Persistent Cannabis Users Show Neuropsychological Decline from Childhood to Midlife

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Why Cannabis?

• Timely issue
  – Debate regarding the medicinal use and legalization of cannabis in the US and abroad
Why Cannabis?

Mixed Messages

Therapeutic

Harmful
People think cannabis use results in...

**Memory Problems**

“If I am ever asked to pop to the shop to buy more than 2 items, I need them [to be] written down.”

- Carl from the UK, age 31
  (used cannabis from age 16 to 27)

**Increased Creativity**

“...marijuana use can stimulate creativity and actually enhance intelligence. Many scientific breakthroughs during my career occurred while under the influence.”

- Bobbie from the US
  (used cannabis in his 20’s and 30’s)
Rationale

• Case-control studies suggest that long-term, heavy cannabis use may cause enduring neuropsychological impairment

• Limitations:
  – Chicken or the egg?
Current Study

“Before and After” IQ Testing

IQ Testing

Cannabis Assessments

IQ Testing

Ages 7-13

Age 18-38

Age 38
Dunedin Longitudinal Study

<table>
<thead>
<tr>
<th>Age</th>
<th>Year</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>1972-73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1975-76</td>
<td>1,037</td>
<td>100%</td>
</tr>
<tr>
<td>5</td>
<td>1977-78</td>
<td>991</td>
<td>96%</td>
</tr>
<tr>
<td>7</td>
<td>1979-80</td>
<td>954</td>
<td>92%</td>
</tr>
<tr>
<td>9</td>
<td>1980-82</td>
<td>955</td>
<td>92%</td>
</tr>
<tr>
<td>11</td>
<td>1983-84</td>
<td>925</td>
<td>90%</td>
</tr>
<tr>
<td>13</td>
<td>1985-86</td>
<td>850</td>
<td>82%</td>
</tr>
<tr>
<td>15</td>
<td>1987-88</td>
<td>976</td>
<td>95%</td>
</tr>
<tr>
<td>18</td>
<td>1990-91</td>
<td>993</td>
<td>97%</td>
</tr>
<tr>
<td>21</td>
<td>1993-94</td>
<td>992</td>
<td>97%</td>
</tr>
<tr>
<td>26</td>
<td>1998-99</td>
<td>980</td>
<td>96%</td>
</tr>
<tr>
<td>32</td>
<td>2004-05</td>
<td>972</td>
<td>96%</td>
</tr>
<tr>
<td>38</td>
<td>2010-12</td>
<td>957</td>
<td>95%</td>
</tr>
</tbody>
</table>
Assessment of Cannabis Use

• Cannabis dependence was assessed 5 times between ages 18 and 38
## Persistence of Cannabis Dependence

<table>
<thead>
<tr>
<th>Persistence of Cannabis Dependence</th>
<th>N (%)</th>
<th>% Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Used, Never Diagnosed</td>
<td>242 (28)</td>
<td>38.84</td>
</tr>
<tr>
<td>Used, Never Diagnosed</td>
<td>479 (55)</td>
<td>49.48</td>
</tr>
<tr>
<td>1 Diagnosis</td>
<td>80 (9)</td>
<td>70.00</td>
</tr>
<tr>
<td>2 Diagnoses</td>
<td>35 (4)</td>
<td>62.86</td>
</tr>
<tr>
<td>3+ Diagnoses</td>
<td>38 (4)</td>
<td>81.58</td>
</tr>
</tbody>
</table>
Do persistent cannabis users show IQ decline?
### IQ Before and After Cannabis Use

<table>
<thead>
<tr>
<th>Persistence of Cannabis Dependence</th>
<th>N</th>
<th>% Male</th>
<th>Age 7-13 Full-Scale IQ</th>
<th>Age 38 Full-Scale IQ</th>
<th>Δ in IQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never Used, Never Diagnosed</td>
<td>242</td>
<td>38.84</td>
<td>99.84</td>
<td>100.64</td>
<td>+0.80</td>
</tr>
<tr>
<td>Used, Never Diagnosed</td>
<td>479</td>
<td>49.48</td>
<td>102.32</td>
<td>101.25</td>
<td>-1.07</td>
</tr>
<tr>
<td>1 Diagnosis</td>
<td>80</td>
<td>70.00</td>
<td>96.40</td>
<td>94.78</td>
<td>-1.62</td>
</tr>
<tr>
<td>2 Diagnoses</td>
<td>35</td>
<td>62.86</td>
<td>102.14</td>
<td>99.67</td>
<td>-2.47</td>
</tr>
<tr>
<td>3+ Diagnoses</td>
<td>38</td>
<td>81.58</td>
<td>99.68</td>
<td>93.93</td>
<td>-5.75</td>
</tr>
</tbody>
</table>
Can this effect be explained by alcohol or other drug use?
Never Used, Never Diagnosed
Used, Never Diagnosed
1 Diagnosis
2 Diagnoses
3+ Diagnoses

Full Cohort
Past 24-hour
Past Week
Persistent Tobacco
Persistent Hard Drug
Persistent Alcohol
Schizophrenia

Change in Full-Scale IQ (SD units)
Can this effect be explained by reduced years of education among persistent cannabis users?
Can this effect be explained by low SES?

Correlations between cannabis use and IQ change in the Dunedin cohort are consistent with confounding from socioeconomic status

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The Ragnar Frisch Centre for Economic Research, N-0349 Oslo, Norway

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What about other mental functions?
Executive Function
Processing Speed
Learning
Memory
Verbal Ability

Age 38 Test Performance (Adjusted for Childhood IQ)
Do friends and relatives notice cognitive problems?
<table>
<thead>
<tr>
<th>Informant Reports</th>
<th>Never Used, Never</th>
<th>Used, Never</th>
<th>1</th>
<th>2</th>
<th>3+ Agnoses</th>
<th>Linear Trend T-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention Problems</td>
<td>-0.21</td>
<td>-0.07</td>
<td>0.31</td>
<td>0.64</td>
<td>0.96</td>
<td>7.74*</td>
</tr>
<tr>
<td>Memory Problems</td>
<td>-0.27</td>
<td>-0.03</td>
<td>0.38</td>
<td>0.78</td>
<td>0.75</td>
<td>7.65*</td>
</tr>
</tbody>
</table>

“Is easily distracted, gets sidetracked easily”

“Forgets to do errands, return calls, pay bills”
Are adolescents particularly vulnerable?
<table>
<thead>
<tr>
<th>Object Recognition (%)</th>
<th>Adult Treatment</th>
<th>Adolescent Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Cannabis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cannabis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Change in Full-Scale IQ (in standard deviation units)

1 Diagnosis | 2 Diagnoses | 3+ Diagnoses

-0.8 | 0 | 0.4

(n=17) | (n=12) | (n=23)

Adolescent-Onset

8-pt IQ loss
1 Diagnosis
2 Diagnoses
3+ Diagnoses

Change in Full-Scale IQ (in standard deviation units)

(n=17) (n=57) (n=12) (n=21) (n=23) (n=14)

Adolescent-Onset
Adult-Onset

8-pt IQ loss
Does quitting restore functioning?
Adolescent-Onset

- Quit by Age 38 (n=17)
- Still Using at Age 38 (n=19)

Child IQ vs. Adult IQ
Summary

• Do persistent cannabis users show IQ decline?
  – Yes, but this effect is limited to adolescent-onset cannabis users

• Can this effect be explained by alcohol and other drug use, reduced years of education, or low SES among persistent cannabis users?
  – No

• Does IQ decline translate to cognitive problems in everyday life?
  – Yes
Brain Implications

• Adolescent brains are especially vulnerable to cannabis
  – Cannabis use disrupts critical brain development that occurs during adolescence (e.g., synaptic pruning, myelination)
Should we be concerned about an 8-pt IQ loss among teens?
An 8-pt IQ Loss Drops A Person with Average IQ from the 50th to the 29th percentile
Perceived Risk↓, Teen Use↑

Marijuana use among 12th graders* vs. perceived risk:
- 2008: 32.4% using, 25.8% perception of risk
- 2010: 34.8% using, 24.5% perception of risk
- 2012: 36.4% using, 20.6% perception of risk

36.4% equates to about 11 students in the average class.

NIH National Institute on Drug Abuse

The National Institute on Drug Abuse is a component of the National Institutes of Health, U.S. Department of Health and Human Services. NIDA supports most of the world’s research on the health aspects of drug abuse and addiction. Fact sheets on the health effects of drugs of abuse and information on NIDA research and other activities can be found at www.drugabuse.gov.
Policy Implications

• Get the message out: adolescent cannabis use is associated with poorer neuropsychological function
• Delay the onset of cannabis use
• Encourage cessation of cannabis use particularly for those who began using cannabis in adolescence
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