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THE COMPLEX BEHAVIOR OF HUMAN ACTIVITY: A COMPARISON BETWEEN HEALTHY AND FIBROMYALGIC INDIVIDUALS.

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SUMMARY

In this work, we discuss the characterization of human activity data in the context of complex systems theory. Using the self-organized-system model we found differences in activity data: rest, active and sleep; within two contexts: patients with fibromyalgia and healthy.

INTRODUCTION

Human behavior is much more than a merely complicated event, it can be better conceptualized as being a complex system [1,2]. According to this approach, new and unexpected states of individual behavior can emerge as a final result of simpler elements interacting through well defined rules. One of the signatures of the complex system is the power law behavior in self-organized criticality (SOC) systems [3].

The systems that exhibit this type of behavior have serious problems in using the conventional statistical tools to characterize the data. However, the SOC approach has a set of statistical tools that are better suitable for complex systems. This work uses a SOC index to characterize the difference between fibromyalgic patients and healthy individuals biomechanics activity.

Fibromyalgic patients (FM) show a profile characterized by chronic pain and fatigue, which results in a significant decline in physical activity, affecting their functional performances [4]. Such weaknesses causes, in the literature, a lack of clarity about whether the pathogenesis of changes precede or not those symptoms. Despite the awareness of the central nervous system is considered the main mechanism involved in the pathophysiology, peripheral changes at muscle also occurs as a physiological adaptation mechanism, exacerbating the physical and psychological disorders [5,6].

METHODS AND MATERIALS

The data was taken for 12 FM patients and 10 healthy participants (HP) using an Actwatch device [7]. This device works like a watch, used by the participants along their daily activities, registering, in oscillation per time, the activity level. Records were taken at each 30 seconds for approximately 4 weeks.

The activity data was classified in 3 different state types: active, rest and sleep. The analysis consists in estimate the probability distribution (PD) of the activity level for each individual and state. The slope of the linear fitting for the log-log plot of the PD was used to characterize the complex behavior of the data.

RESULTS AND DISCUSSION

The probability distributions (Figure 1) show a non-normal curve for all individuals.

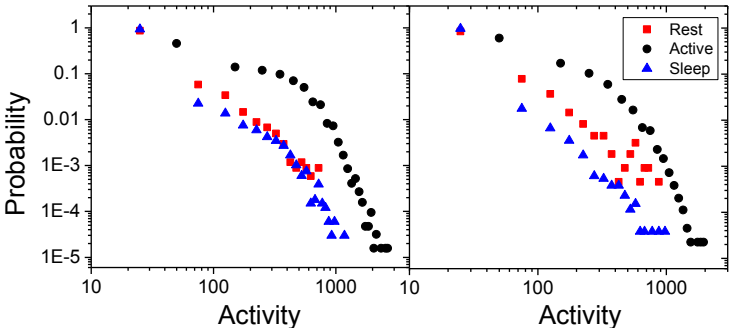

Figure 1: A log-log plot of the probability distributions for FM patient #500 (on left) and for the HP #000 (on right).

For FM and HP distributions the rest state always presents a SOC behavior with a power law fitting with R^2>0.92. For sleeping state a power law is only observed for HP. The average power exponent for the rest state in both FM and HP were 2.1±0.3 and for the sleep state in HP was 2.6±0.1, indicating a significant difference between rest and sleep states in healthy participants. This type of distribution has no second and high-order statistical moments, i.e. the variance and the skewness goes infinity with sample size.

CONCLUSIONS

This study aimed to discuss the problem in use the conventional statistic in characterizes human actgraphy and the possible use of SOC as a more conceptualized framework to characterize it.

Based in empirical but limited evidence, we show that Fibromyalgic and Healthy participants have similar activity dynamic for rest and active states, but a completely different pattern in sleep state. We believe that this difference should be due the typical poor sleep problem with FM, changing the natural self-organized dynamic of activity in sleep state.

Another important observation was that the patterns of rest distributions in healthy and FM participants had the same general fitting model (power law) however, with systematic greater exponents, this could indicate that the FM actigraphy can be accurately used to characterize this issue.

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