Reliability and Validity of Self-reported Health Status: Two Measures of Self-reported General Health Status in the National Health and Nutrition Examination Survey (NHANES)

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Disclaimer for Hee-Choon Shin

The findings and conclusions stated in this manuscript are solely those of the author. They do not necessarily reflect the views of the National Center for Health Statistics or the Centers for Disease Control and Prevention.
“If you cannot measure, your knowledge is meager and unsatisfactory.” – Lord Kelvin
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Introduction

• Self-reported general health status (SRH)
  • good proxy measure for actual health and mortality (Idler & Benyamini, 1997; Maeland & Havik, 1988; McCallum, Shadbolt, & Wang, 1994; Miilunpalo, Vuori, Oja, Pasanen, & Urponen, 1997; Mossey & Shapiro, 1982).

• This SRH has been included in various large-scale surveys
  • The National Health Interview Survey (NHIS),
  • The National Health and Nutrition Examination Survey (NHANES),
  • The Current Population Survey (CPS),
  • The National Longitudinal Surveys (NLS),
  • The General Social Survey (GSS).
The National Health and Nutrition Examination Survey (NHANES)

- a periodic survey conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), is a program of studies designed to assess the health and nutritional status of adults and children in the United States. NHANES is a nationally representative survey of the resident civilian non-institutionalized U.S. population. The survey is unique in that it combines interviews and physical examinations. It consists of questionnaires administered in the home, followed by a standardized physical examination in a specially equipped mobile examination center (MEC). The examination includes physical measurements such as blood pressure, a dental examination, and the collection of blood and urine specimens for laboratory testing.
SRH in NHANES

• In NHANES surveys, self-reported general health is measured twice – first, in a home interview, and then in an MEC interview.

• In both interviews, participants were asked to respond to a single-item question: “Would you say your health in general is...” with five category response options of Excellent, Very Good, Good, Fair, or Poor.

• A signed consent form must be obtained from each eligible individual before the household interview can be conducted. A refusal to sign the consent form is considered a refusal to participate in the survey.

• After the household interview is completed, the interviewer then explains the MEC examination, obtains another signed consent form for the MEC examination, and contacts the field office to schedule a MEC appointment for the respondent. Therefore, respondents did not know about the potential MEC examination before self-reporting of their general health status in home interview.
Mobile Examination Centers (MECs)

• NHANES conducts exams in mobile examination centers (MECs), which are essentially traveling clinics. Each MEC comprises four 52-foot-long trailers; the 2011-12 survey includes a fifth 48-foot-long trailer for conducting the National Youth Fitness Survey. Three MECs travel across the country to randomly-selected destinations, with two in operation and one being set up at any given time.
Mobile Examination Centers (MECs)
Mobile Examination Centers (MECs)

- There are 16 individuals on each traveling team:
  - 1 MEC manager,
  - 1 MEC coordinator,
  - 1 licensed physician,
  - 3 medical technologists,
  - 4 health technologists,
  - 2 registered dental hygienists,
  - 2 MEC interviewers,
  - 2 dietary interviewers, and
  - 1 phlebotomist. In addition,
  - local assistants are recruited, trained, and employed at each stand to assist the examination staff.
Research Objectives

• Our objective is to study the reliability between, and validity of, the two measures by analyzing the relationships between them and measured health indicators.
  • Reliability: Agreement between responses/measurements
    • Relationship between response and settings (Home v. MEC)
    • Validity: Relationships between the two SRHs and measured health indicators

• Data: The 2011-2012 NHANES public use file will be used for data analyses.
Analytic Sample

There are 9,756 respondents to home interview in the 2011-2012 NHANES public use file. Among the 9,756 respondents, 9,338 were examined. Among the examined, the SRH question was asked of a random subset of participants 12 years of age and older, and all of 5,892 participants responded to the SRH question. Among the 5,892 participants, one respondent’s SRH in home interview was missing (“Don’t Know”) and 5,891 participants were identified as valid cases for the current analysis. For the SRH question, however, 12-15 year old participants responded by proxy in home interview but responded for themselves at the MEC interview. Therefore, 606 respondents of 12-15 years of age were excluded from the 5,891 since we are interested in comparing two responses from the same participants. The analytic sample is 5,285 respondents of 16 and older age with valid responses for SRH in home interview and SRH in MEC interview.
Figure 1. Self-reported Geneal Health Status (%)

Data: NHANES 2011-12
Table 1. Distribution (%) of 16 year and older respondents (n=5,285) by general health conditions in home interview and in mobile examination center (MEC) interview: National Health and Nutrition Examination Survey (NHANES) 2011-2012.

<table>
<thead>
<tr>
<th>General Health Condition in Home Interview</th>
<th>General Health Condition in MEC Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Excellent</td>
</tr>
<tr>
<td>Excellent</td>
<td>9.09</td>
</tr>
<tr>
<td>Very Good</td>
<td>2.12</td>
</tr>
<tr>
<td>Good</td>
<td>1.00</td>
</tr>
<tr>
<td>Fair</td>
<td>0.21</td>
</tr>
<tr>
<td>Poor</td>
<td>0.02</td>
</tr>
<tr>
<td>Total</td>
<td>12.42</td>
</tr>
</tbody>
</table>
Table 2. Transition matrix from the general health condition in home interview to the general health condition in mobile examination center (MEC) interview in percent: National Health and Nutrition Examination Survey (NHANES) 2011-2012.

<table>
<thead>
<tr>
<th>General Health Condition in Home Interview</th>
<th>Response</th>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Excellent</td>
<td>55.25</td>
<td>34.82</td>
<td>8.67</td>
<td>1.17</td>
<td>0.09</td>
<td>100.00</td>
</tr>
<tr>
<td>Very Good</td>
<td>Very Good</td>
<td>6.77</td>
<td>63.62</td>
<td>27.44</td>
<td>2.04</td>
<td>0.12</td>
<td>100.00</td>
</tr>
<tr>
<td>Good</td>
<td>Good</td>
<td>2.76</td>
<td>19.57</td>
<td>66.20</td>
<td>11.01</td>
<td>0.47</td>
<td>100.00</td>
</tr>
<tr>
<td>Fair</td>
<td>Fair</td>
<td>1.56</td>
<td>4.33</td>
<td>31.00</td>
<td>58.52</td>
<td>4.60</td>
<td>100.00</td>
</tr>
<tr>
<td>Poor</td>
<td>Poor</td>
<td>0.63</td>
<td>4.09</td>
<td>12.12</td>
<td>34.81</td>
<td>48.35</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Modeling: Independence

Let $\pi_{ii}$ be joint probability and $\mu_{ii}$ be expected cell frequency of the $i^{th}$ row and $j^{th}$ column of a $l \times J$ cross-tabulation under an assumed model with $n$ samples. The independence model is

$$\mu_{ii} = n \cdot i+ \pi_{i+} \cdot j \cdot \pi_{+j}, \quad i = 1, 2 \ldots l; \quad j = 1, 2 \ldots J$$

where + is a summation notation. And $\pi_{i+}$ and $\pi_{+j}$ are the $i^{th}$ row and the $j^{th}$ column marginal probabilities respectively.
Log-linear model of Independence

\[ l(\mu_{ii}) = \lambda + \lambda_i + \lambda_j, \] (2)

where \( \lambda = \log n, \lambda_i = \log \pi_{i+}, \) and \( \lambda_j = \log \pi_{+j}. \) The log-linear model of independence applied to Table 1 can be specified as

\[ l(\mu_{ii}) = \lambda + \lambda_{i}^H + \lambda_{j}^E, \] (3)

where \( H \) stands for general health condition in home interview and \( E \) for that in MEC interview.
Saturated Model

Various sub-models can be derived with restrictions to the model terms (Agresti, 1988; Goodman, 1979; Goodman, 1985; Tanner & Young, 1985).
Quasi-independence Model

Quasi-independence model fits the log-linear model of independence only to off-diagonal cells with the constraints:

\[ \lambda_{ii}^H = \begin{cases} \lambda_{ii}^H, & \text{if } i = j \\ 0, & \text{if } i \neq j \end{cases} \]  

(5)
Symmetry Model

Symmetry model is to test if the square table exhibits symmetry and can be specified with two simultaneous constraints:

\[
\lambda^H_{ii} = \lambda^H_{jj}; \quad \text{and} \quad \lambda^E_i = \lambda^E_j, \quad \text{for} \ i = j.
\]
Quasi-Symmetry Model

• Quasi-symmetry model does not assume that margins are the same, and obtained by omitting the constraint (6.2) from the symmetry model.
Marginal Homogeneity Model

Quasi-symmetry model does not assume that margins are the same, and obtained by omitting the constraint (6.2) from the symmetry model. Marginal homogeneity model is to test whether the row and column distributions are the same:

\[ \mu_{i+} = \mu_{+j} \]  \hspace{1cm} (7)

When the quasi-symmetry model fits the data, marginal homogeneity model can be tested by comparing the symmetry model and the quasi-symmetry model since symmetry model is a special case of quasi-symmetry model (Agresti, 2002; Bishop, Fienberg, & Holland, 1975).
Table 3. Log-linear models applied to the cross-classification data in Table 1.

<table>
<thead>
<tr>
<th>Model</th>
<th>DF</th>
<th>Rao-Scott Goodness-of-Fit</th>
<th>Rao-Scott Likelihood Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Chi-Square</td>
<td>Chi-Square</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Size</td>
<td>P-Value</td>
</tr>
<tr>
<td>Independence</td>
<td>16</td>
<td>1,470.13 &lt; .001</td>
<td>1,024.43 &lt; .001</td>
</tr>
<tr>
<td>Quasi-independence</td>
<td>11</td>
<td>221.84 &lt; .001</td>
<td>190.83 &lt; .001</td>
</tr>
<tr>
<td>Symmetry</td>
<td>10</td>
<td>27.53 .002</td>
<td>28.44 .001</td>
</tr>
<tr>
<td>Quasi-symmetry</td>
<td>6</td>
<td>4.84 .564</td>
<td>4.67 .587</td>
</tr>
<tr>
<td>Marginal Homogeneity</td>
<td>4</td>
<td>22.69 &lt; .001</td>
<td>23.77 &lt; .001</td>
</tr>
</tbody>
</table>
Conclusion/Discussion/Additional Work

• The Two SRHs are different.
• Why? – Cognitive science
• Validity – Which is better indicator?
Figure 2. Glycohemoglobin (%) by Interview Location and Self-reported General Health Status

Data: NHANES 2011-12
Figure 2a. Glycohemoglobin (%) by Interview Location and Self-reported General Health Status

Data: NHANES 2011-12
Figure 7. Blood Pressure Classification by Interview Location and Self-reported General Health Status

Data: NHANES 2011-12; H (Home interview), M (MEC interview)
Figure 8. Body Mass Index by Interview Location and Self-reported General Health Status

Kg/m^2

Data: NHANES 2011-12
Figure 8a. Body Mass Index by Interview Location and Self-reported General Health Status

Data: NHANES 2011-12
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Gratias
Merci
Dank
Thanks
감사합니다