

Supplement to Messer et al. “Association of changes in cigarette price and state tobacco control funding with the major 20-year decline in US 18-24-year-old cigarette smoking: a repeated cross-sectional TUS-CPS study”

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eTable 1. Respondents ages 18-24 in the 2000-2019 TUS-CPS, by sociodemographic characteristics and state, for the 24 most populous US states

Variable		Population		Average Smoking Prevalence 2000-2019	
		N	%*	Wtd %	95% CI
Age	18-21	27777	51.1	15.6	15.2 to 16.1
	22-24	26631	48.9	20.0	19.5 to 20.6
Sex	Male	24617	45.2	19.8	19.3 to 20.3
	Female	29791	54.8	15.5	15.1 to 16.0
Education	Any College	26915	49.5	12.8	12.4 to 13.2
	No college	27493	50.5	22.5	21.9 to 23.0
Race-ethnicity	NHW	27608	50.7	21.6	21.1 to 22.2
	NH Black	6284	11.5	12.3	11.5 to 13.3
	Hispanic/Latino	883	1.6	9.3	8.7 to 9.9
	Other/Multiple races	2232	4.1	22.9	20 to 26.1
	API	11277	20.7	9.0	7.7 to 10.4
	Missing	6124	11.3		
State	Alabama	1459	2.7	22.0	18.7 to 25.7
	Arizona	1512	2.8	16.2	14.2 to 18.5
	California	7221	13.3	11.7	10.9 to 12.6
	Colorado	1761	3.2	20.3	17.9 to 22.9
	Florida	3519	6.5	14.5	13.3 to 15.8
	Georgia	1775	3.3	17.2	14.9 to 19.7
	Illinois	1480	2.7	18.3	16.8 to 20.0
	Indiana	2870	5.3	24.5	22.2 to 27.1
	Maryland	1322	2.4	16.0	13.7 to 18.7
	Massachusetts	1346	2.5	15.8	13.7 to 18.1
	Michigan	2233	4.1	21.8	20.0 to 23.6
	Minnesota	1820	3.3	21.9	19.5 to 24.5
	Missouri	1378	2.5	24.0	21.4 to 26.8
	New Jersey	1491	2.7	13.8	12.0 to 15.8
	New York	3397	6.2	15.1	14.0 to 16.4
	North Carolina	1819	3.3	22.0	20.1 to 24.0
	Ohio	2639	4.9	24.3	22.5 to 26.3
	Pennsylvania	2506	4.6	20.8	19.3 to 22.4
	South Carolina	1209	2.2	20.2	17.7 to 23.0
	Tennessee	1279	2.4	22.6	20.1 to 25.3
	Texas	5352	9.8	15.2	14.2 to 16.1
	Virginia	1497	2.8	19.5	17.2 to 22.1
	Washington	1723	3.2	21.5	19.1 to 24.0
	Wisconsin	1800	3.3	24.5	22.3 to 26.8
	Total	54408	100		

* Percents total to 100 within each variable

eTable 2. Current Cigarette Smoking Prevalence of US 18-24-year-olds, 24 most populous US States, 1992/3 to 2018/9, ordered by state average rank on cigarette price and tobacco control expenditures over the period														
State	1992/ 1993	1995/ 1996	1998/ 1999	2001/ 2002	2003	2006/ 2007	2010/ 2011	2014/ 2015	2018/ 2019 9	Decline 1998- 2019	Price Rank	TC \$ Rank	Sum of Ranks	Tob Cont Aggressive ness Rank
Panel A: Highest ranked states on price/expenditure														
Massachusetts	26.7	26.6	26.4	21.0	20.6	17.5	14.5	14.7	3.8	85.6%	1	5	6	1
Minnesota	29.8	28.0	27.8	30.5	28.4	26.3	16.9	15.3	6.7	75.9%	5	1	6	2
Arizona	26.9	26.3	24.7	24.5	17.5	17.6	21.8	8.7	6.4	74.1%	7	2	9	3
Washington	29.9	31.8	27.4	28.0	30.2	31.3	17.1	15.9	4.5	83.6%	6	6	12	4
California	19.4	18.5	19.4	15.8	14.8	14.6	8.5	7.4	6.2	68.0%	10	4	14	5
Ohio	28.7	32.9	29.2	32.6	29.6	24.1	22.7	16.0	10.8	63.0%	8	7	15	6
Pennsylvania	26.4	35.3	34.0	28.9	24.6	25.5	18.2	13.2	6.9	79.7%	4	11	15	7
New York	21.8	24.9	25.1	23.6	18.8	17.7	12.6	8.9	6.5	74.1%	2	15	17	8
Panel B: Middle group of states on price/expenditure										75.5%				
Colorado	25.6	26.5	29.0	30.5	27.3	22.3	17.3	14.6	7.2	75.2%	16	3	19	9
Illinois	26.4	25.0	26.6	26.8	19.8	20.9	18.9	8.8	10.3	61.3%	3	16	19	10
Indiana	30.2	36.0	31.4	33.0	29.3	31.3	21.8	22.4	11.3	64.0%	14	8	22	11
Wisconsin	32.4	31.6	31.2	35.6	32.7	27.3	21.7	14.4	8.7	72.1%	9	13	22	12
Florida	25.6	23.4	22.6	19.8	21.0	15.9	13.9	8.6	5.5	75.7%	15	10	25	13
Maryland	17.2	27.7	24.8	21.0	16.5	20.2	14.7	9.5	11.4	54.0%	13	12	25	14
North Carolina	30.6	30.5	26.8	30.7	20.1	25.9	22.4	17.5	13.0	51.5%	17	9	26	15
New Jersey	21.7	21.2	24.5	24.3	15.6	12.7	14.7	9.8	2.3	90.6%	11	17	28	16
Panel C: Lowest group of States on price/expenditure										68.0%				
Virginia	28.6	22.8	30.6	34.0	21.9	19.2	18.0	13.9	3.8	87.6%	18	14	32	17
Michigan	29.4	30.8	32.4	30.4	26.3	23.0	19.6	17.7	6.4	80.2%	12	23	35	18
South Carolina	24.4	32.4	22.2	28.2	33.1	25.0	17.4	13.9	4.4	80.2%	19	19	38	19
Georgia	20.5	24.3	21.1	23.4	24.2	20.6	14.1	14.7	6.0	71.6%	23	18	41	20
Alabama	23.9	24.5	22.3	24.0	23.3	27.2	23.0	21.4	12.2	45.3%	21	21	42	21
Texas	23.3	20.8	24.0	20.7	19.6	17.5	16.8	11.1	4.3	82.1%	24	20	44	22
Tennessee	30.1	25.2	26.0	31.1	27.0	26.7	24.1	15.4	9.6	63.1%	22	22	44	23
Missouri	27.1	27.5	31.8	32.3	34.8	25.5	25.2	17.1	4.3	86.5%	20	24	44	24
										74.6%				
US overall (all states)	25.3	25.8	25.9	25.7	22.4	21.1	17.0	13.0	7.4	71.4%				

Abbreviations: Ave=average, Diff=difference, TC=Tobacco Control, Grey shaded cells indicate the lowest prevalence in that year, orange shaded cells indicate the highest prevalence in that year. Data Source: Tobacco Use Supplement to the Current Population Survey (TUS-CPS)

eTable 3. Percent of CDC recommended expenditures on Tobacco Control by 24 most populous US States in 4 year intervals 2000-2019

State	Average 2000-3	Average 2004-7	Average 2008-11	Average 2012-15	Average 2016-19	Average 2000-09	Average 2010-19	Average 2000-19	Rank of Overall Change
Minnesota	114.6	72.4	45.2	37.4	38.5	86.0	37.2	61.6	1
Arizona	106.7	85.2	44.3	26.6	26.8	88.3	27.5	57.9	2
Colorado	47.1	61.2	46.9	36.6	43.9	58.8	35.5	47.1	3
California	64.5	49.7	24.7	16.4	51.7	52.1	30.7	41.4	4
Massachusetts	90.8	43.1	26.8	12.2	21.0	62.7	14.9	38.8	5
Washington	55.3	80.8	41.2	2.2	2.3	66.6	6.1	36.4	6
Ohio	71.2	74.3	20.2	1.7	9.7	65.8	5.0	35.4	7
Indiana	97.0	31.2	22.8	10.1	9.1	57.8	10.2	34.0	8
North Carolina	36.5	53.6	41.4	17.9	19.5	48.1	19.4	33.8	9
Florida	49.5	2.8	40.7	32.0	35.4	31.1	33.0	32.1	10
Pennsylvania	35.6	61.7	22.5	7.9	10.5	45.8	9.5	27.6	11
Maryland	98.6	13.3	15.0	5.2	5.9	49.7	5.4	27.6	12
Wisconsin	58.9	32.1	23.3	8.7	9.2	43.6	9.3	26.4	13
Virginia	43.1	36.5	17.7	9.0	9.8	36.8	9.6	23.2	14
New York	60.3	24.4	9.7	0.3	1.9	37.1	1.5	19.3	15
Illinois	44.3	16.4	7.5	7.4	4.7	26.1	6.0	16.0	16
New Jersey	3.7	34.1	22.6	4.7	1.8	20.7	6.0	13.4	17
Georgia	42.0	17.3	2.7	1.5	1.3	24.4	1.5	13.0	18
South Carolina	7.5	2.1	4.9	8.9	9.8	4.7	8.6	6.6	19
Texas	10.5	6.6	6.1	3.2	2.8	8.4	3.2	5.8	20
Alabama	12.1	1.6	2.0	0.3	2.9	6.0	1.5	3.8	21
Tennessee	0.0	0.0	9.7	3.5	4.1	3.8	3.1	3.4	22
Michigan	0.0	0.0	3.5	1.5	1.5	1.0	1.6	1.3	23
Missouri	0.0	0.0	1.2	0.1	0.1	0.3	0.3	0.3	24
Overall US	44.4	34.8	23.1	13.6	17.8	38.0	15.5	26.7	

Grey shaded cells indicate the highest Tobacco Control expenditures in that year, orange shaded cells the lowest.

Adapted from Campaign for Tobacco Free Kids: State Tobacco Settlement Spending for Tobacco Prevention 2000-2021.
<https://www.tobaccofreekids.org/assets/factsheets/0209.pdf>

eTable 4: Percent change in inflation-adjusted cigarette price from previous 4-year time period															
States	1992 Price in \$2020	Percentage Change in Price from previous 4-year period								2019 Price in \$2020	Percent increase				Rank on % overall Change
		1992-1995	1995-1998	1998-2001	2001-2003	2003-2006	2006-2010	2010-2014	2014-2019		1992-1998	1998-2010	2010-2019	1998-2019	
Massachusetts	3.58	-17.0%	16.1%	52.7%	-3.8%	-0.4%	23.7%	0.6%	3.0%	10.63	-6%	81%	75%	197%	1
New York	4.04	4.8%	13.1%	33.1%	7.7%	-1.9%	36.7%	-2.0%	1.1%	11.48	6%	92%	39%	184%	2
Illinois	3.71	-10.8%	6.8%	63.6%	-4.5%	-9.2%	25.3%	-4.5%	35.1%	9.78	4%	78%	42%	164%	3
Pennsylvania	3.64	-6.8%	13.2%	38.5%	0.9%	14.1%	16.5%	-0.1%	1.4%	8.98	-4%	86%	38%	147%	4
Minnesota	4.27	-14.3%	12.7%	42.4%	-4.1%	-5.6%	48.0%	-5.9%	16.1%	9.95	-13%	91%	41%	133%	5
Washington	4.01	-13.7%	13.2%	51.0%	3.7%	-3.9%	20.3%	-1.7%	1.5%	9.34	-19%	81%	60%	133%	6
Arizona	3.63	-6.9%	19.8%	34.1%	11.9%	7.9%	12.4%	15.5%	12.4%	8.19	14%	82%	9%	126%	7
Ohio	3.22	-13.3%	20.8%	46.9%	11.8%	-9.7%	35.8%	-1.8%	-0.8%	7.22	1%	102%	10%	124%	8
Wisconsin	3.87	-15.3%	16.0%	55.8%	6.9%	-9.2%	40.1%	-3.0%	1.9%	8.64	-2%	112%	8%	123%	9
California	4.06	6.1%	27.8%	30.7%	24.2%	-11.8%	37.0%	10.6%	0.9%	8.87	20%	96%	-7%	119%	10
New Jersey	4.07	14.7%	7.1%	34.1%	9.9%	11.0%	8.1%	-2.0%	-0.8%	8.79	10%	77%	11%	116%	11
Michigan	3.66	-10.6%	2.5%	41.5%	-5.2%	21.6%	16.1%	26.6%	6.1%	7.73	7%	89%	4%	111%	12
Maryland	3.84	-6.3%	15.9%	42.7%	0.0%	-6.6%	16.3%	4.0%	3.9%	7.91	-12%	55%	50%	106%	13
Indiana	3.12	-12.6%	32.2%	28.6%	38.5%	-0.5%	12.1%	-4.5%	-1.4%	6.42	51%	99%	-31%	106%	14
Florida	3.84	-3.0%	11.3%	57.1%	23.7%	-10.8%	63.4%	-2.2%	-5.0%	7.73	14%	183%	-37%	101%	15
Colorado	3.33	-12.4%	20.6%	44.0%	2.8%	-3.9%	28.5%	-2.8%	2.4%	6.61	-4%	83%	12%	98%	16
North Carolina	3.04	-9.2%	13.7%	48.3%	11.4%	6.0%	21.0%	-3.4%	6.0%	5.85	9%	112%	-17%	92%	17
Virginia	3.28	-14.8%	13.7%	44.3%	17.6%	-0.1%	21.1%	7.1%	15.8%	6.25	8%	105%	-14%	90%	18
South Carolina	3.26	-16.1%	12.9%	55.4%	1.0%	-11.4%	40.2%	-0.6%	1.4%	6.07	-5%	95%	1%	86%	19
Missouri	3.12	-15.3%	14.2%	49.8%	-0.3%	-7.4%	36.0%	-2.0%	0.7%	5.68	4%	88%	-7%	82%	20
Alabama	3.49	-14.9%	12.2%	34.3%	2.7%	-13.3%	56.0%	-4.2%	0.022	6.30	11%	87%	-13%	81%	21
Tennessee	3.37	-11.0%	8.2%	48.5%	5.0%	36.8%	-12.4%	-0.3%	6.0%	6.04	-6%	87%	2%	79%	22
Georgia	3.31	12.6%	9.2%	27.4%	13.5%	5.3%	29.8%	-3.8%	-0.4%	5.84	49%	98%	-40%	76%	23
Texas	4.05	-5.2%	14.1%	46.2%	-4.8%	-7.7%	67.1%	0.5%	-4.3%	7.07	3%	115%	-21%	74%	24
Wt US Average by market share	3.64	-9.6%	13.8%	43.3%	6.0%	-4.0%	30.3%	-1.4%	5.1%	7.37	3%	90%	4%	97%	

Abbreviations: Wt=weighted, Prices for each state in each year are from Tax Burden on Tobacco 2021, with all prices adjusted to 2020 dollars using the Consumer Price Index. Grey shaded cells indicate the highest and orange shaded cells the lowest change in inflation-adjusted cigarette price from the previous period, among the 24 most populous US States.

eTable 5. Model selection strategy, logistic regression of young adult smoking prevalence 2000-2019*

Model #		Random Effects Models (unable to include survey weights)	AIC
Model 1	logit3.glmer.ri.rp	Random intercept for state , <i>categorical time</i> (chosen sensitivity model)	43288.70
Model 2	logit3.glmer.ri	Random intercept for state , <i>linear time</i>	43325.07
Model 3	logit3.glmer.ris	Random intercept and slopes for state , <i>linear time</i>	43327.62

Model #		Unweighted Fixed Effects Models [#]	AIC
Model 4	logit3.glm.noint.rp	Main effects for state and <i>categorical time</i> (lowest AIC of Models 1-9)	43266.06
Model 5	logit3.glm.noint	Main effects for state and <i>linear time</i>	43302.45
Model 6	logit3.glm	Full model with state , <i>linear time</i> , and interaction of state by time	43320.15
Model 7	logit3.glm.timeOnly.rp	With <i>categorical time</i> effect only, not including state effect	43406.83
Model 8	logit3.glm.timeOnly	With <i>linear time</i> effect only, not including state effect	43439.69
Model 9	logit3.glm.stateOnly	With state effect only, not including time effect	43541.11

* The model fixed effects model, was rerun including survey weights for the final analysis

Model #		Weighted Fixed Effects Models ^{&}	AIC
Model 10	logit3.svyglm.noint.rp	Main effects for state and <i>categorical time</i> (final model)	41850.87
Model 11	logit3.svyglm.noint	Main effects for state and <i>linear time</i>	41911.95
Model 12	logit3.svyglm	Full model with state , <i>linear time</i> , and interaction of state by time	41929.05
Model 13	logit3.svyglm.timeOnly.rp	With <i>categorical time</i> effect only, not including state effect	41957.34
Model 14	logit3.svyglm.timeOnly	With <i>linear time</i> effect only, not including state effect	42011.77
Model 15	logit3.svyglm.stateOnly	With state effect only, not including time effect	42306.41

*Same variables included in all models: year, sex, education, race, yearly state-level expenditure, and yearly state-level average inflation-adjusted price. Data are from the TUS-CPS with state-level Tobacco Control spending from the CDC and state price from Orzechowski W, Walker RC. The Tax Burden on Tobacco:

[#] Unweighted Fixed Effect Models for comparison with unweighted Random Effect models. Software is not available which can include weights in random effects models for these comparisons.

[&] Weighted Fixed Effect Models are the most appropriate for the analysis as they allow generalizations to the population

eTable 6: Sensitivity Analysis: the Optimal Random Effects Model* of 18-24-year-old Smoking Prevalence, 24 most populous US States 2000 to 2018/9. Data from the TUS-CPS and the CDC.

Effect		Estimated OR [95% CI]	Pr(> z)	
Fixed	(Intercept)	0.466 [0.360, 0.605]	<0.0001	
	Time (Survey Year)	2000	reference	
		2001	1.042 [0.876, 1.241]	0.6399
		2002	0.990 [0.819, 1.196]	0.9174
		2003	0.901 [0.757, 1.071]	0.2371
		2006	0.854 [0.714, 1.022]	0.0848
		2007	0.779 [0.644, 0.941]	0.0097
		2010	0.733 [0.600, 0.894]	0.0022
		2011	0.665 [0.538, 0.822]	0.0002
		2014	0.545 [0.435, 0.683]	<0.0001
		2015	0.557 [0.452, 0.686]	<0.0001
		2018	0.329 [0.253, 0.428]	<0.0001
	2019	0.281 [0.221, 0.357]	<0.0001	
	Sex	Male	reference	
		Female	0.768 [0.732, 0.805]	<0.0001
	Education	Any college	reference	
		No college	2.166 [2.061, 2.277]	<0.0001
	Race-ethnicity	NHW	reference	
		NH Black	0.450 [0.415, 0.488]	<0.0001
		Other/Multiple races	1.260 [1.077, 1.474]	0.0039
API		0.494 [0.428, 0.570]	<0.0001	
	Hispanic/Latino	0.339 [0.314, 0.367]	<0.0001	
Expenditure	State Tobacco Control Expenditure	1.000 [0.999, 1.001]	0.6405	
Price	Inflation-adjusted State Cigarette Price	0.943 [0.911, 0.976]	0.0009	

*State is modeled as a random effect (model 1 from eTable 5). The random intercept for each of the 24 most populous states followed a normal distribution with mean 0 and standard deviation 0.138.

eTable 7: Post hoc models of 2000-19 18-24-year-old prevalence to address potential confounding

Model Number	Model Description*	Effect of Cigarette Price			Effect of Tobacco Control Expenditures				
		estimate	95% C.I.	p-value	estimate	95% C.I.	p-value		
Model 1	State, Price, Expenditure	0.756	0.732	0.780	<0.001	1.002	1.001	1.004	<0.001
Model 2	Time, Price, Expenditure	0.956	0.934	0.979	<0.001	0.999	0.998	1.000	0.097
Model 3	Price, Expenditure	0.844	0.826	0.862	<0.001	1.003	1.002	1.004	<0.001
Model 4	Expenditure	na				1.004	1.003	1.005	<0.001
Model 5	Price	0.839	0.822	0.857	<0.001	na			
*All models include sex, education and race-ethnicity.									
* Time is categorical									

eTable 8: Modified model of cigarette smoking prevalence allowing effects of cigarette price and tobacco control spending to differ between 2000-2010 and 2010-2019.

Independent Variables		Adjusted OR [95% CI]	p-value
	(Intercept)	0.593 [0.40, 0.88]	0.01
Time (Survey Year)	2000	reference	
	2001	0.988 [0.812, 1.203]	0.904
	2002	0.948 [0.785, 1.144]	0.574
	2003	0.859 [0.713, 1.035]	0.0884
	2006	0.814 [0.673, 1.035]	0.034
	2007	0.730 [0.596, 0.894]	0.003
	2010	0.627 [0.459, 0.855]	0.003
	2011	0.564 [0.407, 0.781]	<0.001
	2014	0.452 [0.321, 0.637]	<0.001
	2015	0.443 [0.318, 0.619]	<0.001
	2018	0.247 [0.170, 0.360]	<0.001
	2019	0.218 [0.153, 0.311]	<0.001
Sex	Male	reference	
	Female	0.757 [0.720, 0.797]	<0.001
Education	Any college	reference	
	No college	2.114 [1.999, 2.235]	<0.001
Race-ethnicity	NHW	reference	
	NH Black	0.468 [0.426, 0.515]	<0.001
	Other/Multiple races	1.235 [1.031, 1.480]	0.023
	API	0.505 [0.429, 0.594]	<0.001
	Hispanic/Latino	0.352 [0.321, 0.387]	<0.001
State Tobacco Control Spending	From 2000-2010	1.00 [0.999, 1.002]	0.809
	From 2010-2019	1.004 [1.000, 1.008]	0.07
State Cigarette Price	From 2000-2010	0.936 [0.873, 1.010]	0.065
	From 2010-2019	1.011 [0.964, 1.061]	0.643
State Indicator (fixed effect)	Indiana	reference	
	California	0.574 [0.47, 0.70]	<0.001
	Florida	0.619 [0.506, 0.756]	<0.001
	New Jersey	0.719 [0.535, 0.967]	0.029
	Massachusetts	0.754 [0.56, 1.1015]	0.062
	Texas	0.796 [0.649, 0.976]	0.028
	Georgia	0.758 [0.59, 0.973]	0.03
	Maryland	0.76 [0.577, 1.00]	0.05
	Pennsylvania	0.831 [0.679, 1.017]	0.072
	Arizona	0.814 [0.642, 1.032]	0.089
	Virginia	0.819 [0.644, 1.103]	0.103
	New York	0.868 [0.646, 1.167]	0.347
	Illinois	0.876 [0.686, 1.12]	0.289
	Minnesota	0.861 [0.698, 1.076]	0.187
	South Carolina	0.851 [0.660, 1.098]	0.213
	Colorado	0.877 [0.697, 1.103]	0.26
	Tennessee	0.916 [0.733, 1.145]	0.44
	Michigan	0.966 [0.754, 1.237]	0.783
	Washington	0.969 [0.738, 1.273]	0.822
	Ohio	0.956 [0.779, 1.172]	0.661
	Missouri	0.952 [0.75, 1.21]	0.689
	Wisconsin	1.063 [0.84, 1.346]	0.608
Alabama	0.99 [0.744, 1.317]	0.946	
North Carolina	0.981 [0.785, 1.2226]	0.867	