

Vivago clinical validation and findings

1. Automatic Sleep-Wake and Nap Analysis with a New Wrist Worn Online Activity Monitoring Device Vivago WristCare, Lötjönen et al, Sleep 01/2003

- The performance of the WristCare can be assumed to be well comparable to actigraphy in sleep/wake studies. The study suggests that the device may be used in long-term monitoring of sleep/wake patterns with similar performance to actigraphy.

2. Vivago - an intelligent social and remote wellness monitoring system for the elderly, Särelä et al, IEEE, 2003

- Vivago system provides an integrated intelligent social alarm and remote monitoring system to be used both in institutional settings and by the elderly user living independently at home. Experiences gained so far suggest that social alarms provided by the IST system perform comparably with traditional social alarm systems, while the intelligent features enable remarkably higher usage rates (94%) to be achieved. The activity monitoring integrated in the same device provides unique long-term follow up data of wellbeing through the analysis of circadian activity patterns.

3. Circadian activity rhythm in demented and non-demented nursing-home residents measured by telemetric actigraphy, Paavilainen et al, Journal of Sleep Research, 03/2005

- The IST Vivago system provides a useful and promising instrument for monitoring sleep/wake patterns and the overall well-being of demented elderly persons both in institutions and at home.
- The results showed clear differences between the circadian rhythm of demented and non-demented subjects. The study also suggests potential correlation between functional ability and activity data. Results support the use of the telemetric actigraphy in the long-term screening and follow-up of elderly subjects for sleep and circadian rhythm-related problems associated with dementia and changes in functional capacity.
- Non-demented subjects had higher daytime and lower nocturnal activity than demented subjects. The variation in activity during the 24-h cycle was lower among the demented subjects. Subjective assessments of sleep quality parameters did not differ between the two groups. However, we evidenced low correlation between the objective (activity signal) and subjective assessments of sleep and alertness in the elderly. Activity data correlated also with functional ability assessed by the BI.
- We found a significant correlation between functional capacity (the BI) and the activity data. The subjects with better functional capacity tended to have a clearer difference between day and night activity, suggesting a stronger circadian rhythm.

4. Telemetric activity monitoring as an indicator of long-term changes in health and well-being of older people, Case Study Paavilainen et al, Gerontechnology Journal, 10/2005

- Our results suggest that the IST Vivago system can be used as a simple unspecific screening and follow-up tool of the health and well-being of the elderly and hence, the system support clinical nursing and medical practices both in institutions and at home care settings, too.
- The presented cases suggest that monitoring the circadian activity signal produced by the IST Vivago® system provides a sensitive, but non-specific method for monitoring changes in the health status of older people. In many instances, the changes in the quality of the circadian rhythm paralleled or even preceded urinary Infection the clinical notes of significant changes in the physical health status, such as acute diseases. This is not surprising as some earlier studies have associated poor circadian rhythm or sleep disturbances with the poor physical or mental health or life satisfaction

5. Differences in light sleep and deep sleep measured with Vivago® wristcare, Lamminmäki et al, EMBEC'05, 2005

- The results indicate that Vivago® signals provide information on the quality of sleep. Activity measured with Vivago® is significantly smaller in deep sleep than in light sleep. The method could be used for screening and follow-up of sleep quality.

6. Validation of the Vivago Wrist-worn accelerometer in the assessment of physical activity, Vanhelst et al, BMC Public Health 2012

- Results of the study suggest that the Vivago Wrist-worn accelerometer is a valid measure of PA at varying levels of intensity. The study has also defined threshold values at 4 intensities and hence the Vivago Wrist-worn accelerometer may be used to quantify PA in free living conditions among adults. This device has possible application in treating a variety of important health concerns.

7. Association between continuous wearable activity monitoring and self-reported functioning in assisted living facility and nursing home residents, Merilahti et al, Journal of Frailty & Aging 2016

- The results suggest that more activity during daytime and more variance in activity patterns are associated with a better functioning status in this study population. The actigraphy measures describing activity rhythm patterns can potentially be a new insight for monitoring health status, and health changes among older people in the nursing homes and assisted living facilities.
- Our indicative results suggest that external stimuli such as facility activities and local weather patterns affect the behavior of older individuals, and that these influences might differ according to subjects' levels of functioning. This observation is supported both by quantitative group analysis (housing rhythm correlation with ADL) and qualitative case analysis.

8. Wearable Monitoring of Physical Functioning and Disability Changes, Circadian Rhythms and Sleep Patterns in Nursing Home Residents, Merilahti et al, IEEE Journal of Biomedical and Health Informatics, 2016

- The result suggest that long-term wearable physical activity monitoring may be useful for detecting trend changes in several activity behaviors reflecting functioning and health changes in nursing home environment.
- The activity rhythm and activity level indices were more sensitive to indicate physical functioning changes than sleep indices.
- Our results suggest that degeneration and break-down of circadian rhythm due memory disorders has to be taken into account when interpreting long-term nursing home residents' actigraphy recordings.
- In the longitudinal analysis (12-18 months), at an individual level the activity rhythm indices and activity level had the strongest correlations with changes in physical functioning but the associations were to some extent individual.
- In long-term case recordings, decrease in the physical functioning was most strongly associated with decreasing levels of activity, stability, and strength of the activity rhythm, and with increasing fragmentation of rhythm and daytime passivity. Daily wearable monitoring of physical activity may hence reveal information about functioning state and health of older adults.

9. Correlation between Vivago wellbeing measurement and RAI physical activity measurement ADLH, IADL6 and MAPLe5; Nordic Healthcare Group, NHG, 2017

- Results of the study shows that Vivago Wellbeing measurement and RAI PA measurements ADLH, IADL6 and MAPLe5 has correlation. Vivago wellbeing notifications and alarms can be used to determine need to update RAI evaluation.

10. Actigraphy in evaluation and follow up of physical functioning of older adults, Merilahti J. PhD Thesis, VTT Science, 2017

- Since the correlations slightly differed depending on the study population we suggest that monitoring activity level, activity rhythm strength, similarity and variability simultaneously is recommended.
- The thesis results suggest that the actigraph is a feasible health monitoring concept to be utilized in assisted living and nursing home settings and is suitable for follow up of changes in activity patterns associated with changes in physical functioning.