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The interference of flexible working time with the circadian rhythm as a predictor of impairment to health and well-being

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Introduction

- Circadian rhythms can be disturbed / affected by flexible working hours
- In shift work these disturbances have been shown to be associated with health impairments, especially in those domains which are subject to circadian rhythms
- Can such effects also be demonstrated for flexible working hours ?

Methods

- Uni- and multivariate time series analyses:
  - spectrum analysis of working hours (on/off) and cross spectrum analyses of working hours and body temperature
  - using indicators like spectral power of selected periodic components
  - using the phase shifts of these periodic components

Methods – data base

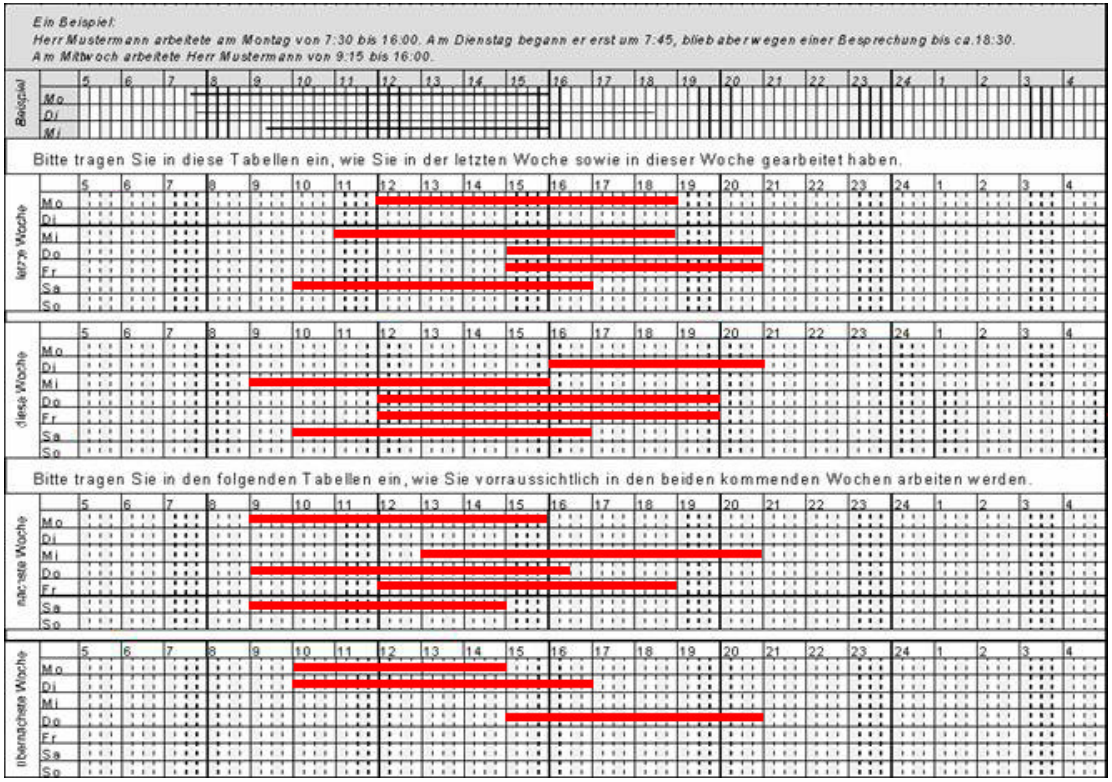
- Secondary analyses

  – survey on **flexible working times**
    - reported working hours over 4 weeks,
      – (= first time series; working time = 1, time off-work = 0 → rectangular signal)
    - questions on social and health impairments
      – dependent variables

  – rhythm of **body temperature**
    - from Colquhoun (1968b)
      – (= second time series)

Methods

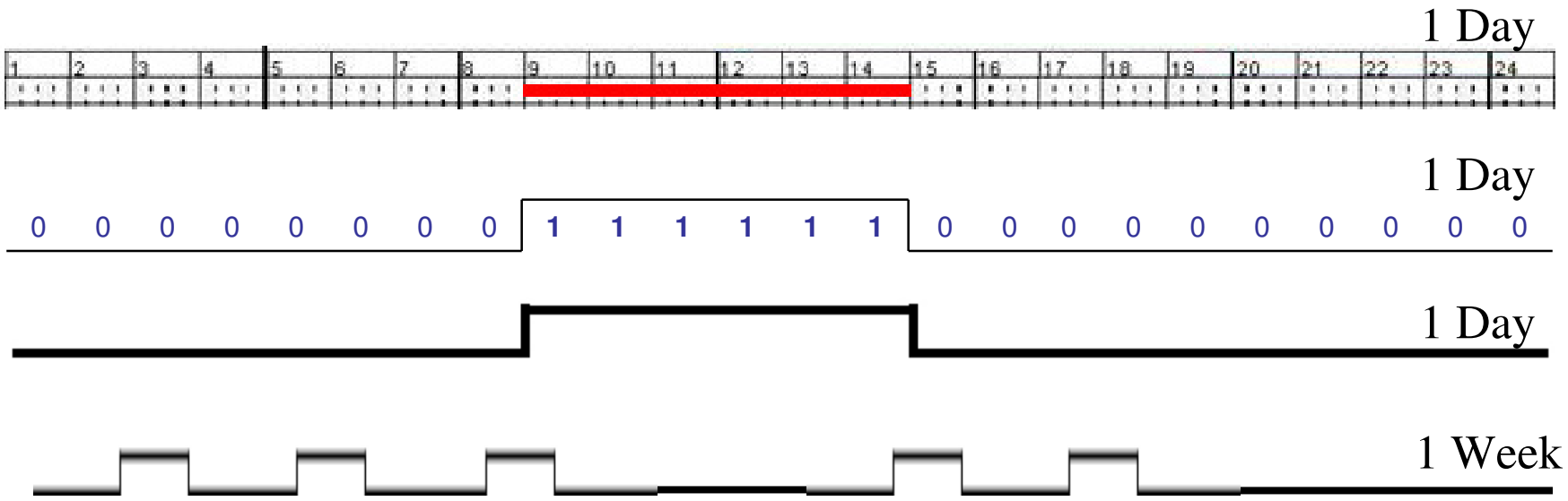
- Working hours over 4 weeks



Methods

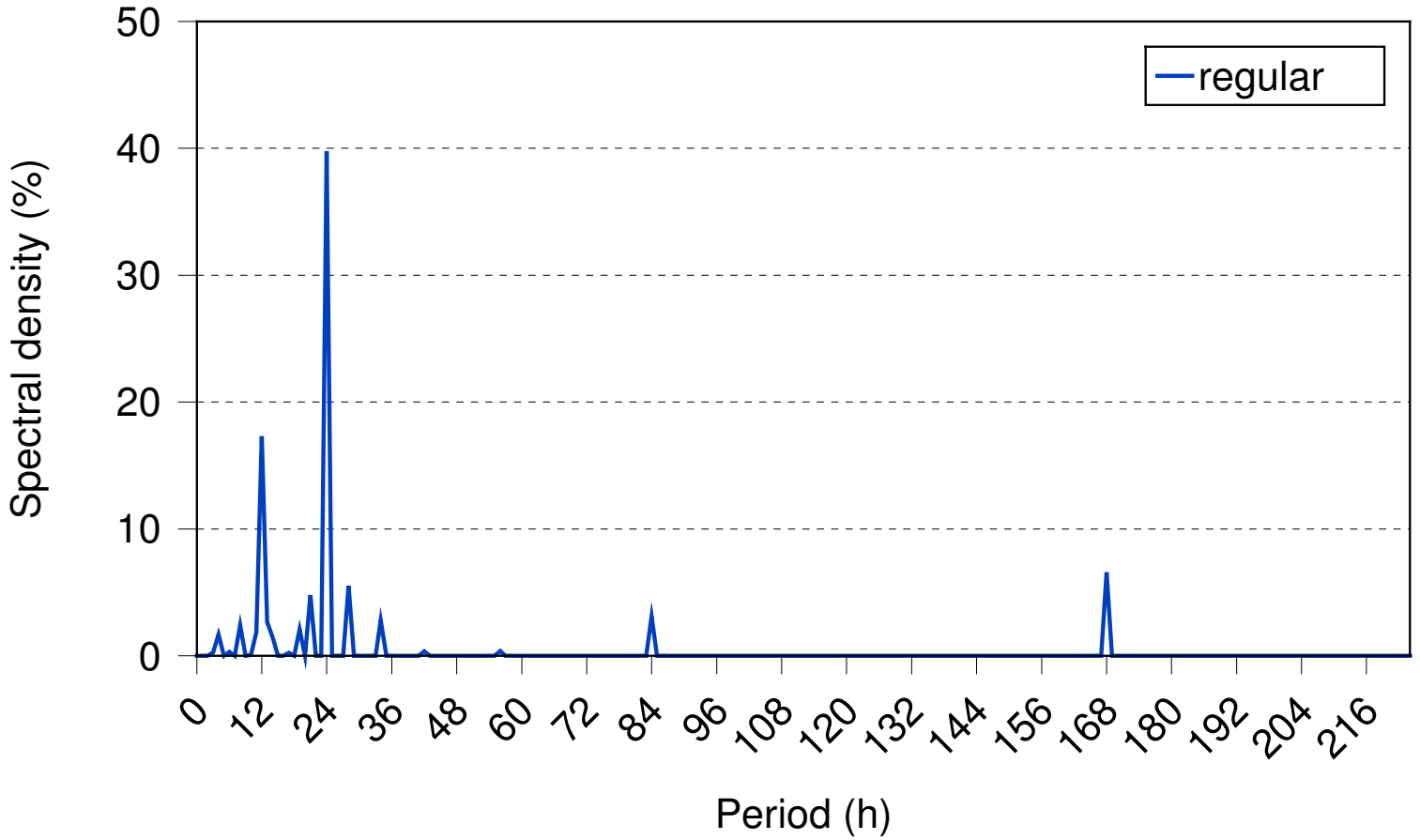
- Construction of time series (¼ h):

0 = off work / 1 = at work



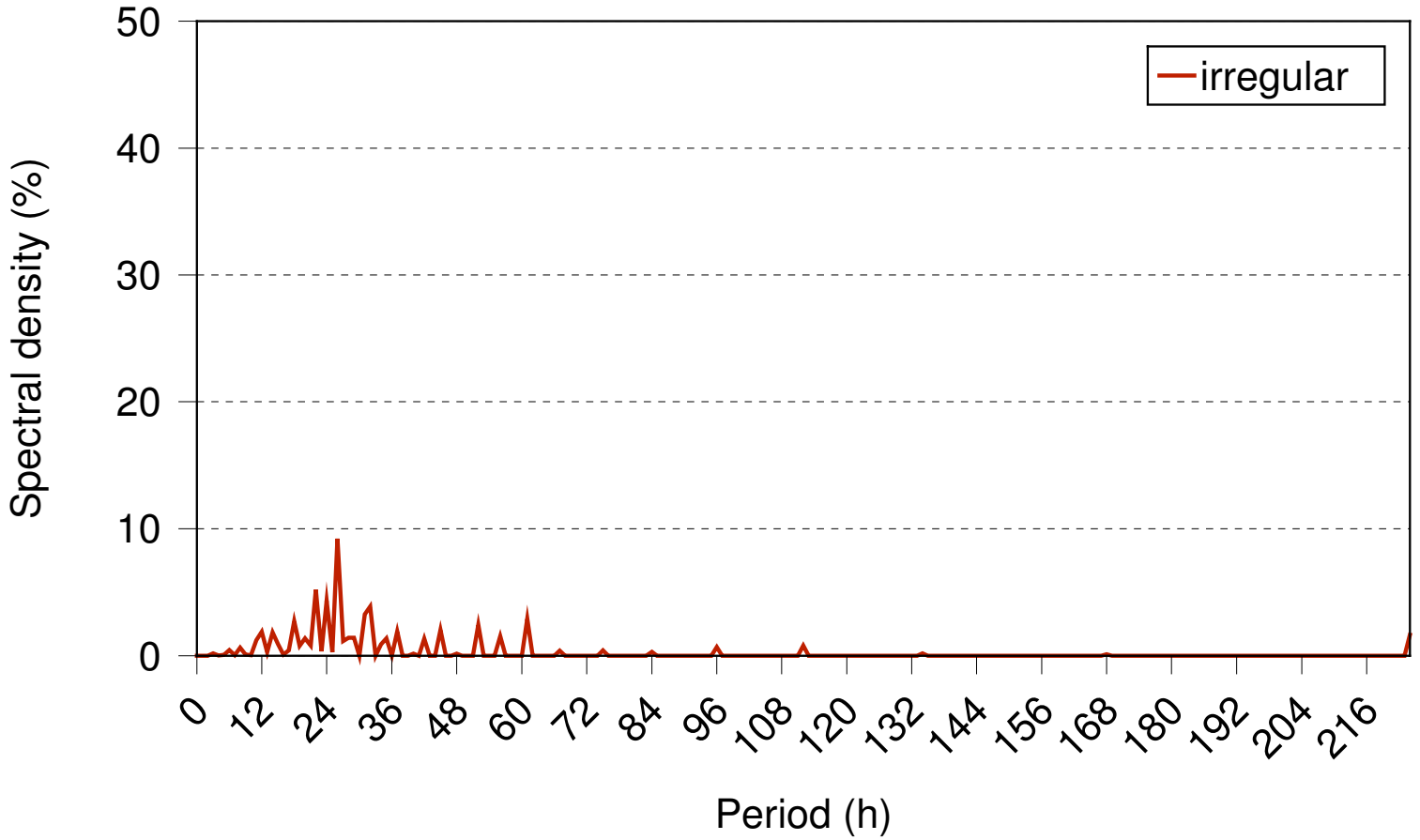
Methods

- Spectrum analysis of working times series



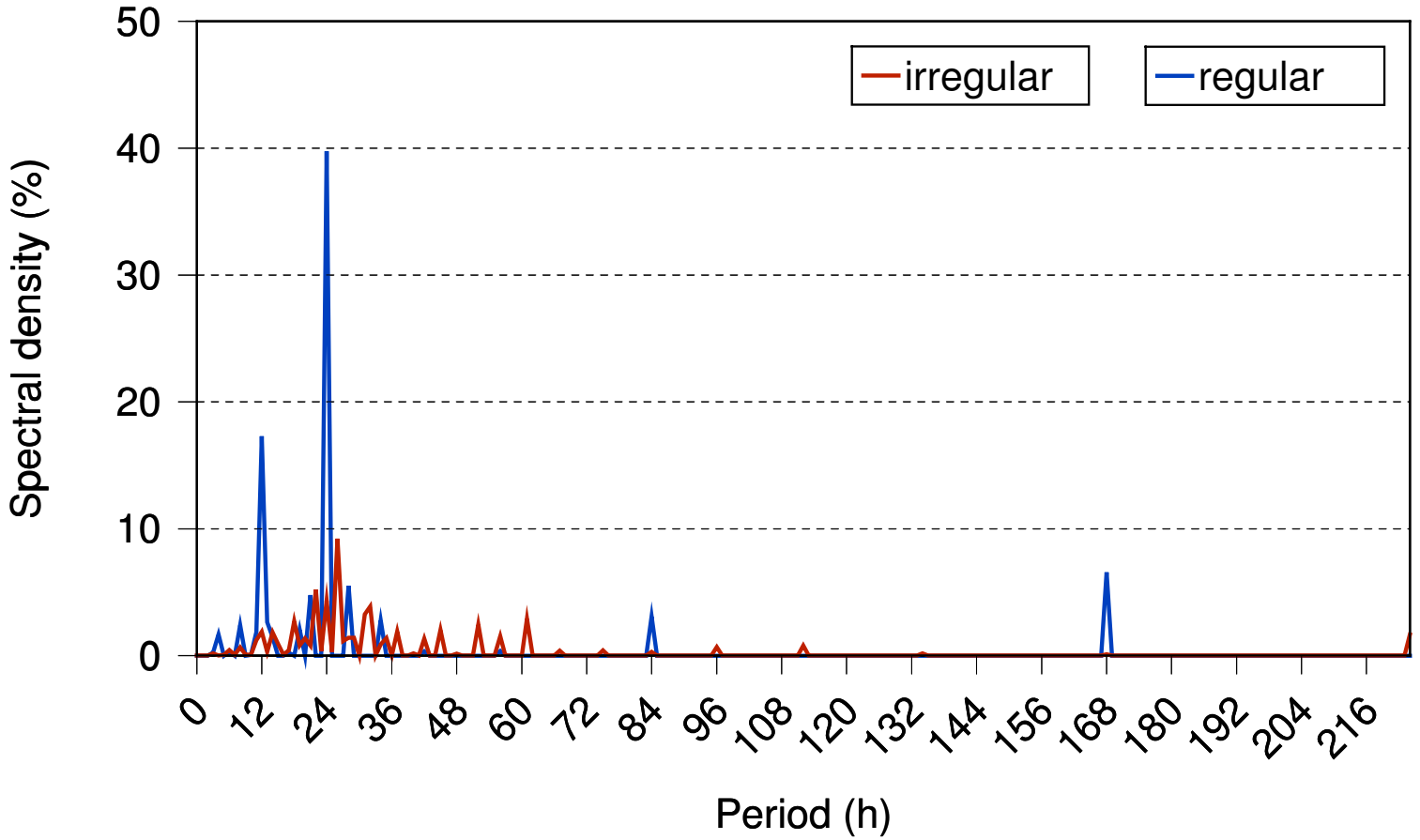
Methods

- Spectrum analysis of working times series



Methods

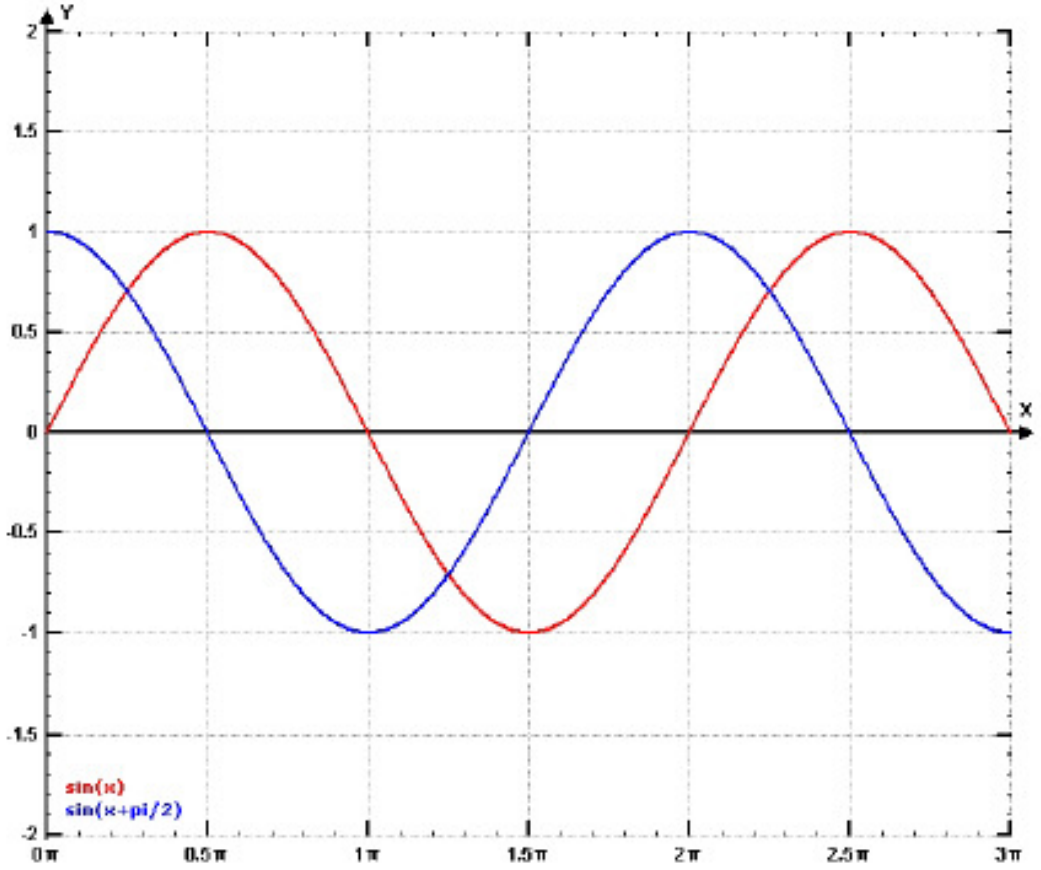
- Spectrum analysis of working times series



Methods

- Phase shift of time series

detection of the phase shift (φ) between two signals

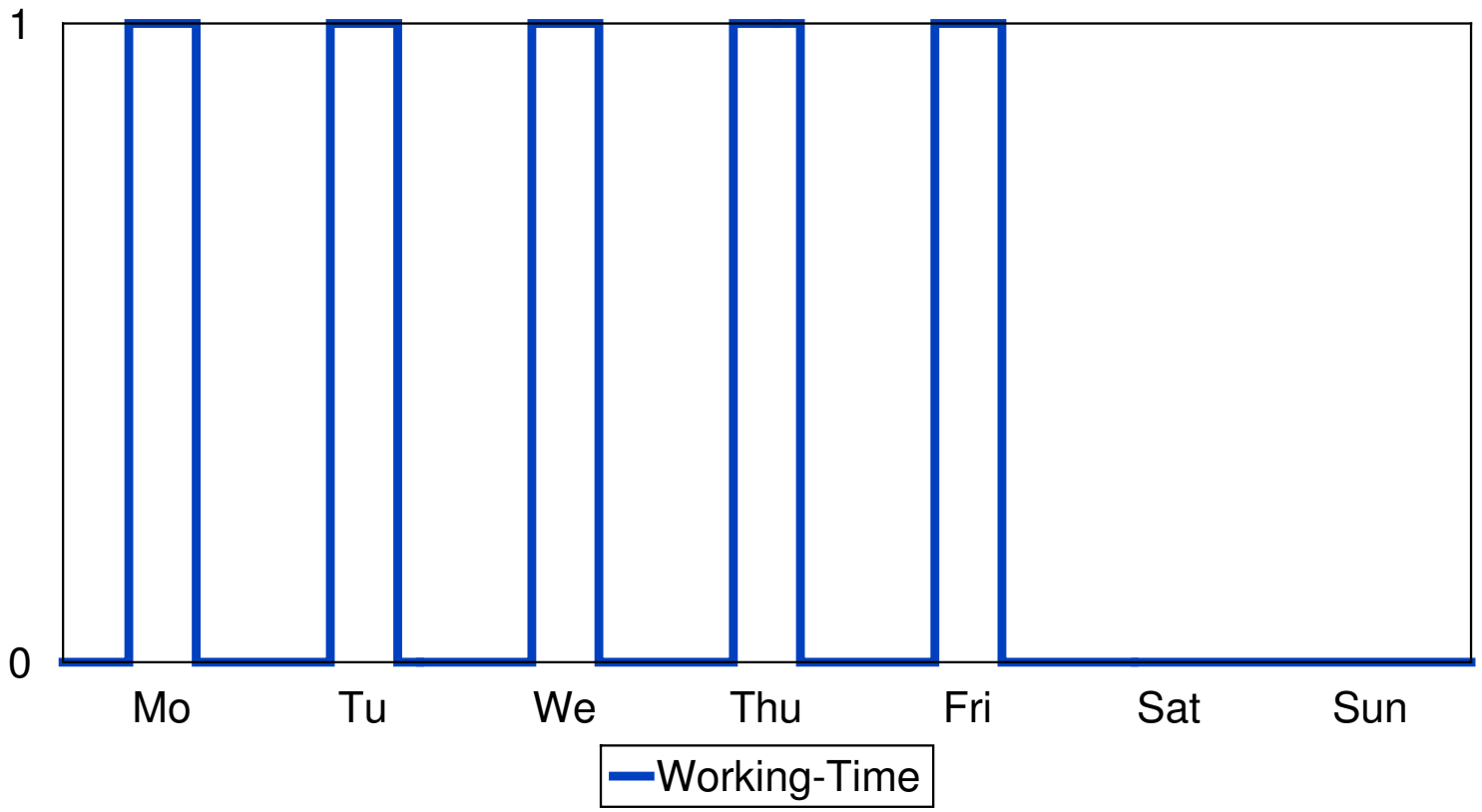


Methods

- Description of time series used
  - working hours
  - body temperature

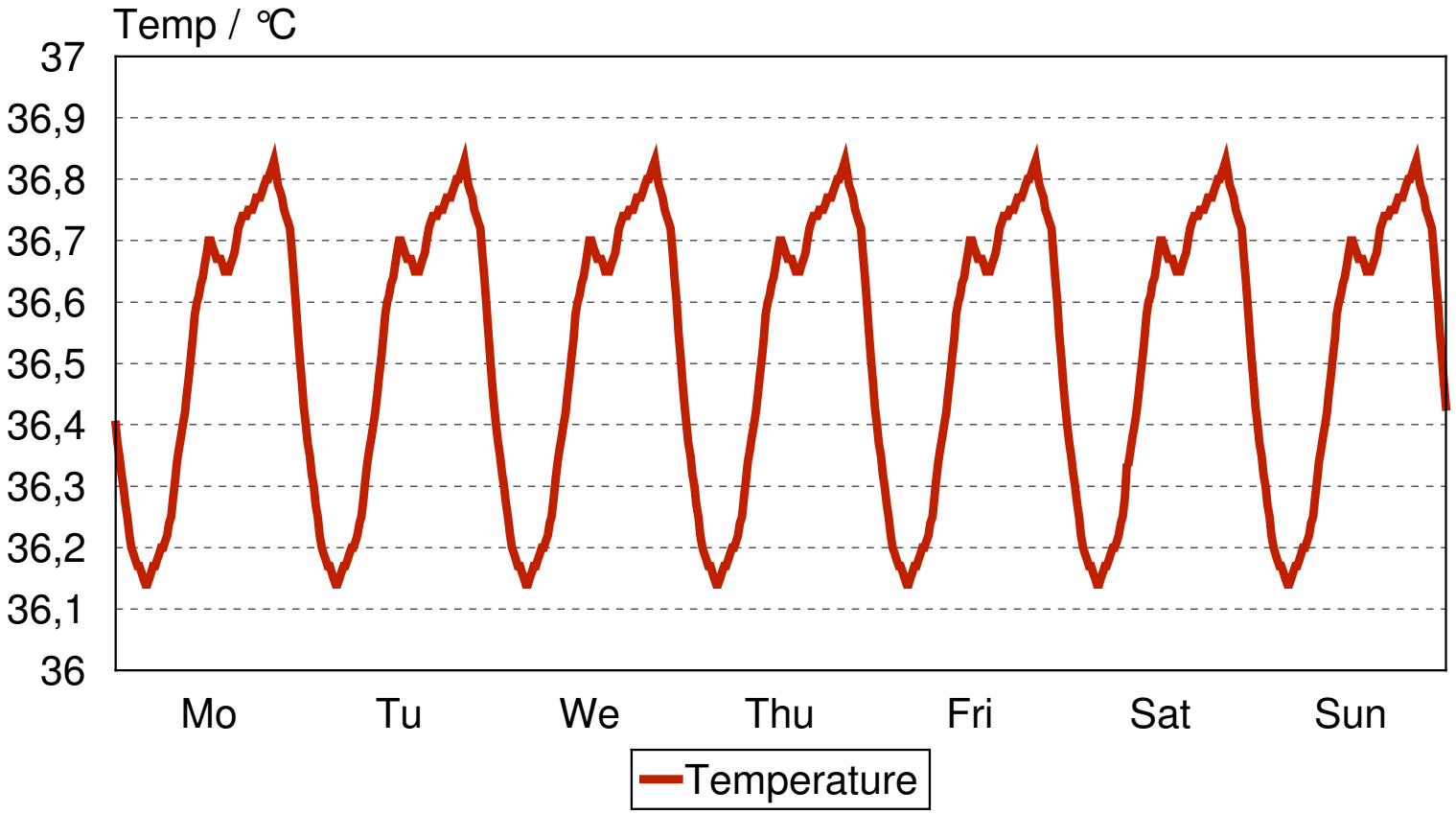
Methods

- time series (working-time)



Methods

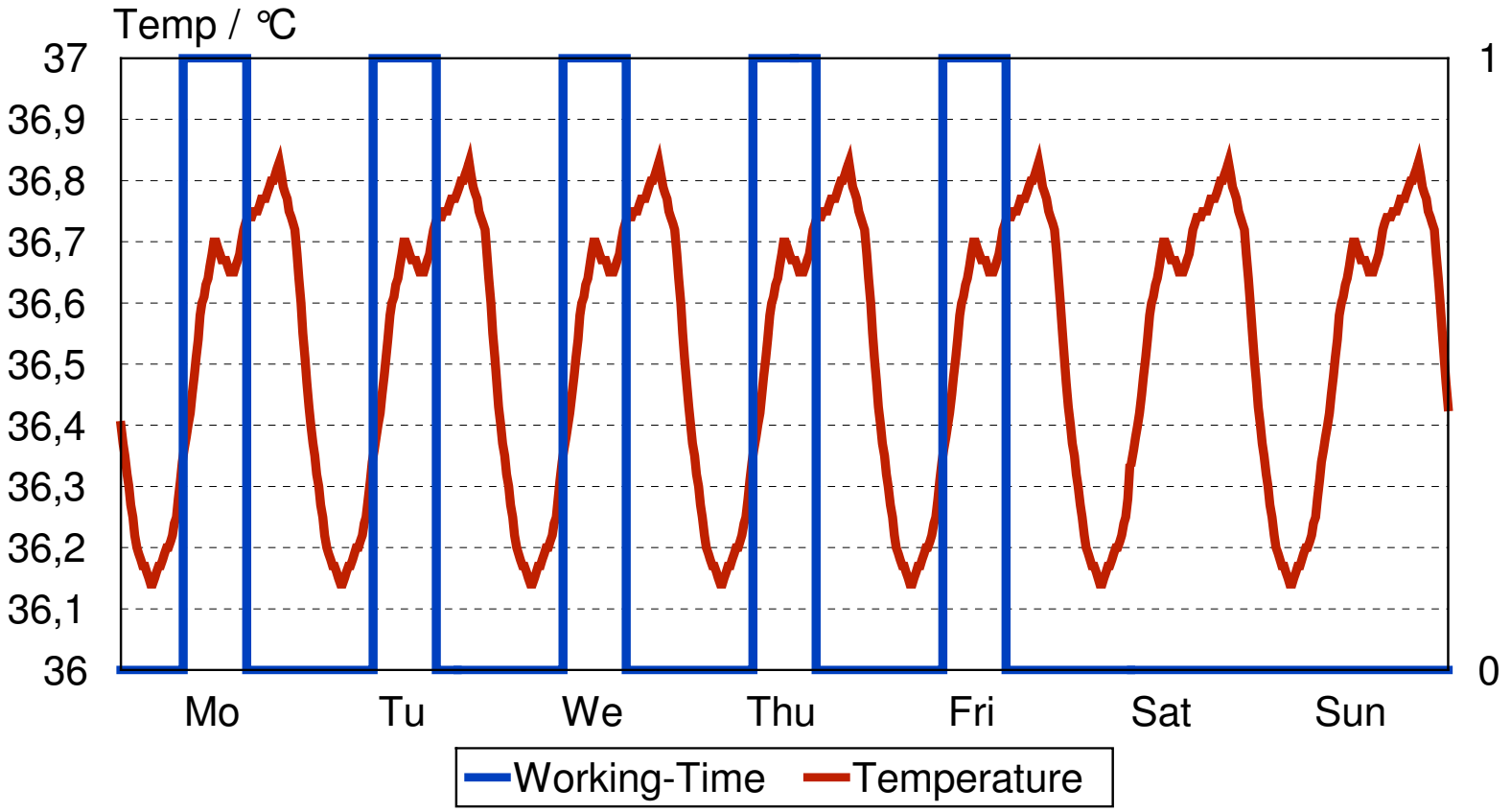
- time series (body temperature)



(Colquhoun et al. 1968b)

Methods

- time series (working-time and body temperature)



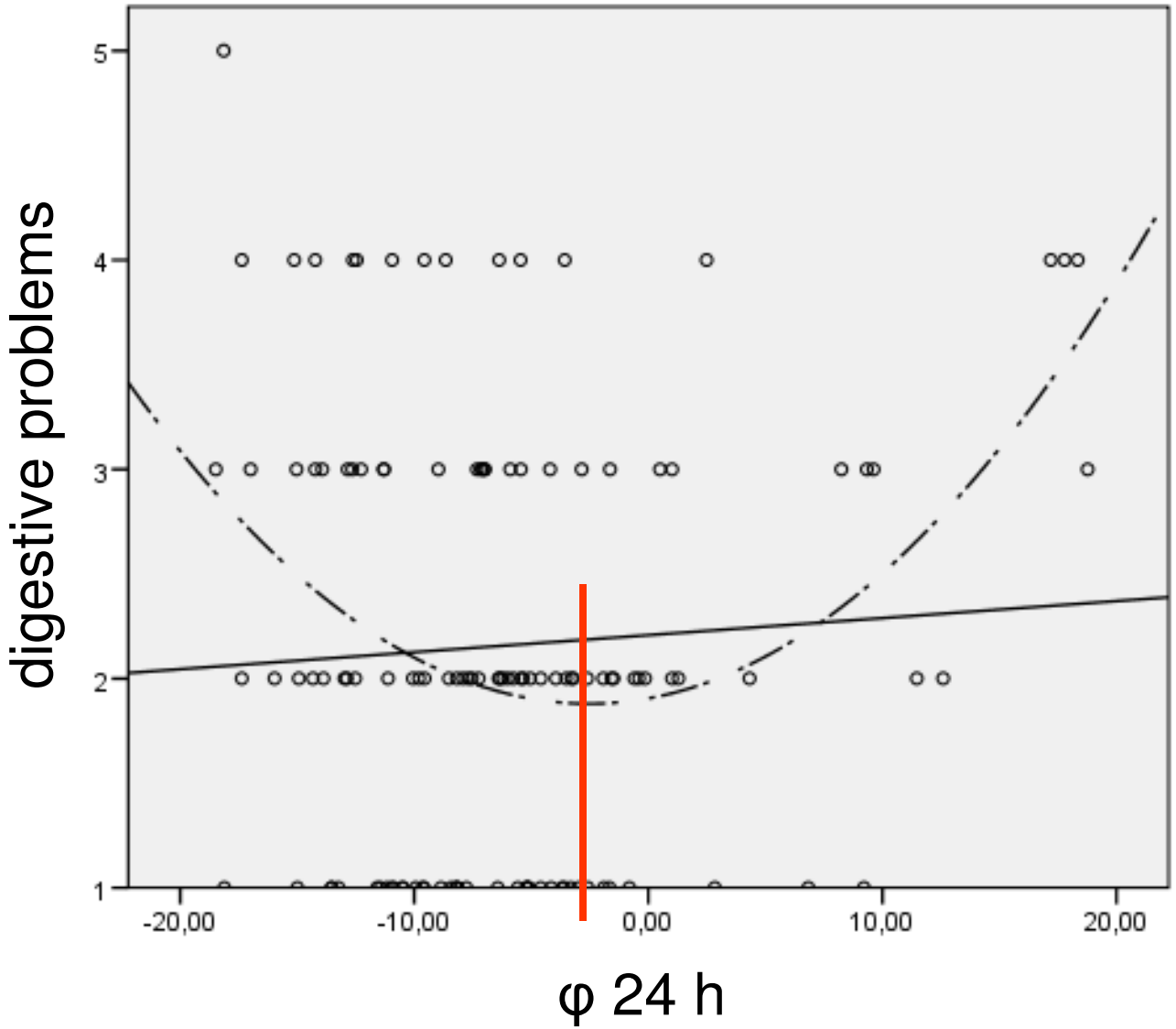
Selected Results

- correlation between spectral indicators and selected impairments

health impairments	Spectral power 168 h	Spectral power 24 h	Phase shift φ 24 h (-3h)
stomach or abdominal pain	-.209 (*)	-.052	.192 (*)
digestive problems	-.219 (*)	-.114	.324 (**)
sleeping problems	-.327 (**)	-.281 (**)	.150

(**) $p<0.01$ / (*) $p<0.05$

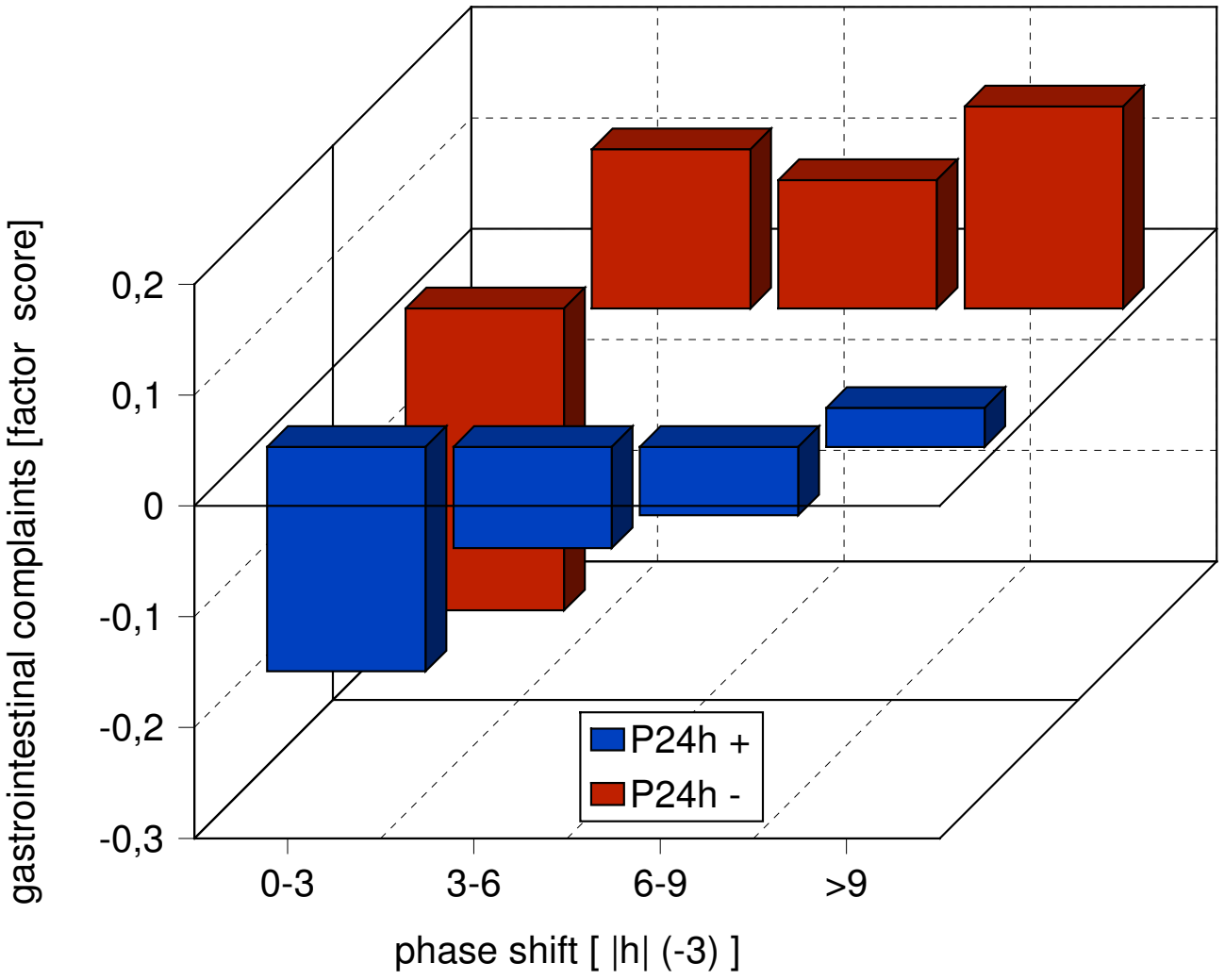
Selected Results



R^2 - linear: .004

R^2 - quadratic: .122

- Relation of the interaction of spectral power P24 and phase shift φ24 to gastrointestinal complaints [factor score]



Selected Results

- power spectra
  - moderate effects of the suppression of single components (p24, p168),
- phase shifts of the p24 are also moderately correlated with impairments
  - phase shifts of - 3h (with the temperature rhythm) seem to be optimal

Selected Results

- There is, as expected, no linear trend in the relation of complaints with phase shift ($R^2 = 0$)
- Instead, a quadratic trend is responsible for the variance explained (which amounts to roughly 12%), indicating that deviations of working hours to both sides from an optimum phase shift of working hours with circadian rhythm (ca. -3 h from the body temperature rhythm) lead to increased impairments

Conclusions

- A more extended database is needed (e.g. different kinds of flexible working hours with different phase shifts)

- to achieve stronger predictive power a more complex model is needed,
  - including more periodic components
  - including and / or controlling for the number of working hours

Thank you for your attention!

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