Passively collected data from smartphones correlate with subjective disease severity in Atopic Dermatitis

Aleksander Eiken[1], Charlotte Laugesen[1], Ari Isberg[1], Andrei Chiriac[1], Ana Maria Dutei[1], Irina Deaconescu[1], Ionela Manole[1], Teske Valk[1], Anders D. Andersen[1], John R. Zibert[1]

Affiliation: [1]LEO Innovation Lab, LEO Pharma A/S, Denmark

BACKGROUND

Atopic dermatitis (AD) often fluctuates in intensity with changes in sleep, busyness-levels, stress, pollen and weather conditions including humidity.

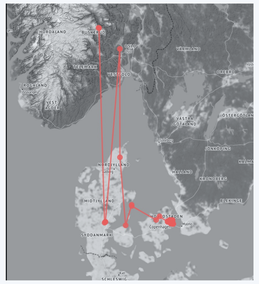
As objective data confirming these factors' association with AD disease activity is limited, we utilized smartphone data in a fully remote trial to assess their association over time.

METHODS

For 12 weeks, AD patients completed weekly Patient-Oriented-Eczema-Measure (POEM) and twice weekly stress (1-10 scale) online questionnaires.

MOBILE

LOCATION



AD patients were recruited online. Diagnosis was confirmed via photos and the UK working party's diagnostic criteria of AD. Patient-obtained smartphone photos (getimagine.io) of target lesions were sent twice weekly for objective severity evaluations by three blinded dermatologists using the intensity (i) items from SCORAD.

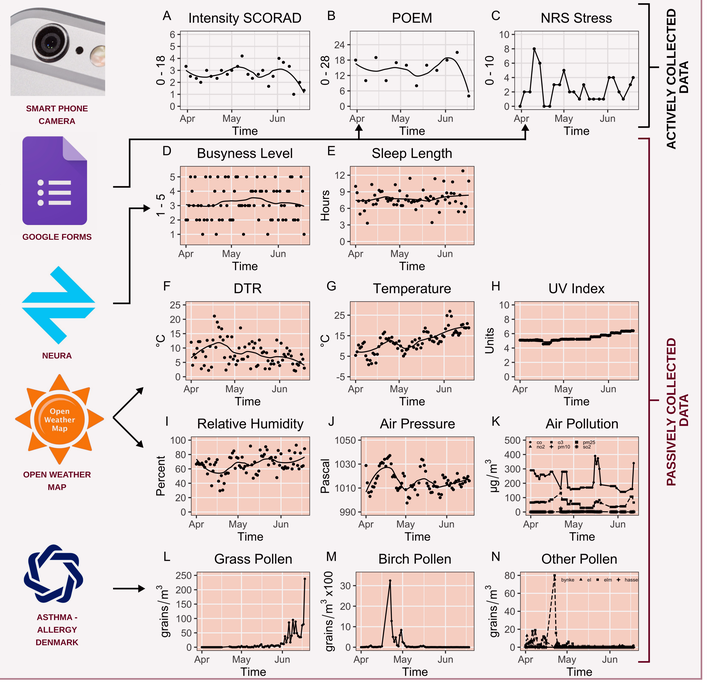
A mobile app (theneura.com) captured smartphone sensor data and calculated busyness level and sleep length. GPS location was used to extract weather and pollen data from external databases.

Data was analysed with linear mixed effects models. If the model did not converge, paired non-parametric tests were applied by comparing severity difference between high and low exposure weeks.

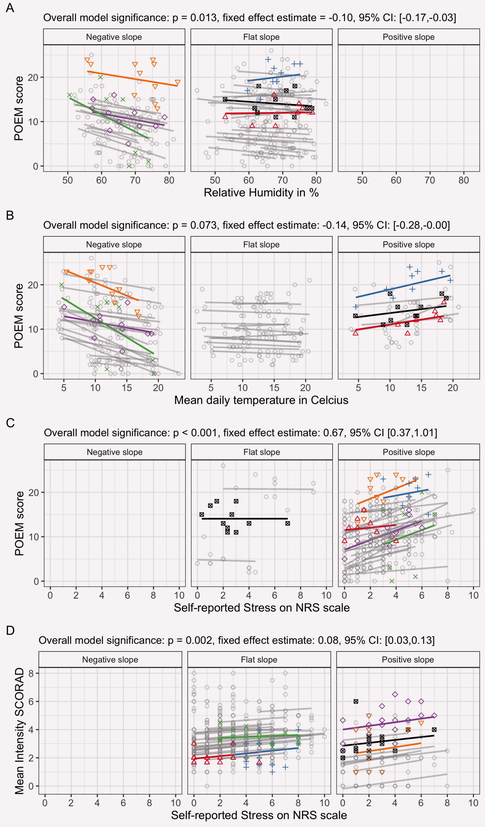
RESULTS

DATA FROM ONE PATIENT

The figure below shows data collected from a single study participant. Passively collected data is highlighted in red.



LINEAR MIXED EFFECT MODELS



The graph to the left shows selected LME models, with selected patients highlighted. Segmentation is based on the individually prediced slope.

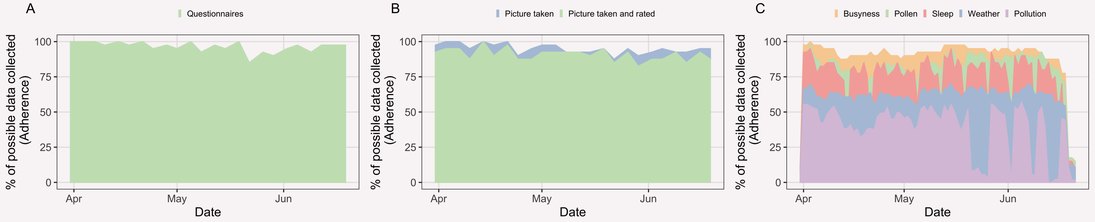
POEM correlated positively with air pressure and stress, and negatively with relative humidity and busyness levels (all $p < 0.05$).
POEM tended to correlate negatively with temperature ($p = 0.07$) and UV ($p = 0.06$).
POEM was significantly higher for weeks with high Birch/Elm.

iSCORAD was only positively associated with stress ($p < 0.01$).

POEM vs	Corr. coef.	95% CI	P-value
Relative air humidity	-0.1	-0.18 : -0.02	0.01
Busyness level	-1.1	-2.04 : -0.17	0.03
Air pressure	0.09	0.03 : 0.15	0.01
Self-reported stress	0.67	0.32 : 1.01	<0.001
Daily temperature	-0.14	-0.28 : 0.01	0.07
Daily UV index	-1.2	-2.3 : -0.04	0.06
Birch pollen*			0.02
Elm pollen*			<0.001
Sleep length*			0.06

*Non-parametric test. For sleep: Severity between of weeks short and long weekly average sleep length was compared. For pollen data, severity in seasonal weeks vs non-seasonal weeks was compared.

ADHERENCE



- 925/960 (96.4%) of all questionnaires were completed, and 872/960 (90.8%) iSCORAD evaluations were possible.
- Percentages of collected passive data was: busyness (89%), pollen (81%), sleep (74%), weather (60%) and pollution (38%).
- Passive data collection was lower, but more granular, as data was collected on daily basis.

CONCLUSION

Smartphone-obtained data associated patients' perception of disease severity (POEM) with air pressure, pollen, humidity, and busyness.

Smartphone derived data may hold promise in understanding the etiology and trigger factors of chronic skin diseases such as AD.

BASELINE DEMOGRAPHICS

Demographics	
n (f/m)	38 (31/7)
Age [mean (sd)]	33.5 (9.9)
Disease severity	
Baseline Intensity SCORAD [mean (sd)]	3.6 (1.9)
Body Surface Area (self-reported)	
1-3 [n (%)]	32 (84.2)
4-9 %	4 (10.5)
10 % or more	2 (5.3)
Patient Oriented Eczema Measure (POEM)	
Baseline POEM [mean (SD)]	12.0 (5.9)
Extremely mild eczema (POEM: 1-2) [n (%)]	1 (2.6)
Mild eczema (POEM 3-7) [n (%)]	8 (21.1)
Moderate eczema (POEM 8-16) [n (%)]	22 (57.9)
Severe eczema (POEM 17-24) [n (%)]	6 (15.8)
Very severe eczema (POEM 25-28) [n (%)]	1 (2.6)
Comorbidities	
Asthma [n (%)]	15 (39.5)
Hay fever [n (%)]	20 (52.6)
Medication	
Emollients and moisturizers	35 (92.1)
Topical medication	33 (86.8)
Photodynamic therapy	4 (10.5)
Oral Medication inc. antihistamines	5 (13.2)
Injectables	1 (2.6)
No treatment	2 (5.3)

Funding: This study was funded by LEO Pharma.

Acknowledgements: Thanks to Asthma - Allergy Denmark for supplying pollen data.

Contact: aleksander.eiken@leoilab.com +45 4021 0080