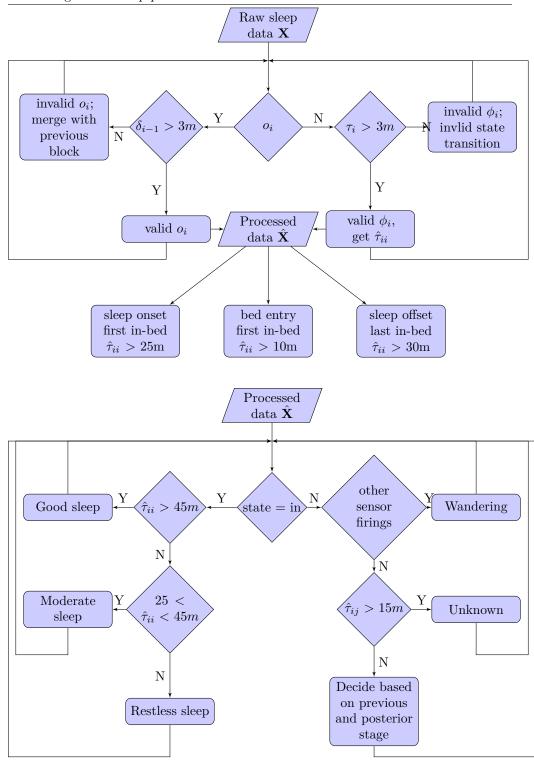# Supporting information

S3 Algorithm: Two level rule-based algorithm to analyse environmental data and extract night-time sleep pattern

Raw sleep data $\mathbf{X}$

invalid o_i; merge with previous block

$\delta_{i-1} > 3m$ —Y— o_i —N— $\tau_i > 3m$ —N→ invalid ϕ_i; invlid state transition

N

Y

valid o_i → Processed data $\hat{\mathbf{X}}$ ← valid ϕ_i, get $\hat{\tau}_{ii}$

Y

sleep onset first in-bed $\hat{\tau}_{ii} > 25$m

bed entry first in-bed $\hat{\tau}_{ii} > 10$m

sleep offset last in-bed $\hat{\tau}_{ii} > 30$m

Processed data $\hat{\mathbf{X}}$

Good sleep ←Y— $\hat{\tau}_{ii} > 45m$ —Y— state = in —N— other sensor firings —Y→ Wandering

N

N

Moderate sleep ←Y— $25 < \hat{\tau}_{ii} < 45m$

$\hat{\tau}_{ij} > 15m$ —Y→ Unknown

N

N

Restless sleep

Decide based on previous and posterior stage