

Voluntariness and extent of telework – association with heart rate variability

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SUMMARY

We evaluated the impact that (1) voluntariness and (2) extent of telework had on 24h heart rate variability (HRV) measured objectively for three days in white-collar workers during the COVID-19 pandemic. Workers with high voluntariness had higher root mean square of successive differences between R-R intervals (RMSSD), however high extent of telework did not affect HRV metrics, after adjusting for suitable covariates. These results may indicate higher parasympathetic activity, an indicator of good health.

KEYWORDS

24h time-use, remote work, telecommuting, working from home.

Introduction

Telework increased significantly during the COVID-19 pandemic and telework became normative in many white-collar occupations. However, little is known about the effects of telework voluntariness on psychophysiological responses, and whether those effects depend on telework extent (Bouziri et al. 2020). The aim of this study was to investigate associations of voluntariness and extent of telework with 24-h measures of HRV, during the COVID-19 pandemic.

Methods

We used data from the *Flexible Work: Opportunity and Challenge* cohort (Svensson et al. 2022), including 294 white-collar workers from 8 companies, working $\geq 50\%$ of full time, who had answered a web-survey and accepted to participate in technical measurements of heart rate monitoring and physical activity (PA).

Data collections and analysis

Telework was measured using two questions, one about voluntariness to telework (“Do you currently have the freedom to choose whether you want to do your work remotely or not?”) and another about the extent of telework (“How much do you use the opportunity to work remotely during the ongoing pandemic?”). The possible answers were categorized as either high (“To a very high degree / quite a lot”) or low (“To some extent / not at all”). Each worker participated in technical measurements initiated by the research team at the workplaces or during on-line meetings, where body height and weight were also assessed to calculate body mass index (BMI). A heart rate monitor was used for three days (Bodyguard2, Firstbeat Technologies Ltd., Jyväskylä, Finland) and data were processed in the Acti4 software (Skotte and Kristiansen 2014). Heart rate (HR), RMSSD and standard deviation of R-R intervals (SDNN) were derived during work, leisure, and sleep, as

identified through a diary. A thigh-worn accelerometer (Axivity AX3, Axivity Ltd, Newcastle, UK) was used to assess PA for 7 days in terms of moderate to vigorous PA and sedentary/ light PA behaviors, using validated algorithms (Skotte et al. 2014) according to compositional data analysis (Hallman et al. 2021). Each company provided information about the workers' age and gender. We ran unadjusted and adjusted multilevel linear mixed models to estimate the effects of voluntariness and extent of telework on HRV, considering the period of the day (work, leisure, and sleep). Adjusted models included age, gender, BMI, and PA level. We performed all tests in SPSS (v. 27, IBM Corp, Armonk, NY, USA) with significance level at 0.05.

Results

Telework voluntariness was significantly associated with RMSSD in both the unadjusted (not shown) and adjusted models (table 1). RMSSD reflects the variance in the beat-to-beat HR and is used to estimate changes in HRV that are mediated through the vagal system, which can indicate that the high voluntariness of telework is associated with higher HRV, even though effect sizes were small. Contrary to expected, the relationship between telework voluntariness and HRV was not affected by telework extent nor period of the day, since we found no interaction between voluntariness and extent of telework nor period of the day. A low extent of telework per se did not affect HRV metrics after adjustment for covariates. Work and leisure were both associated with increased HR and reduced RMSSD and SDNN compared with sleep. Higher values of RMSSD and SDNN can be translated to efficient autonomic mechanisms (particularly parasympathetic cardiac modulations), which indicates good general health.

Table 1: Estimated effects (p-values) on heart rate (beats-per-minute - bpm), RMSSD (milliseconds - ms) and SDNN (ms) for high and low degrees of telework voluntariness and extent, as well as for different periods of the day.

		Heart rate (bpm)	RMSSD (ms)	SDNN (ms)
Voluntariness of telework	Low	0.55 (0.40)	-3.32 (0.01)	-1.74 (0.17)
	High	0.00 ^a	0.00 ^a	0.00 ^a
Extent of telework	Low	-0.08 (0.90)	1.35 (0.33)	1.81 (0.19)
	High	0.00 ^a	0.00 ^a	0.00 ^a
Period of the day	Leisure	16.40 (<0.01)	-15.19 (<0.01)	-6.93 (<0.01)
	Work	14.11 (<0.01)	-13.68 (<0.01)	-4.05 (0.01)
	Sleep	0.00 ^a	0.00 ^a	0.00 ^a
Models adjusted for age, gender, physical activity (accelerometry ILRs) and BMI. a. reference category. Bold values represent statistical significance				

Conclusions

This study showed that during the COVID-19 pandemic, workers with high voluntariness of telework had higher parasympathetic indicators of HRV than those with low voluntariness. Thus, it seems that the voluntariness to choose where to work (at the office or at home) during the pandemic had small, but beneficial effects on parasympathetic activity, which may be relevant to worker health. Telework extent did not affect the HRV metrics evaluated, however, it is important to acknowledge that in this study we measured telework extent as in the opportunity to telework "to a very high degree" or "not at all", and not as the frequency of telework in hours or days.

References

- Bouziri, Smith, Descatha, et. al., 2020. "Working from Home in the Time of COVID-19: How to Best Preserve Occupational Health?" *OEM* 77(7):509–10.
- Hallman, Januario, Mathiassen, et.al., 2021. "Working from Home during the COVID-19 Outbreak

- in Sweden: Effects on 24-h Time-Use in Office Workers.” *BMC Public Health* 21(1):1–10.
- Skotte and Kristiansen. 2014. “Heart Rate Variability Analysis Using Robust Period Detection.” *BioMed Eng OnLine* 13:138.
- Skotte, Korshøj, Kristiansen, et al., 2014. “Detection of Physical Activity Types Using Triaxial Accelerometers.” *J Phys Act Health* 11:76–84.
- Svensson, Hallman, Mathiassen, et. al., 2022. “Flexible Work: Opportunity and Challenge (FLOC) for Individual, Social and Economic Sustainability...” *BMJ Open* 12(7):e057409