Diagnosing Types Of Back Pain Using Intelligent Systems

1.0 Introduction

Low back pain (LBP) is a significant healthcare problem and a diagnostic enigma. There is no definitive diagnostic test in LBP and thus patterns of signs and symptoms are used to diagnose LBP. The location and extent of pain, drawn on a body chart, is thought to be important in discriminating different types of low back pain.

The aim of this study was to evaluate body chart, pain location data and identify any patterns of pain that may exist using a statistical approach, thus avoiding any clinical bias.

2.0 Methods

Sample: 300 patients with LBP were examined by a physiotherapist. Body chart data was gathered and the then later that day the patient was examined again, by another physiotherapist. The body chart was divided into 20 areas and areas of pain were recorded during both examinations. Thus, two sets of body chart data were obtained for each patient and the agreement between the data sets was examined using kappa coefficients.

Exploring for clusters of pain: The analysis of body chart pain location data was carried out using Self Organising Map (SOM) software and analysis. SOMs are a type of unsupervised Artificial Neural Network (ANN). ANNs work by simulating the learning process carried out in the human brain. This involves adjusting connection strengths between many simple processing units, called neurons.

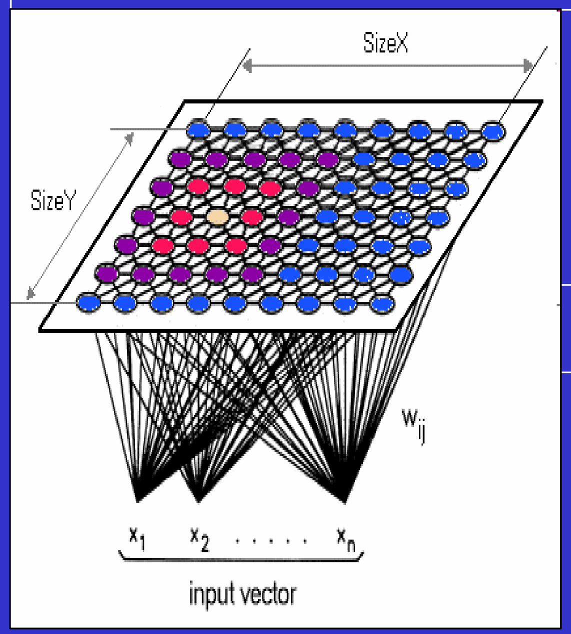

Figure 1 – Self Organising Map.

The structure of a typical SOM can be seen in Figure 1. Input data is iteratively presented to the network and the network adjusts the weights to try and best fit the data. At the end of the learning process different areas of the map represent different patient properties so that each patient will have a neuron which best matches their characteristics.

The map neurons were then examined for clusters using a K-means (Km) clustering algorithm. The clustering results were then compared between raters to see if patients are assigned to the same cluster each time. This agreement was used to establish how many clusters were in the data. See Figure 2.

3.0 Results

The K-means algorithm supported having 3 clusters. This can be seen qualitatively in Figure 2 by comparing cluster results between sets and quantitatively in Figure 3 which measures this agreement using Cohen's Kappa. The three patterns of pain identified are seen in Figure 4. The characteristics of these groups were examined and the clusters named.

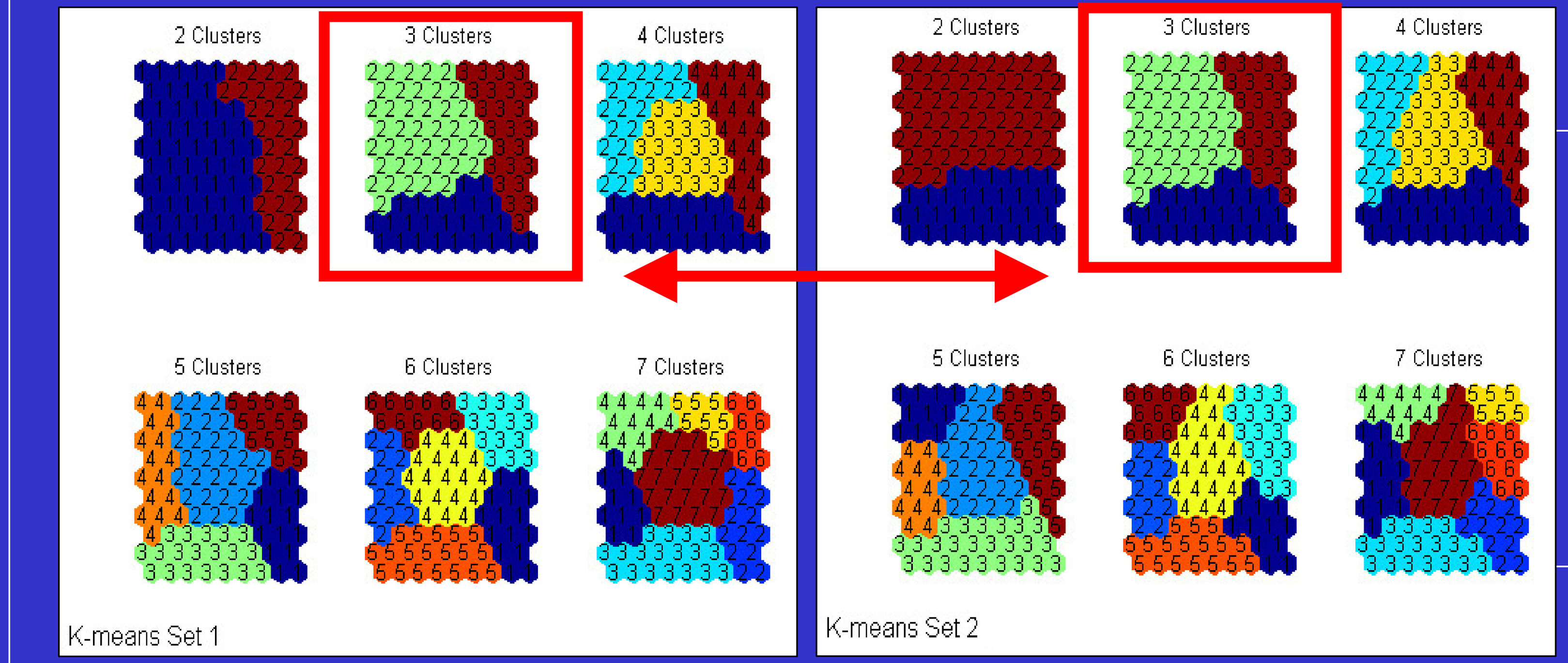

Figure 2 Clustering result of SOM for data sets 1 and 2

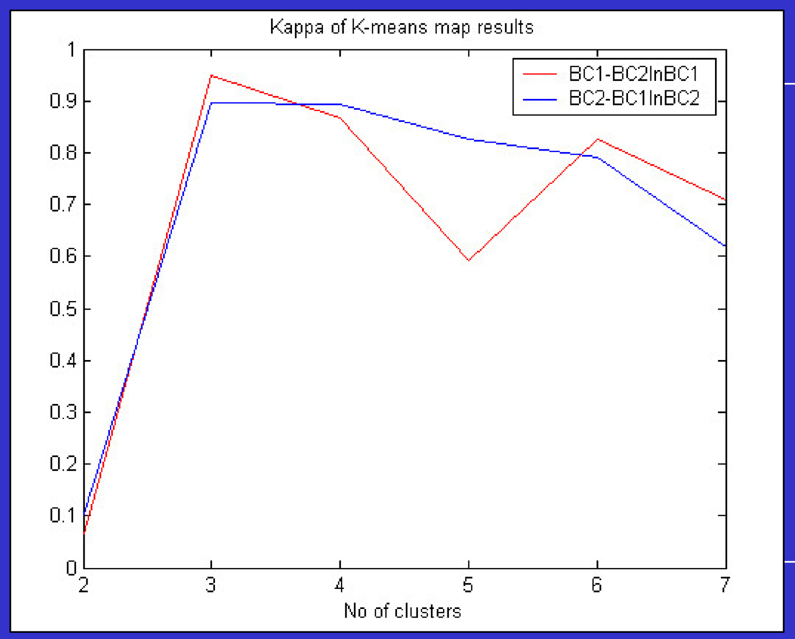

Figure 3
Agreement on numbers of clusters using both data sets from the two examinations

Strongest Agreement for Three clusters

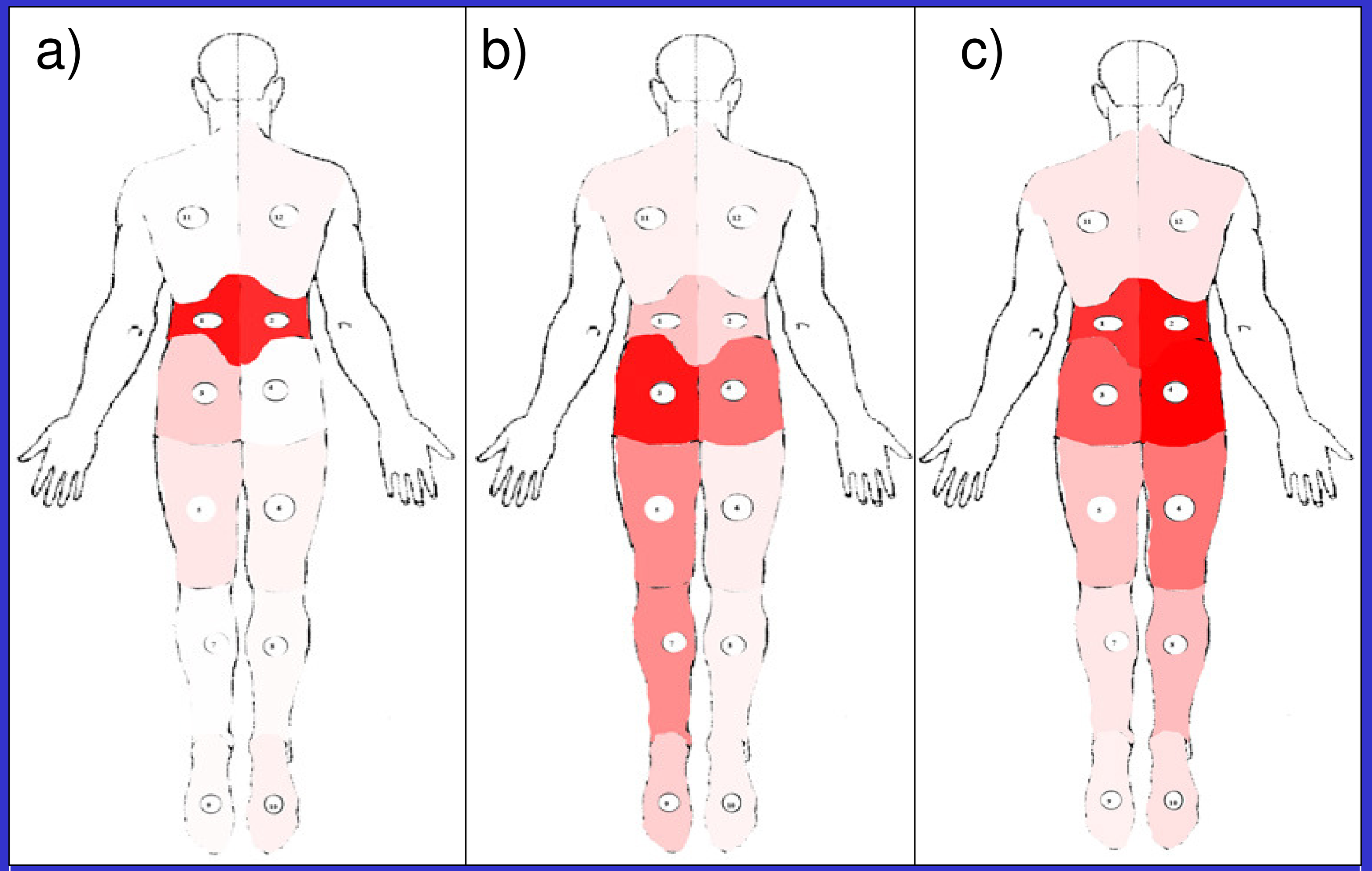

Figure 4 - The 3 Types of LBP identified.

Darker red = greater frequency of pain

a) Typical LBP – "Just in the back"

b) Pain in sacroiliac joint – "Pelvic pain"

c) Hyper-vigilant – "Hurts everywhere"

4.0 Discussion and Conclusion

Data gathered on pain location of LBP patients does cluster into three distinct groups. Not surprisingly one group (**Cluster a**) has pain solely in the back and this is a reassuring finding. If the SOM technique had not identified this pattern of pain confidence in the technique would be low. The technique has also identified two other "typical" pain presentations. **Cluster b** is typical of patients with sacro-illiac joint (pelvic) pain and **Cluster c** of patients who have developed central sensitisation and hyper-vigilance due to chronic pain. These findings confirm that body chart data can aid in LBP diagnosis and that the SOM techniques, used here, have diagnostic potential in this ubiquitous condition

5.0 URSS & Acknowledgements

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