

Medical evaluation as gold standard to control iPrognosis application derived data for early Parkinson's disease Universitätsklinikum Carl Gustav Carus detection **Ci**·**PROGNOSIS**

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Background

Smartphones as daily companions are the digital health tools of the future due to the potential of longitudinal, unobtrusive, remote real-life monitoring of people's behavior. In the i-PROGNOSIS project, we developed the "iPrognosis" Android smartphone application for unobtrusive remote data collection in the general population, with the aim of evolving it into an early Parkinson's disease (PD) detection tool. Early detection of behavioral changes being linked to motor and non-motor symptoms (NMS) of PD allows for timely clinical diagnosis which is an unmet need.

Table 1: iPrognosis App-usage and baseline characteristics of GData-participants

	Germany	Greece	Portugal	UK	Spain	Austria	Australia	Chile	Overall	
No. of users who provided consent	760	727	473	288	41	59	8	31	2387	
No. of participants who contributed data	531	545	342	232	30	36	6	12	1703	
Demographic characteristics of participants (self-reported)										
No. of PD patients / Healthy controls	89/596	60/599	21/391	136/117	6/32	10/45	2/3	1/26	325/1809	
Avg. participant age, years (std)	52 (14)	42 (16)	45 (15)	58 (13)	50 (15)	52 (14)	42 (17)	43 (15)	48 (16)	
No. of women / men	252/433	219/440	168/245	118/135	11/27	20/35	1/0	10/17	799/1336	

Objective

A medical evaluation protocol as gold standard for controlling iPrognosis application derived data of an international multilingual study.

Methods

iPrognosis Android Smarthone App: unobtrusive and passive assessment of participants` behavioral data from the daily use of their

Table 2: "Gold-standard" controlled GData - participants									
		Baseline		6 month follow-up					
	Parkinson patients	ParkinsonHealthypatientscontrols		Parkinson patients	Healthy controls	p-value			
Ν	66	43		23	11				
No. of women / mer	า 22/44	25/18	0.01	7/14	7/3	0.06			
Mean Age, years (st	t d) 60.53 (8.41)	55.02 (11.46)	0.01	62.22 (8.80)	52.05 (10.92)	0.01			
Table 4: Motor an	d non-motor	scores							
	B	aseline		6 month follow-up					
Mean value (std), minmax.	Parkinson patients	Healthy controls	p-value	Parkinson patients	Healthy controls	p-valu			
UPDRS Pat III	18.77 (9.82), 3-62	1.81 (4.21), 0-22	0.001	14.43 (8.74), 2-32	0.18 (0.60), 0-2	0.001			
Hoehn & Yahr									
in ON motor state in OFF motor state	1.86 (0.61), 1-3 2.93 (0.94), 1-5	0.09 (0.37) 0-2	0.001	1.91 (0.68), 1-3 2.73 (1.24), 1-5		0.001			
NMSS	31.88 (29.15) 0-139	10.93 (17.37) 0-88	0.001	32.27 (23.10), 2-82	8.11 (12.33) 0-32	0.001			
NIVINUSCITAST	6.34 (4.62) 0-23	2.58 (2.88) 0-10	0.001	4.19 (2.56) 0-9	3.60 (3.84) 0-12	0.6			
	0 20								
PDQ-8	5.68 (4.35) 0-20	1.32 (2.34) 0-11	0.001	5.00 (4.55) 0-13	2.56 (3.94) 0-11	0.2			

smartphones (= GData) in eight countries since 5/2017

GData = App:

defined based on motor & non-motor symptoms of Parkinson`s disease:

- \rightarrow Dysarthrophonia - speech
- movement (holding the smartphone, typing a message)
 - \rightarrow Tremor, Brady-/Hypokinesia, Rigidity
- facial expression \rightarrow Hypomimia
- \rightarrow Depression - mood
- "Gold-Standard" = Physician: baseline and six month follow-up assessment of participants based on a standardised medical evaluation protocol by a movement disorders specialist in three center:
- physician and participant-based scales covering motor, NMS & health related quality of life
- instrumental diagnostics (olfactory test, actigraphy for tremor, SN sonography)

Table 3: Parkinson specific characteristics		
	Baseline	6 month follow-up
PD duration in years: mean (std)	4.94 (3.48),	6.22 (3.85),
minmax. in years	0.38 - 14.61	1.07 – 15.26
Dominant motor condition, OFF/ON/Dyskinesia (N)	3/59/2	2/17/1

Table 5: Comparison of "gold-standard" and App-based indicators

Table 3: Parkinson specific characteristics	Baseline	6 month follow-up 6.22 (3.85), 1.07 - 15.26 2/17/1 6.22 (3.85), 1.07 - 15.06 2/21		Tremor at rest		Action / postural tremor		Rigidity		Brady-/Hypo- kinesia	
PD duration in years: mean (std) minmax. in years Dominant motor condition, OFF/ON/Dyskinesia (N) Duration of PD medication intake: mean (std), minmax. in years Drug naïve for PD medication yes/no (N)	4.94 (3.48), 0.38 - 14.61 3/59/2 4.70 (3.46), 0.12 - 14.61 8/58		Sensitivity Specifity Diagnostic	0.67	N=109 PD N=375 HC	Gold- Standard N=26 PD N=16 HC 0.45 0.58	GData N=109 PD N=375 HC 0.49 0.77	N=1/	PD	Gold- Standard N=17 N=4 1.00 0.88	PD
Advanced therapies (pump, DBS) yes/no (N) Conclu	0/66 Jsion	0/23	accuracy	0.66	0.71	0.54	0.71	O.76 • • • • • • • • • • • • • • • • • • •	0.74	0.90 • • • • • • • • • • • • • • • • • • •	0.70
Smartphones have the ability of long recognition and monitoring of people's bet The i-PROGNOSIS approach is promosit behavioral pattern and the medical evalue by a movement disorders specialist as g Parkinson`s disease and healthy controls.	navior and of sping as both, the ation of Parking gold standard of	ecific behavio iPrognosis / son`s disease	oral pattern. App derived e symptoms	C C C C C C C C C C C C C C C C C C C	entribution 19.7 MB 19.7 MB 9 Handling Voice Activity 1 Text Photos contribution of research data against interval. Idead based on data uploaded on the Cloud.	Welcome to IF The iPrognosis app is part study of the i-PROGNOSIS project that aims to develor Disease detection Swipe to learn	t of a data collection S European research op early Parkinson's n methods.	 About the project About this study Aim of study and participants What data will be collected Benefits, risks and public involvement Organisation, funding and review Withdrawal and problems Data confidentiality, protection an storage 	> > > > > > > }	What data will be collected The first time you use the app, we will ask you if you are healthy, have a family history of Parkinson's or if you have bed agnosed with Parkinson's. We will also ask you for your date of bid your gender, your level of education and you long you use a smartphone. Thereafter, the GData captured in the background by the iPrognosis app inclute Characteristics of your voice when making a phone call. The personal content of your call is never store We diving calls or typing, using device sensors, such as the acceleromed to be used to be iPrognose keyboard. More the iPrognose keyboard More the iPrognose keyboard More the iPrognose keyboard More the iPrognose keyboard	de: de: de: de: de: de: de: de:

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