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Impact of Retail Cannabis

Implications for Addiction, Teen Brain Development,
and Community and Roadway Safety

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Founding Director, MGH Center for Addiction Medicine

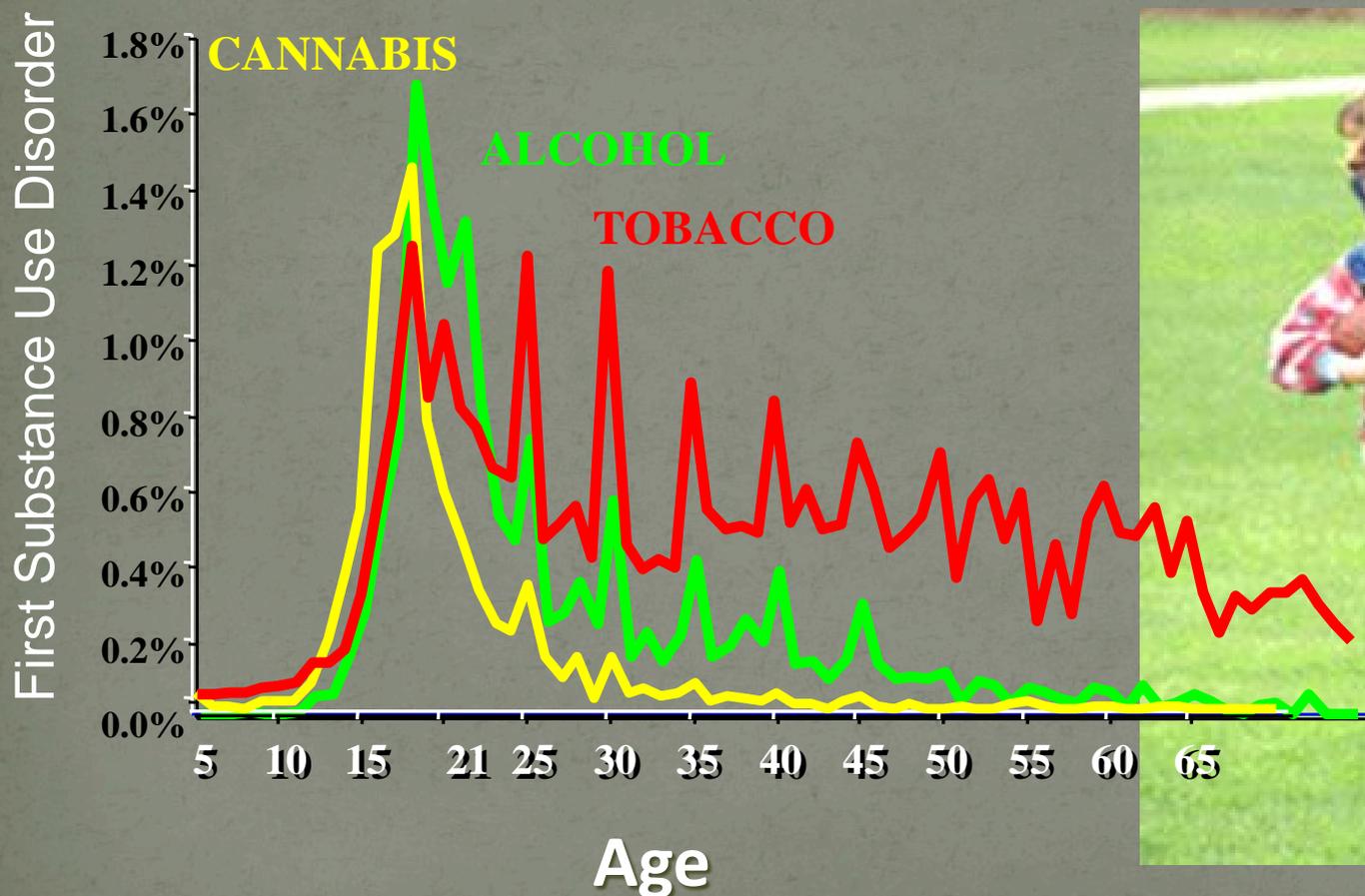
Cox Family Professor of Psychiatry

In the Field of Addiction Medicine, Harvard Medical School

Wayland Town Forum

June 5, 2018

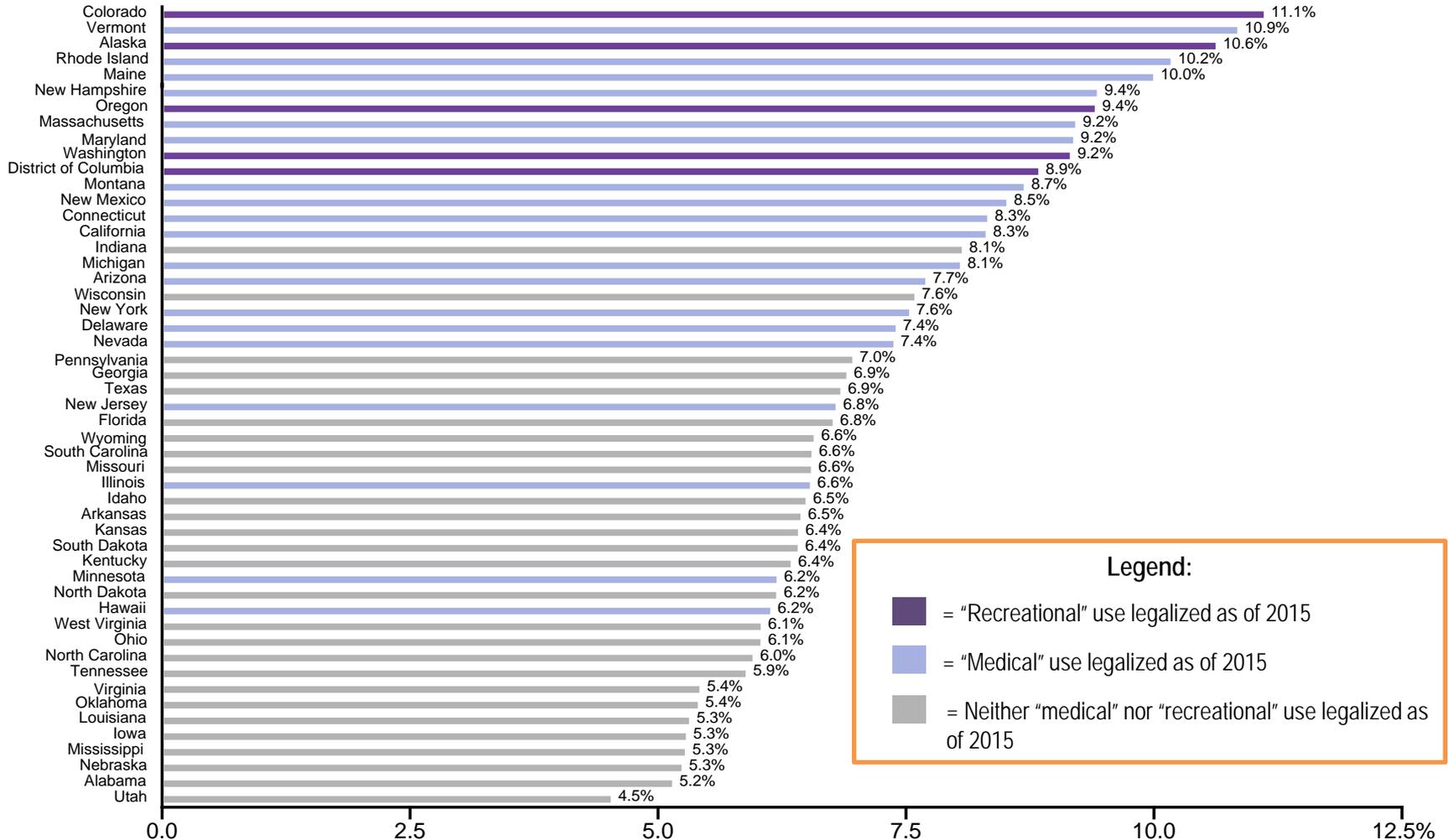
Peak First Onset Cannabis, Nicotine, and Alcohol Use Disorder Is Age 16-19



National Epidemiologic Survey on Alcohol and Related Conditions, 2003

Youth use rates in states that have legalized marijuana outstrip those that have not

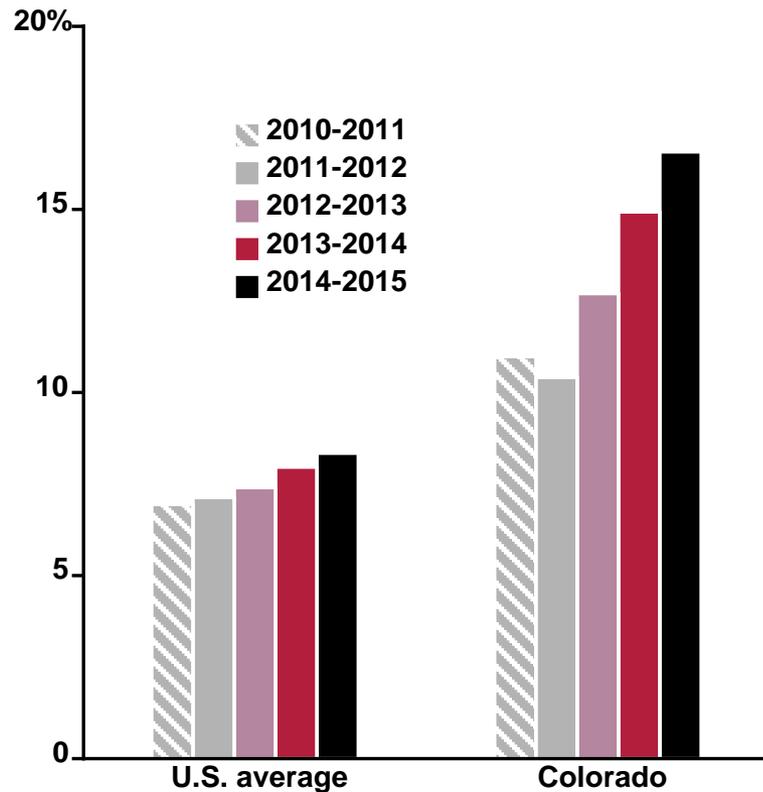
Last-month use, ages 12-17 (2014 - 2015)



• Source: NSDUH (2014-2015)

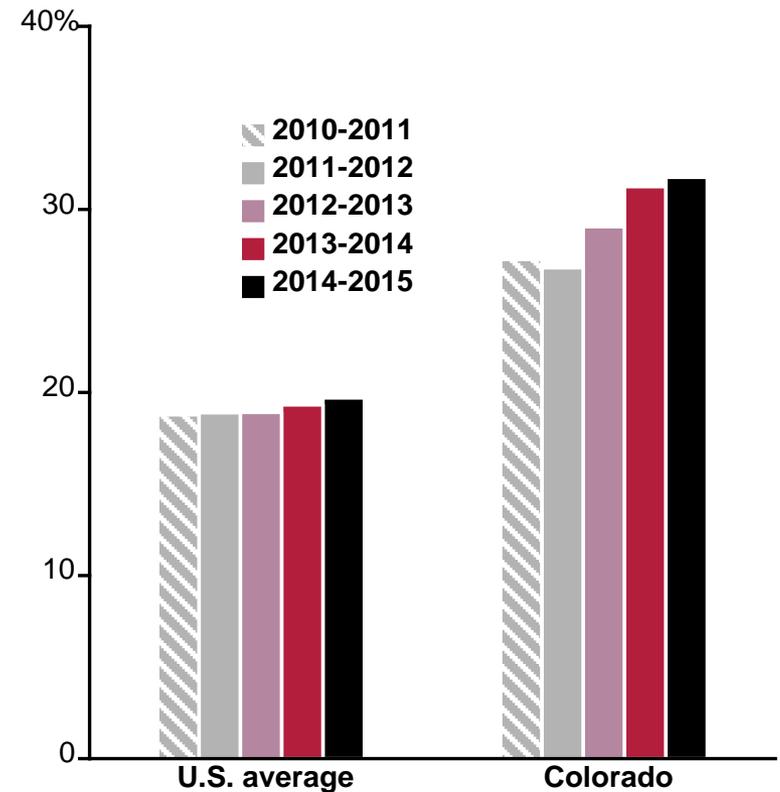
Since legalization, MJ use in kids and young adults in Colorado has climbed faster than the national average

Percentage of population ages 12 and up who used marijuana in the past month



Avg. change per period	U.S. average	Colorado	Avg. change per period	U.S. average	Colorado
	4.7%	10.8%		1.2%	3.9%

Percentage of population ages 18 to 25 who used marijuana in the past month



• Source: NSDUH state estimates



Jolly Gems

Jolly Ranchers

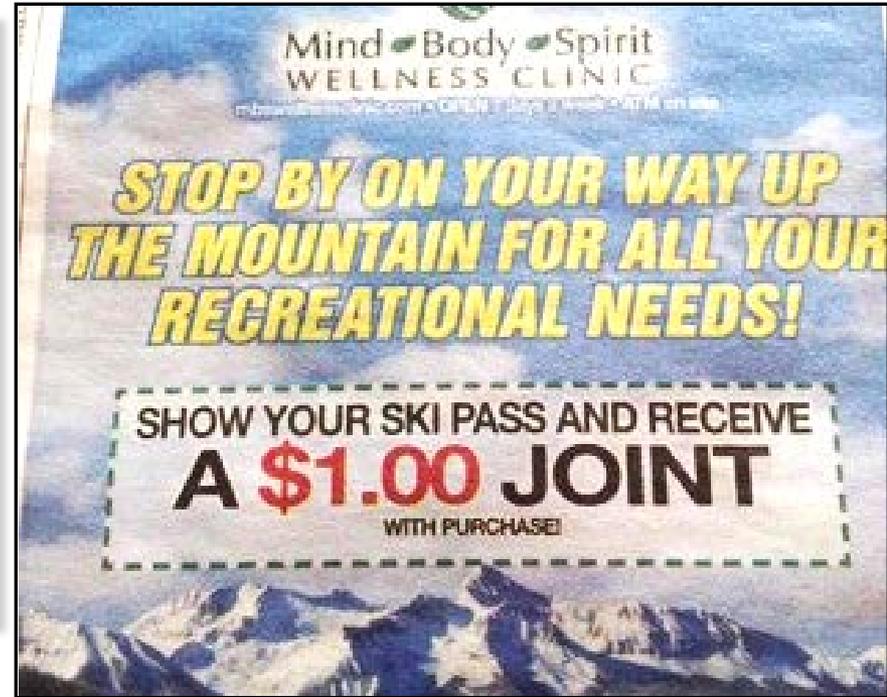


Marketing to kids...
CAN YOU TELL THE DIFFERENCE?

Billboards



Coupons



Event sponsorships



Marijuana Sodas



nugtella

A composite image featuring a slice of bread with hazelnut spread, a butter knife, a glass of milk, and a pile of cannabis buds. The word "nugtella" is written in large, bold letters, with "nug" in black and "tella" in red.

Hazelnut spread with Medical Marijuana

High THC Potency Nutella Marketed to Kids

Nugtella is a chocolate hazelnut spread
with hash oil (320 mg THC per cup)

available in CA with a medical marijuana card *L.A. Times*

Retail Display of Marijuana Candies, Mints, Lollipops, Chocolates, Beers, Vodka, Etc



THC Potency Increased Over Ten-Fold

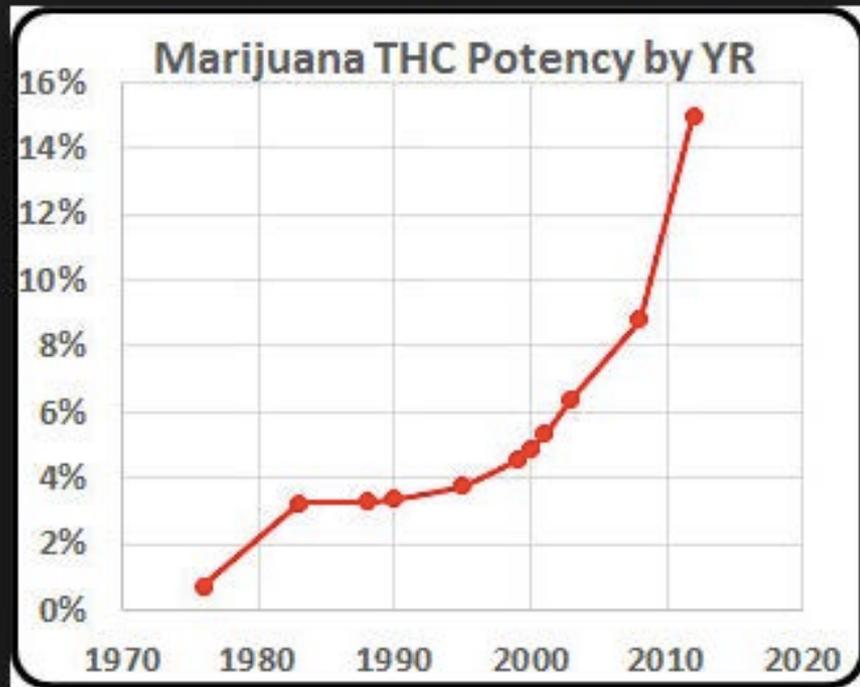
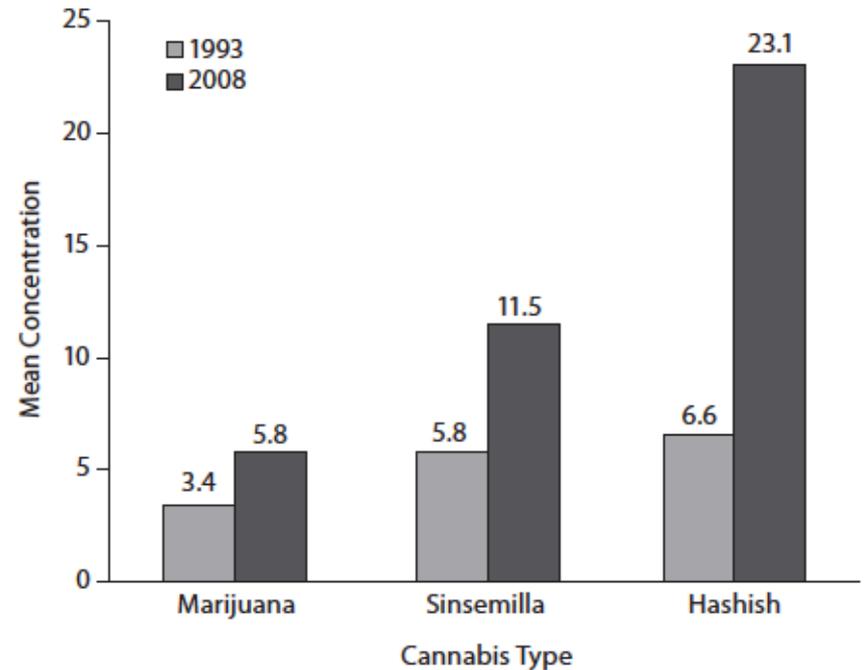


Figure 1. Mean Δ^9 -THC^b Potency by Cannabis Type^a



^aData from Mehmedic et al.³¹

^bAbbreviation: Δ^9 -THC = delta 9 tetrahydrocannabinol.

Biol Psychiatry. 2016 Apr 1;79(7):613-9. doi:
[10.1016/j.biopsych.2016.01.004](https://doi.org/10.1016/j.biopsych.2016.01.004).

Dabs and Oils Contain Over 80% THC

Marijuana Available Where it is Legal is More Potent and, Well, More Available

Average potency of Mexican 'brick marijuana' is 4%

Average potency of American indoor grown marijuana is 10-20%

Washington State: Avg potency is 15%



THC Oil in a JUUL Pod



JUUL: THE NEW CIGARETTE?



Marijuana is not “just a plant” anymore – derivatives contain up to 98% THC



*“Green Crack”
wax*



“Ear Wax”



Butane Hash Oil
(BHO)



Hash Oil Capsules



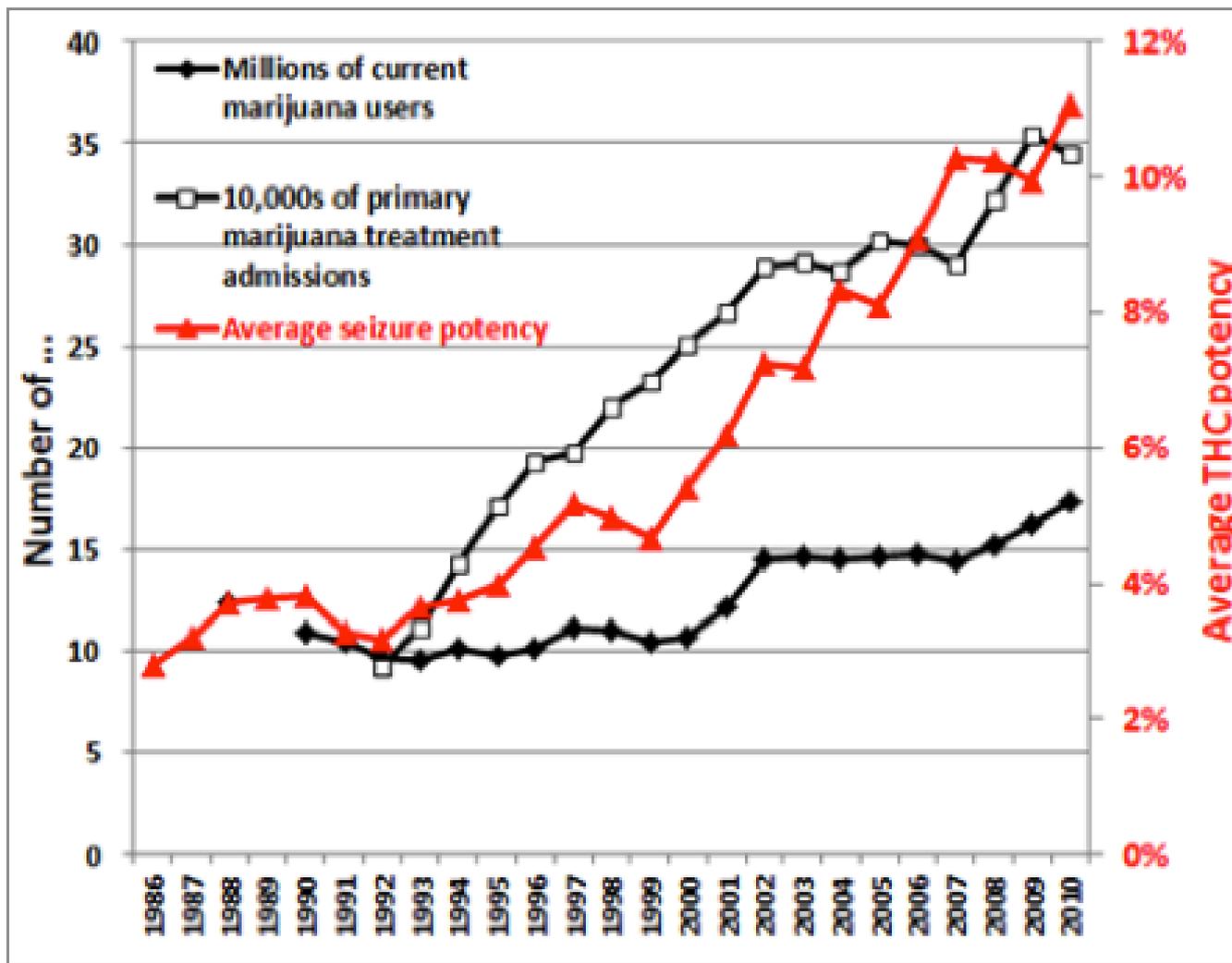
“Budder”

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“Shatter”



MARIJUANA USERS, TREATMENT ADMISSIONS, AND AVERAGE POTENCY: 1986-2010



Sources: [NSDUH](#), [TEDS](#), National Seizure System

IQ: The Dunedin Study (New Zealand) (N=1,037)



13 yrs
(Pre-initiation)



18 yrs

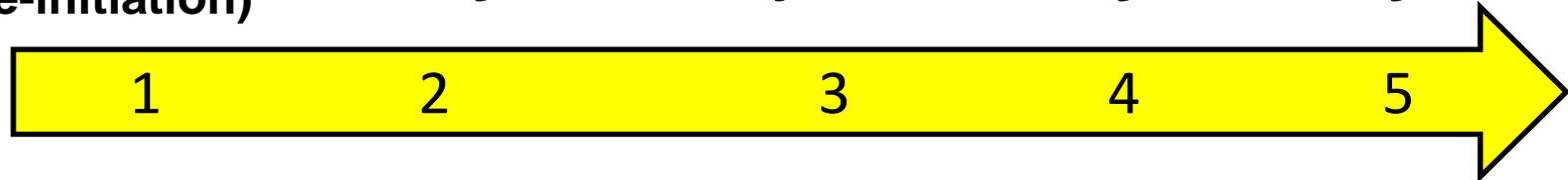


21 yrs



32 yrs

38 yrs



Assessment ages

Change in IQ from 13-38 yrs old

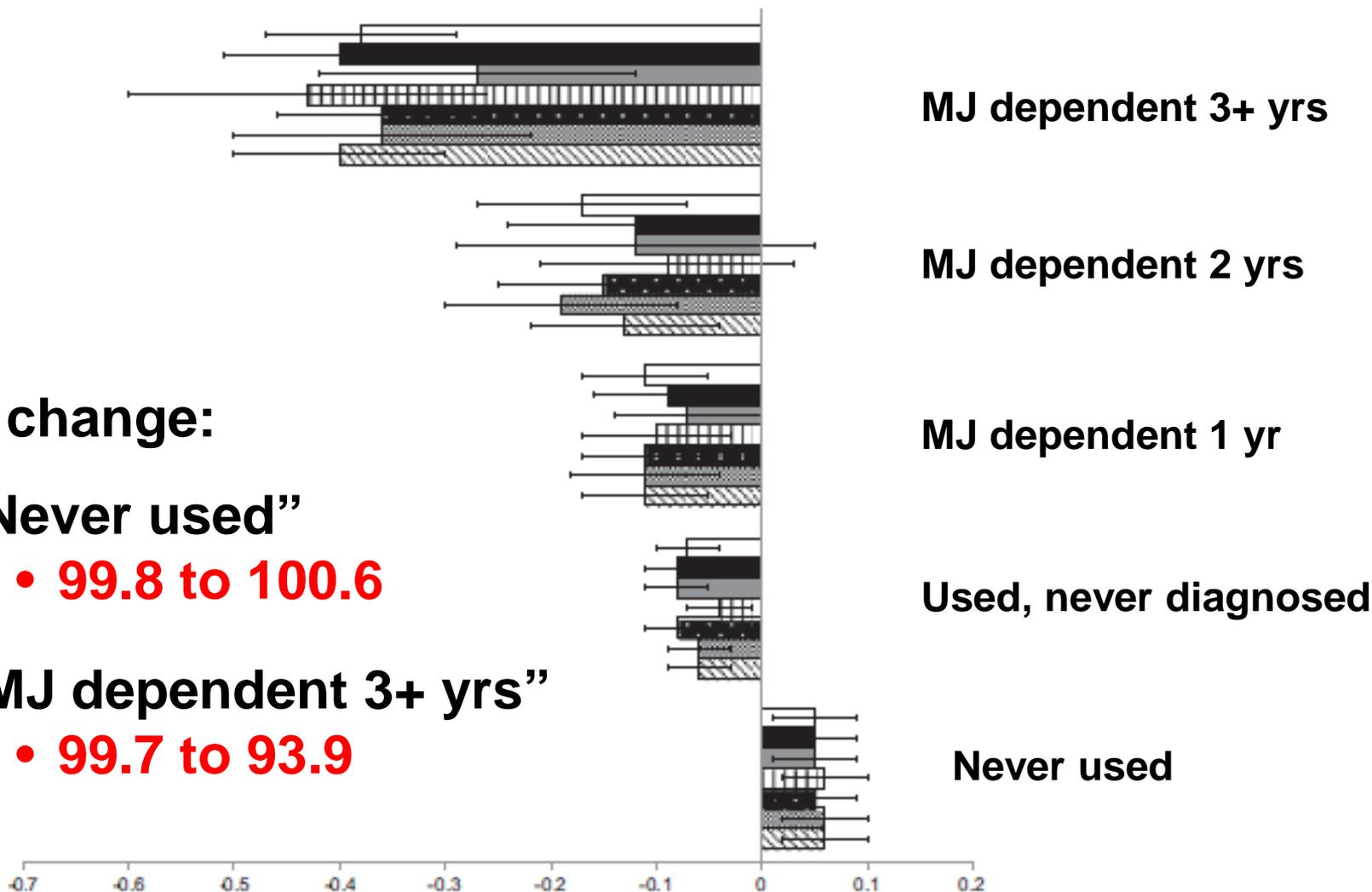
IQ change:

- “Never used”

- 99.8 to 100.6

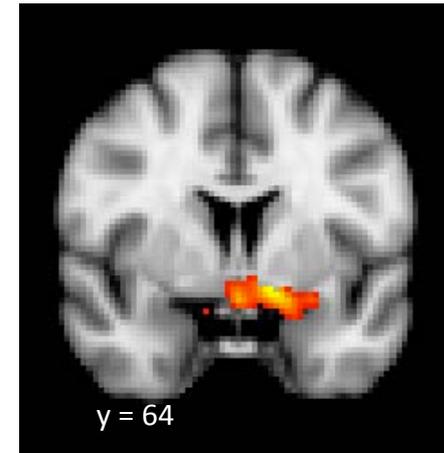
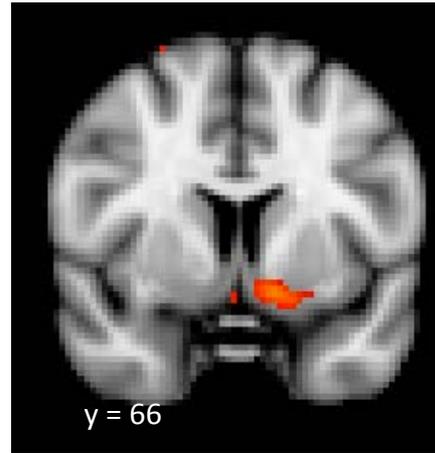
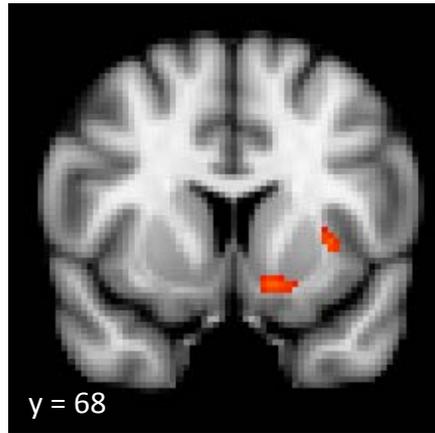
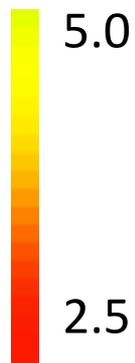
- “MJ dependent 3+ yrs”

- 99.7 to 93.9

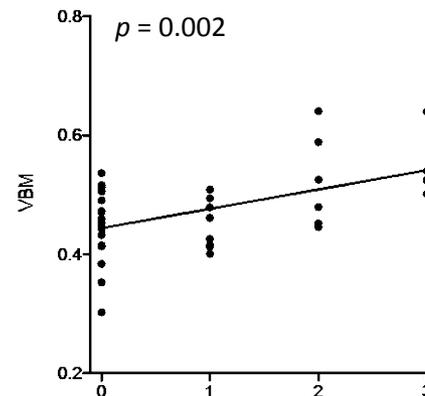
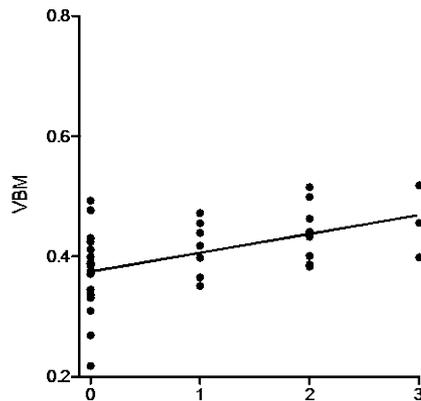


Dose-related Changes in Brain Structure Observed in Young Adults Who Use Marijuana

MJ > CON



Gray Matter Density in Nucleus Accumbens Increases Proportional to Marijuana Dose



Smoking Occasions per Day

Joints per Occasion

Early Onset MJ Use Associated with Learning Deficits

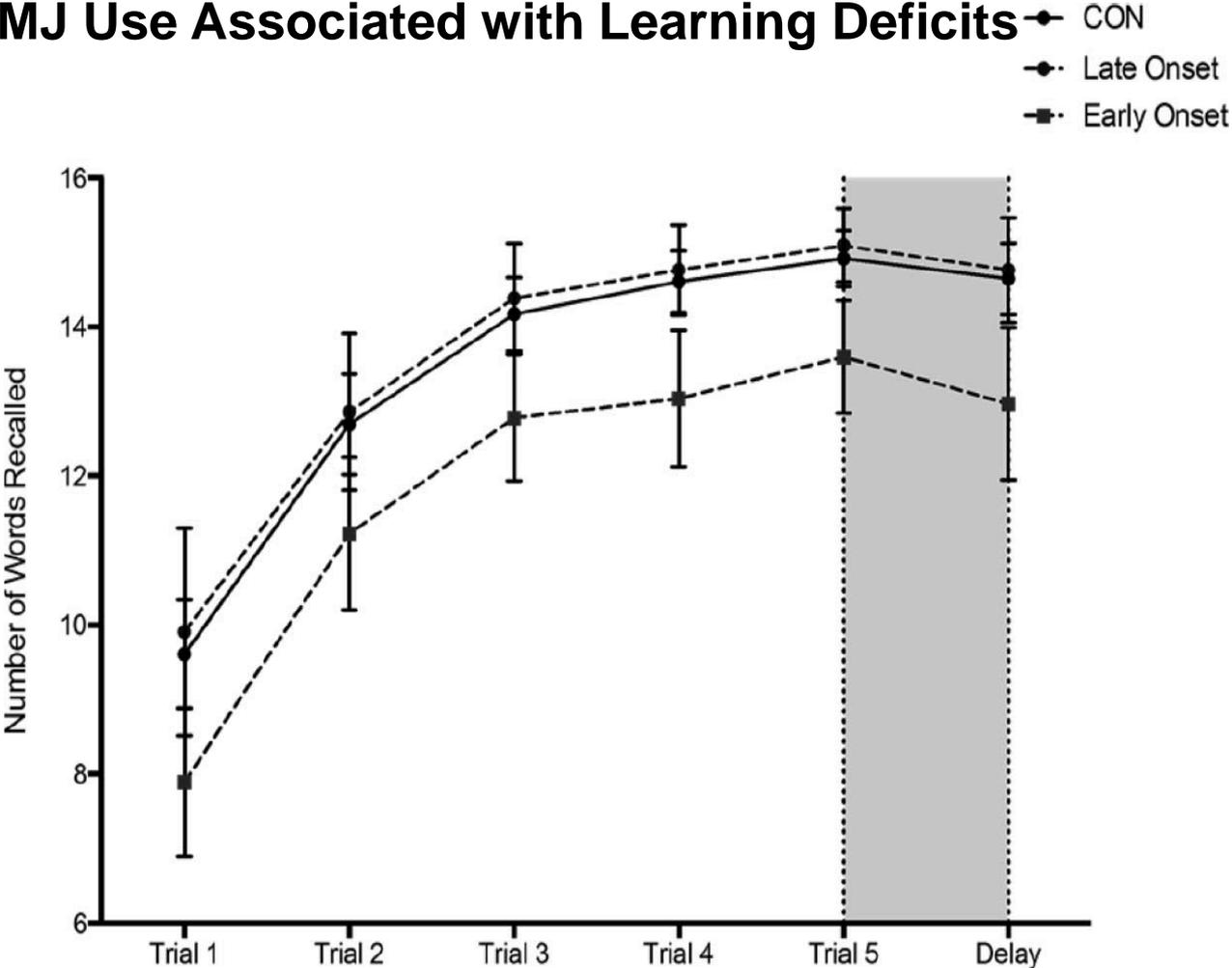
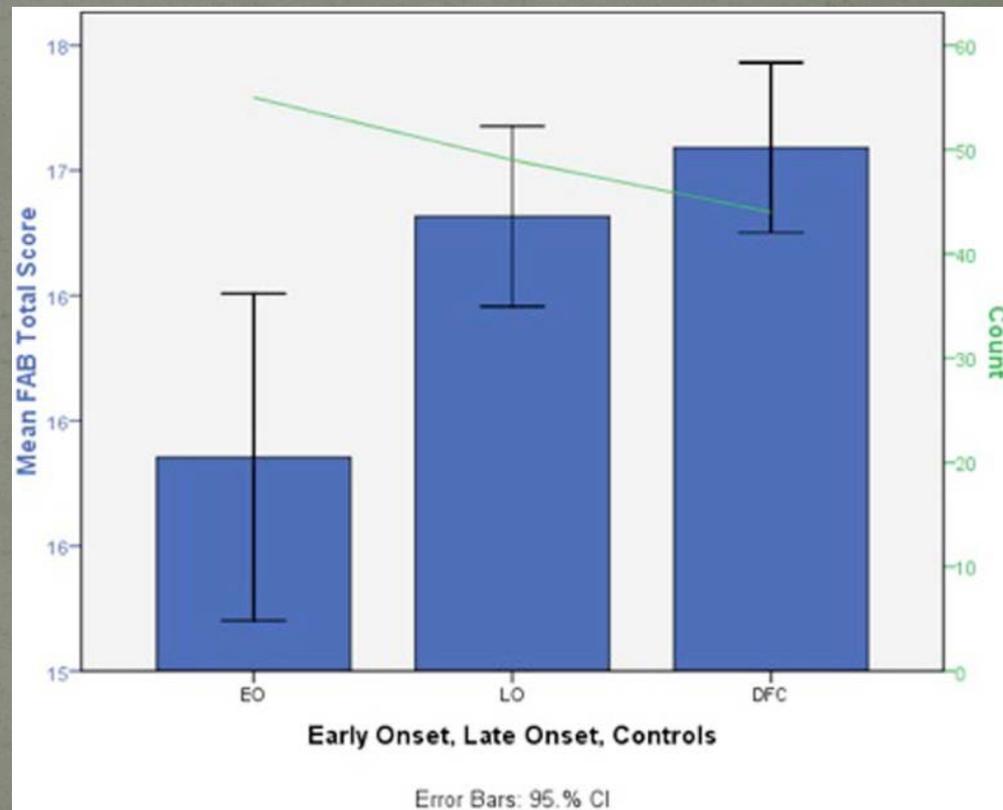


Figure 1. Differences in learning across five learning trials among controls, late onset marijuana users and early onset marijuana users. Groups were significantly different in overall learning (EMJ < LMJ, CON; LMJ = CON). Recall improved significantly and similarly over time across all groups. Groups were significantly different in delayed recall (EMJ < LMJ, CON; LMJ = CON), but similar in percent retention. CON = controls; LMJ = late onset marijuana users; EMJ = early onset marijuana users.

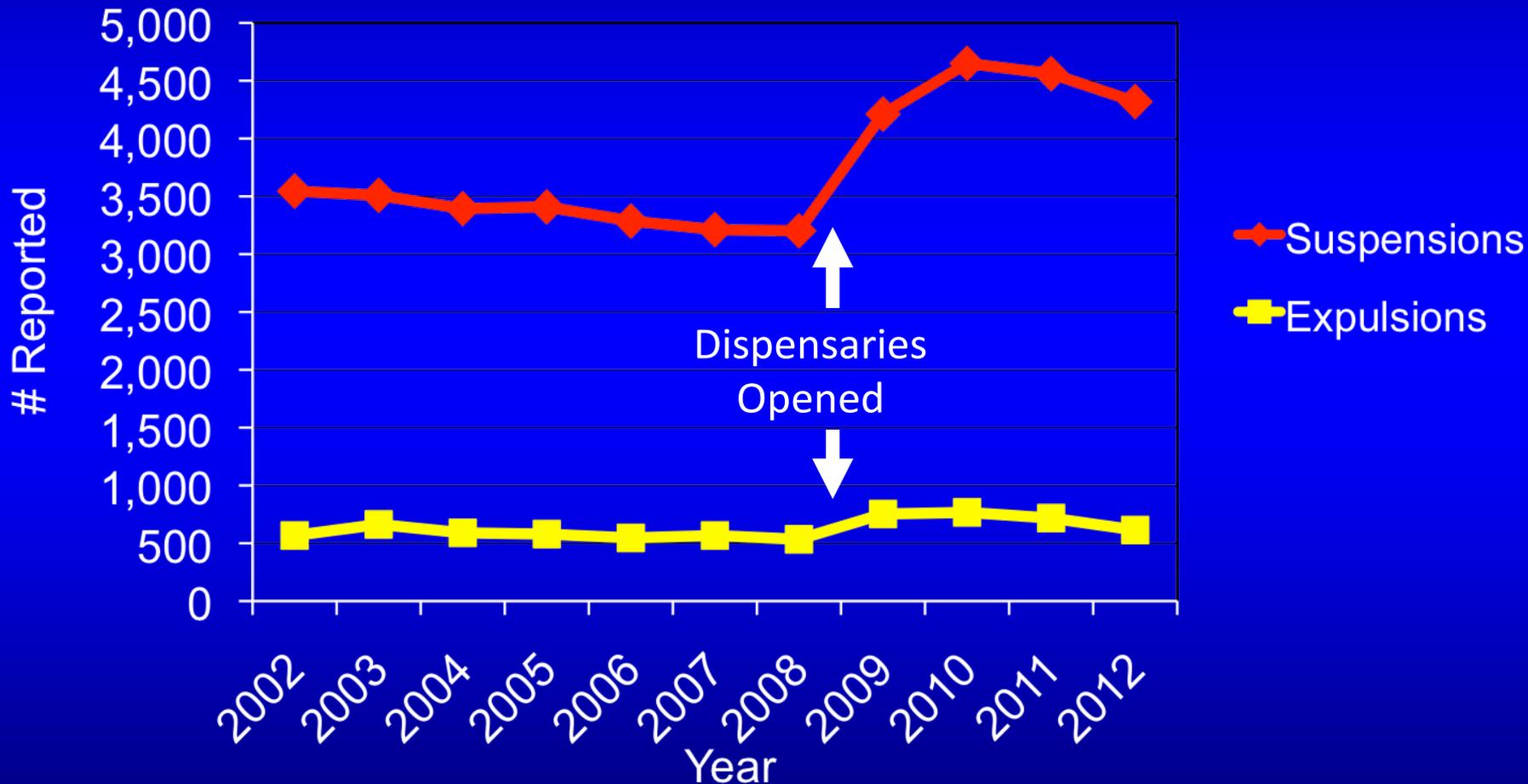
Cannabis use before age 15 and subsequent executive functioning

- Matched for IQ, years of daily use, current MJ use, lifetime consumption, and length of abstinence
- MJ users with use before age 15, had significantly poorer sustained attention, impulse control, and executive functioning
- Cross sectional



Early onset: n=49, Late onset: n=55, Controls: n= 44

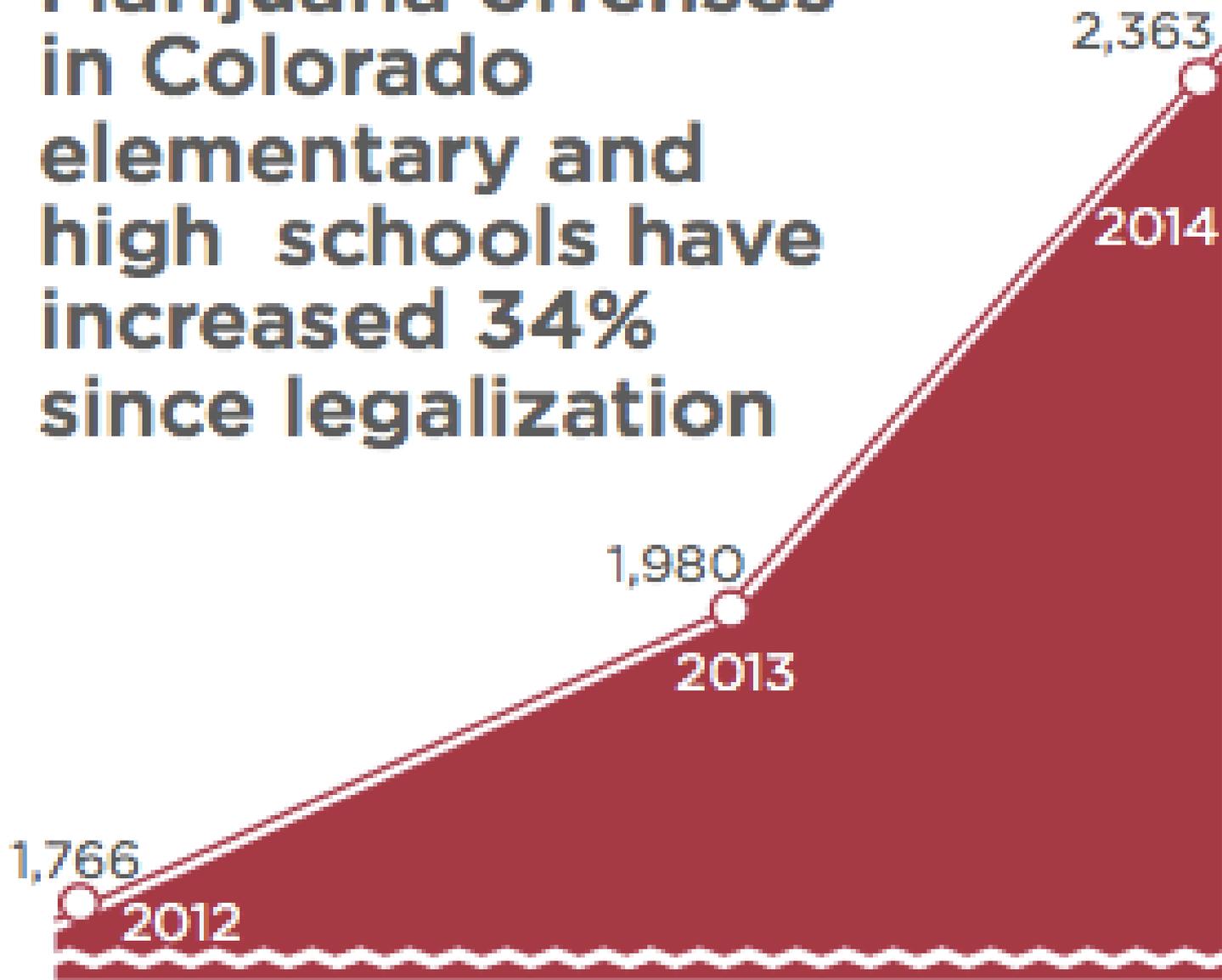
Drug-Related School Suspensions/ Expulsions in Colorado, 2002-2012



Slide courtesy of Sharon Levy, MD MPH, Boston Children's Hospital and Harvard Medical School

Source: <http://www.cde.state.co.us/cdereval/rv2011sdiincidents.htm>

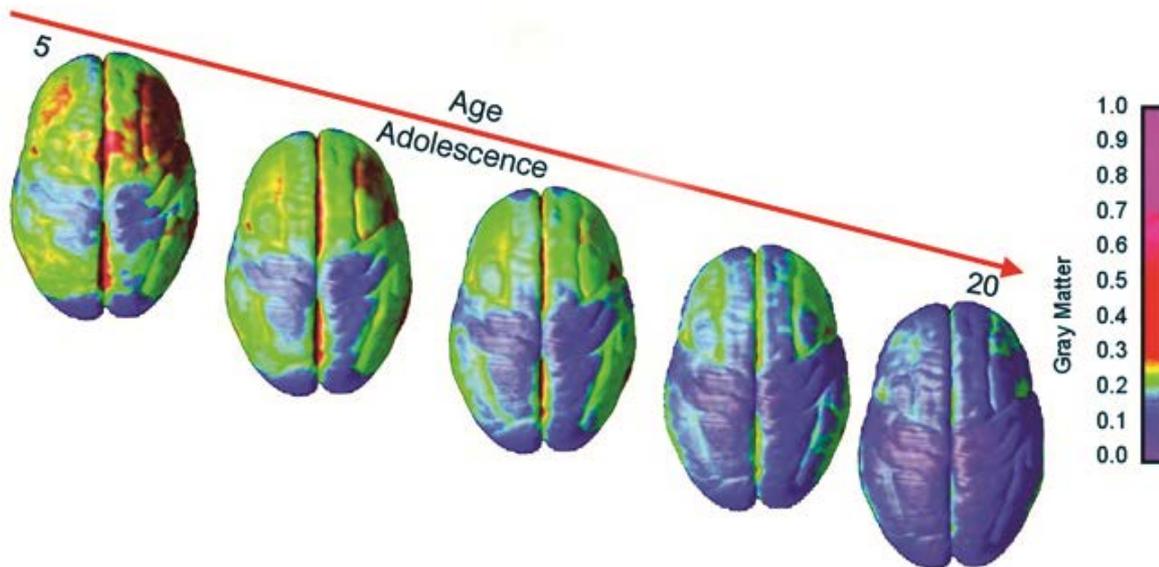
Marijuana offenses in Colorado elementary and high schools have increased 34% since legalization



Source: Colorado Bureau of Investigation

Why is early MJ use worse?

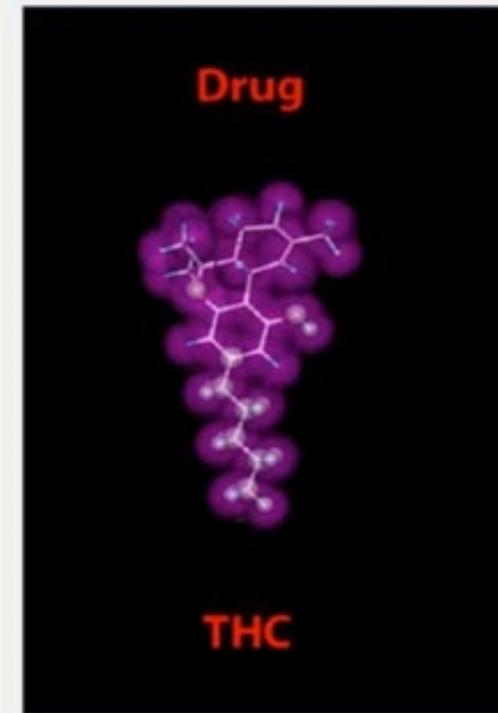
- Adolescence: a developmentally vulnerable period when the brain is undergoing global cortical development, strengthening circuits that are used, pruning those not used
- Myelination continues through age 25 - back to front pattern



MJ Impacts the Adolescent Brain in Particular



- Marijuana products deliver THC to the brain and body.
 - Rapidly when inhaled
 - Slowly in food or drink.
- THC acts on brain cannabinoid (CB1) receptors, normally activated by anandamide.
 - The CB1 receptor activation plays a critical role in normal adolescent brain development.
 - This may be why adolescents have particular vulnerability to cognitive and addictive effects of MJ.



THC's chemical structure is similar to the endocannabinoid neurotransmitter, anandamide.

THE ENDOCANNABINOID SYSTEM

Shapes adolescent brain development by...

- Guiding neurons to grow to the right places in the brain for correct function
- Controlling neuronal activity, thereby affecting brain wiring (“neurons that fire together, wire together”)
- Supporting myelin growth on neurons

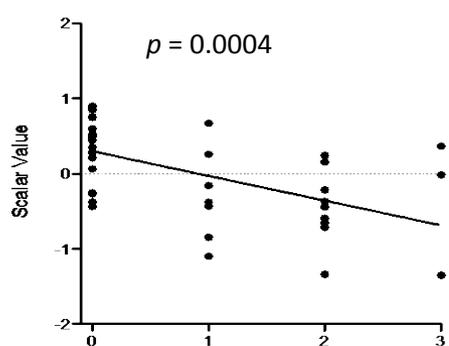
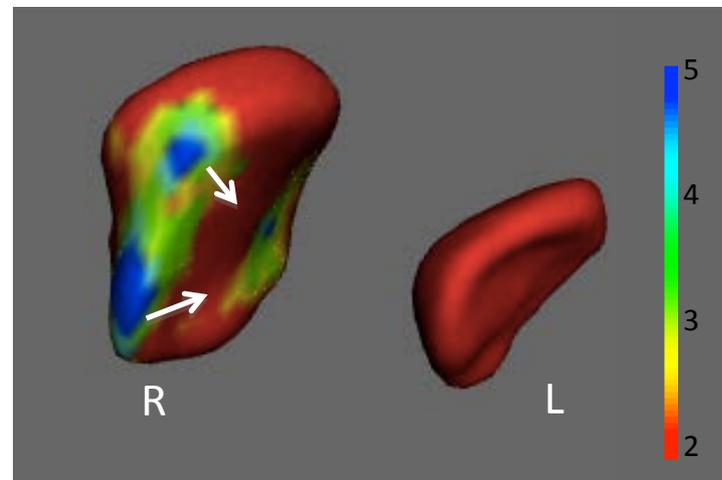
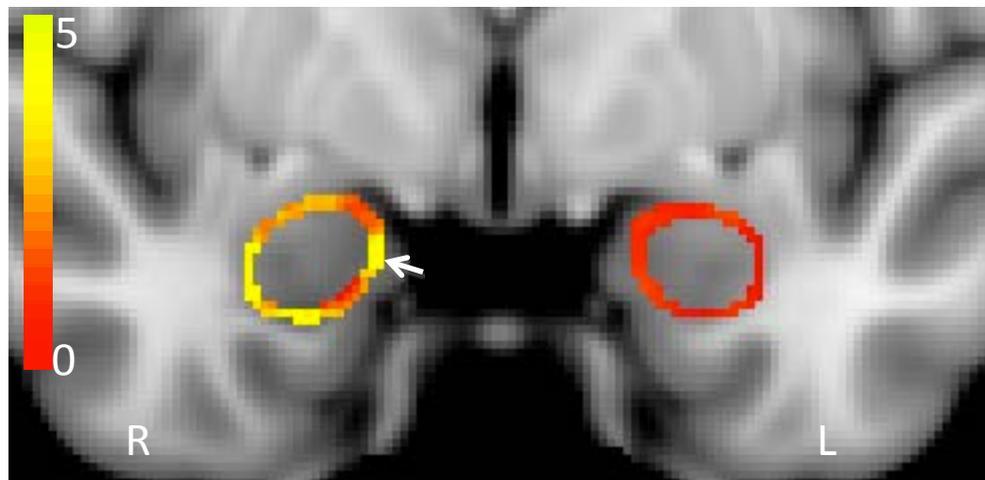
ANANDAMIDE VS. THC

THC binds brain CB1 receptors and has a STRONGER, LONGER effect than anandamide at CB1 receptors

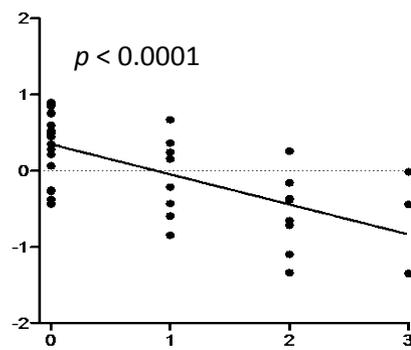
- Frequent exposure to high dose THC obscures anandamide selective signaling
 - Floods the system
 - Obscures selective anandamide signals needed to guide brain development
- In the presence of THC, anandamide can't do its job to protect and balance neuronal activity critical in development.

Galve-Roperh I, et al., Eur Arch Psychiatry Clin Neurosci. 2009;259:371-382.

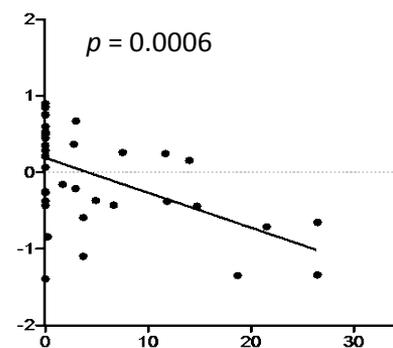
Amygdala is Deformed in Young MJ Users vs. Controls Associated with Frequency and Heaviness of Use



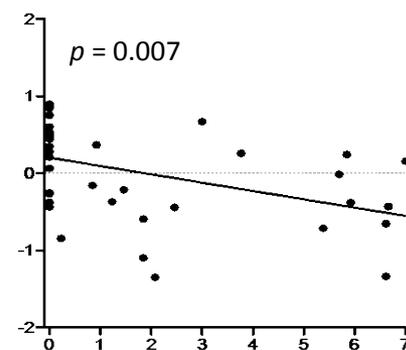
Smoking Occasions per Day



Joints per Occasion

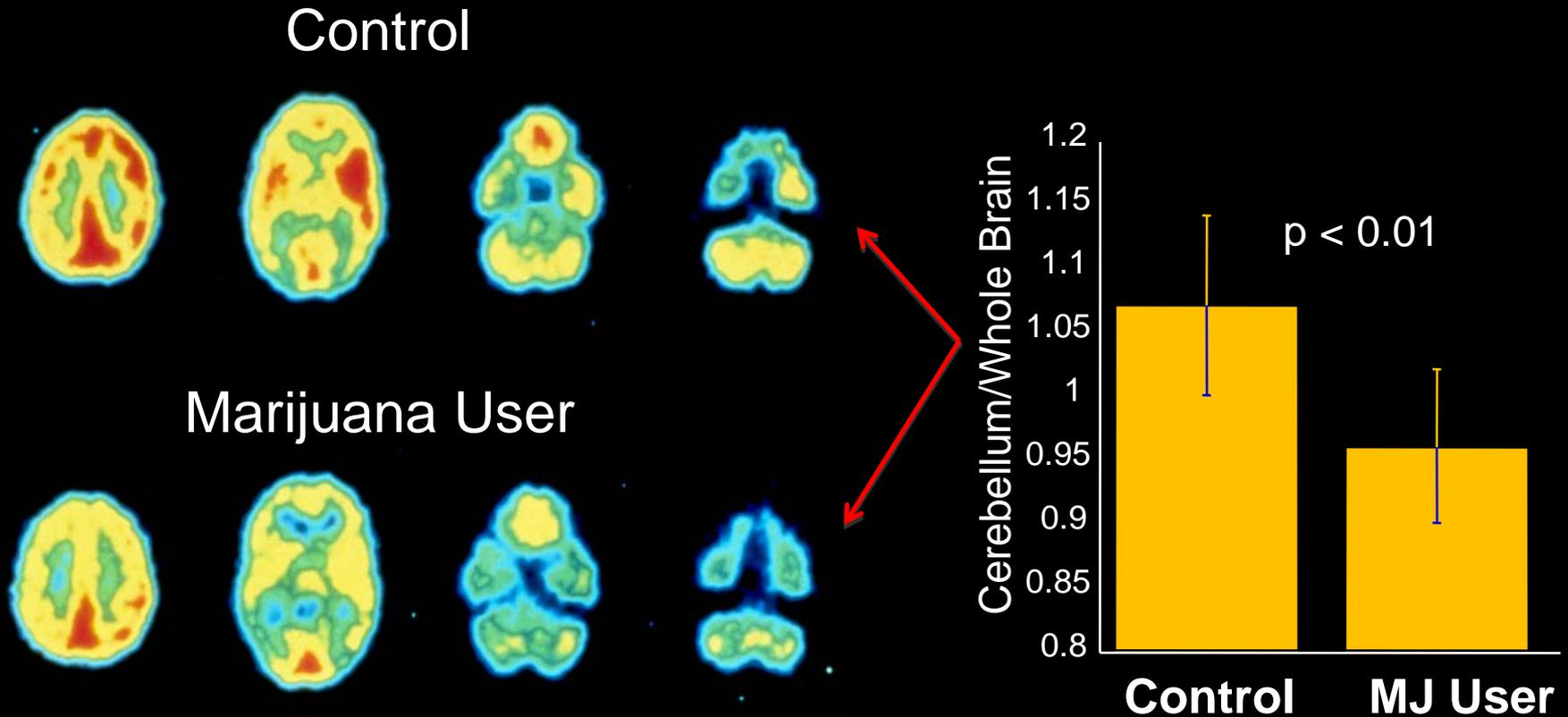


Joints per Week



Smoking Days Per Week

Lower Baseline Cerebellar Glucose Metabolism in Marijuana Users May Result in Motor Deficits



Cannabis significantly affects driving

- 3-4X increase in overall risk of a crash
- Psychomotor impairment
- Impaired attention (lane weaving)
- Slow reaction times
- Reduced critical tracking

States with legalized recreational use are seeing increase in accidents, overdoses and hospital admissions

Sources: Hall, 2015; Ligouri, Gatto, and Jarrett, 2002; Messnis, Kypriandou, Malefaki, and Papathanasopoulos, 2006; Weinstein et al., 2008;

Anderson, Rizzo, Block, Pearlson, and O'Leary, 2010; Downey et al., 2013; Hartman and Huestis, 2013; Lenne et al., 2010

MJ intoxication doubles the risk of motor vehicle accidents

More than doubles the risk of fatal motor vehicle accidents

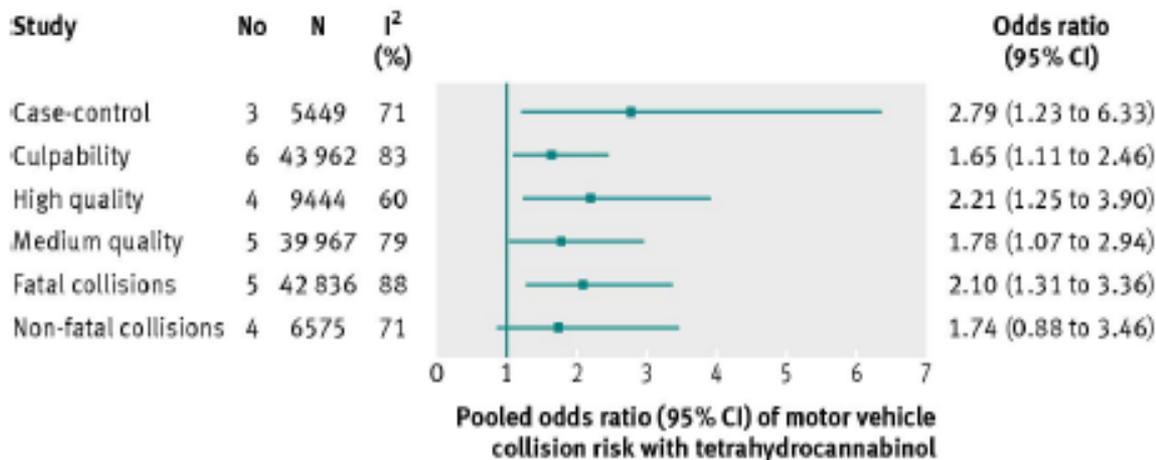
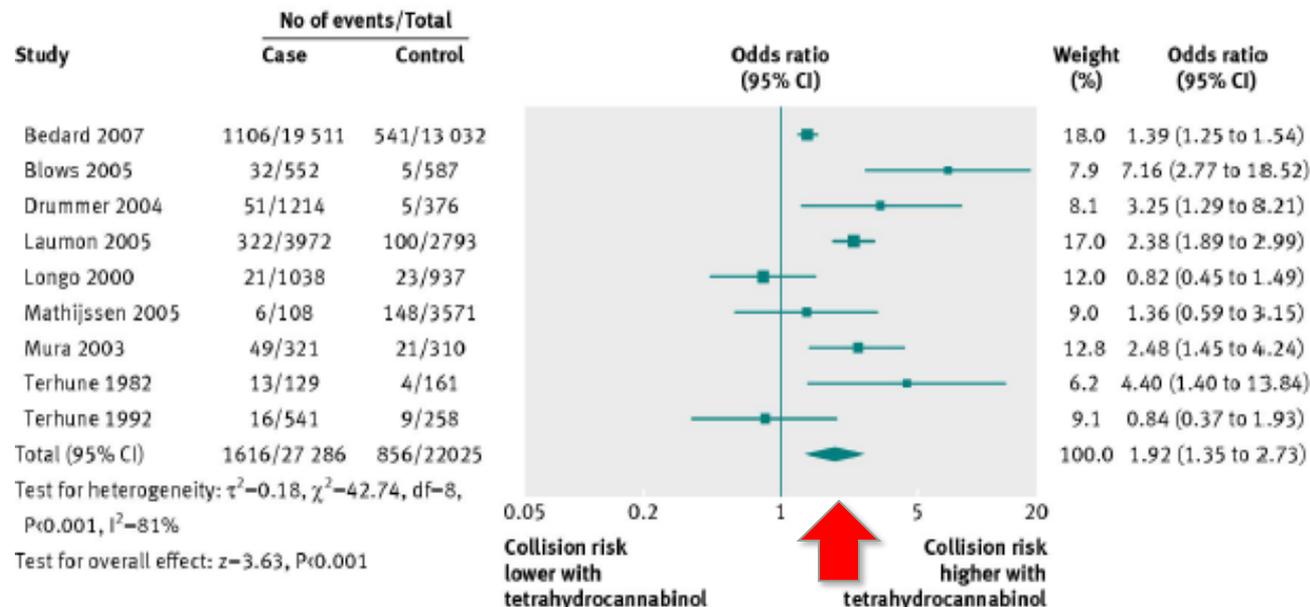
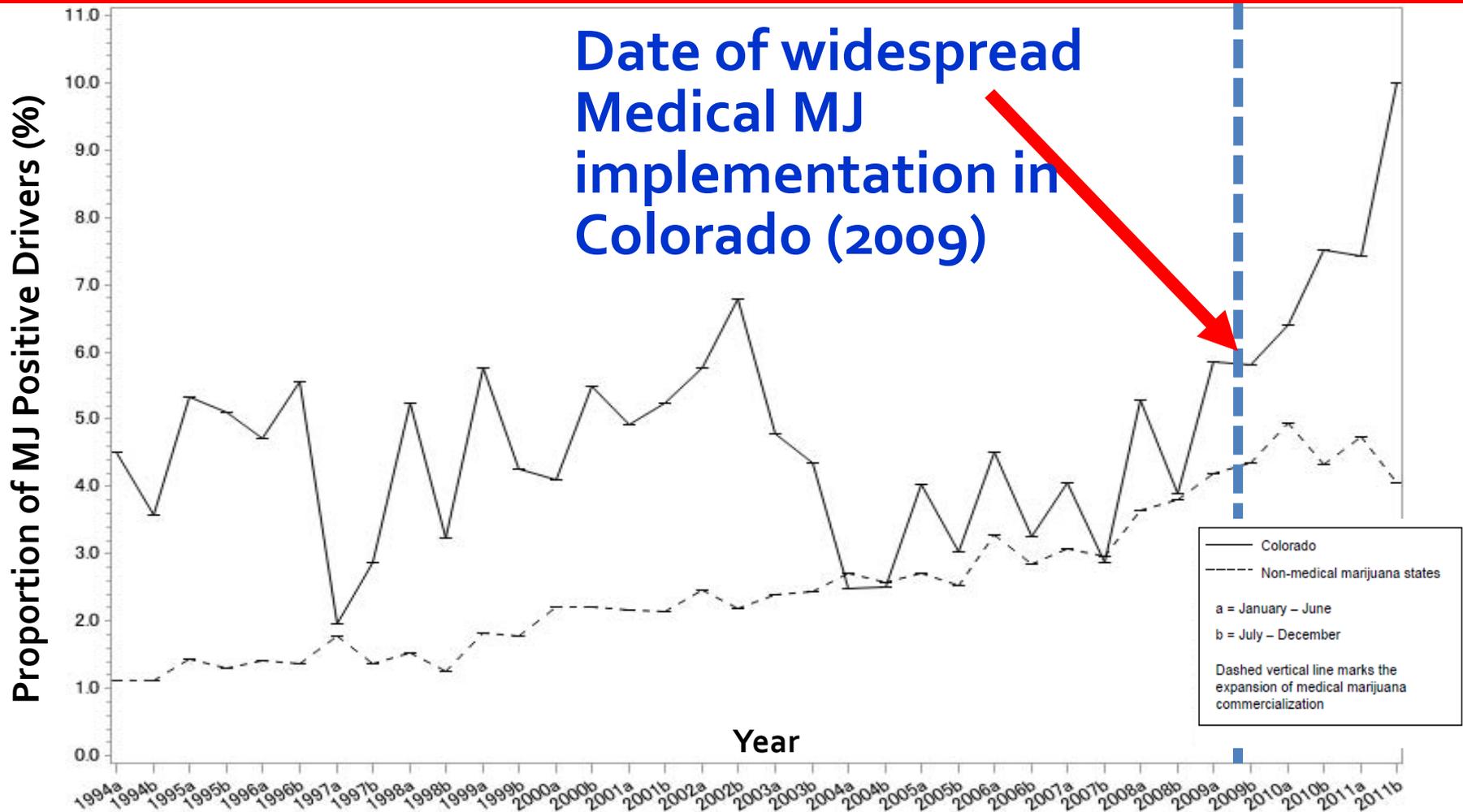


Fig 3 Pooled odds ratio (95% CI) of motor vehicle collision risk with tetrahydrocannabinol

Proportion of MJ-Positive Fatal Crash Drivers In Colorado

vs.

34 States Without Medical MJ, 1994-2011



MJ use forcing CO employers to hire out-of-state employees instead of CO citizens



- “Jim Johnson [construction company GE Johnson’s CEO]...said his company has encountered **so many job candidates who have failed pre-employment drug tests** because of their THC use that **it is actively recruiting construction workers from other states.**”

The Colorado Experience: Property crime around marijuana stores

- Legal marijuana shops are linked to higher levels of property crime in nearby areas, according to a nearly three-year study in Denver.
- Adjacent areas saw about 84 more property crimes per year than neighborhoods without a nearby marijuana store.
- It is the number and density of outlets that is important, not whether they are medical or recreational
- “There are definitely negative public health consequences, including increased crime,” the study author concluded

What Retail Marijuana Looks Like in the US Today



First 200* receive a gift bag containing one joint, one sample of premium flowers, and a Bite from Bliss Edibles
*with \$10 donation minimum



- 1** 
Kid-friendly: comes in shapes & colors attractive to children, like **candy and soda**
- 2** **95%**
Potent: often made w/ concentrates of up to **95% pure THC** (joints are ~ 15% THC)
- 3** **\$\$\$**
Aggressive marketing: free samples, billboard advertising, and other **Big Tobacco tactics**
- 4** 
Contaminants: In 2015, CO recalled 100s of thousands of edibles containing **banned pesticides**
- 5** 
Fighting regulation: The pot industry has lobbied hard against regulation (e.g., warning labels, dosing rules, and bans on ads targeting kids)

Revenue streams already disappoint

SECTIONS



HOME



SEARCH

The New York Times

TheUpshot

REVENUE DISAPPOINTMENT

Marijuana Taxes Won't Save State Budgets

APRIL 9, 2015



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Colorado's marijuana tax collections are not as high as expected.

In February 2014, Gov. John Hickenlooper's office projected Colorado would take in \$118 million in taxes on recreational marijuana in its first full year after legalization. With seven months of revenue data in, his office has cut that projection and believes it will collect just \$69 million through the end of the fiscal year in June, a miss of 42 percent.

That figure is consequential in two ways. First, it's a wide miss. Second, compared with Colorado's all-funds budget of \$27 billion, neither \$69 million nor \$118 million is a large number.




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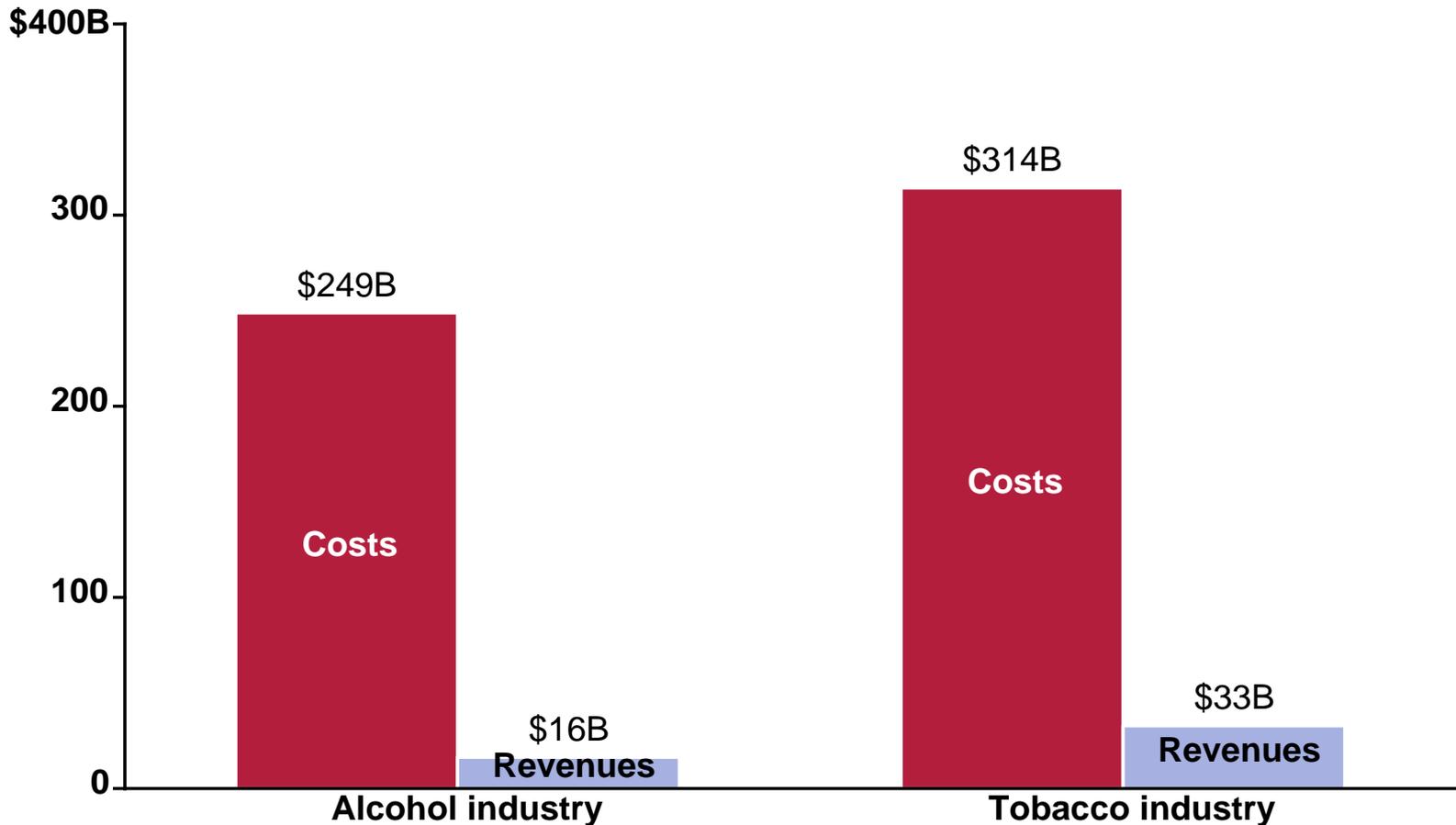
Why pot taxes can't solve Colorado's budget problem



By **CHRIS STIFFLER**

Alcohol and tobacco are money-drainers, not money-makers

Billions of U.S. dollars (indexed to 2012 values)



- Source: CDC, American Lung Association, Tax Policy Center
Note: Total revenues are state and federal combined from 2012. They are compared with costs that were adjusted for inflation and are stated in 2012 values.

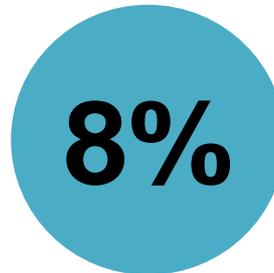
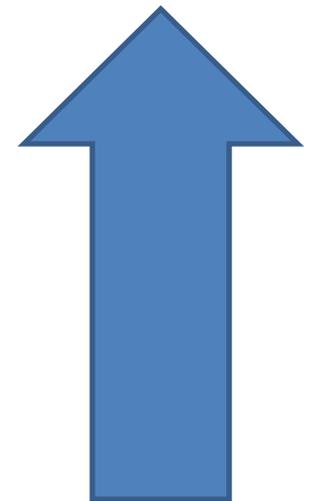
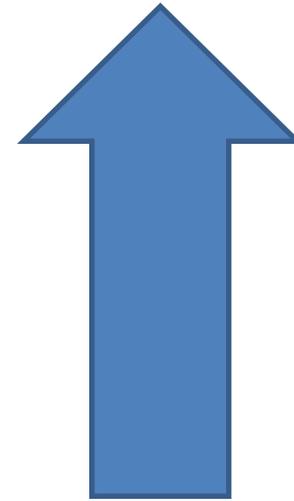
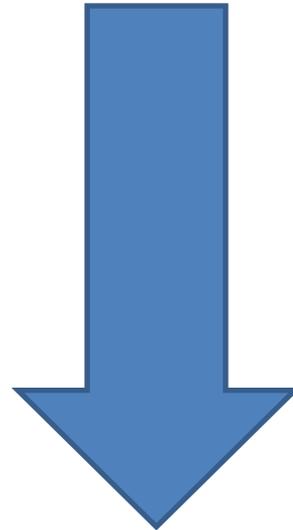
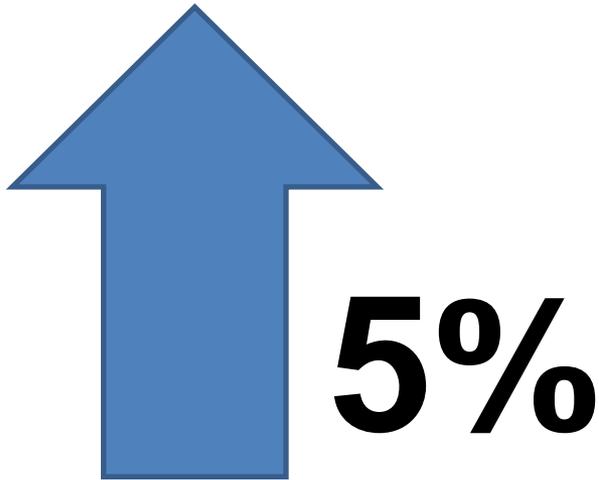
Juvenile Arrest Rate Before and After Legalization: Colorado

Overall Juvenile Arrests

Whites

Hispanics

Blacks





nugtella



Hazelnut spread with Medical Marijuana

