artefactual detections beyond physical limits of the tube.

Hierarchical clustering

$$D(p,q) = \frac{\sum_{t \in T} BD_t(p_t, q_t)}{|T|} \tag{7}$$

$$BD_t(p_t, q_t) = -\ln(BC(p_t, q_t)) \tag{8}$$

$$BC(p_t, q_t) = \sum_{x \in X} \sqrt{p_t(x) q_t(x)} \tag{9}$$

Where,

- BD_t is the Bhattacharyya distance at a time interval t,
- T is the set of all tested time intervals: $T = \{[0, 0.25), [0.25, 0.5), ..., [23.75, 24)\}h$,
- BC_t is the Bhattacharyya coefficient at a time interval t,
- p and q are the observed distributions of behaviour for two different individuals, and
- X is a the set of discrete behaviours: $X = \{quiescent, micro\text{-}movement, walking\}$.