A Bayesian latent variable model for the consistency of symptoms reported during hypoglycaemia

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Several studies have allowed the most common symptoms of hypoglycaemia for diabetic patients to be identified and categorised [1]. However, limited attention has been given to symptom variability at individual patient level. In this work we develop a model for assessing intra-individual consistency in reporting specific symptoms throughout a number of hypoglycaemic episodes. The data are taken from a study aiming to record prospectively the symptoms of hypoglycaemia experienced by adults with type 1 and type 2 diabetes. Patients used self-completed symptom forms, on which they selected from a typical list of 26 symptoms commonly associated with hypoglycaemia. A logistic-type model for individual subjects is used, in which the probability p_{ijk} for individual i to report symptom j at episode k depends on a stochastic threshold being exceeded by a critical value determined by latent variables representing the propensity of reporting symptom j and the acuteness of episode k. The stochastic thresholds are assumed to follow a Weibull or a log-normal distribution. The model parameters are estimated under a Bayesian framework employing Markov chain Monte Carlo techniques, and the symptom reporting consistency is quantified through the variability of the threshold distribution, with highly concentrated thresholds interpreted as consistent reporting of associated symptoms. Our results are in agreement with a hypothesis of 'hierarchical symptom presence' principle, under which consistency implies that reported symptoms should adhere to the hierarchy imposed by the threshold order. The association between symptom reporting consistency and various patient-specific covariates (such as gender, age, type and duration of diabetes etc) is also investigated through an appropriate GLM analysis. The results suggest higher intra-individual variability in symptom reporting than previously recognised, and an association between reporting consistency and gender of the patient.

References

[1] Deary, I.J., Hepburn, D.A., MacLeod, K.M and Frier, B.M. (1993) Partitioning the symptoms of hypoglycaemia using multiple-sample confirmatory factor analysis. *Diabetologia* **36**, 771–777.