

Using wearables to enhance police officers' resilience

Dr. Wim Kamphuis



TNO innovation
for life

Dr. Roos Delahaij, Helen Verhoef, MSc., dr. Herman de Vries, Marianne van Zwieten, MSc

Background

- Police officers → high mental load and stress
- Risk of development of illness and dropout
- Wish to tailor support to individual needs and self-management
- Developments in wearable technology provide opportunities
- Could wearables be used to enhance Resilience and Vitality?



Previous research

- Research in this domain is gaining momentum
- Recent review: González Ramírez et al (2023):
- 31 studies → stress reduction due to wearable intervention, however:
 - Most studies conducted in controlled lab settings
 - With students
 - Focusing on acute stress
 - Of short duration
- Need for studies
 - in natural (work) context,
 - with high-risk professionals (military, police, fire-fighters),
 - exposed to daily work stressors (chronic and acute)
 - Focusing on self-management of stress
 - monitoring intervention effects over a longer period of time

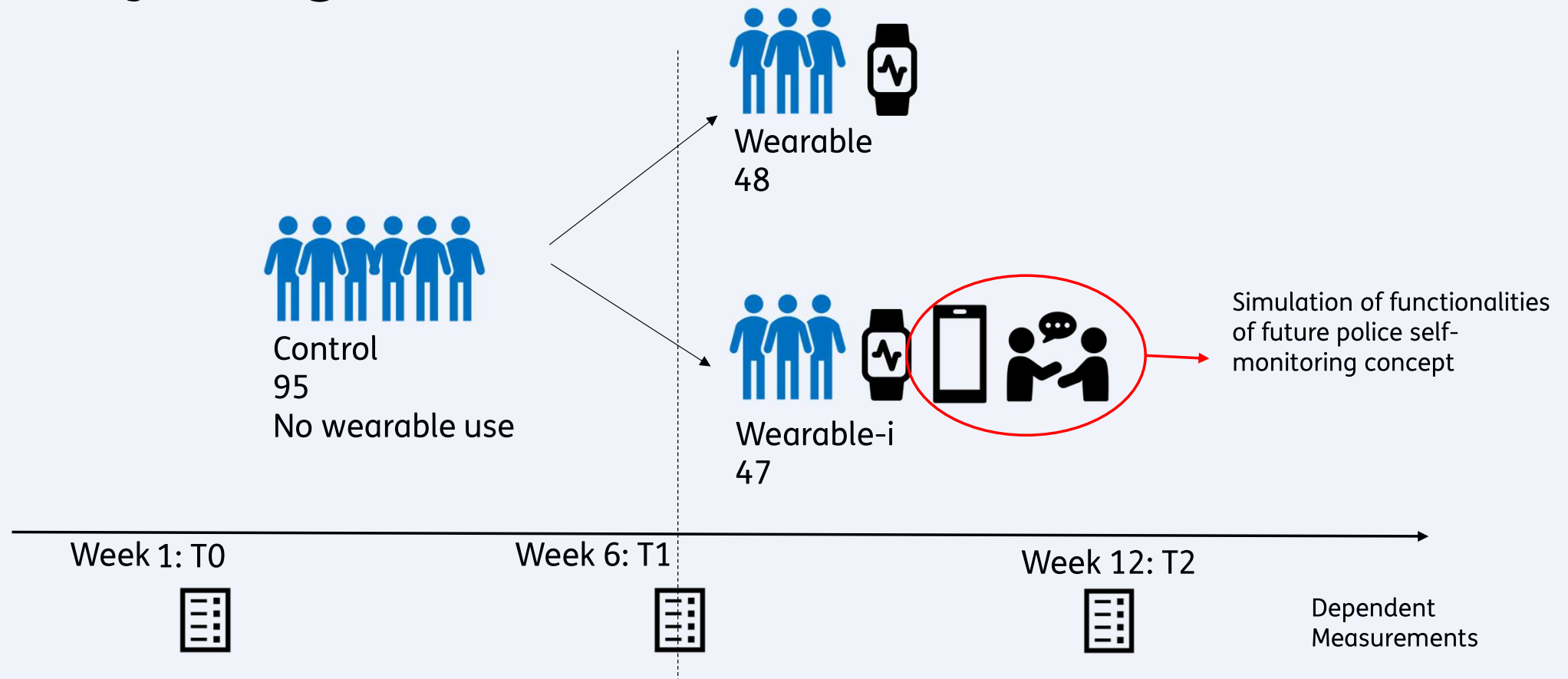
González Ramírez, M. L., García Vázquez, J. P., Rodríguez, M. D., Padilla-López, L. A., Galindo-Aldana, G. M., & Cuevas-González, D. (2023). Wearables for Stress Management: A Scoping Review. *Healthcare*, 11(17), 2369



Current Study

- Investigate, in the natural context, effects of personal monitoring with a smartwatch on:
 - **Awareness** of and insight in stress and stress related factors
 - **Self-efficacy** with regard to behavioral change, coping, stress resilience
 - **Perceived** stress, recovery and well-being
- Explore potential added value of functionalities based on a future police self-monitoring technology concept
 - Based on needs assessment in Dutch police officers
 - More personalized and contextualized feedback, more information, better integration in organisation

Study Design

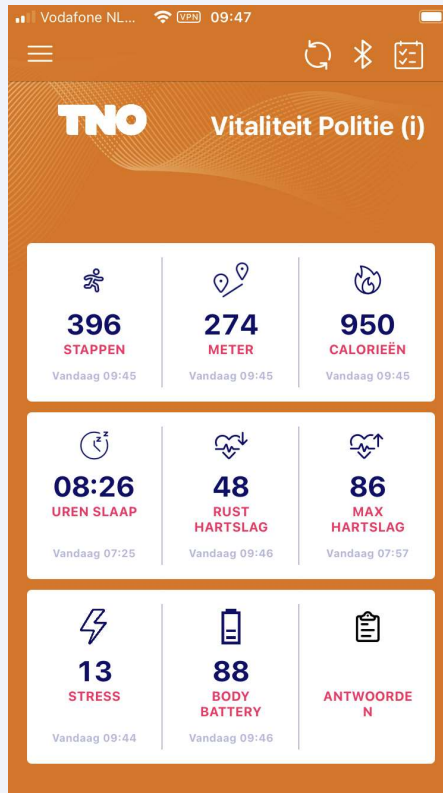


Wearable



Garmin Forerunner 255

- › Stress
- › Sleep
- › Movement
- › Heart Rate
- › Heart Rate Variability status

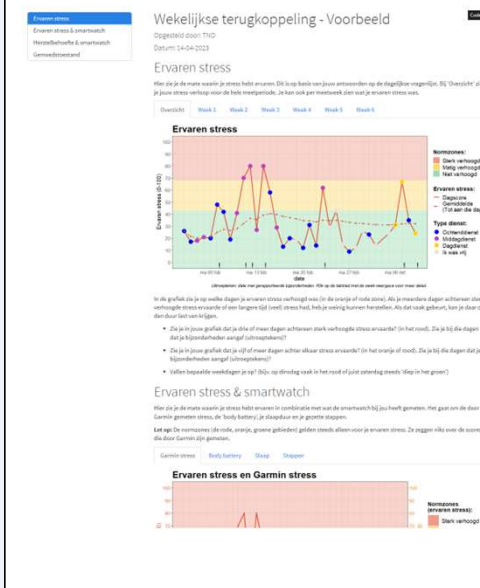


Sensorium app

- › Safe data storage within EU
- › No data on Garmin servers
- › Current, day-, week-, month-data

Wearable-i

Personal report Week 4



+ EMA questions
subjective mental state

- › Stress
- › Affect
- › Recovery
- › Incidents/issues

+ Personal report

- › Integration subjective and objective measures
- › Relations between factors
- › One-time Personalised advice

+ Embedding in team/org

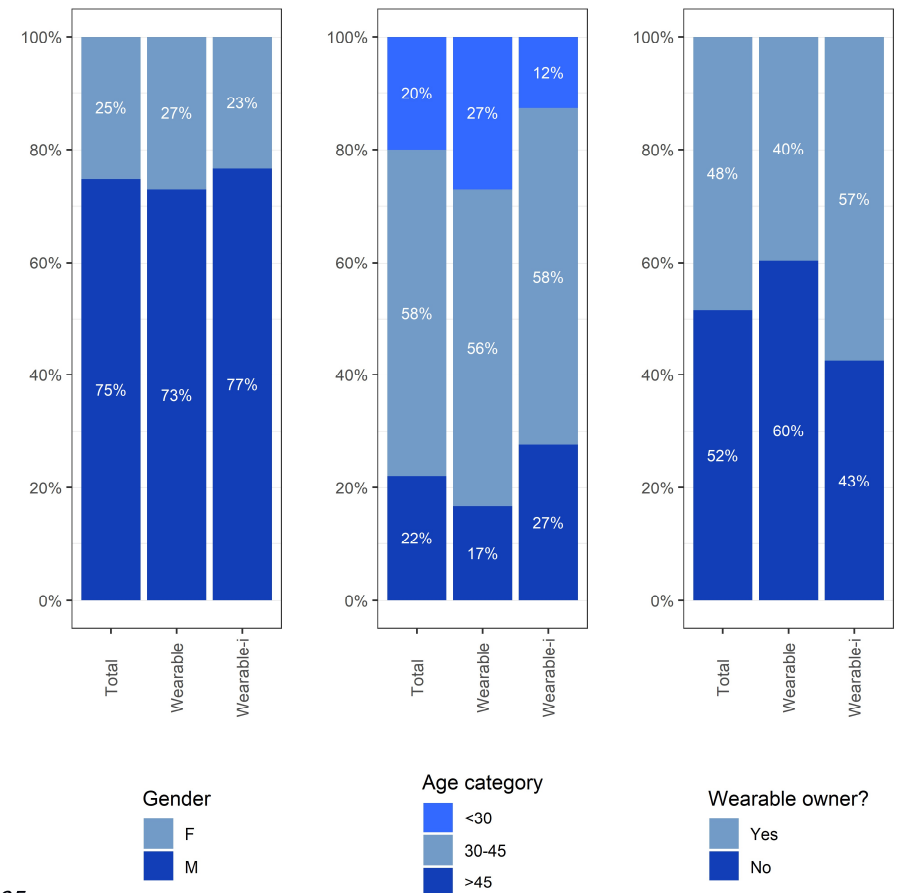
- › Intervention session with team (weekly)

Outcome measures (T0-T1-T2)

- Metacognitive Awareness (Awareness & Cause and Regulation) (MASC - Delahaij et al, 2008)
 - Stress
 - Physical activity
 - Sleep
- Self-efficacy (Police Resilience Monitor - Kamphuis et al, 2014)
 - Behaviour change
 - Coping
 - Stress recovery
 - Police task
- Health-related outcomes
 - Recovery During Work (Demerouti et al, 2012) and After Work (Police Resilience Monitor - Kamphuis et al., 2014))
 - Sleeping Problems (Police Resilience Monitor - Kamphuis et al, 2014)
 - Perceived Stress Scale (PSS-10 – Cohen, 1983)
 - Mental Health Continuum (MHC-SF – Lamers et al, 2011)
- User Experience (only T2)

Sample description and analysis methods

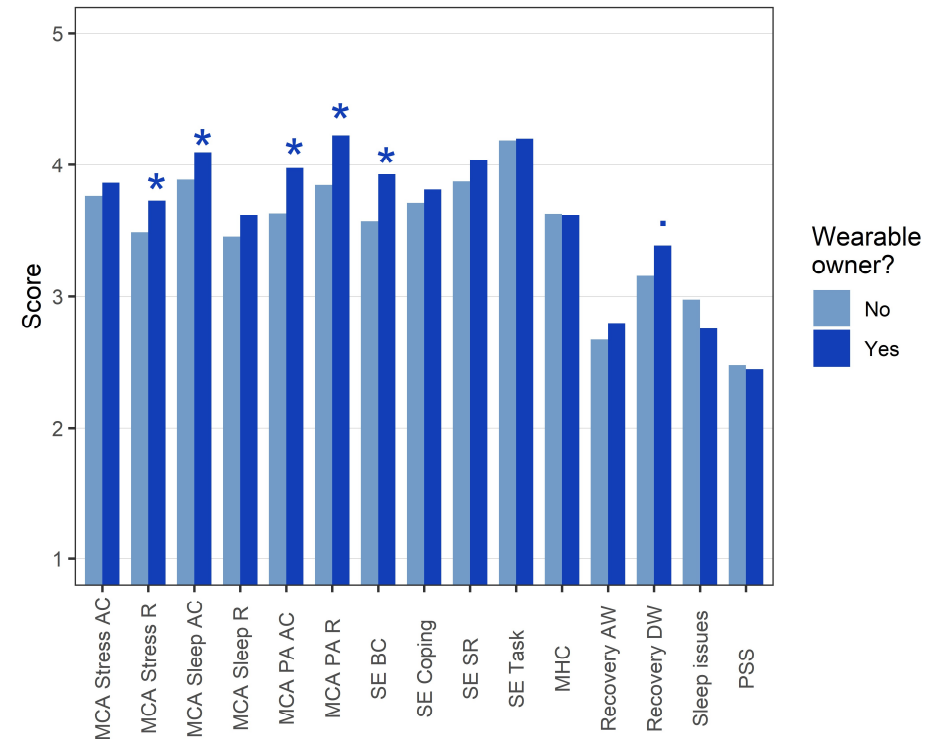
- Study sample:
 - 95 recruited (48 wearable, 47 wearable-i), predominantly:
 - male;
 - aged 30-45;
 - not owning a wearable before
 - 79 analyzed during hypothesis testing (excluded: n=11 used own wearable during control period, n=4 dropped out, n=1 used Garmin Connect during intervention period)
- Statistical method for hypothesis testing:
 - Linear Mixed Models (LMM)
 - Fixed factors: period (control versus intervention) & time (before versus after)
 - Random factor: participant ID



N=95

Results - Smartwatch users vs. non-users T0

- Wearable users at T0 score consistently better than non-users
- Especially on Meta Cognitive Awareness
- Difference statistically significant for 5 variables:
 - Stress Regulation
 - Sleep Awareness and Cause
 - Physical activity Awareness and Cause
 - Physical Activity Regulation
 - Self-efficacy behavior change
- Not manipulated → no causal effect (e.g. self-selection)



The MCA-variables, SE BC (1-7 to 1-5) & MHC (1-6 to 1-5) were rescaled for data-visualization purposes

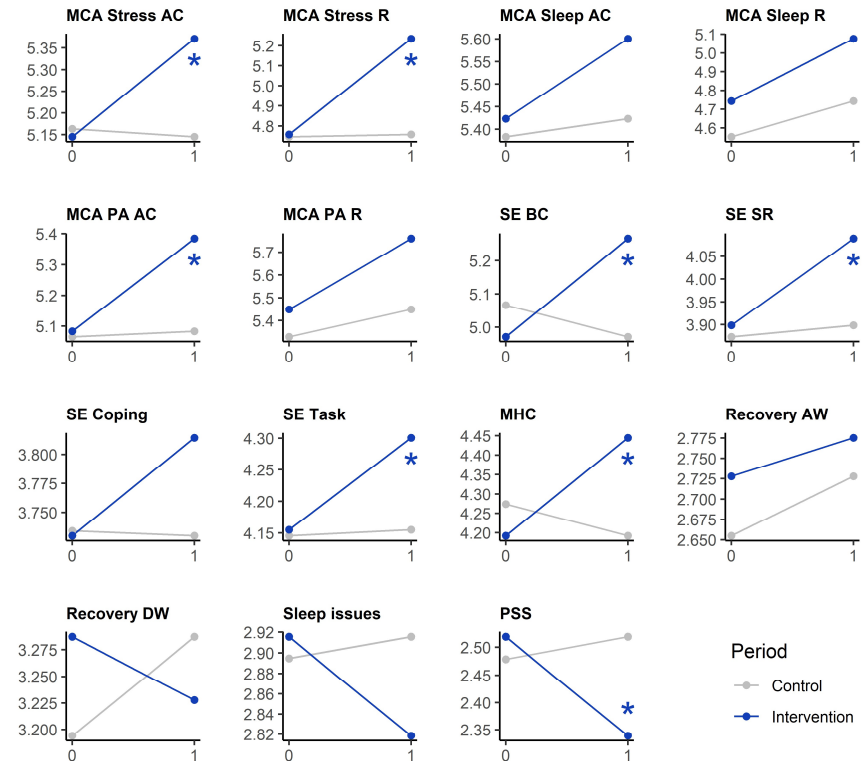
Bars with a starred ($p < .05$) or dotted item ($p < .1$) are significantly larger; T-Test, 1-sided

Abbreviations: AC = Awareness & Cause; AW = After Work; BC = Behavior Change; DR = During Work; MCA = Meta-Cognitive Awareness; MHC = Mental Health Continuum; PA = Physical activity; PSS = Perceived Stress Scale; R = Regulation; SE = Self-Efficacy; SR = Stress Resilience; W = Work

N=95

Results – Control vs. Wearable intervention

- Use of wearables lead to consistent increase in awareness, self-efficacy, and well-being related variables
- Statistically significant effects in 8 out of 15 variables:
 - Stress Awareness and Cause
 - Stress Regulation
 - Physical activity Awareness and Cause
 - Self-efficacy Behavior Change
 - Self-efficacy Stress Resilience
 - Self-efficacy Task
 - Mental Well-being (MHC)
 - Perceived Stress (PSS)



* The interaction effect in the starred items is statistically significant (p < .05)

Abbreviations: AC = Awareness & Cause; AW = After Work; BC = Behavior Change; DR = During Work; MCA = Meta-Cognitive Awareness; MHC = Mental Health Continuum; PA = Physical activity; PSS = Perceived Stress Scale; R = Regulation; SE = Self-Efficacy; SR = Stress Resilience; W = Work

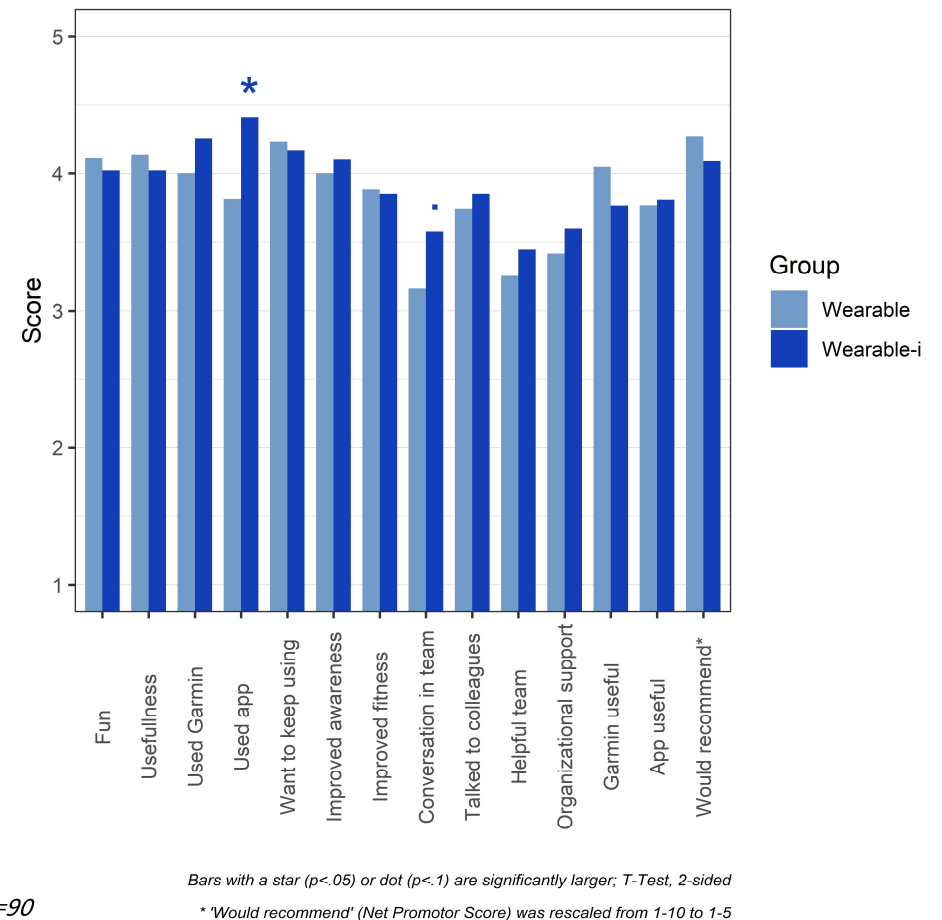
N=79

Results – exploration of wearable vs. wearable-i

- Hardly any differences between wearable and wearable-i condition
- Some significant 3-way interactions, but mainly due to (random) increase/decrease in control condition
- Additional analyses:
 - Participants who already used smartwatches benefitted more from wearable-i intervention
 - Non-users benefitted more from wearable condition
- Additional qualitative insights:
 - Remarks field in questionnaire show more positive attitude towards implementing self-monitoring for wearable-i condition

Results – Experience

- Participants were quite positive about both interventions
- Wearable-i participants more consistently used the app and experienced (slightly) more conversations in their teams on the topic of personal monitoring
- Quotes from 3 different participants:
 - *“It’s a great tool to gain insight in the effects of our work on our health. **In my eyes, this truly has added value for us as police employees.**”*
 - *“**I think it can be a positive contribution for police colleagues - provided there is proper guidance and monitoring. If colleagues misinterpret the data then it can have a negative effect.**”*
 - *“**I found that the graphs in the weekly feedback gave a more recognizable picture than the scores on the Garmin smartwatch. In the app it often seemed like I was very stressed, but the weekly feedback showed that I was not experiencing much stress at all. This was more in line with my feelings.**”*



Discussion

- Overall: many positive effects after just 5-6 weeks of use (!)
 - Awareness, self-efficacy, well-being and stress
- In addition: positive experience for participants, wish to continue using smartwatches
- No clear added value of functionalities based on technology concept,
 - **Existing users** did profit more in wearable-i condition
 - For **new users**, detailed feedback in wearable-i condition maybe too much
 - In Wearable-i, app was used more, more conversations in team
- Other potential reasons:
 - Difficulty of simulating new functionalities (e.g., risk detection)
 - Ceiling effects
 - Difference in individual needs

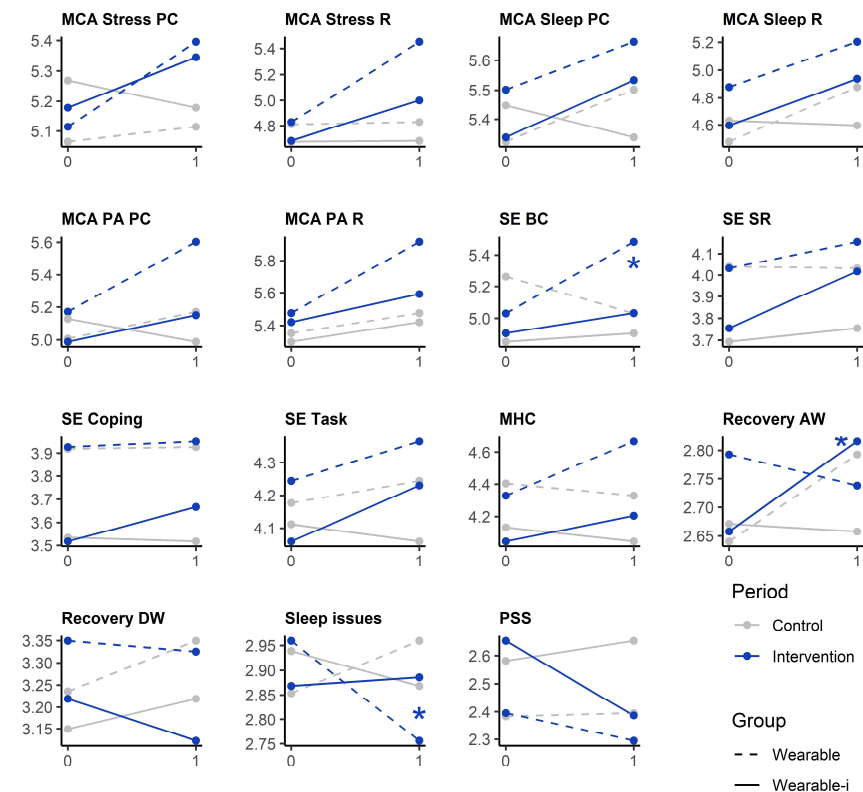
To conclude

- Personal monitoring with a smartwatch has clear benefits for resilience and vitality of police officers
- A personalized approach (which functionality/support is offered to whom) may result in best outcomes
- Can similar results be expected in military population?
 - Under what conditions?
 - With what functionality?
 - Facilitated by the organisation?



Results – Wearable vs. Wearable-i

• ...



* In starred items, the effect of the intervention significantly ($p < .05$) differs between groups

Abbreviations: AC = Awareness & Cause; AW = After Work; BC = Behavior Change; DR = During Work; MCA = Meta-Cognitive Awareness; MHC = Mental Health Continuum; PA = Physical activity; PSS = Perceived Stress Scale; R = Regulation; SE = Self-Efficacy; SR = Stress Resilience; W = Work

N=79

Previous research

Research in this area is gaining momentum. Few empirical studies yet that investigate the use of wearables to support self-management with regard to stress, especially in high-risk professions (i.e. military, police, fire fighters). Studies in other domains suggest potential positive effects.

- Khakurel, J., Melkas, H., Porras, J. (2018). Tapping into the wearable device revolution in the work environment: a systematic review", Information Technology & People. Doi: 10.1108/ITP-03-2017-0076
- Smith, E. N., Santoro, E., Moraveji, N., Susi, M., & Crum, A. J. (2020). Integrating wearables in stress management interventions: Promising evidence from a randomized trial. *International Journal of Stress Management*, 27, 172–182. Doi:10.1037/str0000137 Sit amet commodo magna eros quis urna
- Spook, S. M., Koolhaas, W., Bültmann, U, & Brouwer, S. (2019). Implementing sensor technology applications for workplace health promotion: a needs assessment among workers with physically demanding work. *BMC Public Health*, 19:1100. Vivamus a tellus
- González Ramírez, M. L., García Vázquez, J. P., Rodríguez, M. D., Padilla-López, L. A., Galindo-Aldana, G. M., & Cuevas-González, D. (2023). Wearables for Stress Management: A Scoping Review. *Healthcare*, 11(17), 2369. MDPI AG. Retrieved from <http://dx.doi.org/10.3390/healthcare11172369>
- 31 studies report significant stress reduction using different interventions; few real-live studies, many in lab, few in workplace, many with students, most focused on acute stress (short studies), less focused on prolonged behavioural changes, many non-controlled experiments
- 3 domains: self-regulation during stress episodes (most), self regulation therapies, awareness for prevention
- The use of wearable-based interventions helps to reduce stress since most studies report positive outcomes [[25](#),[26](#),[41](#),[42](#),[44](#),[45](#),[47](#),[49](#),[50](#),[51](#),[52](#),[53](#),[54](#),[56](#),[58](#),[59](#),[60](#),[61](#),[62](#),[63](#),[64](#),[65](#),[66](#),[68](#),[69](#),[70](#),[71](#),[72](#),[75](#),[76](#),[77](#)].
- The studies provide promising results regarding stress management through wearable devices. However, their results cannot be generalized to the rest of the population because most were conducted with students under controlled conditions in academic settings [[44](#),[50](#),[55](#),[56](#),[58](#),[64](#),[67](#),[75](#)]. Furthermore, there is a lack of evidence on adopting wearable devices for stress management.
- The evaluations of the interventions have been carried out in laboratory settings under controlled conditions, so more evidence gathered in a natural context is needed to conclude about the benefits of these approaches in the long term and their adoption. Also, many studies were excluded due to not reporting intervention evaluations, which indicate that the research interest is growing.
- However, it is essential to acknowledge that the generalizability of the results might be limited, as the evaluation of wearables was conducted in a specific context, particularly within an academic environment, and under controlled conditions. Consequently, it is imperative to conduct more extensive evaluations in real-life and daily settings to assess the broader applicability and effectiveness of these wearable-based interventions in