Literacy, Numeracy, Technological Problem Solving, and Health among U.S. Adults: PIAAC Analyses

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November 2, 2015
SOCIAL DETERMINANTS OF HEALTH

- We know a lot about educational attainment and health…but far less about basic skills.
- Need to know whether immigrants and U.S.-born adults accumulate similar health benefits from basic skills.
- Many prior studies on literacy/numeracy did not account for background characteristics.

Adapted from Braveman, Egerter, & Williams (2011, p. 383)
RESEARCH QUESTIONS

• Literacy, numeracy, and problem solving in technology-rich environments (PS-TRE)
  • RQ 1: Among U.S. adults, are literacy, numeracy, and PS-TRE scores associated with self-rated health (SRH), after controlling for various sociodemographic characteristics?

• Immigrant status
  • RQ 2: Are associations between SRH and proficiency in literacy and numeracy moderated by immigrant status?
  • RQ 3: Among immigrants, are literacy and numeracy skills more strongly associated with SRH for Hispanics versus Asians?
VARIABLES

• Dependent (outcome) variable: self-rated health
  • In general, would you say your health is excellent, very good, good, fair, or poor?

• Independent (predictor) variables
  • RQ #1: Literacy, numeracy, PS-TRE scores
    • Excluded people who did not answer PS-TRE questions
  • RQ #2 and 3: Literacy and numeracy scores

• Moderators (RQ #2)
  • Immigrant status – U.S.-born (reference group), foreign-born
CONTROL VARIABLES

- Age
- Sex
- Employment status
- Living with spouse or partner
- Children 12 or younger
- Household size
- U.S.- or foreign-born
- Mother’s and father’s educational attainment

- Vision problems, hearing problems, learning disability
- Health insurance status
- English proficiency score
- Race/ethnicity
- RQ #2 & 3:
  - U.S. Census region
  - Rec’d flu shot in past yr.
  - Age of learning English
  - # years in USA
RQ 1: These respondents differ in only 1 way: their literacy, numeracy, or PS-TRE scores.

Latina woman employed born in US 25-34 years old no HS diploma lives with spouse no health insurance has children under 12 4 people in household speaks English “very well” mother completed HS, father did not no vision/hearing problems or learning disability

Maria

literacy score: 230*

*average for U.S. adults with < high school

Does Lucia report better health?

Lucia

literacy score: 240
ANALYTIC APPROACH

• Ordinal logistic regression models
  • Unadjusted (no control variables)
  • Adjusted (all control variables)
  • RQ #2 and 3: Interaction models – whether relationship varies by (a) immigrant status or (b) Hispanic vs. Asian

• Can’t determine causality!
SAMPLE CHARACTERISTICS (RQ #1)

- Average scores
  - Literacy: 272 (Level 2 = 226 – 275)
  - Numeracy: 255 (Level 2)
  - PS-TRE: 278 (Level 2 = 241 – 290)

- Health: excellent (34%), very good (24%), good (28%), fair (11%); poor (3%)

- Female (51%)

- Ethnicity: non-Hispanic White (67%); Hispanic (14%), non-Hispanic Black (11%); Asian (5%); Other (2.5%)

- Education
  - No HS diploma (14%)
  - HS/some college (41%)
• Parents’ educational attainment:
  • Mother: < HS (26%), HS (47%), college+ (27%)
  • Father: < HS (27%), HS (45%), college+ (28%)

• Employment:
  • Employed (65%)
  • Unemployed (8%)
  • Not working due to disability (5%)

• No health insurance (20%)
• Vision or hearing problem or diagnosed learning disability (23%)
• Foreign-born (15%)
RQ #1
DESCRIPTIVE RESULTS
RELATIONSHIP BETWEEN LITERACY AND HEALTH

Literacy scores for excellent & very good health significantly higher than good, fair, & poor categories (N=4,647; weighted)
RELATIONSHIP BETWEEN NUMERACY AND HEALTH

Numeracy scores for excellent & very good health significantly higher than good, fair, & poor categories (N=4,647; weighted)
PS-TRE scores for excellent & very good health significantly higher than good, fair, & poor categories (N=3,942; weighted)
RQ #1
REGRESSION RESULTS
LITERACY, NUMERACY, PS-TRE AND HEALTH: WITHOUT CONTROL VARIABLES

<table>
<thead>
<tr>
<th></th>
<th>UNADJUSTED (no controls)</th>
<th>ADJUSTED (all controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LITERACY</td>
<td>1.105*** (1.090-1.120)</td>
<td></td>
</tr>
<tr>
<td>NUMERACY</td>
<td>1.085*** (1.073-1.098)</td>
<td></td>
</tr>
<tr>
<td>PS-TRE</td>
<td>1.076*** (1.057-1.095)</td>
<td></td>
</tr>
</tbody>
</table>

***p<.001 (two-tailed tests); weighted

- 10-point increase on literacy scale: +11% odds of being in a better health category
- Numeracy: 9% greater odds
- PS-TRE: 8% greater odds
LITERACY, NUMERACY, PS-TRE AND HEALTH: WITH CONTROL VARIABLES

<table>
<thead>
<tr>
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<th>UNADJUSTED (no controls)</th>
<th>ADJUSTED (all controls)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LITERACY</strong></td>
<td>1.105*** (1.090-1.120)</td>
<td>1.026* (1.004-1.049)</td>
</tr>
<tr>
<td><strong>NUMERACY</strong></td>
<td>1.085*** (1.073-1.098)</td>
<td>1.010 (0.922-1.028)</td>
</tr>
<tr>
<td><strong>PS-TRE</strong></td>
<td>1.076*** (1.057-1.095)</td>
<td>1.004 (0.983-1.026)</td>
</tr>
</tbody>
</table>

***p<.001; *p<.05 (two-tailed tests); weighted

- 10-point increase on the literacy scale: +3% odds of better health category
- Significance of numeracy & PS-TRE disappeared
  - Resources that help people improve scores are the same ones that contribute to health
These respondents differ in only 1 way: their literacy, numeracy, or PS-TRE scores.

Maria

- Latina woman
- employed
- born in US
- 25-34 years old
- no HS diploma
- lives with spouse
- no health insurance
- has children under 12
- 4 people in household
- speaks English “very well”
- mother completed HS, father did not
- no vision/hearing problems or learning disability

Literacy score: 230*

- poor health

*average for U.S. adults with < high school

Lucia

- higher numeracy or PS-TRE score: not significantly related to health

Literacy score: 240

+3% odds of better health (fair)

Health categories: poor, fair, good, very good, excellent
WHICH OTHER VARIABLES PREDICT HEALTH?

- Many control variables are more strongly associated with health than is literacy

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Odds of being in better health category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LITERACY SCORE</strong></td>
<td>3%</td>
</tr>
<tr>
<td>Educational Attainment <em>(reference group = &lt;HS)</em></td>
<td></td>
</tr>
<tr>
<td>Master’s degree or higher</td>
<td>212%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>92%</td>
</tr>
<tr>
<td>Parental Educational Attainment <em>(reference group = &lt;HS)</em></td>
<td></td>
</tr>
<tr>
<td>Mother completed high school</td>
<td>23%</td>
</tr>
<tr>
<td>Father attended college or more</td>
<td>36%</td>
</tr>
<tr>
<td>Employment Status <em>(reference group = employed)</em></td>
<td></td>
</tr>
<tr>
<td>Unable to work due to disability</td>
<td>-96%</td>
</tr>
<tr>
<td>Retired</td>
<td>-39%</td>
</tr>
<tr>
<td>Foreign-born</td>
<td>48%</td>
</tr>
<tr>
<td>Vision/hearing problems or diagnosed learning disability</td>
<td>-42%</td>
</tr>
<tr>
<td>Worse English proficiency</td>
<td>-8%</td>
</tr>
<tr>
<td>Has health insurance</td>
<td>5%</td>
</tr>
</tbody>
</table>
RQ #2: IMMIGRANT STATUS - DESCRIPTIVE RESULTS
U.S.-BORN VERSUS IMMIGRANT CHARACTERISTICS: SELECTED DIFFERENCES

- U.S.-born: significantly higher literacy & numeracy scores; more likely to report very good health

<table>
<thead>
<tr>
<th></th>
<th>U.S.-Born</th>
<th>Immigrant</th>
<th>t-value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(N=4,033)</td>
<td>(N=613)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Literacy Score</td>
<td>277</td>
<td>241</td>
<td>15.25</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Numeracy Score</td>
<td>260</td>
<td>228</td>
<td>11.57</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Self-Rated Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>23.9</td>
<td>25.7</td>
<td>-1.04</td>
<td>0.33</td>
</tr>
<tr>
<td>Very Good</td>
<td>34.5</td>
<td>29.7</td>
<td>2.49</td>
<td>0.01</td>
</tr>
<tr>
<td>Good</td>
<td>27.8</td>
<td>28.8</td>
<td>-0.52</td>
<td>0.60</td>
</tr>
<tr>
<td>Fair</td>
<td>10.3</td>
<td>13.0</td>
<td>-1.84</td>
<td>0.07</td>
</tr>
<tr>
<td>Poor</td>
<td>3.5</td>
<td>2.9</td>
<td>0.90</td>
<td>0.37</td>
</tr>
</tbody>
</table>
U.S.-BORN VERSUS IMMIGRANT CHARACTERISTICS: SELECTED DIFFERENCES

- Compared to U.S.-born respondents, immigrants were
  - significantly more likely to:
    - have < high school degree ($p < .001$)
    - be employed ($p = .037$) or a homemaker ($p = .028$)
  - significantly less likely to:
    - have a master’s degree+ ($p < .001$)
    - be a student ($p = .008$), retired ($p = .023$), unable to work due to disability ($p < .001$)
    - have health insurance ($p < .001$)
Average Literacy Scores by Health Category for U.S.-Born and Immigrant Respondents (N=4,664)

- **US-born**: Literacy scores for excellent, VG, & good health significantly **higher** than fair, & poor
- **Immigrants**: Literacy scores for excellent & VG health **significantly higher** than for good, fair, & poor
Average Numeracy Scores by Health Category for U.S.-Born and Immigrant Respondents (N=4,664)
RQ #2
REGRESSION RESULTS
RELATIONSHIPS BETWEEN LITERACY, NUMERACY, AND HEALTH BY IMMIGRANT STATUS

• Model 1: demographic & health characteristics
• Model 2: demographic, health, AND human capital
  • These drove much of the literacy-health relationship
• U.S.-born: 10-point increase in literacy $\rightarrow$ 3% greater odds of better health category
  • Formal education, employment, income, parental education only partially explain relationship between literacy & health
• Immigrants: literacy became insignificant
  • Assimilation characteristics explained this relationship
    • Income, employment, education, speaking English well
RELATIONSHIPS BETWEEN LITERACY, NUMERACY, AND HEALTH BY IMMIGRANT STATUS

• Added human capital characteristics → numeracy-health relationship became insignificant for U.S.-born and immigrants
  • Human capital characteristics drove this relationship

• Immigrants and U.S.-born respondents derive similar health rewards from higher literacy and numeracy scores
HISPANIC AND ASIAN IMMIGRANT CHARACTERISTICS: SELECTED DIFFERENCES

- Hispanics significantly more disadvantaged than Asians

<table>
<thead>
<tr>
<th></th>
<th>Hispanic (N=254)</th>
<th>Asian (N=166)</th>
<th>t-value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Literacy Score</td>
<td>210</td>
<td>265</td>
<td>-10.98</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Numeracy Score</td>
<td>192</td>
<td>258</td>
<td>-11.50</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Self-Rated Health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>19.9</td>
<td>25.6</td>
<td>-1.34</td>
<td>0.18</td>
</tr>
<tr>
<td>Very Good</td>
<td>24.6</td>
<td>36.3</td>
<td>-2.55</td>
<td>0.01</td>
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<tr>
<td>Good</td>
<td>34.3</td>
<td>28.2</td>
<td>1.33</td>
<td>0.16</td>
</tr>
<tr>
<td>Fair</td>
<td>18.9</td>
<td>6.4</td>
<td>4.03</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Poor</td>
<td>2.3</td>
<td>3.5</td>
<td>-0.72</td>
<td>0.47</td>
</tr>
</tbody>
</table>

- Vision/hearing problems, learning disabilities, health insurance, employment, educational attainment, parental education, income, English proficiency
RELATIONSHIPS BETWEEN LITERACY, NUMERACY, & HEALTH: HISPANICS VS. ASIANS

- Control variables: added age of learning English and # years in USA
- Positive relationships between literacy and numeracy and health for Hispanics and Asians
  - 10-point increase → 4% greater odds of reporting better health
  - Mostly driven by human capital and assimilation characteristics
- Both groups attain similar health benefits from higher literacy & numeracy scores
IMPLICATIONS

• Literacy and numeracy are strongly associated with health for immigrants and non-immigrants → social determinants of health

• These relationships are driven almost entirely by human capital resources → help us improve health AND literacy/numeracy/PS-TRE

  • Socioeconomic resources are the pathway through which literacy, numeracy, and PS-TRE are related to health

• Basic skills instruction: similar health benefits for (1) U.S.-born and immigrants and (2) Hispanic and Asian immigrants

• Formal education
• Parents’ education
• Income
• Employment
• (English proficiency)
• Need longitudinal data to test causal pathways

• Can’t isolate any single thing that improves health → need literacy instruction + other interventions
  • Some strong predictors of health are beyond our control
  • Others CAN be modified through policy:
    • Increase 4-year college completion → multi-generational impact
    • Provide support services for people with disabilities, vision/hearing problems
    • Expand ESL instruction
    • Increase access to health insurance
  • People DON’T have access to same resources → target those with greatest unmet literacy & financial needs, least education (e.g., Hispanic immigrants)
ACCESS THE FULL PAPERS

- Paper: http://tinyurl.com/o5xplpa
- 1-page summary: http://tinyurl.com/pecmbj7

“Examining Associations between Self-Rated Health and Proficiency in Literacy and Numeracy among Immigrants and U.S.-Born Adults” (Prins & Monnat, 2015). PLOSONE.org