Rasch First? Factor First?

Wen-Hung Chen, Lori McLeod, Theresa Coles
RTI Health Solutions, Research Triangle Park, NC, United States

BACKGROUND

– The Rasch model and its estimation have become popular tools for assessing the psychometric properties of patient-reported outcome (PRO) instruments.

– Unidimensionality is a key assumption of the Rasch model. To gain the advantages of Rasch modeling, it is important that this assumption has not been violated.

– There has been much debate about whether to use factor analysis as a first step to assess dimensionality or whether to use the Rasch model directly to identify items that do not fit a unidimensional model.

– Existing literature provides limitations to both methods as follows:

  – For analysis–may identify too many factors. Factor analysis usually reports items clustering at different performance levels (too difficult) as different dimensions; thus, spurious factors (underlying concepts) may be identified.

  – The Rasch model may not identify all relevant factors. The factor analysis may not be sensitive to items not varying from the dominant dimension in the data. This dominant dimension may be a hybrid of two or more factors (underlying concepts); item-fit statistics may not be sensitive to deviations from this dimension.

OBJECTIVE

– To compare the use of factor analysis with the use of Rasch modeling to examine the assumption of unidimensionality and provide recommendations for future application of these methods.

METHODS

– Simulated data that represent a typical PRO instrument were generated in the following variable: sample size, number of factors, and correlation among factors.

– Figure 1 shows the design of the data simulation across the variables and the number of different conditions that is generated.

RESULTS

Exploratory Factor Analysis Key Results

– Table 2 presents the number of factors identified in all simulation conditions greater than 0.7. In a total of 120 data sets (Figure 1),

  – Ten simulated data sets were generated for each of the 12 conditions, for a total of 30 data sets (Figure 1).

  – Each simulated data set contained 15 items, and all items had five response categories.

  – Exploratory factor analysis (EFA) was conducted using Mplus.

  – The number of factors identified by the EFA was determined by examining the eigenvalues of the model goodness-of-fit statistics, including comparative fit index (CFI), root mean square error of approximation (RMSEA), and squared root mean square error of approximation (SRMR).

  – Rasch model analysis was conducted using RUMM2030.

– Table 4 presents the Rasch model results across the 12 simulation conditions. Methods were used to evaluate the detection of the number of true factors (item-fit residuals, item-fit chi-square, principal component analysis of the residuals).

– Table 5 presents the number of items that should be associated with a separate factor.

– When there were three correlated factors, EFA identified three factors in most conditions, but the Rasch model identified fewer misfitting items for correlated factors as well.

– Simulated correlations of 0.0 or 0.4 resulted in no items flagged as misfit, and item-fit chi-square for correlated factors was attributed to the item location factor. However, this item location effect was barely detected when there was only one factor present.

– The results showed that eigenvalue and goodness-of-fit indices function well at identifying underlying concepts, but the best method to use both criteria in combination with the findings. This method identified not only the number of factors, but also the items that were associated with each of the factors.

– The item-fit chi-square statistic identifies factor misfit in the items. When correlation between two factors was as high as 0.7, no items were identified as misfitting, but in this case, remaining items may comprise a hybrid of the correlated factors as the underlying dimension.

– In most situations, however, the principal component analysis of the residuals suggested that the items were unidimensional.

CONCLUSIONS

– The results of this study suggest that the Rasch model analysis provided more accurate and reliable results than factor analysis in most conditions. However, the number of items identified as misfitting shown in the analysis was very similar.

– Factor analysis can be conducted first if the objective is to identify the underlying concepts, but the best method to use both criteria in combination with the findings.

– When correlation between two factors was as high as 0.7, no items were identified as misfitting, but in this case, remaining items may comprise a hybrid of the correlated factors as the underlying dimension.

REFERENCES