Determinant, mediator, moderator?
How does Health Literacy influence self-assessed health?
Results from the HLS–EU–study

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1. PROBLEM & RESEARCH QUESTION
There is growing evidence for the relevance of health literacy (HL) for health, but what are the causal mechanisms at work?

- It has been demonstrated quite well that functional HL has relevant effects on health related indicators for patients and health/disease care related outcomes (cf. Berkman et al. 2011)

- But there is much less research on these relationships in general populations and/or with a wider more comprehensive definition and measure of HL, e.g.
  - For community samples of older citizens or patients & mortality (e.g. Baker et al. 2007, 2008, Bostock & Steptoe 2012, McNaughton et al 2015)
  - For self-rated health status for aged US adults (Bennett et al. 2009, Sentell, et al. 2014), Taiwanese adults (Lee et al. 2010), for Japanese adults (Furuaya et al. 2015), for elderly Chinese (Liu et al. 2015), for immigrants in Canada (Omariba & Ng, 2011)

- There are only a few studies looking explicitly at mediating effects of HL, e.g.
  - between education & self-reported health for Dutch adults (van der Heide et al. 2013)
  - between education & health behaviors for Danish adults (Friis, et al. 2016), or health-insured Belgians (van den Broucke & Renwart, 2014)
  - between race & patient activation for elderly urban minority patients (Gwynn et al. 2016)

- Even less on moderating effects of HL, e.g.
  - between age & health related quality of life responses to chronic disease in Chinese rural women (Wang et al. 2015)

- Data of the HLS–EU survey provide an excellent opportunity for testing the relationship of HL and health for general populations in different countries.
**Research questions**

1. In how far is functional or comprehensive health literacy (HL) associated with self-assessed health (SAH)?

2. How does HL influence SAH? As a determinant, or a mediator, or a moderator of health, or a combination of these mechanisms?

<table>
<thead>
<tr>
<th>HL as a determinant</th>
<th>HL</th>
<th>Indicators of Health (SAH)</th>
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<th>HL as a moderator</th>
<th>HL</th>
<th>Indicators of Health (SAH)</th>
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2. **CAUSAL MODEL & MEASURES OF VARIABLES**
A causal model of limited HL for patients in health care

Figure 1
Causal Pathways between Limited Health Literacy and Health Outcomes

The **Vienna Model** of determinants & consequences of HL in **general populations** based on the HLS–EU model  *(Pelikan et al 2014)*

0. Situational Determinants  *(Country, Province, District, Urban/Rural, etc.)*

1. Personal Determinants

2. Individual Health Literacy

3. Health Behaviors

4. Health Status

5. Illness Behaviors
The Vienna Model of determinants & consequences of HL in general populations based on the HLS–EU model (Pelikan et al 2014)

0. Situational Determinants (Country, Province, District, Urban/Rural, etc.)
Causal ordering & measures of variables used

1. Gender (0 = male, 1 = female)
2. Age (years of age, or grouped)
3. Education (ISCED: from 0 = lowest to 6 = highest level)
4. Financial deprivation (Factor score based on 3 questions from low deprivation to high)
5. Self-assessed social status (from 1 = lowest to 10 = highest place in society)
6. NVS (6 questions on ice crème label, 0–6 points (6 = best), 3 levels)
7. Comprehensive HL (HLS-EU-Q47, Index 0–50 = highest HL, 4 levels)
8. Physical Activity (1 = almost every day to 4 = no physical activity)
9. BMI (Index of weight-for-height; kg/m²; Low to high BMI Index)
10. Long-term illness (Minimum European Health Modul, from 1 = No long-term illnesses, 2 = Yes, one, 3 = Yes, more than one)
11. Self-assessed health (SF36 item, from 1 = very good to 5 = very bad)
## HLS–EU Survey Overview: Sampling, Data collection

<table>
<thead>
<tr>
<th>Countries</th>
<th>Austria (AT), Bulgaria (BG), Germany (DE) (only NRW), Greece (EL) (only Athens +), Spain (ES), Ireland (IE), Netherlands (NL), Poland (PL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey Institut</td>
<td>TNS Opinion on behalf of the HLS-EU Consortium</td>
</tr>
<tr>
<td>Survey Periode</td>
<td>Summer 2011</td>
</tr>
<tr>
<td>Target Population, Population Coverage</td>
<td>EU citizens (!) aged 15 years and over (Euro-barometer Methodology)</td>
</tr>
<tr>
<td>HL Instrument</td>
<td>HLS-EU-Q86 (including HLS-EU-Q47 and NVS Test)</td>
</tr>
<tr>
<td>Data collection</td>
<td>by computer-assisted personal interviewing technique (CAPI) (BG, IE = PAPI)</td>
</tr>
</tbody>
</table>
| Sampling design                    | Euro-barometer Methodology  
Stratified probability sampling (multistage random sample):  
• National sampling points selected randomly (applying random-walk procedure) after stratification for population size and population density (metropolitan, urban and rural areas). |
| Response Rates                     | Austria (67%), Bulgaria (75%), Germany (DE) (53%), Greece (65%), Spain (62%), Ireland (69%), Netherlands (36%), Poland (67%)     |
| Sample Sizes                       | Austria (1015), Bulgaria (1002), Germany (DE) (1057), Greece (1000), Spain (1000), Ireland (1005), Netherlands (1023), Poland (1000) |
| Weights                            | National samples were weighted by gender, age group and size of locality, based on national census data  
Country size was not used as a weighting criterion for the analyses of the total sample. Total sample values therefore represent a 'country average' where all countries are represented with equal weights regardless of their population size. |
3. RESULTS
## Spearman Correlations for all used variables
(for Total, N=8000, HLS–EU 2012)

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>Social Status</th>
<th>Fin. Dep.</th>
<th>NVS</th>
<th>Comp. HL</th>
<th>Physical Activity</th>
<th>BMI</th>
<th>Long-Term Illness</th>
<th>SAHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.066*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>-0.018</td>
<td>-0.204*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Status</td>
<td>-0.007</td>
<td>-0.137*</td>
<td>0.336*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin. Dep.</td>
<td>0.050*</td>
<td>0.036*</td>
<td>-0.200*</td>
<td>-0.422*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NVS</td>
<td>0.011</td>
<td>-0.290*</td>
<td>0.347*</td>
<td>0.296*</td>
<td>-0.196*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comp. HL</td>
<td>0.046*</td>
<td>-0.121*</td>
<td>0.239*</td>
<td>0.291*</td>
<td>-0.300*</td>
<td>0.245*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Physical Activity</td>
<td>0.030*</td>
<td>0.110*</td>
<td>-0.151*</td>
<td>-0.205*</td>
<td>0.196*</td>
<td>-0.170*</td>
<td>-0.189*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>-0.149*</td>
<td>0.336*</td>
<td>-0.103*</td>
<td>-0.113*</td>
<td>0.092*</td>
<td>-0.113*</td>
<td>-0.066*</td>
<td>0.121*</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-Term Illness</td>
<td>-0.073*</td>
<td>-0.425*</td>
<td>0.152*</td>
<td>0.129*</td>
<td>-0.120*</td>
<td>0.165*</td>
<td>0.156*</td>
<td>-0.109*</td>
<td>-0.205*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>SAHS</td>
<td>0.062*</td>
<td>0.443*</td>
<td>-0.213*</td>
<td>-0.254*</td>
<td>0.188*</td>
<td>-0.231*</td>
<td>-0.274*</td>
<td>0.200*</td>
<td>0.256*</td>
<td>-0.589*</td>
<td>1</td>
</tr>
</tbody>
</table>

There are significant correlations between HL indicators & health related outcome indicators, between different health related indicators, but also with socio-demographic & socio-economic confounders!
There is a gradient: The better health literacy, the better Self-Assessed Health (SF–36) (for Total Sample) (HLS–EU 2012)

Percentages of Categories of Self-assessed Health Status

Grouped Scores of Comprehensive Health Literacy Index

The gradient for self-assessed health holds true for each country, but on a different level and differing correlation, (for 8 Countries & Total Sample (HLS–EU 2012))

Percentages of Respondents Reporting Good or Very Good Health

Austria (r=-.314)**
Bulgaria (r=-.302)**
Germany (r=-.227)**
Greece (r=-.379)**
Spain (r=-.295)**
Ireland (r=-.230)**
Netherlands (r=-.172)**
Poland (r=-.336)**
Total (r=-.294)**

(only levels with N > 10 are illustrated)
HEALTH LITERACY AS A DETERMINANT OF SELF-ASSESSED HEALTH, WHEN RELEVANT CONFOUNDERS ARE CONTROLLED FOR
Self-assessed health by 5 social and 2 HL determinants
(Beta Weights and Adjusted R-Square for Total Sample and Countries) (HLS-EU 2012)

There is a social gradient for SAH, CHL is the second strongest predictor and NVS has no significant influence!
Self-assessed health by 5 social, 2 HL determinants and 3 risk factors
(Beta Weights and Adjusted R-Square) (NVS were not significant!), for Countries and Total Sample (HLS-EU 2012)

The direct effect of CHL on SAH stays on as third strongest, even when LTI and 2 life-style indicators are included!
HEALTH LITERACY AS A DETERMINANT & MEDIATOR OF HEALTH RELATED INDICATORS – DIRECT AND INDIRECT EFFECTS OF HEALTH LITERACY
Path Model for all variables explaining variation of self-assessed health

(Beta weights for TOTAL, HLS-EU 2012) Explained Variance of SAH by CHL: direct .133, indirect .63, total .196

Gender

Age

Educ.

Fin. Dep.

Soc. St.

BMI

LTI

PHA

NVS

CHL

SAH

Gender

.030

.062

-.119

.030

Age

.236

.135

-.123

-.133

Educ.

-.249

-.037

-.056

-.021

Fin. Dep.

-.058

-.242

-.056

-.092

Soc. St.

.158

.123

-.188

-.102

Pelikan & Ganahl HARC 2016
Direct & indirect effects of CHL on SAH and explained variance of dependent health related indicators in path models
(Beta weights and adjusted R², Total & 4 countries, HLS–EU 2012)

<table>
<thead>
<tr>
<th>Effects of CHL on SAH</th>
<th>Total</th>
<th>NL</th>
<th>ES</th>
<th>PL</th>
<th>EL</th>
</tr>
</thead>
<tbody>
<tr>
<td>- direct</td>
<td>-0.133</td>
<td>-0.113</td>
<td>-0.188</td>
<td>-0.123</td>
<td>-0.054</td>
</tr>
<tr>
<td>- indirect</td>
<td>-0.063</td>
<td>-0.040</td>
<td>-0.010</td>
<td>-0.053</td>
<td>-0.069</td>
</tr>
<tr>
<td>- total</td>
<td>-0.196</td>
<td>-0.153</td>
<td>-0.197</td>
<td>-0.176</td>
<td>-0.124</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R-Square</th>
<th>SAH</th>
<th>CHI</th>
<th>BMI</th>
<th>PHA</th>
<th>CHL</th>
<th>NVS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- SAH</td>
<td>0.454</td>
<td>0.315</td>
<td>0.412</td>
<td>0.555</td>
<td>0.616</td>
<td></td>
</tr>
<tr>
<td>- CHI</td>
<td>0.196</td>
<td>0.119</td>
<td>0.187</td>
<td>0.291</td>
<td>0.281</td>
<td></td>
</tr>
<tr>
<td>- BMI</td>
<td>0.087</td>
<td>0.059</td>
<td>0.146</td>
<td>0.110</td>
<td>0.117</td>
<td></td>
</tr>
<tr>
<td>- PHA</td>
<td>0.063</td>
<td>0.019</td>
<td>0.016</td>
<td>0.035</td>
<td>0.083</td>
<td></td>
</tr>
<tr>
<td>- CHL</td>
<td>0.189</td>
<td>0.081</td>
<td>0.102</td>
<td>0.258</td>
<td>0.293</td>
<td></td>
</tr>
<tr>
<td>- NVS</td>
<td>0.220</td>
<td>0.366</td>
<td>0.229</td>
<td>0.211</td>
<td>0.348</td>
<td></td>
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</tbody>
</table>
HEALTH LITERACY AS A MODERATOR OF HEALTH RELATED INDICATORS
Probability of having fair, bad or very bad self-assessed health for age groups moderated by HL levels (for Total Sample, N= 6923, HLS-EU 2012).

> With older age the probability of having fair, bad or very bad self-assessed health is rising steadily, but much less, when one has better HL!

Logistic Regression controlled for: long-term illness (*), social status (*), exercising (*), BMI (*), Gen-HL-Raw (ns), age (*), gender (female ↑) (*), financial deprivation (*), demographic standard weights (ns),) – means by HL-levels and age groups Nagelkerke/pseudo $R^2=0.46$
Probability of having fair, bad or very bad self-assessed health, for education (ISCED-Levels) moderated by HL levels (for Total Sample, N= 6903, HLS–EU 2012)

> With better education the probability of having fair, bad or very bad self-assessed health is decreasing steadily, but much less when one has better health literacy!

Logistic Regression controlled for: long-term illness (*), social status (*), exercising (*), BMI (*), Gen-HL-Raw (*), Education (ns), Gender (female ↑) (*), financial Deprivation(*) – means by HL-Levels and Education-Levels

Nagelkerke/pseudo $R^2=0,44$
Summary & discussion

» Summary

» For a comprehensive measure of HL (CHL) and for general populations in 8 European countries it could be demonstrated
  » That CHL is a relevant social determinant of health (SDH) in multivariate models
  » That CHL & NVS are mediating social determinants on health and their impact on health is also mediated by health behavior indicators or LTI
  » That CHL is moderating the relationship of age and education on self-assessed health
  » Explained variances & coefficients of effects vary by country.

» Limitations

» Cross-sectional study!
» Limited number of variables included
» No model combining mediating & moderating effects
» Our results partly depend on the model we have chosen for analysis!
References


References


Thank you for your attention!

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