Objective: We introduce Sleep Fit, the first tablet application to collect subjective and objective clinical data especially designed for patients with Parkinson's Disease (PD).

Background: Home-based systems to collect data from patients with PD have been getting increasingly common in last years. New technologies provide helpful tools to improve patients' care and quality of life. Nevertheless, these devices might not be easy to use by these patients.

Methods: Sleep Fit is a tablet app conceived especially for patients with PD with the aim to collect objective and subjective data at their home. Its core structure consists in a) an electronic finger tapping test; b) motor, sleepiness and emotional subjective scales; c) a sleep diary. From the prototype "alpha" to the current version v1.1.4, key improvements were made in order to enhance the patients' compliance and the quality of collected data. Sleep Fit v1.1.4 provides enhanced ergonomics and graphical features, automated flows that guide the patients in performing tasks throughout the 24 hours; secured real-time data collection and consultation; possibility to easily integrate new tasks and features. The patients were asked to perform multiple assessments four times a day, during two weeks at their home, by mean of Sleep Fit. We evaluated the patients' compliance, defined as the percentage of completed tasks on the total expected tasks. We also evaluated the satisfaction of the 17 patients having used the final version of Sleep Fit.

Results: Sleep Fit was tested by 43 consecutive PD patients (10 females, mean age 67.7 ± 9.8). Of them, 19 used the alpha version, 7 an intermediate version and 17 the final v1.1.4 version. Overall, the compliance was 90%. It increased from 88% for the patients using the alpha version to 94% with the final one. At the end of the two weeks, 94% of the patients declared they would use again Sleep Fit for clinical purposes for the same time (76.5%) or even for longer (17.7%).

Conclusions: Sleep Fit is a well-accepted, easy-to-use tool to accurately collect objective and subjective data in PD and to increase compliance in home-based studies in these patients. It outstands other home-based systems for ergonomics and usability for patients with PD. Patients' compliance was higher in our study compared to previous similar studies. [figure1]

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1122

Tracking RBD and PD progression with longitudinal structural brain connectomes

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Objective: To compare longitudinal structural connectomes derived from whole brain dMRI and PD clinical rating scales as a disease progression biomarker, on three cohorts: de-novo PD, RBD and matched controls

Background: REM behavior disorder (RBD) patients have an estimated lifetime rate of conversion to an alpha-synuclein neurodegenerative disorder of 75-90% and by the time Parkinson's disease (PD), the most common alpha-synucleinopathy, is diagnosed more than 60% of nigrostriatal neurons have already been lost. There are no known biomarkers for disease diagnosis or progression. Diffusion MRI (dMRI), combined with machine learning (ML) holds potential as a structural connectivity biomarker to track longitudinal changes in white matter connectivity more objectively.

Methods: The dataset was created by selecting all RBD subjects with at least two dMRI scans as of May 2017 from the publicly available Parkinson's Progression Markers Initiative (PPMI) dataset. Images were acquired using 3T TIM Trio Siemens scanners with 64 diffusion-weighting gradient directions. The dataset included 16 RBD, 21 PD and 30 controls matched for age, sex, and time between scans. Selected clinical rating scales include the most common scales for motor and cognitive progression (UPDRS-III, SDM and MoCA). Anatomical segmentation was done with a multi-contrast PD atlas, which includes 16 areas of the nigrostriatal pathway. A machine learning (ML) model was trained to identify differences in progression of PD and control group, and used the RBD cohort as a fully external validation. Statistical significance was computed with logistic regression corrected for confounding effects of age and sex.

Results: The best performing ML model was able to distinguish progression between the PD and Control group (AUC=0.89, p<0.001). Most notable was that it found the same PD-specific progression pattern in the RBD group (AUC=0.76, p<0.01). This model was compared with cross-sectional and longitudinal data from clinical rating scales for both motor (UPDRS-III) and cognitive assessment (SDM and MoCA) which showed that the longitudinal brain connectomes had the best performance in identifying differences in progression.

Conclusions: These results demonstrate feasibility of a computational dMRI-based structural connectome biomarker to quantify the progression of neurodegenerative patterns occurring in PD and found in the prodromal RBD group. This approach is a first step towards developing an objective clinical tool to track progression and predict with high specificity and sensitivity the individual RBD patients who will convert to PD.

1123

Safety and efficacy of high definition tDCS for proprioception and balance in Parkinson's disease: A pilot randomised trial

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Objective: To determine: 1. Is HD-tDCS safe and well-tolerated in PD? 2. Does combined HD-tDCS and physical exercise improve proprioception and balance in PD?

Background: Proprioception is decreased in people with Parkinson's Disease (PD) and this reduction is clearly evident at early stages of the disease. Transcranial direct current stimulation (tDCS) combined with exercise can improve motor outcomes in people with PD. It is possible that high definition tDCS combined with exercise may increase proprioception in people with PD.

Methods: Randomized cross-over trial consisting of 8 participants with early to mid-stages PD, aged between 68 and 75 years (M=72.63 SD=2.62). Participants completed 4 weeks of experimental intervention (combining active HD-tDCS with exercises), and 4 weeks of control intervention (combining sham tDCS and cognitive training). Measurements were taken of ankle proprioception in inversion and plantarflexion, balance, symptom severity and fear of falling by a blinded physiotherapist at baseline, 2 weeks and 4 weeks.

Results: There was no significant change in proprioception during inversion or plantarflexion between experimental and control conditions. Participants had significantly, and clinically important, improved balance during the experimental condition compared with during the control condition (p = 0.006), with a mean difference of 3.25 out of 28 (95% CI 1.09 to 5.41). 100% of participants reported being unable to notice the difference between sham and active HD-tDCS protocols. No adverse events were reported.

Conclusions: Combined HD-tDCS and physical exercise did not significantly improve proprioception in PD sufferers, however balance was significantly improved. High definition transcranial direct current stimulation was well tolerated in this population.

1124

Objective monitoring of drug response in early PD patients using remote, at-home typing data through machine learning analysis

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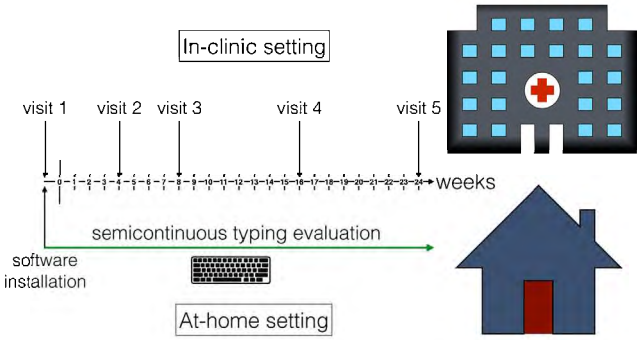

FIG. 1. (1124)

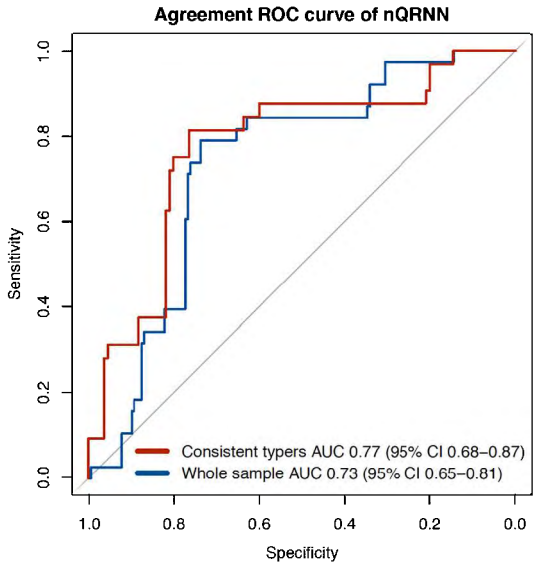

FIG. 2. (1124)

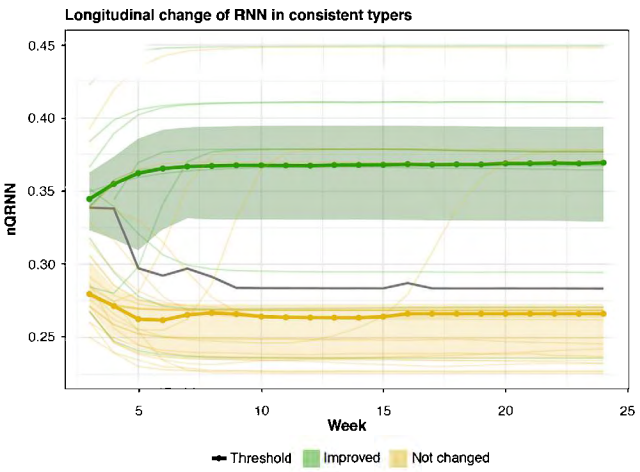

FIG. 3. (1124)

Objective: We designed an algorithm to detect response to medication in an early PD population using at-home, unsupervised, unobtrusive typing data.

Background: Advances in technology are opening a new era to remotely evaluate people with PD. In previous studies we have shown that features of in-lab keyboard typing can be used to evaluate motor skills and to classify subjects as having PD or not [1]. More recently we have shown the same capability from typing on a touch-screen based information and from keyboard data at-home [2]. We now hypothesized that typing on an electronic device, a habitual behavior, likely controlled by the nigro-striatal dopaminergic pathway, could allow for objectively and non--obtrusively monitoring parkinsonian features and response to medication in an at--home setting.

Methods: We designed a naturalistic prospective validation study to evaluate whether typing patterns changed in accordance with responsiveness to medication. 31 early PD subjects, who were going to start a dopaminergic drug, and 30 matched controls were enrolled. We remotely monitored their typing pattern over a 6--month follow--up period while antiparkinsonian medications were being titrated (fig.1). A novel deep learning algorithm (nQRNN) was developed to detect participants' outcome defined as the response to medication assessed by the UPDRS--III minimal clinically important difference (MCID) at the final visit (6 months). Further, we tested if this model could predict that outcome earlier than 6 months.

Results: The nQRNN had an overall moderate kappa agreement (k=0.50) and fair 0.73 area under the ROC curve with the time--coincident UPDRS--III MCID--based classification of response (fig.2). Furthermore, the nQRNN at week 3 (and beyond) could reliably predict which subjects would respond and which wouldn't. (fig.3)

Conclusions: This preliminary study suggests that a habitual task based on remotely--gathered unsupervised typing data at home allows for an accurate and predictive classification of drug response in PD. If confirmed by a larger prospective study, this approach could provide supplementary information to clinicians for a more continuous monitoring of motor symptoms of PD, thus helping to take informed decision on therapeutic strategies and disease management. Also, this tool could be useful as a cost- effective and reliable outcome measure for clinical trials to test response to medication.

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1125

The Use of Technology-Enabled Care (TEC) in Patients with Parkinson's Disease: An Italian Survey

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Objective: The present survey aims to explore the use and need of connected health or technology-enabled care (TEC) in patients with Parkinson's disease (PD) in Italy.

Background: TEC includes telecare, telehealth, telemedicine, Mobile Health and technological tools, and it is increasingly believed to contribute to achieve the challenges of health, social care, and wellness, and to enable more effective integration of care. Currently, few TEC tools specifically developed for PD symptoms are available and most of these are still prototype. However, TEC is being recognized as a valuable option to improve quality of life in patients with PD [1, 2].

Methods: 142 PD patients (90 males; aged 31-90 years; education 5-17 years) answered to a specifically developed multiple-choices questionnaire composed by 36 items concerning medical history and daily use of TEC (medical devices, health applications, and hardware including mobile diagnostics, remote monitoring devices, wearables and tools).

Results: Overall PD patients are very interested in technological tools: 81.7% of patients consider technologies useful for managing PD, 58% would use technologies to communicate with physicians, 53% for daily reminder of drug schedule, 56% to practice physical training and 60% for cognitive exercises. In contrast, the real use of technologies specifically targeting the symptoms and dysfunctions of the disease by PD patients is remarkably rare: for instance, 14.8% of