



Differences in the temporal dynamics of daily activity between chronic pain patients and healthy controls

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INTRODUCTION

Chronic pain is commonly assumed to be associated with reduced levels of everyday physical activity. However, there is almost no quantitative data on this relationship. Here we study the dynamical properties of spontaneous pain and physical activity among chronic back pain (CBP) patients and contrast activity with healthy control subjects.

METHODS

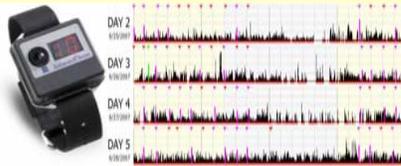
- Two populations participated in the study, 18 CBP patients (mean age 48.7 years; mean pain duration 89.3 months) and 10 healthy controls (mean age 39.1 yrs).
- Activity level was evaluated each 30 seconds during a 3 week period using a wrist accelerometer (AWScore Actiwatch from MiniMitter, Bend, OR).
- Pain ratings were recorded on the same Actiwatch device each hour, by querying the patients to enter a value (0-15, 0 = no pain to 15 = unbearable pain) in response to an audible alarm provided by the wrist device. Patients were also instructed to enter pain ratings manually at any time, when they felt any change in pain perception.
- To characterize the statistical properties of the time series of activity level and pain rating, the rescaled range analysis and the power spectra were calculated and compared in both groups.

References:

Foss JM, Apkarian AV, Chialvo DR (2006) Dynamics of pain: fractal dimension of temporal variability of spontaneous pain differentiates between pain states. *J Neurophysiol* 95:730–736.

1 Long term recording of daily activity and pain perception

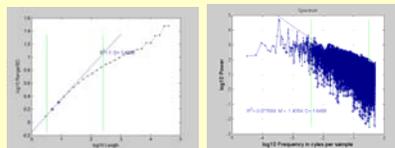
- All participants wore the Actiwatch during at least 3 weeks.



Pain Intensity = 0/15

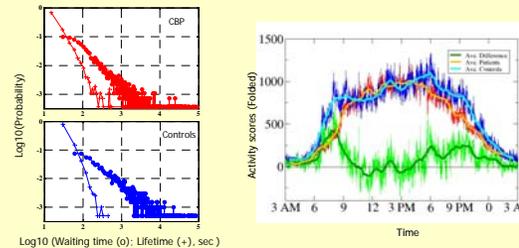
- Chronic pain patients were instructed to rate their pain every hour between 8 AM and 10 PM. Purple marks in the figure indicate requested pain rating; red marks indicate ratings not reported; green marks indicate pain ratings introduced by the patient without request.

2 Scaling properties of activity time series



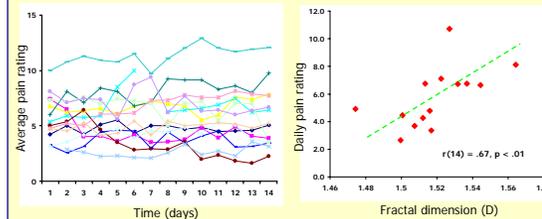
- Fractal dimension of activity scores was determined using two independent approaches: rescaled range analysis (left panel) and spectral analysis (right panel) (for details, see Foss et al., 2006). In both cases, the fractal dimension D was derived from the slope of the log-log function plot.

3 Both groups show similar activity derived long-term correlations. Activity scores are significantly different in early morning and late afternoon, but not during night hours



- Left: Overall statistic of waiting time between consecutive movements and duration of movement for CBP patients (top) and 9 control subjects (bottom).
- Right: Average activity scores (thin traces) for the two groups and differences (running average, thick traces).

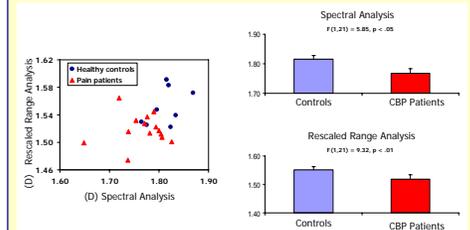
4 Increased pain levels were associated with increased activity derived fractal dimension (D)



- Left: daily average of pain ratings for each chronic low back pain patient during the first 2 weeks of recording. Right: relation between fractal dimension of activity scores (scaled range approach) and average pain ratings.

RESULTS

5 Significant differences in fractal dimension D of activity scores between healthy controls and chronic pain patients



- Scaling properties of activity scores for healthy controls and pain patients.
- Left: scatter plot showing fractal dimensions from activity scores calculated by the two approaches (power spectra and rescaled range). Right: chronic low back pain patients showed significantly lower fractal dimensions than healthy controls.

CONCLUSIONS

- Fractal analysis of activity data over a scale of weeks provides a relevant tool for assessing the influence of chronic pain on everyday activity. In the present study, we observed significant differences between chronic pain patients and healthy controls on fractal dimension of activity scores. Furthermore, a significant correlation was found between pain perception and fractal dimension of activity time series in CBP patients.
- These results further suggest that characterizing temporal dynamics of daily activity and spontaneous pain fluctuations might be helpful in discriminating between clinical pain states.
- Future studies should examine the temporal dynamics of motor activity, pain perception and brain functioning in chronic pain patients for a better understanding of the mechanisms involved in pain persistence.