Long-term adherence with wearing a multi-sensor watch in the Personalized Parkinson Project

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Background

Wearable sensors can potentially provide valuable insights into real-life symptoms and function with minimal impact on daily life. For longitudinal deployment, maximizing data completeness and minimizing patient attrition is essential. In the Personalized Parkinson Project, a single center cohort study, participants are asked to wear a multi-sensor watch for 2 years, up to 23 hours per day, 7 days a week.

The Verily Study Watch

- Continuous collection of data from multiple sensors (accelerometer, photoplethysmogram (PPG), skin empedance, and ambient light).
- Data transferred to secure cloud during charging (~1 hour per day) via cellular internet connection.
- No interaction with watch is required; screen displays time and date.
- Device use encouraged by education before study entry, in-person instructions at study start, and helpdesk for troubleshooting.
- Wear time monitored, proactive support for those with suboptimal wear times.

Table 1. Baseline characteristics PPP cohort (N = 379)

		Total	Men (n=214)	Women (n=138)
Demographics				
Age (years)	**Mean (SD)**	62.5 (8.8)	62.9 (8.6)	61.7 (9.0)
Disease at onset				
Age at diagnosis (years)	**Mean (SD)**	59.6 (8.6)	60.0 (8.3)	58.9 (9.0)
Time since diagnosis (years)	**Mean (SD)**	2.9 (1.5)	3.0 (1.4)	2.7 (1.5)
Motor functioning in OFF				
MDS-UPDRS part III	**Mean (SD)**	20.0 (7.4)	21.1 (7.3)	18.2 (7.1)
Timed UP & GO (fastest, in seconds)	**Mean (SD)**	7.2 (2.1)	7.1 (2.1)	7.4 (2.2)
Pegboard test	**Mean (SD)**	27.5 (6.5)	25.8 (6.4)	30.7 (5.5)
Hoehn & Yahr	**Mean (SD)**	2.1 (0.6)	2.0 (0.6)	2.1 (0.6)
1 *(unilateral)*	**Count (%)**	40	25 (10.9%)	15 (11.8%)
2 *(bilateral)*	**Count (%)**	266	175 (76.1%)	91 (71.7%)
3 *(physical independent)*	**Count (%)**	44	25 (10.9%)	19 (15.0%)
4 *(can still walk without help)*	**Count (%)**	7	5 (2.2%)	2 (1.6%)
5 *(wheel chair or bed)*	**Count (%)**	0	0 (0%)	0 (0%)
Neuropsychological symptoms				
MDS-UPDRS part I	**Mean (SD)**	2.9 (2.6)	3.0 (2.5)	2.8 (2.6)
MoCa	**Mean (SD)**	26.7 (2.5)	26.3 (2.6)	27.4 (2.2)
≤ 26	**Count (%)**	135	102 (42.3%)	33 (24.1%)
Brixton Spatial Anticipation Test	**Mean (SD)**	16.5 (7.9)	17.2 (8.1)	15.3 (7.3)
BDI-II	**Mean (SD)**	10.9 (6.5)	10.9 (6.6)	10.7 (6.5)
Apathy scale	**Mean (SD)**	29.3 (5.0)	28.7 (5.0)	30.3 (4.9)
STAI	**Mean (SD)**	75.7 (18.3)	74.5 (18.2)	77.6 (18.5)
				Status August 21, 2019

SD = standard deviation; MDS-UPDRS = Movement Disorders Society-sponsored revision of the Unified Parkinson's Disease Rating Scale; MoCa = Montreal Cognitive Assessment; BDI-II = Beck Depression Inventory, version II; STAI = State Trait Anxiety Inventory for Adults.

Objectives

- Assess long-term participant engagement with a multi-sensor watch in participants of the Personalized Parkinson Project.
- Collect user experiences and suggestions to improve the Study Watch.

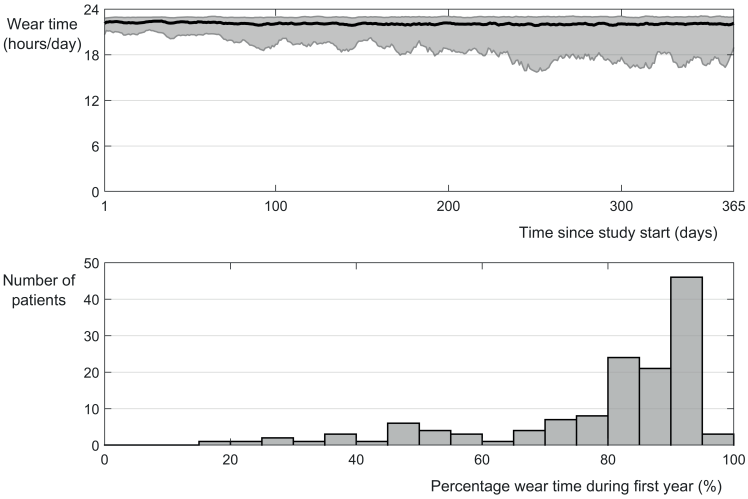

Figure 1a: Median wear time per day, since study enrollment in participants who have been enrolled for at least 1 year (n=136), with IQR in grey shades. Figure 1b: Distribution of the percentage of cumulative wear time in the first year of participation (100% = 24 hours for 365 days).

Results

- In participants who have been enrolled for at least one year (n=136), the median percentage of cumulative wear time in the first year was 85%* (IQR: 75%-92%).
  *the percentage was calculated per participant by dividing the number of hours of cumulative wear time by the total number of hours in one year.
- Wear time is relatively stable over time [figure 1].
  - Six participants dropped out, one related to Study Watch use.
  - In an online survey (n=214), 76% indicated it was pleasant to wear the watch, 5% thought it was unpleasant, and 19% responded neutrally.
  - Suggestions to improve the Study Watch include feedback on own data (e.g. step counts), add an alarm for medication intake, and make the watch waterproof.
  - Study is ongoing.

Conclusion

It is feasible to achieve stable, high wear times with a multi-sensor watch in the context of a large Parkinson's cohort study, even without provision of individual data back to participants. Probable facilitators are high wearing comfort and ease of use of the device, as well as personal support and positive attitude towards the study's objectives and technology used.

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