How can we decide which is the best treatment for an individual with back pain?

Low back pain is a very common problem and there is no known cause for the majority of cases. There are a great many treatments which can be shown to be effective. In our paper [1], we are interested in which treatment is most likely to be effective for a particular individual.

For this we used data from the Back Skills Training (BeST) trial [2] which tested the efficacy of a cognitive behavioural approach (CBA) for non-specific low back pain, and found it to be effective on average. The trial had 701 patients who had non-specific low back pain of at least 6 weeks' duration and which was at least moderately troublesome. All patients received a copy of The Back Book, which encourages a positive outlook, keeping active and to take painkillers as needed. The patients were divided so that 1/3 had this treatment alone, whilst the other 2/3 had this plus 6 cognitive behavioural sessions (CBA).

In order to discover for which types of patients CBA was effective, we used a probabilistic model called Latent Class Analysis (LCA) which classifies based on similarity between patients. We defined 'recovery' as a 3-point improvement in the Roland Morris pain and disability questionnaire (RMQ) because that was enough of an improvement for patients themselves to notice. The attributes that were used to build the classes were those the CBA treatment was designed to tackle, namely depression, anxiety, pain self-efficacy, fear avoidance, social impact and troublesomeness of back pain; we did not use any information about response to the treatment and patients from both CBA treatment and control (non-CBA treatment) arms of the trial were used to form the classes. LCA allows the user to compare how well choosing different numbers of classes fits the data they have. We tested 2 to 6 classes, and found the best fit was 3 classes.

For each class, the model gives the probability that a person in that class has the attributes used to define the class, e.g. that a person in Class I would be clinically depressed. In this way, we were able to build up a profile of the people in each class.

For each patient, the model gives the probability that they belong to each class, and for our purposes we assigned each one to the class with the highest probability. For the majority of our cases, there was one class they were much more likely to belong to than the others, but we did try counting patients as belonging to a class only if their probability was at least 80% or at least 90% and excluding the patients whose class membership was less certain. This did not change any of the conclusions of the analysis, so we were satisfied that the results are not sensitive to how certain we are of the class membership every last patient.

There were 407 patients from both the CBA treatment and control arms of the trial who had their data recorded for all of the attributes used to allocate patients to classes plus their response to treatment and these were the cases we used for analysis. We were interested in whether one of the three classes of patients had different recovery outcomes following the treatment that the others. We first modelled if recovery could be predicted from treatment and class membership and a mixture of these, then we compared the patients within each class according to whether they had the CBA treatment or not.

We found that there was an association between class membership and outcome for those patients who did receive the CBA treatment, but not for those who did not, suggesting that patients in

different classes responded differently to the treatment. It was not possible to discover the precise relationship between class and outcome, possibly because 407 cases divided into 3 classes and again into treatment and control did not have enough information to reveal the detail.

We were also interested in discovering how effective our method for categorising patients is compared to other, similar classifications in use. We selected the STarT back tool [3] which was developed recently and has been taken up by practitioners and used to decide what type of treatment a patient requires. In order to do this we had to allocate our patients to their STarT categories. We had the information we needed to do this from the data collected to our trial. We found no association between membership of any of the STarT groups and outcome.

For further work, the University of Warwick has been collecting data from trials of back pain interventions into a repository and it is likely to be possible to make use of this much larger combined dataset for confirming ideas from the individual trials and finding some insights into this complex problem.

Body In Mind

After 20 years as a full-time Mum, Martine took a BSc in Mathematics at Coventry University with the ambition of becoming a school teacher. Whilst there, she was astonished to discover that mathematics can be used to make people's lives better, such as by identifying an optimal strategy for vaccination at the outbreak of an epidemic or improving traffic flows. She then studied for an MSc in Complexity Science and a PhD in Complexity Sciences and Health Sciences at the University of Warwick's Complexity Science Doctoral Training Centre and obtained her PhD in 2013. Martine has stayed with the theme of using maths to make good decisions, now working on a project building decision support for Food Security Policy.

References:

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