Recreational Marijuana Legalization and Human Capital Accumulation

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ASHEcon 2026

Motivation

- Recreational Marijuana Laws (RMLs) legalize the possession, sale, and cultivation of marijuana, expanding legal access to about half of American adults by Dec 2023.
  - Share of adults reporting recent marijuana use more than doubled from 7.1% in 2012 (1st law passage) to 16.1% in 2023 (NSDUH)
  - Share reporting daily marijuana use increased from 3.5% in 2016 to 7% in 2023 (BRFSS)

- Policy debates often weigh adult welfare, tax revenue, public safety, and health consequences of RMLs (Anderson & Rees, 2023; Pacula et al., 2022), but the long-run social costs may also depend on effects on human capital formation (Becker, 1964; Becker & Tomes, 1976; Heckman, 2006; Cunha & Heckman, 2007)

→ Despite this, recent public-health literature notes that the causal impact of recreational cannabis legalization on academic achievement and post-secondary education remains unclear (Chan et al., 2024; Hinckley et al., 2024)

This Paper

- **Research Question:** What is the causal effect of recreational marijuana legalization on youth and young-adult human-capital outcomes?

▷ **Approach:** Use a staggered-adoption **difference-in-differences** design to examine the impact of state RML passage on:

- GED-or-higher attainment among young adults ages 18–35
- Middle-school test scores in grades 5–8
- Potential mechanisms

→ State RML passage leads to:

- Increased teen marijuana use
- Lower young-adult educational attainment
- Lower middle-school test scores
- Evidence consistent with worse household routines and reduced parental time inputs

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Data & Sample Construction

Main Educational Outcomes

1. **American Community Survey (ACS)**, 2009–2023
   - Individual-level GED-or-higher attainment, ages 18–35
2. **Stanford Education Data Archive (SEDA)**, 2009–2023
   - State-year-grade standardized test scores, grades 5–8

Direct Channels

*3. **National Survey on Drug Use and Health via KIDS COUNT**, 2009–2019
   - State-level past-month marijuana use among teenagers, ages 12–17

Indirect Channels

4. **Youth Risk Behavior Surveillance System (YRBSS)**, 2009-2023
   - Adolescent routines and health-related behaviors, ages 14–18

*5. **National Child Abuse & Neglect Data System via KIDS COUNT**, 2009-2023
   - Substantiated child maltreatment by age group

6. **American Time Use Survey (ATUS)**, 2009-2023
   - Parental time spent caring for own children

Descriptive Statistics

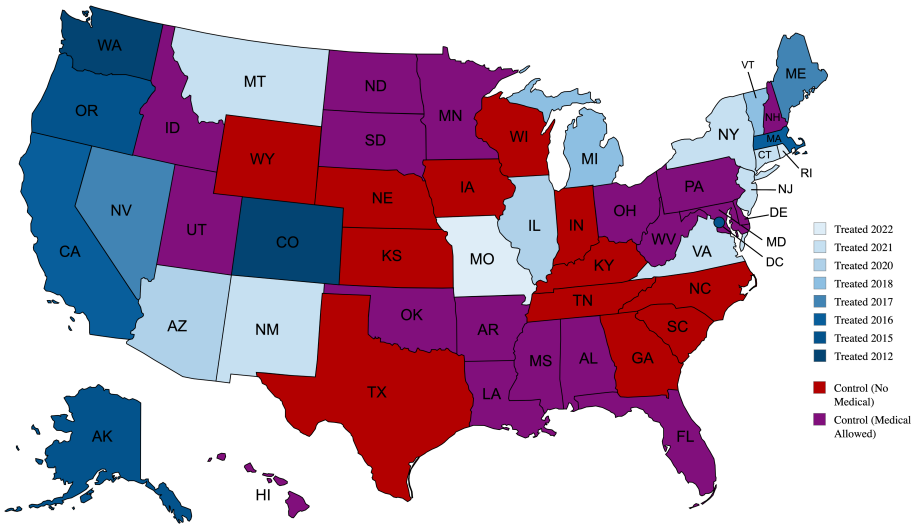
Main Outcomes & Direct Channel

	Treated States		Control States	
	Mean	S.D.	Mean	S.D.
Educational Attainment (ACS 2009–2023)				
Share with GED or higher, ages 18-35	0.897	0.304	0.887	0.317
Individual observations	6,401,256		7,052,926	
Middle School Test Scores (SEDA 2009–2023)				
Combined test scores, grades 5–8	-0.022	0.201	-0.027	0.161
Math test score, grades 5–8	-0.031	0.210	-0.026	0.182
Reading/language arts test score, grades 5–8	-0.013	0.192	-0.029	0.136
State-year-grade observations	2,288		3,016	
Teen Marijuana Use (NSDUH 2009–2019)				
Past-month marijuana use, ages 12–17	0.086	0.012	0.066	0.011
State-year observations	120		492	

Indirect Channels

	Treated States		Control States	
	Mean	S.D.	Mean	S.D.
Home Environment (YRBSS 2009–2023)				
No breakfast in past 7 days, ages 14–18	0.146	0.353	0.173	0.378
Individual observations	349,095		627,760	
Usual sleep of 5 hours or less	0.242	0.428	0.246	0.430
Individual observations	150,619		395,736	
No dental visit in past 12 months	0.262	0.439	0.248	0.432
Individual observations	143,472		479,109	
Substantiated Child Maltreatment (NCANDS 2010–2023)				
Cases per 1,000 children aged 8-11	1.791	0.959	1.544	0.773
Cases per 1,000 children aged 12-15	1.631	0.895	1.395	0.664
Cases per 1,000 children aged 16-17	0.586	0.335	0.456	0.231
State-year observations	294		420	
Parental Time Use (ATUS 2009–2023)				
Minutes per day caring for children aged 8-11	75.4	100.1	73.0	99.3
Individual observations	8425		9400	
Minutes per day caring for children aged 12-15	52.1	88.8	49.9	87.6
Individual observations	7704		8549	

Identifying Variation: End of Sample Period



Empirical Model: Sun & Abraham Event Study

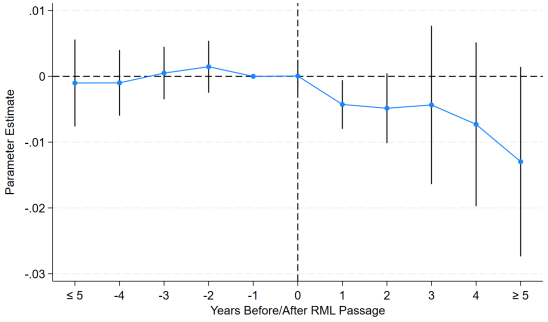
$$Y_{st} = \sum_{e \notin C} \sum_{\substack{l=-5 \\ l \neq -1}}^{5} \delta_{e,l}(\mathbb{1}\{E_s = e\} \times RML^{l}_{s,t}) + \theta_1 MML_{st} + \theta_2 MDL_{st} + ...$$

$$... + X'_{st}\beta + \alpha_s + \gamma_t + \epsilon_{st} \quad (1)$$

- $\mathbb{1}\{E_s = e\}$: indicator function where e represents each treated cohort by year of treatment in the support set of all treated cohorts E_s
- $RML^{l}_{s,t}$: indicator for treatment status in a given relative year, state, and calendar year
- $\delta_{e,l}$: coefficients of interest, the CATT of law passage on Y_{st} within each year relative to treatment (two more balancing/weighting steps to form $\widehat{\delta}^{IW}_{\ell}$)
- X'_{st}: vector of state-year controls (demographics, social welfare policies, macro)

Findings: Educational Attainment (ACS)

Event study: GED or higher, ages 18–35



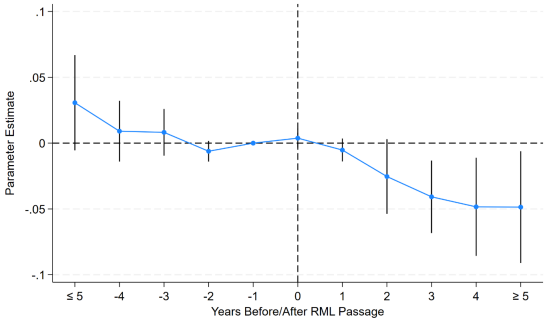
ATT Estimates

	Estimator		
	(1) S&A	(2) CS	(3) TWFE
Share of Sample with GED or Higher *ages 18–35*			
RML	-0.0077**	-0.0057***	-0.0078**
	(0.0038)	(0.0017)	(0.0034)
Control mean	0.887	0.880	0.880
Percent effect	0.87%	0.65%	0.89%
Individual obs.	10,247,745	10,247,745	10,247,745
Model	S&A	CS	TWFE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Findings: Middle School Test Scores (SEDA)

Event study: mean test scores, grades 5–8



ATT Estimates

	Estimator		
	(1) S&A	(2) CS	(3) TWFE
Mean District Test Score, All Subjects *grades 5–8*			
RML	-0.025**	-0.031**	-0.017
	(0.011)	(0.015)	(0.015)
Control mean	Normalized to zero	Normalized to zero	Normalized to zero
Effect size	14% of one SD	17% of one SD	–
State-year-grade obs.	5,304	5,304	5,304
Model	S&A	CS	TWFE

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Heterogeneity: Middle School Test Scores (SEDA)

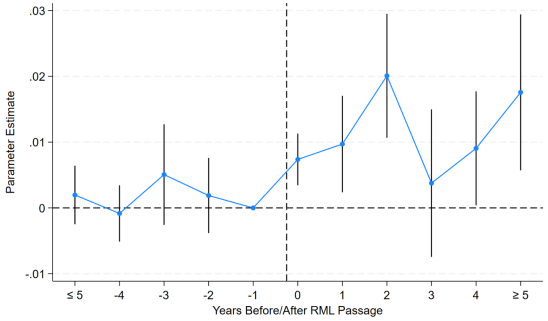
ATT estimates for effect of RML passage on middle school test scores (SEDA, 2009–2023)

	Subject		
	(1) All Subjects	(2) Mathematics	(3) Reading
Mean District Test Score *Grades 5–8*			
RML (law passage)	-0.025**	-0.034***	-0.016
	(0.011)	(0.013)	(0.011)
Control Mean	Normalized to zero	Normalized to zero	Normalized to zero
Effect Size	14% of one SD	19% of one SD	9% of one SD
State-year-grade Observations	5,304	2,652	2,652
Model	Sun & Abraham	Sun & Abraham	Sun & Abraham

* $p < 0.10$, ** $p < .05$, *** $p < .01$.

Direct Channel: Teen Marijuana Use (NSDUH)

Event study: any prior-month marijuana use (ages 12–17)



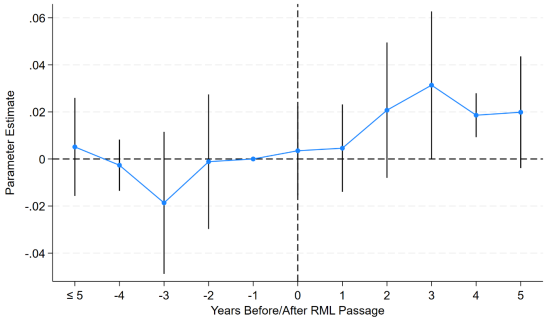
ATT Estimates

	Estimator		
	(1) S&A	(2) CS	(3) TWFE
Prior-Month Marijuana Use			
ages 12–17			
RML	0.0100***	0.0086***	0.0104***
	(0.0022)	(0.0033)	(0.0019)
Control mean	0.0662	0.0691	0.0691
Percent effect	15.2%	12.2%	15.1%
State-year obs.	612	612	612

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Indirect Channel: Deteriorating Home Environment (YRBSS)

Event study: never eating breakfast, ages 14–18



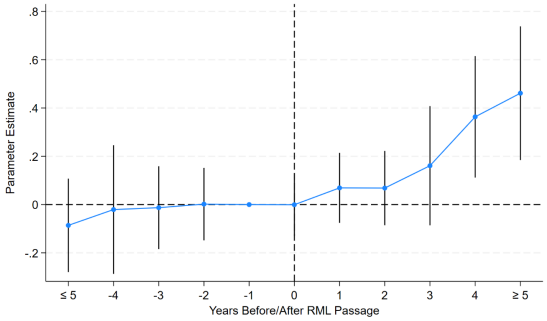
ATT Estimates

	Outcome		
	Never Eats Breakfast	Sleeps $\leq$ 5 Hours	No Recent Dentist Visit
Share of Children *ages 14–18*			
RML	0.013**	0.017**	0.015***
	(0.006)	(0.008)	(0.004)
Control mean	0.171	0.244	0.251
Percent effect	7.6%	7.0%	6.0%
Individual obs.	711,498	533,145	620,246
Model	S&A	S&A	S&A

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Indirect Channel: Child Maltreatment (NCANDS)

Event study: substantiated child maltreatment cases per 1,000 children (ages 12–15)



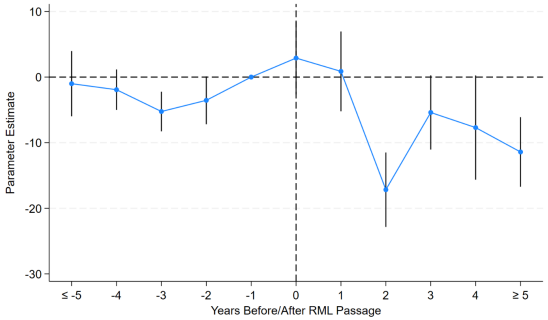
ATT Estimates

	Age Category		
	8–11	12–15	16–17
Substantiated Child Maltreatment *cases per 1,000*			
RML	0.141	0.204***	0.044
	(0.110)	(0.077)	(0.032)
Control mean	1.54	1.39	0.46
Percent effect	–	14.7%	–
Model	S&A	S&A	S&A

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Indirect Channel: Parental Time Use (ATUS)

Event study: time spent caring for own children (ages 12–15)



ATT Estimates

	Age Category		
	8–11	12–15	16–17
Time Spent Caring for Own Children *minutes per day*			
RML	1.37	-5.99***	-3.42
	(2.41)	(2.12)	(2.63)
Control mean	71.19	49.7	32.97
Percent effect	–	12%	–
Model	S&A	S&A	S&A

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Discussion & Conclusions

→ **This study provides evidence that RML has adverse spillover effects on child and adolescent human capital accumulation.**

- GED-or-higher attainment among ages 18–35 *falls by 0.77 percentage points*.
- Middle-school test scores *fall by 14% of one SD*, with larger effects in mathematics.
- **Direct mechanism:** Teen marijuana use *rises by 15.2%* relative to the control mean.
- **Indirect mechanisms:** ↓ parent support, ↓ *structured home routines*, ↑ *substantiated maltreatment* of 12-15-year-olds

Conclusion:

- RMLs may have spillover effects on children and adolescents beyond adult consumers.
- These potential human-capital costs should be included in policy evaluations of marijuana liberalization.