Smoking and Substance Abuse in Individuals with ADHD

Brooke Molina, Ph.D.  Jessica Rhodes, Ph.D.
University of Pittsburgh  University of Pittsburgh

Disclosure

Brooke Molina and Jessica Rhodes have no actual or potential conflicts of interest in relation to this presentation.

ADHD and Drug Abuse

Multiple Reasons for an Association

• Core symptoms of ADHD (inattention, impulsivity, hyperactivity/restlessness) implicated in addictions

• The disorders run together in families (includes inheritance and socialization vulnerabilities)

• ADHD-related impairments (e.g., school difficulty, social problems, increased risk of conduct problems) predict substance use in other populations (Molina et al., 2012)

• Overlap in implicated brain regions and genetic vulnerabilities (e.g., Clark et al., 2008; Schuckit, 2008; Substance Abuse Treatment).

• Impact of stimulant treatment? (e.g., Volkow & Swanson, 2000; Volkow et al., 2012, Neuroimaging; Wang et al., 2008, J Addict Med).
Recent Meta-Analyses

~11 studies of adolescents
• Lifetime nicotine use, OR = 2.08
• Lifetime alcohol use, OR = 1.27, ns
• Lifetime marijuana use, OR = 2.78

~13 studies of adults, mostly 18-20s
• Nicotine dependence, OR = 2.82
• Alcohol abuse or dependence, OR = 1.74
• Marijuana abuse or dependence, OR = 1.58
• Cocaine abuse or dependence, OR = 2.05
• Non-specific substance abuse or dependence, OR = 2.64

Lee et al., 2011, Clinical Psychology Review; Charach et al., 2011, JAACAP

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Percent of Sample Smoking by Mean Age and Study

Molina (2011) review in (Eds) Evans & Hoza

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Age Started Smoking Adolescents with Childhood ADHD versus no ADHD

Molina & Pelham, 2003

<table>
<thead>
<tr>
<th>Age First Cigarette</th>
<th>Age First Daily Smoking</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADHD: 13.9</td>
<td>ADHD: 16.3</td>
</tr>
<tr>
<td>nonADHD: 15.3</td>
<td>nonADHD: 17.4</td>
</tr>
</tbody>
</table>
ADHD and Smoking Progression

- More severe ADHD → more severe nicotine dependence.
- More ADHD symptoms → faster progression from non-smoking to experimenting and then to daily use.
- Some data suggest more difficulty quitting.
  - (Note that cessation is already extremely difficult; success rates are less than a third of those who are motivated to quit).

Mechanisms

- ADHD and cigarette smoking may have common genetic origins
- Nicotine enhances cognitive processes that are impaired in ADHD (attention, inhibitory control, working memory), but self-medication hypothesis has mixed support.
- Familial factors, especially parental smoking, contribute.
- Initial use and escalation of smoking is correlated with social and behavioral impairments of ADHD.

McClernon & Kollins, 2008; Glass & Flory, 2010
Is Risk for Cigarette Smoking Different from Other Drugs of Abuse?

- Risk for daily smoking is less tied to conduct problems, but it is not independent.
- Initial use and escalation of all substances is socially mediated.
- Escalation and dependency is probably more affected by biological vulnerability.
- Implications for prevention and treatment.

Substance Use to the 8 Year Follow-Up of the MTA Children

Group differences were statistically significant at each time point.

Mean Age = 17 at 8 Year F-Up

Daily Smoking 16.7% vs 7.9%

40%-50%

Percentage of MTA participants reporting each type of substance

Few Sole Tobacco Users:
- 3.6% of ADHD (15/420)
- 0 in nonADHD group
**PALS**  
The Pittsburgh ADHD Longitudinal Study

**PIs:**  
Brooke Molina, Ph.D., University of Pittsburgh  
William Pelham, Jr., Ph.D., Florida International U.

**Financial Support:**  
NIAAA; NIDA; NIMH

- 364 children with ADHD being followed through adolescence and early adulthood.
- 240 adolescents and young adults without ADHD, demographically similar
- Annual visits through adolescence and early adulthood followed by age-targeted visits
- Designed to study the course of alcohol and other substance use and potential explanatory domains.

**Contributing Factors to Substance Abuse in ADHD**  

- Biological (genetic, teratogenic)
- Familial (substance use, mental health)
- Biological response to drugs of abuse
- Impairments in daily life functioning  
  - School difficulties
  - Behavior problems
  - Social difficulties that promote behavior problems
- Persisting symptoms  
  - Poor emotional control; insufficient coping skills
- Peers
- Parenting and the parent-child relationship

**Persistence of ADHD and Conduct Disorder (CD) in adolescence (13-18 yrs)**

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>ADHD Persisters No CD</th>
<th>ADHD Persisters with CD</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Drunk &gt; Once in Past 6 Mos</td>
<td>11.3</td>
<td>15.8</td>
<td>28.6</td>
<td>3.58/5.60</td>
</tr>
<tr>
<td>% Smoked Daily in Past 6 Mos</td>
<td>9.4</td>
<td>13.5</td>
<td>28.8</td>
<td>4.47/8.11</td>
</tr>
<tr>
<td>N</td>
<td>96</td>
<td>36</td>
<td>59</td>
<td>34</td>
</tr>
</tbody>
</table>

ADHD, Peers, and Adolescent Substance Use
Pittsburgh ADHD Longitudinal Study

- Peer substance use is one of the strongest proximal predictors of adolescent substance use
- Influence and selection
- Among adolescents with childhood ADHD:
  - The association between substance-using peers and own substance use is stronger for adolescents with ADHD, both cross-sectionally (Marshal et al., 2003) and longitudinally (Belendiuk, in prep).

Coping skills, lower in adolescents with ADHD histories, partially mediates ADHD-related smoking risk.

Molina, Marshal, Pelham, Wirth, 2005

Medication treatment should theoretically decrease risk
Stimulant Treatment and Adolescent Substance Use in the MTA Study

Summary

• Treatment with stimulants between ages 7 and 9.9 did not predict later substance use.
• Treatment in the past year was not associated with substance use in adolescence.
• Total days treated from childhood into adolescence did not predict later substance use.

Molina and MTA Group (2013) JAACAP

What Drives the Risk for Smoking in ADHD?

Influence of ADHD on Stages of Smoking

McClernon & Kollins, 2008; Berlin et al., 2012; Covey et al., 2006; Furrmutter et al., 2007; Hesse, 2010; Himmelfarb et al., 2005; Kollins et al., 2008; Kollins et al., 2005; Lambert & Hartnagel, 1998; Milberger et al., 1997; Milberger et al., 1997; Milberger & Pelham, 2003; Petraitis et al., 1990; Wilens et al., 2008
Mechanisms

ADHD

Neurobiological Factors

Psychological/Psychosocial Factors

Smoking

Risk Factors

Neurobiological Factors

Psychological/Psychosocial Factors

Genetic Predisposition

Brain Systems

Cognitive Systems

Impulsivity

Social Functioning

Family Factors

Risk Factors – Symptoms of ADHD

ADHD symptoms associated with:

- Earlier initiation
- More cigarettes smoked

Figure 1. Percentage of individuals with attention-deficit/hyperactivity disorder initiation and hyperactive-impulsive symptoms reporting not regular smoking

McClernon & Kollins, 2008; Beato et al., 2004; De Boer & Davis, 2011; Green, 2005; Kollins et al., 2003; Krause et al., 2000; Lande et al., 2003; Pomerleau et al., 2003; Szekeres, 1998; Svensson et al., 1998; Volkow et al., 2007; Volkow et al., 2012
Why Smoking?

Nicotine Impacts Processes Related to ADHD

Attention
Inhibition
Working Memory
Learning
Fine Motor Skills

Heishman, Kleykamp, & Singleton (2010); Levin, McClennen, & Rezvani (2006)

Nicotine Impacts Processes Related to ADHD

- Improves attention performance
- Improves inhibition/impulsivity
- Non-smoking adolescents & young adults with ADHD show improvement in cognitive processes with nicotine

Smokers With & Without ADHD Differ on Key Characteristics

- Smokers with ADHD:
  - Higher Novelty Seeking & Harm Avoidance
  - Higher Negative Affect
  - Report smoking reduces irritability and improves concentration

Van Voorhees et al., 2013

Is Smoking More Reinforcing for Those with ADHD?

- ADHD → Reward areas of the brain (dopamine)
  - Related to EF
- Disruptions increase the reward value of nicotine
  - During laboratory tasks, work harder for puffs of cigarettes
- Smoking may reinforce difficulties with attention and inhibition
  - More severe withdrawal symptoms
- Higher levels of dependence and difficulty quitting

Koltes et al., 2013

Smokers with ADHD Report Greater Withdrawal Severity

- Following abstinence, ADHD smokers demonstrate:
  - Greater disruptions in cognitive functioning & negative affect

McClernon et al., 2008; McClernon et al., 2011
Treating ADHD & Smoking

Could Nicotine be Used as a Treatment for ADHD?

- Nicotine reduces ADHD symptoms in adults
- Chronic nicotine improves attention and ADHD symptom severity
- Nicotine and stimulant medication, alone & in combination, improve concentration and core ADHD symptoms

Gehricke et al., 2006; Levin, Conners, Silva, Canu & March, 2001; Levin, Conners, et al., 1996

Does Stimulant Treatment Reduce Smoking?

- Stimulant treatment for ADHD smokers:
  - Improved ADHD symptoms
  - Did not improve smoking cessation rates
- Beneficial effect of OROS MPH on smoking outcome for those with greater ADHD severity and the most improvement in symptoms

Kollins et al., 2013; Kollins et al., 2014; Nunes et al., 2013; Winhusen et al., 2010
Does Smoking Cessation Treatment Improve ADHD-Related Processes?

- In Non-ADHD Adult Smokers:
  - Varenicline/Chantix improves attention
  - Bupropion/Zyban improves inhibition

Cigarette Smoking & Cessation

- Leading preventable cause of death and disability in US
  - 440,000 premature deaths annually
  - In US, $150 billion in annual costs
- Estimated that 19% of US adults smoke; 78% smoke everyday
- Typically begins in adolescence
- Frequent, unsuccessful quit rates
- First-line treatments result in <30% success

Summary

- Smokers with ADHD:
  - Smoke more; may be more dependent
  - Find cigarette smoking more reinforcing, especially when acutely abstinent
  - Experience greater withdrawal, including more disruption in inhibitory control process
- Potential Treatment Options:
  - First-line smoking cessation aids
  - Stimulants