Association of Secondhand Tobacco Smoke and Abdominal Adiposity in the United States Population

Omar Tahtamooni MBBS
Wright State University
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Presentation Outline

- Objective
- Background
- Methods
- Results
- Discussion, Conclusion
Objectives and Background

Objectives

To evaluate the association between SHS exposure and abdominal adiposity in US adults (aged 21+)
Secondhand smoke (SHS):

- inhaled smoke from tobacco products or inhaled smoke that has been expelled by other smokers (CDC, 2016);
- contains 4,000+ chemicals: e.g., hydrogen cyanide, carbon monoxide, ammonia, cadmium, arsenic (National Cancer Institute, 2011);
- globally, causes 600,000+ premature deaths per year;

Background

Evidence shows that exposure to SHS is associated with:

- Developing obesity (Abdominal Adiposity)
  - Emerging science: Barnoya & Glantz, 2005; Capul-Uicab et al., 2012; Moore et al., 2015

- Metabolic Syndrome (MetS) (Pagani et al., 2016)
  - High blood pressure
  - Raised blood glucose
  - High cholesterol levels
  - Deposition of abdominal fat
  - All are adverse cardiometabolic conditions
Methods

Tested association between:

**Exposure**: SHS using serum **Cotinine** (ng/ml):
- Non-smokers (<1 ng/ml)
- SHS (1-10 ng/ml)
- Smokers (>10 ng/ml)

Nicotine $\rightarrow \sim 80\%$ **Cotinine**

**Outcome**: Sagittal Abdominal Diameter (SAD)

Data for covariates: age, gender, ethnicity, and income
The Sagittal Abdominal Diameter (SAD) Measurement

Measured with a caliper, it is the distance from the back to the upper abdomen midway between the top of the pelvis and the bottom of the ribs (CDC, 2011).

- Clinically simple measure
- Visceral fat impacts metabolism
• **Age:** 21 years and older, data for all variables available

• **Ethnicity**
  - Non-Hispanic White
  - Non-Hispanic Black
  - Non-Hispanic Asian
  - Others

• **Gender:** Males and Females

• **Annual household income:**
  - <25,000
  - 25,000-54,999
  - >=55,000

• For the three smoking status groups
  - Non-smokers
  - SHS
  - Smokers

• **Descriptive Statistics**
  - Continuous variables: means (SD)
  - Categorical variables: Chi-square ($\chi^2$)

• **Comparisons of smoking exposure groups**
  - Univariate linear regression analyses
  - Multivariate linear regression analyses
• Indicator /dummy coding for categories
  • Ethnicity
  • Gender
  • Income

• Dummy variables allowed for multiple comparisons in a single multivariate model while controlling experimentwise error.
Results

Figure 1. Prevalence of smoking by gender (p<0.001).

Figure 2. Prevalence of smoking by ethnicity (p<0.001).

Figure 3. Smoking status by income (p<0.001).

Figure 4. Sagittal Abdominal Diameter (cm) by smoking status (p=0.003).
### Univariate Linear Regression Models

1. Smoking Status → SAD
2. Age + Smoking Status → SAD
3. Gender + Smoking Status → SAD
4. Ethnicity + Smoking Status → SAD
5. Income + Smoking Status → SAD

### Univariate Linear Regression

<table>
<thead>
<tr>
<th>Models</th>
<th>B</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Reference: Non-smokers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>22.700</td>
<td>(22.54, 22.86)</td>
<td>&lt;0.001</td>
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<tr>
<td>SHS</td>
<td>1.252</td>
<td>(0.53, 1.97)</td>
<td>0.001</td>
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<tr>
<td>Smokers</td>
<td>0.154</td>
<td>(-0.16, 0.47)</td>
<td>0.350</td>
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<tr>
<td>Age (in years at screening) &amp; Smoking</td>
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<tr>
<td>Status</td>
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<td></td>
<td></td>
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<tr>
<td>Constant</td>
<td>19.823</td>
<td>(19.39, 20.25)</td>
<td>&lt;0.001</td>
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<tr>
<td>SHS</td>
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<td>(1.04, 2.45)</td>
<td>&lt;0.001</td>
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<tr>
<td>Smokers</td>
<td>0.412</td>
<td>(0.09, 0.72)</td>
<td>0.011</td>
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<tr>
<td>Gender &amp; Smoking Status</td>
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<tr>
<td>(Reference: Females)</td>
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<tr>
<td>Constant</td>
<td>22.227</td>
<td>(22.02, 22.43)</td>
<td>&lt;0.001</td>
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<tr>
<td>SHS</td>
<td>1.088</td>
<td>(0.37, 1.80)</td>
<td>0.002</td>
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<tr>
<td>Smokers</td>
<td>-0.023</td>
<td>(-0.34, 0.30)</td>
<td>0.887</td>
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<tr>
<td>Ethnicity &amp; Smoking Status</td>
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<tr>
<td>(Reference: Others)</td>
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<tr>
<td>Constant</td>
<td>22.989</td>
<td>(22.71, 23.26)</td>
<td>&lt;0.001</td>
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<tr>
<td>SHS</td>
<td>0.841</td>
<td>(0.15, 1.52)</td>
<td>0.016</td>
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<tr>
<td>Smokers</td>
<td>-0.330</td>
<td>(-0.64, -0.01)</td>
<td>0.038</td>
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<tr>
<td>Income &amp; Smoking Status</td>
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<tr>
<td>(Reference: High Income)</td>
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<tr>
<td>Constant</td>
<td>22.100</td>
<td>(21.87, 22.32)</td>
<td>&lt;0.001</td>
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<td>SHS</td>
<td>1.062</td>
<td>(0.34, 1.77)</td>
<td>0.004</td>
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<tr>
<td>Smokers</td>
<td>-0.089</td>
<td>(-0.41, 0.23)</td>
<td>0.593</td>
</tr>
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## Multivariate Linear Regression

<table>
<thead>
<tr>
<th>Variables</th>
<th>B</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Smoking Status</strong> (Reference: Non-smokers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>19.635</td>
<td>(19.14, 20.12)</td>
<td>&lt;0.001</td>
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<tr>
<td>SHS</td>
<td>0.982</td>
<td>(0.31, 1.65)</td>
<td>0.004</td>
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<tr>
<td>Smokers</td>
<td>-0.418</td>
<td>(-0.73, -0.10)</td>
<td>0.009</td>
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<tr>
<td><strong>Covariates</strong></td>
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<tr>
<td><strong>Gender</strong> (Reference: Female)</td>
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<tr>
<td>Male</td>
<td>1.127</td>
<td>(0.87, 1.38)</td>
<td>&lt;0.001</td>
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<tr>
<td><strong>Income</strong> (Reference: High Income)</td>
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<tr>
<td>Low-Income</td>
<td>0.812</td>
<td>(0.50, 1.12)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Middle-Income</td>
<td>0.634</td>
<td>(0.32, 0.94)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Ethnicity</strong> (Reference: Others)</td>
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<tr>
<td>Non-Hisp White</td>
<td>-0.164</td>
<td>(-0.50, 0.17)</td>
<td>0.339</td>
</tr>
<tr>
<td>Non-Hisp Black</td>
<td>1.164</td>
<td>(0.79, 1.53)</td>
<td>&lt;0.001</td>
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<tr>
<td>Non-Hisp Asian</td>
<td>-3.024</td>
<td>(-3.46, -2.58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age</td>
<td>0.049</td>
<td>(0.04, 0.05)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

### Discussion and Conclusions
Discussion

• The highest percentage of SHS exposure was among males, non-Hispanic Blacks, and individuals with low and middle income. These results are similar to the Women’s Health USA report (2011) and CDC report (2016).

• Univariate and multivariate linear regression analysis showed a significant positive association between exposure to SHS and SAD for most groups. This is similar to the studies of Barnoya & Glantz, 2005; Moore et al., 2015; and Pagani et al., 2016.

Discussion

• Non-Hispanic Whites: No significant association between Smoking Status and SAD.
• Females: lower mean SAD than males.
  • According to Tanner et al. (2016), functional CYP2A6 enzyme allele metabolizes Nicotine and Cotinine, removes them from the system
    • Functional CYP2A6 enzyme allele frequencies
      • Non-Hispanic Whites 0-4%
      • Non-Hispanic Blacks 0-2% (PharmGKB, 2001-2016)
  • Smoking Status does not affect the hormonal balance as much in Whites.
  • Lower CYP2AD in females than males
Discussion

• Non-Hispanic Asians: Lower mean SAD than Others.
  • Unexpected results? Asians have more abdominal adiposity than Whites and Blacks (Lear et al., 2007)
  • But…Others = Mexican-American, other Hispanic, and other Multi-Racial individuals
  • Mexican-American have high rate of overweight/obesity and metabolic diseases (Laing et al., 2015)

• Smokers: lower mean SAD than non-Smokers.
  • Nicotine decreases appetite (Jo et al., 2002)

Conclusions

We conclude that the highest exposure to SHS was among:
• Males
• Non-Hispanic Blacks
• Individuals with low and middle income

Additionally..
There was a significant positive association between SHS exposure and SAD among individuals exposed to SHS (p=0.004).

Public Health Implications
• Increase awareness high risk groups
• Public health efforts
Thank you

Questions??