Selection of bolt-ons after factor analysis identification. Are linear regressions a useful technique?

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Background

• GPBMs are used in economic evaluations to assess the benefits of healthcare interventions.

• To ensure consistent decisions, health technology assessment bodies suggest the use of only one GPBM for all interventions.

• Theoretically, GPBMs are employable across all conditions. However, some studies suggest they might lack validity and responsiveness in some populations (e.g. Finch et al., 2017).

• When this happens, values are elicited directly from patients, or a different GPBMs or disease specific measure is used.

A possible solution: Bolt-ons

Bolt-ons are dimensions that can be added to expand the descriptive system of a GPBM, simultaneously retaining its core structure.

How should bolt-on be identified?

Studies to date use psychometric evidence (lack of validity and responsiveness) to claim bolt-on relevance (e.g. Yang et al., 2015).

Drawbacks of this method:
1. It does not allow to identify the specific dimensions missing from the core descriptive system.
2. It does not allow to identify dimensions relevant for multiple conditions to improve the measure generically.

Yang Y, Rowen D, Brazier J, Tsuchiya A, Young T. An exploratory study to test the impact of three bolt-on items to the EQ-5D. Value in Health. 2015. 18: 52-60.
An alternative approach: PCA and CFA

- Principal component analysis and confirmatory factor analysis examine the latent structure to which measures relate.

- They allow to identify factors and items not already covered by the parent measure descriptive system.

- Factor and items can be subsequently developed / adapted into bolt-on dimensions.

Problem: Not all bolt-ons can be added simultaneously.

Objective of the study

Testing the possibility of using regressions to select factors and items that might be adapted and developed into bolt-on dimensions.
Methods: Data

Multi-instrument comparison database (largest available worldwide).

GPBM\text{s included in the dataset:}

\begin{itemize}
  \item EQ-5D-5L, SF-6D, HUI 3, AQoL 8D, 15D.
\end{itemize}

Subjective wellbeing measures:

\begin{itemize}
  \item Satisfaction with life scale (SWLS), Office of National Statistics (ONS), Personal Wellbeing Index (PWI), ICECAP.
\end{itemize}

Latent factors:

\begin{itemize}
  \item Satisfaction, relationships, energy/sleep, speech/ cognition, hearing, vision (Finch et al., 2017).
\end{itemize}

Methods: Analysis 1

Test 1

• Factors and dummy for the items were regressed over the VAS health, controlling for socio-demographic variables and EQ-5D-5L dimensions (dummy variables).

Interpretation

• For factors, unstandardized coefficients indicated the amount of decrease in HRQoL as a result of a unit change in the latent factor.

• For items, unstandardized coefficients indicated the amount of decrease in HRQoL associated to the level of the dummy variable compared to the reference case i.e. best possible health/ satisfaction.

• Larger coefficients indicated that the factor / item was better in detecting changes in HRQoL not already captured by the EQ-5D-5L.
Methods: Analysis 2

Test 2

• A base model was calculated regressing nine chronic condition dummies i.e. asthma, cancer, chronic obstructive pulmonary disease, depression, diabetes, hearing problems, arthritis, heart diseases or stroke, the EQ-5D-5L dimensions (dummy) and socio-demographic variables over the health VAS.

• The model was extended adding factors and items individually.

Interpretation

• In the base model, coefficients for the conditions indicated the difference in HRQoL between responders in a disease group and the general population not accounted by the EQ-5D-5L.

• In the extended model, a reduction in the chronic condition coefficient represented the responsiveness of the bolt-on to changes in HRQoL for that condition not already accounted by the EQ-5D-5L.

Results: Test 1

Coefficients and 95% confidence intervals for factors

Note: p≤0.05 for all coefficients.
Results: Test 1 (continued)

Coefficients for a mild, a moderate and a severe level of selected items using the first test

![Bar chart showing coefficients for different levels of AQoL, 15D, SF-6D vitality, and AQoL energy.](chart)

Note: p≤0.05 for all coefficients.
## Results: Test 2

### Differences in chronic conditions coefficients after inclusion of selected factors and items

<table>
<thead>
<tr>
<th>Chronic conditions</th>
<th>Factors</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relationships</td>
<td>Vision</td>
</tr>
<tr>
<td><strong>Cancer</strong></td>
<td>0.067</td>
<td>-0.397</td>
</tr>
<tr>
<td><strong>Asthma</strong></td>
<td>0.048</td>
<td>-0.206</td>
</tr>
<tr>
<td><strong>COPD</strong></td>
<td>0.294</td>
<td><strong>-0.436</strong></td>
</tr>
<tr>
<td><strong>Depression</strong></td>
<td>0.053</td>
<td><strong>-0.863</strong></td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td>0.053</td>
<td><strong>-0.503</strong></td>
</tr>
<tr>
<td><strong>Hearing problems</strong></td>
<td>0.031</td>
<td>-0.274</td>
</tr>
<tr>
<td><strong>Arthritis</strong></td>
<td>0.039</td>
<td>-0.060</td>
</tr>
<tr>
<td><strong>Heart disease</strong></td>
<td>0.063</td>
<td>-0.322</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td>0.010</td>
<td><strong>-2.623</strong></td>
</tr>
</tbody>
</table>

**Note:** All coefficients remained significant at p≤0.05.
Limitations and conclusions

Limitations

• Regressions can be used only in presence of large datasets.

• Other fundamental issues exist for bolt-on selection e.g. effect of bolt-ons on individuals’ preferences for health states.

Conclusions

• Regressions using the first test seem an appropriate technique for bolt-on selection.

• Regressions using the second test do not seem an appropriate technique for bolt-on selection.
References


• Yang Y, Rowen D, Brazier J, Tsuchiya A, Young T. An exploratory study to test the impact of three bolt-on items to the EQ-5D. Value in Health. 2015. 18: 52-60.
Thank you for your attention