SES AND HYPERTENSION

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EGAT investigator
Mahidol University
Background

- Socioeconomic status (SES) has impacts on health
- Lower SES poses health risks behavior and negative biological factors
- Hypertension is a major cardiovascular (CV) risk factor
- Whether SES affects incidence of hypertension is unknown
Level of Income & Mortality

Hazard Ratio for Level of Income: Multivariable Analysis
Adjusted for Age, Sex, DM, HT, Smoking, Alcohol, BMI, TChol, LDL, HDL

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Hazard Ratio (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5,000</td>
<td>3.85*** (p&lt;0.001)</td>
</tr>
<tr>
<td>5K-10,000</td>
<td>2.13* (p&lt;0.01)</td>
</tr>
<tr>
<td>10K-20,000</td>
<td>1.33</td>
</tr>
<tr>
<td>&gt;20,000</td>
<td>1.23</td>
</tr>
</tbody>
</table>

*p<0.01
**p<0.001

CVD All-cause
Hazard Ratio for Level of Education: Multivariable Analysis

Adjusted for Age, Sex, DM, HT, Smoking, Alcohol, BMI, TChol, LDL, HDL

<table>
<thead>
<tr>
<th>Education Level</th>
<th>CVD Hazard Ratio</th>
<th>All-cause Hazard Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>3.13</td>
<td>2.38</td>
</tr>
<tr>
<td>Secondary</td>
<td>1.72</td>
<td>1.72</td>
</tr>
<tr>
<td>Bachelor</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* p<0.01
** p<0.001
How SES affects outcome...

Low SES

Health Risk Behavior

Access to Medical Care

Negative Biological Factors

- Health Risk Behavior
- Access to Medical Care
- Negative Biological Factors
Objective

To analyze effects of each socioeconomic parameter on prevalence of hypertension in a cohort study from Thailand
Method

- A cohort study

- 3,499 Participants from the Electricity Generating Authority of Thailand (EGAT) study: 22 years follow up
  - Completed SES data in 1985
  - Repeated surveys in 1997, 2002 and 2007

- Blood pressure measurement

- Socioeconomic measures

- Data analysis; Logistic regression model
Blood pressure measurement

- Sitting position / after 5-minute rest
- Calculated suitable cuff size
- 2 standard measurement by automatic machine
- Operated by trained nurses
Definition of Hypertension

- JNC 7
  - Systolic blood pressure $\geq 140$ mmHg
  - Diastolic blood pressure $\geq 90$ mmHg
  - Currently taking antihypertensive medication for at least 2 weeks

- Cross-sectional - prevalence in 1985
- Longitudinal – progression to HTN in 1997
- Longitudinal – Incidence rate over 22 years (1985-2007)
Socioeconomic status measures

<table>
<thead>
<tr>
<th><em>Level of Income (baht)</em></th>
<th>Level of Education</th>
<th>Occupational class</th>
</tr>
</thead>
<tbody>
<tr>
<td>• &lt;5,000</td>
<td>• Primary or Less</td>
<td>• Non-skilled</td>
</tr>
<tr>
<td>• 5k – 10k</td>
<td>• Secondary</td>
<td>• Skilled manual</td>
</tr>
<tr>
<td>• &gt; 10k</td>
<td>• Bachelor or more</td>
<td>• Non-manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Manager</td>
</tr>
</tbody>
</table>

*Level of income in 1985 multiply by 2.25 = income in 2007 (Consumer Price Index; BOT)
Statistical Analysis

- Logistic model
  - prevalence in 1985
  - progression to HTN in 1997

- Cox-proportional hazard model
  - incidence rate over 22 years (1985-2007)

- Adjusted for age, sex, diabetes, HDL- and LDL-cholesterol, BMI, smoking status, alcohol consumption and physical activity in 1985
Results:
Prevalence of Hypertension by year of survey

Overall incidence from 1985 to 2007 = 58%
Distribution of SES

**Level of Income**
- <5,000: 19.60%
- 5,000-10,000: 38.30%
- 10,000-20,000: 36.30%
- >20,000: 5.80%

**Level of Education**
- Primary or Below: 20.40%
- Secondary: 52.40%
- Bachelor or Above: 27.20%

**Occupational Status**
- Non-Skilled worker: 15.20%
- Skilled Manual: 42.20%
- Skilled Non-Manual: 27.00%
- Manager: 15.50%
Prevalence of HT by Education Levels

1985
- Primary school: 23%
- Secondary school: 21%
- University: 16%

1997
- Primary school: 50%
- Secondary school: 40%
- University: 30%

2002
- Primary school: 60%
- Secondary school: 50%
- University: 40%

2007
- Primary school: 80%
- Secondary school: 70%
- University: 60%

p < 0.001
Prevalence of hypertension in 1985 and 1997 according to income level

**1985**

- <5K: 18%
- 5K - 10K: 20%
- 10K - 20K: 21%
- >20K: 22%

**1997**

- <5K: 46%
- 5K - 10K: 49%
- 10K - 20K: 48%
- >20K: 48.4%

P-values:
- 1985: p = 0.36
- 1997: p = 0.67
Prevalence of hypertension in 1985 and 1997 according to occupational class

<table>
<thead>
<tr>
<th>Occupational class</th>
<th>1985</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-skill labour</td>
<td>19</td>
<td>51</td>
</tr>
<tr>
<td>Skill labour</td>
<td>24</td>
<td>55</td>
</tr>
<tr>
<td>Office worker</td>
<td>13</td>
<td>38</td>
</tr>
<tr>
<td>Executive</td>
<td>22</td>
<td>45</td>
</tr>
</tbody>
</table>
SES & HTN prevalence in 1985:

multivariable analysis
Adjusted for Age, Sex, DM, Smoking, Alcohol, BMI, LDL, HDL, Physical activity

Odd Ratio

- <6: p 0.037
- 6 to 12: p 0.12
- >12: p 0.001
- <5,000: 0.8
- 5,000-10,000: 0.6
- 10,000-20,000: 0.4
- >20,000: 0.2
- Non-skilled worker: 0.6
- Skilled worker: 0.4
- Skilled non-manual: 0.2
- Manager: 0.1
SES & Progression to HTN at 1997

**multivariable analysis**

*Adjusted for Age, Sex, DM, Smoking, Alcohol, BMI, LDL, HDL, Physical activity*

<table>
<thead>
<tr>
<th>Relative Risk</th>
<th>p 0.001</th>
<th>p 0.064</th>
<th>p 0.15</th>
<th>p for trend &lt;0.05</th>
<th>p 0.064</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 to 12</td>
<td></td>
<td></td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5,000</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5,000-10,000</td>
<td>1</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;10,000</td>
<td>0.8</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;20,000</td>
<td>0.7</td>
<td>0.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-skilled worker</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled manual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled non manual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manager</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HTN in 1985 removed
## SES & incidence rate of HTN

<table>
<thead>
<tr>
<th>Predictor</th>
<th>n</th>
<th>no. of events</th>
<th>Incidence rate/1000 person-years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤6</td>
<td>569</td>
<td>249 (44%)</td>
<td>38.7</td>
</tr>
<tr>
<td>6 to 12</td>
<td>1436</td>
<td>719 (50%)</td>
<td>39.1</td>
</tr>
<tr>
<td>&gt;12</td>
<td>786</td>
<td>362 (46%)</td>
<td>31.8</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5,000</td>
<td>571</td>
<td>261 (46%)</td>
<td>37.5</td>
</tr>
<tr>
<td>5,000-10,000</td>
<td>1077</td>
<td>486 (45%)</td>
<td>35.1</td>
</tr>
<tr>
<td>10,000-20,000</td>
<td>985</td>
<td>507 (51%)</td>
<td>37.9</td>
</tr>
<tr>
<td>&gt;20,000</td>
<td>154</td>
<td>76 (49%)</td>
<td>38.2</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-skilled worker</td>
<td>427</td>
<td>191 (45%)</td>
<td>38.6</td>
</tr>
<tr>
<td>Skilled manual</td>
<td>1092</td>
<td>567 (52%)</td>
<td>41.0</td>
</tr>
<tr>
<td>Skilled non manual</td>
<td>801</td>
<td>367 (46%)</td>
<td>31.8</td>
</tr>
<tr>
<td>Manager</td>
<td>416</td>
<td>202 (49%)</td>
<td>36.1</td>
</tr>
</tbody>
</table>
SES & incidence rate of HTN

**multivariable analysis**

Adjusted for Age, Sex, DM, Smoking, Alcohol, BMI, LDL, HDL, Physical activity

![Graph showing hazard ratios and p-values for different SES and jobs](image)
Conclusion

- Education is an independent predictor for development of hypertension after adjusting for metabolic risk factors.
- Income has a trend association with future development of hypertension.
- Occupation also shows different risks among classes before adjusting with others HTN risk factors.
Acknowledgement

- All Staff of the EGAT study
- Ramathibodi Hospital
- Mahidol University
- Thai Research Fund
The largest and longest cohort study in Thailand started in 1985.


Multidisciplinary team & International collaboration

Follow up time 22 years

Cardiologist
Neurologist
Gastroenterologist
Nephrologist
Endocrinologist
Oncologist
Toxicologist
Nutritionist
Dentist
General practitioner
Pharmacist
Biologist
Social science
Demographic Characteristic

Table 2: Demographic data of each SES indicators

<table>
<thead>
<tr>
<th>Education</th>
<th>n=530</th>
<th>n=859</th>
<th>n=1,207</th>
<th>n=193</th>
<th>n=3,327</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Female</td>
<td>31.1</td>
<td>20.5</td>
<td>22.2</td>
<td>13.5</td>
<td>22.8</td>
</tr>
<tr>
<td>Age (year)</td>
<td>41.9</td>
<td>42.0</td>
<td>43.7</td>
<td>47.5</td>
<td>42.9</td>
</tr>
<tr>
<td>Hypertension</td>
<td>17.3</td>
<td>19.9</td>
<td>20.8</td>
<td>21.8</td>
<td>21.8</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7.5</td>
<td>6.0</td>
<td>7.0</td>
<td>6.2</td>
<td>6.7</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>74.4</td>
<td>75.3</td>
<td>76.0</td>
<td>76.5</td>
<td>75.5</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>119</td>
<td>120</td>
<td>121</td>
<td>122</td>
<td>121</td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>74</td>
<td>75</td>
<td>76.0</td>
<td>77.0</td>
<td>75.0</td>
</tr>
<tr>
<td>BMI</td>
<td>23.0</td>
<td>23.0</td>
<td>23.0</td>
<td>23.6</td>
<td>23.1</td>
</tr>
<tr>
<td>Smoking</td>
<td>49.1</td>
<td>44.8</td>
<td>38.9</td>
<td>36.8</td>
<td>43.0</td>
</tr>
<tr>
<td>Alcohol beverage</td>
<td>65.6</td>
<td>67.1</td>
<td>62.8</td>
<td>69.4</td>
<td>65.4</td>
</tr>
<tr>
<td>FBG</td>
<td>90.6</td>
<td>88.9</td>
<td>90.1</td>
<td>89.2</td>
<td>89.7</td>
</tr>
<tr>
<td>Total Cholesterol</td>
<td>214.3</td>
<td>223.6</td>
<td>225.9</td>
<td>228.9</td>
<td>222.9</td>
</tr>
<tr>
<td>HDL-C</td>
<td>45.6</td>
<td>46.7</td>
<td>48.3</td>
<td>48.1</td>
<td>47.1</td>
</tr>
<tr>
<td>LDL-C</td>
<td>139.5</td>
<td>148.5</td>
<td>148.5</td>
<td>149.4</td>
<td>146.8</td>
</tr>
<tr>
<td>All Cause Mortality</td>
<td>19.5</td>
<td>16.9</td>
<td>11.4</td>
<td>8.8</td>
<td>14.9</td>
</tr>
<tr>
<td>Cardiovascular Mortality</td>
<td>4.9</td>
<td>5.2</td>
<td>3.8</td>
<td>3.1</td>
<td>4.5</td>
</tr>
</tbody>
</table>

High SES
- % Male (78% v 72%)
- Older (44 v 42 y.o.)
- Higher LDL-C (150 v 140 mg/dl)

Low SES
- More Diabetes (8.3% v 5.5%)
- More Smoker (50% v 35%)
- Lower HDL (46 v 49 mg/dl)