Book: Measurement in medicine

Authors: HCW de Vet, CB Terwee, LB Mokkink, DL Knol

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Answers Chapter 4:

1. Methods of item selection

1a. The impact method is based on the importance of the items, preferably rated by the patients, either during field testing, or in focus interviews. Sometimes clinicians or researchers rate the importance of the items based on their experience with patients. Factor analysis is based on the clustering of items that measure the same aspect (dimension) of the construct. The importance of items for the patients is not taken into consideration.

1b. The item 'experience asthma symptoms as a result of being exposed to cigarette smoke' has a high impact score (3.12), but apparently does not correlate with other items which are troublesome for patients with asthma. Vice versa, the item 'feeling irritable' has a low impact score (1.23), but loads on the factor 'Emotions'.

1c. First, do a factor analysis, and then if there are too many items in a scale, keep the items with the highest impact. However, if IRT methods can be used, the distribution of the items over the scale of the trait level is more important than the impact on the patients. If there are many items at the same location on the scale (see Figure 4.3, RDQ items) it is possible to select the items with the most impact in that range.

2. Interpretation of factor analysis

Example physical workload questionnaire

2a. Sitting (item 2) is the opposite of 'standing' and 'walking' (items 1 and 4), and thus load on the same factor, but with a negative sign. And one can imagine that 'video display unit work' (item 3) is strongly associated with 'sitting', and therefore also loads negatively on the same factor.

2b. In factor analysis the association between items is taken into consideration, and it does not matter whether these are positive or negative associations. Cronbach's alpha is based on a kind of mean value for the mutual item correlations within a scale. Cronbach's alpha is lower when there are items with low or negative correlations. Items with negative correlations are the first candidates for deletion when trying to increase Cronbach's alpha by deleting items.

2c. By reversing the scores of items 2 and 3.

2d. Working with vibrating tools uncomfortable posture involves repetitive movement, but quite often this is also heavy work. It is possible to keep an item that loads on more than one factor in a questionnaire, but the score for this item contributes to the total score for more than one factor, and in this way gets more weight in the questionnaire. For this reason, items that load on more than one factor are often deleted in the phase of item reduction.

3. Factor analyses GO-QOL

3. Factor analyses for the GO-QOL

The answers of Assignment 3a, 3b and 3c are based on output 4.1.

3a. Step 1: Correlation matrix

Output 4.1 shows that there are no items which correlate highly with each other, which would point to almost identical items. Only a few items show a correlation higher than 0.6. Moreover, all items correlate > 0.3 with one of the other items, which points to a sufficient correlation of all items.

3b PCA analysis, following the steps described in section 4.4.2 and 4.4.3

Step 2: The number of factors to be extracted

The table with communalities shows that all items explain a certain amount of variation in the data.

The Table Total variances explained, shows that the first four factors all have an eigenvalue larger than 1. Together they explain 64.6% of the variance factor. The scree plot shows a distinct break between the steep slope of the first two factors (with high eigenvalues), and the gradual trailing of the rest of the factors (with lower eigenvalues), which indicates that two factor may be adequate to describe the data.

The component matrix (unrotated factors) shows the typical correlation as depicted in Table 4.2, with all positive and substantial associations for factor 1, and then smaller and some negative associations for the next factors.

Step 3 Rotation

After rotation the factor loadings are easier to interpret. We can now see which items substantially load on which factors.

Step 4 Interpretation of the factors

The first factor reflects problems with distant vision (driving, cycling, walking indoors and outside). Items that loaded high on the second factor were related to social problems feelings of social isolation, influence on self confidence, and friendships) and items loaded high on the third factor were related to problems with near vision (reading, watching, TV, and hobbies). However, a number of items were related to two or more different factors, especially in factors 2 and 3.

3c How many factor would you distinguish?

Because of the difficulties with distinguishing factor 2 and 3, and the results on the scree plot, a two factor model might be sensible. For the authors it was the fact that it was difficult to understand what these four different factors meant that made them decide to try a two factor model.

3d. PCA analysis forcing a 2 factor model and comments on the interpretation.

The first part of the output is exactly the same as the PCA under 3b, i.e. the correlation matrix, the communalities, the total variance explained and the scree plot. In the component matrix there are only two components presented now, with all positive and substantial associations for factor 1, and smaller and some negative associations for factor 2.

In the rotated component matrix, a clearer picture appears of which items load on the two factors. The first seven items load high on factor 2 and low on factor 1. The item “Interference with daily life” loads high on factor 2, but also to some extent on factor 1, with factor loadings 0.64 and 0.35 respectively. The other items load mainly on Factor 1 and hardly on Factor 2, although two factor loadings are between 0.4 and 0.5. The role of the item “Interference with daily life” is somewhat unclear. The authors decided to keep the item and to include it in the factor 2.

Looking at the content of the items factor 2 appears to measure ‘visual functioning’ and factor 1 ‘appearance’.

4. Cronbach’s alpha: GO-QOL

Assignments 4 is based on the Output 4.2.

4a. Cronbach’s alpha is 0.86 for the scale ‘Visual functioning’ and 0.82 for the scale ‘ Appearance’. Factor analysis has shown that there are two sub-scales measuring different constructs, one measuring visual functioning, and the other appearance. The values of Cronbach’s alpha for these sub-scale are high. This means that the scales are homogenous and the items all measure the same construct.

4b. Cronbach's alpha for the total scale (16 items) = 0.82.

The value for the total scale is also high. However, this does not mean that the scales are homogeneous and the items all measure the same construct. The conclusion about homogeneity only holds for unidimensional scales.

4c. For a complete analysis see output 4.2.

Table 4.7 summarizes the results of item reduction by Cronbach's alpha.

Table 4.7 Results of item reduction by Cronbach's alpha.

	Scale 'Visual functioning'		Scale 'Appearances'	
	Item deleted	Cronbach's alpha	Item deleted	Cronbach's alpha
8 items		0.862		0.817
7 items	Reading	0.854	Mask changes	0.830
6 items	Watching TV	0.849	Isolation	0.830
5 items	Hobby	0.835	Friends	0.816
4 items	Interference	0.832	Photos	0.799

4d. The authors decided that the scales were sufficiently short for use in research. Further reducing the number of items would lead to a lower "structural" reliability, as we will see in the next chapter.