Beyond Bruising: How Violence and Hostility May Impact Lung Disease

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HARVARD MEDICAL SCHOOL
Hostility – Medical Morbidity

• Large body of research in this general domain (hostility, Type A)

• Hostility and anger co-occur with (?risk factors) for many health problems in older adults
  – CVD, all-cause mortality, altered immune function
Historical Framework

“The influence of emotion upon the respiratory function is well known from everyday life. Sudden cessation of breathing in anxiety is referred to in such expressions as ‘breathtaking’… Sighing is a common expression of despair. Crying is another complex expressive phenomenon in which the expiratory phase of respiration is involved… Because of this close correlation between emotional tension and the respiratory functions, it is probable that in most diseases of the respiratory organs, psychological factors play an important role.”

Hostility – Medical Morbidity

- Beginning evidence for emotion - PF link
- Plausible that Hostility & PF are related
- More than replication of CVD effects, a social epidemiological approach
  - Put hostility & poor health in social context
Pulmonary Function

• Variability in pulmonary function (PF) with aging
  – Development of healthy lung function
  – Rate of decline

• Accelerated rate of decline
  – Associated with maximally attained lung function in earlier life
  – Associated with risk of increased mortality
  – CVD & PF are inversely related
    • PF as a marker of CVD?
Epidemiology of COPD

• Afflicts more than 14 million in the US

• In the US, COPD is the fourth leading cause of death and the third leading cause of morbidity

• Accounts for 13% of US hospital admissions

• Projected to be the fourth leading cause of death worldwide in 2020

• Incidence is rising, particularly in women
Pathophysiology of COPD

• Airway inflammation is now recognized as a central process in the pathogenesis of COPD


  – Pro-inflammatory cytokines demonstrated in induced sputum in COPD patients (Keatings VM, et al. *Am J Respir Crit Care Med* 1997; 155:542)
**1990s—The Age of Airway Inflammation**

- **Mast cells**
- **Eosinophils**
- **Lymphocytes**

**Mediators**
- Granule proteins
- Cytokines

**Bronchoconstriction**
- Inflammation
- Airway hyperresponsiveness

**Clinical asthma/COPD**
Psychoneuroimmunology: Mind-Body Connections

Webster, Tonnelli and Sternberg 2002
Early Life Risk Factors

• Nutrition
• Birthweight
• Respiratory infections
• Asthma
• Toxicants (e.g., cigarette smoke, air pollutants)

Background Motivation

• Two motivations for current research
  – Hostility - CVD link
  – SES - pulmonary function (PF) link
Research question

Childhood SES → Pulmonary fxn

Sample

• CARDIA (Coronary Artery Risk Development in Young Adults) Study
• Sponsored by NHLBI
• Community-based, 4 US sites
• Race, gender, class variation
• Started in 1985, ages 18-30 at baseline
• PF years 0, 2, & 5
• n ~ 5,000
<table>
<thead>
<tr>
<th>Covariates</th>
<th>Mean (SD) or Percentage</th>
<th>Range</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (SD), in cm</td>
<td>170.35 (9.27)</td>
<td>149.50-193.00</td>
<td>5100</td>
</tr>
<tr>
<td>Age (SD), in years</td>
<td>24.76 (3.63)</td>
<td>18 -30</td>
<td>5113</td>
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<tr>
<td>Females (%)</td>
<td>54.47%</td>
<td>Female (ref),</td>
<td>5113</td>
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<tr>
<td></td>
<td></td>
<td>Male</td>
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<tr>
<td>Blacks (%)</td>
<td>51.72%</td>
<td>Black (ref),</td>
<td>5099</td>
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<tr>
<td></td>
<td></td>
<td>White</td>
<td></td>
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<tr>
<td>Current SES (SD), in years of education</td>
<td>13.59 (1.85)</td>
<td>10-16</td>
<td>5110</td>
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<tr>
<td>Asthma, unconfirmed (%)</td>
<td>5.48%</td>
<td>Yes (ref), No</td>
<td>5113</td>
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<tr>
<td>Asthma, confirmed by a doctor (%)</td>
<td></td>
<td>Yes (ref), No</td>
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<tr>
<td>Maternal smoking (%)</td>
<td>48.21%</td>
<td>Yes (ref), No</td>
<td>5096</td>
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<td>Paternal smoking (%)</td>
<td>58.16%</td>
<td>Yes (ref), No</td>
<td>5086</td>
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<td>Former smokers (%)</td>
<td>13.31%</td>
<td>Yes (ref), No</td>
<td>5077</td>
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<td>Current smokers (%)</td>
<td>30.41%</td>
<td>Yes (ref), No</td>
<td>5077</td>
</tr>
</tbody>
</table>
PF by childhood SES over time: CARDIA

WOMEN

MEN
Questions

• Does rate of change of pulmonary function differ by hostility?
• Is this relationship influenced by group membership (childhood SES, race/ethnicity, gender)?
  – Mediated
  – Moderated
Vulnerability/Resiliency Factors

• Genetics
• Behavioral/personality factors
  – **Stress Vulnerable**
    • Low threshold for perceiving threat, sensitive to “danger cues”, ruminate/worry, defensive, hostile, defeatist
  – **Stress Resilient**
    • High threshold for perceiving threat, sensitive to “safety cues”, optimistic, problem solvers, confident
• External buffers
  – Social networks
Research question

Hostility \rightarrow \text{Pulmonary fxn}

(Jackson, Kubzansky, Cohen, Jacobs, Weiss, Wright. Health Psychol 2006, in press)
Preliminary analyses

• Sample descriptives
• Hostility & pulmonary function
  – Gender
  – Race
  – Childhood SES
• Hostility predicting $\Delta$PF
Hostility by childhood SES

Note: Each levels is significantly different from each other.
Hostility by gender

Note. Groups significantly differ.
Hostility by race

Note: Groups significantly differ.
Analysis

- Hierarchical linear modeling (HLM, PROC MIXED in SAS) using repeated measures

- Mixed models method
  - Considers correlation in repeated measures of pulmonary function
  - Controls for baseline levels of pulmonary function
  - Includes interaction term to assess effects over time
Multivariate-adjusted effects of a one-unit increase in hostility on FEV\textsubscript{1}

Hostility * -.002 (.0008)
Hostility x Time * .0003 (.000009)

Time * (-)
Childhood SES
Childhood SES x Time * (-)
Female * (Females, lower FEV\textsubscript{1})
Black * (Blacks, lower FEV\textsubscript{1})

Height * (+)
Age * (-)
Current SES + (+)
Self-rep asthma symptoms * (-)
Dr. dx asthma * (-)
Mother smoked
Father smoked
Current smoker + (-)
Former smoker * (+)
Next steps

• Focus of paper?
  – Hostility & PF, with/out social context variables
  – With social context variables
    • Choose to focus on e.g., race, controlling for childhood SES
    • Mediator/moderator

• Examine $\Delta$PF interactions with gender, race, childhood SES
  – Power issue
    • Differences in cell sizes
    • e.g., relatively few with low childhood SES, esp. whites
Hostility – PF Prospectively

To examine prospectively the effects of hostility on pulmonary function over time in the Normative Aging Study (NAS), a longitudinal study of 2280 community-dwelling men.
Hypothesis

Increased levels of hostility would be associated with lower levels of pulmonary function at baseline and an accelerated rate of decline in lung function over time.
The MMPI-2 was administered by mail to all active cohort members (n = 1881) in 1986.

1550 men responded (82.4% response rate), in whom complete and valid questionnaire data were available in 95% (n = 1472).

To be included in the present study, men had to have had a pulmonary exam within one year of completing the MMPI-2. This resulted in a study population of 670 men.
Study Description

• Assessment of hostility 1986
• Physical exam every 3-5 years
• Average follow-up time 8.22 years
• Average number of spirometric tests 3.5
• n 670
Assessment of Pulmonary Function

• Measures of FEV$_1$ and FVC obtained

• Spirometric tests administered at each physical exam
  – Spirometry was repeated up to a maximum of eight spirograms
  – at least 3 acceptable tests obtained from each subject
  – at least 2 tests were reproducible

• Acceptability of spirograms judged according to American Thoracic Society standards
Hostility and Lung Function Decline: NAS

(Kubzansky, Sparrow, Jackson, Cohen, Weiss, Wright. Thorax 2006; 61:863)
Violence and Childhood Lung Function

Franco Suglia S, Laden F, Ryan L, Dockery D, Wright RJ. Submitted manuscript
Memory - Strong Emotions

Amygdala

Hippocampus

More facts of nature: All forest animals, to this very day, remember exactly where they were and what they were doing when they heard that Bambi’s mother had been shot.
MISSEB

• **Study Population**
  - Maternal-Infant Smoking Study of East Boston (MISSEB)
  - prospective cohort of women and children enrolled before 20 weeks gestation.

• **Environmental Health Measures**
  - Maternal prenatal smoking assessed by standardized questionnaires and urinary cotinine
  - postnatal environmental tobacco smoke (ETS) assessed through standardized questionnaires
Measures of Violence Exposure

• Mother’s reported on child’s lifetime exposure to interparental conflict using the Conflict Tactics Scale
  – Verbal Aggression, Minor and Severe Physical

• Mother’s reported on child’s community violence exposure using the My Exposure to Violence (ETV) scale
  – Rasch modeling, a form of latent variable analysis, used to create a continuous ETV scale
Outcome Measures

• At age 6 years, children completed Spirometry testing
  – Forced expiratory volume in one second (FEV1), forced vital capacity (FVC), ratio of FEV1 to FVC (FEV1/FVC) and forced mid-expiratory flow rate (FEF25-75%) were measured from the best acceptable blow as defined by the American Thoracic Society Standards.
Data Analysis

• Rasch models, a form of latent variable analysis to obtain a continuous scale of ETV from dichotomous responses in the questionnaire
• Model can accommodate unrestricted and conditional responses from the ETV survey and incorporate multiple informant information
• Associations between violence measures and pulmonary function adjusted for race, maternal education, child’s gender, age, birth-weight, height, maternal prenatal smoking and ETS were examined using linear regression.
MISSEB Cohort (N=330)

- 50% boys
- 55% Hispanic
- 66% less than six years of age
- 40% maternal education <high school.

Mean and standard deviation (SD) PFT indicators
- FEV1: 1.28 ± .21
- FVC: 1.39 ± .23
- FEV1/FVC: 0.92 ± .06
- FEF25-75%: 1.35 ± .29
## MISSEB Cohort (N=330)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
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<tbody>
<tr>
<td><strong>Medical History</strong></td>
<td></td>
<td></td>
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<tr>
<td>Birth-weight &lt; 2500 g</td>
<td>26</td>
<td>8.1</td>
</tr>
<tr>
<td>Gestational Age &lt; 37 wks</td>
<td>116</td>
<td>35.3</td>
</tr>
<tr>
<td>Physician Dx Asthma</td>
<td>61</td>
<td>18.5</td>
</tr>
</tbody>
</table>

| **Environmental Exposures**    |    |     |
| Smoking during pregnancy       | 69 | 21.0|
| Postnatal ETS                  | 113| 34.2|

| **Community Violence Exposures** |    |     |
| Seen shoving/pushing            |    |     |
| Heard gunshots                  |    |     |
| Witnessed verbal abuse          |    |     |
| Witnessed Knife attacks         |    |     |
| Witnessed Shooting              |    |     |
Estimated change in mean FEV$_1$ and 95% CI by verbal aggression scale tertiles, ETV tertiles and pre and post natal tobacco exposure.
Verbal Abuse and Lung Function: Gender Effects

Mean adjusted FEV1 by verbal aggression scale tertiles stratified by gender

Mean adjusted FVC by verbal aggression tertiles stratified by gender
Community Violence and Lung Function: Gender Effects

Mean adjusted FEV1 by ETV scale tertiles stratified by gender

Mean adjusted FVC by ETV scale tertiles stratified by gender
Follow-up research question

Childhood SES → Violence → Hostility → Pulmonary fxn
Acknowledgments

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• Co-Investigators
  – Sheldon Cohen
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  – David Jacobs (CARDIA)